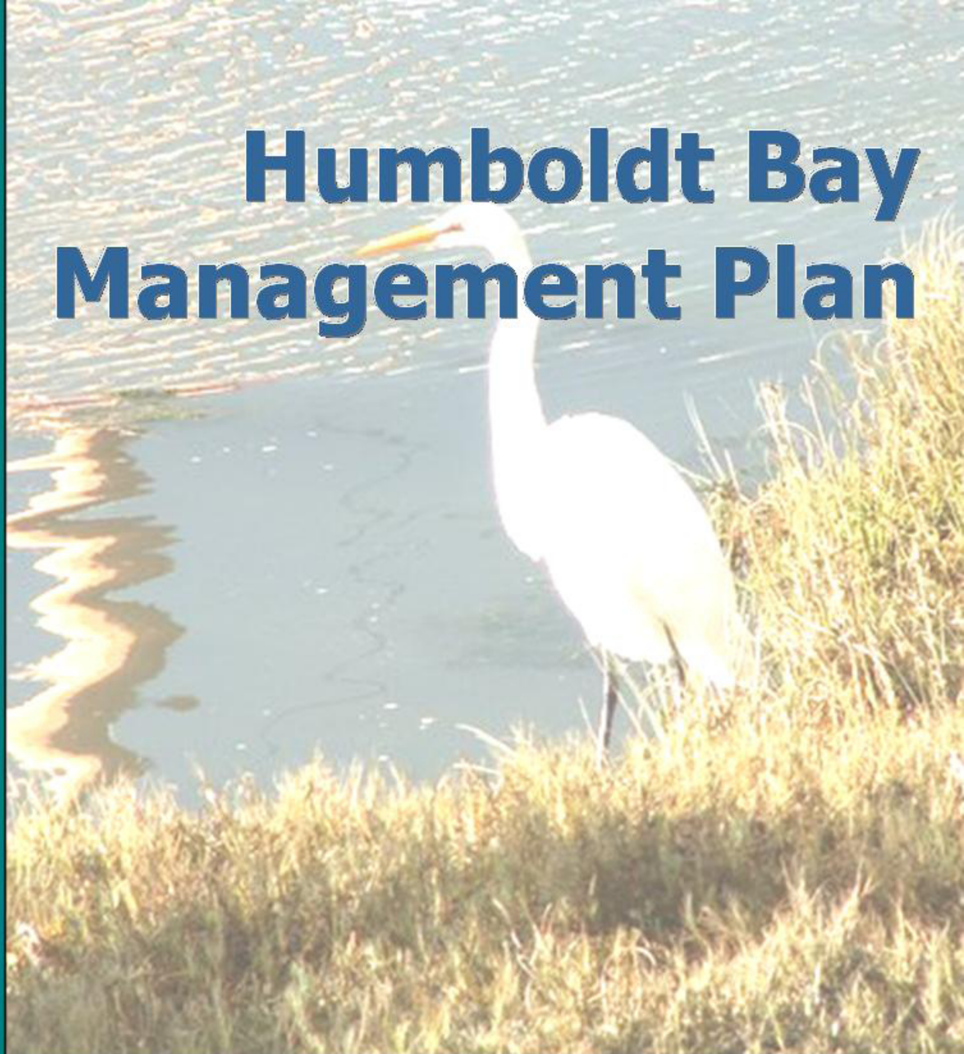

Humboldt Bay Management Plan

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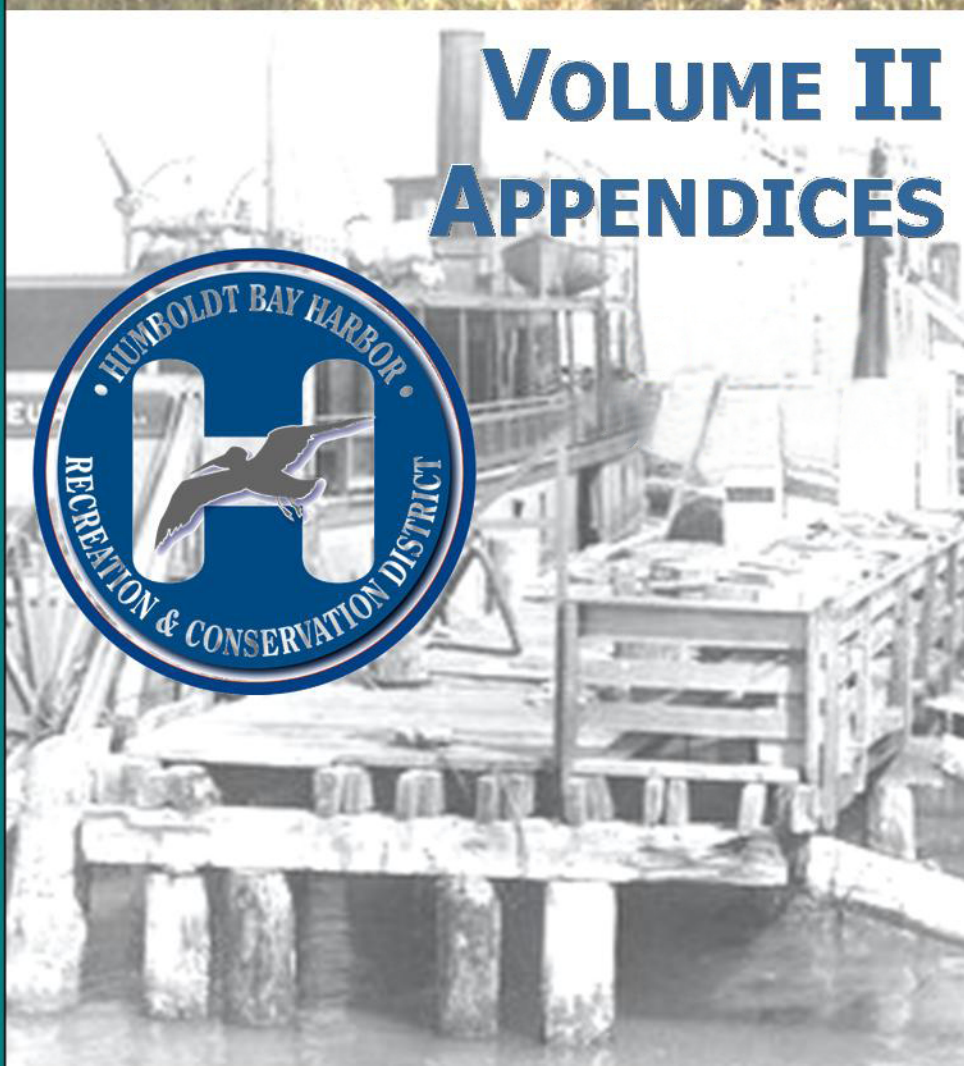

Humboldt Bay Harbor Recreation & Conservation District

Volume II – Appendices

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Appendix A

Glossary of Selected Terms

Abiotic
A non-living component of the environment.

Adaptive Management
A dynamic planning process that recognizes that the future cannot be predicted perfectly. In response to these imperfect predictions, planning and management strategies are modified frequently as better information becomes available. It is a continuous process requiring constant monitoring and analysis of past actions, which are then fed back into current decisions.

Algae
Any of several groups of autotrophs (organisms that produce organic material from inorganic chemicals and energy) that lack the structural features (true leaves, roots, and stems) of the higher plants.

Annual Increment
A management section addendum, prepared annually, to facilitate implementation of a Natural Resource Management Plan section. The annual increment concisely provides detail and cost estimates of proposed work or projects to be accomplished during a fiscal year.

Artificial Hard Substrate
An artificial habitat that may consist of rock riprap, seawalls, pier pilings, floating docks, mooring systems, and derelict ships/ship parts.

Assessment
An evaluation that can be based on a single measurement or observation, or can incorporate a series of observations to obtain a better estimate of a particular parameter; often an assessment or inventory serves as the first step towards establishing a monitoring project.

Baseline
Serving as a basis against which future assessments are compared, such as for biological surveys.

Bathymetry
The science of mapping the contours of ocean and bay floors or lake beds.

Bayscaping
Appropriate native and water-conserving landscaping designs.

Beaches and Dunes
Habitats along the shoreline that are subject to wind and wave turbulence, salt spray, shifting sands, high temperatures, and desiccation.

Benthic
Occurring or related to the bottom of the oceans and other water bodies.

Benthos
The collective name for organisms that dwell on, in, or close to bottom habitats from intertidal to deep seafloor sediments.

Best Management Practices (BMPs)
Practical, economical, and effective management or control practices that will achieve desired results, such as reducing or preventing water pollution. Usually applied as a system of practices based on site-specific conditions rather than singly. BMPs may be developed by local, state, or federal agencies, or by other parties in partnership with these agencies, for such activities as agriculture, forestry, and construction.

Bight
An inward bend or curve in a coastline.

Bioaccumulation
An increase in concentration on account of biological activity, such as through concentration of contaminants in higher trophic levels of food chains; an effect that increases the potential for chronic effects of sediment contaminants in long-term exposures.

Biological Diversity (Biodiversity)
The diversity of life and its processes; this concept includes living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

Biological Assessment
A biological evaluation conducted as part of the interagency regulations under the Endangered Species Act. The purpose of the assessment is to allow the regulatory agency to determine whether or not the proposed action is likely to

adversely affect the continued existence of a species listed as endangered or threatened, or proposed for listing.

Biomass
The total weight of living organisms in a given sample.

Biotic
A living component of the environment.

Bloom
A sharp increase in the population of phytoplankton; blooms may be largely natural events, or they may occur as a result of water pollution events.

Brackish
A term referring to seawater diluted by freshwater; somewhat salty, but not as saline as open ocean water.

Candidate Species
A species being considered by the Secretary of Interior or Commerce for formal listing under the federal Endangered Species Act, but not yet the subject of a proposed listing. Also, a species formally noticed by the California Fish and Game Commission as under consideration for, or as proposed for, listing under the California Endangered Species Act.

Cetaceans
Highly evolved marine mammals with a "blowhole" on the apparent top of the head, flippers as anterior swimming appendages, and horizontal flukes as posterior swimming appendages.

Chlorophyll
A member of a set of several green pigments important in photosynthesis.

Clean Water Act
The informal name generally applied to the 1977 amendments to the 1972 federal Water Pollution Control Act. The Clean Water Act requires that federal agencies maintain the "physical and biological integrity of the nation's waters;" the act is generally implemented through permit processes that are the shared responsibility of the Environmental Protection Agency and the U. S. Army Corps of Engineers.

Coastal Act
The California Coastal Act (Public Resources Code section 30000 *et seq*.), a 1976 legislative act that implemented the 1972 Coastal Initiative. The Coastal Act established the California Coastal Commission as a major regulatory agency,

together with identified standards for many kinds of activities that may be proposed with the area covered by the Act (the Coastal Zone).

Coastal Created Lands and Disturbed Uplands
Habitats created by deposition of dredged sediments from other locations.

Coastal Zone
An area specifically identified by a coastal state in its approved Coastal Zone Management Plan. It is an area of coastal waters and adjacent shorelines strongly influenced by each other, including islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. Excluded from the coastal zone are lands solely subject to or held in trust by the federal government, its officers, or agents.

Coliform
A group of rod-shaped bacteria, including species found in the intestinal tracts of humans and other warm-blooded animals. Coliform counts are used as one measure of the degree to which water has been polluted by sewage, although coliform organisms enter the aquatic environment from many sources other than sewage.

Consensus
A decision-making process in which all parties involved explicitly agree on the final decision. Consensus-based decision-making does not mean that all parties are completely satisfied with the final outcome, but that the decision is acceptable to all because no one feels that his or her vital interests or values are violated by it.

Conservation
The prudent care, protection, and management of natural or environmental resources that reflect sound resource stewardship for present and future generations.

Copepod
A taxonomic category of small crustacean; typically a dominant element in zooplankton.

Creosote
A preservative made from creosote plants, found in pier pilings, from which polycyclic aromatic hydrocarbons are released.

Critical Habitat
The geographic area in which are found those physical or biological features essential to the conservation of a species listed and published by the U.S. Fish

and Wildlife Service or the National Marine Fisheries Service under the authority of the federal Endangered Species Act.

Demersal Fish
Fish that characteristically remain close to the seafloor. Contrast "Pelagic Fish."

Deposit Feeders
Animals that ingest bottom sediments in order to feed upon detritus and associated bacteria accumulating on and within the sediment.

Detritus
Fresh to partly decomposed plant and animal matter.

Diatoms
Single-celled (i.e., microscopic) algae with two-part, perforated, silicious shells. Diatoms are often the most common type of phytoplankton in an estuary.

Dinoflagellate
A unicellular organism with two unequal flagella.

Dissolved Oxygen
As usually expressed, the concentration of oxygen in water at a specified temperature and atmospheric pressure. It is used as a measure of the water's ability to support aquatic life. Low concentrations do not support fish or similar organisms.

Dredge Spoil
Bottom sediments or materials that have been excavated from a waterway.

Ecosystem
A unit of land or water comprising populations of organisms considered together with their physical environment; in a strict sense the term includes all of these elements and the processes through which the elements affect one another.

Ecosystem Functions
The interacting processes among ecosystem elements and their environment. Scientifically a complex concept, involving energy and matter flows, population regulation and stability, and the effects of stressor agents on the state of the ecosystem. An ecosystem may become dysfunctional or nonfunctional under sufficient stress.

Ecosystem Management
A management concept that draws on a long-term vision of desired future ecological conditions, integrating ecological, economic, and social factors. The

goal of ecosystem management is to maintain and improve native biological diversity and the sustainability of ecosystems, while supporting human needs, through accommodating and incorporating natural ecological processes as major elements in the system's management.

Emergent Vegetation
Plants that are rooted in and grow in the sediments at the bottom of a saltwater, brackish, or freshwater body, and which stand erect above the water surface. Compare "Submergent Vegetation."

Endangered Species Act
The federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA). These laws require that federal and/or state and local agencies not approve projects that could lead to the extinction of species of fish, wildlife, or plants. These requirements are generally carried out through a process that involves listing species or other taxonomic units, together with mandatory consultations among permit-granting agencies and trustee agencies for projects or programs that could affect listed species (or habitats, in certain cases).

Endangered or Threatened Species
A species that has been listed by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service for special protection and management under the federal Endangered Species Act, or by the California Fish and Game Commission for protection under the California Endangered Species Act.

Endemic
Naturally found only in a particular location or a restricted geographical area.

Enhancement
To increase the functions and values present in a low-quality or degraded habitat area; may be applied to wetlands, dunelands, or other natural ecosystem types.

Entrainment
A physical process in which material is picked up and carried along in moving water.

Environmental Resources
Landforms, soils, waters, and their associated flora and fauna that have an intrinsic value for ecological or environmental purposes, independent of cultural or commercial value. Compare "Natural Resources."

Epifauna
Marine animals that live on the surfaces of rocks or other substrates.

Epiphyte
A plant that grows upon another plant, but is not parasitic upon it.

Estuary
A semi-enclosed body of water that has a free connection with the open ocean and within which sea water is measurably diluted with fresh water derived from land drainage. Estuaries are typically found at the mouths of rivers and streams and are subject to tidal conditions. Estuarine areas characteristically provide five broad habitat categories: (1) Upland, (2) Freshwater, (3) Intertidal, (4) Subtidal, and (5) Marine.

Exotic Species
Species that occur in a given place, area, or region as the result of direct or indirect, deliberate or accidental introduction because of human activity, and for which introduction has permitted the species to cross a natural barrier to dispersal. Also called non-native, non-indigenous, or alien species.

Filter Feeders
Organisms that feed by filtering out small food items such as detritus and plankton that are suspended in the water column; distinguished from deposit feeders that glean such items by consuming bottom sediments.

Fine Sediments (Fines)
In aquatic ecology, small-sized bed materials, typically less than 2 millimeters (mm) in diameter, including sand, silt, clay, and fine organic materials.

Fish and Wildlife Management
A coordinated program of actions designed to preserve, enhance, and/or regulate indigenous fish and wildlife species and their habitats, including various elements such as conserving protected species and non-game species, managing the harvest of game species, and animal damage control.

Food Web
An ecological concept based on nutrient or energy flows among trophic elements in an ecosystem, including producers (plants), primary and secondary consumers (herbivores and carnivores), and decomposers. Energy flows in food webs are typically nonlinear, with multiple branches and pathways.

Fouling Organism
A plant or invertebrate, such as various red or brown algae, a barnacle, or shipworm, that bores into or encrusts submerged surfaces such as boat hulls and pilings.

Freshwater Marsh
Wetland in which emergent vegetation is dominated by persistent, emergent, non-woody plant species and the water is not saline.

Game Species
Fish and wildlife species that may be harvested legally pursuant to applicable state sport hunting and fishing codes.

Gastropods
Snails and other molluscs that typically possess a coiled dorsal shell and a ventral creeping foot.

Geographical Information System (GIS)
A computer system used to manage large volumes of spatial data of different kinds. The data are referenced to a set of geographical coordinates and encoded in digital format so that they can be sorted, selectively retrieved, statistically and spatially analyzed.

Goal
A broad statement of intent, direction, and purpose. An enduring, visionary description of where you want to go. A goal is not necessarily completely obtainable.

Grounds
All land areas not occupied by buildings, structures, pavements, and other facilities. Depending on the intensity of management, grounds may be classed as improved (such as those near buildings), semi-improved, or unimproved.

Habitat
An area where a plant or animal species lives, grows, and reproduces. Generally habitat is considered to be an area that provides all of the necessary elements for species persistence, including food, water, shelter, and opportunities for reproducing.

Habitat Conversion
A management approach to manipulating habitat conditions in which a habitat is converted from one type to another in order to mimic a desirable natural habitat present at another location; also called "Habitat Replacement." The conversion actions may not be beneficial for all species, and habitat value trade-offs may be necessary.

Habitat Creation
A management approach in which desired habitat conditions would be created anew from an area previously lacking habitat conditions suitable for the species of interest.

Habitat Enhancement
A management approach that involves the rejuvenation and improvement of existing habitat conditions in ways that favor the species of management interest. The enhancement actions may not be beneficial for all species, and habitat value trade-offs may be necessary.

Habitat Restoration
Habitat restoration is a management approach that involves returning one or more habitat elements to a former condition; restoration frequently is enacted to benefit species of management interest. The restoration actions may not be beneficial for all species, and habitat value trade-offs may be necessary.

Holoplankton
Zooplankton species that spend their entire lives in the open-water environment.

Hydrodynamic
The physical features of water motion, typically reacting to complex physical laws and forces.

Hypersaline
Saltier than sea water; generally having a salinity greater than 35 parts per thousand (>35 $^{0/00}$).

Ichthyoplankton
Planktonic larvae of fishes.

Infauna
Marine animals that live within sediments (e.g., gravel, sand, mud) or other harder bottom materials or structures in order to avoid predation or disturbances by wave action and other physical stresses.

Injury
Any adverse change in a natural resource or impairment of a service provided by a resource relative to baseline, reference, or control conditions. Injury incorporates the concepts of “destruction,” “loss,” and “loss of use.”

Interstitial Fauna
Tiny invertebrates that live and move around in spaces between sediment grains, or attach to the grains.

Inventory
A list of items compiled within a specific time frame for a particular place or region, such as an inventory of organisms, habitats, or boats within Humboldt Bay during a particular period of time.

Invertebrate
An animal lacking a backbone.

Isopods
Small, dorsoventrally flattened crustaceans, including aquatic sea lice and terrestrial pillbugs.

Landscape
A landscape, in biogeographic or conservation planning contexts, is a relatively large geographic region in which conservation and landscape-ecological processes occur that are relevant for conservation planning. Landscape planning focuses on the regional distributions of habitats (such as Humboldt Bay or coniferous forest), linkages (such as streams or riparian corridors), and processes that relate to the movements of individuals, energy, or nutrients within the landscape.

Larva
An immature life stage of many invertebrate species, which differs in form and ecological adaptations from those of adults. Larval stages frequently differ in substantial ways from adults.

Life History
The biological "phases" that an organism may pass through during its life, including egg, larva, and adult, in which the ecological forces in the environment act on the organism to shape its morphological and ecological characteristics.

Listed
A plant or animal species that has been placed by the state or federal government under the protection of an Endangered Species Act. Listed status may be "Endangered" or "Threatened," or a species may also be listed as a "Candidate" species, or (under the federal Endangered Species Act only) as "Proposed."

Littoral
In a literal sense, the shoreline area between the highest high mark and the lowest low tide mark; more generally, the area along the shoreline.

Macroalgae
Generally the brown and red (and a few green) algae; "seaweed." Algae lack roots, true leaves, and vascular systems, and reproduce in a manner that differs from most plant species.

Management
A discipline or set of practices applied to the manipulation, use, treatment, or control of things or persons, or in the conduct of an activity, project, program, etc. "Management" includes, but is not limited to, the application of actions, methods, or concepts such as assessment, education, enhancement, inventories, laws, mitigation, monitoring, objectives, policies, protection, regulations, research, restoration, and surveys. Management includes, as a subset, the set of actions known as "stewardship."

Management Strategy
The application of a combination of objectives, policies, and implementation programs in order to accomplish the intended purposes of the management activity.

Mariculture
Any of a set of cultural systems applied to the commercial production of marine organisms in captivity; also called "aquaculture."

Marine Protection Area
An area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical, and cultural features, that has been reserved by law or other effective means to protect part or all of the enclosed environment.

Marsh
A general term for wetlands that are dominated by herbaceous vegetation; marshes may occur in intertidal areas as well as in contexts where the marsh's hydrology is dominated by fresh or brackish water.

Meiofauna
Small animals that live within the interstices in the bottom of many marine environments; the term is often used as a categorical name for interstitial fauna.

Meroplankton
The larval forms of invertebrates that later settle to the bottom and become benthic juveniles and adults; also called "temporary plankton."

Mitigation
A legal term referring to the avoidance, minimization, rectification, reduction, or elimination of negative impacts that result from proposed management activities ar development projects, or to compensation by replacement or substitution.

Monitoring
Monitoring may address a variety of activities that allow the application of adaptive management within a management program. Monitoring may include actions that range from assuring the implementation of management requirements to the implementation of a series of observations of a particular area or activity over time with the intent of assessing change. Often an assessment or inventory serves as the first step towards establishing a monitoring project. Monitoring may include:

- ✍ Trend monitoring: Measurements that are made at regular, well-spaced time intervals in order to determine the long-term trend in a particular parameter.
- ✍ Baseline monitoring: Measurements used to characterize existing conditions (e.g., water quality, wildlife population, habitat quality) and to establish a data base for planning or future comparisons. While the intent is to capture much of the temporal variability of the constituents of interest, there is no explicit end point at which continued baseline monitoring becomes trend monitoring. Often used synonymously with "inventory monitoring" and "assessment monitoring."
- ✍ Implementation monitoring: Administrative determination taken to assess whether activities were carried out as planned (e.g., Best Management Practices, mitigation measures, permit conditions).
- ✍ Effectiveness monitoring: Measurements taken to evaluate whether specified individual management practices had the desired effect.
- ✍ Project monitoring: Measurements taken to assess the impact of a particular activity or project, such as on a before or after basis or on a control site versus impact site basis. May be considered by some agencies to be a subset of effectiveness monitoring.
- ✍ Compliance monitoring: Measurements taken to determine whether specified measurable criteria are being met. Usually the regulations associated with individual criterion specify the location, frequency, and method of measurement.

Mudflat
Part of the continuum from open water to dry land, mudflats are rich in organic matter and microorganisms, and are generally exposed during parts of all tidal cycles in environments favorable for the formation of the flats.

Multiple Use
The sustainable use of environmental and natural resources for a combination of public purposes.

Natural Community
This term generally refers to a vegetation community that appears to be similar to relatively undisturbed plant associations in the region of interest, but it may also be used to encompass all of the habitats, ecosystems, and plant and animal species found within the community.

Natural Resources
Landforms, soils, waters, and their associated flora and fauna that may have a cultural or commercial value. Compare "Environmental Resources."

Nematode
Technically, an invertebrate group characterized by a cylindrical body, a conspicuous body cavity, and a complete digestive tract. Called "roundworms," nematodes constitute an important element of the invertebrate fauna of the marine environment.

Nongame Species
Fish and wildlife species that are not identified under state law as "game" species, which are therefore not harvested for sport or recreational purposes.

Nonpoint Source (NPS) Pollution
Water pollution that results from diffuse sources that are not identified as "point sources" such as sewer or factory discharge locations. NPS pollution is generally associated with runoff from construction activities, urban areas, agricultural and silvicultural operations, atmospheric deposition, and a variety of other sources and activities.

Noxious Weeds
Plant species identified by federal or state agencies as requiring control or eradication.

Objective
A statement that describes a desired planning condition or outcome; typically "objectives" in a planning context are the guidance for specific policies or sets of actions necessary to achieve the objectives.

Pelagic Fish
A term applied to fish that normally occupy the water column above the bottom of the ocean or coastal embayments. "Pelagic" is a general adjective that is

applied to a variety of life forms that typically spend their entire lives on, over, or within the waters of the open ocean. Compare with “Demersal Fish.”

Phytoplankton
Minute, floating aquatic plants.

Plankton
Floating or drifting organisms, typically very small, that occur at various depths in the ocean or in fresh water; planktonic species include representatives of protozoa, diatoms and other algae, invertebrates, and larval forms of vertebrates.

Policy
In a planning context, a formally-adopted strategy or direction that indicated specific actions to be taken, or criteria to be met, to achieve the planning goals and objectives.

Polychaete
A species of segmented worm in the Annelid phylum that typically has flat lateral bristle extensions on each body segment.

Polychlorinated Biphenyls (PCBs)
A group of man-made organic chemicals, including about 70 different but closely related compounds made up of carbon, hydrogen, and chlorine. PCBs are carcinogenic (i.e., can cause cancer), persist in the environment for long periods, and can bioconcentrate in food webs.

Polycyclic (Polynuclear) Aromatic Hydrocarbons (PAHs)
A class of organic compounds that are among the heaviest molecular fraction of petroleum hydrocarbons, some of which are persistent and/or cancer causing. PAHs are released through fossil fuel combustion; spills of oil, gasoline, diesel, and other petroleum products; leaching from creosote oil; and asphalt production.

Projects
In a regulatory context, a “project” may include any of a variety of potential actions studies, plans, surveys, inventories, and land/water treatments, as well as activities or actions that result in physical changes in the environment.

Proposed Species
A species of plant or animal that has been formally proposed for listing under the federal Endangered Species Act by the U.S. fish and Wildlife Service or NOAA Fisheries.

Regulation
A rule prescribed for controlling ("regulating") an issue, a practice, or some other subject that is legally under the jurisdiction of the agency issuing the regulation. Generally this term refers to statutory laws, administrative rules, and other restrictive conditions placed on activities attended to by regulatory agencies.

Regulatory Agency
A government agency that has a delegated legal authority to develop and implement regulations in carrying out its responsibilities pursuant to law. Regulatory agencies may exercise authority directly as permit-granting agencies (e.g., the Environmental Protection Agency, a Regional Water Quality Control Board, or the U.S. Army Corps of Engineers), or indirectly as an advisory or trustee agency for actions considered by permit-granting agencies (e.g., NOAA Fisheries and U.S. Fish and Wildlife Service with respect to permits pursuant to the federal Clean Water Act). Many agencies are both, in differing circumstances, permit-granting regulatory agencies and advisory agencies to other permit-granting agencies.

Renewable / Nonrenewable Natural Resources
"Natural resources" are products of the environment that have economic value to humans. Forests, fish, and wildlife that recover from population reductions in a relatively short time are examples of what are sometimes termed "renewable resources." Minerals, petroleum, and other commodities that recover only on geologically long time-scales are sometimes termed "nonrenewable resources."

Research
A search or investigation undertaken to discover facts and reach new conclusions by the critical study of a subject or by a course of scientific inquiry.

Riprap
Layer of large, durable fragments of broken rock, specially selected and graded. The purpose of riprap is to prevent erosion by waves or currents and thereby preserve the shape of a surface, slope, or underlying structure.

Riparian Areas
Areas closely related to or bordering rivers, streams, lakes, arroyos, playas, ravine bottoms, etc. Many floodplain riparian areas are wetlands, or function in ways similar to wetlands. Riparian areas may be dominated by tall, woody forest vegetation; by shorter shrubby thickets; by dense meadows of sedges and rushes; or by grasslands. Riparian areas are generally responsive to the hydrology in instream and overbank flows, or to groundwater movements, but near estuaries riparian areas may respond to tidally influenced water regimes in the streams that they border.

River Mouths
Locations at which rivers flow into the sea or into coastal estuaries.

Salinity
The total amount of salts in seawater. The nominal salinity of seawater is 3.5 percent by weight, or 35 parts per thousand (per mil; $^{0/00}$).

Salt Marsh
A marsh area having high salinities in the ambient water and substrate, typical of estuarine areas, or other areas subject to flooding with ocean water, and characterized by salt-tolerant plant species.

Seagrass
Any of various grass-like plants growing in marine or estuarine areas; especially eelgrass (*Zostera* spp.) and surf-grass (*Phyllospadix* spp.).

Seaweed
A colloquial term referring to macroscopic marine algae, such as kelp; such plants en masse or collectively.

Sediment
Particles of organic or inorganic origin that accumulate in loose form as a consequence of water movement. Sediments may be coarse or fine, including boulders, cobbles, sand, silt, or clay. They may be moved as suspended or bedload material in streams and other waters, or may be carried as dissolved solids.

Sensitive Habitat
Land, water, and habitat conditions that are identified as environmentally significant pursuant to one or more federal or state laws or local ordinances, potentially including wetlands, dunelands, streamside and riparian areas, and habitats needed to maintain one or more sensitive species.

Sensitive Species
A general term for species that are listed under the federal or state Endangered Species Acts, or are proposed for listing or have candidate status; are considered "rare, threatened, or endangered" by the California Native Plant Society; have a "Species of Special Concern" status with the California Department of Fish and Game; or have special status under one or more local laws or ordinances.

Sessile
Firmly attached to one place in the environment, such as kelp attached to subsurface rocks.

Significant
Resources identified as having special importance, or as having or likely to have more influence on a particular aspect of the environment than other components.

Sludge
Semiliquid sewage, rich in biosolids, that has been treated and partially decomposed by bacteria.

Species
Biologically, a group of individuals having a common ancestor and a similar ecological role. The species concept in biology also includes an element of limited interbreeding with individuals that are not part of the same species.

Species Abundance
The number of individuals of a given species detected. Abundance is not the same as the localized density, which is the number of individuals per unit area. A related concept is "relative abundance," which generally addresses the numbers of individuals of several species in a community.

State-Listed Species
A species of fish, wildlife, or plant that is protected by an appropriate state agency under the state's endangered species law and other pertinent regulations.

Stewardship
The responsibility to inventory, manage, conserve, protect, and enhance the natural resources entrusted to one's care in a way that respects the intrinsic value of those resources, and the needs for present and future generations.

Stratification
Separation of a community or ecosystem (including aquatic communities) into distinguishable layers on the basis of temperature, light, vegetative structure, and other such factors, creating zones for different plant and animal types.

Strategy
Explicit description of ways and means chosen to achieve objectives.

Structural Surrogates
Habitats being added or modified in order to sustain endangered or other sensitive species.

Submergment Vegetation
Plants that are rooted in and grow in the sediments at the bottom of a saltwater, brackish, or freshwater body, and which do not stand erect above the water surface. Compare "Emergent Vegetation."

Substrate
The material forming the bed of a body of water; the material upon which plants grow; or the nutrient medium or physical structure on which an organism feeds and develops.

Subtidal
The area below the low tide zone in oceans and bays, not exposed to air.

Survey
A comprehensive look or description; a written statement embodying the result of an inspection.

Suspension Feeders
Animals that capture particles suspended in the overlying water by filtering or other means.

Sustainability
Sustainability refers to the management concept that managed activities maintain the ecological processes and functions, biological diversity, and productivity of managed ecosystems over time. Sustainability refers to the potential management of any kind of resource extraction or use that is associated with a non-declining abundance of desirable ecosystem elements and ecological processes, including agriculture, mining, fishing, forestry, housing construction, or resource-based commerce and manufacturing.

Sustainable Management
Managing the use, development, and protection of natural and physical resources in a manner or at a rate that enables people and communities to provide for their social, economic, and cultural well-being, and for their health and safety while (1) sustaining the potential of natural and physical resources to meet reasonably foreseeable needs of future generations; (2) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and (3) avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Sustainable Use
Use of an organism, ecosystem, or other renewable natural resource at a rate that does not exceed its capacity for renewal; "sustainable use" theoretically results in a "non-declining annual flow" of the resource in perpetuity.

Take
"Take," as defined in the federal Endangered Species Act, is defined to include any activity that may "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct," with regards to listed or candidate species. A similar definition applies under the California Endangered Species Act.

Terrestrial Habitat
A general term that refers to non-aquatic habitats, such as grasslands, forests, non-wetland agricultural lands, dunelands, and similar upland areas.

Tidal cycle
A tidal cycle is the exchange of tidewaters in an ebb tide and a flood tide, including both a high tide and a low tide, with respect to a given tidal reference (such as "mean tide level"). The "cycle" begins and ends at the reference elevation, and includes the intervening high tide and the intervening low tide. In Humboldt Bay there are generally two complete tidal cycles in each 24-hour day.

Tide
The apparent periodic rise and fall of the waters of the ocean and its inlets, known as a "tide," is a very long wave-length wave that rotates around the Pacific Basin. The wave is produced by the gravitational interactions of the ocean's water with the moon and the sun, in combination with the Earth's rotation. The tide on the Pacific Coast of North America generally exhibits a "mixed semi-diurnal tidal cycle," with one high tide-low tide cycle occurring about every 12 hours, in which the two daily highs generally differ from each other and the two lows differ from each other.

Tintinnid
A ciliate protozoan that secretes vase-like cases.

Toxic
Relating to or caused by a substance that is poisonous substance to a living organism.

Trophic level
A functional classification of organisms in a food web according to feeding relationships. Autotrophs produce energy through photochemical synthesis. Other trophic levels consume the production by virtue of consuming the producers or other consumers (herbivores and carnivores), or through the breakdown of organic material by decomposers, or by consuming decomposing material (detritivores). Organisms that derive sustenance by feeding on similar materials are considered to be part of the same trophic level, although this is a simplification of the complexity of real ecosystems.

Trustee Agency
Trustee agencies have statutory responsibilities with regard to protection or management of natural resources, or stewardship responsibilities as an manager of federally or state-owned land.

Turbidity
A measure of the "opaqueness" of water; generally this is a measures of the concentration of sediment in the water. Increasing turbidity decreases the amount of light that penetrates the water column. Very high turbidity levels are often harmful to aquatic life, both directly and through behavioral changes caused by the limited visibility.

Upland / Wetland Transition or Boundary
From a regulatory perspective, the identified location or boundary at which wetland becomes upland. This boundary characteristically defines the regulatory jurisdiction of some agencies, although in nature the actual transition between wetlands and uplands may not be sharply demarcated.

Watchable Wildlife
A federal program promoting recreational wildlife viewing.

Water Column
Roughly, the total depth of water above any point; generally includes the concept that this water provides pelagic or open-water habitat and is occupied by fish, other wildlife, and/or plants.

Water Quality
A concept related to the chemical, physical, and biological purity and integrity of water. Water quality is regulated by a number of federal, state, and local laws (most importantly the federal Clean Water Act and the state Porter-Cologne Act).

Waterbirds
A general name for a variety of birds that are associated with aquatic habitats. Approximately 260 waterbird species inhabit North America, including loons; grebes; cormorants and pelicans; ibises; gulls and terns; herons, egrets, and bitterns; cranes and rails; sandpipers and phalaropes; waterfowl (ducks, geese, and swans); and kingfishers.

Watershed
A drainage basin contributing runoff to a particular point-of-concentration, such as the mouth of a river or the opening of a coastal embayment; thus, a watershed represents the collection basin for water, sediments, organic matter, nutrients, and pollutants for a stream, lake, or bay.

Wetlands
Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, such as swamps, marshes, bogs, or any of a variety of other categories. Wetland identification for regulatory purposes is a technical subject that may require professional assistance.

Wildlife Management
The practical application of scientific and technical principles to wildlife populations and habitats so as to manage such populations for ecological, recreational, and/or scientific purposes.

Zooplankton
Small, often microscopic, animals that drift or swim in the water column. Many zooplankton species are always small, but zooplanktonic species also include larval and immature stages of larger animals.

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Appendix B

APPENDIX

II. HUMBOLDT BAY HARBOR, RECREATION, AND CONSERVATION DISTRICT

[Stats 1970 ch 1283. Amended Stats 1970 ch 1448; Stats 1972 ch 213, effective June 30, 1972; Stats 1974 ch 1191; Stats 1975 ch 587; Stats 1976 ch 1040; Stats 1977 ch 1227.]

An act to provide for the establishment of the Humboldt Bay Harbor, Recreation, and Conservation District; to provide for the calling of elections therefor; describing the powers, duties, and functions thereof, authorizing the district to borrow money and issue bonds for district purposes; to provide means of raising revenues for the operation, maintenance and bond redemption of the district; and to provide for the transfer to such district of tide and submerged lands.

CHAPTER 1

General Provisions

§ 1. Title

This act shall be known and may be cited as the Humboldt Bay Harbor, Recreation, and Conservation District Act. The district created in accordance with the provisions of this act is a public corporation created for the purposes set forth herein.

Added Stats 1970 ch 1283.

§ 2. Declaration of policy

It is hereby declared to be the policy of the State of California to develop the harbors and ports of this state for multiple purpose use for the benefit of the people. A necessity exists within Humboldt County for such development. Because of the separate cities and unincorporated populated areas in the area hereinafter described, only a specially created district can operate effectively in developing the harbors and port facilities, and in developing and protecting the natural resources of the area. Because of the unique problems presented by this area, and the facts and circumstances relative to the development of harbor and port facilities, and to the development and protection of the natural resources of the area, the adoption of a special act and the creation of a special district is required.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Statutes § 8.

§ 3. Definitions

For the purposes of this act the following words shall have the following meanings;

(a) "District" shall mean the Humboldt Bay Harbor, Recreation, and Conservation District.

(b) "Board" or "board of commissioners" shall mean the Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District.

(c) "County" shall mean the County of Humboldt.

(d) "Board of supervisors" shall mean the Board of Supervisors of Humboldt County.

(e) "Area" shall mean the territory within the district's jurisdiction.

(f) "Humboldt Bay" or "Humboldt Bay Harbor" shall mean the land and overlying waters, to the limit of tidal action, of what is commonly known as Humboldt Bay, including the land and overlying waters of all streams and estuaries tributary thereto to the limit of tidal action.

Added Stats 1970 ch 1283.

§ 4. District powers and authority

A district for the acquisition, construction, maintenance, operation, development, and regulation of harbor works and improvements, including rail, water, and air terminal facilities, for the development, operation, maintenance, control, regulation, and management of Humboldt Bay upon the tidelands and lands lying under the inland navigable waters of Humboldt Bay, for the promotion of national and international commerce, navigation, fisheries, and recreation thereon, and for the development and protection of the natural resources of the area, may be established or organized and governed as provided in this act and it may exercise the powers expressly granted herein.

Anything herein to the contrary notwithstanding, the powers and authority granted herein shall not apply to public utilities operated under the jurisdiction of the Public Utilities Commission of the State of California.

Added Stats 1970 ch 1283. Amended Stats 1984 ch 1043 § 1.

§ 5. Territory of district

The territory to be embraced in the district shall include all of the incorporated areas of the Cities of Arcata and Eureka, and such incorporated and unincorporated territory in the county as is approved by the Local Agency Formation Commission, and the Board of Supervisors of the County of Humboldt, and by the voters of the proposed district at a district formation election.

Added Stats 1970 ch 1283. Amended Stats 1972 ch 213, effective June 30, 1972.

§ 5.5. Jurisdiction of district

The jurisdiction of the district to exercise its powers shall extend only over the following;

(a) All tide, submerged and other lands granted to the district.

(b) Humboldt Bay as defined in subdivision (f) of Section 3 of this act, including all rivers, sloughs, estuaries and areas tributary to Humboldt Bay, subject to tidal action as of the effective date of this act, provided that only those portions of Gunther, Woodley, and Daby Islands bayward of the mean high tide line shall be under the jurisdiction of the district.

Added Stats 1970 ch 1283.

CHAPTER 2

Formation of the District

Article

ARTICLE 1

Initiation of Proceedings

Section

§ 5.6. District formation proposal

A proposal to form the district shall be submitted to the Humboldt County Local Agency Formation Commission pursuant to the provisions of Chapter 6.6 (commencing with Section 54773) of Part 1 of Division 2 of Title 5 of the Government Code. The local agency formation commission shall not approve a proposal to form the district unless the boundaries of the proposed district shall encompass the entire incorporated territory of the Cities of Arcata and Eureka.

Added Stats 1970 ch 1283.

§ 6. Formation proceedings

After a proposal to form the district has been approved by the local agency formation commission, proceedings for the formation of the district may be initiated either by a resolution of intention to form the district adopted by the board of supervisors, or by petition. Whenever 50 or more persons residing within the area of the proposed district desire to form the district, they may sign and present to the board of supervisors, a petition in writing.

Added Stats 1970 ch 1283.

§ 7. Contents of petition or resolution of intention

The petition or resolution of intention shall contain:

(a) A declaration calling for the creation of the Humboldt Bay Harbor, Recreation, and Conservation District.

(b) A declaration setting forth the boundaries of the proposed district.

(c) A declaration setting forth the following purposes to be served within the jurisdiction by creation of the district:

(1) Improvement of navigation and commerce through maintenance and construction of channels, shipways, berths, anchorage places, turning basins, breakwaters, bulkheads, wharves, processing plants, warehouses, roads, spur tracks or beltline railways, and any other work that is deemed necessary that would not otherwise be accomplished by other public or private agencies.

(2) Planning, designation, and protection of wildlife habitats, establishment of open space areas and areas provided for recreational use with open access for the public, protection, conservation, supervision and improvement of the wildlife, fish resources and the ecology of the area, and control and enhancement of the aesthetic appearance of the areas within the jurisdiction of the district.

(3) Regulation of use and control of pollution, dredging, and filling of areas that are subject to district jurisdiction through planning, zoning, and policing, subject to the limitations provided in Section 20 of this act.

Added Stats 1970 ch 1283.

§ 8. Qualification of petition signatories

Each signer of a petition shall be a registered voter and property owner within the district.

Added Stats 1970 ch 1283.

Cross References:

Registration of voters: Elec C §§ 2100 et seq.

§ 9. Initiation of resolution proceedings

To initiate formation proceedings by resolution, the board of supervisors, at a regular meeting, shall adopt a resolution containing the matters required by Section 7. To initiate formation proceedings by petition, the proponents of formation shall submit to the board of supervisors, at a regular meeting, a petition which complies with the provisions of Sections 6, 7 and 8.

Added Stats 1970 ch 1283.

ARTICLE 2

Hearing on Formation

§ 10. Date of hearing

Upon receipt of a formation petition or passage of a resolution of intention to form the district, the board of supervisors shall fix a date for a hearing on the proposal to form the district. The date shall be not less than 20 nor more than 40 days from receipt of the petition or passage of the resolution.

Added Stats 1970 ch 1283.

§ 10.1. Publication of notice of hearing

Notice of the hearing shall be published pursuant to Section 6066 of the Government Code in a newspaper of general circulation which is circulated within the proposed district.

Added Stats 1970 ch 1283.

Cross References:
Establishing standing as newspaper of general circulation: Gov C §§ 6020 et seq.

Collateral References:

Annotations:
What constitutes newspaper of "general circulation" within meaning of state statutes requiring publication of official notices and the like in such newspaper, 24 ALR4th 822.

§ 10.2. Examination of formation petition; Prima facie evidence of residency

Upon receipt of a formation petition the board of supervisors shall cause its clerk to ascertain whether the petition is signed by the requisite number of qualified persons and to report back to the board of supervisors at the formation hearing.

The appearance of a person's name on the last equalized assessment roll of the county for land located within the proposed district shall be prima facie evidence that the person is a property owner within the district. The appearance of a person's name as a registered and uncanceled voter of the county residing within the boundaries of the proposed district shall be prima facie evidence that the person is a resident of the proposed district.

Added Stats 1970 ch 1283.

Cross References:
Residence for voting: Elec C § 349 .

§ 11. Conduct of hearing

At the time and place specified in the notice, the board of supervisors shall consider the petition or resolution and may continue the hearing from time to time, not exceeding a period of 90 days.

At the hearing the board of supervisors shall investigate and determine whether or not the harbor improvement and development work, and the development, protection, and conservation of the natural resources of the Humboldt Bay area, generally described in the petition or in the resolution of intention, is feasible and will result in the improvement and development of harbors and in the development, protection, and conservation of the natural resources of the area.

If it appears, and the board of supervisors finds, that it is necessary in order to make sufficient and adequate investigation upon which to determine such questions to continue the hearing beyond 90 days, the board of supervisors may do so, but the hearing shall be completed within six months from the date of the presentation of the petition or hearing on the resolution of intention.

Added Stats 1970 ch 1283.

§ 11.5. Resolution after hearing; Findings

At any time not later than 30 days after the conclusion of the hearing, the board of supervisors shall adopt a resolution approving or disapproving the formation of the district. A resolution approving the formation of the district shall find at least the following:

(a) That notice of the hearing by the board of supervisors was duly published pursuant to Section 10.1.

(b) If proceedings have been initiated by petition, that the petition was signed by the requisite number of qualified signers.

(c) That a harbor exists within the proposed district.

(d) That the harbors can be improved and developed as generally described in the petition or in the resolution of intention.

(e) That it is desirable and feasible to undertake the development, protection, and conservation of the natural resources of the area as generally described in the petition or in the resolution of intention.

Added Stats 1970 ch 1283.

§ 12. Findings as conclusive evidence

The findings are conclusive evidence of the existence of every fact so found by the board of supervisors and vest the board of supervisors with authority to proceed pursuant to this act.

Added Stats 1970 ch 1283.

ARTICLE 3

Election on Formation; Election of Commissioners

§ 12.1. District formation election

The board of supervisors, upon making such findings and approving the formation of the district, shall pass a resolution calling an election in the area to be included within the district, for the purpose of submitting to the qualified voters the proposition of the formation of the district and the election of persons to the board of commissioners.

Added Stats 1970 ch 1283.

§ 12.5. Date and divisions of election

The board of supervisors, by resolution, shall fix the date of the election and it shall make an order dividing the area of the proposed district into five divisions, which shall be as equal in population as may be.

Added Stats 1970 ch 1283.

§ 13. Governing law for formation election

Except as otherwise provided in this act, the formation election shall be conducted in accordance with the general election laws of this state so far as applicable. An election called pursuant to the provisions of this act may be consolidated with any other election pursuant to the provisions of Chapter 4 (commencing with Section 23300) of Part 2 of Division 12 of the Elections Code.

Added Stats 1970 ch 1283.

Editor's Notes—Elections Code §§ 23300 et seq. have been repealed; consolidation of elections is now covered in Elections Code §§ 10400 et seq.

§ 14. Candidates for board of commissioners

A candidate for election to the board of commissioners shall be a resident and qualified elector of the proposed district, and shall qualify for election by securing a nomination paper proposing his candidacy signed by not less than 25 qualified electors of the district who reside within the division within which the candidate resides.

At the first election for commissioners, all candidates shall file their nomination papers with the county clerk of the county, not more than 65 nor less than 50 days before the day of election, and all candidates for commissioners at any subsequent election shall file nomination papers with the board not more than 85 nor less than 60 days before the day of election.

Added Stats 1970 ch 1283.

Cross References:
Residence for voting purposes: Elec C § 349.

§ 15. Division representation

Each member of the board shall be elected by the division which he represents.

Added Stats 1970 ch 1283. Amended Stats 1972 ch 213, effective June 30, 1972.

§ 15.5. Term of office and succession

The members of the board first elected upon the formation of the district shall classify themselves by lot so that two of them shall hold office until the election and qualification of their successors at the first succeeding general district election, and three of them shall hold office until the election and qualification of their successors in the second general district election. The term of office of each member, other than members first elected or members appointed to fill an unexpired term, shall be four years.

Added Stats 1970 ch 1283.

§ 16. Applicable law for general district elections

Except as otherwise provided in this act, the provisions of the Uniform District Election Law (Part 3 (commencing with Section 23500) of Division 12 of the Elections Code), shall be applicable to general district elections of elected members of the board.

Added Stats 1970 ch 1283.

Editor's Notes—Elections Code §§ 23500 et seq. have been repealed; the Uniform District Election Law is now found in Elections Code §§ 10500 et seq.

§ 16.1. Decennial redistricting of district divisions

Following each decennial federal census and using the census as a basis, the board shall adjust the boundaries of any or all of the election divisions of the district so that the election divisions shall be as nearly equal in population as may be.

Added Stats 1970 ch 1283.

§ 16.2. Interim redistricting by board

At any time between the decennial adjustments of the election division boundaries, the board may make an interim adjustment of election division boundaries as may be necessary to insure equality in population among the various election divisions.

An interim redistricting shall be made on the basis of the populations or estimated populations contained in the most recent of any of the following: any census of a county, taken as provided in Section 26203 of the Government Code; any census of a city, taken as provided in Chapter 17 (commencing with Section 40200), Part 2, Division 3, of Title 4 of the Government Code; any census or population estimate of a city or a city and county, taken or made as provided in Sections 2107.1 and 2107.2, Streets and Highways Code; population estimates contained in any official document prepared by the State Department of Finance and issued to the public.

Added Stats 1970 ch 1283.

CHAPTER 3

Harbor Commission

ARTICLE 1

General Provisions

§ 16.5. Board of commissioners

The district shall be governed by a board of commissioners composed of five persons elected pursuant to the provisions of Article 3 of Chapter 2 of this act.

Added Stats 1970 ch 1283.

§ 17. Governing law for board vacancies, oaths, salaries, audits, and meetings

The provisions of Section 6054.3 of the Harbors and Navigation Code shall govern the filling of vacancies with respect to elected members of the board. The oath of office, bond, and salaries of members of the board, salaries of subordinate officers or employees, audit of books, statement of finances, and meetings of the board shall be governed by the provisions of Sections 6055, 6056, 6060, 6061, 6062 and 6063 of the Harbors and Navigation Code.

Added Stats 1970 ch 1283.

§ 17.5. Recall provisions

Commissioners shall be subject to recall pursuant to the provisions of Chapter 2 (commencing with Section 27200) of Division 14 of the Elections Code.

Added Stats 1970 ch 1283.

Editor's Notes—Elections Code §§ 27200 et seq. have been repealed; recall of local officers is now governed by Elections Code §§ 11200 et seq.

§ 18. Conveyances to district

Upon the establishment of the district, the Cities of Eureka and Arcata may convey to the district all their right, title and interest in and to such tidelands and submerged lands, together with any improvements of facilities therein or thereon, upon and subject to such terms and conditions as shall be mutually agreed upon by the district and the cites, including reasonable commitments by the district to pay to the cities the cost of maintenance or improvement of such tidelands and submerged lands during such time as the same were subject to construed to impose any obligation upon the district to accept the conveyance of any tidelands or submerged lands from the Cities of Eureka and Arcata. There is hereby granted to the district as of the date of the establishment of the district all the right, title, and interest of the State of California held by virtue of its sovereignty in and to any ungranted tidelands and submerged lands, whether filled or unfilled, situated within Humboldt Bay, as defined in subdivision (f) of Section 3 of this act. The district shall hold such lands in trust for the uses and purposes and subject to the terms and conditions which are set forth in this act.

Added Stats 1970 ch 1283. Amended Stats 1974 ch 1191 § 2.

ARTICLE 2

Powers and Duties of the Board and of the District

§ 19. Master plan

The board of commissioners shall draft a master plan for harbor and port improvement and for the use of all of the tidelands and submerged lands which shall be conveyed to the district pursuant to the provisions of this act and other lands or areas subject to its jurisdiction. The board may from time to time modify the master plan by a majority vote of the board.

The provisions in the master plan shall not override or supersede any local existing zoning ordinance which was in effect on November 23, 1970; provided, that if any local zoning ordinance is repealed, or expires, or becomes nonoperative for any reason, thereafter the provisions of the master plan adopted by the board shall control as to all lands and waters under the jurisdiction of the district.

The district shall improve the Humboldt Bay Harbor for navigation and commerce through maintenance and construction of channels, shipways, berths, anchorage places, turning basins, breakwaters, bulkheads, wharves, processing plants, warehouses, roads, spur tracks or beltline railways, and any other work that is deemed necessary that would not otherwise be accomplished by other public or private agencies.

The district shall plan, designate, and protect wildlife habitats, establish open space areas and areas provided for recreational use with open access for the public, protect, conserve, supervise, and improve the wildlife and fish resources of, and control and enhance the aesthetic appearance of, the area.

The district shall regulate the use of Humboldt Bay by control of pollution, dredging, and filling within the area subject to its jurisdiction under Section 5.5.

The district shall work closely with the planning agencies of the adjacent corporate bodies in the exercise of those powers and duties.

Added Stats 1970 ch 1283. Amended Stats 1984 ch 1043 § 2.

§ 20. Fiscal year and budget

The board shall establish a fiscal year for its operations and shall prepare and adopt a budget for each fiscal year.

At the end of each fiscal year or as soon as possible after the end of each fiscal year, the board shall make a complete report of the affairs and financial condition of the district for the preceding fiscal year, which shall show the sources of all receipts and the purposes of all disbursements during the year. The report shall be verified by the chairman of the board and the secretary thereof. The board may, at its discretion, use the statement of finances prepared pursuant to Section 17 to satisfy the requirements of this section.

Added Stats 1970 ch 1283.

§ 21. Ordinances and resolutions

The board may pass all necessary ordinances and resolutions for the regulation of the district.

The enacting clause of all ordinances passed by the board shall be in substantially the following form:

"The Board of Commissioners of the Humboldt Bay Harbor, Recreation, and Conservation District do ordain as follows:"

All ordinances and resolutions shall be signed by the chairman of the board and attested by the clerk.

All ordinances and resolutions shall be entered in the minutes. All ordinances passed by the board shall be published, within 15 days from the passage thereof, with the names of the members voting for and against them at least once in some daily newspaper of general circulation printed and published in the district.

Added Stats 1970 ch 1283.

Cross References:

Establishing standing as newspaper of general circulation: Gov C §§ 6020 et seq.

Collateral References:

Annotations:

What constitutes newspaper of "general circulation" within meaning of state statutes requiring publication of official notices and the like in such newspaper. 24 ALR4th 822.

§ 22. Publication of ordinances and effective dates

Ordinances passed by the board shall not go into effect until the expiration of 30 days from their publication except ordinances ordering or otherwise relating to the following which shall take effect upon their publication.

(a) An election.

(b) The adoption of the annual budget.

(c) The bringing or conducting of suits or actions.

(d) The condemnation of private property for public use.

(e) The immediate preservation of the public peace, health or safety, which ordinance shall contain a specific statement showing its urgency and be passed by a two-thirds vote of the board.

Added Stats 1970 ch 1283.

§ 23. District grants, franchises, leases, permits, rights and privileges

All grants, franchises, leases, permits, rights or privileges shall be made in accordance with such rules and regulations as the board shall prescribe by resolution. Irrevocable grants of fee title shall be granted or issued.

Added Stats 1970 ch 1283. Amended Stats 1976 ch 1040 § 10.

§ 24. Permitted uses of district territory; Application procedure

(a) No individual, agency, association or corporation, including the district itself, now subject, or which hereafter may become subject, to the jurisdiction of the district shall be granted any permit, lease, franchise, right or privilege without the board having first found, after consideration of the impact of the proposed use upon the air, water, land, environment and ecology of the lands under the jurisdiction of the district, that such proposed uses are necessary to promote the safety, health, comfort and convenience of the public, and that they are required by the public convenience and necessity, and that such proposed uses will not have any substantial adverse environmental or ecological effect.

(b) Every applicant shall be required to present satisfactory proof that the proposed use will not have any substantial adverse environmental or ecological effect.

(c) Every successful applicant shall, annually, on or before January 1, furnish a report to the board. Such report shall contain such information as is prescribed by rule, resolution, or ordinance of the board.

(d) The individual, agency, association, or corporation desiring to obtain any permit, lease, franchise, right, or privilege shall file a request with the board in not less than the period of time specified by rule or regulation of the board prior to the date of the required decision by the board. The application shall contain such information as is prescribed by rule, resolution, or ordinance of the board.

(e) Notice of the filing of each application shall be given by the board to the county and municipal planning commissions and to the county and municipal legislative bodies and, in addition, to the Secretary of the Resources Agency, representing the Departments of Conservation, Water Resources, Parks and Recreation, Fish and Game, and Navigation and Ocean Development, to the Department of Public Health, to the State Water Resources Control Board, to the North Coastal Regional Water Quality Control Board, to the State Air Resources Board, to any appropriate county or regional air pollution control district, to the Department of Public Works, and to the State Lands Commission. Such notices shall be given by certified mail not less than 10 days after the filing of the application. Notice shall also be given to the general public by advertisement, not less than once in a newspaper of general circulation in the district. Such publication shall be no later than 10 days after filing of the application.

(f) Those to whom notice has been sent under subdivision (e), and any other party entitled under the board's rules to participate in such proceedings, may, within 30 days after the notice was mailed and published, request the board to hold a hearing on the application. Any such request should include the reasons therefor. If the board, as a result of its preliminary investigation after such request, determines that public hearings should be held, it shall fix a date for such a hearing and shall mail notice of the hearing to each party who is entitled to notice or who has requested a hearing.

(g) The board shall find, as required by subdivision (a), that a proposed permit, lease, franchise, right or privilege is required by the public convenience and necessity only if it finds that the proposed use is (1) reasonably required to promote area growth and to meet area demands, and does not adversely affect the environment or ecology of the area to any substantial degree, and (2) will not produce an unreasonable burden on the natural resources and aesthetics of the area, on the public health and safety and air and water quality in the vicinity, or on parks, recreational and scenic areas, historic sites and buildings, or archeological sites in the area.

Added Stats 1970 ch 1283.

Cross References:

Publication and official advertising: Gov C §§ 6000 et seq.
Establishing standing as newspaper of general circulation: Gov C §§ 6020 et seq.

Collateral References:

Annotations:

What constitutes newspaper of "general circulation" within meaning of state statutes requiring publication of official notices and the like in such newspaper. 24 ALR4th 822.

Necessity and sufficiency of environmental impact statements under § 102(2)(C) of National Environmental Policy Act of 1969 (42 USCS § 4332(2)(C)) in cases involving water and waterworks projects. 67 ALR Fed 54.

§ 25. Officers and employees; Treasurer and duties

The board may employ engineers, attorneys and any other officers and employees necessary in the work of the district. The chief executive officer shall appoint a treasurer whose duty it shall be to receive and safely keep all moneys of the district. He shall comply with all provisions of law governing the deposit and securing of public funds. He shall pay out moneys only as authorized by the board and not otherwise; provided, however, that no authorization shall be necessary for the payment of principal and interest on bonds of the district. He shall at regular intervals, at least once each month, submit to the secretary of the district a written report and accounting of all receipts and disbursements and fund balances, a copy of which report he shall file with the board. The treasurer shall execute a bond covering the faithful performance by him of the duties of his office and his duties with respect to all moneys coming into his hands as treasurer in such amount as shall be fixed by resolution of said board. The surety bond herein required shall be executed only by a surety company authorized to do business in the State of California and the premium therefor shall be paid by the district. The bond shall be approved by the board and filed with the secretary of the district. The treasurer before entering upon the duties of his office shall take and file with the secretary of the district the oath of office required by the Constitution of this state.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Public Officers §§ 12 et seq.

§ 26. Capacity to sue and be sued

The district and the board may sue and be sued in all actions and proceedings in all courts and tribunals of competent jurisdiction.

The district may also bring an action to determine the validity of any of its bonds, warrants, contracts, obligations or evidences of indebtedness pursuant to Chapter 9 (commencing with Section 860) of Title 10 of Part 2 of the Code of Civil Procedure.

Added Stats 1970 ch 1283.

§ 27. Seal

The board may adopt a seal for the district and alter it at pleasure.

Added Stats 1970 ch 1283.

§ 28. Power to acquire and convey territory

The district may take by grant, purchase, gift, devise, lease or otherwise acquire, hold and enjoy and lease and dispose of real and personal property of every kind, within the district, necessary to the full or convenient exercise of its powers.

Added Stats 1970 ch 1283.

§ 29. Prohibition of district uses as public nuisance

Any proposed use by the district of any particular land within its jurisdiction which would constitute a public nuisance may be prohibited by ordinance adopted by the city or by the county within which such land is located.

Added Stats 1970 ch 1283.

Collateral References:

Annotations:
Punitive damages in actions based on nuisance. 31 ALR3d 1346.

§ 30. Power of eminent domain

The district may exercise the power of eminent domain for any of the following purposes:

(a) To acquire, enhance, or improve lands within its jurisdiction as set forth in Section 5.5.

(b) To acquire lands immediately contiguous to lands subject to its jurisdiction as set forth in Section 5.5 as of November 23, 1970.

(c) To acquire rights-of-way to lands within such jurisdiction.

(d) To acquire any property necessary or convenient for the purposes specified in this act.

Added Stats 1970 ch 1283. Amended Stats 1972 ch 213, effective June 30, 1972; Stats 1975 ch 587.

Collateral References:
Cal Jur 3d (Rev) Eminent Domain §§ 1 et seq.

Annotations:
Eminent domain: validity of appropriation of property for anticipated future use. 80 ALR3d 1085.

§ 31. Power to issue bonds and incur indebtedness

The district may issue bonds, borrow money and incur indebtedness as authorized by law or in this act provided. The district may also refund any indebtedness as provided in this act or in any other applicable law, and may also refund any indebtedness by the issuance of the same type of obligations as those refunded and following the same procedure as at that time may be applicable to the issuance of such obligations, and may retire any indebtedness or lien that may exist against the district or its property.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Public Securities and Obligations §§ 3 et seq.

§ 32. General regulatory powers of district

The board may regulate and control the anchoring, mooring, towing, docking movement and pilotage of all vessels.

The district may perform the functions of warehousemen, stevedores, lighterers, reconditioners, shippers and reshippers of properties of all kinds.

The board may manage the business of the district and promote the maritime and commercial interests by proper advertisement of its advantages and by the solicitation of business within or without the district, within other states or in foreign countries, through such employees or agencies as are expedient.

Within the boundaries of the district, the district may acquire, purchase, take over, construct, maintain, operate, develop and regulate bunkering facilities, belt or other railroads, floating plants, lighterage, towage facilities, and any and all other facilities, aids, equipment or property necessary for or incident to the development and operation of a harbor or for the accommodation and promotion of commerce, navigation or fisheries in the district.

Added Stats 1970 ch 1283.

§ 32.5. Establishment of offices in other jurisdictions to provide export trade services; Procedures

(a) The board may establish offices in other states or in foreign countries for the purpose of providing export trade services. The board may also create an export trading company, with offices where it deems appropriate, to promote the maritime and commercial interests of the district.

(b) Notwithstanding any other provision of this act, no moneys in the Humboldt Bay Harbor, Recreation and Conservation District Revenue Fund shall be used to establish, operate, or fund any out-of-state or foreign office or any export trading company, including transportation or warehousing services. However, any tolls, charges, compensation, or fees levied by the district for services provided by an out-of-state or foreign office or by an export trading company, other than for transportation or warehousing services on tide and submerged lands granted to the district, may be used for purposes of those offices or an export trading company.

(c) The district shall submit to the State Controller, at the end of each fiscal year or as soon thereafter as possible, detailed statements of all revenues and expenditures attributable to the operation of each out-of-state or foreign office and each export trading company, if any, for that fiscal year. The statements shall include, but not be limited to, a balance sheet, an income statement, and a statement of sources and applications of funds.

(d) As used in this section, "export trading company" means a person, partnership, association, or similar organization, whether operated for profit or as a nonprofit organization, which does business under the laws of the United States or the State of California and which is organized and operated principally for the purpose of facilitating export trade services, including, but not limited to, consulting, international market research, advertising, marketing, assistance to obtain insurance, product research and design, legal assistance, transportation, including trade documentation and freight forwarding, communication, and processing of foreign orders to and for exporters and foreign purchasers, warehousing, and facilitating foreign exchange and financing. An export trading company established under this section shall not itself make loans or otherwise provide credit, become an insurance carrier, or take title to goods.

Added Stats 1984 ch 1043 § 3.

§ 33. Contracting power

As to any service which the district is authorized to perform pursuant to the provisions of this act, the district may contract for the performance of such service by the city or by the county.

Added Stats 1970 ch 1283.

§ 34. Power to do necessary and convenient acts

The board may do all other acts necessary and convenient for the exercise of its powers.

Added Stats 1970 ch 1283.

§ 35. Wharfage and other use charges

The board shall by ordinance fix the rate of wharfage charges and other charges which are appropriate for the use of any of the facilities owned and constructed or services furnished or provided by the district.

Added Stats 1970 ch 1283.

Collateral References

Annotations:

Power of municipality to charge nonresidents higher fees than residents for use of municipal facilities. 57 ALR3d 998.

§ 36. Contract procedures; Emergency waiver provisions; Exceptions

The district may itself, without letting contracts therefor, do work and make improvements. The work shall be done under the direction of its officers or employees in accordance with the following paragraph;

In the construction or reconstruction of public buildings, streets, utilities and other public works, and in furnishing supplies, materials, equipment or contractual services for the same, when the expenditure therefor shall exceed the sum of five thousand dollars ($5,000), the same shall be done by written contract, except as otherwise provided in this act, and the board, on the recommendation of the chief executive officer, shall let the same to the lowest responsible and reliable bidder, not less than 10 days after advertising for one day in the official newspaper of the district for sealed proposals for the work contemplated. All maintenance or repair projects where the cost of materials and labor exceeds three thousand five hundred dollars ($3,500) shall be let to the lowest responsible and reliable bidder. If the cost of the public contract work exceeds the sum of three thousand five hundred dollars ($3,500), but is not in excess of five thousand dollars ($5,000), the board may let the contract without advertising for bids, but not until the chief executive officer shall have secured competitive prices from contractors interested, which shall be taken under consideration by the board before the contract is let. The board may, however, upon the recommendation of the chief executive officer and by a vote of a majority of its members, order the performance of any such construction and reconstruction or repair work by appropriate district forces when the estimates submitted as part of the chief executive officer's recommendation indicate that the work can be done by the district forces more economically than if let by contract.

In case of a great public calamity, such as extraordinary fire, flood, storm, epidemic or other disaster the board may, by resolution passed by a vote of a majority of its members, determine and declare that the public interest or necessity demands the immediate expenditure of district money to safeguard life, health or property, and thereupon they may proceed, without advertising for bids or receiving the same, to expend, or enter into a contract involving the expenditure of any sum required in such emergency, on hand in the district fund and available for such purpose. All contracts before execution shall be approved as to form and legality by the attorney for the district.

Contracts for consulting services shall be let only after submission of proposals and evaluation of the expertise, experience, and proposed price of the vendor. Contracts for consulting services not limited to a specific project shall not exceed one year in length.

The provisions of this section do not apply to any contract for architectural, engineering, legal, or auditing services.

Added Stats 1970 ch 1283. Amended Stats 1977 ch 1227.

§ 37. Contracts with United States

The board may, without advertising for bids, negotiate with the government of the United States for the purpose of assisting the board in the performance of any of the work authorized by this act, and the board may contribute to the United States all or any portion of the estimated cost of any work authorized by this act which is to be done by or under contract with the United States.

Added Stats 1970 ch 1283.

Collateral References:

Annotations:

Authority of Secretary of Army to deny dredging and filling permit for ecological reasons under § 10 of Rivers and Harbors Act of 1899 (33 USCS § 403). 25 ALR Fed 706.

§ 38. Rules and regulations

The board may:

(a) Make and enforce all necessary rules and regulations governing the use and control of all navigable waters and all tidelands and submerged lands, filled or unfilled, and other lands within the jurisdiction limits of the district.

(b) Regulate and control the anchoring, mooring, and docking of all vessels.

(c) Establish and maintain a system of harbor police and may establish harbor fire protection within the jurisdictional limits of the district for the enforcement of the ordinances, rules and regulations of the district, and employ the necessary officers, who shall as to such matters have all the power of peace officers and firemen within the district; or in the alternative, the district may contract with the governmental entities whose territorial limits are adjacent to or contiguous to those of the district to provide such services.

Added Stats 1970 ch 1283.

§ 39. Adoption and enforcement of police and sanitary regulations

The board shall make and enforce such local police and sanitary regulations relative to the construction, maintenance, operation and use of all public services and public utilities in the district, operated in connection with or for the promotion or accommodation of commerce, navigation, fisheries, and recreation therein as are now vested in the district.

Added Stats 1970 ch 1283.

§ 40. Construction of necessary facilities for commerce, navigation, fisheries, and recreation

The board may acquire, construct, erect, maintain or operate within the district, all improvements, utilities, appliances or facilities which are necessary or convenient for the promotion and accommodation of commerce, navigation, fisheries, and recreation, or their use in connection therewith upon the lands and waters under the control and management of the board, and it may acquire, maintain and operate facilities of all kinds within the district.

Added Stats 1970 ch 1283.

§ 41. Emergency suspension of rules and regulations

In case of emergency the board may suspend, modify or amend any rule or regulation of the board, or it may place in effect any emergency rule or regulations, for periods not exceeding 30 days, and every such ordinance shall so provide.

Added Stats 1970 ch 1283.

§ 42. Offense as misdemeanor

Any person who violates the provisions of any ordinance, or any local police or sanitary regulation, of the board shall be guilty of a misdemeanor.

Added Stats 1970 ch 1283.

Cross References:
"Misdemeanor": Pen C §§ 17, 19, 19.2.

§ 43. Application of local police, fire, and sanitary regulations

In the absence of the adoption of any police, fire and sanitary regulations by the district, the police, fire and sanitary regulations of the county or any city whose boundaries are adjacent to or contiguous to the territorial limits of the district shall be applicable.

Added Stats 1970 ch 1283.

CHAPTER 4

Finances

ARTICLE 1

Budget

§ 44. Budget

On or before the 15th day of June of each year, the district board shall estimate and determine the amount of money required by the district and shall adopt a preliminary budget which shall be divided into the following main classes;

(a) Ordinary annual expenses.

(b) Capital outlay and Capital Outlay Fund.

(c) Prior indebtedness.

Added Stats 1970 ch 1283.

§ 45. Notice of adoption of preliminary budget; Inspection; Final budget

On or before the 15th day of June of each year, the board shall publish a notice pursuant to Section 6061 of the Government Code in the district stating:

(a) That the preliminary budget has been adopted and is available at a time and at a place within the district specified in the notice for inspection by interested taxpayers.

(b) That on a specified date not less than one month after the publication of the notice and at a specified time and place, the district board will meet for the purposes of fixing the final budget, and that any taxpayer may appear and be heard regarding the increase, decrease or omission of any item in the budget, or for the inclusion of additional items.

Added Stats 1970 ch 1283.

§ 46. Hearing on budget

At the time and place designated in the published notice for the meeting, any taxpayer may appear and be heard regarding the increase, decrease or omission of any item in the budget or for the inclusion of additional items. The hearing on the budget may be continued from time to time.

Added Stats 1970 ch 1283.

§ 47. Report of final budget to board of supervisors

The district board shall report the final budget to the board of supervisors after the budget hearing but not later than the first day of August each year after making any changes in the preliminary budget it deems advisable during or after the hearing, including deductions, increases or additions.

Added Stats 1970 ch 1283.

§ 48. Taxes required to fund budget; Collection

The board of supervisors shall at the time of levying the county taxes levy the taxes required by other sections of this act and also a tax upon all the taxable property within the district sufficient to meet the amounts set forth in the final budget submitted by the district board.

The money when collected by the tax collector of the county shall be paid to the treasurer of the district. The tax shall not, however, exceed a rate of ten cents ($0.10) on each one hundred dollars ($100) of assessed valuation, exclusive of taxes levied or required to be levied under Sections 61, 62, and 63 of this act, unless approved by a majority of the electors of the district.

Added Stats 1970 ch 1283.

§ 49. Transfers to Capital Outlay Fund

At any time the board may transfer to the Capital Outlay Fund any unencumbered surplus funds raised from sources other than from taxation, for any purpose whatsoever, remaining on hand at the end of any fiscal year or years.

Added Stats 1970 ch 1283.

§ 50. Procedures for disbursement of fund monies

The Capital Outlay Fund shall remain inviolate for the making of any capital outlays and the money shall not be disbursed from the fund except for such a purpose unless the district board submits a proposition to the electors of the district to obtain their consent to use the money in the fund for some other specific purpose. The proposition may be submitted at any election. A majority vote of all the voters voting at the election is necessary to authorize the expenditure of the money for such other purpose.

Added Stats 1970 ch 1283.

§ 51. Reimbursement to governments for water or navigation improvements

The district may contribute money to the federal or the state government or to the county in which it is located or to any city within the district, for the purpose of defraying the whole or a portion of the cost and expenses of work and improvement to be performed, either within or without the territorial limits of the district, by the federal, state, county or city government, in improving rivers, streams, or in doing other work, when such work will improve navigation, commerce, or renewable natural resources, in or to the navigable waters in the district.

Added Stats 1970 ch 1283.

§ 52. Humboldt Bay Harbor, Recreation and Conservation District Revenue Fund; Deposits and appropriations

All money received or collected from or arising out of the use or operation of any harbor or port improvement, work, appliance, facility or utility, or vessel, owned, controlled or operated by the district; all tolls, charges and rentals collected by the board, and all compensations or fees required to be paid for franchises or licenses, or otherwise by law or ordinance or order, to the district for the operation of any public service utility upon lands or waters under the control and management of the board, shall be deposited in the treasury of the district to the credit of a fund to be known as the Humboldt Bay Harbor, Recreation and Conservation District Revenue Fund. The money in or belonging to the fund shall not be appropriated or used for any purpose except those enumerated in this act and such enumeration shall not be deemed to create any priority of one use of purpose over another.

Added Stats 1970 ch 1283.

§ 53. Uses of fund monies; Operation and maintenance of facilities

The fund may be used for the necessary expenses of conducting the district, including the operation and maintenance of all harbor or port improvements, works, utilities, appliances, facilities and vessels owned, controlled or operated by the district for the promotion and accommodation of commerce, navigation, fisheries, and recreation, or used in connection therewith, and for the purposes set forth in any grants in trust.

Added Stats 1970 ch 1283.

§ 54. Advertising uses of fund monies

The money in the fund may also be used for advertising the commercial and other advantages and facilities of any harbor in the district, and for encouraging and promoting commerce, navigation and transportation in and through such harbor.

Added Stats 1970 ch 1283.

§ 55. Acquisition and improvement uses of fund monies

The money in the fund may also be used for the acquisition, construction, completion and maintenance of harbor and port improvements, works, utilities, appliances, facilities, and vessels, for the promotion and accommodation of commerce, navigation and fisheries, and recreation, or uses in connection therewith; and for extraordinary improvements and betterments to lands and property under the control, supervision and management of the district, including the purchase or condemnation of necessary lands and other property and property rights.

Added Stats 1970 ch 1283.

§ 56. Payment of principal or interest of district bonds from fund

The money in the fund may also be used for the payment of th principal, or interest, or both, of district bonds authorized, issued and sold pursuant to this act and for the establishment and maintenance of bond service funds, sinking funds, reserve funds or other funds or accounts established to secure the payment of principal of, interest on, or redemption of or for the security of such bonds.

Added Stats 1970 ch 1283.

Collateral References:

Cal Jur 3d Public Securities and Obligations § 55.

§ 56.5. Regulation of pilotage and towing

The board shall regulate and control the pilotage and towing of all vessels.

Added Stats 1970 ch 1448 § 3.

Former Sections:

Former § 56.6 was added Stats 1970 ch 1283 and repealed Stats 1970 ch 1448 § 2.

§ 57. Use of fund monies to pay principal and interest of local bonds for district improvements

The money in the fund may also be used for the payment of the principal or interest, or both, of the bonds of the county or any city in the district, for harbor improvements, authorized or outstanding prior to the establishment of the district, or thereafter issued and sold by such county or city for harbor improvements pursuant to this act.

Added Stats 1970 ch 1283.

§ 58. Transfer of appropriations to other budget items

The chief executive officer may make application in writing to the board for a transfer of amounts from one appropriated item to another in the budget allowance. On the approval of the board by a majority vote, the auditor shall make such transfer; but a transfer shall not be made except as herein provided. Any transfer of bond or note proceeds or of bond or note service, reserve or sinking funds shall be made only as provided in the proceedings authorizing the issuance of such bonds.

Added Stats 1970 ch 1283.

ARTICLE 2

Temporary Borrowing

§ 59. Temporary borrowing

Notwithstanding any other provision of this act, the board may borrow money by issuance of negotiable promissory notes, or execute conditional sales contracts to purchase personal property, in an amount or of a value not exceeding in the aggregate at any one time the sum of two hundred thousand dollars ($200,000), for the purposes of the acquisition, construction, completion or repair of any or all improvements, works, property or facilities authorized by this act or necessary or convenient for the carrying out of the powers of the district.

Notwithstanding any other provision of this act, the board may borrow money, until June 30, 1975, by the issuance of negotiable promissory notes, to provide working capital for the necessary expenses of conducting the district, provided that at the time of issuance of any such notes the aggregate amount of said notes outstanding and issued for such purpose shall not exceed one-fourth of the annual budget for such expenses for the fiscal year (or portion thereof in the case of 1970–1971) in which such borrowing occurs.

Notwithstanding any other provision of this act, the board may borrow money, until June 30, 1975, by the issuance of negotiable promissory notes to provide any or all sums required to be paid pursuant to the provisions of Section 64 of this act.

Negotiable promissory notes issued pursuant to this section shall mature in not exceeding five years from their respective dates and shall bear interest at a rate or rates not exceeding 7 percent per annum payable annually or semiannually.

No conditional sales contract shall be for a term in excess of five years from the date of execution thereof.

The negotiable promissory notes and the conditional sales contracts shall contain such terms and provisions as the board shall specify in the ordinance providing for the issuance thereof. The negotiable promissory notes shall be signed in the same manner as general obligation bonds of the district and the conditional sales contracts shall be signed in the same manner as other contracts of the district.

As a condition precedent to the issuance of any negotiable promissory notes for the purposes of the acquisition, construction, completion or repair of any or all improvements, works, property or facilities authorized by this act or necessary or convenient for the carrying out of the powers of the district or the execution of any conditional sales contract for such purposes, as provided in this section, in excess of twenty-five thousand dollars ($25,000), the board shall first unanimously approve by resolution and have on file a report approved by the chief executive officer on the engineering and economic feasibility relating to the project contemplated for the expenditure of said borrowed money or conditional sales contract. Said feasibility report shall be prepared and signed by an engineer or engineers licensed and registered under the laws of the State of California.

Taxes for the payment of all negotiable promissory notes or conditional sales contracts issued under this section shall be levied, collected, paid to the district and used in the same manner as is hereinafter provided for general obligation bonds of the district.

Added Stats 1970 ch 1283.

ARTICLE 3

General Obligation Bonds

§ 60. General obligation bonds

Whenever the board deems it necessary for the district to incur a general obligation bonded indebtedness for the acquisition, construction, completion or repair of any or all improvements, works, property or facilities, authorized by this act or necessary or convenient for the carrying out of the powers of the district, it shall, by ordinance, adopted by a majority of all members of the board, so declare and call an election to be held in said district for the purpose of submitting to the qualified voters thereof the proposition of incurring indebtedness by the issuance of general obligation bonds of said district. Said ordinance shall state;

(a) The purpose for which the proposed debt is to be incurred, which may include expenses of all proceedings for the authorization, issuance and sale of the bonds.

(b) The estimated cost of accomplishing said purpose.

(c) The amount of the principal of the indebtedness.

(d) The maximum term the bonds proposed to be issued shall run before maturity, which shall not exceed 40 years from the date thereof or the date of each series thereof.

(e) The maximum rate of interest to be paid, which shall not exceed 7 percent per annum.

(f) The proposition to be submitted to the voters.

(g) The date of the election.

(h) The manner of holding the election and the procedure for voting for or against the measure.

Notice of the holding of such election shall be given by publishing, pursuant to Section 6066 of the Government Code, the ordinance calling the election in at least one newspaper published in such district. No other notice of such election need be given. Except as otherwise provided in the ordinance, the election shall be conducted as other district elections.

If any proposition is defeated by the electors, the board shall not call another election on a substantially similar proposition to be held within six months after the prior election. If a petition requesting submission of such a proposition, signed by 15 percent of the district electors, as shown by the votes cast for all candidates for Governor at the last election, is filed with the board, it may call an election before the expiration of six months.

If a majority of the electors voting on the proposition vote for it, then the board may, by resolution, at such time or times as it deems proper, issue bonds of the district for the whole or any part of the amount of the indebtedness so authorized and may from time to time, in such resolution or resolutions, provide for the issuance of such amounts as the necessity thereof may appear, until the full amount of such bonds authorized shall have been issued. Said full amount of bonds may be divided into two or more series and different dates and different dates of payment fixed for the bonds of each series. A bond need not mature on an anniversary of its date. The maximum term the bonds of any series shall run before maturity shall not exceed 40 years from the date of each series respectively. In such resolution or resolutions the board shall prescribe the form of the bonds and the form of any coupons to be attached thereto, the registration, conversion and exchange privileges, if any, pertaining thereto, and fix the time when the whole or any part of the principal shall become due and payable.

The bonds shall bear interest at a rate or rates not exceeding 7 percent per annum, payable semiannually, except that the first interest payable on the bonds or any series thereof may be for any period not exceeding one year as determined by the board. In the resolution or resolutions providing for the issuance of such bonds the board may also provide for call and redemption of such bonds prior to maturity at such times and prices and upon such other terms as it may specify, provided that no bond shall be subject to call or redemption prior to maturity unless it contains a recital to that effect or unless a statement to that effect is printed thereon. The denomination or denominations of the bonds shall be stated in the resolution providing for their issuance, but shall not be less than one thousand dollars ($1,000). The principal of and interest on such bonds shall be payable in lawful money of the United States at the office of the treasurer of the district or at such other place or places as may be designated, or at either place or places at the option of the holders of the bonds. The bonds shall be dated, numbered consecutively and shall be signed by the chairman and treasurer, countersigned by the clerk and the official seal of the district attached. The interest coupons of such bonds shall be signed by the treasurer. All such signatures, countersignatures and seal may be printed, lithographed or mechanically reproduced, except that one of such signatures or countersignatures on the bonds shall be manually affixed. If any officer whose signature or countersignature appears on bonds or coupons ceases to be such officer before the delivery of the bonds, his signature is as effective as if he had remained in office.

The bonds may be sold as the board determines by resolution but for not less than par. Before selling the bonds, or any part thereof, the board shall give notice inviting sealed bids in such manner as it may prescribe. If satisfactory bids are received the bonds offered for sale shall be awarded to the highest responsible bidder. If no bids are received or if the board determines that the bids received are not satisfactory as to price or responsibility of the bidders the board may reject all bids received, if any, and either readvertise or sell the bonds at private sale.

Delivery of any bonds may be made at any place either inside or outside the state, and the purchase price may be received in cash or bank credits.

All accrued interest received on the sale of bonds shall be placed in the fund to be used for the payment of principal of and interest on the bonds and the remainder of the proceeds of the bonds shall be placed in the treasury to the credit of the proper improvement fund and applied exclusively to the purpose for which the debt was incurred; provided, however, that when said purpose has been accomplished any moneys remaining in such improvement fund (a) shall be transferred to the fund to be used for the payment of principal of and interest on the bonds, or (b) shall be placed in a fund to be used for the purchase of outstanding bonds of the district.

After the expiration of three years after a general obligation bond election the board may determine, by ordinance adopted by a majority of all the members of the board, that any or all of the bonds authorized at said election remaining unsold shall not be issued or sold. When the ordinance takes effect, the authorization to issue said bonds shall become void.

Whenever the board deems that the expenditure of money for the purpose for which the bonds were authorized by the voters is impractical or unwise, it may, by ordinance adopted by the majority of all members of the board, so declare and call an election to be held in the district for the purpose of submitting to the qualified voters thereof the proposition of incurring indebtedness by the issuance of such bonds for some other purpose. The procedure, so far as applicable, shall be the same as when a bond proposition is originally submitted.

The board may provide for the issuance, sale or exchange of refunding bonds to redeem or retire any bonds issued by the district upon the terms, at the times and in the manner which it determines. Refunding bonds may be issued in a principal amount sufficient to pay all or any part of the principal of such outstanding bonds, the interest thereon and the premiums, if any, due upon call and redemption thereof prior to maturity and all expenses of such refunding. The provisions for this section for authorization, issuance and sale of bonds shall apply to the authorization, issuance and sale of such refunding bonds; except that when refunding bonds are to be exchanged for outstanding bonds the method of exchange shall be as determined by the board.

Added Stats 1970 ch 1283.

Collateral References:

Cal Jur 3d Public Securities and Obligations §§ 22 et seq., 38 et seq., 47 et seq., 54 et seq., 62 et seq.

§ 61. Tax levies to pay bond principal and interest

All bonds issued pursuant to Section 60 of this act are general obligations of the district and at the time of making the general tax levy after the incurring of any such bonded indebtedness, and annually thereafter until the bonds are paid or until there is a sum in the treasury of the district set apart for that purpose sufficient to meet all payments of principal and interest on the bonds as they become due, the board must cause a tax to be levied and collected annually, as hereinafter provided in Sections 62 and 63 of this act, sufficient to pay the interest on the bonds and such part of the principal as will become due before the proceeds of a tax levied at the next general tax levy will be available.

Added Stats 1970 ch 1283.

§ 62. Certification to board of supervisors of annual amount of bond principal and interest

The board shall, at least 30 days before the board of supervisors is required by law to fix the general tax levy, certify to the board of supervisors in writing the minimum amount of money required to be raised by taxation during the fiscal year for the payment of the principal and interest. If any of the moneys required to be raised by such annual tax levy are actually on hand and have been set aside in said fund for said purpose from some such other source, the tax levy hereinbefore required for such year may be reduced by such amount.

Added Stats 1970 ch 1283.

§ 63. Procedure for tax levy

The taxes required to be levied by Sections 61 and 62 of this act shall be levied upon all property within the district taxable for county purposes and shall be in addition to any and all other taxes levied by the board of supervisors and it shall be the duty of the officer, officers or body having authority to levy taxes within the county to levy the taxes so required. It shall be the duty of all county or other officers charged with the duty of collecting taxes to collect such taxes in the time, form and manner as county taxes are collected and when collected to pay the same to the district. All such taxes shall be of the same force and effect as taxes levied for county purposes and their collection may be enforced by the same means as provided for the collection of county taxes. Such taxes shall be used only for the payment of the bonds and interest thereon.

Added Stats 1970 ch 1283.

§ 63.5. Financing waterway projects

(a) The district may, in any year, levy assessments, reassessments, or special taxes and issue bonds to finance waterway construction projects and related operations and maintenance, or operations and maintenance projects independent of construction projects in accordance with, and pursuant to, the Improvement Act of 1911 (Division 7 (commencing with Section 5000) of the Streets and Highways Code), the Improvement Bond Act of 1915 (Division 10 (commencing with Section 8500) of the Streets and Highways Code), the Municipal Improvement Act of 1913 (Division 12 (commencing with Section 10000) of the Streets and Highways Code), the Benefit Assessment Act of 1982 (Chapter 6.4 (commencing with Section 54703) of the Government Code), the Integrated Financing District Act (Chapter 1.5 (commencing with Section 53175) of Division 2 of Title 5 of the Government Code), the Mello-Roos Community Facilities Act of 1982 (Chapter 2.5 (commencing with Section 53311) of Part 1 of Division 2 of Title 5 of the Government Code), and the Marks-Roos Local Bond Pooling Act of 1985 (Article 4 (commencing with Section 6584) of Chapters of Division 7 of Title 1 of the Government Code).

(b) Sections 5116, 5117, 5118, 5119, 5190, 5191, 5192, 5193, 10104, and 10302 of the Streets and Highways Code shall not apply to assessment proceedings undertaken pursuant to this section.

(c) Notwithstanding the related provisions of any assessment act which the district is authorized to use, any assessment diagram which any of those acts requires to be prepared prior to final approval of the assessment district may show only the exterior boundaries of the assessment district and the boundaries of any assessment zones or improvement areas within the district. The diagram may refer to the county assessor's maps and records for a detailed description of each lot or parcel.

(d) Notwithstanding any other provision of law, the districts may levy and collect assessments and reassessments in the same manner as provided in Article 3 (commencing with Section 51320) of Chapter 2 of Part 7 of Division 15 of the Water Code, to pay any or all of the following:

(1) For the operation and maintenance of projects, including maintenance of lands, easements, rights-of-way, dredge material disposal areas, and remediation.

(2) For the satisfaction of liabilities arising from projects.

(3) To accumulate a fund which may be used to advance the cost of district projects, provided that the advances be repaid, with interest as determined by the commissioners, from assessments, reassessments, special taxes, or fees charged by the district pursuant to this section.

(4) To acquire real property, easements, or rights-of-way for a navigation project or the maintenance of a navigation project.

(5) To acquire real property within the district for disposal of dredged material.

(e) For purposes of this section, functions designated by Article 3 (commencing with Section 51320) of chapter 2 of Part 7 of Division 15 of the Water Code to be performed by the board of supervisors, the board of trustees, or valuation commissioners shall be performed by the district's board.

(f) For purposes of this section, the board may order the creation of a separate assessment roll to pay the allowable expenses of any single project or any group or system of projects.

(g) Notwithstanding any other provision of law, all assessments, reassessments, and taxes levied by the district may be collected together with, and not separately from, taxes for county purposes. Any county in which the district is located may collect, at the request of the district, all assessments, reassessments, and special taxes levied by the district and shall cause those revenues to be deposited into the county treasury to the credit of the district. Each county may deduct its reasonable collection and administrative costs.

(h) Notwithstanding any other provision of law, any assessment or reassessment levied pursuant to this section may be apportioned on the basis of land use category, tonnage shipped on the waterway, size and type of vessel using the waterway, front footage, acreage, capital improvements, or other reasonable basis, separately or in combination, as determined by the district commissioners.

(i) Notwithstanding any other provision of law, Division 4 (commencing with Section 2800) of the Streets and Highways Code shall not apply to any assessment levied by the district.

(j) Notwithstanding any other provision of law, no bond issued pursuant to this section shall be used to fund the routine maintenance dredging of channels.

Added Stats 1991 ch 978 § 10 (SB 683).

ARTICLE 4

Revenue Bonds

§ 64. Revenue bonds

Whenever the board deems it necessary for the district to incur a revenue bonded indebtedness for the acquisition, construction, completion or repair of any or all improvements, works, property or facilities authorized by this act or necessary or convenient for the carrying out of the powers of the district, the board shall issue such revenue bonds in accordance with the provisions of the Revenue Bond Law of 1941, as the same now exists or may hereafter be amended; provided, however, that;

(a) As an alternative to the election required by the Revenue Bond Law of 1941, the board may provide by ordinance, which shall be subject to referendum, that the bonds shall be issued without an election. Any referendum petition on such an ordinance shall be filed within the requisite time and shall be signed by voters of the district equal in number of at least 5 percent of the entire vote cast within the district for all candidates for Governor at the last gubernatorial election.

(b) The aggregate amount of revenue bonds outstanding at any one time which have not been authorized or approved at an election shall not exceed two million dollars ($2,000,000).

(c) Any provisions of the Revenue Bond Law of 1941 which are inconsistent with the provisions of this act shall not be applicable.

Added Stats 1970 ch 1283.

Cross References:

Revenue Bond Law of 1941: Gov C §§ 54300 et seq.

ARTICLE 5

General

§ 65. Bonds as legal investments

Bonds issued by the district pursuant to this act are legal investments for all trust funds, and for the funds of all insurers, banks, both commercial and savings, and trust companies, and for the state school funds, and whenever any money or funds may, by law now or hereafter enacted, be invested in bonds of cities, cities and counties, counties, school districts or municipalities in this state, such money or funds may be invested in bonds of the district organized pursuant to this act.

Added Stats 1970 ch 1283.

Cross References:
Investment of public funds: Const Art XVI § 17.

§ 66. Enforcement of debt instruments against district

Notwithstanding any other provisions of this act or any other law, the provisions of all ordinances, resolutions and other proceedings in the issuance by the district of any general obligation bonds, general obligation bonds with a pledge of revenues, revenue bonds, negotiable promissory notes, or any and all evidences of indebtedness or liability and the provisions thereof and the provisions of this act shall be enforceable against the district, any or all of its successors or assigns, by mandamus or any other appropriate suit, action or proceeding in law or in equity in any court of competent jurisdiction. Nothing contained in this act or in any other law shall be held to relieve the district or the territory included within it from any bonded or other debt or liability contracted by the district. Upon dissolution of the district or upon withdrawal of territory therefrom, the property formerly included within the district or withdrawn therefrom shall continue to be liable for the payment of all bonded and other indebtedness or liabilities outstanding at the time of such dissolution or withdrawal the same as if the district had not been so dissolved or the territory withdrawn therefrom, and it shall be the duty of the successors or assigns to provide for the payment of such bonded and other indebtedness and liabilities. Except as may be otherwise provided in the proceedings for the authorization, issuance and sale of any revenue bonds or general obligation bonds secured by a pledge of revenues, revenues of any kind or nature derived from any revenue-producing improvements. works, facilities or property owned, operated or controlled by the district shall be pledged, charged, assigned and have a lien thereon for the payment of such bonds as long as the same are outstanding, regardless of any change in ownership, operation or control of such revenue-producing improvements, works, facilities or property and it shall, in such later event or events, be the duty of the successors or assigns to continue to maintain and operate such revenue-producing improvements, works, facilities or property as long as such bonds are outstanding.

Added Stats 1970 ch 1283.

Cross References:
Capacity to be sued: H & N C Appx II § 26.

§ 67. Assumption of city indebtedness incurred for improvement of tidelands and submerged lands

The district in consideration for the conveyance of tidelands and submerged lands by the Cities of Eureka and Arcata, such conveyance having been accepted by the district in accordance with the provisions of Section 18 of this act, shall take over and assume any indebtedness incurred by the cities for the development, improvement, or maintenance of such tidelands and submerged lands, or for the construction of improvements or facilities therein or thereon.

Added Stats 1970 ch 1283.

Cross References:
Administration and control of tidelands or submerged land: Pub Res C §§ 6301 et seq.

§ 68. Investment of funds

The board may, by resolution, order that any of the moneys in the funds under its control which are not necessary for current operating expenses be invested in any obligations, bonds or securities in which a general law city could invest such funds; provided, however, that (1) any such investment shall be made in such a manner that the moneys in such funds will be available at the times and in the amounts necessary to accomplish the purpose for which said funds were established, and (2) no such investment shall be made in contravention of any provision or covenant in any proceedings for the authorization and issuance of bonds, notes, contracts or other evidences of indebtedness.

Added Stats 1970 ch 1283.

§ 69. Execution of instruments of indebtedness

Bonds, notes and other evidences of indebtedness issued or incurred by the district shall be signed as provided in the section of this act applicable thereto or as provided in any other law applicable thereto; provided, however, that if the particular section or law does not prescribe the method of such execution, the method provided for general obligation bonds of the district shall apply so far as applicable. All other contracts of the district shall be executed in such manner as the board may fix by resolution.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Public Securities and Obligations § 32.

CHAPTER 5

Officers and Employees

§ 70. Transfer of county and city employees to district; Retirement and disability system continuation provisions

Notwithstanding the provisions of Section 68 of this act, all employees of the county and any city performing duties in connection with Humboldt Bay Harbor or the respective harbor departments, shall be blanketed in as employees of the district; and the district is empowered to; (a) contract with the Public Employees' Retirement System and may provide retirement and disability benefits for employees under the Public Employees' Retirement System pursuant to its rules and regulations, or (b) contract with any city included within the district which has a retirement system for retirement and disability benefits for district employees. The district may, by contract, continue such employees of the district so blanketed in as members of the retirement system of which they were members while they were employees of the respective cities.

Added Stats 1970 ch 1283.

§ 71. Provisions governing transferred employees

No employee of the district who was previously employed by another governmental agency and was transferred to the district when it was formed and took over functions previously performed by such other agency shall be discharged, except for cause, or transferred to any position of a lesser class.

Nothing in this section shall prevent the district from employing an independent contractor to provide services of a professional, scientific or technical nature where the district has determined that it is impractical to have such service furnished by a person employed or to be employed in the classified service and the employment of such independent contractor will not require the removal, suspension, layoff or transfer of any employee in the classified service or the elimination of any classification thereof.

This section shall not apply to any employee of the district who is or has been employed by another governmental agency in substantially the same class of position and rate of pay as the position held, and pay received, while employed by the district.

Added Stats 1970 ch 1283.

Cross References:
Transfer of public functions: Gov C §§ 53290 et seq.

§ 72. Officers

The officers of the district shall be:

(a) Chief executive officer.

(b) An auditor.

(c) An attorney.

(d) A clerk.

(e) A treasurer.

(f) A chief engineer.

(g) A planner.

The auditor, chief executive officer, and attorney shall be appointed by the board when such positions are required to be filled. The auditor and attorney shall appoint such deputies or assistants as may be authorized by the board. All other officers and employees shall be appointed by the chief executive officer. All officers appointed by the chief executive officer must be confirmed by the board.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Public Officers and Employees §§ 19 et seq.

§ 73. Unclassified and classified employees

(a) Employment in the district shall be divided into the unclassified and classified service.

(b) The unclassified service shall include:

(1) All officers of the district.

(2) All department and division heads.

(3) The principal assistant or deputy of all officers and department and division heads.

(4) All assistant and deputy attorneys.

(c) The board shall establish a classified civil service which shall include all positions not specifically included in the unclassified service; provided, however, any incumbents in the positions included in the unclassified service presently in the classified service shall remain in the classified service until the respective positions are vacated by the incumbents.

(d) Officers and employees appointed by the board may be removed from office by a majority vote of the board.

(e) All persons in the classified service shall be appointed by and may be removed by the chief executive officer subject to the civil service rules and regulations of the district.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Public Officers and Employees §§ 24 et seq.

§ 74. Adoption of civil service rules and regulations

The board may adopt civil service rules and regulations in accordance with the following provisions;

(a) The civil service rules and regulations shall provide:

(1) For the qualifications and examination of all applicants for employment and for the employment of persons on probation.

(2) For the registration of persons, other than unskilled laborers, in the classified civil service, in accordance with their general average standing upon examination.

(3) For promotions on the basis of ascertained merit and seniority in service and examination, and for competitive examinations for promotions.

(4) For the reassignment of persons injured in the service of the district who were at the time of injury actually engaged in the discharge of the duties of their positions.

(5) For leaves of absence.

(6) For the transfer from one position to a similar position of the same class.

(7) For the reinstatement to the list of eligibles on recommendation of the chief executive officer, of persons who have become separated from the service or have been reduced in rank, other than persons who have been removed for cause.

(8) For the keeping of service records of all employees in the civil service, and for their use as one of the bases for promotions or layoffs through stoppage or lack of work.

(9) For the procedure for the removal, discharge or suspension of employees; for the investigation by the board of the grounds thereof, and for the reinstatement or restoration to duty of persons found to have

been removed, discharged or suspended for insufficient grounds or for reasons which are not sustained by investigation.

(10) Generally for any other purpose which may be necessary or appropriate to carry out the objects and purposes of the civil service system and the rules herein specifically authorized.

(b) The following persons may be exempted by the board, by ordinance, from the civil service:

(1) Persons employed to render professional, scientific, technical or expert service of a temporary or exceptional character.

(2) Persons employed on the construction of district works, improvements, buildings or structures.

(3) Persons receiving a salary not exceeding fifty dollars ($50) a month.

Any exemption so made may be terminated at any time by resolution of the board.

Added Stats 1970 ch 1283.

§ 75. Contract for use of county civil service department

Nothing herein contained shall prevent the board from contracting with the County of Humboldt to utilize the services of its civil service commission office or department to effectuate the purposes hereof.

Added Stats 1970 ch 1283.

Cross References:
County civil service: Gov C §§ 31100 et seq.

CHAPTER 6

Tidelands

§ 76. Grant of tidelands and submerged lands to district

The state hereby consents to the grant of tidelands and submerged lands from the Cities of Eureka and Arcata to the district as provided by this act. The district shall, upon its establishment in accordance with the provisions of this act, become the successor of the Cities of Eureka and Arcata whose tidelands and submerged lands shall have been included therein with respect to the management, conduct and operation of the harbor and the development and protection of the natural resources of such lands and with respect to the use, possession and title to such lands, and they shall continue to be held and used by the district pursuant to this act.

Added Stats 1970 ch 1283.

Cross References:
Administration and control of tidelands or submerged land: Pub Res C §§ 6301 et seq.

§ 77. Reversionary provisions upon dissolution of district

If the district is dissolved by operation of law, or otherwise, any tidelands and submerged lands granted thereto pursuant to this act, together with any and all improvements thereon, and the management, conduct and operation thereof, reverts to and is revested in the respective grantors. The lands reverting to the grantors pursuant to this section shall be held by the respective grantors in trust subject to the conditions, terms, and purposes of this act.

Added Stats 1970 ch 1283.

§ 78. Use of ungranted state tidelands and submerged lands

(a) Any ungranted state-owned tidelands and submerged lands located within the district granted by the state to the district upon the establishment of the district together with those certain tidelands and submerged lands conveyed to the district by the cities of Eureka and Arcata, as provided by this act, shall be held by the district and its successors in trust and may be used for purposes in which there is a general statewide purpose, as follows;

(1) For the establishment, improvement and conduct of harbors, and for the construction, reconstruction, repair, maintenance, and operation of wharves, docks, piers, slips, quays, and all other works, buildings, facilities, utilities, structures and appliances incidental, necessary or convenient, for the promotion and accommodation of commerce and navigation.

(2) For all commercial and industrial uses and purposes, and the construction, reconstruction, repair and maintenance of commercial and industrial buildings, plants and facilities.

(3) For the establishment, improvement and conduct of airport and heliport or aviation facilities, including but not limited to approach, takeoff and clear zones in connection with airport runways, and for the construction, reconstruction, repair, maintenance and operation of terminal buildings, runways, roadways, aprons, taxiways, parking areas, and all other works, buildings, facilities, utilities, structures and appliances incidental, necessary or convenient for the promotion and accommodation of air commerce and air navigation.

(4) For the construction, reconstruction, repair and maintenance of highways, streets, roadways, bridges, belt line railroads, parking facilities, power, telephone, telegraph or cable lines or landings, water and gas pipelines, and all other transportation and utility facilities or betterments incidental, necessary or convenient for the promotion and accommodation of any of the uses set forth in this section.

(5) For the construction, reconstruction, repair, maintenance and operation of public buildings, public assembly and meeting places, convention centers, public parks, public playgrounds, public bathhouses and public bathing facilities, public recreation and public fishing piers, public recreation facilities, including but not limited to public golf courses, and for all works, buildings, facilities, utilities, structures and appliances incidental, necessary or convenient for the promotion and accommodation of any such uses.

(6) For the establishment, improvement and conduct of small boat harbors, marinas, aquatic playgrounds and similar recreational facilities, and for the construction, reconstruction, repair, maintenance and operation of all works, buildings, facilities, utilities, structures and appliances incidental, necessary or convenient for the promotion and accommodation of any of such uses, including but not limited to snack-bars, cafes, cocktail lounges, restaurants, motels, hotels, and other forms of transient living accommodations open to the public, launching ramps and hoists, storage sheds, boat repair facilities with cranes

and marine ways, administration buildings, public restrooms, bait and tackle shops, chandleries, boat sales establishments, service stations and fuel docks, yacht club buildings, parking areas, roadways, pedestrian ways and landscaped areas and other compatible commercial and recreational activities and uses.

(7) For the protection of wildlife habitats, the improvement, protection, and conservation of the wildlife and fish resources and the ecology of the area, the providing of open space areas and areas for recreational use with open access to the public, the enhancement of the aesthetic appearance of the bay and the area, control of dredging or filling of the bay, or both, and prevention of pollution of the bay.

(b) The district or its successors shall not, at any time, grant, convey, give or alienate said lands, or any part thereof, to any individual, firm or corporation for any purposes whatsoever; provided, that said district, or its successors, may grant franchises thereon for limited periods, not exceeding 66 years, for wharves and other public uses and purposes, and may lease said lands, or any part thereof, for limited periods, not exceeding 66 years, for purposes consistent with the trusts upon which said lands are held by the State of California, and with the requirements of commerce and navigation, and collect and retain rents and other revenues from such leases, franchises and privileges. Such lease or leases, franchises and privileges may be for any and all purposes which shall not interfere with commerce, navigation, fisheries, and ecological protection.

(c) Said lands shall be improved without expense to the state; provided, however, that nothing contained in this section shall preclude expenditures for the development of said lands for any public purpose not inconsistent with commerce, navigation, fisheries, and ecological protection, by the state, or any board, agency or commission thereof, when authorized or approved by the district, nor by the district of any funds received for such purpose from the state or any board, agency or commission thereof.

(d) In the management, conduct, operation and control of said lands or any improvements, betterments, or structures thereon, the district or its successors shall make no discrimination in rates, tolls or charges for any use or service in connection therewith.

(e) The State of California shall have the right to use without charge any transportation, landing or storage improvements, betterments or structures constructed upon said lands for any vessel or other watercraft, aircraft, or railroad owned or operated by the State of California.

(f) There is hereby reserved to the people of the State of California the right to fish in the waters on said lands with the right of convenient access to said water over said lands for said purpose.

(g) There is hereby excepted and reserved in the State of California all deposits of minerals, including oil and gas, but excluding sand, gravel and inert earth and the right to remove said deposits in said lands, and to the State of California, or persons authorized by the State of California, the right to prospect for, mine, and remove such deposits from said lands as are reserved to the state. Use of the interest excepted and reserved to the State of California hereunder shall be made in accordance with and subject to the provisions of Section 6401 of the Public Resources Code, and any amendment thereto.

(h) Such lands are granted subject to the express reservation and condition that the state may at any time in the future use the lands or any portion thereof for highway purposes without compensation to the city, its successors or assigns, or any person, firm or public or private corporation claiming under it, except that in the event improvements, betterments or structures have been placed upon the property taken by the state for such purposes, compensation shall be made to the person entitled thereto for the value of his interest in the improvements, betterments or structures taken or the damages to such interest.

(i) The State Lands Commission shall, at the cost of the district, survey and monument said lands and record a description and plat thereof in the office of the County Recorder of Humboldt County.

(j) As to any tidelands and submerged lands conveyed to the district by a city which are subject to a condition contained in a grant of said lands to the city by the state that said lands shall be substantially improved within a designated period or else they shall revert to the state, such condition shall remain in effect as to said lands and shall be applicable to the district.

(k) As to any tidelands and submerged lands conveyed to the district by a city which are not subject to such a condition contained in a grant by the state and which have not heretofore been substantially improved, and as to any stateowned tidelands and submerged lands granted to the district pursuant to this act, said lands, within 10 years from the effective date of this act, shall be substantially improved or ecologically enhanced by the district without expense to the state. If the State Lands Commission determines that the district has failed to so improve or enhance said lands as herein required, all right, title and interest of the district in and to said lands shall cease and said lands shall revert and rest in the state.

Added Stats 1970 ch 1283.

Cross References:

Administration and control of tidelands or submerged land: Pub Res C §§ 6301 et seq.

CHAPTER 7

Changes of Organization

§ 79. Organizational changes.

The district shall be subject to the provisions of the District Reorganization Act of 1965 (Division 1 (commencing with Section 56000) of Title 6 of the Government Code).

Added Stats 1970 ch 1283.

Editor's Notes—Government Code §§ 56000 et seq. are now the Cortese-Knox Local Government Reorganization Act, which combines the former District Reorganization Act with two other former laws to produce a single, unified law for boundary changes by California local governments.

CHAPTER 8

Miscellaneous

§ 80. Successor to local government powers

Whenever the district is established under the provisions of this act it is the successor of the county and each of the cities included therein as to all powers theretofore vested in the county or each such city or exercisable by its officers, which are by the provisions of this act granted to the district or are exercisable by its officers. Such powers are relinquished by the county and the cities and surrendered to the district. The title to, and possession and control of, any works, structures, appliances, improvements and equipment of the kinds designated in this act, owned or held by or in trust for the county and each of the cities, or by any officer or board thereof, in trust or otherwise, for any purpose for which the district is authorized to acquire and use property pursuant to this act, are upon the establishment of the district, transferred to and vested in the district and are thereafter owned, operated and controlled by the district pursuant to this act.

Added Stats 1970 ch 1283.

§ 81. Cessation of local government offices whose power and duties are within those of a district

Upon the establishment of the district, all persons then occupying the several offices of or under the government, of the county and each of the cities included therein, except as otherwise provided, whose several powers and duties are within the powers of the district or within the powers or duties of the several officers thereof, shall immediately quit and surrender the occupancy or possession of such offices which shall thereupon cease and determine, except as to any persons who have powers and perform duties for the county and the cities other than those mentioned, whose offices shall not cease and determine as to such other powers and duties but shall continue with respect thereto the same as if the district had not been established.

Added Stats 1970 ch 1283.

§ 82. Application of act to freeholder charter municipal corporations

The provisions of this act shall apply to any municipal corporation which is governed under a freeholders' charter even if such provisions are inconsistent with the charter or its amendments, it being hereby declared that such provisions are a matter of statewide concern and are to prevail over any inconsistent provisions in any such charter. If the district is dissolved by operation of law or otherwise, any works, structures, appliances, improvements and equipment are vested in such municipal corporation, together with any other works, structures, appliances, improvements and equipment acquired or constructed by the district in that portion of the district within the limits of each such municipal corporation respectively.

Added Stats 1970 ch 1283.

Cross References:

City or city and county charters: Gov C §§ 34450 et seq.

§ 83. Nonapplication of act to state crossings or state highways

Nothing in this act shall apply to the location, design, right-of-way acquisition, or construction of any state crossing of Humboldt Bay nor to any route presently on or hereafter added to the state highway system.

Added Stats 1970 ch 1283.

Cross References:

State highway system: Sts & Hy C §§ 50 et seq.

§ 84. Severability provision

If any section, subdivision, sentence, clause, or phrase of this act, or the application thereof to any person or circumstances, is for any reason held invalid, the validity of the remainder of the act, or the application of such provision to other persons or circumstances, shall not be affected thereby. The Legislature hereby declares that it would have passed this act, and each section, subdivision, sentence, clause, and phrase thereof, irrespective of the fact that one or more sections, subdivision, sentences, clauses or phrases, or the application thereof to any person or circumstance, be held invalid.

Added Stats 1970 ch 1283.

Collateral References:
Cal Jur 3d Statutes § 15.

BILL NUMBER: AB 878 CHAPTERED
BILL TEXT

CHAPTER 389
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AMENDED IN ASSEMBLY MAY 12, 2003
AMENDED IN ASSEMBLY MAY 5, 2003
AMENDED IN ASSEMBLY APRIL 21, 2003

INTRODUCED BY Assembly Member Pavley
(Coauthor: Assembly Member Berg)
(Coauthor: Senator Chesbro)

FEBRUARY 20, 2003

An act to amend Sections 6055 and 6077.6 of, and to add Section 6084.2 to, the Harbors and Navigation Code, and to add Section 69.5 to the Humboldt Bay Harbor, Recreation, and Conservation District Act (Chapter 1283 of the Statutes of 1970), relating to harbor districts.

LEGISLATIVE COUNSEL'S DIGEST

AB 878, Pavley. Harbor districts.

(1) Existing law contains various provisions relating to the creation of a harbor commission for each harbor district and the election, terms, and powers of harbor commissioners.

This bill would make changes to commissioners' titles, and authority over certain land and funds.

(2) Existing law authorizes a harbor district to order by resolution that all or any of the funds under its control and not necessary for current operating expenses be invested in obligations, bonds, or securities of the United States of America or of any agency or instrumentality thereof.

This bill would instead authorize those funds to be invested as specified.

(3) Existing law authorizes the board of a harbor district to borrow up to $1,000,000 by issuance of a promissory note for the purposes of acquiring land for, and constructing or operating, a work, project, or facility authorized under specified law. Existing law also authorizes a board to execute a conditional sales contract to purchase personal property with a value up to $1,000,000.

Existing law prohibits the borrowing term from exceeding 5 years. This provision does not apply to money borrowed from an agency or department of the United States government or the State of California.

Existing law establishes the Humboldt Bay Harbor, Recreation, and Conservation District within Humboldt County. Existing law authorizes the district to incur a general obligation bonded indebtedness and a revenue bonded indebtedness for the acquisition, construction, completion, or repair of improvements, works, property, or facilities for the district, as specified.

This bill would authorize a district to borrow money and incur indebtedness through limited obligation notes for any purpose, after adoption, by 4/5 vote of the board, of a resolution. The bill would set the maximum interest rate and maturity dates on the notes and would require that the outstanding amount at any one time not exceed $10,000,000. The bill also would authorize the Humboldt Bay Harbor, Recreation, and Conservation District to borrow money and incur indebtedness through this same type of limited obligation note.

THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:

SECTION 1. Section 6055 of the Harbors and Navigation Code is amended to read:

6055. The commissioners elected at the first election shall, within 10 days from the date of the canvass of the returns of the election, enter upon the duties of office. Before entering upon the duties of his or her office, each commissioner shall take and subscribe the official oath before the secretary or an officer authorized by law to administer oaths and shall file it with the county elections official of the county in which the district is situated.

They shall elect one of their number as president or chairperson and one of their number as secretary. The president or chairperson and secretary shall serve at the pleasure of the board.

SEC. 2. Section 6077.6 of the Harbors and Navigation Code is amended to read:

6077.6. A harbor district may by resolution order that all or any of the funds under its control and not necessary for current operating expenses be invested in accordance with Section 53601 of the Government Code.

SEC. 3. Section 6084.2 is added to the Harbors and Navigation Code, to read:

6084.2. (a) A district may issue limited obligation notes after the adoption, by a four-fifths vote of all the commissioners of the board, of a resolution reciting each of the following:

(1) That the resolution is being adopted pursuant to this subdivision.

(2) The purposes of incurring the indebtedness.

(3) The estimated amount of the indebtedness.

(4) The maximum amount of notes to be issued, and the source of revenue or revenues to be used to secure the limited obligation notes.

(5) The maturity date of the limited obligation notes.

(6) The form of the limited obligation notes.

(7) The manner of execution of the limited obligation notes.

(b) The resolution may also provide for one or more of the following matters:

(1) Insurance for the limited obligation notes.

(2) Procedures in the event of default, terms upon which the limited obligation notes may be declared due before maturity, and the terms upon which that declaration may be waived.

(3) The rights, liabilities, powers, and duties arising upon the district's breach of an agreement with regard to the limited obligation notes.

(4) The terms upon which the holders of the limited obligation notes may enforce agreements authorized by this section.

(5) A procedure for amending or abrogating the terms of the resolution with the consent of the holders of a specified percentage of the limited obligation notes. If the resolution contains this procedure, the resolution shall specifically state the effect of amendment upon the rights of the holders of all of the limited obligation notes.

(6) The manner in which the holders of the limited obligation notes may take action.

(7) Other actions necessary or desirable to secure the limited obligation notes or tending to make the notes more marketable.

(c) The limited obligation notes shall bear interest at a rate not exceeding the rate permitted under Article 7 (commencing with Section 53530) of Chapter 3 of Part 1 of Division 2 of Title 5 of the Government Code.

(d) The limited obligation notes may not mature later than 10 years after the date of the issuance of the notes, and the total amount of the limited obligation notes outstanding at any one time for the district may not exceed the sum of ten million dollars ($10,000,000).

(e) The agreement between the district and the purchasers of the limited obligation notes shall state that the notes are limited obligation notes payable solely from specified revenue of the district. The pledged revenue shall be sufficient to pay the following amounts annually, as they become due and payable:

(1) The interest and principal on the notes.

(2) Payments required for compliance with the resolution authorizing issuance of the notes or agreements with the purchasers of the notes.

(3) Payments to meet any other obligations of the district that are charges, liens, or encumbrances on the pledged revenue.

(f) The limited obligation notes are special obligations of the district, and shall be a charge against, and secured by a lien upon, and payable, as to the principal thereof and interest thereon, from the pledged revenue. If the revenue described in the authorizing resolution is insufficient for the payment of interest and principal on the notes, the district may make payments from any other funds or revenues that may be applied to their payment. The revenue and any interest earned on the revenue constitute a trust fund for the security and payment of the interest on and principal of the notes.

(g) So long as any limited obligation notes or interest thereon are unpaid following their maturity, the pledged revenue and interest thereon may not be used for any other new purpose.

(h) If the interest and principal on the limited obligation notes and all charges to protect them are paid when due, the district may expend the pledged revenue for other purposes.

(i) Limited obligation notes of the same issue shall be equally secured.

(j) The general fund of the district is not liable for the payment of the principal or the interest on the limited obligation notes.

(k) The holders of the limited obligation notes may not compel the exercise of the taxing power by the district, other than the revenue pledged, or the forfeiture of the district's property.

(l) Every agreement shall recite in substance that the principal of, and interest on, the limited obligation notes are payable solely from the revenue pledged to the payment of the principal and interest and that the district is not obligated to pay the principal or interest except from the pledged revenue.

SEC. 4. Section 69.5 is added to the Humboldt Bay Harbor, Recreation, and Conservation District Act (Chapter 1283 of the Statutes of 1970), to read:

69.5. Notwithstanding any other provision of this act, Section 6084.2 of the Harbors and Navigation Code applies to this act.

Appendix C

State and Federal

Implementing Entities

The following summary statements are provided in order to indicate generally the responsibilities of agencies that will assist the Harbor District in implementing the Humboldt Bay Management Plan.

State Agencies

The Resources Agency of California

Mission Statement
The Resources Agency of California is responsible for the conservation, enhancement, and management of California's natural and cultural resources, including land, water, wildlife, parks, minerals, and historic sites. The Agency is composed of 18 State departments, boards, conservancies, and commissions.

Major Roles and Responsibilities in Wetlands Management
In regards to wetlands, the primary of role and responsibility of the Resources Agency is the implementation of the State Wetland Conservation Policy.

On August 23, 1993, Governor Pete Wilson signed Executive Order W-59-93, establishing a State Wetland Conservation Policy (SWCP) and providing comprehensive direction for the coordination of state-wide activities for the preservation and protection of wetland habitats. The SWCP was the first state-wide conservation policy of its type in the United States. The Resources Agency and the California Environmental Protection Agency (Cal EPA) are designated as co-lead to implement the goals of the SWCP. The SWCP has three central goals:

- Ensure no overall net loss and achieve a long-term net gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship and respect for private property;
- Reduce procedural complexity in the administration of State and Federal wetlands conservation programs; and

- ✍ Encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

In addition to the "no net-loss" policy of the SWCP, Secretary for Resources, Douglas P. Wheeler, has set "a goal of a 30 to 50 percent increase in the quantity, quality and permanence of wetlands by the year 2010." The policy means that are employed to achieve the objectives of the SWCP are largely three in nature. They are:

I. Statewide policy initiatives, including:

- ✍ a State-wide wetlands inventory
- ✍ support for wetland planning
- ✍ improved administration of existing regulatory programs
- ✍ strengthened landowner incentives to protect wetlands
- ✍ support for mitigation banking
- ✍ development and expansion of other wetlands programs
- ✍ integration of wetlands policy and planning with other environmental and land use processes

II. Three geographically based regional strategies in which wetlands programs can be implemented, refined, and combined in unique ways to achieve the goals and objectives of the policy. These strategies will be implemented in:

- ✍ the Central Valley
- ✍ San Francisco Bay Area, and
- ✍ Southern California

III. Creation of an interagency wetlands task force on wetlands to direct and coordinate administration and implementation of the policy.

The Resources Agency is also responsible for operating and maintaining the Wetlands Information System, housed within the California Environmental Resources Evaluation System (CERES). This web site includes over 300 pages of information ranging from permitting guidelines, historical and current wetland maps, to Federal/State wetland policies. Detailed regional wetland inventories that include historical and current extent of wetlands and associated wetland functions and values have also been completed for the San Francisco Bay Area and coastal Southern California as part of the Wetland Information System. In addition, we have coordinated the use of data sets through the Natural Heritage Division of the Department of Fish & Game.

Legal Mandate

In regards to wetlands, the primary mandate for the Resources Agency, is Executive Order W-59-93 which established the State Wetland Conservation Policy. However, as a cabinet agency created under Government Code 12805, the Secretary for Resources also has a broader statutory mandate which is applicable to overall wetlands management. The applicable Government Code Sections are:

12850. The secretary of each agency has the power of general supervision over, and is directly responsible to the Governor for, the operations of each department, office, and unit within the agency.

12850.2. The secretary of each agency shall advise the Governor on, and assist him in establishing, major policy and program matters affecting each department, office, or other unit within the agency, and shall serve as the principal communication link for the effective transmission of policy problems and decisions between the Governor and each such department, office, or other unit.

12850.4. The secretary of each agency shall exercise the authority vested in the Governor in respect to the functions of each department, office, or other unit within the agency, including the adjudication of conflicts between or among the departments, offices, or other units; and shall represent the Governor in coordinating the activities of each such department, office, or other unit with those of other agencies, federal, state, or local.

The Resources Agency is also mandated to perform certain tasks related to the California Environmental Quality Act (CEQA). The Secretary for Resources possesses the following responsibilities under CEQA:

- Makes findings that a class of projects given categorical exemptions will not have a significant effect on the environment;
- Certifies state environmental regulatory programs which meet specified standards as being exempt from certain provisions of CEQA;
- Receives and files notices of completion, determination, and exemption; and
- Provides assistance in interpreting the provisions of CEQA and the CEQA Guidelines.
- Periodically revise the guidelines which implement CEQA (Title 14, 15000-15387-California Code of Regulations).

Mailing Address:
Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814

California Department of Fish and Game

Mission Statement
The mission of the California Department of Fish and Game (DFG) is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.

Major Roles and Responsibilities in Wetlands Management
The wetland activities of DFG are divided primarily between the Environmental Services Division (ESD) and the Wildlife Management Division (WMD). ESD conducts all aspects of wetlands regulation, permitting, and mitigation. While WMD is responsible for wetlands protection, restoration and enhancement on state wildlife areas and on private land under voluntary agreements with landowners.

ESD's primary role in wetlands management is executing "Streambed Alteration Agreements." Streambed Alteration Agreements are required in certain instances for construction projects which would impact wetlands associated with rivers, streams, or lakes. ESD also confers with other State and Federal government agencies issuing wetlands permits. These agencies include the U.S. Army Corps of Engineers (CWA §404 Permits), and the California Coastal Commission (Coastal Development Permits), the State Water Resources Control Board and its Regional Water Quality Control Boards (Water Quality Certification), and the San Francisco Bay Conservation and Development Commission (BCDC Permits).

WMD's major role in wetlands management is to meet the wetlands protection, restoration, and enhancement goals of the Central Valley Habitat Joint Venture, a component of the North American Waterfowl Management Plan. These habitat goals are achieved on state-owned wildlife areas and on private land enrolled in WMD's voluntary wetland incentive or easement programs. WMD's wetlands goals are completely separate from any wetland permitting or mitigation activities conducted by ESD although the two DFG divisions work together to achieve common resource benefits.

Legal Mandate
The Department has no officially adopted regulations or statutes pertaining to wetlands. However, as mentioned above Fish and Game Code §1601 and §1603 charge DFG with executing Streambed Alteration Agreements. Fish and Game Codes §§5650-5645 pertain to the protection of water quality but do not charge DFG with additional permitting responsibilities. As designated a Trustee and/or Responsible Agency per the California Environmental Quality Act §15386 and §15381, DFG reviews and comments on documents produced by the lead

agencies. DFG also administers the California Endangered Species Act and "lists plant and animal species per the act.

Mailing Address:
Habitat Conservation Planning Branch
1416 Ninth Street, 12th Floor
Sacramento, CA 95814

Department of Water Resources

<u>Mission Statement</u>
The mission of the Department of Water Resources (DWR) is to manage the water resources of California, in cooperation with other agencies, to benefit the State's people and to protect, restore, and enhance the natural and human environment.

<u>Major Roles and Responsibilities in Wetlands Management</u>
DWR's roles and responsibilities in wetlands management include avoidance and mitigation of wetlands impacts, wetlands protection and restoration, and technical assistance regarding water management.

DWR is responsible for constructing, operating, and maintaining the State Water Project. As part of this responsibility, DWR is required to avoid, minimize, or mitigate for wetland impacts. The largest wetland mitigation project in which DWR is currently involved mitigates for water quality impacts to Suisun Marsh. DWR has spent approximately $40 million to enhance supplies for private and public wetlands in the marsh. DWR is also evaluating the benefit of developing a wetland mitigation bank on lands it owns in the Sacramento-San Joaquin Delta, including Twitchell and Sherman Islands.

DWR programs that support the protection and restoration of wetland habitat are numerous. Some of these programs are mentioned below.

- DWR manages the Urban Stream Restoration Program which assists project proponents in resolving bank erosion and flood problems and protects natural environmental values of streams.
- DWR provides staff for the Upper Sacramento River Advisory Council which seeks to restore the Upper Sacramento River to a continuous riparian ecosystem.
- DWR is active in developing and implementing the San Joaquin River Management Program - a multi-objective river management program.
- DWR and the California Department of Fish and Game are implementing a memorandum of understanding designed to assure no net long-term loss

of fish and wildlife habitat in connection with work on Sacramento-San Joaquin Delta levees.
- ✍ DWR's Floodplain Management Program provides communities with information on laws, regulations, and land use practices which promote the protection of the 100-year floodplain. The primary objective of this program is to reduce flood damages. However, as a result of this program, wetland and riparian habitat in the floodplain are protected.

DWR also offers technical assistance in areas such as engineering, hydrology, mapping, water quality, and water use which are used in the protection and management of wetland an riparian habitats.

Legal Mandate
Several of the legal mandates governing DWR programs that involve wetland and riparian activities include:
- ✍ California State Water Resources Control Board's water rights decisions directing DWR and the U.S. Bureau of Reclamation to develop a plan and monitoring network to meet water quality standards in Suisun Marsh.
- ✍ The Urban Streams Restoration Program established under Water Code §7048.
- ✍ The Floodplain Management Program established under Water Code §8400 et seq. (Coby-Alquist Floodplain Management Act).

DWR is also currently preparing a report required by the Central Valley Improvement Act to assess the water needs and alternative water supplies for private and public wetlands in the Central Valley not provided in the Act.

For more information on the Department of Water Resources contact:

Mailing address:
Environmental Services Office
Department of Water Resources
3251 S Street
Sacramento, CA 95816

California Department of Parks and Recreation

Mission Statement
The mission of the California Department of Parks and Recreation (DPR) is to provide for the health, inspiration, and education of the people of California by helping to preserve the State's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation.

Major Roles and Responsibilities in Wetlands Management

The Department has a major role in the protection, restoration, and interpretation of the State's wetlands. A primary goal for DPR is the preservation of the State's biological diversity and the protection of its valued natural resources including wetlands. DPR manages over 265 park units, including over 280 miles of coastline and 250 miles of rivers. Many of the coastal units contain river mouths with coastal lagoons and estuaries.

Wetlands restoration is a high priority in the Department's Resource Management Program and is pursued in all California bioregions. For example, DPR's coastal area projects focus on the restoration of natural hydrologic conditions and the re-establishment of native plant communities while its riparian restoration projects focus on the restoration of altered channel morphology through the application of bioengineering. Examples of major wetland restoration projects include coastal wetlands at Pescadero Marsh Natural Preserve in San Mateo County, Wilder Beach Natural Preserve in Santa Cruz County, San Simeon State Park in San Luis Obispo County, Gaviota State Park in Santa Barbara County, and Tijuana Estuary Natural Preserve in San Diego County. Significant riparian restoration efforts have undertaken in numerous State Parks including Humboldt Redwoods State Park in Humboldt County, Washoe Meadows State Park in the Lake Tahoe Basin, Picacho State Recreation Area along Colorado River, and Anza-Borrego Desert State Park in San Diego County.

DPR is also involved in wetlands protection and restoration through the administration of local grants programs, such as the California Land and Water Conservation Fund and the Habitat Conservation Grant Program. Both of these programs include priorities for wetlands acquisition and restoration.

DPR provides educational opportunities, such as guided tours and interpretive displays, for park visitors to increase their understanding and appreciation of wetlands.

Legal Mandate

In addition to being included in DPR's primary mission, wetlands preservation is also a mandated responsibility under the Keene-Nejedly California Wetlands Preservation Act of 1976 (Pub. Res. Code Div. 5, Ch. 7). The Act directs DPR, along with the Department of Fish and Game, to recognize opportunities for protecting wetlands which lie within or adjacent to State Park System units, and to consider acquisition of wetlands in proximity of State Parks. In addition to lands directly owned by DPR, the Department also has certain jurisdiction over granted or ungranted tidelands or submerged lands abutting State Park System lands (Pub. Res. Code §5003.5).

For more information on the California Department of Parks and Recreation contact:

Mailing address:
California Department of Parks and Recreation
P.O. Box 942896
Sacramento, CA 94296-0001

The Wildlife Conservation Board

Mission Statement
The Wildlife Conservation Board's (Board) mission is to select, authorize, and allocate funds for the purchase of land and waters suitable for the preservation, protection, and restoration of wildlife habitat. The Board is also responsible for providing compatible recreational facilities. This has included the development of fishing piers and other means of access to coastal and inland waters and cost-sharing for wetlands enhancement.

Major Roles and Responsibilities in Wetlands Management
The Board is responsible for wetlands protection through the acquisition of fee and lesser interests, such as conservation easements. In addition, the Board assists local agencies, special districts, and nonprofit organizations with cost-share projects which restore and enhance public and privately owned wetlands. The Board is also responsible for managing the Inland Wetlands Conservation Program. This program assists the Central Valley Joint Venture in meeting specific objectives which protect, restore, and enhance public and privately owned wetlands in the California Central Valley.

Although the Board does not actively manage wetlands, it does have the authority to manage and award leases for degraded wetlands to nonprofit organizations, special districts, and local and state agencies. Under the terms of the lease, the lessee agrees to restore wetlands to their highest possible wetland value and maintain the wetlands at their highest possible value. Also, the Board has the authority to acquire degraded wetlands, restore the wetland to highest wetland value, and then sell the wetland to the private sector or another governmental entity. Such transactions only require short term management responsibilities.

Legal Mandate
The Board was established by legislation under the Wildlife Conservation Act of 1947 to administer a capital outlay program for wildlife conservation and related public recreation. Subsequent legislation, such as the Inland Wetlands Conservation Program (1990) and the California Riparian Habitats Protection Program (1991), expanded the Board's mandate. Generally, the Board's mandate can be found in §§1300-1431 of the California Fish and Game Code. Although the

Board is a part of the California Department of Fish and Game, it has separate funding.

Mailing address:
1807 13th Street, Suite 103
Sacramento, CA 95814
Phone: (916) 445-8448
Fax: (916) 323-0280

California Coastal Commission

Mission Statement
The California Coastal Commission (Commission) is a State coastal management and regulatory agency that in partnership with local governments, is responsible for implementation of the California Coastal Management Program.

Major Roles and Responsibilities in Wetlands Management
With regards to wetlands, the Coastal Commission's primary role is the regulation of coastal development affecting wetlands in California's coastal zone. (The coastal zone extends three miles seaward and generally about 1,000 yards inland. In particularly important and generally undeveloped areas where there can be considerable impact on the coastline from inland development, the coastal zone extends to a maximum of 5 miles inland from mean high tide line. In developed urban areas, the coastal zone extends substantially less than 1,000 yards inland. The Coastal Commission's jurisdiction does not extend into or around San Francisco Bay, where development is regulated by the San Francisco Bay Conservation and Development Commission.) In this capacity, the Commission has permitting authority over many types of activities proposed in wetlands occurring in the coastal zone.

The Commission also maintains active involvement in select projects involving wetlands restoration, enhancement, and/or mitigation. This involvement may include both procedural and technical assistance during all phases of a project.

Legal Mandate
The Coastal Commission operates under legal authority granted to it by the California Coastal Act of 1976, as amended (California Public Resources Code, Division 20). Jurisdiction also depends on whether a particular activity constitutes "development." ("Development" on land, or in or under water includes, but is not limited to, the placement or erection of any solid material or structure; discharge or disposal of any dredged material; change in the density or intensity of use of land; change in the intensity of use of water or its access; and construction, reconstruction, demolition, or alteration of size of any structure.)

Under the federal Coastal Zone Management Act, the Commission can also regulate federal actions or federally funded projects occurring outside the coastal zone as long as they affect resources within the zone.

Mailing address:
45 Fremont Street, Suite 2000
San Francisco, CA 94105-2219

California State Coastal Conservancy

Mission Statement
The California State Coastal Conservancy (Conservancy) is an independent state agency that works through non-regulatory means to protect, restore, and enhance coastal resources, including wetlands.

Major Roles and Responsibilities in Wetlands Management
The Conservancy works in partnership with public agencies, nonprofit organizations, community groups, landowners, and business interests in resolving land use conflicts, developing restoration and enhancement plans for coastal and San Francisco Bay wetlands and watersheds, and implementing these plans, including land acquisition. It cooperates closely with the California Coastal Commission in implementing projects around San Francisco Bay. The Conservancy also undertakes enhancement or restoration projects directly, or provides funding and technical assistance to local agencies or nonprofit organizations.

Legal Mandates
The Conservancy is authorized to act within the geographic areas described in § 31006 of the California Public Resources Code and as specifically allowed in subsequent sections of Division 21. With some exceptions, Conservancy projects are all within the "coastal zone" (see below) or around San Francisco Bay. For purposes of resource enhancement, the Conservancy may also undertake projects in coastal watersheds, which may extend inland of the coastal zone. (The "coastal zone" is the area of California's land and water from the Oregon border to the border of the Republic of Mexico and extending seaward to the State's outer limit of jurisdiction and extending inland generally a 1,000 yards from the mean high tide line.)

Mailing address:
1330 Broadway Street, Suite 1100
Oakland, CA 94612
(510)286-1015
Fax (510)286-0470

California State Lands Commission

Mission Statement
The mission of the California State Lands Commission (Commission) is to manage some 4.5 million acres of land held in trust for the people of California. The State holds these lands for all the peoples of the State for the public trust purposes of water related commerce, navigation, fisheries, recreation, and open space.

Major Roles and Responsibilities in Wetlands Management
Within these State owned lands lie many wetlands. The Commission manages the use of the State owned wetlands through leases to other public agencies and private parties. For example, the Commission has leased wetlands around San Francisco Bay to the California Department of Fish and Game and other lands to the U.S. Fish and Wildlife Service for wetlands and habitat management and restoration. Private parties may also apply to lease lands for wetlands or habitat purposes for environmental mitigation. In its role as Trustee of the Kapiloff Land Bank Fund, the Commission has participated in acquiring wetlands for the inclusion in habitat management projects. The State also retains a public trust easement over some formerly State-owned sovereign lands which have been conveyed into private ownership. The Commission may exercise this public trust easement to constrain the use of those lands consistent with their resource values. For example, the Commission has exercised the easement over the mudflats in the City of Albany to protect their wetlands habitat values.

Legal Mandate
The Commission has jurisdiction and control over State owned lands pursuant to Public Resources Code §6000 et seq. These lands include: a three mile-wide section of tidal and submerged land adjacent to the coast and offshore islands, including bays, estuaries, and lagoons; the waters and underlying beds of more than 120 rivers, lakes, streams, and sloughs; and 585,000 acres of school lands granted to the state by the federal government to support public education.

Mailing address:
California State Lands Commission
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202
(916) 574-1900
Fax (916) 574-1810

California Environmental Protection Agency

Mission Statement

The California Environmental Protection Agency (Cal/EPA) is responsible for coordinating and prioritizing the State's efforts to protect the environment. Cal/EPA's mission is to improve environmental quality in order to protect public health, the welfare of our citizens, and California's natural resources.

The Agency is composed of the following Boards, Offices, and Departments:
Air Resources Board
Department of Pesticide Regulation
Department of Toxic Substances Control
Integrated Waste Management Board
Office of Environmental Health Hazard Assessment
State Water Resources Control Board
Regional Water Quality Control Boards

Major Roles and Responsibilities in Wetlands Management

The State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB) promulgate and enforce water quality standards in order to protect water quality. Also, the RWQCBs adopt and the SWRCB approves Water Quality Control Plans (Basin Plans). Basin Plans identify legally binding beneficial uses of water and water quality objectives which protect those uses and establish a program of implementation.

The State Board and the Regional Boards regulate discharges to surface waters including wetlands under the federal Clean Water Act (CWA) and the California Porter-Cologne Water Quality Control Act (Porter-Cologne). Discharges to land are regulated under Porter-Cologne. The RWQCBs have the lead permitting role and decide which regulatory instrument to use. The RWQCBs may specify wetland restoration, enhancement, or mitigation as a condition of a discharge permit.

Legal Mandate

The Secretary for Environmental Protection is the administrative head of the Agency, and serves as the primary point of accountability, reporting directly to the Governor, for coordination of the State's many environmental protection programs.

Mailing address:
P.O. Box 100
Sacramento, CA 95812

State Water Resources Control Board

Mission Statement

The State Water Resources Control Board (State Board) and the nine (9) Regional Water Quality Control Boards (Regional Boards) work together to protect California's water resources. With passage of the Porter-Cologne Water Quality Control Act in 1969, the Boards together became the "principal state agencies with primary responsibility for the coordination and control of water quality." In 1991, the Boards were brought together with five other State environmental protection agencies under the newly crafted California Environmental Protection Agency (Cal/EPA).

The State Board is generally responsible for setting statewide water quality policy and considering petitions contesting Regional Board actions. The State Board is also solely responsible for allocation of surface water rights. The State Board is organized into four divisions encompassing three broad program areas and an administration function that supports not only the State Board, but also the nine Regional Boards. Five full-time, appointed Board members and over 550 employees work at the State Board.

Within the State Board, the Division of Water Quality is responsible for providing the statewide perspective on a wide range of water quality planning and regulatory functions, including regulation of activities affecting wetlands under Federal Clean Water Act and State Porter-Cologne Act programs. The Division of Water Rights may also at times be involved in regulating discharges to wetlands as they pertain to regulation of water storage or hydroelectric facilities.

The nine Regional Boards are each semi-autonomous and comprised of nine part-time Board members appointed by the Governor. Regional boundaries are based on and consistent with major State watersheds. Each Regional Board makes water quality planning and regulatory decisions for its region. These decisions include issuing State waste discharge requirements (discharge permits) or recommending Clean Water Act certification for activities affecting wetlands and other water bodies. Most Regional Board decisions can be appealed to the State Board. Together, the Regional Boards have over 650 employees working in 12 regional locations.

Major Roles and Responsibilities in Wetlands Management

The State Board and the Regional Boards promulgate and enforce narrative and numeric water quality standards in order to protect water quality. Also, the Regional Boards adopt and the State Board approves Water Quality Control Plans (Basin Plans). Basin Plans identify (designate) legally-binding beneficial uses of water for water bodies, including wetlands, assign water quality objectives (criteria) to protect those uses, and establish appropriate implementation programs.

The State Board and the Regional Boards regulate discharges of harmful substances to surface waters including wetlands under the federal Clean Water Act (CWA) and the California Porter-Cologne Water Quality Control Act (Porter-Cologne). Discharges to dry land are regulated under Porter-Cologne. For discharges to most wetlands the Regional Boards have the lead permitting role and decide which regulatory instrument to use. Regional Boards may specify wetland restoration, enhancement, or mitigation as a condition of a permit to discharge to a wetland.

Legal Mandate

The Porter-Cologne Act establishes a comprehensive program for the protection of water quality and beneficial uses of water. It applies to surface waters (including wetlands), groundwater, and point and non-point sources of pollution. The Regional Boards regulate discharges under Porter-Cologne primarily through the issuance of waste discharge requirements. Porter-Cologne provides several means of enforcement, including cease and desist orders, cleanup and abatement orders, administrative civil liability orders, civil court actions, and criminal prosecution.

Section §40l of the Clean Water Act gives the State Board and Regional Boards the authority to regulate through water quality certification any proposed federally-permitted activity which may result in a discharge to water bodies, including wetlands. Among such activities are discharges of dredged or fill material permitted by the U.S. Army Corps of Engineers under §404 of the CWA (e.g., navigational dredging; flood control channelization; levee construction; channel clearing; and fill of wetlands or other water bodies for land development). The State may issue, with or without conditions, or deny certification for activities, which may result in such discharges.

For more information on the State Water Resource Control Board contact:
STATE BOARD DIVISION OF WATER QUALITY
Division of Water Rights
1001 I Street, 14th Floor
Sacramento, CA 95814
Tele: (916) 341-5300
Website: http://www.dwrweb.swrcb.ca.gov

Division of Water Quality
1001 I Street, 15th Floor
Sacramento, CA 95814
Tele: (916) 341-5455
Website: http://www.swrcb.dwq.ca.gov

California Department of Transportation

Mission Statement
The mission of the California Department of Transportation (Caltrans) is to provide the people of California with a safe efficient and intermodal transportation system. In pursuit of its mission, Caltrans plans, develops, maintains, and manages the interregional transportation system and assists and guides the delivery of local and regional transportation services. Caltrans also provides leadership for California's transportation future by conducting research and development, and by formulating plans, programs, guidelines, and standards.

Major Roles and Responsibilities in Wetlands Management
Caltrans is required to be in compliance with regulations pertaining to wetlands and to implement the state and federal policies of "no net loss" of wetlands. As a result of these policies, disturbances or impacts to wetlands due to transportation projects are compensated through the creation, restoration, enhancement, and/or preservation of wetlands.

Legal Mandate
Caltrans complies with all state and federal laws pertaining to wetlands and wetlands protection. These laws include the California Environmental Quality Act, National Environmental Policy Act, §401 and §404 of the federal Clean Water Act, § 10 of the Rivers and Harbors Act, and the President's Executive Order 11990.

For more information on the California Department of Transportation contact:
Mailing address:
Environmental Program
P.O. Box 942874
Sacramento, CA 94274-0001

DISTRICT OFFICES
District 1/Del Norte, Humboldt, Mendocino, Lake, and W1/2 Trinity Counties
(707)445-6600

Federal Agencies

U.S. Fish and Wildlife Service

Mission Statement

The mission of the U.S. Fish and Wildlife Service (USFWS) is to conserve, protect, and enhance fish and wildlife, and their habitats for the continuing benefit of the American people. USFWS activities include, but are not limited to: enforcing the federal Endangered Species Act; acquiring wetlands, fishery habitats, and other lands for restoration and preservation; insuring compliance with the National Environmental Policy Act; managing National Wildlife Refuges and National Fish Hatcheries; and reviewing and commenting on all water resource projects.

Major Roles and Responsibilities in Wetlands Management

The Fish and Wildlife Service through it various divisions is involved in wetlands permitting, protection, planning, restoration, enhancement, and acquisition. Although most divisions have specific areas of responsibility there is some overlap.

The Ecological Services Division, along with the Law Enforcement Division and individual National Wildlife Refuges, are responsible for wetlands protection. For example, under §7 of the Federal Endangered Species Act, the U.S. Army Corps (Army Corps) of Engineers is required to consult with USFWS prior to issuing a permit allowing certain activities to take place in a wetland. (§7 applies to property containing federally listed threatened or endangered species.) USFWS will then issue a biological opinion stating whether the Army Corps permit is likely to jeopardize the continued of existence of a listed species.

Planning efforts in California may involve the Ecological Services Division and/or the Central Valley Habitat Joint Venture (CVHJV), and the Realty Division.

The CVHJV was established by a working agreement in July of 1988, "to protect, maintain and restore habitat to increase waterfowl populations to desired levels in the Central Valley of California consistent with other objectives of the North American Waterfowl Management Plan." The CVHJV is coordinated by USFWS and is comprised of representatives from the California Waterfowl Association, Defenders of Wildlife, Ducks Unlimited, National Audubon Society, The Nature Conservancy, The Trust for Public Lands, and the Waterfowl Habitat Owners Alliance.

Wetlands restoration and enhancement may require the involvement of a number of USFWS divisions including, the California Private Lands Office, the

Central Valley Habitat Joint Venture, the National Wildlife Refuges, the Riparian Habitat Joint Venture, and Ecological Services Division.

The two primary USFWS divisions facilitating wetlands acquisition are the Central Valley Habitat Joint Venture and the Realty Division. Lastly, USFWS oversees thousands of acres of wetlands nationally as managers of National Wildlife Refuges.

Legal Mandate
The Fish and Wildlife Service's jurisdiction is nationwide and operates under a host of federal legal mandates that explicitly and implicitly refer to wetlands. Among these mandates are the Coastal Wetlands, Planning, Protection, and Restoration Act; the Coastal Zone Management Act; the Emergency Wetlands Resources Act; Endangered Species Act; Federal Water Pollution Control Act ("Clean Water Act"); Fish and Wildlife Coordination Act; Land and Water Conservation Fund (Public Law 88-578); Lea Act; Migratory Bird Hunting and Conservation Stamp Act; Migratory Bird Treaty Act; National Environmental Policy Act; National Wildlife Refuge Act; National Wildlife Refuge System Administration Act; North American Wetlands Conservation Act; Rivers and Harbors Act; and the Wetlands Loan Act.

Through various pieces of Federal legislation a number of National Wildlife Refuges have been established in California, among these are Humboldt Bay, San Francisco Bay, Seal Beach, and Tule Lake-Klamath Wildlife Refuges to name a few.

For more information on the U.S. Fish and Wildlife Service contact:

ECOLOGICAL SERVICES
Sacramento Office
2800 Cottage Way, E-2605
Sacramento, CA 95825

U.S. Army Corps of Engineers

Mission Statement
The U.S. Army Corps of Engineers (Army Corps) provides design and engineering services, and construction support for a variety of military and civilian projects world wide. One of the Army Corps' primary civil roles is to manage the nation's waterways and wetlands. The Army Corps activities include, but are not limited to, constructing projects approved by Congress for flood control, commercial navigation, or shipping channel maintenance; emergency response to natural disasters; operating and maintaining flood control reservoirs and public

reclamation facilities; and regulating activities in wetlands including issuing dredge and fill permits and authorizing the establishment of wetland areas.

Major Roles and Responsibilities in Wetlands Management
The regulatory branch of the Army Corps is responsible for implementing and enforcing §404 of the federal Clean Water Act (CWA) (33 Code of Federal Regulations parts 320 to 330). Army Corps regulations require that any activity which discharges fill material and/or requires excavation in "waters of the United States" (see below), including wetlands, requires a §404 permit. As part of the permit process, mitigation for unavoidable impacts to wetlands are usually required for affected. Mitigation can be in the form of wetland restoration, creation, enhancement, or preservation.

Legal Mandate
The Army Corps' regulatory authority is contained within §404 of the CWA. Army Corps jurisdiction is over "waters of the United States" which is defined at 33 Code of Federal Regulations 328.3 as (1) all navigable waters and their tributaries; (2) all interstate waters and their tributaries; (3) all other waters, the use, degradation, or destruction of which could affect interstate commerce; (4) all water impoundments; (5) territorial seas; and (6) wetland adjacent to waters identified above.

For more information on the U.S. Army Corps of Engineers Regulatory Program contact:

SAN FRANCISCO DISTRICT
Regulatory Branch
San Francisco District (SPN-CO-R)
333 Market Street, 8th Floor
San Francisco, CA 94105-2197

U.S. Environmental Protection Agency

Mission Statement
The U.S. Environmental Protection Agency (EPA) is responsible for implementing federal laws designed to protect air, water, and land. While this is done primarily through regulation, the EPA has also developed a wide variety of funding, planning, and education programs.

Major Roles and Responsibilities in Wetlands Management
EPA activities which affect wetlands include, but are not limited to, developing rules to regulate municipal and industrial wastewater discharge, and stormwater discharge; overseeing drinking water quality; and overseeing U.S. Army of Corps

of Engineers regulatory activities pertaining to wetlands protection, and dredge and fill activities.

Legal Mandate
While numerous federal environmental laws guide the EPA's activities pertaining to wetlands, its primary mandate is provided by the Federal Clean Water Act (CWA). Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in the program that are regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry.

For more information on U.S. Environmental Protection Agency contact:

OFFICE OF WETLANDS, OCEANS, AND WATERSHEDS/WETLANDS DIVISION

Mailing address:
USEPA Headquarters
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

REGION IX; CA, NV, AZ, HI, PACIFIC ISLANDS
Mailing address:
75 Hawthorne Street
San Francisco, CA 94105

National Marine Fisheries Service

Mission Statement
The National Marine Fisheries Service (NMFS) has the primary Federal responsibility for the conservation, management, and development of living marine resources and for the protection of certain marine mammals and endangered species under numerous federal laws. These responsibilities are inherent in NMFS's mission which is "to achieve a continued optimum utilization of living marine resources for the benefit of the Nation."
Major Roles and Responsibilities in Wetlands Management

NMFS comments on all National Environmental Policy Act (NEPA) and federal Clean Water Act (CWA) §404 documents for projects that could affect marine, estuarine, or anadromous fish or their habitat. This includes intertidal wetlands, subtidal areas, and eelgrass habitat for marine and estuarine species and riparian habitat for salmonids. NMFS is also responsible for designating critical habitat for species it lists under the federal Endangered Species Act (ESA). The critical habitat designation may include wetlands; e.g., the shaded riverine aquatic habitat of the winter-run Chinook salmon.

NMFS works with project proponents during a project's scoping stage to assure that species and habitat concerns are addressed early in the planning process. Furthermore, NMFS participates in a number of statewide and regional wetland restoration efforts and planning groups; e.g., Brush Creek Restoration Project in Sonoma County. Wetland mitigation is often recommended by NMFS during the planning process, or during consultation under ESA.

NMFS's research laboratory in Beaufort, North Carolina (part of the NMFS Habitat Restoration Center) conducts basic research to assess and develop habitat restoration techniques. In coordination with the National Oceanic and Atmospheric Administration (NOAA), NMFS maps and evaluates long-term habitat changes along the U.S. coasts through the "Coastal Change Analysis Program."

Legal Mandate

NMFS's direct regulatory jurisdiction is limited to those wetlands that are defined as part of the critical habitat for NMFS-listed species under the ESA. As mentioned above, under NEPA and CWA §404, NMFS is required to comment on all projects that could affect marine, estuarine, or anadromous fish or their habitat.

For more information on the National Marine Fisheries Service contact:

NORTHERN CALIFORNIA OFFICE
North/Central Coast
Mailing address:
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

Natural Resources Conservation Service

Mission Statement
The mission of the Natural Resource Conservation Service (NRCS) is to provide national leadership in the conservation of soil, water, and related natural resources. The NRCS provides balanced technical assistance and cooperative conservation programs to landowners and land managers throughout the United States as part of the U.S. Department of Agriculture (USDA).

Major Roles and Responsibilities in Wetlands Management

The NRCS makes wetlands determinations and delineations in agricultural areas under §404 of the Clean Water Act for the U.S. Army Corps of Engineers and for Farm Bill purposes (see below) but does not issue permits pertaining to wetlands. However, the NRCS has long provided technical assistance to those involved in land conservation and planning and wetlands restoration and enhancement. The agency has also assisted in wetlands restoration and enhancement through programs such as, the Water Bank Program, the Wetland Reserve Program, the Agricultural Conservation Program, the Conservation Reserve Program, the Resource Conservation and Development Program (RC&D), and the Small Watersheds Program (PL-566). As part of the NRCS's Wetlands Protection Policy, landowners have the option of mitigating wetland impacts in order to continue receiving NRCS assistance. Also, in programs such as RC&D and PL-566 mitigation has been an option.

<u>Legal Mandates</u>
In 1979 Executive Order 11990 established the NRCS's Wetlands Protection Policy (WPP). WPP and the National Environmental Policy Act regulate all the NRCS's activities. The Farm Bills of 1985 and 1990 established "Swampbuster." Under this program a landowner or manager could lose USDA benefits or eligibility to participate in USDA programs if they convert a wetland to agricultural production.

For more information on the USDA, NRCS contact:

Mailing address:
NRCS West Regional Office
430 G Street. Suite 4165
Davis, CA 95616

There is a NRCS field office in almost every county where general information can be obtained. However, if there is no field office in your county there are also area offices in Red Bluff, Salinas, and Fresno.

U.S. National Park Service

<u>Mission Statement</u>
The mission of the U.S. National Park Service (NPS) is to conserve the scenery, the natural and historic objects, and the wildlife in United States' national parks, and to provide for the public's enjoyment of these features in a manner that will leave them unimpaired for the enjoyment of future generations.
Major Roles and Responsibilities in Wetlands Management

Since the National Park Service (NPS) was established in 1916, Congress has included millions of acres of wetlands in the National Park System. These wetlands provided the special protection inherent in the NPS mission. Unfortunately, many wetland areas enter the System in a non-pristine state or are adversely affected by activities like sewage treatment or drainage operations. Consequently, the NPS must often play an active role in wetlands management, restoration, and public awareness.

The NPS has a multi-faceted program for protecting and managing its wetland resources, which includes: protecting wetlands from pollution; providing technical expertise and funding to parks for wetland inventory and restoration projects; providing up-to-date management techniques to preserve wetland functions and values; and protection or acquisition of water rights. Also, the NPS plays key roles in other local, state, and federal government wetlands-related programs including the Rivers and Trails Conservation Assistance Program, the Wild and Scenic Rivers Program, and the preparation of State Comprehensive Outdoor Recreation Plans.

The NPS conducts research to determine how to best protect and restore wetlands. For example, at Everglades National Park, results of wildlife, hydrology, plant ecology, and marine science research support a massive project to protect and restore over 500,000 acres of critical tidal and non-tidal wetlands.

<u>Legal Mandates</u>
There are three laws that constitute the primary authorities for the administration of the National Park System. Under the 1916 NPS Organic Act, the NPS is charged with the management of the parks to "...conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The General Authorities Act of 1970 defined the National Park System as including all the areas administered by the NPS "...for park, monument, historic, parkway, recreational, or other purposes..." In 1978, in an act expanding Redwood National Park, NPS general authorities were further amended to specifically mandate that all park units be managed and protected "in light of the high public value and integrity of the National Park System" and that no activities should be undertaken "in derogation of the values and purposes for which these various areas have been established," except where specifically authorized by law.

For more information on the National Park Service contact:

Pacific Great Basin System Support Office
600 Harrison Street, Suite 600
San Francisco, CA 94107

Redwood National Park
1111 Second Street
Crescent City, CA 95531

Appendix A: References

- ✍ California Wetlands Information System
  http://ceres.ca.gov/wetlands/agencies.html

Appendix D

Regulatory Roles – Who Does What?

Aquatic Resources

Regulate ship ballast

- California Department of Fish and Game
- California Department of Health Services
- U.S. Coast Guard

Prohibit exotic species

- California Fish and Game Commission

Control exotic species

- California Department of Boating and Waterways
- California Department of Fish and Game
- California Department of Food and Agriculture

Reduce poaching

- California Department of Fish and Game
- California Department of Water Resources

Harvest regulations

- Department of Fish and Game
- California Fish and Game Commission
- Regional Water Quality Control Board
- Pacific Fisheries Management Council

Contaminants

- California Environmental Protection Agency
- Caltrans
- Dischargers
- State Water Resources Control Board
- U.S. Army Corps of Engineers

- U.S. Environmental Protection Agency

Reduce incidental take
- California Department of Fish and Game
- Fishing Industry
- National Marine Fisheries Service
- Sea Grant

Recovery plan
- California Department of Fish and Game
- National Fisheries Service
- U.S. Fish and Wildlife Service

Monitor candidate species
- California Department of Fish and Game
- National Fisheries Service
- U.S. Fish and Wildlife Service

Consult re: listed species
- Federal Action Agency
- National Marine Fisheries Service
- U.S. Fish and Wildlife Service

Review proposals and actions
- California Department of Fish and Game
- National Marine Fisheries Service
- U.S. Fish and Wildlife Service

Habitat conservation
- National Marine Fisheries Service
- Non-Federal Action Agencies
- State Lands Commission
- U.S. Fish and Wildlife Service

Species recovery
- National Marine Fisheries Service
- Non-Federal Action Agencies

Aquatic Resources Part II

Standards and operations
- California Department of Water Resources
- U.S. Bureau of Reclamation

- U.S. Environmental Protection Agency

Control entrainment

- California Department of Fish and Game
- Central Valley Regional Water Quality Control Board

Industrial Facilities

- U.S. Fish and Wildlife Service

Design/install gates

- California Department of Fish and Game
- California Department of Water Resources
- National Marine Fisheries Service
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service

Fish screens

- California Department of Fish and Game
- California Department of Water Resources

Diverters

- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service

Screens at projects

- California Department of Fish and Game
- California Department of Water Resources
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service

Reduce predation

- California Department of Fish and Game
- California Department of Water Resources

Protect against erosion

- California Department of Fish and Game
- California Reclamation Board
- State Lands Commission
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

Avoid habitat damage

- California Department of Fish and Game
- Central Valley Regional Water Quality Control Board
- National Marine Fisheries Service
- Regional Water Quality Control Board
- State Lands Commission
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Fisheries values

- California Department of Fish and Game
- Regional Water Quality Control Board
- Resource Conservation Districts
- State Lands Commission
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Long-term management

- California Department of Fish and Game
- California Department of Water Resources
- California Environmental Protection Agency
- California Resources Agency
- State Water Resources Control Board

EIS/EIR

- California Department of Fish and Game
- California Department of Water Resources
- California Resources Agency

Implement preferred alternative

- California Department of Water Resources
- State Water Resources Control Board
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency

Flows and Temperature

- California Department of Water Resources
- Regional Water Quality Control Board
- Federal Energy Regulatory Commission
- Private Water Projects

- State Water Resources Control Board
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency

Screen diversions

- California Department of Fish and Game
- California Department of Water Resources
- Private Water Projects
- U.S. Bureau of Reclamation

Seek damages

- California Department of Fish and Game
- Regional Water Quality Control Board
- National Marine Fisheries Service
- State Lands Commission
- State Water Resources Control Board
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service

Wildlife

HBNWR expansion

- U.S. Fish and Wildlife Service

Wetlands acquisition

- California Coastal Conservancy
- California Department of Fish and Game
- Landowners
- U.S. Fish and Wildlife Service
- U.S. Soil Conservation Service

Tidal marshes restoration

- California Coastal Conservancy
- California Department of Fish and Game
- Non-Governmental Organizations
- State Lands Commission
- U.S. Fish and Wildlife Service

Non-wetland restoration

- California Coastal Conservancy
- California Department of Fish and Game
- Landowners

- U.S. Fish and Wildlife Service
- U.S. Soil Conservation Service

HBNWR management plan

- U.S. Fish and Wildlife Service

Biodiversity

- California Coastal Conservancy
- California Department of Fish and Game
- California Department of Transportation
- National Park Service
- Public Land Management Agencies
- U.S. Department of Defense
- U.S. Fish and Wildlife Service

Habitat restoration

- California Department of Fish and Game
- Landowners
- U.S. Fish and Wildlife Service

Predator control programs

- California Department of Fish and Game
- Local Governments
- Public Land Management Agencies
- U.S. Fish and Wildlife Service

Recovery plans

- California Department of Fish and Game
- U.S. Army Crops of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Candidate species status

- California Department of Fish and Game
- U.S. Fish and Wildlife Service

Wetlands

Regional Wetland management plan

- Humboldt Bay Harbor, Recreation and Conservation District
- California Coastal Conservancy
- California Department of Fish and Game
- California Environmental Protection Agency

- California Resources Agency
- Department of Water Resources
- Local Governments
- National Marine Fisheries Service
- Non-Governmental Organizations
- Non-Profit Organizations
- Public Trusts
- Regional Water Quality Control Board
- Soil Conservation Service
- Special Districts
- State Lands Commission
- State Water Resources Control Board
- University of California Cooperative Extension Service
- U.S. Army Crops of Engineers
- U.S. Congress
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Cooperative protection efforts

- Humboldt Bay Harbor, Recreation and Conservation District
- California Coastal Conservancy
- California Department of Fish and Game
- California Environmental Protection Agency
- California Resources Agency
- Landowner
- Local Governments
- National Marine Fisheries Service
- Non-Profit Organizations
- Soil Conservation Service
- State Lands Commission
- U.S. Army Crops of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Comprehensive state program

- California Coastal Commission
- California Department of Fish and Game
- California Environmental Protection Agency
- California Resources Agency
- California State Legislature
- Local Governments
- State Lands Commission
- State Water Resources Control Board

Increase enforcement efforts

- California Environmental Protection Agency
- California Secretary of Resources
- Regional Water Quality Control Board
- Local Governments
- National Marine Fisheries Service
- U.S. Army Crops of Engineers
- U.S. Congress
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Compensatory mitigation

- California Department of Fish and Game
- California Environmental Protection Agency
- California Resources Agency
- Department of Water Resources
- Local Governments
- National Marine Fisheries Service
- State Water Resources Control Board
- U.S. Army Crops of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

Clean Water Act

- California State Legislature
- U.S. Army Crops of Engineers
- U.S. Congress
- U.S. Environmental Protection Agency

Acquisition programs

- California Coastal Conservancy
- California Environmental Protection Agency
- Non-Governmental Organizations
- State Lands Commission
- U.S. Fish and Wildlife Service

Assistance programs

- California Environmental Protection Agency
- California Secretary of Resources
- California State Legislature
- Landowners
- State Lands Commission

- U.S. Army Crops of Engineers
- U.S. Fish and Wildlife Service

Convert/restore non-wetlands
- California Coastal Conservancy
- California Department of Fish and Game
- Landowners
- Non-Profit Organizations
- Public Trusts
- Soil Conservation Service
- Special Districts
- U.S. Fish and Wildlife Service

Water Use

Feasibility
- California Department of Water Resources
- Local Governments
- Publicly Owned Treatment Works
- Regional Water Quality Control Board
- State Water Resources Control Board
- U.S. Bureau of Reclamation
- Water Districts

Public education
- Agricultural Water Suppliers
- California Department of Health Services
- Environmentalists
- Local Governments
- Publicly Owned Treatment Works
- Water Districts

Efficient management practices
- Agricultural Water Suppliers
- California Department of Food and Agriculture
- California Department of Water Resources
- California Farm Bureau Federation
- California Farm Water Coalition
- Environmentalists
- Farmers
- State Farm Water Coalition
- State Water Conservation Coalition
- State Water Resources Control Board

- University of California Cooperative Extension
- U.S. Bureau of Reclamation
- U.S. Department of Agriculture
- U.S. Soil Conservation Service

Groundwater management

- California Department of Water Resources
- California State Legislature
- Governor
- Regional Water Quality Control Board
- State Water Resources Control Board
- U.S. Bureau of Reclamation
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- Water Conservation Districts
- Water Districts

Pollution Prevention and Reduction

Toxic pollution discharge

- California Department of Fish and Game
- California Department of Food and Agriculture
- California Environmental Protection Agency
- California State Legislature
- Regional Water Quality Control Board
- Private Sector
- State Water Resource Control Board
- U.S. Congress
- U.S. Soil Conservation Service

Environmental audit procedures

- California Environmental Protection Agency
- Regional Water Quality Control Board
- State Water Resources Control Board

Agricultural practices

- California Department of Water Resources
- Landowners
- U.S. Soil Conservation Service
- Water Districts

Pesticide reduction

- California Department of Fish and Game

- California Department of Pesticide Regulation
- California Environmental Protection Agency
- California State Legislature
- Regional Water Quality Control Board
- Local Agencies
- State Water Resources Control Board
- U.S. Environmental Protection Agency

Water quality objectives
- California Department of Health Services
- California Environmental Protection Agency
- Water Quality Control Board
- State Water Resources Control Board

Urban runoff
- Regional Water Quality Control Board
- Local Agencies

Pollutant loadings
- California Air Resources Board
- Caltrans
- Hazardous Waste Control Agencies

Agricultural toxic substances
- California Department of Fish and Game
- California Department of Food and Agriculture
- California Environmental Protection Agency
- Regional Water Quality Control Board
- State Water Resources Control Board
- U.S. Soil Conservation Service

Toxic loadings
- California Department of Health Services
- California Environmental Protection Agency
- California State Legislature
- Regional Water Quality Control Board
- State Water Resources Control Board
- U.S. Environmental Protection Agency

Model environmental compliance
- U.S. Department of Agriculture
- U.S. Department of Defense
- U.S. Department of Energy

- ✍ U.S. Department of the Interior
- ✍ U.S. Environmental Protection Agency

Clean up contaminants

- ✍ California Department of Fish and Game
- ✍ Regional Water Quality Control Board
- ✍ State Water Resources Control Board
- ✍ U.S. Environmental Protection Agency
- ✍ U.S. Fish and Wildlife Service

Toxic hot-spots

- ✍ California State Legislature
- ✍ Regional Water Quality Control Board
- ✍ State Water Resources Control Board

Dredging and Waterway Modification

Marsh and mudflats

- ✍ Regional Water Quality Control Board
- ✍ National Oceanic and Atmospheric Administration
- ✍ Regional Water Quality Control Board
- ✍ U.S. Geological Survey

Estuarine sediment production

- ✍ Lead & Responsible Agencies Under CEQA & NEPA

Sediment quality objectives

- ✍ Regional Water Quality Control Board
- ✍ State Water Resources Control Board

Reuse regulatory procedures

- ✍ Local Land Use Agencies

Removal of derelict structures

- ✍ U.S. Army Corps of Engineers

Adopt regulatory and management policies

- ✍ Diverse Agencies
- ✍ Project Proponents

Saltwater intrusion

- ✍ Project Proponents
- ✍ U.S. Army Corps pf Engineers

Flooding

- Local Governments
- U.S. Environmental Protection Agency
- U.S. Geological Survey

Flood control policies

- Local Governments
- State Agencies

Diked historical Baylands

- California Coastal Conservancy

Land Trusts

- State Legislature

Land Use Management

Watershed protection plans

- California Office of Planning & Research
- Local Governments

Amend CEQA

- California Office of Planning & Research
- Regional Water Quality Control Board

Integration into other initiatives

- California Resources Agency
- California Office of Planning & Research

Consistent policies

- Regional Water Quality Control Board
- Councils of Governments
- Potential New Regional Entities

Promote development

- Caltrans
- Councils of Governments
- Local Governments
- Metropolitan Transportation Commission
- Potential New Regional Entities

Future population

- California Resources Agency

- California Office of Planning & Research
- Caltrans
- Councils of Governments
- Metropolitan Transportation Commission
- Universities

Watershed management plans

- Regional Water Quality Control Board
- Landowners
- Local Governments
- Non-Governmental Organizations
- Resources Conservation Districts

Best Management Practices

- California Resources Agency
- Regional Water Quality Control Board
- Councils of Governments
- Landowners
- Local Governments
- Non-Governmental Organizations

Public education

- Public Involvement & Education Program

Land use training workshops

- Public Involvement & Education Program

Economic incentives

- California State Legislature
- U.S. Congress

New funding mechanisms

- California State Legislature

Market-based incentives

- California State Legislature
- Councils of Governments

Public Involvement and Education

- Build support for the Humboldt Bay Management Plan
- Educational resource for government
- Information clearinghouse
- Model projects for education
- Environmental programs

- ✍ Building knowledge of Humboldt Bay
- ✍ Existing public education
- ✍ Public education tools
- ✍ Humboldt Bay Symposium
- ✍ Public opportunities
- ✍ Citizen monitoring programs
- ✍ Develop public involvement
- ✍ Promote research

Appendix E

Overview of Various Laws and Regulations Affecting Humboldt Bay

Land Use

- Federal Regulatory Role
- Sect 6217 Coastal Zone Act
- Reauthorization Amendments
- City of Eureka
- City of Arcata
- Humboldt County

Wetlands

- Rivers and Harbors Act (RHA) of 1899 (USCOE)
- Sect 10 (prohibits unauthorized alteration)
- Sect 404 CWA (limited for a tool in habitat protection)
- Sect 9 RHA - dams & dikes across navigable H2o
- Sect 10 RHA - any obstruction or alteration of navigable waters
- Sect 404 CWA '72 - discharge of dredge or fill materials into US waters
- 401 CWA - state water quality certification requirements
- Sect 307 (c) - requires federal consistency with state CZM plans
- Coastal Zone Management Act '72
- Habitat Loss & Alteration (US Dept. of Commerce)
- Coastal Zone Management Act (CZMA) 1972, 1990
  - Preserve, protect, develop, restore, enhance nations coastal zone
- Federal consistency (15 CFR Part 930)

Public Access

- Public Trust Doctrine

Navigation & Water Dependent Activities

- COE Sect 404 CWA
- Water Resources Development Act (WRDA) 1996
- Sect 206

Parks & Recreation

Public Health & Education
- Shellfish Sanitation
- Dept. of Health (State, County)
- Dept of F & G
- NPDES

Water
- Fed. 1948, 72, 77, 81, 87
- Sect 402 CWA
- Sect 208 & 303 (e) NPS
- Sect 303 (d) total max daily load
- Sect 312 no discharge zone
- Sect 320 NEP
- Sect 401 Dredge
- Sect 404 fed permit fill dredge

Clean Vessel Act 1992
Administered USFWS

Air
Clean Air Act
National emissions

Resource Conservation and Recovery Act (RCRA) 1976, 84
Manage hazardous material

Superfund 1980
Clean up
Superfund Amendments & Reauthorization Act

Spill Prevention & Control
National Oil & Hazardous Substance Pollution

Contingency Plan (CWA Sect 311 (c)(2))
Sect 105 Superfund Act

Solid Waste
RCAA

Snapshot of existing institutional framework for Humboldt Bay Regulatory and non-regulatory programs

Habitat and Living Resources

- Land Use management (City of Arcata, Eureka) (County)
- Coastal Zone Management
- Wetlands Protection
- National Environmental Policy Act & State Related programs
- Fish & Shellfish Management
- Endangered & Threatened Species Programs
- Wildlife Refuges & Preserves

Water Quality

- Clean Water Programs
- Clean Air, Solid Waste, Hazardous Waste
- Clean Vessel Program

Human Activities & Competing Uses

- Public Access
- Public Health and Education
- Navigation and Water

National Environmental Policy Act of 1969	-requires environmental impact statements for federal actions significantly affecting the quality of human activity.
The Fish & Wildlife Act of 1956 & The Migratory Game Fish Act	-protects aquatic environment as it relates to fish and wildlife resources.
The Fish & Wildlife Coordination Act	-requires equal consideration of fish and wildlife resources in water resource planning : authorizes fish and wildlife service consultation.

Endangered Species Act	-protects federally listed endangered and threatened wildlife and their habitats.
Migratory Bird Treaty Act	-protects migratory birds and nesting habitats
Executive Orders 11988 & 11990	-protects wetlands and flood plains

<u>Federal Agency Coordination</u>

National Environmental Policy Act (NEPA) 1970
Three levels of analysis:
1. categorical exclusion determination
2. preparation of an environmental assessment/finding of no significant impact (EA/FONSI)
3. preparation of an environmental impact statement (EIS)

Fish & Shellfish
Magnuson Fishery Conservation and Management Act (MFCMA) Public Law 94-265 provides for the conservation and exclusive management of all fishery resources within the US Exclusive Economic Zone (EEZ) 3 nautical miles to 200 nm offshore Under MFCMA eight regional management councils are charged with preparing Fishery Management Plans (FMPs)

FMPs objectives:
1. reduce fishing morality on a stock
2. increase yield from the fishery
3. promote compatible management regulations between territorial sea and the EEZ
4. minimize regulations to achieve the three management objectives recognized above

National Marine Fisheries Service's Habitat Conservation Program (HCP)
HCPs are a reflection of three considerations:
1. the pressures on the living marine resource habitats
2. the size of area managed
3. the commercial and recreational value of species

Essential Fish Habitat EFH (1996)
Direct action to stop or reverse the continued loss of fish habitats cooperation among NOAA fisheries, the Councils, fishing participants, federal & state agencies and others in achieving the essential fish habitat goals of habitat protection, conservation, and enhancement

Endangered and Threatened Species
The Endangered Species Act of 1973

USFWS authority to protect and conserve all forms of wildlife and plants that are threatened or endangered with extinction

NOAA fisheries similar authority for marine mammals under the Marine Mammals Protection Act of 1972 (MMPA) also the Cetacean and Turtle Assessment Program (CETAP) Section 7

Wildlife Refuges and Preserves
National Wildlife Refuge System
Teddy Roosevelt 1903 Pelican Island, Florida

Appendix F

Partial Humboldt Bay Species Listing

The following species lists are provided as a general background for the Management Plan. The entries in the following lists have not been independently reviewed for consistency with currently accepted taxonomic categories, and should not be considered as descriptive of the biological diversity present in the Humboldt Bay region or the nearshore Pacific Ocean.

These lists should not be considered as representing a portrayal of the habitats, ecosystem elements, complexity, or functions that occur within Humboldt Bay. The degree of "completeness" of the sampled biodiversity in the Humboldt Bay region is uncertain, although it is statistically unlikely that adequate sampling has occurred to identify all of the species that occur in the region at the present time. The following lists must be considered as incomplete and transitional, since it is unlikely that all of the species present in the Bay at the present time have been detected; further, it is inevitable that some species that are present in the Bay at the present time will not be present in the future and that species that are not currently known to occur in Humboldt Bay will colonize the Bay in the future.

F.1 Aquatic Invertebrate Species Found in Humboldt Bay

Table F-1 presents a listing of invertebrate species currently expected to be present in Humboldt Bay.

Table F-1: Aquatic Invertebrate Taxa Identified in Humboldt Bay.

Taxa	Year Reported
Porifera	
Sponges	

Taxa	Year Reported
Cliona celata	2001
Cliona s p.	1992
Halichondria bowerbanki	2001
Haliclona Permollis	1992
Haliclona sp.	1992
Microciona prolifera	2001

Cnidarians

Jellyfishes, Corals, etc.

Aequorea sp.	1992
Anthopleura artemisia	1992
Anthopleura elegantissima	1992
Anthopleura xanthogrammica	1992
Aurelia aurita	2001
Aurelia spp.	1992
Campanularia integra	1992
Cerianthus sp.	1992
Chrysaora sp	1992
Diadumene leucolena	2001
Diadumene lineata	2001
Diadumene spp.	1992
Epiactis prolifera	1992
Gersemia rubriformis	1992
Haliplanella luciae	1992
Metridium senile	1992
Nematostella vectensis	1992
Obelia borealis	1992
Obelia dichotoma	2001
Obelia longissima	1992
Pelagia sp	1992
Pleurobrachia bachei	1992
Plumularia setacea	2004
Plumularia spp.	1992
Sertularia spp.	1992
Tealia crassicornis	1992
Thuiaria similis	1992
Tubularia crocea	1992
Tubularia marina	1992
Velella velella	1992

Nemertea

Taxa	Year Reported
Ribbon worms	
Amphiporus imparispinosus	1992
Carinoma mutabilis	1992
Carinoma lactea	1992
Cerebratulus californiensis	1992
Emplectonema sp.	1992
Paranemertes californica	1992
Tubulanus pellucidus	1992
Tubulanus polymorphus	1992
Annelida	
Segmented worms	
Polychaeta	
Bristle worms, Fan worms, Clam worms, etc.	
Abarenico la antebranchia	1992
Abarenicola humboldtensis	1992
Abarenicola pacifica	1992
Amaena occidentalis	1992
Ampharete arctica	1992
Ampharetidae sp.	2004
Anaitides groenlandica	1992
Anaitides williamsi	1992
Aphelochaeta sp.	2004
Arabellidae sp.	2004
Arenicolidae sp.	2004
Aricidea suecica	1992
Armandia brevis	1992
Autolytus cornutus	2001
Autolytus sp.	1992
Boccardia berkeleyorum	1992
Boccardiella hamata	2001
Brania brevipharyngea	2004
Brania sp.	1992
Capitella capitata	1992
Capitella capitata Complex	2001
Capitella sp.	2004
Caprella acanthogaster	2001
Caprella californica	2001
Caprella drepanochir	2001

Taxa	Year Reported
Caulleriella alata	1992
Caulleriella hamata	1992
Caulleriella sp.	1992
Chaetozone acuta	2004
Chaetozone setosa	1992
Chaetozone sp.	1992
Cheilonereis cyclurus	1992
Chone gracilis	1992
Chone sp	1992
Chone/Euchone sp.	2004
Cirratulidae sp.	2004
Cirratulus cirratus	1992
Cistenides brevicoma	1992
Cossura pygodactylata	1992
Dipolydora bidentata	2001
Dipolydora socialis	2001
Dodecaceria concharum	1992
Dorvillea rudolfi	2004
Drilonereis falcata	1992
Eteone californica	1992
Eteone dilatae	1992
Eteone pacifica	1992
Eteone sp.	2004
Euchone analis	2004
Euchone limnicola	2001
Euclymene delineata	1992
Eudistylia vancouveri	2004
Eulalia aviculiseta	1992
Eumidia bifoliata	1992
Eumidia sanguinea	1992
Eunereis sp.	1992
Eupolymnia crescentis	1992
Eusyllis assimilis	1992
Euzonus mucronata	1992
Exogone lourei	1992
Exogone sp.	1992
Fabricia sabella	2001
Glycera acapitata	1992
Glycera americana	1992
Glycera oxycephala	1992
Glycera robusta	2004
Glycera sp.	2004

Taxa	Year Reported
Glycera tenuis	1992
Glycinde armigera	2004
Glycinde polygnatha	1992
Glycinde sp.	1992
Gyptis brevipalpa	1992
Halosydna brevisetosa	1992
Halosydna latior	1992
Haploscoloplos elongatus	1992
Harmothoe im bricata	1992
Harmothoe imbricata	2001
Harmothoe lunulata	1992
Harmothoe priops	1992
Harmothoe sp.	2004
Hemipodus borealis	1992
Hemipodus imbricata	1992
Hesperone adventor	1992
Heteromastus filiformis	2001
Heteromastus filobranchus	1992
Heteropodarke heteromorpha	2001
Laetmonice pellucida	2004
Leitoscoloplos pugettensis	2004
Lepidonotus squamatus	2004
Lumbrineridae sp.	2004
Lumbrineris californiensis	1992
Lumbrineris japonica	1992
Lumbrineris tetraura	1992
Lumbrineris zonata	1992
Lysilla labiata	1992
Magelona pacifica	1992
Magelona pitelkai	1992
Magelona sacculata	1992
Maldanidae sp.	2004
Marphysa sanguinea	2001
Marphysa sp.	2004
Mediomastus californiensis	1992
Mediomastus sp.	2004
Mellina oculata	1992
Mesochaetopterus taylori	1992
Myxicola infundibulum	2001
Nainereis sp.	1992
Neanthes sp.	1992
Nephtys caecoides	1992

Taxa	Year Reported
Nephtys californiensis	1992
Nephtys ferruginea	1992
Nephtys parva	1992
Nephtys sp.	2004
Nereidae sp.	2004
Nereis pelagica	2001
Nereis procera	1992
Nereis s p.	1992
Nothria sp.	1992
Notomastus tenuis	1992
Ophelia assimilis	1992
Ophelia magna	1992
Ophelina sp.	2004
Orbiinidae sp.	2004
Owenia collaris	1992
Paleonotus bellis	1992
Paranis gracilis	1992
Phloe glabra	1992
Phloe tuberculata	1992
Pholoe minuta	2001
Pholoe sp.	2004
Pholoides aspera	1992
Phragmatopoma californica	1992
Phyllodoce williamsi	2004
Pilargis maculata	1992
Pisione remota	1992
Pista cristata	1992
Pista pacifica	1992
Platynereis agassizi	1992
Platynereis bicanaliculata	1992
Polycirrus sp.	2004
Polydora brachycephala	1992
Polydora cornuta	2001
Polydora ligni	1992
Polydora limicola	2001
Polydora pygidialis	1992
Polydora socialis	1992
Polydora sp.	2004
Polydora websteri	1992
Polynoidae sp.	2004
Prionospio cirrifera	1992
Protodorvillea gracilis	1992

Taxa	Year Reported
Pseudopolydora kempi	1992
Pseudopolydora paucibranchiata	2001
Pygospio elegans	2001
Sabellaria cementarium	1992
Sabellaria gracilis	1992
Sabellidae sp.	2004
Scalibregma inflatum	1992
Schistomeringos longicornis	1992
Schizobranchia insignis	2004
Scolelepis sp.	1992
Scoloplos sp.	1992
Serpula vermicularis	1992
Sphaerosullis californiensis	1992
Spio filicornis	1992
Spionidae sp.	2004
Spiophanes anoculata	1992
Spiophanes berkeleyorum	1992
Spiophanes bombyx	1992
Spiophanes kroyeri	2004
Spiophanes wigleyi	2001
Spirorbidae sp.	2004
Sternapsis fossor	1992
Sthenelais berkeleyi	1992
Sthenellais tertiaglabrata	1992
Streblosoma crassibranchia	1992
Streblospio benedicti	1992
Syllidae sp.	2004
Tenonia kitsapensis	1992
Terebellidae sp.	2004
Tharyx monilaris	1992
Tharyx multifilis	1992
Thelepus sp.	2004
Trochochaeta franciscanum	1992
Typosyllis fasciata	1992
Typosyllis hyalina	1992
Typosyllis sp.	2001
Archiannelida	
Polygordius sp.	1992
Saccocirrus sp.	1992

Taxa	Year Reported
Sipuncula	
Sipunculans, or Peanut worms	
Goldfinfia hespera	1992
Echiura	
Echiuran worms	
Listriolobus pelodes	1992
Urechis caupo	1992
Phoronida	
Phoronopsis viridis	1992
Phoronis pallida	1992
Anthropoda	
Crustacea	
Barnacles, Beach hoppers, Shrimps, Lobsters, Crabs, etc.	
Amphipoda	
Beach hoppers, Sand fleas, Skeleton shrimps, etc.	
Allorchestes angusta	1992
Amphithoe lacertosa	2001
Amphithoe valida	2001
Ampithoe sp.	2004
Anisogammarus confervicolus	1992
Anisogammarus pugettensis	1992
Aorides intermedius	2004
Aoroides columbiae	1992
Atylus tridens	1992
Caprella acanthogaster	2001
Caprella angusta	1992
Caprella californica	1992
Caprella drepanochir	2001
Caprella equilibra	1992
Caprella gracilior	1992
Caprella laeviuscula	1992

Taxa	Year Reported
Caprella mutica	2001
Chaetocorophium lucasi	2001
Chelura terebrans	2001
Corophium acherusicum	1992
Corophium insidiosum	2001
Corophium sp.	2004
Corophium spinicorne	1992
Corophium stimpsom	1992
Corophium uenoi	2001
Cymadusa sp.	1992
Eohaustorius sp.	1992
Grandidierella japonica	2001
Hyale plumulosa	2001
Incisocalliope nipponensis	2001
Ischyyrocerus anguipes	1992
Jassa falcata	1992
Jassa marmorata	2001
Jassa staudei	2001
Jassa slatteryi	2001
Jassa sp.	2004
Leptochelia dubia	2001
Megamphopus martesia	1992
Melita dentata	1992
Melita nitida	2001
Metacaprella kennerlyi	1992
Microdeutopus gryllotalpa	2001
Microjassa litotes	2001
Monocorophium acherusicum	2001
Monocorophium sp.	2001
Oithona similis	2001
Orchestia traskiana	1992
Orchestoidea benedicti	1992
Orchestoidea californicana	1992
Palaemon macrodactylus	2001
Paracorophium sp.	2001
Paramicrodeutopus schmitti	2004
Paraphoxus spp.	1992
Photis brevipes	1992
Photis pachydactyla	2001
Photis sp.	2004
Podocerus cristatus	1992
Podocerus fulanus	2001

Taxa	Year Reported
Pontogeneia rostrata	2004
Protomedeia sp.	2004
Protomedia articulata	1992
Sinelobus sp.	2001
Stenothoe valida	2001
Synchelidium rectipalmum	1992
Synchelidium shoemakeri	1992
Tritella pilimana	1992
Cirripedia	
Barnacles	
Balanus crenatus	1992
Balanus glandula	1992
Balanus nubilus	1992
Chthamalus dalli	1992
Pollicipes polymerus	1992
Semibalanus cariosus	1992
Copepoda	
Acartia clausi	1992
Acartia logiremis	1992
Acartia tonsa	1992
Calanus finmarchicus	1992
Clausidium vancouverense	1992
Coryceaus affinis	1992
Eucalanus bungii	1992
Eurytemora affinis	1992
Mytilicola orientalis	1992
Oithona spinirostris	1992
Paracalanus parva	1992
Pseudocalanus minutus	1992
Tortanus discaudatis	1992
Peracarida	
Cumacea	
Cumacea sp.	1992
Cumella vulgaris	1992
Diastylis sp.	1992
Diastylopsis dawnsoni	1992

Taxa	Year Reported
Eudorella pacifica	1992
Lamprops sp.	1992
Decapoda	
Shrimps, Lobsters, Crabs, etc.	
Callianassa californiensis	1992
Callianassa gigas	1992
Cancer antennarius	1992
Cancer anthonyi	1992
Cancer gracilis	1992
Cancer magister	1992
Cancer productus	1992
Carcinus maenas	2001
Crangon franciscorum	1992
Crangon nigricauda	1992
Crangon nigromaculata	1992
Crangon sp.	2004
Crangon stylirostris	1992
Emerita analoga	1992
Hemigrapsus nudus	1992
Hemigrapsus oregonensis	1992
Heptacarpus brevirostris	1992
Heptacarpus sitchensis	2004
Hippolyte californiensis	1992
Hippolyte clarki	2004
Hippolytidae sp.	2004
Lophopanopeus bellus	1992
Pachycheles rudis	1992
Pachygrapsus crassipes	1992
Paguridae sp.	2004
Pagurus spp.	1992
Pandalus danae	1992
Panulirus interruptus	2004
Petrolisthes cinctipes	1992
Pinnixia franciscana	1992
Pugettia producta	1992
shrimp juv.	2004
Upogebia pugettensis	1992
Isopoda	
Pillbugs, Sowbugs, etc.	

Taxa	Year Reported
Alloniscus perconvexus	1992
Armadillioniscus coronacapitalis	1992
Cirolana harfordi	1992
Gnorimosphaeroma oregonensis	1992
Gnorimosphaeroma sp.	2004
Iais californica	2001
Ianiropsis tridens	2001
Idotea fewkesi	2004
Idotea resecata	2004
Idotea rufescens	2004
Idotea sp.	2004
Idotea stenops	1992
Idotea urotoma	2004
Idotea wosnesenskii	1992
Limnoria lignorum	2001
Limnoria quadripunctata	1992
Limnoria tripunctata	1992
Littorophiloscia richardsonae	1992
Munna sp.	1992
Paracerceis cordata	2004
Porcellio sp.	1992
Sphaeroma quoyanum	2001
Synidotea sp	1992
Mysidacea	
Archaeomysis grebnitzkii	1992
Tenaidacea	
Chelifera	
Leptocheha dubia	1992
Tenais sp.	1992
Pycnogonida	
Sea spiders	
Achelia chelata	1992
Achelia nudiuscula	1992
Halosoma viridintestinale	1992

Taxa	Year Reported
Mollusca	
Bivalvia	
Pelecypoda	
Clams, Cockles, Mussels, Oysters, Shipworms	
Adula diegensis	1992
Axinopsida serricata	1992
Bankia setacea	1992
Clinocardium nuttallii	1992
Crassadoma giganteus	1992
Crassostrea gigas	1992
Cryptomya californica	2004
Entodesma navicula	2004
Gemma gemma	1992
Laternula marilina	2001
Lyonsia californica	1992
Macoma balthica	1992
Macoma identata	1992
Macoma inquinata	1992
Macoma nasuta	1992
Macoma sp.	2004
Mercenaria mercenaria	1992
Musculista senhousia	2001
Mya arenaria	1992
Mytilidae sp.	2004
Mytilus californianus	1992
Mytilus edulis	1992
Mytilus trossulus	2004
Nutricola tantilla	1992
Nuttallia nutallii	2004
Ostrea conchaphila	1992
Ostrea edulis	1992
Panopea abrupta	1992
Penitella penita	1992
Petricola carditoides	1992
Pododesmus macrochisma	1992
Protothaca staminea	1992
Protothaca tenerrima	1992
Rochefortia tumida	1992
Saxidomus giganteus	1992
Saxidomus nuttalli	1992
Siliqua patula	1992

Taxa	Year Reported
Solen sicarius	1992
Tagelus californianus	1992
Tellina bodegensis	1992
Tellina modesta	1992
Tellina nuculoides	1992
Tresus allomyax	2002
Tresus capax	1992
Tresus nuttallii	1992
Venerupis philippinarum	1992
Zirfaea pilsbryi	1992
Gastropoda	
Snails, Limpets, Sea hares, Nudibranchs, etc.	
Acmaea mitra	1992
Alia carinata	2002
Alvinia compacta	1992
Anisodoris nobilis	1992
Archidoris montereyensis	2004
Assiminea californica	1992
Astyris gausapata	1992
Calliostoma canaliculatum	1992
Calliostoma ligatum	2002
Crepidula fornicata	2004
Crepidula sp.	2001
Cryptochiton stelleri	2004
Cyclostremella sp.	1992
Cylichna alba	1992
Dendronotus giganteus	1992
Dialula sandiegensis	1992
Diaphoroodoris lirulatocauda	2004
Diodora aspera	1992
Dirona albolineata	1992
Dirona picta	2004
Euspira lewisii	1992
Fartulum occidentale	1992
Haminoea vesicula	1992
Hermissenda crassicornis	1992
Ilyanassa obsoleta	2001
Lacuna sp.	1992
Lirabuccinum dira	1992
Littorina keenae	1992

Taxa	Year Reported
Littorina newcombiana	1992
Littorina scutulata	1992
Lottia asmi	1992
Lottia digitalis	1992
Lottia pelta	1992
Lottia scabra	1992
Melanochlamys diomedea	1992
Nassarius fossatus	1992
Nassarius mendicus	1992
Nitidiscala sawinae	1992
Nucella lamellosa	1992
Nucella ostrina	1992
Odostomia sp	1992
Olivella biplicata	1992
Olivella pycna	1992
Onchidoris bilamellata	2004
Ovatella myosotis	1992
Philine sp.	2004
Phyllaplysia taylori	1992
Rictaxis punctocaelatus	1992
Tegula brunnea	1992
Tegula funebralis	1992
Triopha catalinae	2004
Triopha maculata	2004
Turbonilla sp.	1992
Urosalpinx cinerea	2001
Cephalopoda	
Octopods, Squids, Nautilus	
Octopus dolfleini	1992
Polyplacophora	
Chitons, or Sea cradles	
Cryptochiton stelleri	2004
Ischnochiton regularis	1992
Katharina tunicata	1992
Mopalia ciliata	1992
Mopalia lignosa	1992
Echinodermata	

Taxa	Year Reported
Amphiodia occidentalis	1992
Amphipholis sp	1992
Amphipholis squamata	2004
Dendraster excentricus	1992
Eupentacta quinquesemita	1992
Leptasterias pusilla	1992
Leptosynapta albicans	1992
Ophiuroidea sp.	2004
Pisaster brevispinus	1992
Pisaster ochraceous	1992
Pycnopodia helianthoides	1992
Strongylocentrotus purpuratus	1992
Ectoprocta	
Bryozoa	
Alcyonidium polyoum	2001
Bowerbankia gracilis	1992
Bugula californica	2004
Bugula neritina	2001
Bugula pacifica	1992
Bugula stolonifera	2004
Celleporella hyalina	2001
Conopeum sp.	2001
Crisia occidentalis	1992
Cryptosula pallasiana	2001
Membranipora membranacea	1992
Schizoporella unicornis	1992
Scrupocellaria diagensis	2004
Tricellaria occidentalis	1992
Watersipora subtorquata	2001
Chordata	
Urochordata (Tunicata)	
Sea squirts, Compound ascidians, Tunicates	
Botrylloides perspicuum	2001
Botrylloides sp.	2001
Botryllus schlosseri	2001
Botryllus sp.	2001
Botryllus tuberatus	2001

Taxa	Year Reported
Ciona intestinalis	2001
Ciona savignyi	2001
Didemnum lahillei	2004
Diplosoma macdonaldi	2004
Displosoma listerianum	2001
Distaplia occidentalis	2004
Molgula manhattensis	2001
Pyura haustor	2004
Styela clava	2001

Table F-1 References

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F.2 Bird Species Identified in the Humboldt Bay Vicinity

LOONS - Order Gaviiformes
Red-throated loon
Pacific loon
Common loon
Yellow-billed loon

GREBES - Order Podicipediformes
Pied-billed grebe
Horned grebe
Red-necked grebe
Eared grebe
Western grebe
Clark's grebe

TUBENOSES – Order Procellariiformes
Northern fulmar
Fork-tailed storm-petrel
Leach's storm-petrel

PELICANS & CORMORANTS – Order Pelicaniformes
American white pelican
Brown pelican
Brandt's cormorant
Double-crested cormorant
Pelagic cormorant
Magnificent frigatebird

HERONS, IBIS & NEW WORLD VULTURES - Order Ciconiiformes
American bittern
Great blue heron
Great egret
Snowy egret
Cattle egret
Green heron
Black-crowned night-heron
White-faced ibis

SWANS, GEESE & DUCKS - Order Anseriformes
White-fronted goose
Ross's goose
Snow goose
Emperor goose
Brant

Canada goose
Wood duck
Green-winged teal
Mallard
Northern pintail
Cinnamon teal
Northern shoveler
Gadwall
Eurasian wigeon
American wigeon
Canvasback
Redhead
Ring-necked duck
Tufted duck
Greater scaup
Lesser scaup
King eider
Steller's eider
Harlequin duck
Black scoter
Surf scoter
Common goldeneye
White-winged scoter
Barrow's goldeneye
Bufflehead
Hooded merganser
Common merganser
Red-breasted merganser
Ruddy duck

EAGLES, KITES, FALCONS & HAWKS - Order Falconiformes
Osprey
Northern harrier
Sharp-shinned hawk
Cooper's hawk
Red-shouldered hawk
Red-tailed hawk
Rough-legged hawk
American kestrel
Merlin
Peregrine falcon
Prairie falcon

GROUSE, TURKEY & QUAIL - Order Galliformes
California quail

RAILS, LIMPKIN & CRANES - Order Gruiformes
Virginia rail
Sora
American coot

SHOREBIRDS, AUKS, GULLS, & TERNS - Order Charadriiformes
Black-bellied plover
American golden-plover
Snowy plover
Semipalmated plover
Killdeer
Black oystercatcher
Black-necked stilt
American avocet
Greater yellowlegs
Lesser yellowlegs
Solitary sandpiper
Willet
Wandering tattler
Spotted sandpiper
Whimbrel
Long-billed curlew
Hudsonian godwit
Bar-tailed godwit
Marbled godwit
Ruddy turnstone
Black turnstone
Surfbird
Red knot
Sanderling
Semipalmated sandpiper
Western sandpiper
Least sandpiper
Baird's sandpiper
Pectoral sandpiper
Rock sandpiper
Dunlin
Stilt sandpiper
Ruff
Short-billed dowitcher

Long-billed dowitcher
Common snipe
Wilson's phalarope
Red-necked phalarope
Red phalarope
Pomarine jaeger
Parasitic jaeger
Laughing gull
Franklin's gull
Little gull
Black-headed gull
Bonaparte's gull
Heerman's gull
Mew gull
Ring-billed gull
California gull
Herring gull
Thayer's gull
Western gull
Glaucous-winged gull
Glaucous gull
Black-legged kittiwake
Sabine's gull
Caspian tern
Elegant tern
Common tern
Forster's tern
Least tern
Black tern
Common murre
Pigeon guillemot
Marbled murrelet

DOVES - Order Columbiformes
Rock dove
Mourning dove

OWLS - Order Strigiformes
Barn Owl
Great horned owl
Short-eared owl

SWIFTS & HUMMINGBIRDS - Order Apodiformes

Vaux's swift
Anna's hummingbird
Allen's hummingbird

KINGFISHERS - Order Coraciiformes
Belted kingfisher

WOODPECKERS - Order Piciformes
Red-breasted sapsucker
Downy woodpecker
Hairy woodpecker
Northern flicker

PERCHING BIRDS - Order Passeriformes
Willow flycatcher
Black Phoebe
Ash-throated flycatcher
Horned lark
Purple martin
Tree swallow
Violet-green swallow
Northern rough-winged swallow
Bank swallow
Cliff swallow
Barn swallow
American crow
Common raven
Chestnut-backed chickadee
Bushtit
Red-breasted nuthatch
Brown creeper
Bewick's wren
Winter wren
House wren
Marsh wren
Ruby-crowned kinglet
Golden-crowned kinglet
Hermit thrush
Swainson's thrush
American robin
Wrentit
Cedar waxwing
Tennessee warbler

Orange-crowned warbler
Nashville warbler
Yellow warbler
Cape may warbler
Yellow-rumped warbler
Black-throated gray warbler
Townsend's warbler
MacGillivray's warbler
Common yellowthroat
Wilson's warbler
Western tanager
Black-headed grosbeak
Spotted towhee
Chipping sparrow
Clay-colored sparrow
Vesper sparrow
Lark sparrow
Savannah sparrow
Fox sparrow
Song sparrow
Lincoln's sparrow
Swamp sparrow
White-throated sparrow
Golden-crowned sparrow
White-crowned sparrow
Dark-eyed junco
Lapland longspur
Snow bunting
Bobolink
Red-winged blackbird
Western meadowlark
Brewer's blackbird
Rusty blackbird
Brown-headed cowbird
Northern oriole
Purple finch
House finch
Pine siskin
Lesser goldfinch
American goldfinch
Red crossbill
House sparrow

F-2 References

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F.3 Fishes of Humboldt Bay

CARTILAGINOUS FISHES

Family Petromyzontidae	**Lampreys**
Lampetra tridentata	Pacific lamprey
Family Hexanchidae	**Cow sharks**
Notorynchus maculatus	Sevengill shark
Family Triakidae	**Hound sharks**
Galeorhinus zyopterus	Soupfin shark
Mustelus henlei	Brown smoothhound
Triakis semifasciata	Leopard shark
Family Squalidae	**Dogfish sharks**
Squalus acanthias	Spiny dogfish
Family Rajidae	**Skates**
Raja binoculata	Big skate
Family Urolophidae	**Round stingrays**
Urolophus halleri	Round stingray
Family Myliobatidae	**Eagle rays**
Myliobatis californica	Bat ray
Family Chimaeridae	**Chamaeras**
Hydrolagus colliei	Spotted ratfish

BONY FISHES

Family Acipenseridae	**Sturgeons**
Acipenser medirostris	Green sturgeon
Acipenser transmontanus	White Sturgeon
Family Ophichthidae	**Snake eels**
Ophichthus zaphocir	Yellow snake eel
Family Clupeida	**Herrings**
Alosa sapidissima	American shad
Clupea harengus pallasi	Pacific herring
Dorosoma petenense	Threadfin shad
Sardinops sagax	Pacific sardine
Family Engraulidae	**Anchovies**
Engraulis mordax	Northern anchovy
Family Salmonidae	**Trouts and Salmon**
Oncorhynchus clarkii	Cutthroat trout
Oncorhynchus kisutch	Coho salmon
Oncorhynchus mykiss	Rainbow trout
Oncorhynchus tshawytscha	Chinook salmon
Family Osmeridae	**Smelts**
Allosmerus elongatus	Whitebait smelt
Hypomesus pretiosus	Surf smelt
Spirinchus starksi	Night smelt
Spirinchus thaleichthys	Longfin smelt
Thaleichthys pacificus	Eulachon
Family Gonostomatidae	**Lightfishes**
Cyclothone acclinidenus	Benttooth bristlemouth
Family Myctophidae	**Lanternfishes**
Stenobrachius leucopsarus	Northern lampfish
Tarletonbeania crenularis	Blue lanternfish
Family Gadidae	**Cods**
Microgadus proximus	Pacific tomcod
Family Ophidiidae	**Cusk-eels**
Chilara taylori	Spotted cusk-eel

Family Atherinidae	**Silversides**
Atherinops affinis	Topsmelt
Atherinops californiensis	Jacksmelt
Family Trachipteridae	**Ribbonfishes**
Trachipterus altivelis	King-of-the-salmon
Family Gasterosteidae	**Sticklebacks**
Aulorhynchus flavidus	Tube-snout
Gasterosteus aculeatus	Threespine stickleback
Family Syngnathidae	**Pipefish**
Syngnathus leptorhynchus	Bay pipefish
Cosmocampus arctus	Snubnose pipefish
Family Percichthyidae	**Moronidae temperate basses**
Morone saxatilis	Striped bass
Family Acropomatidae	**Temperate ocean- basses**
Stereolepiis gigas	Giant sea bass
Family Sciaenidae	**Croakers**
Atractoscion nobilis	White seabass
Genyonemus lineatus	White croaker
Family Embiotocidae	**Surfperches**
Amphistichus koelzi	Calico surfperch
Amphistichus rhodoterus	Redtail surfperch
Cymatogaster aggregata	Shiner perch
Embiotoca lateralis	Striped seaperch
Hyperprosopon anale	Spotfin surfperch
Porichthys notatus	Plainfin midshipman
Hyperprosopon argenteum	Walleye surfperch
Hyperprosopon ellipticum	Silver surfperch
Phanerodon furcatus	White seaperch
Damalichthys vacca	Pile perch
Family Batracoidae	**Toadfishes**
Porichthys notatus	Plainfin midshipman
Family Trichodontidae	**Sandfishes**
Trichodon trichodon	Pacific sandfish

Family Stichaeidae	**Pricklebacks**
Anoplarchus purpurescens	High cockscomb
Cebidichthys violaceus	Monkeyface prickleback
Chirolophis decoratus	Decorated warbonnet
Lumpenus sagitta	Snake prickleback
Family Pholidae	**Gunnels**
Apodichthys flavidus	Penpoint gunnel
Pholis ornata	Saddleback gunnel
Family Anarhichadidae	**Wolffishes**
Anarrhichthys ocellatus	Wolf-eel
Family Cryptacanthodidae	**Wrymouths**
Delolepis gigantea	Giant wrymouth
Family Ammodytidae	**Sand lances**
Ammodytes hexapterus	Pacific sand lance
Family Gobiidae	**Gobies**
Clevelandia ios	Arrow goby
Coryphopterus nicholsi	Blackeye goby
Eucyclogobius newberryi	Tidewater goby
Lepidogobius lepidus	Bay goby
Family Luvaridae	**Louvar**
Luvarus imperialis	Louvar
Family Centrolophidae	**Medusafish**
Icichthys lockingtoni	Medusafish
Family Scorpaenidae	**Scorpionfishes**
Sebastes auriculatus	Brown rockfish
Sebastes caurinus	Copper rockfish
Sebastes flavidus	Yellowtail rockfish
Sebastes melanops	Black rockfish
Sebastes miniatus	Vermilion rockfish
Sebastes mystinus	Blue rockfish
Sebastes paucispinis	Bocaccio
Sebastes rastrelliger	Grass rockfish
Family Hexagrammidae	**Greenlings**

Hexagrammos decagrammus	Kelp greenling
Hexagrammos Supercilious	Rock greenling
Ophiodon elongatus	Lingcod
Oxylebius pictus	Painted greenling
Family Cottidae	**Sculpins**
Artedius fenestralis	Padded sculpin
Artedius harringtoni	Scalyhead sculpin
Artedius notospilotus	Bonehead sculpin
Ascelichthys rhodorus	Rosylip sculpin
Clinocottus acuticeps	Sharpnose sculpin
Cottus aleuticus	Coastrange sculpin
Enophrys bison	Buffalo sculpin
Cottus asper	Prickly sculpin
Hemilepidotus hemilepidotus	Red Irish lord
Hemilepidotus spinosus	Brown Irish lord
Leptocottus armatus	Pacific staghorn sculpin
Oligocottus snyderi	Fluffy sculpin
Scorpaenichthys marmoratus	Cabezon
Family Hemiripteridae	
Blepsias cirrhosus	Silverspotted sculpin
Nautichthys oculofasciatus	Sailfin sculpin
Family Agonidae	**Poachers**
Odontopyxis trispinosa	Pygmy poacher
Pallasina barbata	Tubenose poacher
Stellerina xyosterna	Pricklebreast poacher
Family Liparidae	**Snailfishes**
Liparis fucensis	Slipskin snailfish
Liparis pulchellus	Showy snailfish
Liparis rutteri	Ringtail snailfish
Liparis mucosus	Slimy snailfish
Family Paralichthyidae	**Sanddabs and Halibut**
Citharichthys sordidus	Pacific sanddab
Citharichthys stigmaeus	Speckled sanddab
Paralichthys californicus	Califonia halibut
Family Pleuronectidae	**Righteye flounders**
Isopsetta isolepis	Butter sole
Microstomus pacificus	Dover sole

Pleuronectes vetulus	English sole
Platichthys stellatus	Starry flounder
Pleuronichthys coenosus	C-O Turbot
Pleuronichthys decurrens	Curlfin sole
Psettichthys melanostictus	Sand sole
Family Cynoglossidae	**Tonguefishes**
Symphurus atricauda	California tonguefish
Family Molidae	**Molas**
Mola Mola	Ocean sunfish
Family Batracoididae	**Toadfishes**
Porichthys notatus	Plainfin midshipman
Family Stomateidae	**Butterfishes**
Peprilus simillimus	Pacific butterfish

F.3 References

- A Guide to the Fishes of Humboldt Bay, 1995, Ronald A. Fritzsche & J. William Cavanagh
- Froese, R. and D. Pauly. Editors. 2004. FishBase. World Wide Web electronic publication.
  www.fishbase.org, version (12/2004)
- The Ecology of Humboldt Bay, CA: An Estuarine Profile, 1992, Roger A. Barnhart, Milton J. Boyd, and John E. Pequegnat
- Humboldt Bay Wetlands Review & Baylands Analysis, 1980, Shapiro and Associates, Inc.
- The Natural Resources of Humboldt Bay, 1973, Gary W. Monroe, Stanley J. Thompson, Phillip G. Swartzell, Bruce M. Browning, and John W. Speth
- Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries Volume I & II. Mark E. Monaco, David M. Nelson, Robert Emmett, and Susan A. Hinton, ELMR Report No. 4, NOAA/NOS 1990, revision 1994
- Fish Communities in Eelgrass, Oyster Culture, and Mud Flat Habitats of North Humboldt Bay, California Progress Report, 2004, US Fish and Wildlife Service, William D. Pinnix, Thomas A. Shaw, and Nicholas J. Hetrick

F.4 Algae and Salt Marsh Plant Species of Humboldt Bay

ALGAE

Chlorophyta

Bryopsis hypnoides	Moss alga
Enteromorpha intestinalis	Green alga
Spongomorpha coalita	Sponge alga
Ulva lactuca	Sea lettuce

Phaeophyta

Alaria marginata	Wing kelp
Egregia menziesii	Feather boa kelp
Fucus gardneri	Rock weed
Fucus distichus	Rock weed
Fucus spiralis	Rock weed
Pelvetiopsis limitata	Rock weed
Sargassum muticum	Grape kelp

Rhodophyta

Botryoglossum farlowianum	Grape tongue alga
Botryoglossum ruprectianum	Grape tongue alga
Chandracanthus teedi	Red alga
Corallina spp.	Coralline alga
Endocladia muricata	Red alga
Gigartina papillata	Grapestone alga
Gracilaria verrucosa	Slender red alga
Iridaea cordata	Iridescent red alga
Lomentria hakodatenis	Red alga
Microcladia borealis	Red alga
Microcladia coulteri	Red alga
Polysiphonia paniculata	Red alga
Polysiphonia pacifica	Red alga
Porphyra lanceolata	Laver, nori
Porphyra perforata	Laver, nori
Porphyra sanjuanensis	Laver, nori
Rhodomela larix	Red alga
Rhodymenia oweniae	Red alga

Chrysophyta

Vaucheria longicaulis	Yellow-brown alga

COASTAL SALT MARSH PLANTS

Flowering plants (Anthophyta)

Amisinckia spectabilis var. *spectabilis*	Seaside fiddleneck
Astragalus pycnostachyus	Loco Weed
Atriplex patula var. *hastata*	Fat hen
Baccharis douglasii	Douglas' baccharis
Calystgia sepium	Hedge bindweed
Carex lyngbyei	Lyngbye's sedge
Castilleja ambigua ssp. *humboldtiensis*	Humboldt Bay owl's clover
Centaurium trichanthum	Alkali centaury
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's beak
Cotula coronopifolia	Common brassbuttons
Cuscuta salina	Dodder
Deschampsia caespitosa	California Hairgrass
Distichlis spicata	Saltgrass
Eleocharis pachycarpa	Black sand spikerush
Eleocharis parvula	Dwarf spikerush
Eryngium aristulatum	California eryngo
Euthamia occidentalis	Western flat-topped goldenrod
Glaux maritima	Sea milk-wort
Grindelia stricta ssp. *Blakei*	Humboldt bay gumplant
Hypericum anagalloides	Creeping St. John's wort
Iva axillaris ssp. Robustior	Poverty weed
Jaumea carnosa	Fleshy Jaumea
Juncus effusus	Bog Rush
Juncus breweri	Salt Rush
Lilaeopsis occidentalis	Lilaeopsis
Limonium californicum	California sealavender
Parapholis incurva	Curved sicklegrass
Parapholis strigosa	sicklegrass
Plantago coronopus	Buckhorn plantain
Plantago maritima	Pacific Seaside Plantain
Plantago subnuda	Mexican Plantain
Potentilla anserina ssp. *pacifica*	Pacific potentilla
Puccinellia grandis	Alaska alkali grass
Puccinellia nutkaensis	Alaska alkali grass
Puccinellia pumila	Dwarf alkali grass
Pyrrocoma racemosa	Clustered goldenweed

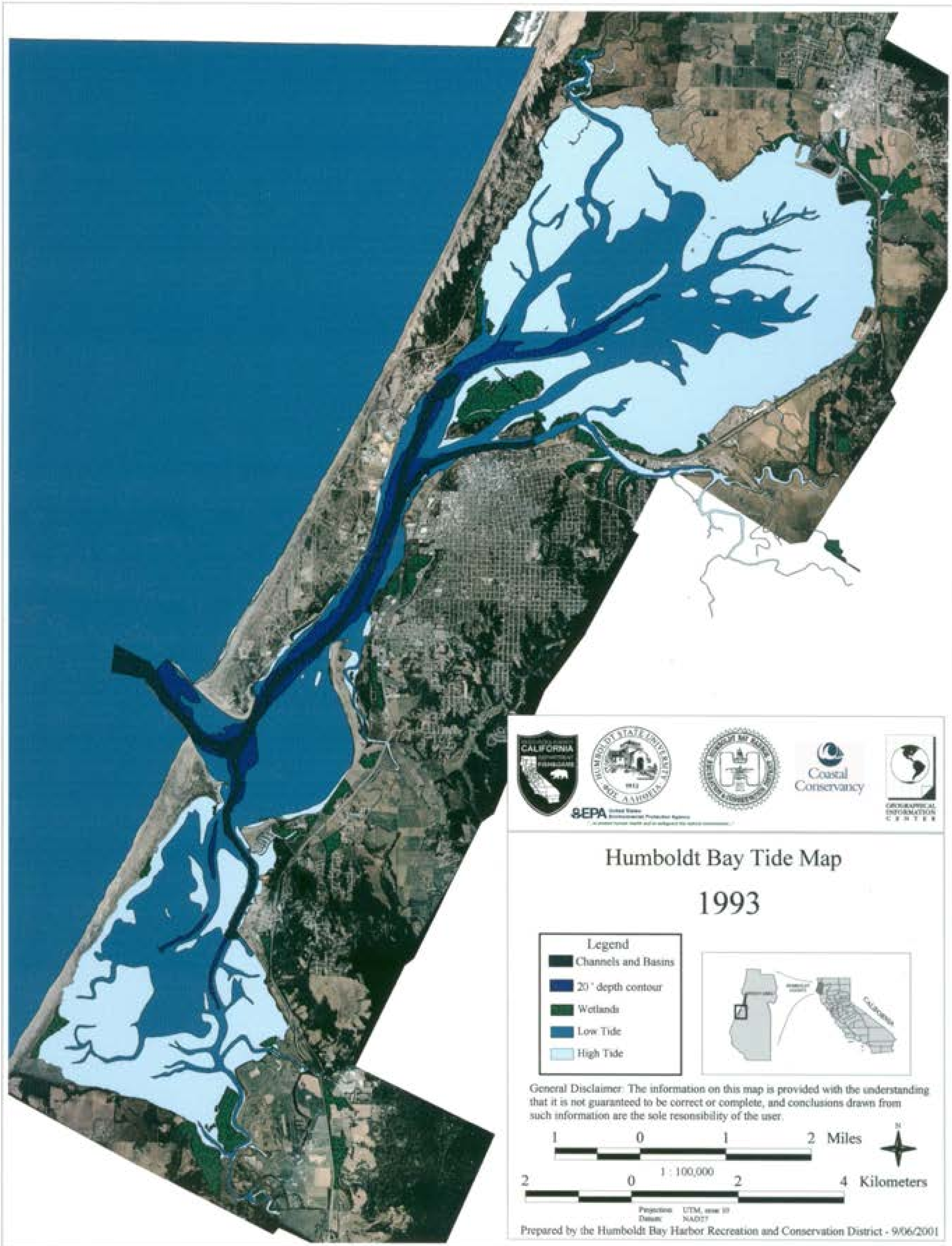
Ruppia maritima	Ditchgrass
Salicornia bigelovii	Pickleweed
Salicornia virginica	Pickleweed
Scirpus americanus	American threesquare
Scirpus cernuus	Annual tule
Scirpus maritimus	Saltmarsh bulrush
Scirpus robustus	Bull tule
Sidalcea calycosa	Pt. Reyes Sidalcea
Spartina densiflora	Cordgrass
Spartina foliosa	California cordgrass
Spergularia canadensis var. *occidentalis*	Northern sandspurry
Spergularia villosa	Spurry
Triglochin concinna	Utah arrowgrass
Triglochin maritimum	Arrowgrass
Zostera japonica	Dwarf eelgrass
Zostera marina	Eelgrass

E-4 References

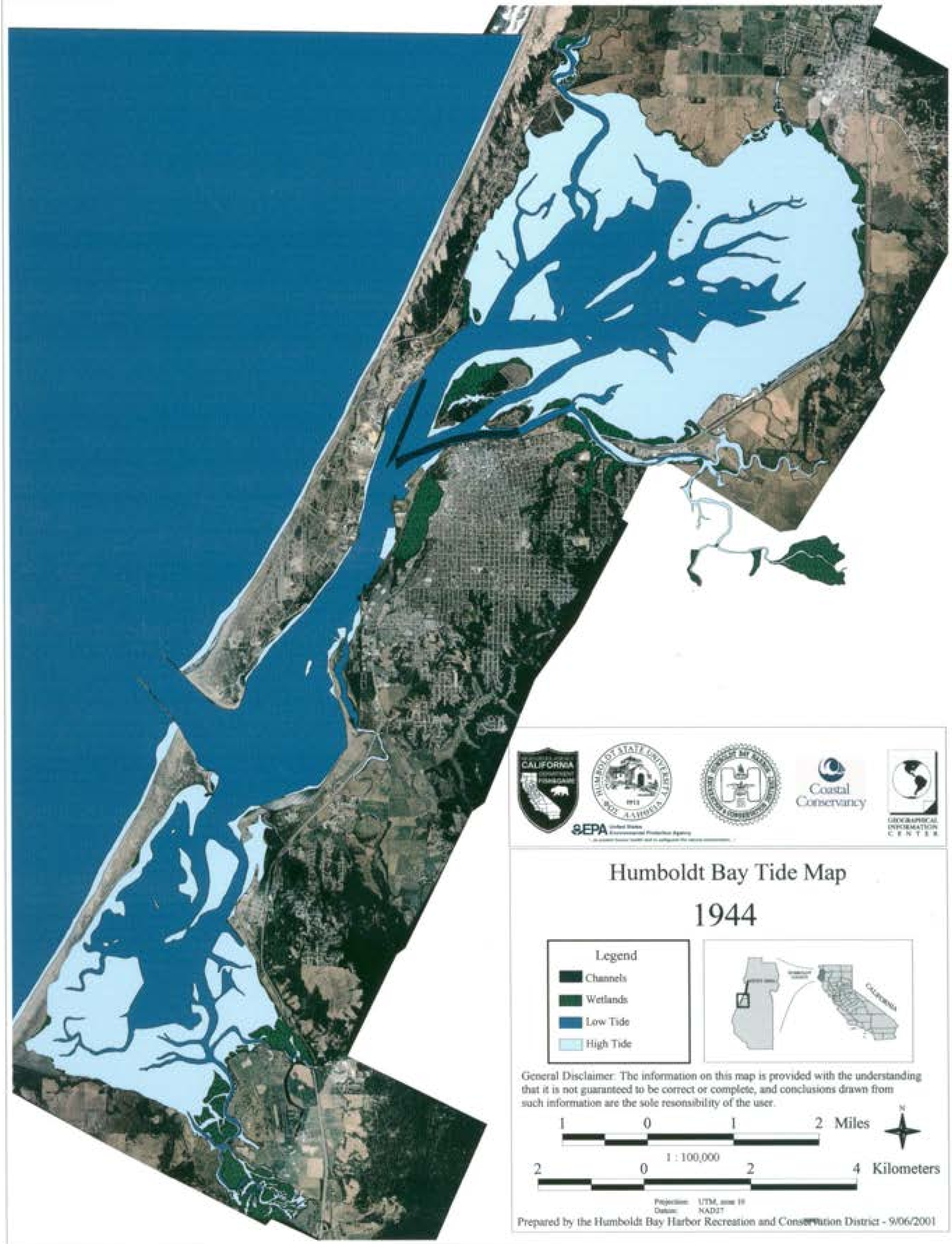
- The Ecology of Humboldt Bay, CA: An Estuarine Profile, 1992, Roger A. Barnhart, Milton J. Boyd, and John E. Pequegnat
- Humboldt Bay Wetlands Review & Baylands Analysis, 1980, Shapiro and Associates, Inc.
- The Natural Resources of Humboldt Bay, 1973, Gary W. Monroe, Stanley J. Thompson, Phillip G. Swartzell, Bruce M. Browning, and John W. Speth
- California Native Plant Society, 2004, http://www.cnps.org

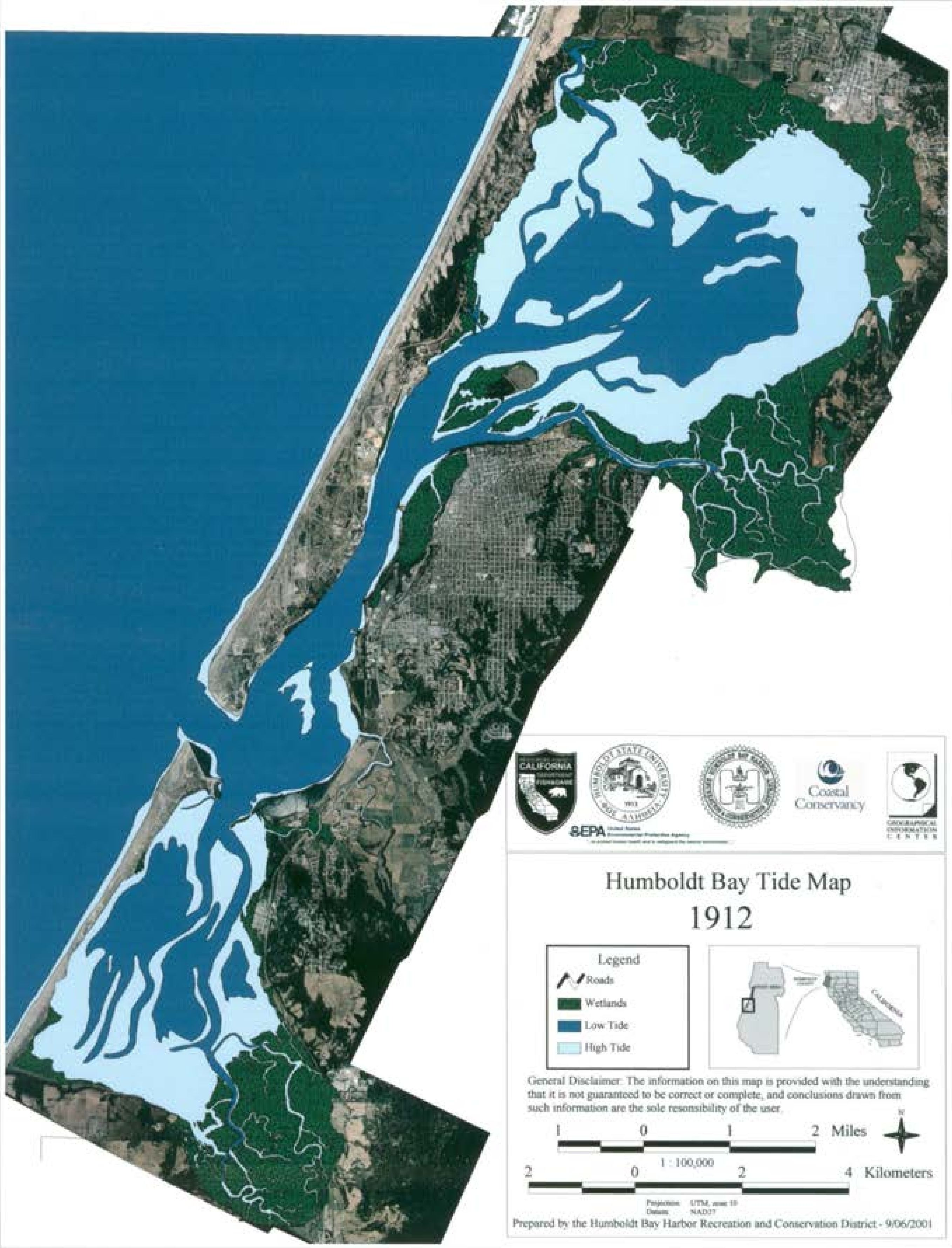
Appendix G

Maps



CALIFORNIA
Coastal Conservancy
GEOGRAPHICAL INFORMATION CENTER
Humboldt Bay Tide Map
1993
Legend
Channels and Basins
20 ' depth contour
Wetlands
Low Tide
High Tide
CALIFORNIA
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
1 : 100,000
2 0 2 4 Kilometers
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001


CALIFORNIA
Coastal Conservancy
GEOGRAPHICAL INFORMATION CENTER
EPA United States Environmental Protection Agency
Humboldt Bay Tide Map
1944
Legend
Channels
Wetlands
Low Tide
High Tide
CALIFORNIA
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
N
1 : 100,000
2 0 2 4 Kilometers
Projection: UTM, zone 10
Datum: NAD27
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001



Humboldt Bay Tide Map
1912
Legend
Roads
Wetlands
Low Tide
High Tide
Coastal Conservancy
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
1 : 100,000
2 0 2 4 Kilometers
Projection UTM, zone 10
Datum NAD27
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001

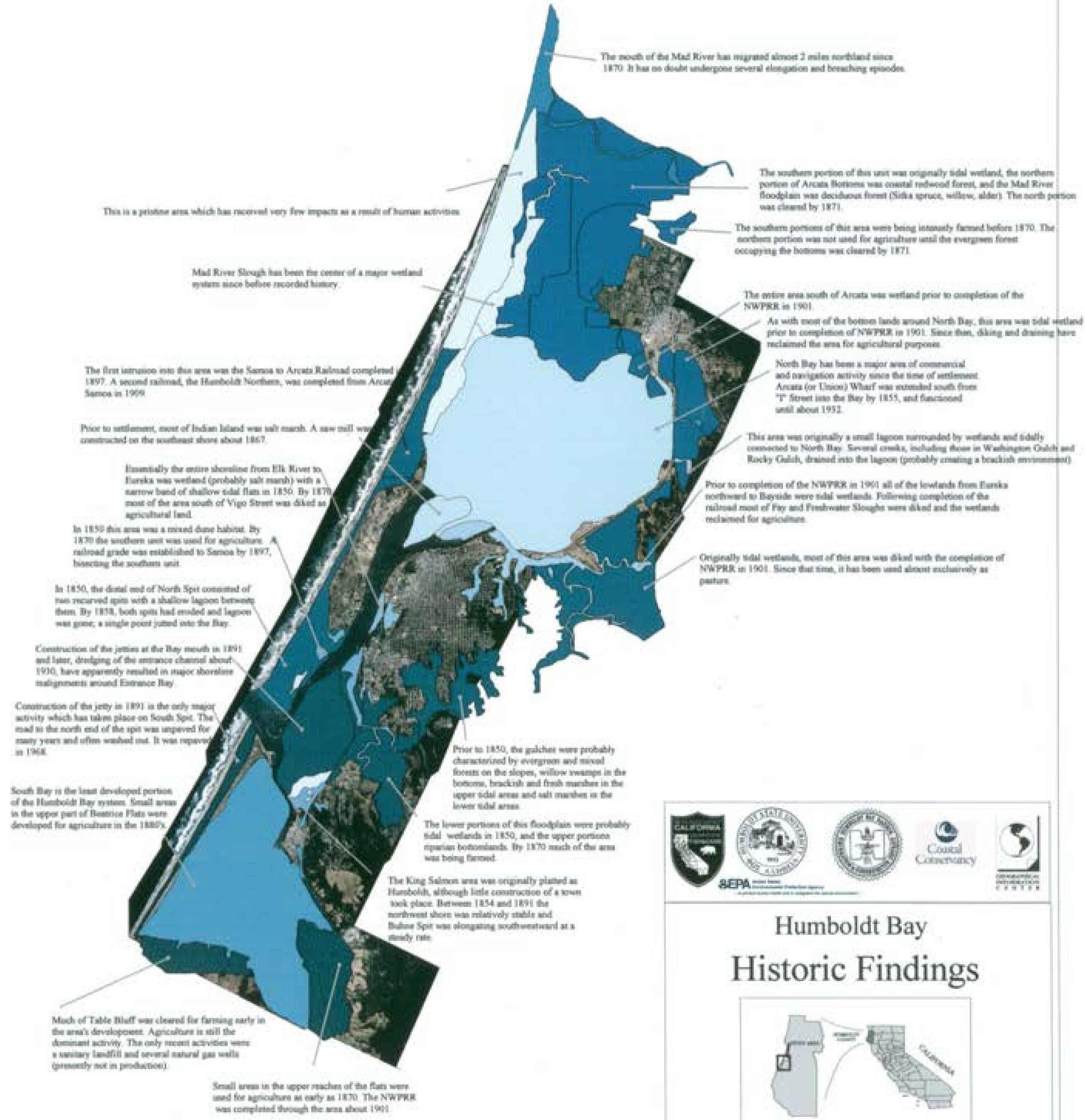
Historic salt marsh in Humboldt Bay, 1870

Map created by U.S. Fish and Wildlife Service 2002

Base map, U.S. Coast Survey 1870
courtesy of Humboldt County Public Works Department


Humboldt Bay
Tidal Area Flux Map
Legend
Low Tide Area Flux
Low Tide gain
Low Tide loss
High Tide Area Flux
High Tide gain
High Tide loss
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
1 : 100,000
2 0 2 4 Kilometers
Projection: UTM, zone 10
Datum: NAD27
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001
Coastal Conservancy
CALIFORNIA

CALIFORNIA
Coastal Conservancy
GEOGRAPHICAL INFORMATION CENTER
EPA United States Environmental Protection Agency
Humboldt Bay
Wetland Area Flux Map
Legend
Wetland Area Flux
Wetland gain
Wetland loss
N/A
CALIFORNIA
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
1 : 100,000
2 0 2 4 Kilometers
N
Projection: UTM, zone 10
Datum: NAD27
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001



Coastal Conservancy

Humboldt Bay

Historic Findings

General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.

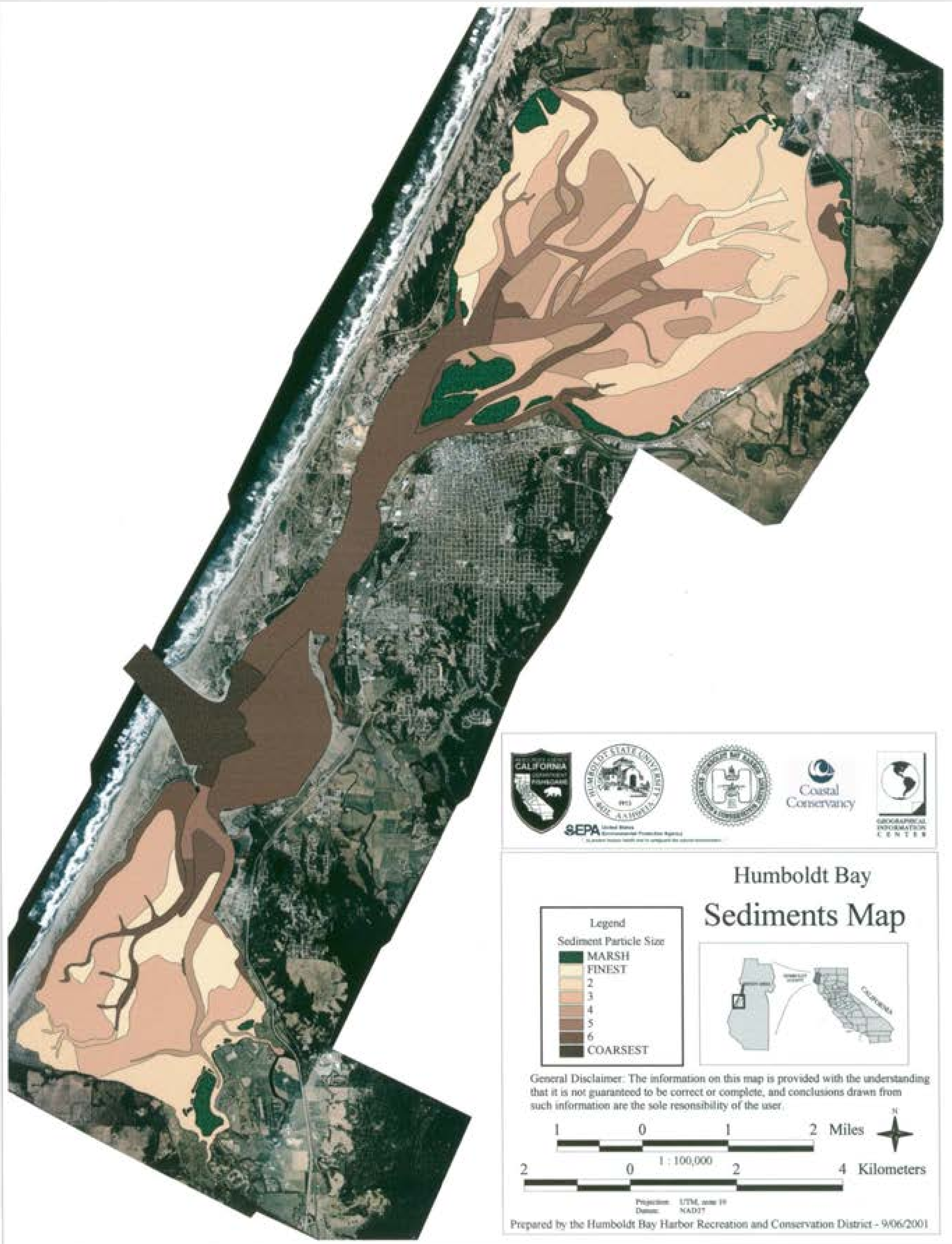
N

1 0 1 2 Miles

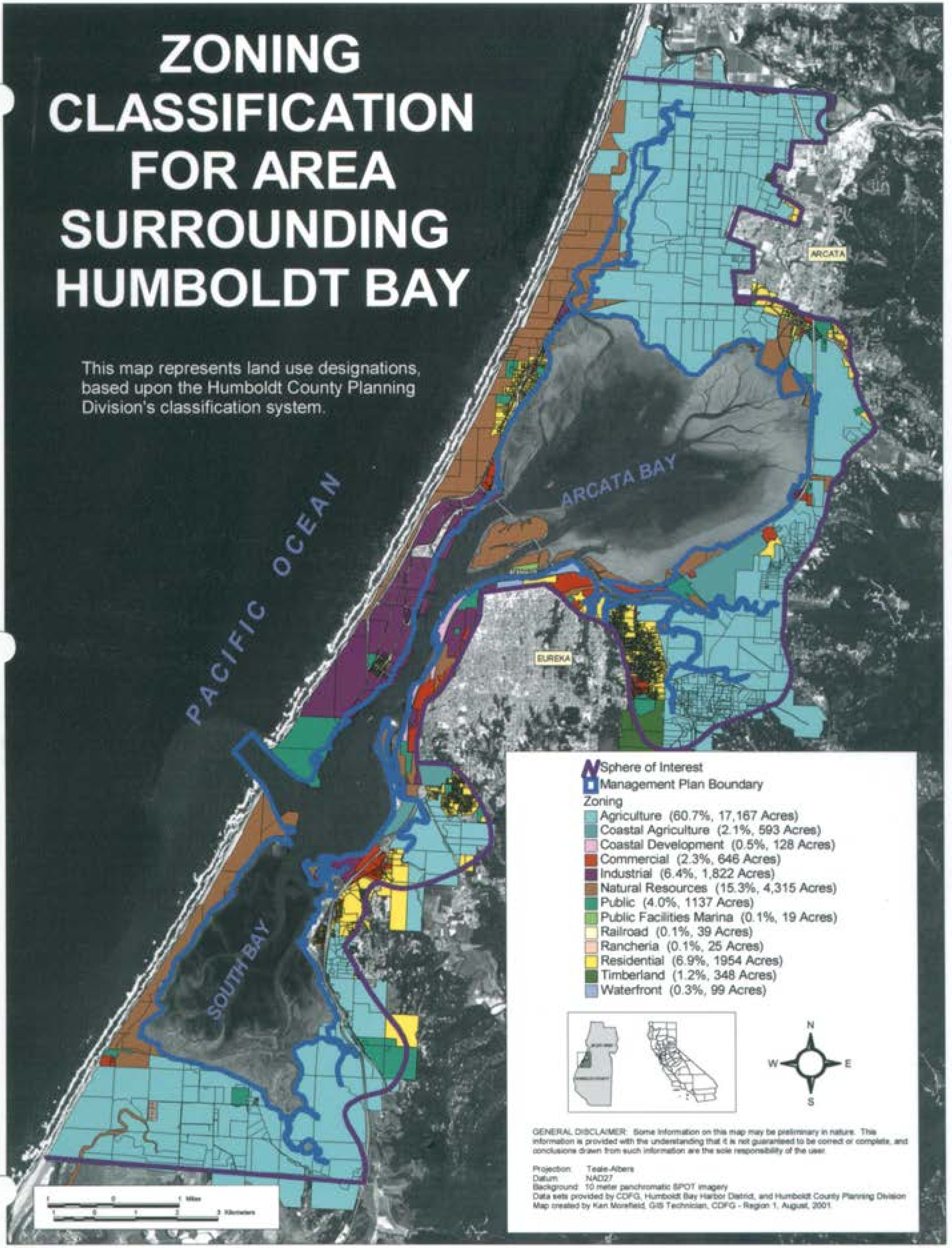
2 0 1 : 180,000 2 4 Kilometers

Projection: UTM, zone 10
Datum: NAD27

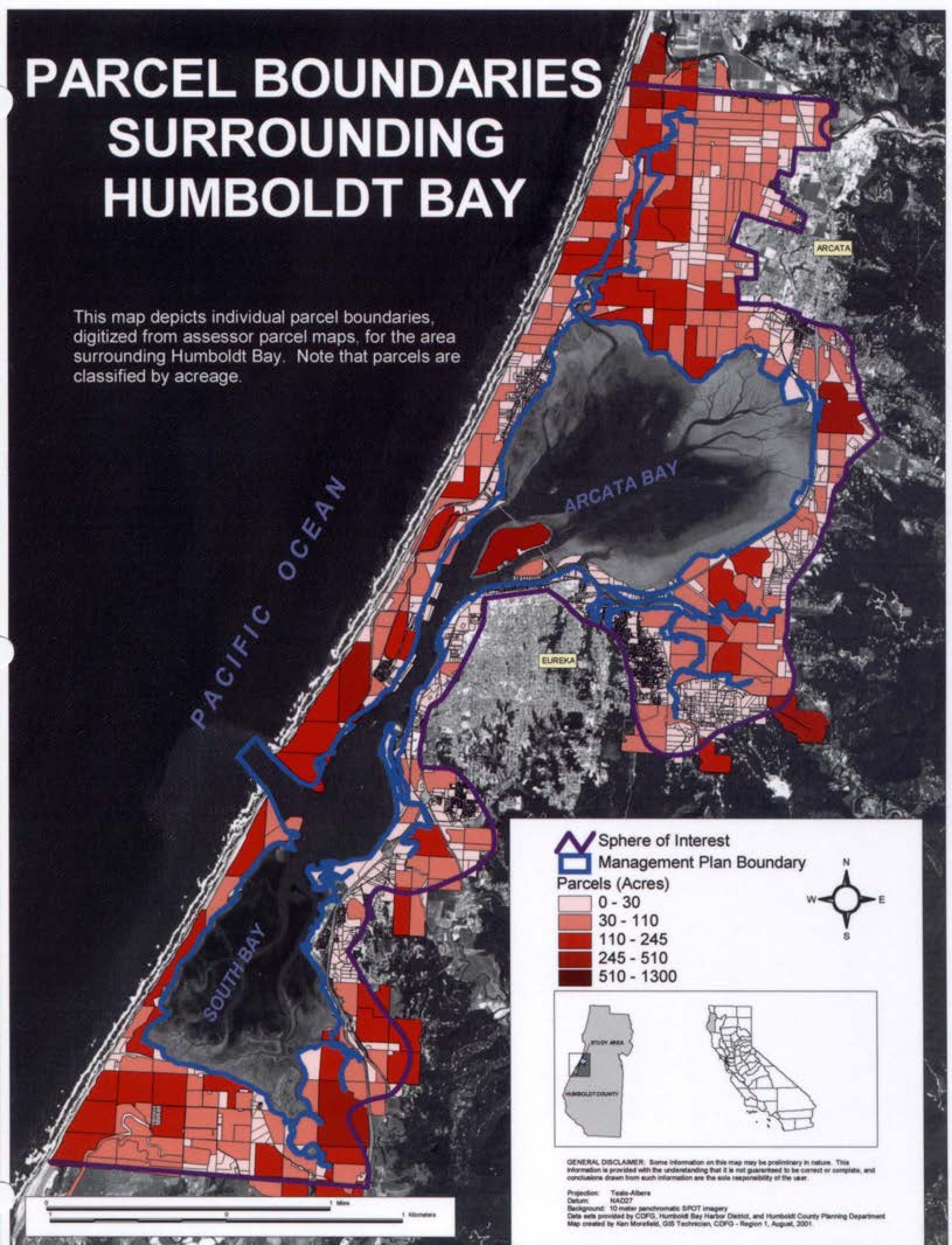
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001

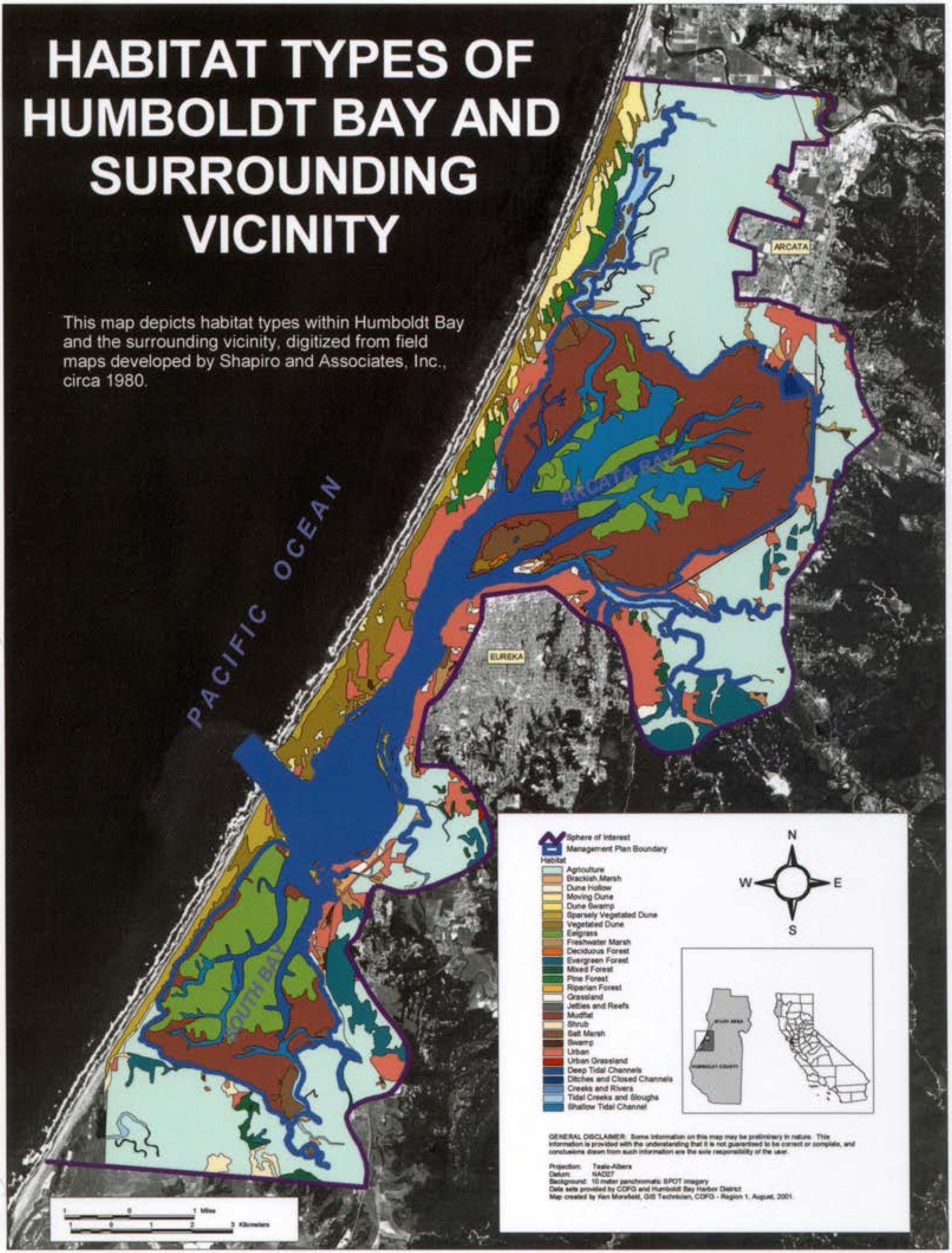


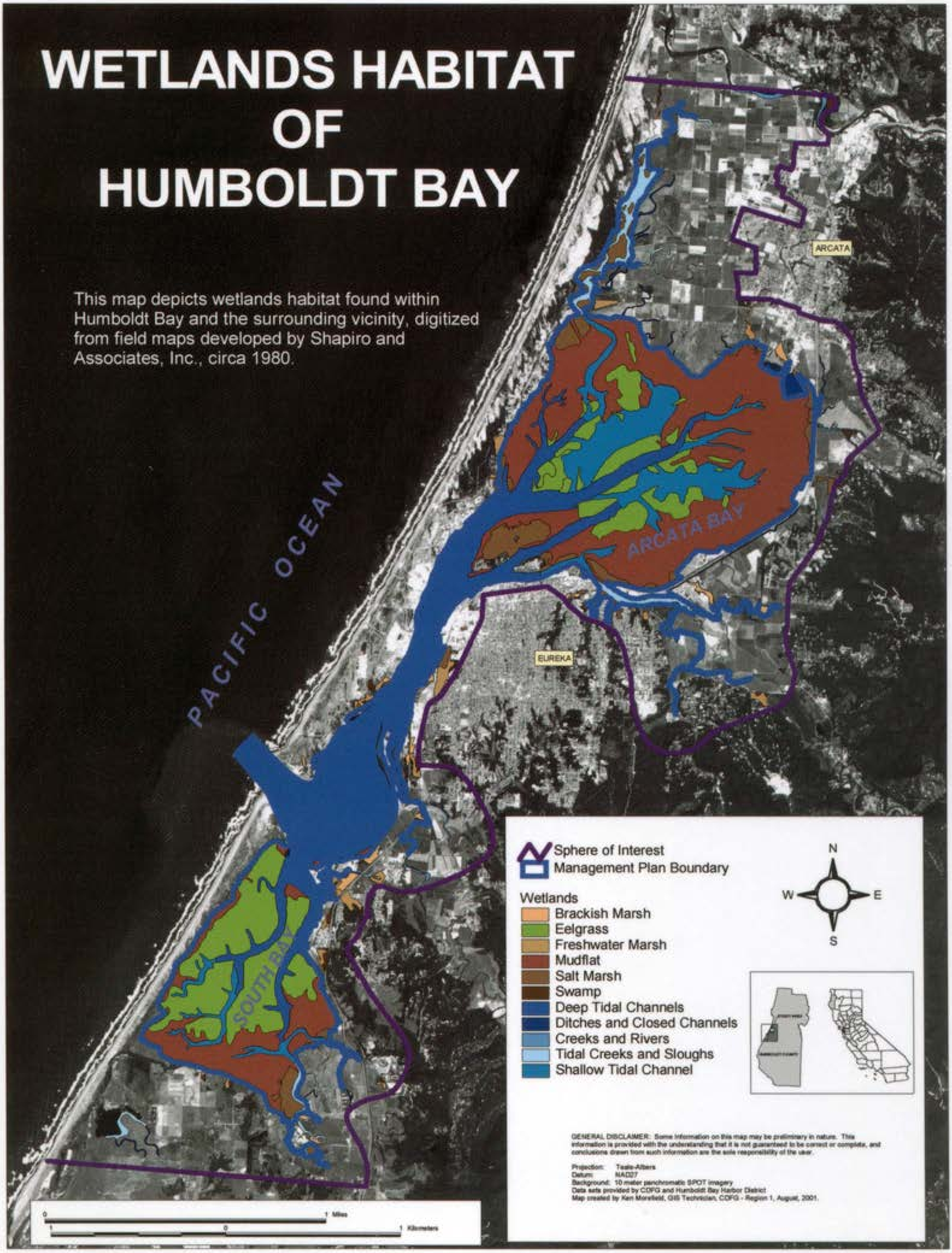
CALIFORNIA
DEPARTMENT OF FISH AND GAME
HUMBOLDT STATE UNIVERSITY
1913
EPA United States Environmental Protection Agency
Coastal Conservancy
GEOGRAPHICAL INFORMATION CENTER
Humboldt Bay
Sediments Map
Legend
Sediment Particle Size
MARSH
FINEST
2
3
4
5
6
COARSEST
CALIFORNIA
General Disclaimer: The information on this map is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole resonsibility of the user.
1 0 1 2 Miles
N
1 : 100,000
2 0 2 4 Kilometers
Projection:
Datum: NAD27
Prepared by the Humboldt Bay Harbor Recreation and Conservation District - 9/06/2001


ZONING CLASSIFICATION FOR AREA SURROUNDING HUMBOLDT BAY
This map represents land use designations, based upon the Humboldt County Planning Division's classification system.
PACIFIC OCEAN
ARCATA BAY
SOUTH BAY
ARCATA
EUREKA
Sphere of Interest
Management Plan Boundary
Zoning
Agriculture (60.7%, 17,167 Acres)
Coastal Agriculture (2.1%, 593 Acres)
Coastal Development (0.5%, 128 Acres)
Commercial (2.3%, 646 Acres)
Industrial (6.4%, 1,822 Acres)
Natural Resources (15.3%, 4,315 Acres)
Public (4.0%, 1137 Acres)
Public Facilities Marina (0.1%, 19 Acres)
Railroad (0.1%, 39 Acres)
Rancheria (0.1%, 25 Acres)
Residential (6.9%, 1954 Acres)
Timberland (1.2%, 348 Acres)
Waterfront (0.3%, 99 Acres)
N
W
E
S
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG, Humboldt Bay Harbor District, and Humboldt County Planning Division
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.

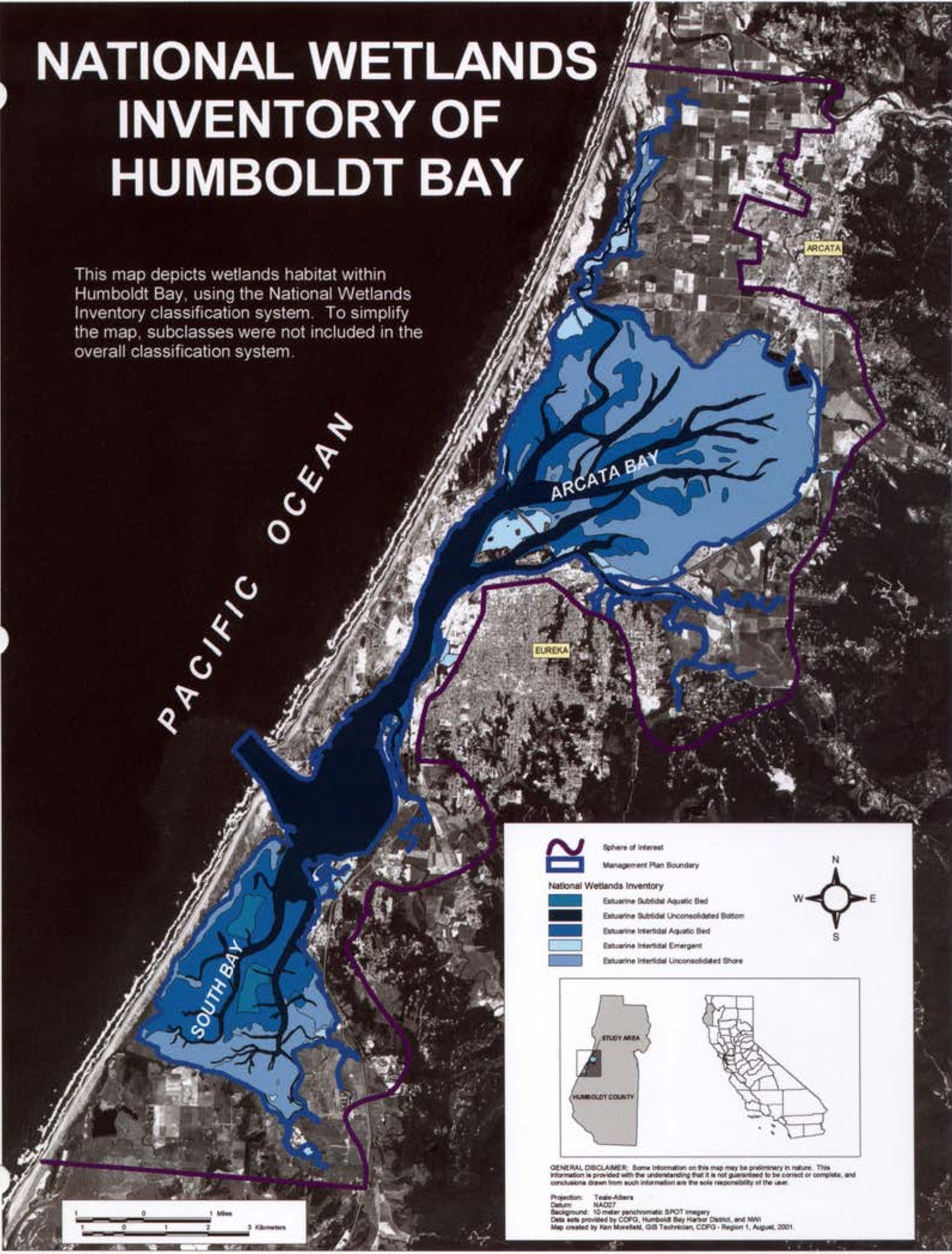

HUMBOLDT BAY PUBLIC LAND OWNERS AND MANAGERS
This map depicts individual parcel boundaries for major public land owners and managers, digitized from assessor parcel maps, for the area surrounding Humboldt Bay. Total acreage has been included for each land owner.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
US Fish and Wildlife Service (600 Acres)
US Army Corps. (59 Acres)
US Coast Guard (227 Acres)
Bureau of Land Management (264 Acres)
Humboldt Bay National Wildlife Refuge (1227 Acres)
Humboldt County (216 Acres)
Humboldt Bay Harbor District (159 Acres)
CA Fish and Game/Wildlife Conservation Board (1485 Acres)
CA State Lands - Other (696 Acres)
City of Eureka (1074 Acres)
City of Arcata (220 Acres)
Manila Community Service District (127 Acres)
Northwest Pacific Railroad (160 Acres)
PG&E (24 Acres)
N
W
E
S
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG, Humboldt Bay Harbor District, and Humboldt County Planning Division
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
Miles
Kilometers

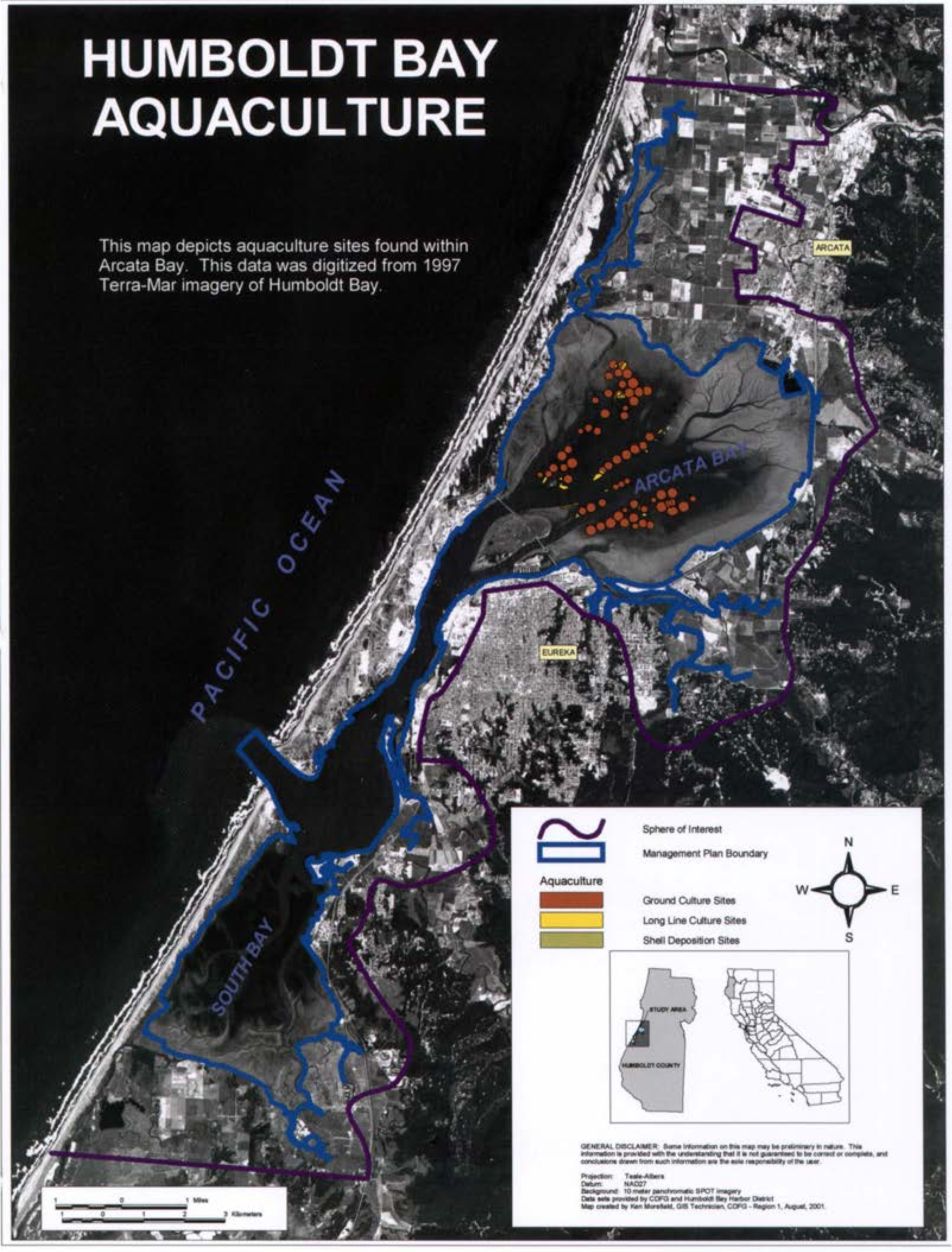

PARCEL BOUNDARIES SURROUNDING HUMBOLDT BAY
This map depicts individual parcel boundaries, digitized from assessor parcel maps, for the area surrounding Humboldt Bay. Note that parcels are classified by acreage.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Parcels (Acres)
0 - 30
30 - 110
110 - 245
245 - 510
510 - 1300
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG, Humboldt Bay Harbor District, and Humboldt County Planning Department
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001
0
1 Miles
1
0
1 Kilometers

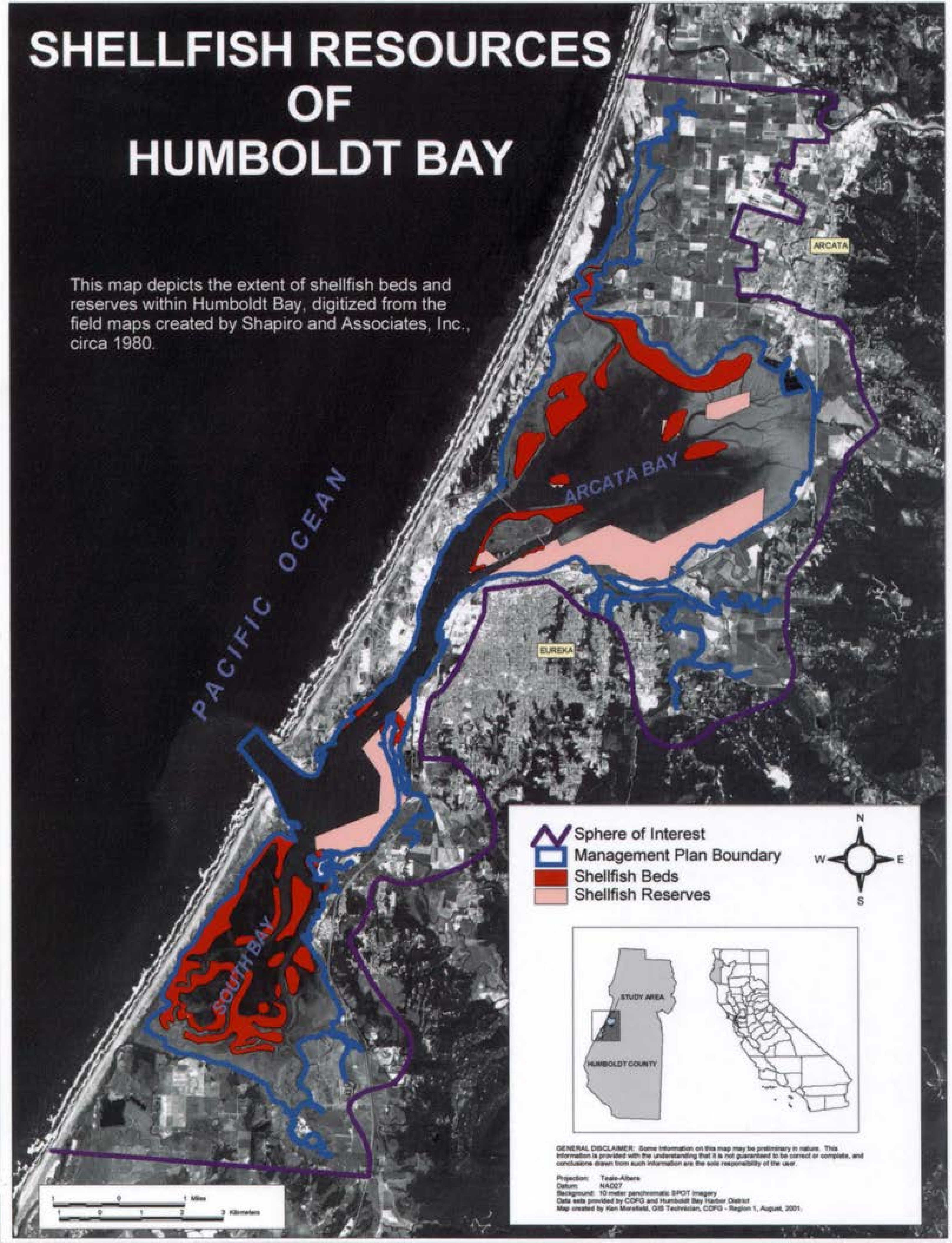

HABITAT TYPES OF HUMBOLDT BAY AND SURROUNDING VICINITY
This map depicts habitat types within Humboldt Bay and the surrounding vicinity, digitized from field maps developed by Shapiro and Associates, Inc., circa 1980.
PACIFIC OCEAN
ARCATA
ARCATA BAY
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Habitat
Agriculture
Brackish Marsh
Dune Hollow
Moving Dune
Dune Swamp
Sparsely Vegetated Dune
Vegetated Dune
Eelgrass
Freshwater Marsh
Deciduous Forest
Evergreen Forest
Mixed Forest
Pine Forest
Riparian Forest
Grassland
Jetties and Reefs
Mudflat
Shrub
Salt Marsh
Swamp
Urban
Urban Grassland
Deep Tidal Channels
Ditches and Closed Channels
Creeks and Rivers
Tidal Creeks and Sloughs
Shallow Tidal Channel
N
W
E
S
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
1 Mile
3 Kilometers



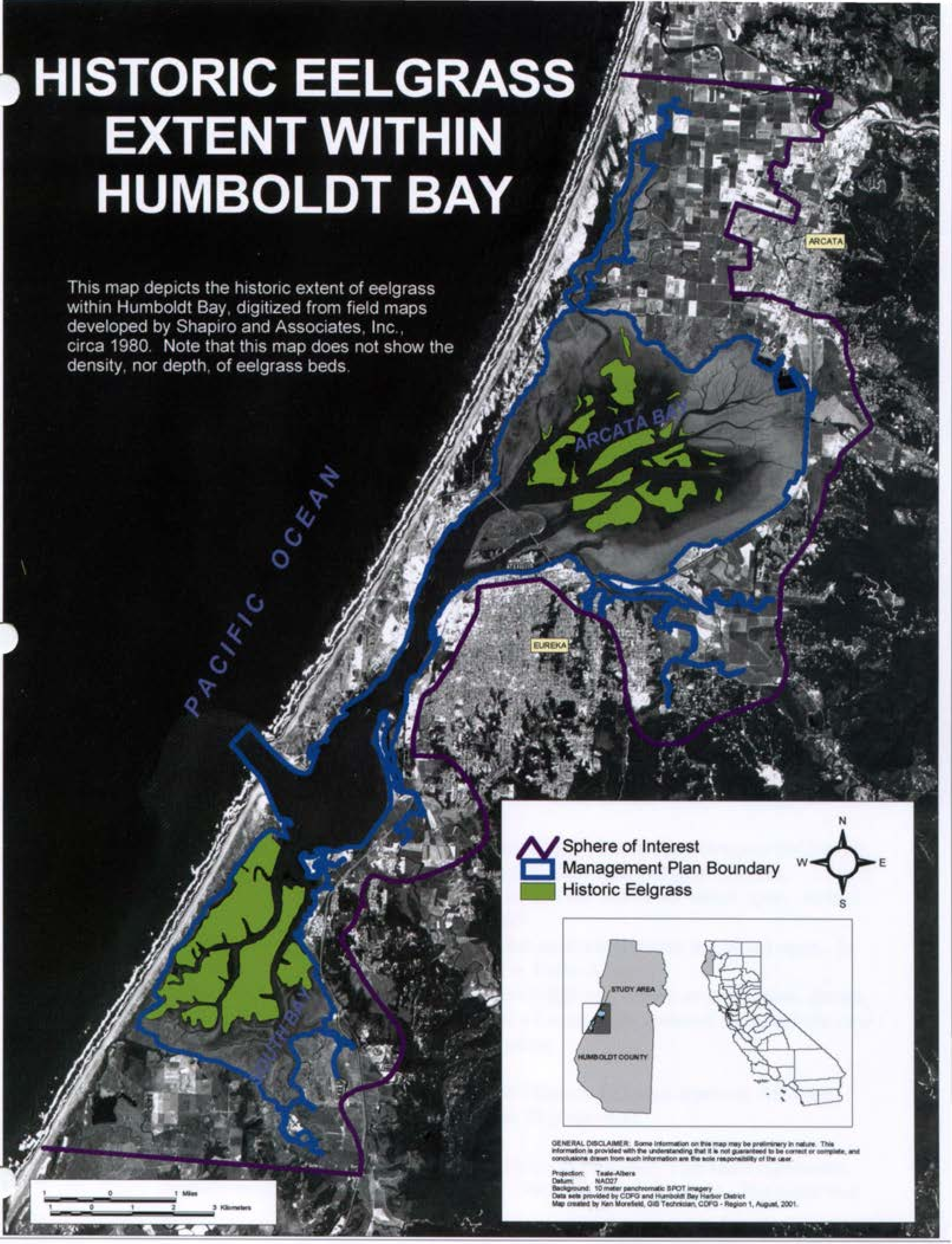
WETLANDS HABITAT
OF
HUMBOLDT BAY
This map depicts wetlands habitat found within Humboldt Bay and the surrounding vicinity, digitized from field maps developed by Shapiro and Associates, Inc., circa 1980.
ARCATA
PACIFIC OCEAN
ARCATA BAY
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Wetlands
Brackish Marsh
Eelgrass
Freshwater Marsh
Mudflat
Salt Marsh
Swamp
Deep Tidal Channels
Ditches and Closed Channels
Creeks and Rivers
Tidal Creeks and Sloughs
Shallow Tidal Channel
N
W
E
S
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
0
1 Miles
1
0
1 Kilometers


NATIONAL WETLANDS INVENTORY OF HUMBOLDT BAY
This map depicts wetlands habitat within Humboldt Bay, using the National Wetlands Inventory classification system. To simplify the map, subclasses were not included in the overall classification system.
PACIFIC OCEAN
ARCATA
ARCATA BAY
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
National Wetlands Inventory
Estuarine Subtidal Aquatic Bed
Estuarine Subtidal Unconsolidated Bottom
Estuarine Intertidal Aquatic Bed
Estuarine Intertidal Emergent
Estuarine Intertidal Unconsolidated Shore
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG, Humboldt Bay Harbor District, and NWI
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
1 0 1 Miles
1 0 1 2 3 Kilometers

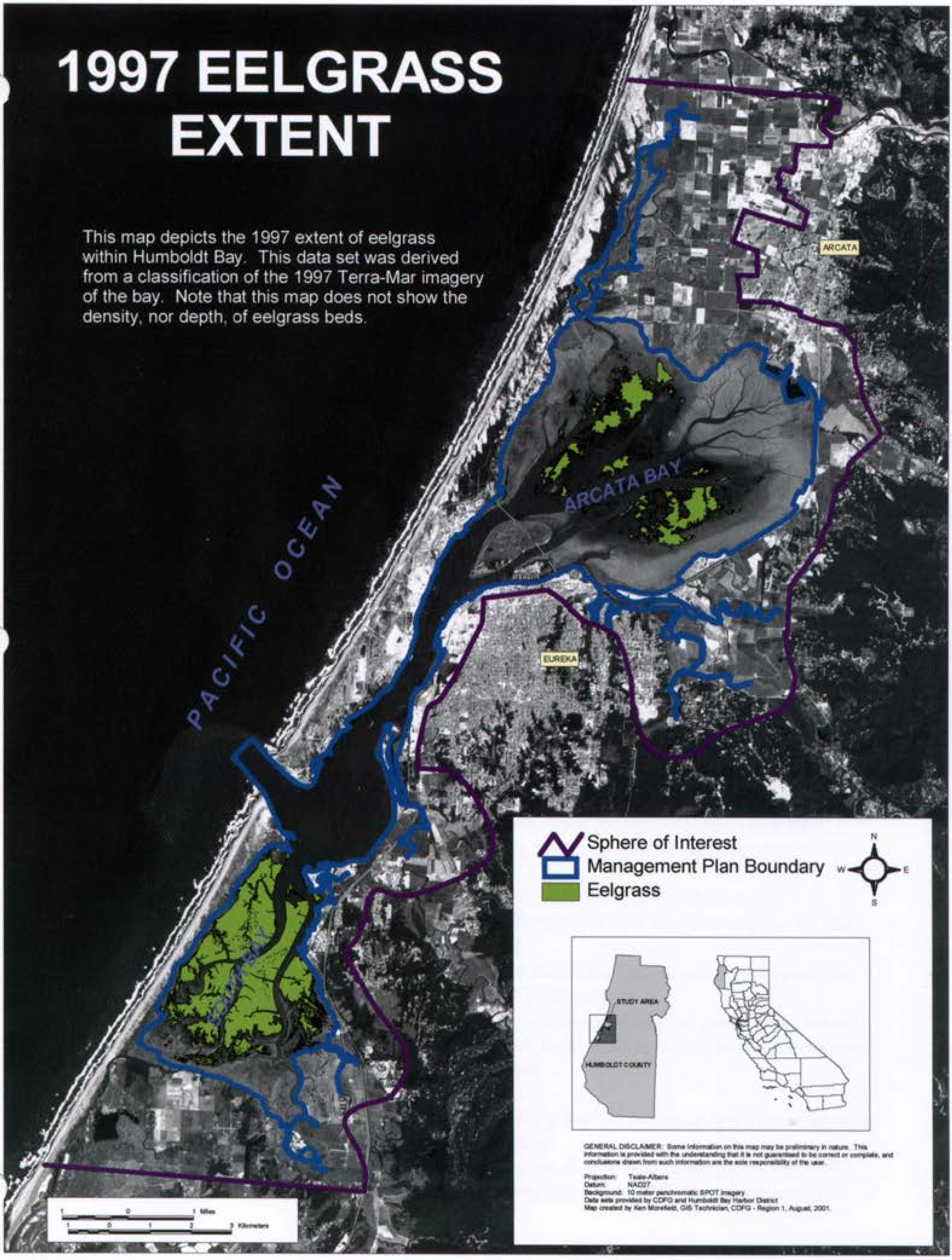

HUMBOLDT BAY
AQUACULTURE
This map depicts aquaculture sites found within Arcata Bay. This data was digitized from 1997 Terra-Mar imagery of Humboldt Bay.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Aquaculture
Ground Culture Sites
Long Line Culture Sites
Shell Deposition Sites
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
1 0 1 Miles
1 0 1 2 3 Kilometers

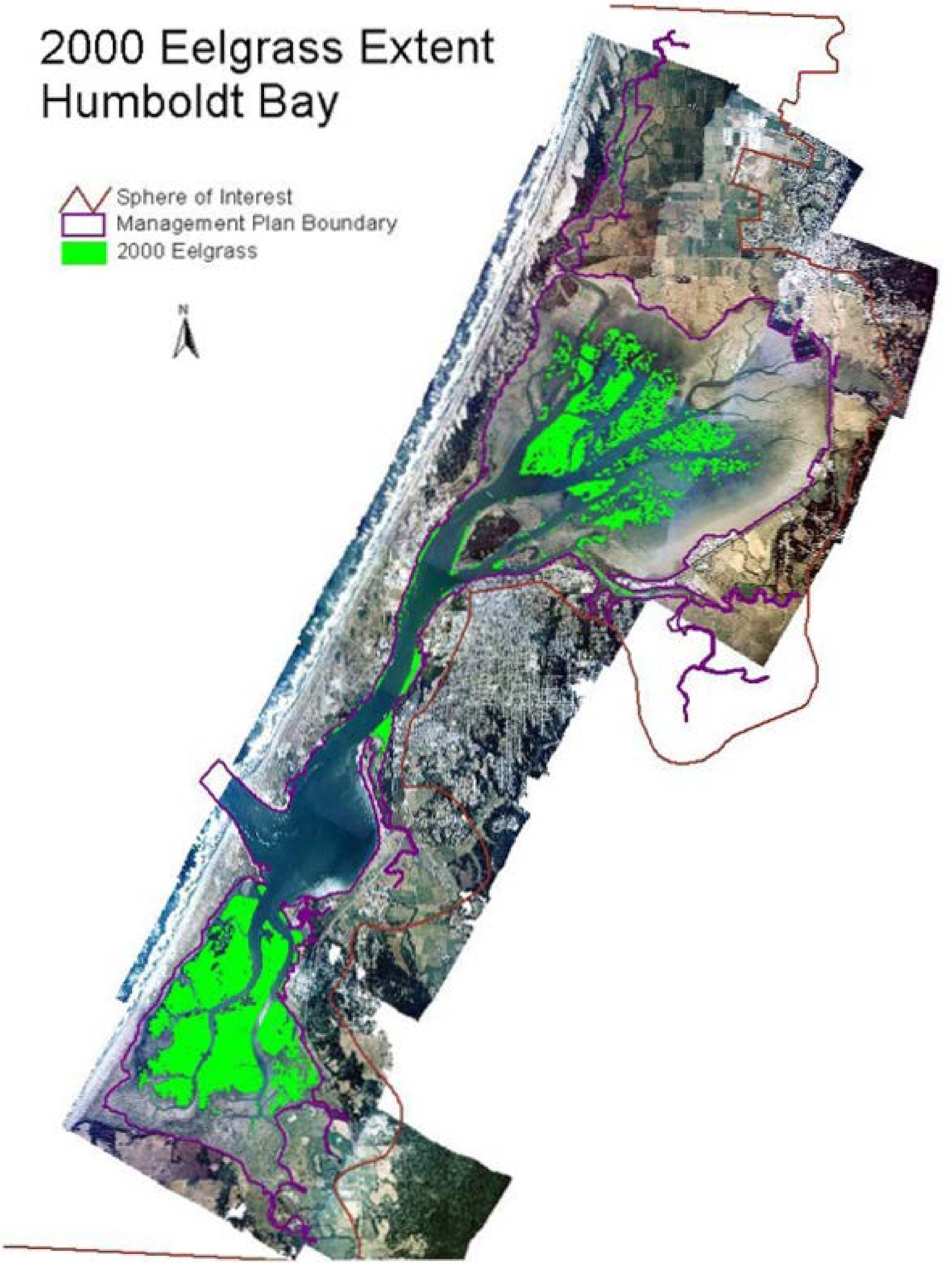


SHELLFISH RESOURCES OF HUMBOLDT BAY
This map depicts the extent of shellfish beds and reserves within Humboldt Bay, digitized from the field maps created by Shapiro and Associates, Inc., circa 1980.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Shellfish Beds
Shellfish Reserves
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
1 0 1 Miles
1 0 1 2 3 Kilometers



HISTORIC EELGRASS EXTENT WITHIN HUMBOLDT BAY
This map depicts the historic extent of eelgrass within Humboldt Bay, digitized from field maps developed by Shapiro and Associates, Inc., circa 1980. Note that this map does not show the density, nor depth, of eelgrass beds.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Historic Eelgrass
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
1 0 1 Miles
1 0 1 2 3 Kilometers


1997 EELGRASS EXTENT
This map depicts the 1997 extent of eelgrass within Humboldt Bay. This data set was derived from a classification of the 1997 Terra-Mar imagery of the bay. Note that this map does not show the density, nor depth, of eelgrass beds.
ARCATA
ARCATA BAY
PACIFIC OCEAN
EUREKA
SOUTH BAY
Sphere of Interest
Management Plan Boundary
Eelgrass
N
W
E
S
STUDY AREA
HUMBOLDT COUNTY
GENERAL DISCLAIMER: Some information on this map may be preliminary in nature. This information is provided with the understanding that it is not guaranteed to be correct or complete, and conclusions drawn from such information are the sole responsibility of the user.
Projection: Teale-Albers
Datum: NAD27
Background: 10 meter panchromatic SPOT imagery
Data sets provided by CDFG and Humboldt Bay Harbor District
Map created by Ken Morefield, GIS Technician, CDFG - Region 1, August, 2001.
Miles
Kilometers


2000 Eelgrass Extent
Humboldt Bay
Sphere of Interest
Management Plan Boundary
2000 Eelgrass
N

Appendix H

Supplementary Electronic Information

Appendix H is a supplement containing the following items in electronic format:

1. California Department of Fish and Game Title 14 Section 550
2. Classification of Wetlands and Deepwater Habitats of the United States
3. Humboldt Bay Interpretive Signing Manual
4. Marine and Estuarine Habitats of the California Wildlife Habitat Relationship System
5. The South Spit Interim Management Plan
6. The Ecology of Humboldt Bay
7. Species Guide of Humboldt Bay Birds
8. Species Guide of Humboldt Bay Fishes
9. Species Guide of Humboldt Bay Coastal Salt Marsh Plants

550. Regulations for General Public Use Activities on All State Wildlife Areas Listed Below.

(a) State Wildlife Areas:

(1) Antelope Valley Wildlife Area (Sierra County) (Type C);

(2) Ash Creek Wildlife Area (Lassen and Modoc counties) (Type B);

(3) Bass Hill Wildlife Area (Lassen County), including the Egan Management Unit (Type C);

(4) Battle Creek Wildlife Area (Shasta and Tehama counties);

(5) Big Lagoon Wildlife Area (Humboldt County) (Type C);

(6) Big Sandy Wildlife Area (Monterey and San Luis Obispo counties) (Type C);

(7) Biscar Wildlife Area (Lassen County) (Type C);

(8) Buttermilk Country Wildlife Area (Inyo County) (Type C);

(9) Butte Valley Wildlife Area (Siskiyou County) (Type B);

(10) Cache Creek Wildlife Area (Colusa and Lake counties), including the Destanella Flat and Harley Gulch management units (Type C);

(11) Camp Cady Wildlife Area (San Bernadino County) (Type C);

(12) Cantara/Ney Springs Wildlife Area (Siskiyou County) (Type C);

(13) Cedar Roughs Wildlife Area (Napa County) (Type C);

(14) Cinder Flats Wildlife Area (Shasta County) (Type C);

(15) Collins Eddy Wildlife Area (Sutter and Yolo counties) (Type C);

(16) Colusa Bypass Wildlife Area (Colusa County) (Type C);

(17) Coon Hollow Wildlife Area (Butte County) (Type C);

(18) Cottonwood Creek Wildlife Area (Merced County), including the Upper Cottonwood and Lower Cottonwood management units (Type C);

(19) Crescent City Marsh Wildlife Area (Del Norte County);

(20) Crocker Meadow Wildlife Area (Plumas County) (Type C);

(21) Daugherty Hill Wildlife Area (Yuba County) (Type C);

(22) Decker Island Wildlife Area (Solano County) (Type C);

(23) Doyle Wildlife Area (Lassen County) (Type C);

(24) Dutch Flat Wildlife Area (Modoc County) (Type C);

(25) East Walker River Wildlife Area (Mono County) (Type C);

(26) Eel River Wildlife Area (Humboldt County) (Type C);

(27) Elk Creek Wetlands Wildlife Area (Del Norte County);

(28) Elk River Wildlife Area (Humboldt County) (Type C);

(29) Eureka Slough Wildlife Area (Humboldt County);

(30) Fay Canyon Wildlife Area (Alpine County) (Type C);

(31) Fay Slough Wildlife Area (Humboldt County) (Type C);

(32) Feather River Wildlife Area (Sutter and Yuba counties), including the Abbott Lake, Lake of the Woods, Marysville, Morse Road, Nelson Slough, O'Connor Lakes, Shanghai Bend, and Star Bend management units (Type C);

(33) Fremont Weir Wildlife Area (Yolo County) (Type C);

(34) Grass Lake Wildlife Area (Siskiyou County) (Type C);

(35) Gray Lodge Wildlife Area (Butte and Sutter counties) (Type A);

(36) Green Creek Wildlife Area (Mono County) (Type C);

(37) Grizzly Island Wildlife Area (Solano County), including the Cordelia Slough, Crescent (Type A), Gold Hills (Type B), Goodyear Slough (Type B), Grey Goose (Type C), Grizzly Island (Type A), Island Slough (Type B), Joice Island (Type A), and Montezuma Slough management units;

(38) Hallelujah Junction Wildlife Area (Lassen and Sierra counties) (Type C);

(39) Heenan Lake Wildlife Area (Alpine County) (Type C);

(40) Hill Slough Wildlife Area (Solano County);

(41) Honey Lake Wildlife Area (Lassen County) (Type B);

(42) Hope Valley Wildlife Area (Alpine County) (Type C);

(43) Horseshoe Ranch Wildlife Area (Siskiyou County) (Type C);

(44) Imperial Wildlife Area (Imperial County), including the Wister Management Unit (Type A) and Finney Ramer Management Units (Type C);

(45) Indian Tom Wildlife Area (Siskiyou County) (Type C);

(46) Indian Valley Wildlife Area (Lake County) (Type C);

(47) Kelso Peak and Old Dad Mountains Wildlife Area (San Bernardino County) (Type C);

(48) Kinsman Flat Wildlife Area (Madera County) (Type C);

(49) Knoxville Wildlife Area (Napa and Yolo counties) (Type C);

(50) Laguna Wildlife Area (Sonoma County) (Type C);

(51) Lake Berryessa Wildlife Area (Napa County) (Type C);

(52) Lake Earl Wildlife Area (Del Norte County) (Type C);

(53) Lake Sonoma Wildlife Area (Sonoma County) (Type C);

(54) Little Panoche Reservoir Wildlife Area (Fresno County) (Type C);

(55) Los Banos Wildlife Area (Merced County) (Type A);

(56) Lower Sherman Island Wildlife Area (Sacramento County) (Type C);

(57) Mad River Slough Wildlife Area (Humboldt County) (Type C);

(58) Marble Mountains Wildlife Area (San Bernardino County) (Type C);

(59) Mendota Wildlife Area (Fresno County) (Type A);

(60) Merrill's Landing Wildlife Area (Tehama County) (Type C);

(61) Miner Slough Wildlife Area (Solano County) (Type C);

(62) Monache Meadows Wildlife Area (Tulare County) (Type C);

(63) Morro Bay Wildlife Area (San Luis Obispo County) (Type C);

(64) Moss Landing Wildlife Area (Monterey County) (Type C);

(65) Mouth of Cottonwood Creek Wildlife Area (Shasta and Tehama counties) (Type C);

(66) Mud Lake Wildlife Area (Siskiyou County) (Type C);

(67) Napa-Sonoma Marshes Wildlife Area (Solano, Napa, and Sonoma counties), including the American Canyon, Coon Island, Dutchman Slough, Huichica Creek, Napa River, Ringstrom Bay, Sonoma Creek, Tolay Creek, White Slough, and Wingo management units (All Type C, except White Slough);

(68) North Grasslands Wildlife Area (Merced and Stanislaus counties), including the China Island, Gadwall, and Salt Slough management units (Type A);

(69) O'Neill Forebay Wildlife Area (Merced County) (Type C);

(70) Oroville Wildlife Area (Butte County), including the Thermalito Afterbay Management Unit (Type C);

(71) Petaluma Marsh Wildlife Area (Marin and Sonoma counties), including the Black John Slough, Burdell, Day Island, Green Point, Novato Creek, Petaluma River, Point Sonoma, and Rush Creek management units (Type C);

(72) Pickel Meadow Wildlife Area (Mono County (Type C));

(73) Pine Creek Wildlife Area (Modoc County) (Type C);

(74) Point Edith Wildlife Area (Contra Costa County) (Type C);

(75) Putah Creek Wildlife Area (Solano County) (Type C);

(76) Rector Reservoir Wildlife Area (Napa County) (Type C);

(77) Red Lake Wildlife Area (Alpine County) (Type C);

(78) Sacramento Bypass Wildlife Area (Yolo County) (Type C);

(79) Sacramento River Wildlife Area (Butte, Colusa, and Glenn counties) (Type C);

(80) San Felipe Valley Wildlife Area (San Diego County) (Type C);

(81) San Jacinto Wildlife Area (Riverside County) (Type A);

(82) San Luis Obispo Wildlife Area (San Luis Obispo County);

(83) San Luis Reservoir Wildlife Area (Merced County) (Type C);

(84) San Pablo Bay Wildlife Area (Marin and Sonoma counties) (Type C);

(85) Santa Rosa Wildlife Area (Riverside County) (Type C);

(86) Shasta Valley Wildlife Area (Siskiyou County) (Type B);

(87) Sheepy Ridge Wildlife Area (Siskiyou County) (Type C);

(88) Silver Creek Wildlife Area (Lassen County) (Type C);

(89) Slinkard-Little Antelope Wildlife Area (Mono County) (Type C);

(90) Smithneck Creek Wildlife Area (Sierra County) (Type C);

(91) South Fork Wildlife Area (Kern County) (Type C);

(92) Spannus Gulch Wildlife Area (Siskiyou County) (Type C);

(93) Spenceville Wildlife Area (Yuba and Nevada counties) (Type C);

(94) Surprise Valley Wildlife Area (Modoc County) (Type C);

(95) Sutter Bypass Wildlife Area (Sutter County) (Type C);

(96) Tehama Wildlife Area (Tehama County) (Type C);

(97) Truckee River Wildlife Area (Placer and Nevada counties), including the Boca, Polaris, Union Ice, and West River management units (Type C);

(98) Upper Butte Basin Wildlife Area (Butte and Glenn counties), including the Howard Slough, Little Dry Creek, and Llano Seco management units (Type A);

(99) Volta Wildlife Area (Merced County) (Type A);

(100) Walker River Wildlife Area (Mono County) (Type C);

(101) Waukell Creek Wildlife Area (Del Norte County) (Type C);

(102) Warner Valley Wildlife Area (Plumas County) (Type C);

(103) West Hilmar Wildlife Area (Merced and Stanislaus counties) (Type C);

(104) White Slough Wildlife Area (San Joaquin County) (Type C);

(105) Willow Creek Wildlife Area (Lassen County) (Type B);

(106) Yolo Bypass Wildlife Area (Yolo County).

(b) Area Regulations:

(1) Regional Manager's Authority: The regional manager shall have the authority to regulate public use of State wildlife areas where such use is not provided for in these regulations or in sections 551 and 552 of this title.

(2) Entry Restrictions. The department may limit the number of persons entering any area listed in section 550 or 551 of this title during any period for safety reasons, to reduce crowding, to provide for the limited take of a species, or may close portions of areas or close areas entirely to public entry or to specific activities. No person shall enter an area that has been closed to the public, except by written permission of the regional manager. On wildlife areas where entry and exit sites are designated by the department, no person shall enter or leave except at designated sites.

(3) Procedures for Issuing Entry Permits. In the event that the department elects to limit the number of hunters, trappers, or other users, entry permits will be issued on a first-come, first-served basis, or by a drawing to be held at a designated department office. The department shall inform the commission in writing and the public via the news media of any implementation of the provisions of this subsection, when limits imposed under this subsection differ substantially for a specific area from the prior year. Such notification shall include: the State wildlife area affected, the time period, the reason for the limitation or closure, the number of entry permits to be issued, and the method of issuance.

(4) Permit Requirements. No person shall enter any State wildlife area or portion thereof where the department has limited public entry without a valid entry permit in their immediate possession. [See subsections 551(f), (g), and (h) for regulations regarding general requirements and costs for individual entry permits. See subsection 551(q) for entry permit requirements for specific areas.]

(5) Use Permits for Organized Events. Any person organizing an event or gathering to be conducted on a State wildlife area shall obtain a use permit from the appropriate regional manager. Such events or gatherings shall be compatible with wildlife area objectives.

(6) Motor Driven Vehicles.

(A) No person shall drive, operate, leave, place, or stop any motor driven vehicle or trailer on any State wildlife area except on public or established roads or on designated jeep trails and such other areas as designated by the Department. No person shall park or leave any motor driven vehicle or trailer in any area where signs prohibiting parking are posted. The Department may designate the parking lot where a person must park a vehicle while on the wildlife area.

(B) No person shall drive a vehicle carelessly in willful disregard of the rights or safety of others, or without due caution or at a speed or in a manner likely to endanger any person, property, or wildlife.

(7) Signs, Traffic and Road Closures.

(A) Drivers of motor driven vehicles operated within the wildlife areas shall comply with the directions of traffic signs posted in the area by the department.

(B) No person shall damage, remove, or destroy any barrier, sign, signpost, or signboard on any wildlife area.

(8) Boats.

(A) The department may restrict the use and operation of boats on State wildlife areas, department administered national wildlife refuges, and State recreation areas to protect natural resources or provide for the orderly operation of hunting and fishing programs on these areas. Boating restrictions may include, but not be limited to, limiting boat speeds, limiting motor size and type, or prohibiting the use of motors. During the times waterfowl are present, the provisions of Section 251 of this Title will also apply.

(B) Except as prohibited in subsection 551(q), boats may be used under the following regulations on State wildlife areas, department administered national wildlife refuges, and State recreation areas.

1. When launch sites are designated by the department, all boats must be launched and removed from those sites.

2. All persons shall remove their boats from the waters when instructed to do so by an employee of the department.

3. The use of boats may be restricted to certain zones designated by the department.

4. Boat speed shall not exceed five miles per hour.

(9) Vandalism and Litter.

(A) No person shall tamper with, damage, or remove any property not his own when such property is located within a State wildlife area.

(B) No person shall leave, deposit, drop, bury, or scatter bottles, broken glass, feathers, hides, wastepaper, cans, sewage, or other rubbish in any State wildlife area except in a receptacle or area designated for that purpose, and no person shall import and deposit any rubbish or toxic substance into State wildlife areas from other places. Where no designated receptacles are provided, any refuse resulting from a person's use of the area must be removed from the area by such person.

(10) Trees and Minerals.

(A) No person shall dig up, cut, damage, or remove from a wildlife area any trees, shrubs, vines, plants or wood, except that vegetation may be cut and used for the purpose of building blinds, unless otherwise directed by the area manager.

(B) No person shall dig up or remove any humus, soil, sand, gravel, or rock.

(11) Bottles and Artifact Collecting. No person shall collect or remove bottles or artifacts, or dig or otherwise disturb the soil to locate or remove bottles or artifacts, from any Wildlife Area.

(12) Camping and Unattended Personal Property. No person shall camp in any part of a State wildlife area except in areas designated by the department. (See subsection 551(q) for additional camping restrictions on specific areas). Camping on wildlife areas shall be limited to not more than seven consecutive days, and not more than 14 days total in any calendar year, except by written permission of the Regional Manager. Personal property may not be left on State wildlife areas for camping or other purposes, except at authorized locations. Decoys may not be left in the field overnight, except as provided in subsection 551(q). Any hunting blinds on wildlife areas shall be available on a first-come, first-served basis.

(13) Fires. From April 30 through October 30 on Type C areas, and during the entire year on Type A and B areas, no person shall build or maintain fires except in portable gas stoves, in charcoal briquette barbeques, or in fireplaces at sites developed by the department. No fire shall be left unattended and all fires shall be extinguished with water before leaving. (See subsection 551(q) for additional fire restrictions.)

(14) Use of Dogs and Field Trials. The department may prohibit or restrict the use of dogs on any State wildlife area (see subsection 551(q)). Except as further prohibited in subsection 551(q), dogs are allowed only for hunting or when under immediate control. Dogs must be leashed at designated campsites and check station areas. Special permits are required for field trials. Dog training is allowed only in areas maintained by the department.

(15) Pesticides Use. No person, other than authorized federal, state, or local employees conducting a pest control program approved by the department, shall apply any pesticide in any State wildlife area.

(16) Livestock. No person shall permit livestock, including but not limited to cattle, horses, sheep, goats, and hogs, to browse, graze, bed, cross, or otherwise trespass on any State wildlife area except under an authorized grazing permit issued by the department. The recreational use of horses is allowed, except as designated in subsection 551(q). Persons who fail to remove their livestock from any State wildlife area within 48 hours after receiving official notice of trespass by the regional manager through certified mail, shall be in violation of this section.

(17) Fish and Frogs. Fish and frogs may not be taken for commercial purposes (see subsection 551(q) for specific area regulations).

(18) Hunting and Trapping. Hunting and trapping shall be allowed on State wildlife areas during the regular open seasons subject to subsection 550(b)(19), 551(b), and 551(q), and such other area use regulations as specified by the regional manager.

(19) Special Restrictions. (Areas where hunting and possession of firearms and archery equipment is prohibited).

No person, except authorized personnel, shall possess or discharge a firearm, bow and arrow, air or gas gun, spear gun, or other propulsive device of any kind in the following areas: Battle Creek, Crescent City Marsh, Elk Creek Wetlands, Eureka Slough, and Hill Slough wildlife areas; Cordelia Slough and Montezuma Slough management units of Grizzly Island Wildlife Area; White Slough Unit of Napa-Sonoma Marshes Wildlife Area; and Day Island, Green Point, Novato Creek, Point Sonoma, and Rush Creek units of the Petaluma Marsh Wildlife Area.

(20) Ejection. The department may eject any person from a State wildlife area for violation of any of these rules or regulations or for disorderly conduct, intoxication, or when a department employee determines that the general safety or welfare of the area or persons thereon is endangered. The decision, in such respect, of any department employee assigned management or enforcement responsibilities for the area shall be final.

(21) User Responsibility for Knowing Regulations. All wildlife area users shall be responsible for area-specific regulations listed under subsection 551(q). Failure to comply with any of the area-specific regulations shall be a violation of this subsection.

NOTE

Authority cited: Sections 200, 202, 203, 355, 713, 1526, 1528, 1530, and 10504, Fish and Game Code. Reference: Sections 355, 711, 1055.3, 1526, 1528, 1530, 1585, 1764, 1765, and 10504, Fish and Game Code.

HISTORY

1. Repealer and new section filed 10-8-93; operative 10-8-93 pursuant to section 202 and 215, Fish and Game Code (Register 93, No. 41). For prior history, see Register 93, No. 28.

2. New subsections (a)(8), (24), (60), (70), (83), (94) and (98) and subsection renumbering filed 9-20-94; operative 10-24-94 (Register 94, No. 38).

3. Editorial correction of subsections (b)(10), (13), (14) and (16) (Register 94, No. 38).

4. Amendment filed 10-5-94; operative 11-4-94 (Register 94, No. 40).

5. New subsection (a)(99), amendment of subsections (b)(8)-(10) and (b)(15), new subsection (b)(18), and amendment of Note filed 9-12-95; operative 9-12-95 pursuant to Government Code section 11343.4(d) (Register 95, No. 37).

6. Amendment of section and Note filed 10-1-96; operative 10-1-96 pursuant to Government Code section 11343.4(d) (Register 96, No. 40).

7. New subsections (a)(63) and (a)(73), subsection renumbering and amendment of subsection (b)(12) filed 10-3-97; operative 10-3-97 pursuant to Fish and Game Code sections 202 and 215 (Register 97, No. 40).

8. New subsections (a)(52) and (a)(77), subsection renumbering and amendment of subsection (b)(2) filed 10-16-98; operative 10-16-98 pursuant to Fish and Game Code sections 202 and 215 (Register 98, No. 42).

9. New subsection (a)(81), subsection renumbering, repealer of former subsection (a)(106) and amendment of subsections (b)(2), (b)(6)(A), (b)(7), (b)(7)(B) and (b)(19) filed 10-6-99; operative 10-6-99 pursuant to Fish and Game Code sections 202 and 215 (Register 99, No. 41).

10. Repealer of subsection (a)(9), subsection renumbering and amendment of newly designated subsection (a)(96) and subsection (b)(13) filed 9-28-2000; operative 9-28-2000 pursuant to Fish and Game Code section 215 (Register 2000, No. 39).

11. Amendment of subsections (a)(29), (a)(32), (a)(49), (a)(67), (a)(103), (b)(17) and (b)(19) filed 10-23-2001; operative 10-23-2001 pursuant to Fish and Game Code sections 202 and 215 (Register 2001, No. 43).

§551. Hunting, Firearms, and Archery Equipment Use and Permit Requirements on State and Federal Areas.

§551. Hunting, Firearms, and Archery Equipment Use and Permit Requirements on State and Federal Areas.

(a) The following regulations apply to areas listed below:

(1) State wildlife areas listed in Section 550. (See subsection 550(b)(19) for areas where possession and use of firearms and archery equipment are completely prohibited.)

(2) Areas operated in cooperation with the U.S. Fish and Wildlife Service (for additional regulations for Federal areas, see Section 552):

(A) Colusa National Wildlife Refuge, Type A (Colusa County);

(B) Delevan National Wildlife Refuge, Type A (Colusa County);

(C) Kern National Wildlife Refuge, Type A (Kern County);

(D) Merced National Wildlife Refuge, Type A (Merced County);

(E) Sacramento National Wildlife Refuge, Type A (Glenn and Colusa counties);

(F) San Luis National Wildlife Refuge, Type A (Merced County), including the San Luis, Kesterson, and Blue Goose Units;

(G) Sonny Bono Salton Sea National Wildlife Refuge, Type A (Imperial County) (operated with the Imparial Wildlife Area);

(H) Sutter National Wildlife Refuge, Type A (Sutter County).

(3) Areas operated in cooperation with other Federal agencies:

(A) Baldwin Lake, Type C (San Bernardino County);

(B) Volta Wildlife Area, Type A (Merced County);

(C) Lake Sonoma Wildlife Area, Type C (Sonoma County).

(4) Areas operated in cooperation with other State agencies:

(A) Lake Earl Project Area, Type C (Del Norte County) (Unclassified land administered by the Department of Parks and Recreation);

(B) O'Neill Forebay Wildlife Area, Type C (Merced County);

(C) San Luis Reservoir Wildlife Area, Type C (Merced and Santa Clara counties);

(D) Little Panoche Reservoir Wildlife Area, Type C (Fresno County);

(E) Perris Reservoir State Recreation Area, area day use fee (Riverside County).

(F) Clifton Court Forebay, Type C (Contra Costa County).

(b) Method of Take.

(1) Firearms and Archery Equipment, General: Except as otherwise provided, no person shall possess in the field or discharge a firearm, bow and arrow, air or gas gun, or other propulsive device of any kind on any wildlife area (see section 551(b)(9)).

(2) Except as otherwise provided, no shotguns larger than twelve gauge and no rifles, pellet guns, combination rifle-shotguns, pistols, archery equipment, or revolvers shall be possessed in the field or discharged on any Type A or Type B areas. All legal firearms and archery equipment may be used on Type C areas unless prohibited (see subsection 551(q)).

(3) Shotgun shells shall not contain shot size larger than size BB in lead and size T in steel. On those areas where big game species may be hunted, shotguns with slugs may be used.

(4) At Grizzly Island Wildlife Area and on all national wildlife refuges listed in Section 552, only steel or other nontoxic shot approved by the U.S. Fish and Wildlife Service may be used or possessed in the field.

(5) Archery equipment shall not be used during the waterfowl and pheasant seasons on Type A and B areas, unless provided for in subsection 551(q).

(6) Loaded firearms, as defined in Section 2006 of the Fish and Game Code, are prohibited in the parking lots on all wildlife areas and on national wildlife refuges listed in Section 552.

(7) On Type C areas, raptors may be used to take legal game in accordance with general hunting regulations.

(8) On Type A and B state wildlife areas, raptors may be used to take legal game only from the first Saturday following the end of the general waterfowl season through the end of the falconry pheasant season. Raptors may be used only on Saturdays, Sundays, and Wednesdays.

(9) Except as otherwise provided, an adult-supervised youth may possess and discharge a BB gun on any wildlife area. A BB gun is not an authorized method of take and may not be used to take wildlife on any wildlife area. A BB gun is defined as an air and/or spring-actuated rifle similar to Daisy BB gun models 95 (Timberwolf), 105 (Buck), or 1938 (Red Ryder), firing a spherical BB no longer than 0.177 inches in diameter (4.5mm) at a muzzle velocity no greater than 350 feet per second. For the purpose of this section a youth is defined as a person under the age of 16.

(c) Nonhunting Uses of Firearms and Archery Equipment:

(1) Except at designated shooting sites or with a special permit, possession in the field and use of firearms and archery equipment is permitted only for the purpose of hunting on all wildlife areas and on national wildlife refuges listed in Section 552.

(2) No glass or porcelain targets shall be used on any wildlife area. Clay targets shall be used only at designated sites where their use is permitted.

(d) Hunting Days:

(1) Except as provided for in subsection 551(q), waterfowl may be taken on Type A and Type B areas only on Saturdays, Sundays, and Wednesdays.

(2) All Type A and Type B areas shall be closed to hunting on Christmas Day, except for the following Type B areas: Island Slough and Gold Hills units of Grizzly Island Wildlife Area. These areas will be open to hunting on Christmas Day when Christmas occurs on a Wednesday, Saturday, or Sunday.

(3) On Type C areas, shooting days shall be daily except as noted in subsections 551(b) and 551(q).

(e) Shooting Hours: Waterfowl: Except as provided for in subsection 551(q), shooting hours on all Type A and Type B areas shall be the legal waterfowl shooting hours as designated by the U.S. Fish and Wildlife Service. Other Species: Except as noted in subsection 551(q), other species may be taken only during the hours designated for the taking of each species under the regulatory powers of the Fish and Game Commission or U.S. Fish and Wildlife Service.

(f) Requirements for Entry Permits and Trespass: No person shall enter upon any area listed in sections 550 or 551 of this Title where the department requires a valid daily entry permit without the required entry permit in their immediate possession, or unless otherwise authorized by the department. Entry must be made at locations designated by the department. Daily entry permits are required to hunt during the waterfowl and pheasant seasons on Type A and B areas. During this period daily entry permits must be returned to the checking stations where issued within one and one half hours after sunset unless otherwise designated in 551(g). Daily entry permits also may be required at other times on Type A and B areas or on Type C areas (see subsection 551(q)).

(g) Season Pass, Two-day Pass, and Entry Permit Fees:

(1) To obtain a daily entry permit to hunt during the waterfowl and pheasant seasons on Type A areas, possession of a season pass, a two-day pass, or payment of a daily fee is required, except as provided in subsection 551(q).

(2) The base fee for a Type A season pass is $75 and the base fee for a Type B season pass is $25. These fees shall be adjusted annually, as required under Fish and Game Code Section 713. Holders of junior hunting licenses are exempt from these fees.

(3) On Type B areas during the waterfowl and pheasant seasons, a Type B season pass or a Type A season pass is required to obtain a daily entry permit for all hunting, unless otherwise provided in subsections 551(q) or 551(1)(3).

(4) The fee for a one-day entry permit is $12 and the fee for a two-day pass is $20. Holders of junior hunting licenses are exempt from these fees.

(5) At State recreation areas included in subsection 551(a)(4), the entry permit fee for hunting shall be the recreation area day-use fee.

(6) On Type C areas (all wildlife areas not listed as Type A, Type B, or State recreation areas in Section 551), no fees for hunting are required.

(7) On some areas (see subsection 551(q)), day use passes are required for all public access. Fees may be charged (see Fish and Game Code Section 1765).

(h) Issuance of One-day Entry Permits:

(1) Hunters with season passes shall not receive priority in the issuance of daily entry permits over hunters who do not have season passes.

(2) Holders of junior hunting licenses will be issued entry permits only when accompanied by an adult. An adult is defined as a person at least 18 years old. An adult may be accompanied by up to two junior hunters. On Type A and B areas, adults must accompany junior hunters in the field. On Type A and B areas when a non-shooter accompanies a junior hunter, the non-shooter will be considered a hunter possessing valid resident or nonresident hunting license in establishing his or her place in line. Persons 16 or 17 years of age in possession of a valid resident or nonresident hunting license will be issued entry permits but may not be accompanied by junior hunters.

(3) Entry permits must be returned, as required by the department, when departing the area. Hunters are required to report the number and species of all game taken, as required by the Department, before departing the area.

(4) No person shall apply for, obtain, use, or have in his or her possession while hunting, any one-day entry permit which has not been issued to that person by the department or which is a duplicate, forgery, or alteration of an official department form; or which has been obtained by use of a non-validated or fraudulent application or advance reservation form. Any person who violates this section shall be barred from all State-operated areas for the entire waterfowl season following the date of discovery of the violation by the department.

(5) Any person who violates regulations governing drawing procedures for hunting opportunities on State-operated areas, other than reservation drawings described in subsection 551(j), shall not be issued a permit for that day, or shall be ejected for that day if a permit has been issued, and shall be denied entry for the remainder of the season.

(i) Daily Entry Permit Revocations, Refusals, and Ejections: On Type A and Type B areas the department is authorized to refuse to issue a one-day entry permit to anyone and to revoke this permit and eject the holder forthwith from the area for disorderly conduct, intoxication, or for any other reason when it appears that the general safety or welfare of the area, or persons thereon, is endangered. Decision of the Department employee in charge of the area in such respect shall be final. Any person whose entry permit has been revoked shall not be entitled to hunt on any wildlife area during the current hunting year. Persons affected by this section may appeal such actions to the Commission.

(j) Reservations:

(1) Advance reservations for waterfowl and pheasant hunting will be available for certain areas as specified under subsections 551(q) and 552(a).

(2) Reservations shall be issued by drawing to licensed hunters as follows: Official applications shall be made available to the public through license agents and department offices. Applicants shall purchase either a $1.05 application card or a $5.25 application card and submit it to the Department's License and Revenue Branch at the address indicated on the application. Applicants may also apply for every available Saturday, Sunday, and/or Wednesday hunt date for one or more areas by completing a season-long application card and returning it with the appropriate payment to the License and Revenue Branch. Applications must be received in the License and Revenue Branch office at least 17 days prior to the authorized shoot date on which the applicant wishes to hunt. Late, incomplete, or incorrect applications will not be included in the drawing.

(3) Multiple Applications:

(A) The applicant is limited to one application for each area for each authorized shoot date as specified under subsections 551(q) and 552(a), unless otherwise specified in subsection 551(q).

(B) The department may eliminate from any drawing all applications not in compliance with these regulations. Persons who submit more than one application for the same shoot date for the same area may be barred from hunting on State-operated areas for a period of one year following the date of discovery of the violation by the department. Any reservation issued to any person as a result of such improper submission, or to any person already barred from the State-operated areas, shall be void and of no force and effect.

(4) Priorities: Unless otherwise stated on the reservation or on information mailed with the reservation, upon paying the appropriate fee for a one-day entry permit or presenting a two-day pass or season pass, successful applicants shall be granted a one-day entry permit during the waterfowl or pheasant season, a one-day permit shall be granted, however, only if the applicant's reservation was issued by the department in the applicant's name and is for the area requested. Applicants must enter, at the appropriate checking station on the assigned or stated hunt date. Unless otherwise provided for, the reservation will expire one and one-half hours before waterfowl shoot time. For some areas, reservations will be numbered by the department in the order in which they are drawn. These reservations will be accepted at checking stations in that order, only if the reservation holder is present at the time the number is called.

(5) Except as provided for in subsections 551(j)(6) or 551(q), or **Section** 552, a reservation shall assure entry for up to six persons. No more than two may be adult (see subsection 551(h)(2)) hunters who have valid resident or nonresident licenses and no more than two may be persons 16 or 17 years of age in possession of a valid resident or nonresident hunting license (see subsection 551(h)(2)). Each adult may be accompanied by up to two hunters holding junior licenses or two non-shooters irrespective of age, or one of each. Non-shooters are defined as persons who wish to accompany a permittee in the field or remain at a designated parking space. Non-shooters shall not discharge or possess a firearm on the area.

(6) If hunting a special blind area, a reservation will assure entry of no more persons (adult hunters, junior hunters, and/or nonshooters) than will fill the blind.

(7) Unless otherwise provided for in this **section**, the advance reservation system only serves to assure entry onto the area and does not necessarily constitute a method for prioritization over other users.

(k) Deferred Openings: When the department considers such deferment desirable to protect agricultural crops from waterfowl, it is hereby authorized and directed to defer opening to public access any area until in the opinion of the Department the danger of crop damage in the immediate region is abated.

(**l**) Species Allowed:

(1) On Type A and Type B areas, only ducks, geese, coots, moorhens, and snipe which are then in season may be legally taken by permittees on designated shooting days during the open waterfowl hunting season; unless otherwise provided under this **section** or **Section** 552 of these regulations.

(2) Pheasant Hunting: Pheasant hunting shall be permitted as provided for in subsection 551(q) and **Section** 552. The regional manager may authorize junior pheasant hunts during or outside the general pheasant season.

(3) Hunting on Type C areas General: Except as provided for in subsection 551(q), hunting is permitted for each authorized species allowed to be hunted on each area, during the open season of that species.

(4) Turkey Hunting: Turkey hunting shall be permitted as provided for in subsection 551(q) and **Section** 552. The regional manager may authorize junior turkey hunts on state wildlife areas during the regular season.

(m) Assigned Hunting Zones: In order to assure proper hunter dispersal and to promote safety, the Department may subdivide the open hunting portion of any Type A or Type B area into zones and assign hunters to these zones or designate where hunters shall park.

(n) Posting Closed Areas: Any portion of any State wildlife area and any adjoining lands under control of the Department, may be closed to hunting or public access by the Department by posting such lands with signs at least five (5) to the mile.

(o) Penalties: Failure to comply with regulations contained in sections **550**, 551, or 552 may result in any or all of the following:

(1) denial of permission to enter a State-operated area; and/or

(2) revocation of any permit already issued; and/or

(3) ejection from the area; and/or

(4) citation under the provisions of the Fish and Game Code or Title 14 of the California Code of Regulations. A proceeding under (1), (2), (3) or (4) will not preclude the invocation of any other remedy.

(p) Enforcement of Regulations: These regulations shall be incorporated by reference into and become a part of all permits.

(q) ADDITIONAL REGULATIONS FOR SPECIFIC AREAS

In addition to the regulations in Section 550 and subsections 551(a) through 551(p), the following areas have special regulations which are listed below (see Section 552 for additional regulations on national wildlife refuges on which the Department of Fish and Game manages hunting programs):

Antelope Valley Wildlife Area, Type C (Sierra County);

Ash Creek Wildlife Area, Type B (Modoc and Lassen counties);

Baldwin Lake, Type C (San Bernardino County);

Bass Hill Wildlife Area, Type C (Lassen County);

Battle Creek Wildlife Area, (Shasta and Tehama counties);

Big Lagoon Wildlife Area, Type C (Humbolt County);

Big Sandy Wildlife Area, Type C (Monterey and San Luis Obispo counties);

Butte Valley Wildlife Area, Type B (Siskiyou County);

Cache Creek Wildlife Area, including the Destanella Flat and Harley Gulch Management Units, Type C (Colusa and Lake counties);

Clifton Court Forebay, Type C (Contra Costa County);

Collins Eddy Wildlife Area, Type C (Sutter and Yolo counties);

Colusa Bypass Wildlife Area., Type C (Colusa County);

Cottonwood Creek Wildlife Area, Type C (Merced and Santa Clara counties);

Daugherty Hill Wildlife Area, Type C (Yuba County);

Decker Island Wildlife Area, Type C (Solano County);

Eel River Wildlife Area, Type C (Humboldt County);

Elk River Wildlife Area, Type C (Humboldt County);

Fay Slough Wildlife Area, Type C (Humboldt County);

Feather River Wildlife Area, including the Abbot Lake, Lake of the Woods, Marysville, Morse Road, Nelson Slough, O'Connor Lakes, Shanghai Bend, and Star Bend management units. Type C (Yuba and Sutter counties);

Fremont Weir Wildlife Area, Type C (Sutter and Yolo counties);

Gray Lodge Wildlife Area, including the west side and east side units, Type A (Butte County);

Grizzly Island Wildlife Area, including the Type A Crescent, Joice Island, and Grizzly Island management units, the Type B Gold Hills, Goodyear Slough, and Island Slough management units, the Type C Grey Goose Management Unit, and the Cordelia Slough and Montezuma Slough management units (Solano County);

Hallelujah Junction Wildlife Area, Type C (Lassen and Sierra counties);

Heenan Lake Wildlife Area, Type C (Alpine County);

Honey Lake Wildlife Area, including the Dakin and Fleming units, Type B (Lassen County);

Hope Valley Wildlife Area, Type C (Alpine County);

Horseshoe Ranch Wildlife Area, Type C (Siskiyou County);

Imperial Wildlife Area, including the Type A Wister Unit and the Type C Finney Ramer Unit (Imperial County);

Indian Valley Wildlife Area, Type C (Lake County);

Kinsman Flat Wildlife Area, Type C (Madera County);

Knoxville Wildlife Area, Type C (Napa and Yolo counties)

Laguna Wildlife Area, Type C (Sonoma County);

Lake Berryessa Wildlife Area, Type C (Napa County);

Lake Earl Wildlife Area, Type C (Del Norte County);

Lake Earl Project Area, Type C (Del Norte County);

Lake Sonoma Wildlife Area, Type C (Sonoma County);

Little Panoche Reservoir Wildlife Area, Type C (Fresno County);

Los Banos Wildlife Area, Type A (Merced County);

Lower Sherman Island Wildlife Area, Type C (Sacramento County);

Mad River Slough Wildlife Area, Type C (Humboldt County);

Mendota Wildlife Area, Type A (Fresno County);

Miner Slough Wildlife Area, Type C (Solano County);

Morro Bay Wildlife Area, Type C (San Luis Obispo County);

Moss Landing Wildlife Area, Type C (Monterey County);

Mouth of Cottonwood Creek Wildlife Area, Type C (Shasta County);

Napa-Sonoma Marshes Wildlife Area, including the American Canyon, Coon Island, Dutchman Slough, Huichica Creek, Napa River, Ringstrom Bay, Sonoma Creek, Tolay Creek, and Wingo management units, Type C, and White Slough Management Unit (Napa, Solano, and Sonoma counties);

North Grasslands Wildlife Area, including China Island, Gadwall, and Salt Slough units, Type A (Merced and Stanislaus counties);

O'Neill Forebay Wildlife Area, Type C (Merced County);

Oroville Wildlife Area, Type C (Butte County);

Petaluma Marshes Wildlife Area, Type C (Marin and Sonoma counties);

Point Edith Wildlife Area, Type C (Contra Costa County);

Putah Creek Wildlife Area, Type C (Solano County);

Rector Reservoir Wildlife Area, Type C (Napa County);

Sacramento Bypass Wildlife Area, Type C (Yolo County);

Sacramento River Wildlife Area, Type C (Glenn, Butte, and Colusa counties);

San Felipe Valley Wildlife Area, Type C (San Diego County);

San Jacinto Wildlife Area, Type A (Riverside County);

San Luis Obispo Wildlife Area, $4 range fee (San Luis Obispo County);

San Luis Reservoir Wildlife Area, Type C (Merced and Santa Clara counties);

San Pablo Bay Wildlife Area, Type C (Marin and Sonoma counties);

Santa Rosa Wildlife Area, Type C (Riverside County);

Shasta Valley Wildlife Area, Type B (Siskiyou County);

Spenceville Wildlife Area, Type C (Nevada and Yuba counties);

Surprise Valley Wildlife Area, Type C (Modoc County);

Sutter Bypass Wildlife Area, Type C (Colusa and Sutter counties);

Tehama Wildlife Area, Type C (Tehama County);

Truckee River Wildlife Area, including the Boca, Polaris, Union Ice, and West River management units, Type C (Placer and Nevada counties);

Upper Butte Basin Wildlife Area, including the Howard Slough, Little Dry Creek, and Llano Seco units, Type A (Butte and Glenn counties);

Volta Wildlife Area, Type A (Merced County);

West Hilmar Wildlife Area, Type C (Merced County);

White Slough Wildlife Area, Type C (San Joaquin County);

Willow Creek Wildlife Area, Type B (Lassen County);

Yolo Bypass Wildlife Area, Type A (Yolo County).

REGION 1

(1) Ash Creek Wildlife Area

(A) Hunt Days: Waterfowl, coots, moorhens, pheasants, and snipe: Saturdays, Sundays, and Wednesdays during open seasons. Doves: Daily during the September dove season and on waterfowl hunt days during the late dove season.

(B) Authorized Species: Waterfowl, coots, moorhens, doves, pheasants, and snipe. Pronghorn antelope may be taken during junior hunts only.

(C) Camping and Trailers: Allowed.

(D) Special Restrictions: Designated portions may be closed to public entry from March 1 through August 15. No person shall enter or leave the wildlife area except at designated entry points. All dogs must be on a leash from March 1 to August 15.

(2) Bass Hill Wildlife Area

(A) Hunt Days: Daily during seasons for authorized species, except for Special Restrictions listed below.

(B) Authorized Species: All legal species.

(C) Camping and Trailers: Not allowed.

(D) Special Restrictions: The Egan Management Unit of Bass Hill Wildlife Area shall be open to the use of shotguns, archery equipment, or muzzle-loading weapons, only, for all hunting seasons.

(3) Battle Creek Wildlife Area

(A) Special Restrictions: Public entry is allowed from 6:00 a.m. to 10:00 p.m. Dog field trials, dog training, horseback riding and bicycles are prohibited. Dogs must be on leash and under direct owner control.

(B) Hunting and possession of firearms and archery equipment is prohibited.

(4) Big Lagoon Wildlife Area

(A) Special Restrictions: Motorized boards are restricted to 5 mph or less.

(5) Butte Valley Wildlife Area

(A) Hunt Days: Waterfowl, coots, moorhens, and snipe: Saturdays, Sundays, and Wednesdays during the waterfowl season. Pheasants: Sundays only during the pheasant season. Doves: Daily during the September dove season and on waterfowl hunt days during the late dove season.

(B) Authorized Species: Waterfowl, coots, moorhens, snipe, pheasants, and doves. Pronghorn antelope may be taken during junior hunts only.

(C) Camping and Trailers: Allowed.

(D) Special Restrictions: Boats with motors are prohibited. Boating and other water-related sports are prohibited from March 1 to September 1. No person shall enter or leave the area except at designated entry points. The area is open to public use only from two hours before sunrise to one hour after sunset. Dogs must be on a leash from March 1 to August 15.

(6) Eel River Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily, during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coot, snipe, and pheasant.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Dogs must be on a leash from March 1 through August 15. Designated portions of the Eel River Wildlife Area may be closed to vehicle entry from March 1 through September 15. Use of all terrain vehicles is prohibited all year with the exception of commercial anglers who may utilize the wave-slope for fishing access.

(7) Elk River Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coot, and snipe.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Dogs must be on a leash from March 1 through August 15.

(8) Fay Slough Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Saturdays, Sundays, and Wednesdays during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coot, and snipe.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Dogs must be on a leash from March 1 through August 15.

(9) Honey Lake Wildlife Area. (Fleming and Dakin Units)

(A) Hunt Days: Waterfowl, coots, moorhens, and snipe: Saturdays, Sundays, and Wednesdays during open seasons. Pheasants: Waterfowl hunt days during the pheasant season. Quail and rabbits: Waterfowl hunt days that occur during the pheasant season. Doves: Daily during the September dove season and on waterfowl hunt days during the late dove season.

(B) Authorized Species: Waterfowl, snipe, coots, moorhens, pheasants, quail, doves, and rabbits.

(C) Camping and Trailers: Allowed.

(D) Special Restrictions: Designated portions of the wildlife area may be closed to all public entry from March 1 through August 15. No person shall enter or leave the area except at designated entry points. Dogs must be on a leash from March 1 to August 15.

(10) Horseshoe Ranch Wildlife Area

(A) Method of Take Restrictions: All authorized methods of take except during the spring turkey season when only shotguns and archery equipment are permitted and during the M-2 deer season when only muzzle loading firearms [as per subsection 353(a)] are permitted.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: All legal species.

(D) Camping: Camping allowed.

(E) Special Restrictions: Only persons possessing a valid M-2 deer tag may possess a firearm on the wildlife area during the M-2 hunt periods.

(11) Lake Earl Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coots, snipe, and moorhens.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Possession and use of authorized firearms and archery equipment is permitted only within the first 100 feet of land along the shoreline and on the water surface of Lake Earl and Lake Talawa during the regular open waterfowl season. Boats are allowed, but motors are prohibited during the waterfowl season. Dogs must be on a leash from March 1 through August 15.

(12) Lake Earl Project Area (Lands administered by the Department of Parks and Recreation)

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Saturdays, Sundays, and Wednesdays during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coots, and moorhens.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Entry for hunting purposes is allowed only from the public access sites on Kellogg Road and Pala Road.

(13) Mad River Slough Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coot, and snipe.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Dogs must be on a leash from March 1 through August 15.

(14) Mouth of Cottonwood Creek Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: All legal species.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Public entry is allowed from one hour before sunrise to one hour after sunset. Dog field trials, dog training, horseback riding, and bicycles are prohibited. Dogs must be on a leash from March 1 through August 15.

(15) Shasta Valley Wildlife Area

(A) Hunt Days: Waterfowl, snipe, coots, and moorhens: Saturdays, Sundays, and Wednesdays during open seasons. Pheasants: Sundays only during the pheasant season. Quail: Waterfowl hunt days only during waterfowl season. Doves: Daily during the September dove season and on waterfowl hunt days during the late dove season. Snipe: waterfowl hunt days only during waterfowl season.

(B) Authorized Species: Waterfowl, snipe, coots, moorhens, pheasants, quail, and doves.

(C) Camping and Trailers: Allowed.

(D) Special Restrictions: No person shall enter or leave the wildlife area except at designated entry points. Only electric boat motors are allowed. Dogs must be on a leash from February 1 to August 15. Pheasant hunters must have special permits obtained at the check station.

(16) Surprise Valley Wildlife Area

(A) Hunt Days: Daily during open seasons for authorized species.

(B) Authorized Species: All legal species.

(C) Camping and Trailers: Allowed in south parking area, except during the period April 1 to August 15.

(17) Tehama Wildlife Area

(A) Hunt Days: Daily during open seasons for authorized species, except for Special Restrictions listed below.

(B) Authorized Species: All legal species.

(C) Camping and Trailers: Allowed.

(D) Special Restrictions:

1. No person shall enter that portion of Tehama Wildlife Area lying south of Hogsback (Belle Mill) Road during the period February 1 through the first Friday in April except with prior written permission of the regional manager.

2. During the Zone G-1 deer season only persons with Department issued entry permits may enter the Tehama Wildlife Area.

3. Pig hunting is restricted to persons who have been issued a Tehama Wildlife Area Pig Hunt Permit.

4. Dogs may not be used to hunt wild pigs.

(18) Willow Creek Wildlife Area

(A) Hunt Days: Saturdays, Sundays, and Wednesdays during open seasons for authorized species.

(B) Authorized Species: Waterfowl, snipe, coots, and moorhens.

(C) Camping and Trailers: Not allowed.

REGION 2

(19) Antelope Valley Wildlife Area

(A) Hunt Days: Daily from July 1 through January 31 during open seasons for authorized species.

(B) Authorized Species: All legal species.

(C) Camping and Trailers: Trailers are not allowed. Camping is allowed only from May 1 through October 31.

(D) Special Restrictions: Hunting is allowed only from July 1 through January 31.

(20) Clifton Court Forebay

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Saturdays, Sundays, and Wednesdays during open seasons for authorized species.

(C) Entry Permit: Self-registration is required.

(D) Authorized Species: Waterfowl, coots, and moorhens.

(E) Camping and Trailers: Not allowed.

(21) Collins Eddy Wildlife Area

(A) Method of Take Restrictions: No rifles, pistols, or archery equipment may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: Waterfowl, coots , moorhens, and all upland game.

(D) Camping and Trailers: Not allowed.

(22) Colusa Bypass Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: All legal species.

(D) Camping and Trailers: Not allowed.

(23) Daugherty Hill Wildlife Area

(A) Method of Take Restrictions: During the spring turkey season, only shotguns and archery equipment may be used, and then only for the purpose of turkey hunting.

(B) Hunt Days: Daily from July 1 through January 31 during open seasons for authorized species and during the spring turkey season.

(C) Authorized Species: All legal species.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: Entry permit, issued by special drawing, is required for the first nine days of the spring turkey season. Hunting is allowed only from July 1 through January 31 and during the spring turkey season, when only turkeys may be hunted. Dogs are allowed only for hunting. Horses and bicycles are allowed only from May 1 to September 15 on the Daugherty Hill Unit of the wildlife area only.

(24) Decker Island Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: All legal species.

(D) Camping and Trailers: Not allowed.

(25) Feather River Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily from July 1 through January 31 during open seasons for authorized species and during the spring turkey season.

(C) Authorized Species: All legal species.

(D) Camping and Trailers: Not allowed.

(E) Special Restrictions: No person shall enter that portion of the O'Connor Lakes Management Unit marked as closed to entry from March 1 through June 30 without special authorization of the Department. Hunting is allowed only from July 1 to January 31 and during the spring turkey season, when only turkeys may be hunted.

(26) Fremont Weir Wildlife Area

(A) Method of Take Restrictions: No rifles or pistols may be used or possessed.

(B) Hunt Days: Daily during open seasons for authorized species.

(C) Authorized Species: Pheasants, doves, quail, and waterfowl.

(D) Camping and Trailers: Not allowed.

(E) Special restrictions: Hunting is allowed only from September 1 through January 31.

(27) Gray Lodge Wildlife Area

(A) Ammunition Restrictions: A hunter shall not possess more than 25 shotgun shells while in the field during the waterfowl season.

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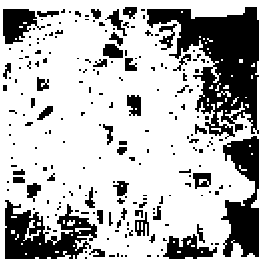

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The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues which have an impact on fish and wildlife resources and their supporting ecosystems. The mission of the Program is as follows:

1. To strengthen the Fish and Wildlife Service in its role as a primary source of information on natural fish and wildlife resources, particularly with respect to environmental impact assessment.

2. To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major land and water use changes.

3. To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process, to prevent or minimize the impact of development on fish and wildlife. Biological Services research activities and technical assistance services are based on an analysis of the issues, the decisionmakers involved and their information needs, and an evaluation of the state-of-the-art to identify information gaps and determine priorities. This is a strategy to assure that the products produced and disseminated will be timely and useful.

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Coal extraction and conversion

Power plants

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Water resource analysis, including stream alterations and western water allocation

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FWS/OBS-79/31
December 1979

CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES

By

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Foreward

Wetlands and deepwater habitats are essential breeding, rearing, and feeding grounds for many species of fish and wildlife. They may also perform important flood protection and pollution control funtions. Increasing National and international recognition of these values has intensified the need for reliable information on the status and extent of wetland resources. To develop comparable information over large areas, a clear definition and classification of wetlands and deepwater habitats is required.

The classification system contained in this report was developed by wetland ecologists, with the assistance of many private individuals and organizations and local, State, and Federal agencies. An operational draft was published in October 1977, and a notice of intent to adopt the system for all pertinent Service activities was published December 12, 1977 (42 FR 62432).

The Fish and Wildlife Service is officially adopting this wetland classification system. Future wetland data bases developed by the Service, including the National Wetlands Inventory, will utilize this system. A one-year transition period will allow for training of Service personnel, amendment of administrative manuals, and further development of the National Wetlands Inventory data base. During this period, Service personnel may continue to use the old wetland classification described in Fish and Wildlife Service Circular 39 for Fish and Wildlife Coordination Act reports, wetland acquisition priority determinations, and other activities in conjunction with the new system, where immediate conversion is not practicable.

Upon completion of the transition period, the Circular 39 system will no longer be officially used by the Fish and Wildlife Service except where applicable laws still reference that system or when the only information available is organized according to that system and cannot be restructured without new field surveys.

Other Federal and State agencies are encouraged to convert to the use of this system. No specific legal authorities require the use of this system-or any other system for that matter. However, it is expected that the benefits of National consistency and a developing wetland data base utilizing this system will result in acceptance and use by most agencies involved in wetland management. Training can be provided to users by the Service, depending on availability of resources. Congressional committees will be notified of this adoption action and will be encouraged to facilitate general adoption of the new system by amending any laws that reference the Circular 39 system.

This is a new system and users will need to study and learn the terminology. The Service is preparing a document to aid in comparing and translating the new system to the Service's former classification system. In the coming year, the Fish and Wildlife Service, in conjunction with the Soil Conservation Service, also plans to develop initial lists of hydrophytic plants and hydric soils that will support interpretation and use of this system.

We believe that this system will provide a suitable basis for information gathering for most scientific, educational, and administrative purposes; however, it will not fit all needs. For instance, historical or potentially restorable wetlands are not included in this system, nor was the system designed to accommodate all the requirements of the many recently passed wetland statutes. No attempt was made to define the proprietary or jurisdictional boundaries of Federal, State, or local agencies. Nevertheless, the basic design of the classification system and the resulting data base should assist substantially in the administration of these programs.

This report represents the most current methodology available for wetland classification and culminates a long-term effort involving many wetland scientists. Although it may require revision from time to time, it will serve us well in the years ahead. We hope all wetland personnel in all levels of government and the private sector come to know it and use it for the ultimate benefit of America's wetlands.

Lynn A. Greenwalt, *Director*
U.S. Fish and Wildlife Service

Preface

Since its publication in 1979, *Classification of Wetlands* and *Deepwater Habitats of the United States* has been used in the National inventory of wetlands conducted by the U.S. Fish and Wildlife Service. The system has been widely used throughout the United States and is often cited in the scientific literature. There has also been considerable international interest in use of the classification.

Copies from the first printing have been expended and demand requires this reprinting. We have taken this opportunity to correct a number of minor typographical errors, bring plant names into conformity with the *National List of Scientific Plant Names* (U.S. Dept. Agriculture 1982), and to upgrade the quality of plates as well as furnish additional plates. No changes have been made that either alter the structure of the classification or the meaning of the definitions. Such major revisions must be deferred until certain prerequisite tasks are accomplished.

Completion of the list of hydrophytes and other plants occurring in wetlands and the list of hydric soils (see page 3) has been a task of far greater complexity than we envisioned when writing the classification. These lists have received extensive review and are being prepared as computer data bases. In addition, the lists will contain a great deal of ancillary information that will make possible the development of methodologies for their use in both the delineation and classification of wetlands. When the lists and methodologies are completed, reviewed, and tested we will revise the classification and use the lists to add precision to the definitions. At the same time, we will address specific technical problems that have arisen during application of the classification.

The plates at the end of this publication are included primarily to illustrate a variety of examples of wetland classification. We have attempted to include photographs from various regions of the country insofar as possible; however, final selection of plates was based on the availability of both high-quality photographs and the detailed field data required for accurate classification. While on sabbatical leave from the University of Rhode Island in 1985, Dr. Frank Golet took numerous photographs of Alaskan wetlands. Addition of many of these and several photographs from other regions helps somewhat to correct a regional imbalance.

We acknowledge the assistance of Dr. J. Henry Sather who served as editor for the reprinting. He spent many hours compiling minor errors and inconsistencies and preparing final copy for the printer. We thank Mr. Jon Hall, National Wetlands Inventory Coordinator for the Alaska region, for his assistance to Dr. Golet during his stay in Alaska.

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September 24, 1985

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Abstract

This classification, to be used in a new inventory of wetlands and deepwater habitats of the United States, is intended to describe ecological taxa, arrange them in a system useful to resource managers, furnish units for mapping, and provide uniformity of concepts and terms. Wetlands are defined by plants (hydrophytes), soils (hydric soils), and frequency of flooding. Ecologically related areas of deep water, traditionally not considered wetlands, are included in the classification as deepwater habitats.

Systems form the highest level of the classification hierarchy; five are defined-Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Marine and Estuarine Systems each have two Subsystems, Subtidal and Intertidal; the Riverine System has four Subsystems, Tidal, Lower Perennial, Upper Perennial, and Intermittent; the Lacustrine has two, Littoral and Limnetic; and the Palustrine has no Subsystems.

Within the Subsystems, Classes are based on substrate material and flooding regime, or on vegetative life form. The same Classes may appear under one or more of the Systems or Subsystems. Six Classes are based on substrate and flooding regime: (1) Rock Bottom with a substrate of bedrock, boulders, or stones; (2) Unconsolidated Bottom with a substrate of cobbles, gravel, sand, mud, or organic material; (3) Rocky Shore with the same substrates as Rock Bottom; (4) Unconsolidated Shore with the same substrates as Unconsolidated Bottom; (5) Streambed with any of the substrates; and (6) Reef with a substrate composed of the living and dead remains of invertebrates (corals, mollusks, or worms). The bottom Classes, (1) and (2) above, are flooded all or most of the time and the shore Classes, (3) and (4), are exposed most of the time. The Class Streambed is restricted to channels of intermittent streams and tidal channels that are dewatered at low tide. The life form of the dominant vegetation defines the five Classes based on vegetative form: (1) Aquatic Bed, dominated by plants that grow principally on or below the surface of the water; (2) Moss-Lichen Wetland, dominated by mosses or lichens; (3) Emergent Wetland, dominated by emergent herbaceous angiosperms; (4) Scrub-Shrub Wetland, dominated by shrubs or small trees; and (5) Forested Wetland, dominated by large trees.

The Dominance Type, which is named for the dominant plant or animal forms, is the lowest level of the classification hierarchy. Only examples are provided for this level; Dominance Types must be developed by individual users of the classification.

Modifying terms applied to the Classes or Subclasses are essential for use of the system. In tidal areas, the type and duration of flooding are described by four Water Regime Modifiers: subtidal, irregularly exposed, regularly flooded, and irregularly flooded. In nontidal areas, eight Regimes are used: permanently flooded, intermittently exposed, semipermanently flooded, seasonally flooded, saturated, temporarily flooded, intermittently flooded, and artificially flooded. A hierarchical system

of Water Chemistry Modifiers, adapted from the Venice System, is used to describe the salinity of the water. Fresh waters are further divided on the basis of pH. Use of a hierarchical system of soil modifiers taken directly from U.S. soil taxonomy is also required. Special modifiers are used where appropriate: excavated, impounded, diked, partly drained, farmed, and artificial.

Regional differences important to wetland ecology are described through a regionalization that combines a system developed for inland areas by R. G. Bailey in 1976 with our Marine and Estuarine provinces.

The structure of the classification allows it to be used at any of several hierarchical levels. Special data required for detailed application of the system are frequently unavailable, and thus data gathering may be prerequisite to classification. Development of rules by the user will be required for specific map scales. Dominance Types and relationships of plant and animal communities to environmental characteristics must also be developed by users of the classification. Keys to the Systems and Classes are furnished as a guide, and numerous wetlands and deepwater habitats ***are*** illustrated and classified. The classification system is also compared with several other systems currently in use in the United States.

The U.S. Fish and Wildlife Service conducted an inventory of the wetlands of the United States (Shaw and Fredine 1956) in 1954. Since then, wetlands have undergone considerable change, both natural and man related, and their characteristics and natural values have become better defined and more widely known. During this interval, State and Federal legislation has been passed to protect wetlands, and some Statewide wetland surveys have been conducted.

In 1974, the U.S. Fish and Wildlife Service directed its Office of Biological Services to design and conduct a new National inventory of wetlands. Whereas the single purpose of the 1954 inventory was to assess the amount and types of valuable waterfowl habitat, the scope of the new project is considerably broader (Montanari and Townsend 1977). It will provide basic data on the characteristics and extent of the Nation's wetlands and deepwater habitats and should facilitate the management of these areas on a sound, multiple-use basis.

Before the 1954 inventory was begun, Martin et al. (1953) had devised a wetland classification system to serve as a framework for the National inventory. The results of the inventory and an illustrated description of the 20 wetland types were published as U.S. Fish and Wildlife Service Circular 39 (Shaw and Fredine 1956). This circular has been one of the most common and most influential documents used in the continuous battle to preserve a critically valuable but rapidly diminishing National resource (Stegman 1976). However, the shortcomings of this work are well known (e.g., see Leitch 1966; Stewart and Kantrud 1971).

In attempting to simplify their classification, Martin et al. (1953) not only ignored ecologically critical differences, such as the distinction between fresh and mixosaline inland wetlands but also placed dissimilar habitats, such as forests of boreal black spruce (*Picea mariana*) and of southern cypress-gum ***(Taxodium distichum-Nyssa aquatica)*** in the same category, with no provisions in the system for distinguishing between them. Because of the central emphasis on waterfowl habitat, far greater attention was paid to vegetated areas than to nonvegetated areas. Probably the greatest single disadvantage of the Martin et al. system was the inadequate definition of types, which led to inconsistencies in application.

Numerous other classifications of wetlands and deepwater habitats have been developed (Stewart and Kantrud 1971; Golet and Larson 1974; Jeglum et al. 1974; Odum et al. 1974; Zoltai et al. 1975; Millar 1976), but most of these are regional systems and none would fully satisfy National needs. Because of the weaknesses inherent in Circular 39, and because wetland ecology has become significantly better understood since 1954, the U.S. Fish and Wildlife Service elected to construct a new National classification system as the first step toward a new National inventory. The new classification, presented here, has been designed to meet four long-range objectives: (1) to describe ecological units that have certain homogeneous natural attributes; (2) to arrange these units in a system that will aid decisions about resource management; (3) to furnish units for inventory and mapping; and (4) to provide uniformity in concepts and terminology throughout the United States.

Scientific and common names of plants (Appendix A) and animals (Appendix B) were taken from various sources cited in the text. No attempt has been made to resolve nomenclatorial problems where there is a taxonomic dispute. Many of the terms used in this classification have various meanings even in the scientific literature and in some instances our use of terms is new. We have provided a glossary (Appendix C) to guide the reader in our usage of terms.

WETLANDSANDDEEPWATER HABITATS

Concepts and Definitions

Marshes, swamps, and bogs have been well-known terms for centuries, but only relatively recently have attempts been made to group these landscape units under the single term "wetlands." This general term has grown out of a need to understand and describe the characteristics and values of all types of land, and to wisely and effectively manage wetland ecosystems. There is no single, correct, indisputable, ecologically sound definition for wetlands, primarily because of the diversity of wetlands and because the demarcation between dry and wet environments lies along a continuum. Because reasons or needs for defining wetlands also vary, a great proliferation of definitions has arisen. The primary objective of this classification is to impose boundaries on natural ecosystems for the purposes of inventory, evaluation, and management.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. The water creates severe physiological problems for all plants and animals except those that are adapted for life in water or in saturated soil.

WETLANDS are lands *transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this* classification *wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes;*[1] *(2) the substrate is predominantly undrained hydric soil;*[2] *and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.*

The term wetland includes a variety of areas that fall into one of five categories: (1) areas with hydrophytes and hydric soils, such as those commonly known as marshes, swamps, and bogs; (2) areas without hydrophytes but with hydric soils-for example, flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes; (3) areas with hydrophytes but nonhydric soils, such as margins of impoundments or excavations where hydrophytes have become established but hydric soils have not yet developed; (4) areas without soils but with hydrophytes such as the seaweed-covered portion of rocky shores; and (5) wetlands without soil and without hydrophytes, such as gravel beaches or rocky shores without vegetation.

Drained hydric soils that are now incapable of supporting hydrophytes because of a change in water regime are not considered wetlands by our definition. These drained hydric soils furnish a valuable record of historic wetlands, as well as an indication of areas that may be suitable for restoration.

Wetlands as defined here include lands that are identified under other categories in some land-use classifications. For example, wetlands and farmlands are not necessarily exclusive. Many areas that we define as wetlands are farmed during dry periods, but if they are not tilled or planted to crops, a practice that destroys the natural vegetation, they will support hydrophytes.

[1]The U.S. Fish and Wildlife Service is preparing a list of hydrophytes and other plants occurring in wetlands of the United States.

[2]The U.S. Soil Conservation Service is preparing a preliminary list of hydric soils for use in this classification system.

Deepwater Habitats

DEEPWATER HABITATS are *permanently flooded lands lying below the deepwater boundary of wetlands,* Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate. As in wetlands, the dominant plants are hydrophytes; however, the substrates are considered nonsoil because the water is too deep to support emergent vegetation (U.S. Soil Conservation Service, Soil Survey Staff 1975).

Wetlands and deepwater habitats are defined separately because traditionally the term wetland has not included deep permanent water; however, both must be considered in an ecological approach to classification. We define five major Systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The first four of these include both wetland and deepwater habitats but the Palustrine includes only wetland habitats.

Limits

The upland limit of wetland is designated as (1) the boundary between land with predominantly hydrophytic cover and land with predominantly mesophytic or xerophytic cover; (2) the boundary between soil that is predominantly hydric and soil that is predominantly nonhydric; or (3) in the case of wetlands without vegetation or soil, the boundary between land that is flooded or saturated at some time during the growing season each year and land that is not.

The boundary between wetland and deepwater habitat in the Marine and Estuarine Systems coincides with the elevation of the extreme low water of spring tide; permanently flooded areas are considered deepwater habitats in these Systems. The boundary between wetland and deepwater habitat in the Riverine and Lacustrine Systems lies at a depth of 2 m (6.6 feet) below low water; however, if emergents, shrubs, or trees grow beyond this depth at any time, their deepwater edge is the boundary.

The 2-m lower limit for inland wetlands was selected because it represents the maximum depth to which emergent plants normally grow (Welch 1952; Zhadin and Gerd 1963; Sculthorpe 1967). As Daubenmire (1968:138) stated, emergents are not true aquatic plants, but are "amphibious," growing in both permanently flooded and wet, nonflooded soils. In their wetland classification for Canada, Zoltai et al. (1975) also included only areas with water less than 2 m deep.

THE CLASSIFICATION SYSTEM

The structure of this classification is hierarchical, progressing from Systems and Subsystems, at the most general levels, to Classes, Subclasses, and Dominance Types. Figure 1 illustrates the classification structure to the class level. Table 1 lists the Classes and Subclasses for each System and Subsystem. Artificial keys to the Systems and Classes are given in Appendix E. Modifiers for water regime, water chemistry, and soils are applied to Classes, Subclasses, and Dominance Types. Special modifiers describe wetlands and deepwater habitats that have been either created or highly modified by man or beavers.

Hierarchical Structure

Systems and Subsystems

The term SYSTEM refers here to a complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors. We further subdivide Systems into more specific categories called SUBSYSTEMS.

The characteristics of the five major Systems-Marine, Estuarine, Riverine, Lacustrine, and Palustrine-have been discussed at length in the scientific literature and the concepts are well recognized; however, there is frequent disagreement as to which attributes should be used to bound the Systems in space. For example, both the limit of tidal influence and the limit of ocean-derived salinity have been proposed for bounding the upstream end of the Estuarine System (Caspers 1967). As Bormann and Likens (1969) pointed out, boundaries of ecosystems are defined to meet practical needs.

Marine System

Definition. The Marine System (Fig. 2) consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30‰, with little or no dilution except outside the mouths of estuaries. Shallow coastal indentations or bays without appreciable freshwater inflow, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind and waves, are also considered part of the Marine System because they generally support typical marine biota.

Limits. The Marine System extends from the outer edge of the continental shelf shoreward to one of three lines: (1) the landward limit of tidal inundation (extreme high water of spring tides), including the splash zone from breaking waves; (2) the seaward limit of wetland emergents, trees, or shrubs; or (3) the seaward limit of the Estuarine System, where this limit is determined by factors other than vegetation. Deepwater habitats lying beyond the seaward limit of the Marine System are outside the scope of this classification system.

Description. The distribution of plants and animals in the Marine System primarily reflects differences in four factors: (1) degree of exposure of the site to waves; (2) texture and physicochemical nature of the substrate; (3) amplitude of the tides; and (4) latitude, which governs water temperature, the intensity and duration of solar radiation, and the presence or absence of ice.

Subsystems.

Subtidal.-The substrate is continuously submerged.

Intertidal. -The substrate is exposed and flooded by tides; includes the associated splash zone.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Reef, Rocky Shore, and Unconsolidated Shore.

Estuarine System

Definition. The Estuarine System (Fig. 3) consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. The salinity may be periodically increased above that of the open ocean by evaporation. Along some low-energy coastlines there is appreciable dilution of sea water. Offshore areas with typical estuarine plants and animals, such as red mangroves (*Rhizophora*

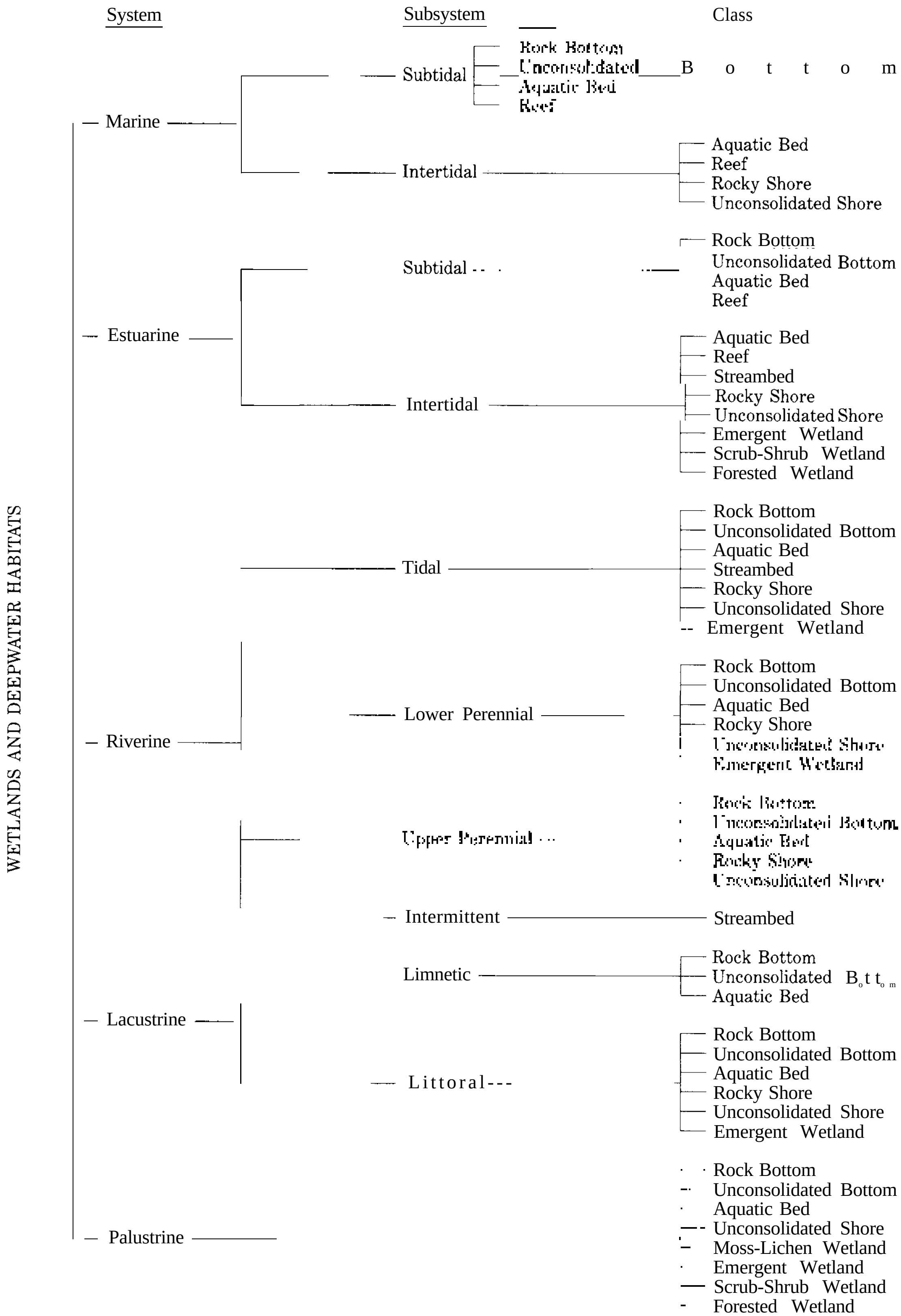

Fig. 1. Classification hierarchy of wetlands and deepwater habitats, showing Systems, Subsystems, and Classes. The Palustrine System does not include deepwater habitats.

Table 1. *Distribution of Subclasses within the classification hierarchy.*

	System and Subsystem”										
	Marine		Estuarine		Riverine				Lacustrine		Palustrine
Class/Subclass	ST	IT	ST	IT	TI	LP	UP	IN	LM	LT	–
Rock Bottom											
Bedrock	X		X		X		X		X	X	X
Rubble	X		X		X		X		X	X	X
Unconsolidated Bottom											
Cobble-Gravel	X		X		X	X	X		X	X	X
Sand	X		X		X	X	X		X	X	X
Mud	X		X		X	X	X		X	X	X
Organic			X		X	X			X	X	X
Aquatic Bed											
Algal	X	X	X	X	X	X	X		X	X	X
Aquatic Moss					X	X	X		X	X	X
Rooted Vascular	X	X	X	X	X	X	X		X	X	X
Floating Vascular			X	X	X	X	X		X	X	X
Reef											
Coral	X	X									
Mollusk			X	X							
Worm	X	X	X	X							
Streambed											
Bedrock				X	X			X			
Rubble				X	X			X			
Cobble-Gravel				X	X			X			
Sand				X	X			X			
Mud				X	X			X			
Organic				X	X			X			
Vegetated								X			
Rocky Shore											
Bedrock		X		X	X	X	X			X	
Rubble		X		X	X	X	X			X	
Unconsolidated Shore											
Cobble-Gravel		X		X	X	X	X			X	X
Sand		X		X	X	X	X			X	X
Mud		X		X	X	X	X			X	X
Organic		X		X	X	X	X			X	X
Vegetated					X	X	X			X	X
Moss-Lichen Wetland											
Moss											X
Lichen											X
Emergent Wetland											
Persistent				X							X
Nonpersistent				X	X	X	X			X	X
Scrub-Shrub Wetland											
Broad-leaved Deciduous				X							X
Needle-leaved Deciduous				X							X
Broad-leaved Evergreen				X							X
Needle-leaved Evergreen				X							X
Dead				X							X

Table 1. Continued.

Class/Subclass	Marine ST	Marine IT	Estuarine ST	Estuarine IT	Riverine TI	Riverine LP	Riverine UP	Riverine IN	Lacustrine LM	Lacustrine LT	Palustrine —
Forested Wetland											
Broad-leaved Deciduous				X							X
Needle-leaved Deciduous				X							X
Broad-leaved Evergreen				X							X
Needle-leaved Evergreen				X							X
Dead				X							X

System and Subsystem[a]

[a]ST = Subtidal, IT = Intertidal, TI = Tidal, LP = Lower Perennial, UP = Upper Perennial, IN = Intermittent, LM = Limnetic, LT = Littoral.

mangle) and eastern oysters (*Crassostrea virginica*), are also included in the Estuarine System.[3]

Limits. The Estuarine System extends (1) upstream and landward to where ocean-derived salts measure less than 0.5‰ during the period of average annual low flow; (2) to an imaginary line closing the mouth of a river, bay, or sound; and (3) to the seaward limit of wetland emergents, shrubs, or trees where they are not included in (2). The Estuarine System also includes offshore areas of continuously diluted sea water.

Description. The Estuarine System includes both estuaries and lagoons. It is more strongly influenced by its association with land than is the Marine System. In terms of wave action, estuaries are generally considered to be low-energy systems (Chapman 1977:2).

Estuarine water regimes and water chemistry are affected by one or more of the following forces: oceanic tides, precipitation, freshwater runoff from land areas, evaporation, and wind. Estuarine salinities range from hyperhaline to oligohaline (Table 2). The salinity may be variable, as in hyperhaline lagoons (e.g., Laguna Madre, Texas) and most brackish estuaries (e.g., Chesapeake Bay, Virginia-Maryland); or it may be relatively stable, as in sheltered euhaline embayments (e.g., Chincoteague Bay, Maryland) or brackish embayments with partly obstructed access or small tidal range (e.g., Pamlico Sound, North Carolina). (For an extended discussion of estuaries and lagoons see Lauff 1967.)

Subsystems.

Subtidal.—The substrate is continuously submerged.

Intertidal.—The substrate is exposed and flooded by tides; includes the associated splash zone.

[3]The Coastal Zone Management Act of 1972 defines an estuary as "that part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea-water is measurably diluted with freshwater derived from land drainage." The Act further states that "the term includes estuary-type areas of the Great Lakes." However, in the present system we do not consider areas of the Great Lakes as Estuarine.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Reef, Streambed, Rocky Shore, Unconsolidated Shore, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland.

Riverine System

Definition. The Riverine System (Fig. 4) includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5‰. A channel is "an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri 1960:5).

Limits. The Riverine System is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. In braided streams, the system is bounded by the banks forming the outer limits of the depression within which the braiding occurs.

The Riverine System terminates at the downstream end where the concentration of ocean-derived salts in the water exceeds 0.5‰ during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the Riverine System.

Description. Water is usually, but not always, flowing in the Riverine System. Upland islands or Palustrine wetlands may occur in the channel, but they are not included in the Riverine System. Palustrine Moss-Lichen Wetlands, Emergent Wetlands, Scrub-Shrub Wetlands, and Forested Wetlands may occur adjacent to the Riverine System, often on a floodplain. Many biologists have suggested that all the wetlands occurring on the river floodplain should be a part of the Riverine System because they

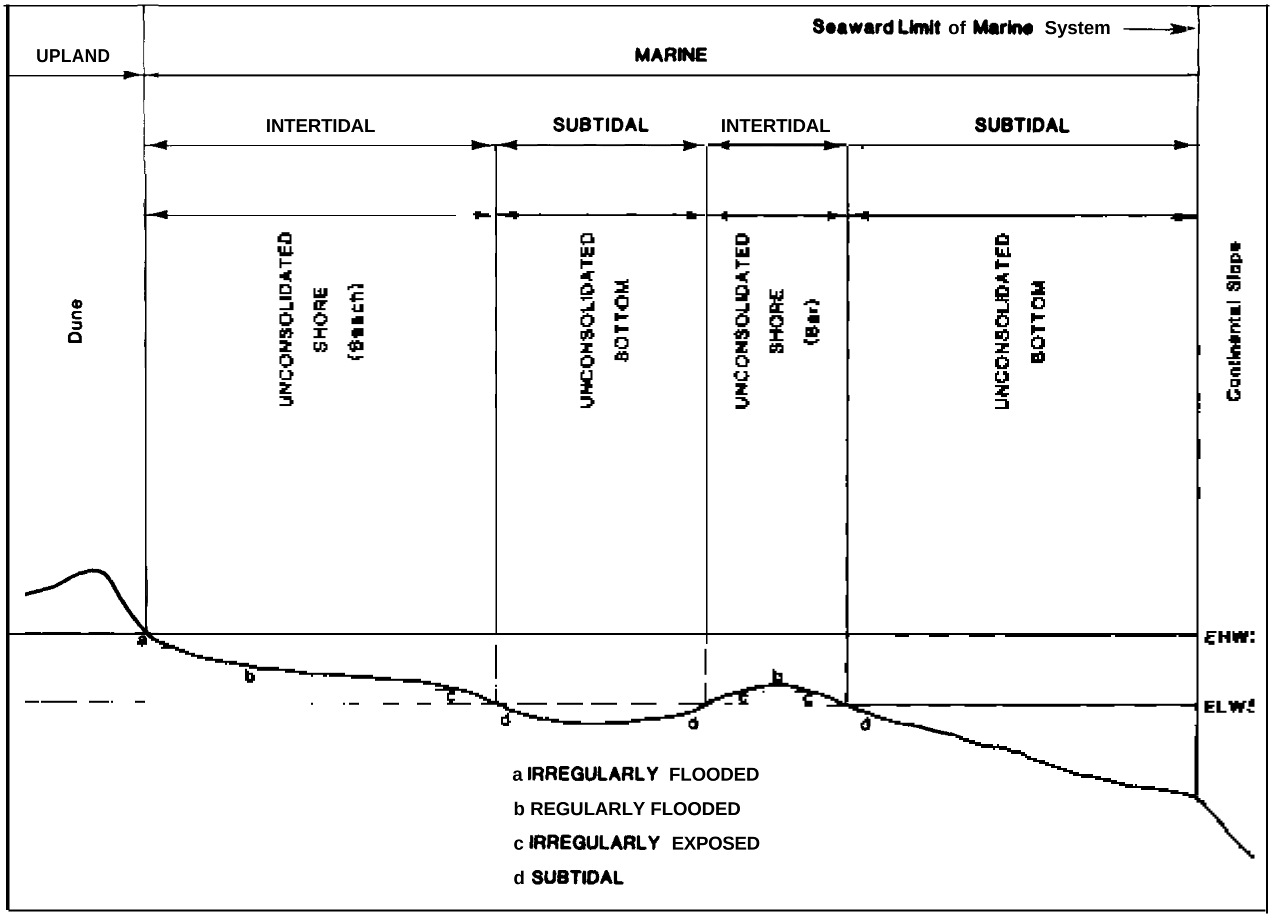

Fig. 2. Distinguishing features and examples of habitats in the Marine System. EHWS = extreme high water of spring tides; ELWS = extreme low water of spring tides.

consider their presence to be the result of river flooding. However, we concur with Reid and Wood (1976:72,84) who stated, "The floodplain is a flat expanse of land bordering an old river. . . . Often the floodplain may take the form of a very level plain occupied by the present stream channel, and it may never, or only occasionally, be flooded. . . . It is this subsurface water [the ground water] that controls to a great extent the level of lake surfaces, the flow of streams, and the extent of swamps and marshes."

Subsystems. The Riverine System is divided into four Subsystems: the Tidal, the Lower Perennial, the Upper Perennial, and the Intermittent. Each is defined in terms of water permanence, gradient, water velocity, substrate, and the extent of floodplain development. The Subsystems have characteristic flora and fauna (see Illies and Botosaneau 1963; Hynes 1970; Reid and Wood 1976). All four Subsystems are not necessarily present in all rivers, and the order of occurrence may be other than that given below.

Tidal.-The gradient is low and water velocity fluctuates under tidal influence. The streambed is mainly mud with occasional patches of sand. Oxygen deficits may sometimes occur and the fauna is similar to that in the Lower Perennial Subsystem. The floodplain is typically well developed.

Lower Perennial.-The gradient is low and water velocity is slow. There is no tidal influence, and some water flows throughout the year. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

Upper Perennial.-The gradient is high and velocity of the water fast. There is no tidal influence and some water flows throughout the year. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the Lower Perennial Subsystem, and there is very little floodplain development.

Intermittent. -In this Subsystem, the channel contains flowing water for only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

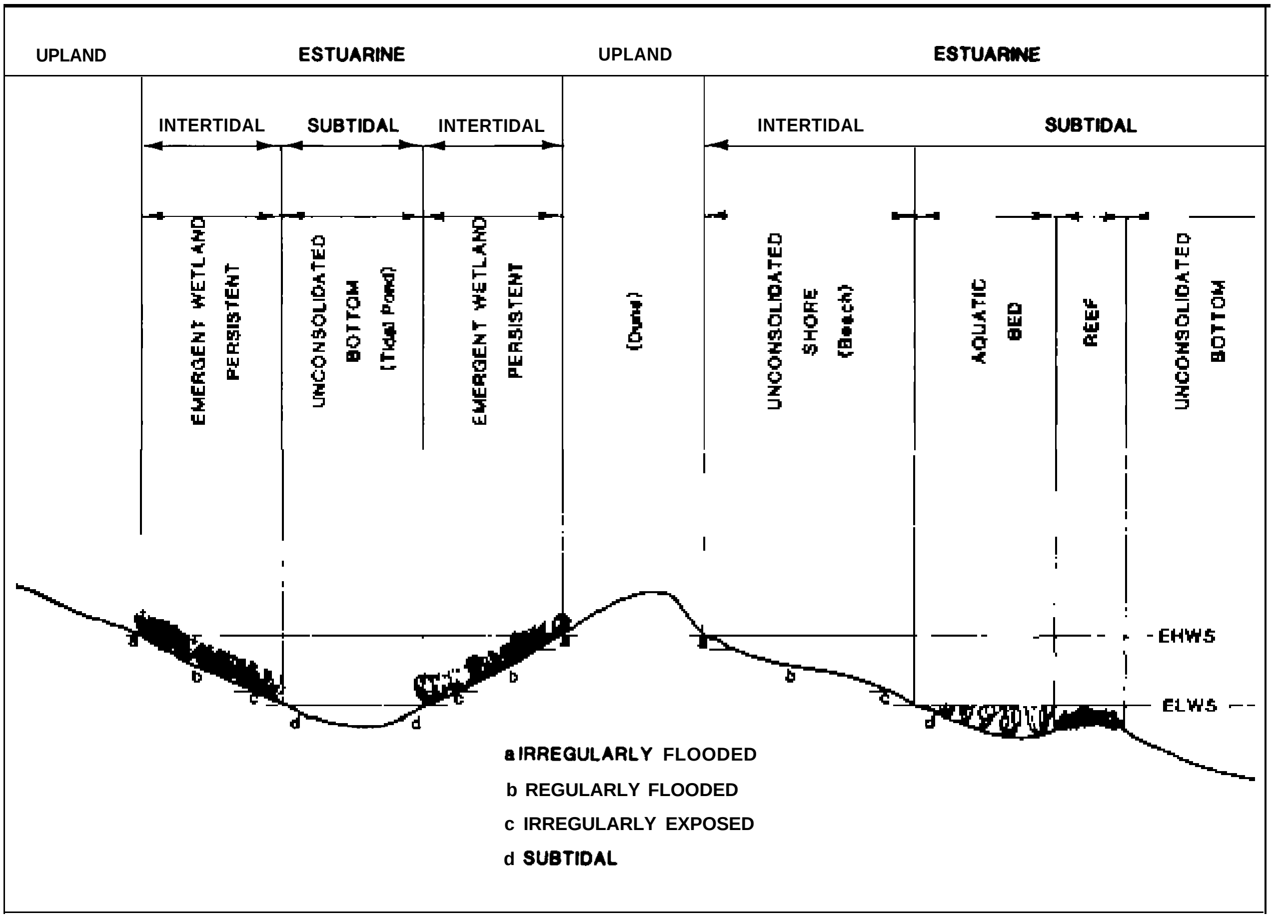

Fig. 3. Distinguishing features and examples of habitats in the Estuarine System. EHWS = extreme high water of spring tides; ELWS = extreme low water of spring tides.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Streambed, Rocky Shore, Unconsolidated Shore, and Emergent Wetland (nonpersistent).

Lacustrine System

Definition. The Lacustrine System (Fig. 5) includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% area1 coverage; and (3) total area exceeds 8 ha (20 acres). Similar wetland and deepwater habitats totaling less than 8 ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2 m (6.6 feet) at low water. Lacustrine waters may be tidal or nontidal, but ocean-derived salinity is always less than 0.5‰.

Limits. The Lacustrine System is bounded by upland or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Lacustrine Systems formed by damming a river channel are bounded by a contour approximating the normal spillway elevation or normal pool elevation, except where Palustrine wetlands extend lakeward of that boundary. Where a river enters a lake, the extension of the Lacustrine shoreline forms the Riverine-Lacustrine boundary.

Description. The Lacustrine System includes permanently flooded lakes and reservoirs (e.g., Lake Superior), intermittent lakes (e.g., playa lakes), and tidal lakes with ocean-derived salinities below 0.5‰ (e.g., Grand Lake, Louisiana). Typically, there are extensive areas of deep water and there is considerable wave action. Islands of Palustrine wetland may lie within the boundaries of the Lacustrine System.

Subsystems.

Limnetic.—All deepwater habitats within the Lacustrine System; many small Lacustrine Systems have no Limnetic Subsystem.

Littoral. -All wetland habitats in the Lacustrine System. Extends from the shoreward boundary of the

Table 2. *Salinity Modifiers used in this classification system.*

Coastal Modifiers[a]	Inland Modifiers[b]	Salinity (parts per thousand)	Approximate specific conductance (μMhos at 25°C)
Hyperhaline	Hypersaline	>40	>60,000
Euhaline	Eusaline	30.0-40	45,000-60,000
Mixohaline (Brackish)	Mixosaline[c]	0.5-30	800-45,000
Polyhaline	Polysaline	18.0-30	30,000-45,000
Mesohaline	Mesosaline	5.0-18	8,000-30,000
Oligohaline	Oligosaline	0.5-5	800- 8,000
Fresh	Fresh	<0.5	<800

[a]Coastal Modifiers are used in the Marine and Estuarine Systems.
[b]Inland Modifiers are used in the Riverine, Lacustrine, and Palustrine Systems.
[c]The term Brackish should not be used for inland wetlands or deepwater habitats.

system to a depth of 2 m (6.6 feet) below low water or to the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 m.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Rocky Shore, Unconsolidated Shore, and Emergent Wetland (nonpersistent).

Palustrine System

Definition. The Palustrine System (Fig. 6) includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5‰. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m at low water; and (4) salinity due to ocean-derived salts less than 0.5‰.

Limits. The Palustrine System is bounded by upland or by any of the other four Systems.

Description. The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods.

The emergent vegetation adjacent to rivers and lakes is often referred to as "the shore zone" or the "zone of emergent vegetation" (Reid and Wood 1976), and is generally considered separately from the river or lake. As an example, Hynes (1970:85) wrote in reference to riverine habitats, "We will not here consider the long list of emergent plants which may occur along the banks out of the current, as they do not belong, strictly speaking, to the running water habitat." There are often great similarities between wetlands lying adjacent to lakes or rivers and isolated wetlands of the same class in basins without open water.

Subsystems. None.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Unconsolidated Shore, Moss-Lichen Wetland, Emergent Wetland, Scrub-Shrub Wetland, and Forested Wetland.

Classes, Subclasses, and Dominance Types

The CLASS is the highest taxonomic unit below the Subsystem level. It describes the general appearance of the habitat in terms of either the dominant life form of the vegetation or the physiography and composition of the substrate-features that can be recognized without the aid of detailed environmental measurements. Vegetation is used at two different levels in the classification. The life forms-trees, shrubs, emergents, emergent mosses, and lichens-are used to define Classes because they are relatively easy to distinguish, do not change distribution rapidly, and have traditionally been used as criteria for classification of wetlands.[4] Other forms of vegetation, such as submerged or floating-leaved rooted vascular plants, free-floating vascular plants, submergent mosses, and algae, though frequently more difficult to detect, are used

[4]Our initial attempts to use familiar terms such as marsh, swamp, bog, and meadow at the Class level were unsuccessful primarily because of wide discrepancies in the use of these terms in various regions of the United States. In an effort to resolve that difficulty, we based the Classes on the fundamental components (life form, water regime, substrate type, water chemistry) that give rise to such terms. We believe that this approach will greatly reduce the misunderstandings and confusion that result from the use of the familiar terms.

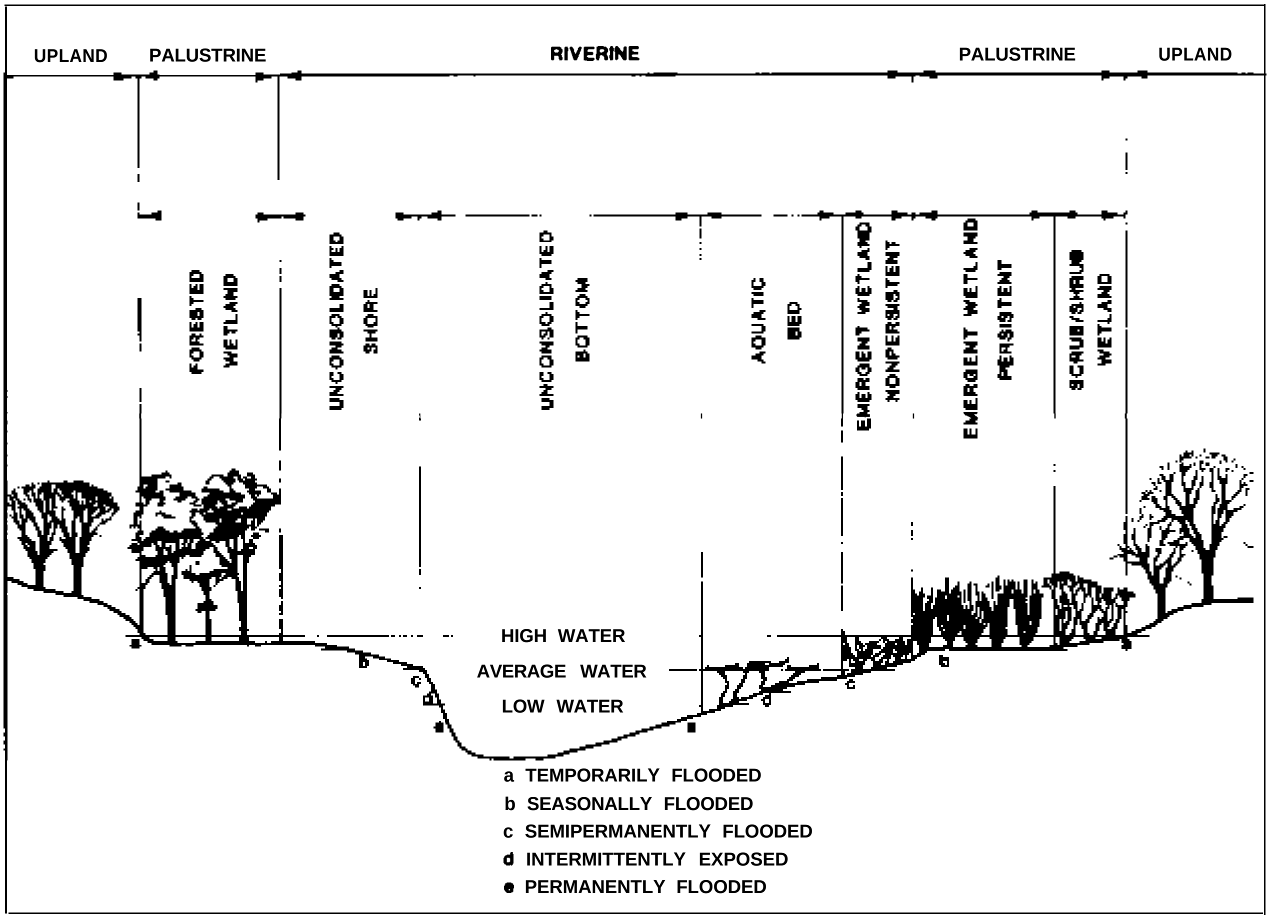

Fig. 4. Distinguishing features and examples of habitats in the Riverine System.

to define the Class Aquatic Bed. Pioneer species that briefly invade wetlands when conditions are favorable are treated at the Subclass level because they are transient and often not true wetland species.

Use of life forms at the Class level has two major advantages: (1) extensive biological knowledge is not required to distinguish between various life forms, and (2) it has been established that various life forms are easily recognizable on a great variety of remote sensing products (e.g., Radforth 1962; Anderson et al. 1976). If vegetation (except pioneer species) covers 30% or more of the substrate, we distinguish Classes on the basis of the life form of the plants that constitute the uppermost layer of vegetation and that possess an area1 coverage 30% or greater. For example, an area with 50% area1 coverage of trees over a shrub layer with a 60% area1 coverage would be classified as Forested Wetland; an area with 20% area1 coverage of trees over the same (60%) shrub layer would be classified as Scrub-Shrub Wetland. When trees or shrubs alone cover less than 30% of an area but in combination cover 30% or more, the wetland is assigned to the Class Scrub-Shrub. When trees and shrubs cover less than 30% of the area but the total cover of vegetation (except pioneer species) is 30% or greater, the wetland is assigned to the appropriate Class for the predominant life form below the shrub layer. Finer differences in life forms are recognized at the SUBCLASS level. For example, Forested Wetland is divided into the Subclasses Broad-leaved Deciduous, Needle-leaved Deciduous, Broad-leaved Evergreen, Needle-leaved Evergreen, and Dead. Subclasses are named on the basis of the predominant life form.

If vegetation covers less than 30% of the substrate, the physiography and composition of the substrate are the principal characteristics used to distinguish Classes. The nature of the substrate reflects regional and local variations in geology and the influence of wind, waves, and currents on erosion and deposition of substrate materials. Bottoms, Shores, and Streambeds are separated on the basis of duration of inundation. In the Riverine, Lacustrine, and Palustrine Systems, Bottoms are submerged all or most of the time, whereas Streambeds and Shores are exposed all or most of the time. In the Marine and Estuarine Systems, Bottoms are Subtidal, whereas Streambeds and Shores are Intertidal. Bottoms, Shores, and Streambeds are further divided at the Class level on the basis of the important characteristic of rock versus

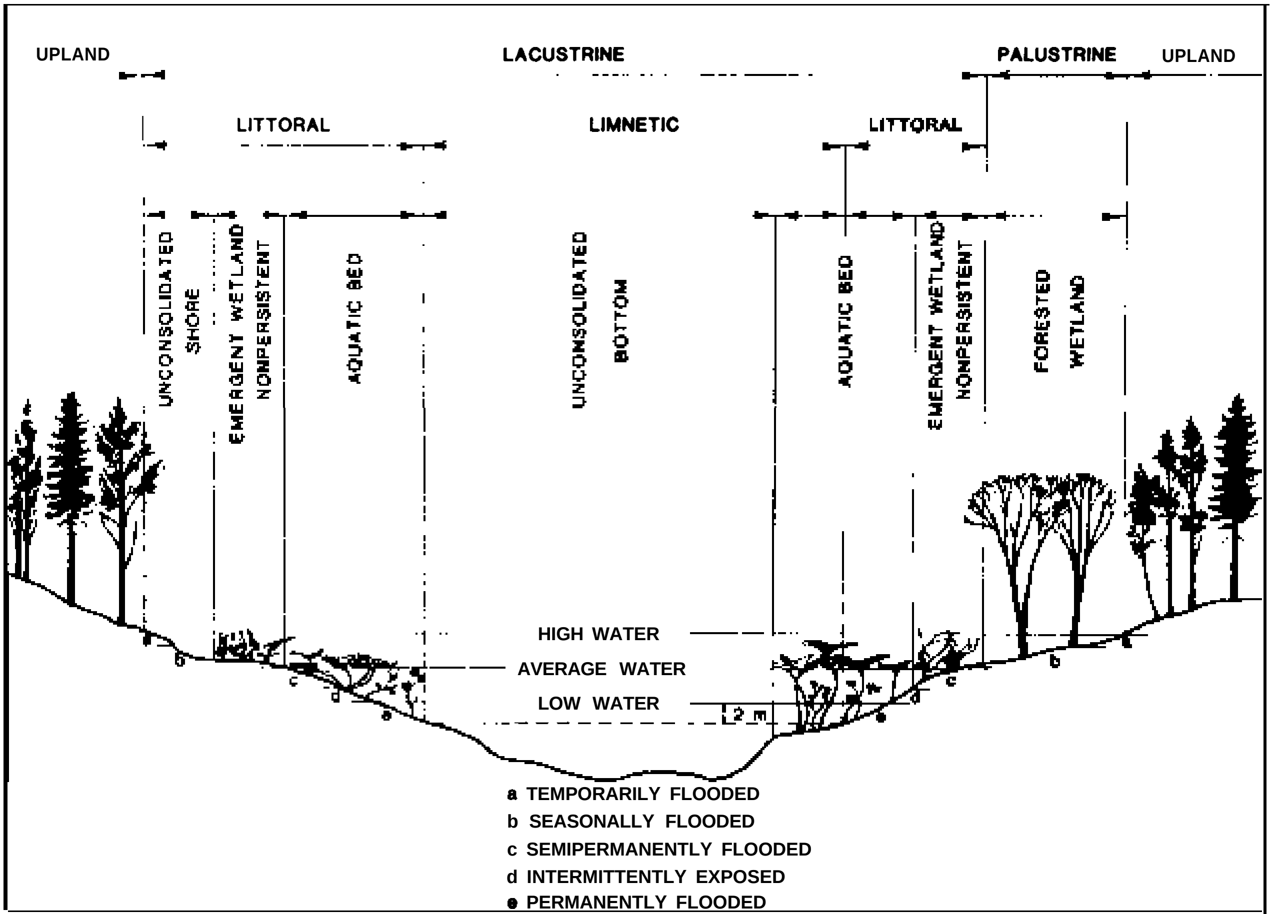

Fig. 5. Distinguishing features and examples of habitats in the Lacustrine System.

unconsolidated substrate. Subclasses are based on finer distinctions in substrate material unless, as with Streambeds and Shores, the substrate is covered by, or shaded by, an area1 coverage of pioneering vascular plants (often nonhydrophytes) of 30% or more; the Subclass is then simply "vegetated." Further detail as to the type of vegetation must be obtained at the level of Dominance Type. Reefs are a unique class in which the substrate itself is composed primarily of living and dead animals. Subclasses of Reefs are designated on the basis of the type of organism that formed the reef.

The DOMINANCE TYPE is the taxonomic category subordinate to Subclass. Dominance Types are determined on the basis of dominant plant species (e.g., Jeglum et al. 1974), dominant sedentary or sessile animal species (e.g., Thorson 1957), or dominant plant and animal species (e.g., Stephenson and Stephenson 1972). A dominant plant species has traditionally meant one that has control over the community (Weaver and Clements 1938:91), and this plant is also usually the predominant species (Cain and Castro 1959:29). When the Subclass is based on life form, we name the Dominance Type for the dominant species or combination of species (codominants) in the same layer of vegetation used to determine the Subclass.6 For example, a Needle-leaved Evergreen Forested Wetland with 70% area1 cover of black spruce *(Picea mariana)* and 30% area1 cover of tamarack (*Larix laricina*) would be designated as a *Picea mariana* Dominance Type. When the relative abundance of codominant species is nearly equal, the Dominance Type consists of a combination of species names. For example, an Emergent Wetland with about equal area1 cover of common cattail (*Typha latifolia*) and hardstem bulrush (*Scirpus acutus*) would be designated a *Typha latifolia–Scirpus acutus* Dominance Type.

When the Subclass is based on substrate material, the Dominance Type is named for the predominant plant or

[5]Percent area1 cover is seldom measured in the application of this system, but the term must be defined in terms of area. We suggest 2 m^2 for herbaceous and moss layers, 16 m^2 for shrub layers, and 100 m^2 for tree layers (Mueller-Dombois and Ellenberg 1974:74). When percent areal cover is the key for establishing boundaries between units of the classification, it may occasionally be necessary to measure cover on plots, in order to maintain uniformity of ocular estimates made in the field or interpretations made from aerial photographs.

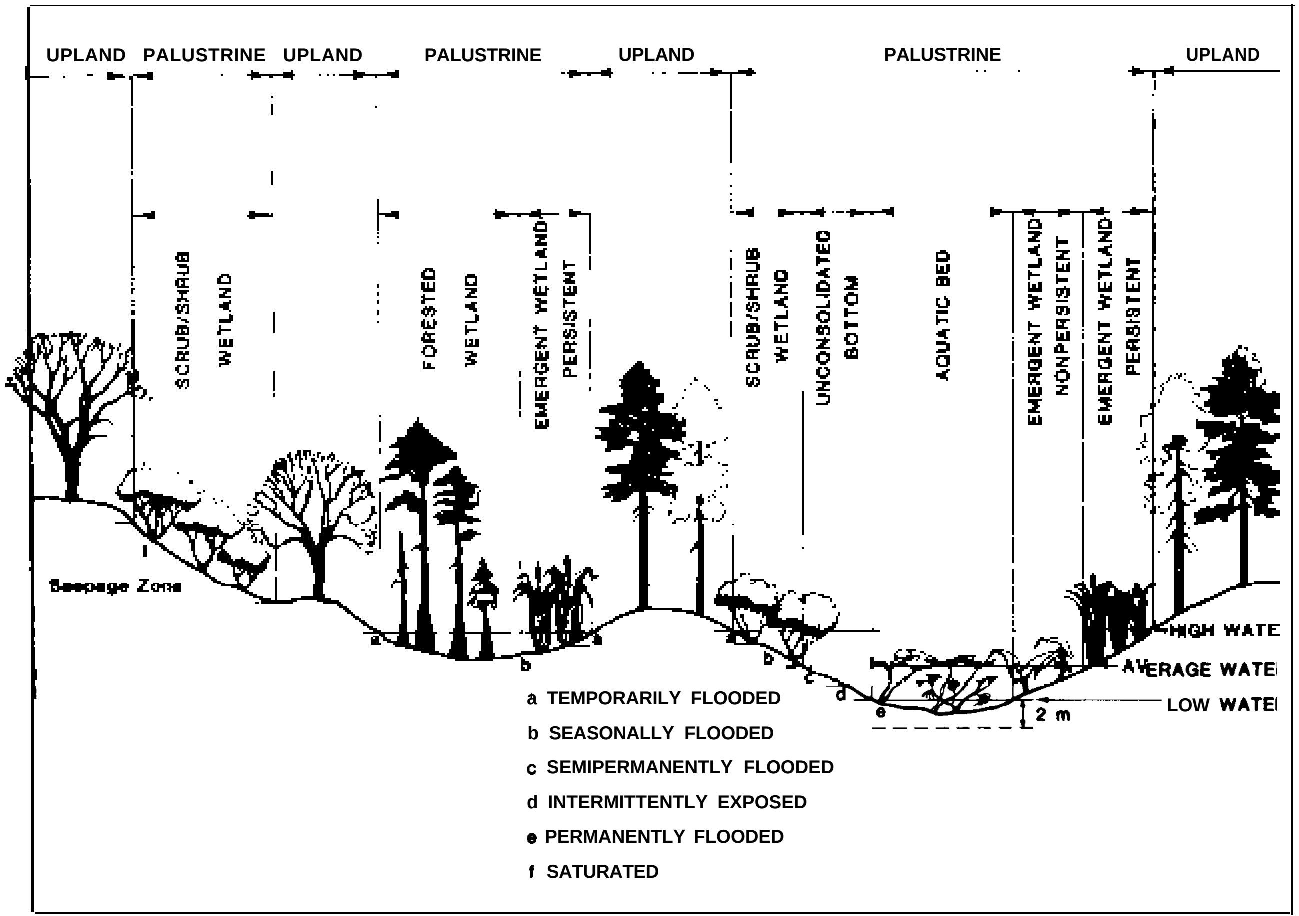

Fig. 6. Distinguishing features and examples of habitats in the Palustrine System.

sedentary or sessile macroinvertebrate species, without regard for life form. In the Marine and Estuarine Systems, sponges, alcyonarians, mollusks, crustaceans, worms, ascidians, and echinoderms may all be part of the community represented by the *Macoma balthica* Dominance Type. Sometimes it is necessary to designate two or more codominant species as a Dominance Type. Thorson (1957) recommended guidelines and suggested definitions for establishing community types and dominants on level bottoms.

Rock Bottom

Definition. The Class Rock Bottom includes all wetlands and deepwater habitats with substrates having an area1 cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%. Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semipermanently flooded.

Description. The rock substrate of the rocky benthic or bottom zone is one of the most important factors in determining the abundance, variety, and distribution of organisms. The stability of the bottom allows a rich assemblage of plants and animals to develop. Rock Bottoms are usually high-energy habitats with well-aerated waters. Temperature, salinity, current, and light penetration are also important factors in determining the composition of the benthic community. Animals that live on the rocky surface are generally firmly attached by hooking or sucking devices, although they may occasionally move about over the substrate. Some may be permanently attached by cement. A few animals hide in rocky crevices and under rocks, some move rapidly enough to avoid being swept away, and others burrow into the finer substrates between boulders. Plants are also firmly attached (e.g., by holdfasts), and in the Riverine System both plants and animals are commonly streamlined or flattened in response to high water velocities.

Subclasses and Dominance Types.

Bedrock.-Bottoms in which bedrock covers 75% or more of the surface.

Rubble.-Bottoms with less than 75% area1 cover of bedrock, but stones and boulders alone, or in combination with bedrock, cover 75% or more of the surface.

Examples of Dominance Types for these two Subclasses in the Marine and Estuarine Systems are the encrusting sponges *Hippospongia,* the tunicate *Cnemidocarpa*, the sea urchin *Strongylocentrotus,* the sea star *Pisaster,* the sea whip *Muricea,* and the American lobster *Homarus americanus.* Examples of Lacustrine, Palustrine, and Riverine Dominance Types are the freshwater sponges Spongilla and *Heteromeyenia,* the pond snail *Lymnaea,* the mayfly *Ephemerella,* various midges of the Chironomidae, the caddisfly *Hydropsyche,* the leech *Helobdella*, the riffle beetle *Psephenus,* the chironomid midge *Eukiefferiella*, the crayfish *Procambarus*, and the black fly *Simulium.*

Dominance Types for Rock Bottoms in the Marine and Estuarine Systems were taken primarily from Smith (1964) and Ricketts and Calvin (1968), and those for Rock Bottoms in the Lacustrine, Riverine, and Palustrine Systems from Krecker and Lancaster (1933), Stehr and Branson (1938), Ward and Whipple (1959), Clarke (1973), Hart and Fuller (1974), Ward (1975), Slack et al. (1977), and Pennak (1978).

Unconsolidated Bottom

Definition. The Class Unconsolidated Bottom includes all wetland and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%. Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semipermanently flooded.

Description. Unconsolidated Bottoms are characterized by the lack of large stable surfaces for plant and animal attachment. They are usually found in areas with lower energy than Rock Bottoms, and may be very unstable. Exposure to wave and current action, temperature, salinity, and light penetration determines the composition and distribution of organisms.

Most macroalgae attach to the substrate by means of basal hold-fast cells *or* discs; in sand and mud, however, algae penetrate the substrate and higher plants can successfully root if wave action and currents are not too strong. Most animals in unconsolidated sediments live within the substrate, e.g., *Macoma* and the amphipod *Melita.* Some, such as the polychaete worm *Chaetopterus,* maintain permanent burrows, and others may live on the surface, especially in coarse-grained sediments.

In the Marine and Estuarine Systems, Unconsolidated Bottom communities are relatively stable. They vary from the Arctic to the tropics, depending largely on temperature, and from the open ocean to the upper end of the estuary, depending on salinity. Thorson (1957) summarized and described characteristic types of level-bottom communities in detail.

In the Riverine System, the substrate type is largely determined by current velocity, and plants and animals exhibit a high degree of morphologic and behavioral adaptation to flowing water. Certain species are confined to specific substrates and some *are* at least more abundant in one type of substrate than in others. According to Hynes (1970:208), "The larger the stones, and hence the more complex the substratum, the more diverse is the invertebrate fauna." In the Lacustrine and Palustrine Systems, there is usually a high correlation, within a given water body, between the nature of the substrate and the number of species and individuals. For example, in the profundal bottom of eutrophic lakes where light is absent, oxygen content is low, and carbon dioxide concentration is high, the sediments are ooze-like organic materials and species diversity is low. Each substrate type typically supports a relatively distinct community of organisms (Reid and Wood 1976:262).

Subclasses and Dominance Types.

Cobble-Gravel. -The unconsolidated particles smaller than stones are predominantly cobble and gravel, although finer sediments may be intermixed. Examples of Dominance Types for the Marine and Estuarine Systems are the mussels *Modiolus* and *Mytilus,* the brittle star *Amphipholis,* the soft-shell clam *Mya*, and the Venus clam *Saxidomus*. Examples for the Lacustrine, Palustrine, and Riverine Systems are the midge *Diamesa,* stonefly-midge *Nemoura–Eukiefferiella* (Slack et al. 1977), chironomid midge-caddisfly-snail *Chironomus-Hydropsyche-Physa* (Krecker and Lancaster 1933), the pond snail *Lymnaea,* the mayfly *Baetis,* the freshwater sponge *Eunapius,* the oligochaete worm *Lumbriculus*, the scud *Gammarus,* and the freshwater mollusks *Anodonta, Elliptio*, and *Lampsilis.*

Sand. -The unconsolidated particles smaller than stones are predominantly sand, although finer or coarser sediments may be intermixed. Examples of Dominance Types in the Marine and Estuarine Systems are the wedge shell *Donax*, the scallop *Pecten*, the tellin shell *Tellina*, the heart urchin *Echinocardium,* the lugworm *Arenicola*, the sand dollar *Dendraster,* and the sea pansy *Renilla.* Examples for the Lacustrine, Palustrine, and Riverine Systems are the snail *Physa,* the scud Gammarus, the oligochaete worm *Limnodrilus,* the mayfly *Ephemerella,* the freshwater mollusks *Elliptio* and *Anodonta,* and the fingernail clam *Sphaerium.*

Mud.-The unconsolidated particles smaller than stones are predominantly silt and clay, although coarser sediments or organic material may be intermixed. Organisms living in mud must be able to adapt to low oxygen concentrations. Examples of Dominance Types for the Marine and Estuarine Systems include the terebellid worm *Amphitrite,* the boring clam *Platyodon,* the deep-sea scallop *Placopecten,* the quahog *Mercenaria,* the macoma *Macoma*, the echiurid worm *Urechis,* the mud snail Nassarius, and the sea cucumber *Thyone*. Examples of Dominance Types for the Lacustrine, Palustrine, and Riverine Systems are the sewage worm *Tubifex*, freshwater mollusks *Anodonta*, *Anodontoides,* and *Elliptio*, the fingernail clams *Pisidium* and *Sphaerium*, and the midge *Chironomus.*

Organic-The unconsolidated material smaller than stones is predominantly organic. The number of species is limited and fauna1 productivity is very low (Welch 1952). Examples of Dominance Types for Estuarine and Marine Systems are the soft-shell clam *Mya*, the false angel wing *Petricola pholadiformis,* the clam worm Nereis, and the mud snail *Nassarius*. Examples for the Lacustrine, Palustrine, and Riverine Systems are the sewage worm *Tubifex*, the snail *Physa,* the harpacticoid copepod *Canthocamptus,* and the oligochaete worm *Limnodrilus.*

Dominance Types for Unconsolidated Bottoms in the Marine and Estuarine Systems were taken predominantly from Miner (1950), Smith (1964), Abbott (1968), and Ricketts and Calvin (1968). Dominance Types for Unconsolidated Bottoms in the Lacustrine, Riverine, and Palustrine Systems were taken predominantly from Krecker and Lancaster (1933), Stehr and Branson (1938), Johnson (1970), Brinkhurst and Jamieson (1972), Clarke (1973), Hart and Fuller (1974), Ward (1975), and Pennak (1978).

Aquatic Bed

Definition. The Class Aquatic Bed includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Water regimes include subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semipermanently flooded, and seasonally flooded.

Description. Aquatic Beds represent a diverse group of plant communities that requires surface water for optimum growth and reproduction. They are best developed in relatively permanent water or under conditions of repeated flooding. The plants are either attached to the substrate or float freely in the water above the bottom or on the surface.

Subclasses and Dominance Types.

Algal.-Algal Beds are widespread and diverse in the Marine and Estuarine Systems, where they occupy substrates characterized by a wide range of sediment depths and textures. They occur in both the Subtidal and Intertidal Subsystems and may grow to depths of 30 m (98 feet). Coastal Algal Beds *are* most luxuriant along the rocky shores of the Northeast and West. Kelp (*Macrocystis*) beds are especially well developed on the rocky substrates of the Pacific Coast. Dominance Types such as the rockweeds *Fucus* and *Ascophyllum* and the kelp *Laminaria* are common along both coasts. In tropical regions, green algae, including forms containing calcareous particles, are more characteristic; *Halimeda* and *Penicillus* are common examples. The red alga *Laurencia,* and the green algae *Caulerpa, Enteromorpha,* and *Ulva* are also common Estuarine and Marine dominance types; *Enteromorpha* and *Ulva* are tolerant of fresh water and flourish near the upper end of some estuaries. The stonewort *Chara* is also found in estuaries.

Inland, the stoneworts *Chara*, *Nitella*, and *Tolypella are* examples of algae that look much like vascular plants and may grow in similar situations. However, meadows of *Chara* may be found in Lacustrine water as deep as 40 m (131 feet) (Zhadin and Gerd 1963), where hydrostatic pressure limits the survival of vascular submergents (phanaerogams) (Welch 1952). Other algae bearing less resemblance to vascular plants are also common. Mats of filamentous algae may cover the bottom in dense blankets, may rise to the surface under certain conditions, or may become stranded on Unconsolidated or Rocky Shores.

Aquatic Moss. -Aquatic mosses are far less abundant than algae or vascular plants. They occur primarily in the Riverine System and in permanently flooded and intermittently exposed parts of some Lacustrine systems. The most important Dominance Types include genera such as *Fissidens*, *Drepanocladus*, and *Fontinalis. Fontinalis* may grow to depths as great as 120 m (394 feet) (Hutchinson 1975). For simplicity, aquatic liverworts of the genus *Marsupella* are included in this Subclass.

Rooted Vascular.—Rooted Vascular Beds include a large array of vascular species in the Marine and Estuarine Systems. They have been referred to by others as temperate grass flats (Phillips 1974); tropical marine meadows (Odum 1974); and eelgrass beds, turtlegrass beds, and seagrass beds (Akins and Jefferson 1973; Eleuterius 1973; Phillips 1974). The greatest number of species occur in shallow, clear tropical, or subtropical waters of moderate current strength in the Caribbean and along the Florida and Gulf Coasts. Principal Dominance Types in these areas include turtle grass *(Thalassia testudinum*), shoalgrass (*Halodule wrightii),* manatee grass (*Cymodocea filiformis*), widgeon grass *(Ruppia maritima), sea* grasses *(Halophila* spp.), and wild celery (*Vallisneria americana).*

Five major vascular species dominate along the temperate coasts of North America: shoalgrass, surf grasses *(Phyllospadix scouleri, P. torreyi),* widgeon grass, and eelgrass *(Zostera marina).* Eelgrass beds have the most extensive distribution, but they are limited primarily to the more sheltered estuarine environment. In the lower salinity zones of estuaries, stands of widgeon grass, pondweed *(Potamogeton),* and wild celery often occur, along with naiads (*Najas*) and water milfoil *(Myriophyllum).*

In the Riverine, Lacustrine, and Palustrine Systems, rooted vascular aquatic plants occur at all depths within the photic zone. They often occur in sheltered areas where there is little water movement (Wetzel 1975); however, they also occur in the flowing water of the Riverine System, where they may be streamlined or flattened in response to high water velocities. Typical inland genera include pondweeds, horned pondweed (*Zannichellia palustris),* ditch grasses *(Ruppia),* wild celery, and waterweed *(Elodea).* The riverweed *(Podostemum ceratophyllum)* is included in this class despite its lack of truly recognizable roots (Sculthorpe 1967).

Some of the rooted vascular species are characterized by floating leaves. Typical dominants include water lilies *(Nymphoxa, Nuphar),* floating-leaf pondweed (*Potamogeton natans*), and water shield (*Brasenia schreberi).* Plants such as yellow water lily *(Nuphar Zuteum)* and water smartweed *(Polygonum amphibium),* which may stand erect above the water surface or substrate, may be con sidered either emergents or rooted vascular aquatic plants, depending on the life form adopted at a particular site.

Floating Vascular.-Beds of floating vascular plants occur mainly in the Lacustrine, Palustrine, and Riverine Systems and in the fresher waters of the Estuarine System. The plants float freely either in the water or on its surface. Dominant plants that float on the surface include the duckweeds *(Lemna, Spiro&la),* water lettuce *(Pistia stratiotes),* water hyacinth *(Eichhornia crassipes*), water nut (*Trapa natuns),* water ferns (*Salvinia* spp.), and mosquito ferns (*Azolla*). These plants are found primarily in protected portions of slow-flowing rivers and in the Lacustrine and Palustrine Systems. They are easily moved about by wind or water currents and cover a large area of water in some parts of the country, particularly the Southeast. Dominance Types for beds floating below the surface include bladderworts (*Utricularia*), coontails (*Ceratophyllum*), and watermeals (*Wolffia*) (Sculthorpe 1967; Hutchinson 1975).

Reef

Definition. The Class Reef includes ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates. Water regimes are restricted to subtidal, irregularly exposed, regularly flooded, and irregularly flooded.

Description. Reefs are characterized by their elevation above the surrounding substrate and their interference with normal wave flow; they are primarily subtidal, but parts of some reefs may be intertidal as well. Although corals, oysters, and tube worms are the most visible organisms and are mainly responsible for reef formation, other mollusks, foraminifera, coralline algae, and other forms of life also contribute substantially to reef growth. Frequently, reefs contain far more dead skeletal material and shell fragments than living matter.

Subclasses and Dominance Types.

Coral.-Coral Reefs are widely distributed in shallow waters of warm seas, in Hawaii, Puerto Rico, the Virgin Islands, and southern Florida. They were characterized by Odum (1971) as stable, well-adapted, highly diverse, and highly productive ecosystems with a great degree of internal symbiosis. Coral Reefs lie almost entirely within the Subtidal Subsystem of the Marine System, although the upper part of certain Reefs may be exposed. Examples of Dominance Types are the corals *Porites, Acropora,* and *Montipora*. The distribution of these types reflects primarily their elevation, wave exposure, the age of the Reef, and its exposure to waves.

Mollusk.-This Subclass occurs in both the Intertidal and Subtidal Subsystems of the Estuarine System. These Reefs are found on the Pacific, Atlantic, and Gulf Coasts and in Hawaii and the Caribbean. Mollusk Reefs may become extensive, affording a substrate for sedentary and boring organisms and a shelter for many others. Reef mollusks are adapted to great variations in water level, salinity, and temperature, and these same factors control their distribution. Examples of Dominance Types for this Subclass are the oysters *Ostrea* and *Crassostrea* (Smith 1964; Abbott 1968; Ricketts and Calvin 1968).

Worm.-Worm Reefs are constructed by large colonies of Sabellariid worms living in individual tubes constructed from cemented sand grains. Although they do not support as diverse a biota as do Coral and Mollusk Reefs, they provide a distinct habitat which may cover large areas. Worm Reefs are generally confined to tropical waters, and are most common along the coasts of Florida, Puerto Rico, and the Virgin Islands. They occur in both the Intertidal and Subtidal Systems of the Marine and Estuarine Systems where the salinity approximates that of sea water. The reefworm *Sabellaria* is an example of a Dominance Type for this Subclass (Ricketts and Calvin 1968).

Streambed

Definition. The Class Streambed includes all wetland contained within the Intermittent Subsystem of the Riverine System and all channels of the Estuarine System or of the Tidal Subsystem of the Riverine System that are completely dewatered at low tide. Water regimes are restricted to irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, and intermittently flooded.

Description. Streambeds vary greatly in substrate and form depending on the gradient of the channel, the velocity of the water, and the sediment load. The substrate material frequently changes abruptly between riffles and pools, and complex patterns of bars may form on the convex side of single channels or be included as islands within the bed of braided streams (Crickmay 1974). In mountainous areas the entire channel may be cut through bedrock. In most cases streambeds are not vegetated because of the scouring effect of moving water, but, like Unconsolidated Shores, they may be colonized by "pioneering" annuals or perennials during periods of low flow or they may have perennial emergents and shrubs that are too scattered to qualify the area for classification as Emergent Wetland or Scrub-Shrub Wetland.

Subclasses and Dominance Types.

Bedrock. -This Subclass is characterized by a bedrock substrate covering 75% or more of the stream channel.

It occurs most commonly in the Riverine System in high mountain areas or in glaciated areas where bedrock is exposed. Examples of Dominance Types are the mollusk *Ancylus*, the oligochaete worm *Limnodrilus,* the snail *Physa,* the fingernail clam *Pisidium*, and the mayflies *Caenis* and *Ephemerella*.

Rubble.-This Subclass is characterized by stones, boulders, and bedrock that in combination cover more than 75% of the channel. Like Bedrock Streambeds, Rubble Streambeds are most common in mountainous areas and the dominant organisms are similar to those of Bedrock and are often forms capable of attachment to rocks in flowing water.

Cobble-Gravel.-In this Subclass at least 25% of the substrate is covered by unconsolidated particles smaller than stones; cobbles or gravel predominate. The Subclass occurs in riffle areas or in the channels of braided streams. Examples of Dominance Types in the Intermittent Subsystem of the Riverine System are the snail *Physa,* the oligochaete worm *Limnodrilus,* the mayfly *Caenis*, the midge *Chironomus,* and the mosquito *Anopheles.* Examples of Dominance Types in the Estuarine System or Tidal Subsystem of the Riverine System are the mussels *Modiolus* and *Mytilus*.

Sand. -In this Subclass, sand-sized particles predominate among the particles smaller than stones. Sand Streambed often contains bars and beaches interspersed with Mud Streambed or it may be interspersed with Cobble-Gravel Streambed in areas of fast flow or heavy sediment load. Examples of Dominance Types in the Riverine System are the scud *Gammarus*, the snails *Physa* and *Lymnaea,* and the midge *Chironomus;* in the Estuarine System the ghost shrimp *Callianassa* is a common Dominance Type.

Mud.-In this Subclass, the particles smaller than stones are chiefly silt or clay. Mud Streambeds are common in arid areas where intermittent flow is characteristic of streams of low gradient. Such species as tamarisk *(Tamarix gallica)* may occur, but are not dense enough to qualify the area for classification as Scrub-Shrub Wetland. Mud Streambeds are also common in the Estuarine System and the Tidal Subsystem of the Riverine System. Examples of Dominance Types for Mud Streambeds include the crayfish *Procambarus,* the pouch snail *Aplexa,* the fly *Tabanus*, the snail *Lymnaea,* the fingernail clam *Sphaerium*, and (in the Estuarine System) the mud snail *Nassarius*.

Organic. -This Subclass is characterized by channels formed in peat or muck. Organic Streambeds are common in the small creeks draining Estuarine Emergent Wetlands with organic soils. Examples of Dominance Types are the mussel *Modiolus* in the Estuarine System and the oligochaete worm *Limnodrilus* in the Riverine System.

Vegetated. -These streambeds are exposed long enough to be colonized by herbaceous annuals or seedling herbaceous perennials (pioneer plants). This vegetation, unlike that of Emergent Wetlands, is usually killed by rising water levels or sudden flooding. A typical Dominance Type is *Panicum capillare*.

Dominance Types for Streambeds in the Estuarine System were taken primarily from Smith (1964), Abbott (1968), and Ricketts and Calvin (1968) and those for streambeds in the Riverine System from Krecker and Lancaster (1933), Stehr and Branson (1938), van der Schalie (1948), Kenk (1949), Cummins et al. (1964), Clarke (1973), and Ward (1975).

Rocky Shore

Definition. The Class Rocky Shore includes wetland environments characterized by bedrock, stones, or boulders which singly or in combination have an area1 cover of 75% or more and an area1 coverage by vegetation of less than 30%. Water regimes are restricted to irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, and intermittently flooded.

Description. In Marine and Estuarine Systems, Rocky Shores are generally high-energy habitats which lie exposed as a result of continuous erosion by wind-driven waves or strong currents. The substrate is stable enough to permit the attachment and growth of sessile or sedentary invertebrates and attached algae or lichens. Rocky Shores usually display a vertical zonation that is a function of tidal range, wave action, and degree of exposure to the sun. In the Lacustrine and Riverine Systems, Rocky Shores support sparse plant and animal communities.

Subclasses and Dominance Types.

Bedrock.-These wetlands have bedrock covering 75% or more of the surface and less than 30% area1 coverage of macrophytes.

Rubble.-These wetlands have less than 75% area1 cover of bedrock, but stones and boulders alone or in combination with bedrock cover 75% or more of the area. The area1 coverage of macrophytes is less than 30%.

Communities or zones of Marine and Estuarine Rocky Shores have been widely studied (Lewis 1964; Ricketts and Calvin 1968; Stephenson and Stephenson 1972). Each zone supports a rich assemblage of invertebrates and algae or lichens or both. Dominance Types of the Rocky Shores often can be characterized by one or two dominant genera from these zones.

The uppermost zone (here termed the littorine-lichen zone) is dominated by periwinkles (*Littorina* and *Nerita*) and lichens. This zone frequently takes on a dark, or even black appearance, although abundant lichens may lend a colorful tone. These organisms are rarely submerged, but are kept moist by sea spray. Frequently this habitat is invaded from the landward side by semimarine genera such as the slater *Ligia*.

The next lower zone (the balanoid zone) is commonly dominated by mollusks, green algae, and barnacles of the balanoid group. The zone appears white. Dominance Types such as the barnacles *Balanus, Chthamalus,* and *Tetraclita* may form an almost pure sheet, or these animals may be interspersed with mollusks, tube worms, and algae such as *Pelvetia, Enteromorpha,* and *Ulva.*

The transition between the littorine-lichen and balanoid zones is frequently marked by the replacement of the periwinkles with limpets such as *Acmaea* and *Siphonaria.* The limpet band approximates the upper limit of the regularly flooded intertidal zone.

In the middle and lower intertidal areas, which are flooded and exposed by tides at least once daily, lie a number of other communities which can be characterized by dominant genera. *Mytilus* and gooseneck barnacles (*Pollicipes*) form communities exposed to strong wave action. Aquatic Beds dominated by *Fucus* and *Laminaria* lie slightly lower, just above those dominated by coralline algae *(Lithothamnion).* The *Laminaria* Dominance Type approximates the lower end of the Intertidal Subsystem; it is generally exposed at least once daily. The *Lithothamnion* Dominance Type forms the transition to the Subtidal Subsystem and is exposed only irregularly.

In the Palustrine, Riverine, and Lacustrine Systems various species of lichens such as *Verrucaria* spp. and *Dermatocarpon fluviatile, as* well as blue-green algae, frequently form characteristic zones on Rocky Shores. The distribution of these species depends on the duration of flooding or wetting by spray and is similar to the zonation of species in the Marine and Estuarine Systems (Hutchinson 1975). Though less abundant than lichens, aquatic liverworts such as *Marsupella emarginata* var. *aquatica* or mosses such as *Fissidens julianus* are found on the Rocky Shores of lakes and rivers. If aquatic liverworts or mosses cover 30% or more of the substrate, they should be placed in the Class Aquatic Bed. Other examples of Rocky Shore Dominance Types are the caddisfly *Hydropsyche* and the fingernail clam *Pisidium.*

Unconsolidated Shore

Definition. The Class Unconsolidated Shore includes all wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75% area1 cover of stones, boulders, or bedrock; (2) less than 30% area1 cover of vegetation other than pioneering plants; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Intermittent or intertidal channels of the Riverine System and intertidal channels of the Estuarine System are classified as Streambed.

Description. Unconsolidated Shores are characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms such as beaches, bars, and flats, all of which are included in this Class. Unconsolidated Shores are found adjacent to Unconsolidated Bottoms in all Systems; in the Palustrine and Lacustrine Systems, the Class may occupy the entire basin. As in Unconsolidated Bottoms, the particle size of the substrate and the water regime are the important factors determining the types of plant and animal communities present. Different substrates usually support characteristic invertebrate fauna. Fauna1 distribution is controlled by waves, currents, interstitial moisture, salinity, and grain size (Hedgpeth 1957; Ranwell 1972; Riedl and McMahan 1974).

Subclasses and Dominance Types.

Cobble-Gravel.-The unconsolidated particles smaller than stones are predominantly cobble and gravel. Shell fragments, sand, and silt often fill the spaces between the larger particles. Stones and boulders may be found scattered on some Cobble-Gravel Shores. In areas of strong wave and current action these shores take the form of beaches or bars, but occasionally they form extensive flats. Examples of Dominance Types in the Marine and Estuarine Systems are: the acorn barnacle *Balunus,* the limpet *Patella,* the periwinkle *Littorina,* the rock shell *Thais,* the mussels *Mytilus* and *Modiolus,* and the Venus clam *Saxidomus.* In the Lacustrine, Palustrine, and Riverine Systems examples of Dominance Types are the freshwater mollusk *Elliptio,* the snails *Lymnaea* and *Physa,* the toad bug *Gelastocoris,* the leech *Erpodella,* and the springtail *Agrenia.*

Sand.-The unconsolidated particles smaller than stones are predominantly sand which may be either calcareous or terrigenous in origin. They are prominent features of the Marine, Estuarine, Riverine, and Lacustrine Systems where the substrate material is exposed to the sorting and washing action of waves. Examples of Dominance Types in the Marine and Estuarine Systems are the wedge shell *Donax,* the soft-shell clam *Mya,* the quahog *Mercenaria,* the olive shell *Oliva,* the blood worm *Euzonus,* the beach hopper *Orchestia,* the pismo clam *Tivela stultorum,* the mole crab *Emerita,* and the lugworm *Arenicola.* Examples of Dominance Types in the Riverine, Lacustrine, and Palustrine Systems are the copepods *Parastenocaris* and *Phyllognathopus,* the oligochaete worm *Pristina,* the freshwater mollusks *Anodonta* and *Elliptio,* and the fingernail clams *Pisidium* and *Sphaerium.*

Mud. -The unconsolidated particles smaller than stones are predominantly silt and clay. Anaerobic conditions often exist below the surface. Mud Shores have a higher organic content than Cobble-Gravel or Sand Shores. They are typically found in areas of minor wave action. They tend to have little slope and are frequently called flats. Mud Shores support diverse populations of tube-dwelling and burrowing invertebrates that include worms, clams, and crustaceans (Gray 1974). They are commonly colonized by algae and diatoms which may form a crust or mat.

Irregularly flooded Mud Shores in the Estuarine System have been called salt flats, pans, or pannes. They are typically high in salinity and are usually surrounded by, or lie on the landward side of, Emergent Wetland (Martin et al. 1953, Type 15). In many arid areas, Palustrine and Lacustrine Mud Shores are encrusted or saturated with salt. Martin et al. (1953) called these habitats inland saline flats (Type 9); they are also called alkali flats, salt flats, and salt pans. Mud Shores may also result from removal of vegetation by man, animals, or fire, or from the discharge of thermal waters or pollutants.

Examples of Dominance Types in the Marine and Estuarine Systems include the fiddler crab *Uca*, the ghost shrimp *Callianassa,* the mud snails *Nassarius* and *Macoma*, the clam worm Nereis, the sea anemone *Cerianthus*, and the sea cucumber *Thyone*. In the Lacustrine, Palustrine, and Riverine Systems, examples of Dominance Types are the fingernail clam *Pisidium,* the snails *Aplexa* and *Lymnaea,* the crayfish *Procambarus*, the harpacticoid copepods *Canthocamptus* and *Bryocamptus,* the fingernail clam *Sphaerium,* the freshwater mollusk *Elliptio*, the shore bug *Saldula*, the isopod *Asellus*, the crayfish *Cambarus*, and the mayfly *Tortopus*.

Organic.-The unconsolidated material smaller than stones is predominantly organic soils of formerly vegetated wetlands. In the Marine and Estuarine Systems, Organic Shores are often dominated by microinvertebrates such as foraminifera, and by Nassarius, *Littorina, Uca, Modiolus*, *Mya*, *Nereis*, and the false angel wing *Petricola pholadiformis*. In the Lacustrine, Palustrine, and Riverine Systems, examples of Dominance Types are *Canthocamptus*, *Bryocamptus, Chironomus,* and the backswimmer *Notonecta*.

Vegetated.-Some nontidal shores are exposed for a sufficient period to be colonized by herbaceous annuals or seedling herbaceous perennials (pioneer plants). This vegetation, unlike that of Emergent Wetlands, is usually killed by rising water levels and may be gone before the beginning of the next growing season. Many of the pioneer species are not hydrophytes but are weedy mesophytes that cannot tolerate wet soil or flooding. Examples of Dominance Types in the Palustrine, Riverine, and Lacustrine Systems are cocklebur *(Xanthium strumarium*) and barnyard grass *(Echinochloa crusgalli*).

Dominance Types for Unconsolidated Shores in the Marine and Estuarine Systems were taken primarily from Smith (1964), Morris (1966), Abbott (1968), Ricketts and Calvin (1968), and Gosner (1971). Dominance Types for Unconsolidated Shores in the Lacustrine, Riverine, and Palustrine Systems were taken primarily from Stehr and Branson (1938), Kenk (1949), Ward and Whipple (1959), Cummins et al. (1964), Johnson (1970), Ingram (1971), Clarke (1973), and Hart and Fuller (1974).

Moss-Lichen Wetland

Definition. The Moss-Lichen Wetland Class includes areas where mosses or lichens cover substrates other than rock and where emergents, shrubs, or trees make up less than 30% of the area1 cover. The only water regime is saturated.

Description. Mosses and lichens are important components of the flora in many wetlands, especially in the north, but these plants usually form a ground cover under a dominant layer of trees, shrubs, or emergents. In some instances higher plants are uncommon and mosses or lichens dominate the flora. Such Moss-Lichen Wetlands are not common, even in the northern United States where they occur most frequently.

Subclasses and Dominance Types.

Moss.-Moss Wetlands are most abundant in the far north. Areas covered with peat mosses *(Sphagnum* spp.) are usually called bogs (Golet and Larson 1974; Jeglum et al. 1974; Zoltai et al. 1975), whether *Sphagnum* or higher plants are dominant. In Alaska, *Drepanocladus* and the liverwort *Chiloscyphus fragilis* may dominate shallow pools with impermanent water; peat moss and other mosses *(Campylium stellatum, Aulacomnium palustre,* and *Oncophorus wahlenbergii)* are typical of wet soil in this region (Britton 1957; Drury 1962).

Lichen.-Lichen Wetlands are also a northern Subclass. Reindeer moss (*Cladina rangiferina*) forms the most important Dominance Type. Pollett and Bridgewater (1973) described areas with mosses and lichens as bogs or fens, the distinction being based on the availability of nutrients and the particular plant species present. The presence of Lichen Wetlands has been noted in the Hudson Bay Lowlands (Sjörs 1959) and in Ontario (Jeglum et al. 1974).

Emergent Wetland

Definition. The Emergent Wetland Class is characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All water regimes are included except subtidal and irregularly exposed.

Description. In areas with relatively stable climatic conditions, Emergent Wetlands maintain the same appearance year after year. In other areas, such as the prairies of the central United States, violent climatic fluctuations cause them to revert to an open water phase in some years (Stewart and Kantrud 1972). Emergent Wetlands are found throughout the United States and occur in all Systems except the Marine. Emergent Wetlands are known by many names, including marsh, meadow, fen, prairie pothole, and slough. Areas that are dominated by pioneer plants which become established during periods of low water are not Emergent Wetlands and should be classified as Vegetated Unconsolidated Shores or Vegetated Streambeds.

Subclasses and Dominance Types.

Persistent.-Persistent Emergent Wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season. This Subclass is found only in the Estuarine and Palustrine Systems.

Persistent Emergent Wetlands dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*S. patens*), big cordgrass (*S. cynosuroides*), needlerush (*Juncus roemerianus*), narrow-leaved cattail (*Typha angustifolia*), and southern wild rice (*Zizaniopsis miliacea*) are major components of the Estuarine systems of the Atlantic and Gulf Coasts of the United States. On the Pacific Coast, common pickleweed (*Salicornia virginica*), sea blite (*Suaeda californica*), arrow grass (*Triglochin maritimum*), and California cordgrass (*Spartina foliosa*) are common dominants.

Palustrine Persistent Emergent Wetlands contain a vast array of grasslike plants such as cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), saw grass (*Cladium jamaicense*), sedges (Carex spp.); and true grasses such as reed (*Phragmites australis*), manna grasses (*Glyceria* spp.), slough grass (*Beckmannia syzigachne*), and whitetop (*Scolochloa festucacea*). There is also a variety of broad-leaved persistent emergents such as purple loosestrife (*Lythrum salicaria*), dock (*Rumex mexicanus*), water-willow (*Decodon verticillatus*), and many species of smartweeds (*Polygonum*).

Nonpersistent.-Wetlands in this Subclass are dominated by plants which fall to the surface of the substrate or below the surface of the water at the end of the growing season so that, at certain seasons of the year, there is no obvious sign of emergent vegetation. For example, wild rice (*Zizania aquatica*) does not become apparent in the North Central States until midsummer and fall, when it may form dense emergent stands. Nonpersistent emergents also include species such as arrow arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), and arrowheads (*Sagittaria* spp.). Movement of ice in Estuarine, Riverine, or Lacustrine Systems often removes all traces of emergent vegetation during the winter. Where this occurs, the area should be classified as Nonpersistent Emergent Wetland.

Scrub-Shrub Wetland

Definition. The Class Scrub-Shrub Wetland includes areas dominated by woody vegetation less than 6 m (20 feet) tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. All water regimes except subtidal are included.

Description. Scrub-Shrub Wetlands may represent a successional stage leading to Forested Wetland, or they may be relatively stable communities. They occur only in the Estuarine and Palustrine Systems, but are one of the most widespread classes in the United States (Shaw and Fredine 1956). Scrub-Shrub Wetlands are known by many names, such as shrub swamp (Shaw and Fredine 1956), shrub carr (Curtis 1959), bog (Heinselman 1970), and pocosin (Kologiski 1977). For practical reasons we have also included forests composed of young trees less than 6 m tall.

Subclasses and Dominance Types.

Broad-leaved Deciduous.-In Estuarine System Wetlands the predominant deciduous and broad-leaved trees or shrubs are plants such as sea-myrtle (*Baccharis halimifolia*) and marsh elder (*Iva frutescens*). In the Palustrine System typical Dominance Types are alders (*Alnus* spp.), willows (*Salix* spp.), buttonbush (*Cephalanthus occidentalis*), red osier dogwood (*Cornus stolonifera*), honeycup (*Zenobia pulverulenta*), spirea (*Spiraea douglasii*), bog birch (*Betula pumila*), and young trees of species such as red maple (*Acer rubrum*) or black spruce (*Picea mariana*).

Needle-leaved Deciduous.-This Subclass, consisting of wetlands where trees or shrubs are predominantly deciduous and needle-leaved, is represented by young or stunted trees such as tamarack or bald cypress (*Taxodium distichum*).

Broad-leaved Evergreen. —In the Estuarine System, vast wetland acreages are dominated by mangroves (*Rhizophora mangle*, *Languncularia racemosa*, *Conocarpus erectus*, and *Avicennia germinans*) that are less than 6 m tall. In the Palustrine System, the broad-leaved evergreen species are typically found on organic soils. Northern representatives are labrador tea (*Ledum groenlandicum*), bog rosemary (*Andromeda glaucophylla*), bog laurel (*Kalmia polifolia*), and the semi-evergreen leatherleaf (*Chamaedaphne calyculata*). In the south, fetterbush (*Lyonia lucida*), coastal sweetbells (*Leucothoe axillaris*), inkberry (*Ilex glabra*), and the semi-evergreen black ti-ti (*Cyrilla racemiflora*) are characteristic broad-leaved evergreen species.

Needle-leaved Evergreen.-The dominant species in Needle-leaved Evergreen Wetlands are young or stunted trees such as black spruce or pond pine (*Pinus serotina*).

Dead.—Dead woody plants less than 6 m tall dominate Dead Scrub-Shrub Wetlands. These wetlands are usually produced by a prolonged rise in the water table resulting from impoundment of water by landslides, man, or beavers. Such wetlands may also result from various other factors such as fire, salt spray, insect infestation, air pollution, and herbicides.

Forested Wetland

Definition. The Class Forested Wetland is characterized by woody vegetation that is 6 m tall or taller. All water regimes are included except subtidal.

Description. Forested Wetlands are most common in the eastern United States and in those sections of the West where moisture is relatively abundant, particularly along rivers and in the mountains. They occur only in the Palustrine and Estuarine Systems and normally possess an overstory of trees, an understory of young trees or shrubs, and a herbaceous layer. Forested Wetlands in the Estuarine System, which include the mangrove forests of Florida, Puerto Rico, and the Virgin Islands, are known by such names as swamps, hammocks, heads, and bottoms. These names often occur in combination with species names or plant associations such as cedar swamp or bottomland hardwoods.

Subclasses and Dominance Types.

Broad-leaved Deciduous. -Dominant trees typical of Broad-leaved Deciduous Wetlands, which are represented throughout the United States, are most common in the South and East. Common dominants are species such as red maple, American elm (*Ulmus americana*), ashes (*Fraxinus pennsylvanica* and *F. nigra),* black gum (Nyssa *sylvatica*), tupelo gum (*N. aquatica),* swamp white oak (*Quercus bicolor),* overcup oak (*Q. lyrata),* and basket oak (Q. *michausii).* Wetlands in this subclass generally occur on mineral soils or highly decomposed organic soils.

Needle-leaved Deciduous-The southern representative of the Needle-leaved Deciduous Subclass is bald cypress *(Taxodium distichum),* which is noted for its ability to tolerate long periods of surface inundation. Tamarack is characteristic of the Boreal Forest Region, where it occurs as a dominant on organic soils. Relatively few other species are included in this Subclass.

Broad-leaved Evergreen.-In the Southeast, Broad-leaved Evergreen Wetlands reach their greatest development. Red bay (*Persea borbonia),* loblolly bay (Gordonia *lasianthus),* and sweet bay *(Magnolia virginiana)* are prevalent, especially on organic soils. This Subclass also includes red mangrove, black mangrove *(Avicennia germinans*), and white mangrove (*Languncularia racemosa*), which are adapted to varying levels of salinity.

Needle-leaved Evergreen. -Black spruce, growing on organic soils, represents a major dominant of the Needle-leaved Evergreen Subclass in the North. Though black spruce is common on nutrient-poor soils, Northern white cedar (*Thuja occidentalis)* dominates northern wetlands on more nutrient-rich sites. Along the Atlantic Coast, Atlantic white cedar (*Chamaecyparis thyoides)* is one of the most common dominants on organic soils. Pond pine is a common needle-leaved evergreen found in the Southeast in association with dense stands of broad-leaved evergreen and deciduous shrubs.

Dead.-Dead Forested Wetlands are dominated by dead woody vegetation taller than 6 m (20 feet). Like Dead Scrub-Shrub Wetlands, they are most common in, or around the edges of, man-made impoundments and beaver ponds. The same factors that produce Dead Scrub-Shrub Wetlands produce Dead Forested Wetlands.

Modifiers

To fully describe wetlands and deepwater habitats, one must apply certain Modifiers at the Class level and at lower levels in the classification hierarchy. The Modifiers described below were adapted from existing classifications or were developed specifically for this system.

Water Regime Modifiers

Precise description of hydrologic characteristics requires detailed knowledge of the duration and timing of surface inundation, both yearly and long-term, as well as an understanding of groundwater fluctuations. Because such information is seldom available, the water regimes that, in part, determine characteristic wetland and deepwater plant and animal communities are described here in only general terms. Water regimes are grouped under two major headings, Tidal and Nontidal.

Tidal Water Regime Modifiers are used for wetlands and deepwater habitats in the Estuarine and Marine Systems and Nontidal Modifiers are used for all nontidal parts of the Palustrine, Lacustrine, and Riverine Systems. The Tidal Subsystem of the Riverine System and tidally influenced parts of the Palustrine and Lacustrine Systems require careful selection of Water Regime Modifiers. We designate subtidal and irregularly exposed wetlands and deepwater habitats in the Palustrine, Riverine, and Lacustrine Systems as *permanently jlooded-tidal* rather than subtidal, and Palustrine, Riverine, and Lacustrine wetlands regularly flooded by the tide as *regularly flooded.* If Palustrine, Riverine, and Lacustrine wetlands are only irregularly flooded by tides, we designate them by the appropriate nontidal Water Regime Modifier with the word tidal added, as in *seasonally flooded-tidal.*

Tidal

The water regimes are largely determined by oceanic tides.

Subtidal. The substrate is permanently flooded with tidal water.

Irregularly Exposed. The land surface is exposed by tides less often than daily.

Regularly Flooded. Tidal water alternately floods and exposes the land surface at least once daily.

Irregularly Flooded. Tidal water floods the land surface less often than daily.

The periodicity and amplitude of tides vary in different parts of the United States, mainly because of differences in latitude and geomorphology. On the Atlantic Coast, two nearly equal high tides are the rule (semidiurnal). On the Gulf Coast, there is frequently only one high tide and one low tide each day (diurnal); and on the Pacific Coast there are usually two unequal high tides and two unequal low tides (mixed semidiurnal).

Individual tides range in height from about 9.5 m (31 feet) at St. John, New Brunswick (U.S. National Oceanic and Atmospheric Administration 1973) to less than 1 m (3.3 feet) along the Louisiana coast (Chabreck 1972). Tides of only 10 cm (4.0 inches) are not uncommon in Louisiana. Therefore, though no hard and fast rules apply, the division between regularly flooded and irregularly flooded water regimes would probably occur approximately at mean high water on the Atlantic Coast, lowest level of the higher high tide on the Pacific Coast, and just above mean tide level of the Gulf Coast. The width of the intertidal zone is determined by the tidal range, the slope of the shoreline, and the degree of exposure of the site to wind and waves.

Nontidal

Though not influenced by oceanic tides, nontidal water regimes may be affected by wind or seiches in lakes. Water regimes are defined in terms of the growing season, which we equate to the frost-free period (see the U.S. Department of Interior National Atlas 1970:110-111 for generalized regional delineation). The rest of the year is defined as the dormant season, a time when even extended periods of flooding may have little influence on the development of plant communities.

Permanently Flooded. Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes.

Intermittently Exposed. Surface water is present throughout the year except in years of extreme drought.

Semipermanently Flooded. Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Seasonally Flooded. Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

Saturated. The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.

Temporarily Flooded. Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. Plants that grow both in uplands and wetlands are characteristic of the temporarily flooded regime.

Intermittently Flooded. The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation. The dominant plant communities under this regime may change as soil moisture conditions change. Some areas exhibiting this regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes.

Artificially Flooded. The amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams. The vegetation growing on these areas cannot be considered a reliable indicator of water regime. Examples of artificially flooded wetlands are some agricultural lands managed under a rice-soybean rotation, and wildlife management areas where forests, crops, or pioneer plants may be flooded or dewatered to attract wetland wildlife. Neither wetlands within or resulting from leakage from man-made impoundments, nor irrigated pasture lands supplied by diversion ditches or artesian wells, are included under this modifier.

Water Chemistry Modifiers

The accurate characterization of water chemistry in wetlands and deepwater habitats is difficult, both because of problems in measurement and because values tend to vary with changes in the season, weather, time of day, and other factors. Yet, very subtle changes in water chemistry, which occur over short distances, may have a marked influence on the types of plants or animals that inhabit an area. A description of water chemistry, therefore, must be an essential part of this classification system.

The two key characteristics employed in this system are salinity and hydrogen-ion concentration (pH). All habitats are classified according to salinity, and freshwater habitats are further subdivided by pH levels.

Salinity Modifiers

Differences in salinity are reflected in the species composition of plants and animals. Many authors have suggested using biological changes as the basis for subdividing the salinity range between sea water and fresh water (Remane and Schlieper 1971). Others have suggested a similar subdivision for salinity in inland wetlands (Moyle 1946; Bayly 1967; Stewart and Kantrud 1971). Since the gradation between fresh and hypersaline or hyperhaline waters is continuous, any boundary is artificial, and few classification systems agree completely.

Estuarine and Marine waters are a complex solution of salts, dominated by sodium chloride ($NaCl$). The term *haline* is used to indicate the dominance of ocean salt. The relative proportions of the various major ions are usually similar to those found in sea water, even if the water is diluted below sea water strength. Dilution of sea water with fresh water and concentration of sea water by evaporation result in a wide range of recorded salinities in both surface water and interstitial (soil) water.

We have modified the Venice System, suggested at a "Symposium on the Classification of Brackish Waters" in 1958, for use in the Marine and Estuarine Systems (Table 2). The System has been widely used during recent years (Macan 1961, 1963; Burbank 1967; Carriker 1967; Reid and Wood 1976), although there has been some criticism of its applicability (den Hartog 1960; Price and Gunter 1964).

The salinity of inland water is dominated by four major cations, calcium (Ca), magnesium (Mg), sodium (Na), and potassium (K); and three major anions, carbonate (CO,), sulfate (SO,), and chloride (Cl) (Wetzel 1975). Salinity is governed by the interactions between precipitation, surface runoff, groundwater flow, evaporation, and sometimes evapotranspiration by plants. The ionic ratios of inland waters usually differ appreciably from those in the sea, although there are exceptions (Bayly 1967). The great chemical diversity of these waters, the wide variation in physical conditions such as temperature, and often the relative impermanence of surface water, make it extremely difficult to subdivide the inland salinity range in a meaningful way. Bayly (1967) attempted a subdivision on the basis of animal life; Moyle (1945) and Stewart and Kantrud (1971) have suggested two very different divisions on the basis of plant life. We employ a subdivision that is identical to that used in the Estuarine and Marine Systems (Table 2).

The term saline is used to indicate that any of a number of ions may be dominant or codominant. The term *brackish* has been applied to inland waters of intermediate salinity (Remane and Schlieper 1971; Stewart and Kantrud 1971), but is not universally accepted (see Bayly 196784); therefore, mixosaline is used here. In some inland wetlands, high soil salinities control the invasion or establishment of many plants. These salinities are expressed in units of specific conductance as well as percent salt (Ungar 1974) and they are also covered by the salinity classes in Table 2.

pH Modifiers

Acid waters are, almost by definition, poor in calcium and often generally low in other ions, but some very soft waters may have a neutral pH (Hynes 1970). It is difficult to separate the effects of high concentrations of hydrogen ions from low base content, and many studies suggest that acidity may never be the major factor controlling the presence or absence of particular plants and animals. Nevertheless, some researchers have demonstrated a good correlation between pH levels and plant distribution (Sjörs 1950; Jeglum 1971). Jeglum (1971) showed that plants can be used to predict the pH of moist peat.

There seems to be little doubt that, where a peat layer isolates plant roots from the underlying mineral substrate, the availability of minerals in the root zone strongly influences the types of plants that occupy the site. For this reason, many authors subdivide freshwater, organic wetlands into mineral-rich and mineral-poor categories (Sjörs 1950; Heinselman 1970; Jeglum 1971; Moore and Bellamy 1974). We have instituted pH modifiers for freshwater wetlands (Table 3) because pH has been widely used to indicate the difference between mineral-rich and mineral-poor sites, and because it is relatively easy to determine. The ranges presented here are similar to those of Jeglum (1971), except that the upper limit of the circumneutral level (Jeglum's mesotrophic) was raised to bring it into agreement with usage of the term in the United States. The ranges given apply to the pH of water. They were converted from Jeglum's moist-peat equivalents by adding 0.5 pH units.

Soil Modifiers

Soil is one of the most important physical components of wetlands. Through its depth, mineral composition, organic matter content, moisture regime, temperature regime, and chemistry, it exercises a strong influence over the types of plants that live on its surface and the kinds of organisms that dwell within it. In addition, the nature of soil in a wetland, particularly the thickness of organic soil, is of critical importance to engineers planning construction of highways or buildings. For these and other reasons, it is essential that soil be considered in the classification of wetlands.

According to the U.S. Soil Conservation Service, Soil Survey Staff (1975:1-2), soil is limited to terrestrial situations and shallow waters; however, "areas are not considered to have soil if the surface is permanently covered by water deep enough that only floating plants are present. .'' Since emergent plants do not grow beyond a depth of about 2 m in inland waters, the waterward limit of soil is virtually equivalent to the waterward limit of wetland, according to our definition. Wetlands can then be regarded as having soil in most cases, whereas deepwater habitats are never considered to have soil.

The most basic distinction in soil classification in the United States is between mineral soil and organic soil (U.S. Soil Conservation Service, Soil Survey Staff 1975). The Soil Conservation Service recognizes nine orders of mineral soils and one order of organic soils (Histosols) in its taxonomy. Their classification is hierarchical and permits the description of soils at several levels of detail. For example, suborders of Histosols are recognized according to the degree of decomposition of the organic matter.

Table 3. *pH Modifiers used in this classification system.*

Modifier	pH of Water
Acid	<5.5
Circumneutral	5.5-7.4
Alkaline	>7 4

We use the Modifiers mineral and organic in this classification. Mineral soils and organic soils are differentiated on the basis of specific criteria that are enumerated in soil taxonomy (U.S. Soil Conservation Service, Soil Survey Staff 1975:13-14, 65). These criteria are restated in our Appendix D for ready reference. If a more detailed classification is desired, the U.S. Soil Conservation Service classification system should be used.

Special Modifiers

Many wetlands and deepwater habitats are man-made, and natural ones have been modified to some degree by the activities of man or beavers. Since the nature of these modifications often greatly influences the character of such habitats, special modifying terms have been included here to emphasize their importance. The following Modifiers should be used singly or in combination wherever they apply to wetlands and deepwater habitats.

Excavated

Lies within a basin or channel excavated by man.

Impounded

Created or modified by a barrier or dam which purposefully or unintentionally obstructs the outflow of water. Both man-made dams and beaver dams are included.

Diked

Created or modified by a man-made barrier or dike designed to obstruct the inflow of water.

Partly Drained

The water level has been artificially lowered, but the area is still classified as wetland because soil moisture is sufficient to support hydrophytes. Drained areas are not considered wetland if they can no longer support hydrophytes.

Farmed

The soil surface has been mechanically or physically altered for production of crops, but hydrophytes will become reestablished if farming is discontinued.

Artificial

Refers to substrates classified as Rock Bottom, Unconsolidated Bottom, Rocky Shore, and Unconsolidated Shore that were emplaced by man, using either natural materials such as dredge spoil or synthetic materials such as discarded automobiles, tires, or concrete. Jetties and breakwaters are examples of Artificial Rocky Shores. Man-made reefs are an example of Artificial Rock Bottoms.

REGIONALIZATION FOR THE CLASSIFICATION SYSTEM

In this classification system, a given taxon has no particular regional alliance; its representatives may be found in one or many parts of the United States. However, regional variations in climate, geology, soils, and vegetation are important in the development of different wetland habitats; and management problems often differ greatly in different regions. For these reasons, there is a need to recognize regional differences. Regionalization is designed to facilitate three activities: (1) planning, where it is necessary to study management problems and potential solutions on a regional basis; (2) organization and retrieval of data gathered in a resource inventory; and (3) interpretation of inventory data, including differences in indicator plants and animals among the regions.

We recommend the classification and map (Fig. 7) of Bailey (1976) to fill the need for regionalization inland. Bailey's classification of ecoregions is hierarchical. The upper four levels are domain (defined as including subcontinental areas of related climates), division (defined as including regional climate at the level of Köppen's [1931] types), province (defined as including broad vegetational types), and section (defined as including climax vegetation at the level of Küchler's [1964] types). On the map, the boundaries between the different levels are designated by lines of various widths and the sections are numbered with a four-digit code; digits 1 through 4 represent the first four levels in the hierarchy. The reader is referred to Bailey (1976, 1978) for detailed discussion and description of the units appearing on his map, reproduced in our Fig. 7.

The Bailey system terminates at the ocean, whereas the present wetland classification includes Marine and Estuarine habitats. Many workers have divided Marine and Estuarine realms into series of biogeographic provinces (e.g., U.S. Senate 1970; Ketchum 1972). These provinces differ somewhat in detail, but the broader concepts are similar. Figure 7 shows the distribution of 10 Marine and Estuarine provinces that we offer for North America.

- ***Arctic Province*** extends from the southern tip of Newfoundland (Avalon Peninsula), northward around Canada to the west coasts of the Arctic Ocean, Bering Sea, and Baffin and Labrador basins. It is characterized by the southern extension of floating ice, the 4°C summer isotherm, and Arctic biota.
- ***Acadian Province*** extends along the Northeast Atlantic Coast from the Avalon Peninsula to Cape Cod and is characterized by a well developed algal flora and boreal biota. The shoreline is heavily indented and frequently rocky. It has a large tidal range and is strongly influenced by the Labrador Current.
- ***Virginian Province*** extends along the Middle Atlantic Coast from Cape Cod to Cape Hatteras. The province

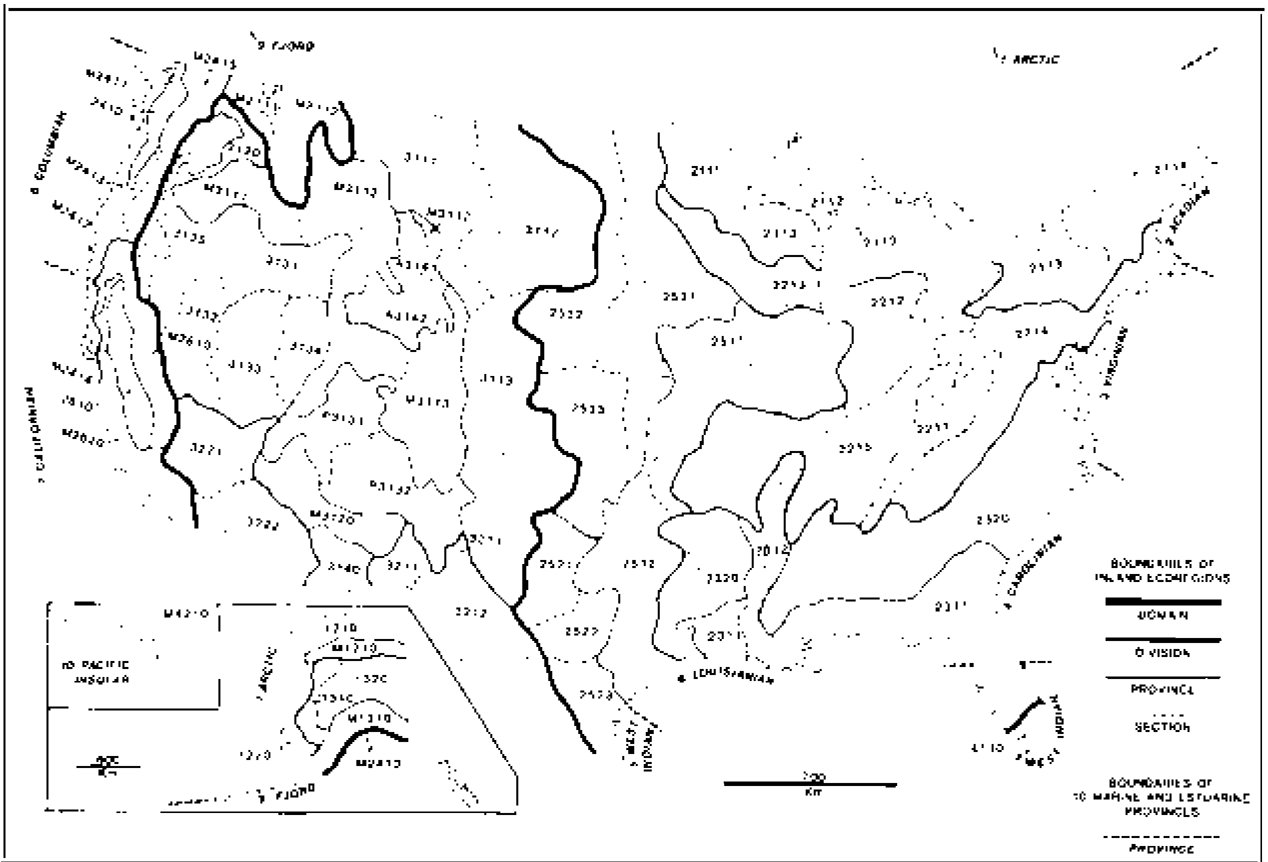

Fig. 7. Ecoregions of the United States after Bailey (1976) with the addition of 10 Marine and Estuarine Provinces proposed in our classification.

"Domains, Divisions, Provinces, and Sections used on Bailey's (1976) map and described in detail in Bailey (1978). Highland ecoregions are designated M mountain, P plateau, and A altiplano.

1000 Polar
- 1200 Tundra
  - 1210 Arctic Tundra
  - 1220 Bering Tundra
  - M1210 Brooks Range
- 1300 Subarctic
  - 1310 Yukon Parkland
  - 1320 Yukon Forest
  - M1310 Alaska Range

2000 Humid Temperate
- 2100 Warm Continental
  - 2110 Laurentian Mixed Forest
    - 2111 Spruce-Fir Forest
    - 2112 Northern Hardwoods-Fir Forest
    - 2113 Northern Hardwoods Forest
    - 2114 Northern Hardwoods-Spruce Forest
  - M2110 Columbia Forest
    - M2111 Douglas-fir Forest
    - M2112 Cedar-Hemlock-Douglas-fir Forest
- 2200 Hot Continental
  - 2210 Eastern Deciduous Forest
    - 2211 Mixed Mesophytic Forest
    - 2212 Beech-Maple Forest
    - 2213 Maple-Basswood Forest + Oak Savanna
    - 2214 Appalachian Oak Forest
    - 2215 Oak-Hickory Forest
- 2300 Subtropical
  - 2310 Outer Coastal Plain Forest
    - 2311 Beech-Sweetgum-Magnolia-Pine-Oak
    - 2312 Southern Floodplain Forest
  - 2320 Southeastern Mixed Forest

2000 Humid Temperate
- 2400 Marine
  - 2410 Willamette-Puget Forest
  - M2410 Pacific Forest (in conterminous U.S.)
    - M2411 Sitka Spruce-Cedar-Hemlock Forest
    - M2412 Redwood Forest
    - M2413 Cedar-Hemlock-Douglas-fir Forest
    - M2414 California Mixed Evergreen Forest
    - M2415 Silver fir-Douglas-fir Forest
  - M2410 Pacific Forest (in Alaska)
- 2500 Prairie
  - 2510 Prairie Parkland
    - 2511 Oak-Hickory-Bluestem Parkland
    - 2512 Oak + Bluestem Parkland
  - 2520 Prairie Brushland
    - 2521 Mesquite-Buffalo Grass
    - 2522 Juniper-Oak-Mesquite
    - 2523 Mesquite-Acacia
  - 2530 Tall-Grass Prairie
    - 2531 Bluestem Prairie
    - 2532 Wheatgrass-Bluestem-Needlegrass
    - 2533 Bluestem-Grama Prairie
- 2600 Mediterranean (Dry-summer Subtropical)
  - 2610 California Grassland
  - M2610 Sierran Forest
  - M2620 California Chaparral

3000 Dry
- 3100 Steppe
  - 3110 Great Plains Shortgrass Prairie
    - 3111 Grama-Needlegrass-Wheatgrass
    - 3112 Wheatgrass-Needlegrass
    - 3113 Grama-Buffalo Grass

3000 Dry
- 3100 Steppe
  - M3110 Rocky Mountain Forest
    - M3111 Grand fir-Douglas-fir Forest
    - M3112 Douglas-fir Forest
    - M3113 Ponderosa Pine-Douglas-fir Forest
  - 3120 Palouse Grassland
  - M3120 Upper Gila Mountains Forest
  - 3130 Intermountain Sagebrush
    - 3131 Sagebrush-Wheatgrass
    - 3132 Lahontan Saltbush-Greasewood
    - 3133 Great Basin Sagebrush
    - 3134 Bonneville Saltbush-Greasewood
    - 3135 Ponderosa Shrub Forest
  - P3130 Colorado Plateau
    - P3131 Juniper-Pinyon Woodland + Sagebrush Saltbush Mosaic
    - P3132 Grama-Galleta steppe + Juniper-Pinyon Woodland Mosaic
  - 3140 Mexican Highland Shrub Steppe
  - A3140 Wyoming Basin
    - A3141 Wheatgrass-Needlegrass-Sagebrush
    - A3142 Sagebrush-Wheatgrass
- 3200 Desert
  - 3210 Chihuahuan Desert
    - 3211 Grama-Tobosa
    - 3212 Tarbush-Creosote Bush
  - 3220 American Desert
    - 3221 Creosote Bush
    - 3222 Creosote Bush-Bur Sage

4000 Humid Tropical
- 4100 Savanna
  - 4110 Everglades
- 4200 Rainforest
  - M4210 Hawaiian Islands

is transitional between the Acadian and Carolinian Provinces. The biota is primarily temperate, but has some boreal representatives. The Labrador Current occasionally extends down to Cape Hatteras and winter temperatures may approach 4°C. The tidal range is moderate.

- Carolinian *Province* is situated along the South Atlantic Coast from Cape Hatteras to Cape Kennedy. It contains extensive marshes and well developed barrier islands. Waters are turbid and productive. The biota is temperate but has seasonal tropical elements. The Gulf Stream is the primary influence, and winter temperatures reach a minimum of 10°C; summer temperatures are tropical (in excess of 20°C). The tidal range is small to moderate.

- *West Indian Province* extends from Cape Kennedy to Cedar Key, Florida, and also includes the southern Gulf of Mexico, the Yucatan Peninsula, Central America, and the Caribbean Islands. The shoreland is usually low-lying limestone with calcareous sands and marls, except for volcanic islands. The biota is tropical and includes reef corals and mangroves. Minimum winter temperatures are about 20°C and the tidal range is small.

- *Louisianian Province* extends along the northern coast of the Gulf of Mexico from Cedar Key to Port Aransas, Texas. The characteristics of the province are similar to those of the Carolinian, reflecting the past submergence of the Florida Peninsula. The biota is primarily temperate and the tidal range is small.

- *Californian Province* extends along the Pacific Coast from Mexico northward to Cape Mendocino. The shoreland is strongly influenced by coastal mountains and the coasts are rocky. Freshwater runoff is limited. In the southern part volcanic sands are present; marshes and swamps are scarce throughout the province. The climate is Mediterranean and is influenced by the California Current. The biota is temperate, and includes well developed offshore kelp beds. The tidal range is moderate.

- Coluw&ian *Province* extends along the northern Pacific Coast from Cape Mendocino to Vancouver Island. Mountainous shorelands with rocky foreshores are prevalent. Estuaries are strongly influenced by freshwater runoff. The biota is primarily temperate with some boreal components, and there are extensive algal communities. The province is influenced by both the Aleutian and California Currents. The tidal range is moderate to large.

- *Fjord Province* extends along the Pacific Coast from Vancouver Island to the southern tip of the Aleutian Islands. Precipitous mountains, deep estuaries (some with glaciers), and a heavily indented shoreline subject to winter icing are typical of the coast. The biota is boreal to sub-Arctic. The province is influenced by the Aleutian and Japanese Currents, and the tidal range is large.

**Pacific Insular Province* surrounds all the Hawaiian Islands. The coasts have precipitous mountains and wave action is stronger than in most of the other provinces. The biota is largely endemic and composed of tropical and subtropical forms. The tidal range is small.

Use of Bailey's sections for the Riverine, Lacustrine, and Palustrine Systems and the Provinces defined above for the Marine and Estuarine Systems provides a regional locator for any wetland in the United States.

USE OF THE CLASSIFICATION SYSTEM

This System was designed for use over an extremely wide geographic area and for use by individuals and organizations with varied interests and objectives. The classification employs 5 System names, 8 Subsystem names, 11 Class names, 28 Subclass names, and an unspecified number of Dominance Types. It is, of necessity, a complex System when viewed in its entirety, but use of the System for a specific purpose at a local site should be simple and straightforward. Artificial keys to the Systems and Classes (Appendix E) are furnished to aid the user of the classification, but reference to detailed definitions in the text is also required. The purpose of this section is to illustrate how the System should be used and some of the potential pitfalls that could lead to its misuse.

Before attempting to apply the System, the user should consider four important points:

(1) Information about the area to be classified must be available before the System can be applied. This information may be in the form of historical data, aerial photographs, brief on-site inspection, or detailed and intensive studies. The System is designed for use at varying degrees of detail. There are few areas for which sufficient information is available to allow the most detailed application of the System. If the level of detail provided by the data is not sufficient for the needs of the user, additional data gathering is mandatory.

(2) Below the level of Class, the System is open-ended and incomplete. We give only examples of the vast number of Dominance Types that occur. The user may identify additional Dominance Types and determine where these fit into the classification hierarchy. It is also probable that as the System is used the need for additional Subclasses will become apparent.

(3) One of the main purposes of the new classification is to ensure uniformity throughout the United States. It is important that the user pay particular attention to the definitions in the classification. Any attempt at modification of these definitions will lead to lack of uniformity in application.

(4) One of the principal uses of the classification system will be the inventory and mapping of wetlands and deepwater habitats. A classification used in the mapping is scale-specific, both for the minimum size of units mapped

and for the degree of detail attainable. It is necessary for the user to develop a specific set of mapping conventions for each application and to demonstrate their relationship to the generalized classification described here. For example, there are a number of possible mapping conventions for a small wetland basin 50 m (164 feet) in diameter with concentric rings of vegetation about the deepest zone. At a scale of 1:500 each zone may be classified and mapped; at 1:20,000 it might be necessary to map the entire basin as one zone and ignore the peripheral bands; and at 1:100,000 the entire wetland basin may be smaller than the smallest mappable unit, and such a small-scale map is seldom adequate for a detailed inventory and must be supplemented by information gathered by sampling. In other areas, it may be necessary to develop mapping conventions for taxa that cannot be easily recognized; for instance, Aquatic Beds in turbid waters may have to be mapped simply as Unconsolidated Bottom.

Hierarchical Levels and Modifiers

We have designed the various levels of the system for specific purposes, and the relative importance of each will vary among users. The Systems and Subsystems are most important in applications involving large regions or the entire country. They serve to organize the Classes into meaningful assemblages of information for data storage and retrieval.

The Classes and Subclasses are the most important part of the system for many users and are basic to wetland mapping. Most Classes should be easily recognizable by users in a wide variety of disciplines. However, the Class designations apply to average conditions over a period of years, and since many wetlands are dynamic and subject to rapid changes in appearance, the proper classification of a wetland will frequently require data that span a period of years and several seasons in each of those years.

The Dominance Type is most important to users interested in detailed regional studies. It may be necessary to identify Dominance Types in order to determine which modifying terms are appropriate, because plants and animals present in an area tend to reflect environmental conditions over a period of time. Water regime can be determined from long-term hydrologic studies where these are available. The more common procedure will be to estimate this characteristic from the Dominance Types. Several studies have related water regimes to the presence and distribution of plants or animals (e.g., Stephenson and Stephenson 1972; Stewart and Kantrud 1972; Chapman 1974).

Similarly, we do not intend that salinity measurements be made for all wetlands except where these data are required; often plant species or associations can be used to indicate broad salinity classes. Lists of halophytes have been prepared for both coastal and inland areas (e.g., Duncan 1974; MacDonald and Barbour 1974; Ungar 1974), and a number of floristic and ecological studies have described plants that are indicators of salinity (e.g., Penfound and Hathaway 1938; Moyle 1945; Kurz and Wagner 1957; Dillon 1966; Anderson et al. 1968; Chabreck 1972; Stewart and Kantrud 1972; Ungar 1974).

In areas where the Dominance Types to be expected under different water regimes and types of water chemistry conditions have not been identified, detailed regional studies will be required before the classification can be applied in detail. In areas where detailed soil maps are available, it is also possible to infer water regime and water chemistry from soil series (U.S. Soil Conservation Service, Soil Survey Staff 1975).

Some of the Modifiers are an integral part of this system and their use is essential; others are used only for detailed applications or for special cases. Modifiers are never used with Systems and Subsystems; however, at least one Water Regime Modifier, one Water Chemistry Modifier, and one Soil Modifier must be used at all lower levels in the hierarchy. Use of the Modifiers listed under mixosaline and mixohaline (Table 2) is optional but these finer categories should be used whenever supporting data are available. The user is urged not to rely on single observations of water regime or water chemistry. Such measurements give misleading results in all but the most stable wetlands. If a more detailed Soil Modifier, such as soil order or suborder (U.S. Soil Conservation Service, Soil Survey Staff 1975) can be obtained, it should be used in place of the Modifiers, mineral and organic. Special Modifiers are used where appropriate.

Relationship to Other Wetland Classifications

There are numerous wetland classifications in use in the United States. Here we relate this system to three published classifications that have gained widespread acceptance. It is not possible to equate these systems directly for several reasons: (1) the criteria selected for establishing categories differ; (2) some of the classifications are not applied consistently in different parts of the country; and (3) the elements classified are not the same in various classifications.

The most widely used classification system in the United States is that of Martin et al. (1953) which was republished in U.S. Fish and Wildlife Service Circular 39 (Shaw and Fredine 1956). The wetland types are based on criteria such as water depth and permanence, water chemistry, life form of vegetation, and dominant plant species. In Table 4 we compare some of the major components of our system with the type descriptions listed in Circular 39.

In response to the need for more detailed wetland classification in the glaciated Northeast, Golet and Larson (1974) refined the freshwater wetland types of

Table 4. *Comparison of wetland types described in U.S. Fish and Wildlife Service* Circular 39 *with some of the major components of this classification system.*

Circular *39* type and references for examples of typical vegetation	Classification of wetlands and deepwater habitats: Classes	Water regimes	Water chemistry
Type l-Seasonally flooded basins or flats Wet meadow (Dix and Smeins 196'7; Stewart and Kantrud 1972) Bottomland hardwoods (Braun 1950) Shallow-freshwater swamps (Penfound 1952)	Emergent Wetland Forested Wetland	Temporarily Flooded Intermittently Flooded	Fresh Mixosaline
Type 2-Inland fresh meadows Fen (Heinselman 1963) Fen, northern sedge meadow (Curtis 1959)	Emergent Wetland	Saturated	Fresh Mixosaline
Type 3-Inland shallow fresh marshes Shallow marsh (Stewart and Kantrud 1972; Golet and Larson 1974)	Emergent Wetland	Semipermanently Flooded Seasonally Flooded	Fresh Mixosaline
Type I-Inland deep fresh marshes Deep marsh (Stewart and Kantrud 1972; Golet and Larson 1974)	Emergent Wetland Aquatic Bed	Permanently Flooded Intermittently Exposed Semipermanently Flooded	Fresh Mixosaline
Type 5-Inland open fresh water Open water (Golet and Larson 1974) Submerged aquatic (Curtis 1959)	Aquatic Bed Unconsolidated Bottom	Permanently Flooded Intermittently Exposed	Fresh Mixosaline
Type B-Shrub swamps Shrub swamp (Golet and Larson 1974) Shrub-carr, alder thicket (Curtis 1959)	Scrub-Shrub Wetland	All nontidal regimes except Permanently Flooded	Fresh
Type 7—Wooded swamps Wooded swamp (Golet and Larson 1974) Swamps (Penfound 1952; Heinselman 1963)	Forested Wetland	All nontidal regimes except Permanently Flooded	Fresh
Type 8—Bogs Bog (Dansereau and Segadas-vianna 1952; Heinselman 1963) Pocosin (Penfound 1952; Kologiski 1977)	Scrub-Shrub Wetland Forested Wetland Moss-Lichen Wetland	Saturated	Fresh (acid only)
Type 9—Inland saline flats Intermittent alkali zone (Stewart and Kantrud 1972)	Unconsolidated Shore	Seasonally Flooded Temporarily Flooded Intermittently Flooded	Eusaline Hypersaline
Type 10—Inland saline marshes Inland salt marshes (Ungar 1974)	Emergent Wetland	Semipermanently Flooded Seasonally Flooded	Eusaline
Type ll-Inland open saline water Inland saline lake community (Ungar 1974)	Unconsolidated Bottom	Permanently Flooded Intermittently Exposed	Eusaline
Type 12—Coastal shallow fresh marshes Marsh (Anderson et al. 1968) Estuarine bay marshes, estuarine river marshes (Stewart 1962) Fresh and intermediate marshes (Chabreck 1972)	Emergent Wetland	Regularly Flooded Irregularly Flooded Semipermanently Flooded-Tidal	Mixohaline Fresh

Table 4. Continued.

Circular *39* type and references for examples of vegetation	Classification of wetlands and deepwater habitats		
	Classes	Water regimes	Water chemistry
Type 13—Coastal deep fresh marshes			
Marsh (Anderson et al. 1968)	Emergent Wetland	Regularly Flooded	Mixohaline
Estuarine bay marshes, estuarine river marshes (Stewart 1962)		Semipermanently Flooded-Tidal	Fresh
Fresh and intermediate marshes (Chabreck 1972)			
Type 14-Coastal open fresh water			
Estuarine bays (Stewart 1962)	Aquatic Bed	Subtidal	Mixohaline
	Unconsolidated Bottom	Permanently Flooded-Tidal	Fresh
Type 15—Coastal salt flats			
Panne, slough marsh (Redfield 1972)	Unconsolidated Shore	Regularly Flooded	Hyperhaline
Marsh pans (Pestrong 1965)		Irregularly Flooded	Euhaline
Type 16—Coastal salt meadows			
Salt marsh (Redfield 1972; Chapman 1974)	Emergent Wetland	Irregularly Flooded	Euhaline
			Mixohaline
Type 17—Irregularly flooded salt marshes			
Salt marsh (Chapman 1974)	Emergent Wetland	Irregularly Flooded	Euhaline
Saline, brackish, and intermediate marsh (Eleuterius 1972)			Mixohaline
Type l&-Regularly flooded salt marshes			
Salt marsh (Chapman 1974)	Emergent Wetland	Regularly Flooded	Euhaline
			Mixohaline
Type 19—Sounds and bays			
Kelp beds, temperate grass flats (Phillips 1974)	Unconsolidated Bottom	Subtidal	Euhaline
Tropical marine meadows (Odum 1974)	Aquatic Bed	Irregularly Exposed	Mixohaline
Eelgrass beds (Akins and Jefferson 1973; Eleuterius 1973)	Unconsolidated Shore	Regularly Flooded	
		Irregularly Flooded	
Type 20-Mangrove swamps			
Mangrove swamps (Walsh 1974)	Scrub-Shrub Wetland	Irregularly Exposed	Hyperhaline
Mangrove swamp systems (Kuenzler 1974)	Forested Wetland	Regularly Flooded	Euhaline
Mangrove (Chapman 1976)		Irregularly Flooded	Mixohaline
			Fresh

Circular *39* by writing more detailed descriptions and subdividing classes on the basis of finer differences in plant life forms. Golet and Larson's classes are roughly equivalent to Types 1-8 of Circular *39*, except that they restrict Type 1 to river floodplains. The Golet and Larson system does not recognize the coastal (tidal) fresh wetlands of *Circular 39* (Types 12-14) as a separate category, but classifies these areas in the same manner as nontidal wetlands. In addition to devising 24 subclasses, they also created 5 size categories, 6 site types giving a wetland's hydrologic and topographic location; 8 cover types (modified from Stewart and Kantrud 1971) expressing the distribution and relative proportions of cover and water; 3 vegetative interspersion types; and 6 surrounding habitat types. Since this system is based on the classes of Martin et al. (1953), Table 4 may also be used to compare the Golet and Larson system with the one described here. Although our system does not include size categories and site types, this information will be available from the results of the new inventory of wetlands and deepwater habitats of the United States.

Stewart and Kantrud (1971) devised a new classification system to better serve the needs of researchers and wetland managers in the glaciated prairies. Their system recognizes seven classes of wetlands which are distinguished by the vegetational zone occupying the central or deepest part and covering 5% or more of the wetland basin. The classes thus reflect the wetland's water regime; for example, temporary ponds (Class II) are those where the wet-meadow zone occupies the deepest part of the wetland. Six possible subclasses were created, based on differences in plant species composition that are correlated with variations in average salinity of surface water. The third component of classification in their system is the cover type, which represents differences in the spatial relation of emergent cover to open water or exposed bottom soil. The zones of Stewart and Kantrud's system are readily related to our water regime modifiers (Table 5), and the subclasses are roughly equivalent to our Water Chemistry Modifiers (Fig. 8).

Wetlands represent only one type of land and the classification of this part separate from the rest is done for practical rather than for ecological reasons (Cowardin 1978). Recently there has been a flurry of interest in a holistic approach to land classification (in Land Classification Series, *Journal of Forestry*, vol. 46, no. 10). A number of classifications have been developed (e.g., Radford 1978) or are under development (e.g., Driscoll et al. 1978). Parts

Table 5. Comparison of *the zones of Stewart and Kantrud's (1971) classification with the Water Regime Modifiers used in the present classification system.*

Zone	Water Regime Modifier
Wetland-low-prairie	Non-wetland by our definition
Wet meadow	Temporarily flooded
Shallow marsh	Seasonally flooded
Deep marsh	Semipermanently flooded Intermittently exposed
Intermittent-alkali	Intermittently flooded (with eusaline or hypersaline water)
Permanent-open-water	Permanently flooded (with mixohaline water)
Fen (alkaline bog)	Saturated

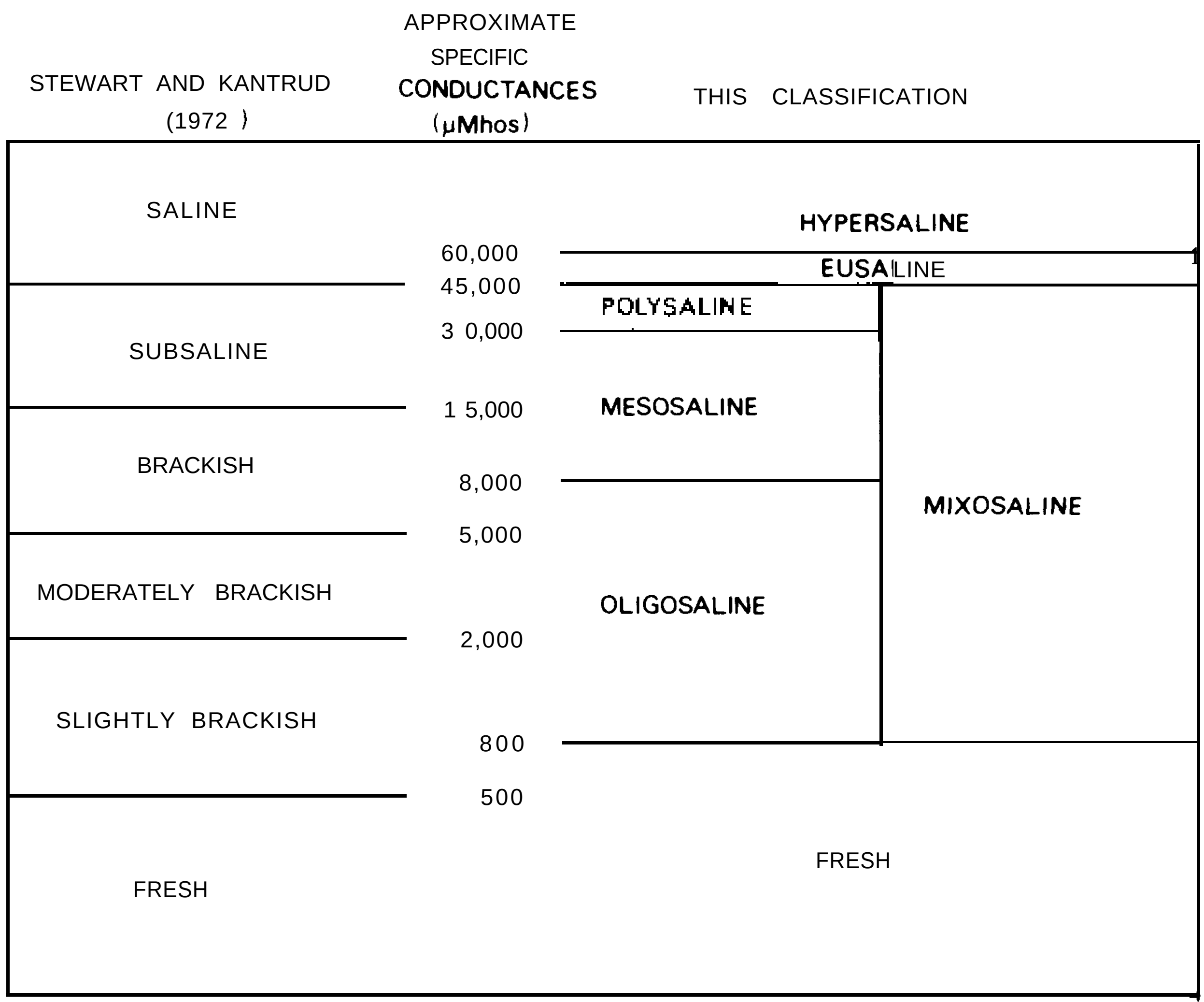

Fig. 8. Comparison of the water chemistry subclasses of Stewart and Kantrud (1972) with Water Chemistry Modifiers used in the present classification system.

of this wetland classification can be incorporated into broader hierarchical land classifications.

A classification system is most easily learned through use. To illustrate the application of this system, we have classified a representative group of wetlands and deepwater habitats of the United States (Plates l-86; pages 46-131).

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APPENDIX A

Scientific and Common Names of Plants

Scientific name[a]	Common name[b]
Acer rubrum L.	Red maple
Alisma plantago-aquatica L.	(Water plantain)
Alnus spp.	Alders
A. rugosa (DuRoi) Spreng.	Speckled alder
A. tenuifolia Nutt.	Thinleaf alder
Alopecurus aequalis Sobol.	Foxtail
Andromeda glaucophylla Link	Bog rosemary
Arctophila fulva (Trin.) Anderss.	Pendent grass
Aristida stricta Michx.	(Three-awn)
Ascophyllum spp.	(Rockweeds)
A. nodosum (L.) LeJol.	Knotted wrack
Aulacomnium palustre (Hedw.) Schwaegr.	(Moss)
Avicennia germinans (L.) L.	Black mangrove
Azolla spp.	Mosquito ferns
Baccharis halimifolia L.	Sea-myrtle
Beckmannia syzigachne (Steud.) Fernald	Slough grass
Betula nana L.	Dwarf birch
B. pumila L.	Bog birch
Brasenia schreberi J. F. Gmel.	Water shield
Calamagrostis canadensis (Michx.) Beauv.	Bluejoint
Calopogon spp.	Grass pinks
Caltha palustris L.	Marsh marigold
Campylium stellatum (Hedw.) C. Jens	(Moss)
Carex spp.	Sedges
C. *aquatilis* Wahlenb.	(Sedge)
C. *atherodes* Spreng.	Slough sedge
C. *bipartita* All.	(Sedge)
C. *lacustris* Willd.	(Sedge)
C. *lasiocarpa* Ehrh.	(Sedge)
C. *lyngbyei* Hornem.	(Sedge)
C. *paleacea* Schreb. *ex* Wahlenb.	(Sedge)
C. *pluriflora* Hulten	(Sedge)
C. *ramenskii* Kom.	(Sedge)
C. *rariflora* (Wahlenb.) J. E. Smith	(Sedge)
C. *rostrata* J. Stokes	Beaked sedge
Cassiope tetragona (L.) D. Don	Lapland cassiope
Caulerpa spp.	(Green algae)
Cephalanthus occidentalis L.	Buttonbush
Ceratophyllum spp.	Coontails
Chamaecyparis thyoides (L.) B.S.P.	Atlantic white cedar
Chamaedaphne calyculata (L.) Moench	Leatherleaf
Chara spp.	(Stoneworts)
Chenopodium glaucum L.	(Goosefoot)
Chiloscyphus fragilis (Roth) Schiffn.	(Liverwort)
Chondrus crispus Stackhouse	Irish moss
Cladina spp.	Reindeer mosses
C. *rangiferina* (L.) Harm	(Reindeer moss)
Cladium jamaicense Crantz	Saw grass
Colocasia esculenta (L.) Scott	Taro
Conocarpus erectus L.	Buttonwood
Cornus stolonifera Michx.	Red osier dogwood
Cymodocea filiformis (Kuetz) Correll	Manatee grass
Cyperus spp.	Nut sedges
Cyrilla racemiflora L.	Black ti-ti
Decodon verticillatus (L.) Elliott	Water willow
Dendranthema arcticum (L.) Tzvel.	Arctic daisy
Dermatocarpon fluviatile G. H. Web) Th. Fr.	(Lichen)
Distichlis spicata (L.) Greene	(Salt grass)
Drepanocladus spp.	(Moss)
Dryas integrifolia Vahl	(Dryas)
Echinochloa crusgalli (L.) Beauv.	Barnyard grass
Eichhornia crassipes (Mart.) Solms	Water hyacinth
Eleocharis sp.	(Spike rush)
E. palustris (L.) Roem. & J. A. Schultes	(Spike rush)
Elodea spp.	Water weeds
Elymus arenarius L.	(Lyme grass)
Empetrum nigrum L.	Crowberry
Enteromorpha spp.	(Green algae)
Eriophorum spp.	Cotton grasses
E. russeolum Fr.	(Cotton grass)
E. vaginatum L.	(Cotton grass)
Fissidens spp.	(Moss)

[a]Taxonomy of vascular plants is according to the National List of Scientific Plant Names (U.S. Dept. Agriculture 1982).
[b]General common names that refer to a higher taxon and names for which there is little agreement are shown in parentheses.

Scientific name[a]	Common name[b]
F. julianus (Mont.) Schimper	(Moss)
Fontinalis spp.	(Moss)
Fraxinus nigra Marshall	Black ash
F. pennsylvanica Marshall	(Red ash)
Fucus spp.	Rockweeds
F. spiralis L.	(Rockweed)
F. vesiculosus L.	(Rockweed)
Glyceria spp.	Manna grasses
Gordonia *lasianthus* (L.) J. Ellis	Loblolly bay
Habenaria spp.	(Orchids)
Halimeda spp.	(Green algae)
Halodule wrightii Aschers.	Shoal grass
Halophila spp.	(Sea grass)
Hippuris tetraphylla L.f.	(Mare's tail)
Hydrilla verticillata Royle	(Hydrilla)
Ilex glabra (L.) Gray	Inkberry
I. *verticillata* (L.) Gray	Winterberry
Iva frutescens L.	Marsh elder
Juncus spp.	Rushes
J. gerardii Loiseleur	Black grass
J. militaris Bigel.	Bayonet rush
J. roemerianus Scheele	Needlerush
Kalmia angustifolia L.	Sheep laurel
K. polifolia Wangenh.	Bog laurel
Kochia scoparia (L.) Schrad.	Summer cypress
Languncularia racemosa (L.) C. F. Gaertn.	White mangrove
Laminaria spp.	(Kelps)
Larix Laricina (DuRoi) K. Koch	Tamarack
Laurencia spp.	(Red algae)
Ledum decumbens (Ait.) Small	Narrowleaf Labrador tea
L. groenlandicum Oeder	Labrador tea
Lemna spp.	(Duckweeds)
L. minor L.	Common duckweed
Leucothoe axillaris (Lam.) D. Don	Coastal sweetbells
Ligusticum scothicum L.	Beach lovage
Lithothamnion spp.	Coralline algae
Lycopodium alopecuroides L.	Foxtail clubmoss
Lyonia lucida (Lam.) K. Koch	Fetterbush
Lythrum salicaria L.	Purple loosestrife
Macrocystis spp.	(Kelps)
Magnolia virginiana L.	Sweet bay
Marsupella spp.	(Liverworts)
M. emarginata (Ehrenberg) Dumortier	(Liverwort)
Myrica gale L.	Sweet gale
Myriophyllum spp.	Water milfoils
M. spicatum L.	(Water milfoil)
Najas spp.	Naiads
Nelumbo lutea (Willd.) Pers.	American lotus
Nitella spp.	(Stoneworts)
Nuphar luteum (L.) Sibth. & J. E. Smith	(Yellow water lily)
Nymphaea spp.	(Water lilies)
N. *odorata* Soland. in Ait.	(White water lily)
Nyssa *aquatica* L.	Tupelo gum
N. *sylvatica* Marshall	Black gum
Oncophorus wahlenbergii Brid.	(Moss)
Panicum capillare L.	Old witch grass
Pedicularis sp.	(Lousewort)
Peltandra virginica (L.) Kunth	Arrow arum
Pelvetia spp.	(Rockweeds)
Penicillus spp.	(Green algae)
Persea borbonia (L.) Spreng.	Red bay
Phragmites australis (Cav.) Trin. ex Steud.	Reed
Phyllospadix scouleri Hook.	(Surfgrass)
P. torreyi S. Wats.	(Surfgrass)
Picea mariana (Mill.) B.S.P.	Black spruce
P. sitchensis (Bong.) Carriere	Sitka spruce
Pinus contorta Dougl. ex Loudon	Lodgepole pine
P. palustris Mill.	Longleaf pine
P. serotina Michx.	Pond pine
Pistia stratiotes L.	Water lettuce
Plantago maritima L.	Seaside plantain
Podostemum ceratophyllum Michx.	Riverweed
Polygonum spp.	Smartweeds
P. amphibium L.	Water smartweed
P. bistorta L.	Bistort
Pontederia cordata L.	Pickerelweed
Potamogeton spp.	Pondweeds
P. gramineus L.	(Pondweed)
P. natans L.	Floating-leaf pondweed
Populus balsamifera L.	Balsam poplar
P. deltoides W. Bartram ex Marshall	Cottonwood
Potentilla anserina L.	Silverweed
P. fruticosa L.	Shrubby cinquefoil
P. palustris (L.) Scop.	Marsh cinquefoil
Puccinellia grandis Swallen	(Alkali grass)
Quercus bicolor Willd.	Swamp white oak
Q. *Lyrata* Walter	Overcup oak
Q. *michauxii* Nutt.	Basket oak
Ranunculus pallasii Schlecht.	(Crowfoot)
R. trichophyllus D. Chaix	White water crowfoot
Rhixophora mangle L.	Red mangrove
Rhododendron maximum L.	Great laurel
Rhynchospora spp.	Beak rushes
Rubus chamaemorus L.	Cloudberry
Rumex maritimus L.	Golden dock

Scientific name[a]	Common name[b]	Scientific name[a]	Common name[b]
R. mexicanus Meisn.	(Dock)	*Suaeda californica* S. Wats.	(Sea blite)
Ruppia spp.	Ditch grasses	*Tamarix gallica* L.	Tamarisk
R. maritima L.	Widgeon grass	*Taxodium distichum* (L.) L. C. Rich.	Bald cypress
Sagittaria spp.	Arrowheads	*Thalassia testudinum* K. D. Koenig	Turtle grass
Salicornia spp.	Glassworts	*Thuja occidentalis* L.	Northern white cedar
S. *europaea* L.	(Samphire)	*Tolypella* spp.	(Stoneworts)
S. *virginica* L.	(Common pickleweed)	*Trapa natans* L.	Water nut
Salix spp.	Willows	*Triglochin maritimum* L.	Arrow grass
S. *alaxensis* (Anderss.) Coville	Feltleaf willow	*Typha* spp.	Cattails
S. *fuscescens* Anderss.	Alaska bog willow	*T. angustifolia* L.	Narrow-leaved cattail
S. *ovalifolia* Trautv.	Ovalleaf willow	*T. latifolia* L.	Common cattail
S. *planifolia* Pursh	Diamondleaf willow	*Ulmus americana* L.	American elm
S. *reticulata* L.	Netleaf willow	*Ulva* spp.	Sea lettuce
Salvinia spp.	Water ferns	*Utricularia* spp.	Bladderworts
Sarcobatus vermiculatus (Hook.) Torr.	Greasewood	*U. macrorhiza* LeConte	(Bladderwort)
Scirpus spp.	Bulrushes	*Vaccinium corymbosum* L.	Highbush blueberry
S. *acutus* Muhl. ex Bigel.	Hardstem bulrush	v. oxycoccos L.	Small cranberry
S. *americanus* Pers.	Common threesquare	*V. uliginosum* L.	Bog blueberry
S. *robustus* Pursh	(Bulrush)	*V. vitis-idaea* L.	Mountain cranberry
Scolochloa festucacea (Willd.) Link	Whitetop	*Vallisneria americana* Michx.	Wild celery
Solidago sempervirens L.	Seaside goldenrod	*Verrucaria* spp.	(Lichens)
Sparganium hyperboreum Laest.	(Bur-reed)	*Wolffia* spp.	Watermeals
Spartina alterniflora Loiseleur	Saltmarsh cordgrass	*Woodwardia virginica* (L.) J. E. Smith	Virginia chain-fern
S. *cynosuroides* (L.) Roth	Big cordgrass	*Xanthium strumarium* L.	(Cocklebur)
S. *foliosa* Trin.	California cordgrass	*Xyris* spp.	Yellow-eyed grasses
S. *patens* (Ait.) Muhl.	Saltmeadow cordgrass	*Xyris smalliana* Nash	(Yellow-eyed grass)
Sphagnum spp.	Peat mosses	*Zannichellia palustris* L.	Horned pondweed
Spiraea beauverdiana C. K. Schneid.	Alaska spiraea	*Zenobia pulverulenta* (W. Bartram) Pollard	Honeycup
S. *douglasii* Hook.	(Spiraea)	*Zizania aquatica* L.	Wild rice
Spirodela spp.	Big duckweeds	*Zizaniopsis miliacea* (Michx.) Doe11 & Aschers.	Southern wild rice
Stellaria spp.	(Chickweed)	*Zostera marina* L.	Eelgrass
		Zosterella dubia (Jacq.) Small	Water stargrass

APPENDIX B

Scientific and Common Names of Animals

Scientific name	Common name[a]
Acmaea spp.	Limpets
Acropora spp.	Staghorn corals
Agrenia spp.	Spring-tails
Amphipholis spp.	Brittle stars
Amphitrite spp.	Terebellid worms
Ancylus spp.	Freshwater mollusks
Anodonta spp.	Freshwater mollusks
Anodontoides spp.	Freshwater mollusks
Anopheles spp.	Mosquitos
Aplexa spp.	Pouch snails
Arenicola spp.	Lugworms
Asellus spp.	Isopods
Baetis spp.	Mayflies
Balanus spp.	Acorn barnacles
Bryocamptus spp.	Harpacticoid copepods
Caenis spp.	Mayflies
Callianassa spp.	Ghost shrimp
Cambarus spp.	Crayfishes
Canthocamptus spp.	Harpacticoid copepods
Cerianthus spp.	Sea anemones
Chaetopterus spp.	Polychaete worms
Chironomus spp.	Midges
Chironomidae	Midges
Chthamalus spp.	Acorn barnacles
Cnemidocarpa spp.	Tunicates
Crassostrea spp.	Oysters
C. virginica (Geml.)	Eastern oyster
Dendraster spp.	Sand dollars
Diamesa spp.	Midges
Donax spp.	Wedge shells
Echinocardium spp.	Heart urchins
Elliptio spp.	Freshwater mollusks
Emerita spp.	Mole crabs
Ephemerella spp.	Mayflies
Erpobdella spp.	Leeches
Eukiefferiella spp.	Midges
Eunapius spp.	Freshwater sponges
Euzonus spp.	Blood worms
Gammarus spp.	Scuds
Gelastocoris spp.	Toad bugs
Gordonia ventalina L.	Common sea fan
Helobdella spp.	Leeches
Heteromeyenia spp.	Horse sponges
Hippospongia spp.	Encrusting sponges
Homarus americanus Milne-Edwards	American lobster
Hydropsyche spp.	Caddisflies
Lampsilis spp.	Freshwater mollusks
Ligia spp.	Slaters
Limnodrilus spp.	Oligochaete worms
Littorina spp.	Periwinkles
Lumbriculus spp.	Oligochaete worms
Lymnuea spp.	Pond snails
Macoma spp.	Macomas
M. balthica (Linne)	Baltic macoma
Melita spp.	Amphipods
Mercenaria spp.	Quahogs
Modiolus spp.	Mussels
Montipora spp.	Corals
Muricea spp.	Sea whips
Mya spp.	Soft-shell clams
Mytilus spp.	Mussels
Nassarius spp.	Mud snails
Nemoura spp.	Stone flies
Nereis spp.	Clam worms
Nerita spp.	Nerites
Notonecta spp.	Back swimmers
Oliva spp.	Olive shells
Orchestia spp.	Beach hoppers
Ostrea spp.	Oysters
Parastenocaris spp.	Copepods
Patella spp.	Limpets
Pecten spp.	Scallops
Petricola pholadiformis Lam.	False angel wing
Phyllognathopus viguieri Maryek	Copepod
Physa spp.	Snails
Pisaster spp.	Sea stars
Pisidium spp.	Fingernail clams
Placopecten spp.	Deep-sea scallops
Platyodon spp.	Boring clams
Pollicipes spp.	Gooseneck barnacles
Porites spp.	Corals
Pristina spp.	Oligochaete worms
Procambarus spp.	Crayfish
Psephenus spp.	Riffle beetles
Renilla spp.	Sea pansies
Sabellaria spp.	Reef worms
Saldula spp.	Shore bugs
Saxidomus spp.	Venus clams
Simulium spp.	Black flies
Siphonaria spp.	False limpets
Sphaerium spp.	Fingernail clams

[a]Most common names refer only to general groupings.

Scientific name	Common name[a]	Scientific name	Common name[a]
Spongilla spp.	Freshwater sponges	*Thyone* spp.	Sea cucumbers
Strongylocentrotus spp.	Sea urchins	*Tivela stultorum* (Mawe)	Pismo clam
Tabanus spp.	Flies	*Tortopus* spp.	Mayflies
Tellina spp.	Tellin shells	*Tubifex* spp.	Sewage worms
Tetraclita spp.	Acorn barnacles	Uca spp.	Fiddler crabs
Thais spp.	Rock shells	*Urechis* spp.	Echiurid worms

APPENDIX C

Glossary of Terms

acid Term applied to water with a pH less than 5.5.

alkaline Term applied to water with a pH greater than 7.4.

bar An elongated landform generated by waves and currents, usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, stones, cobbles, or rubble and with water on two sides.

beach A sloping landform on the shore of larger water bodies, generated by waves and currents and extending from the water to a distinct break in landform or substrate type (e.g., a foredune, cliff, or bank).

brackish Marine and Estuarine waters with Mixohaline salinity. The term should not be applied to inland waters (see page 25).

boulder Rock fragments larger than 60.4 cm (24 inches) in diameter.

broad-leaved deciduous Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season; e.g., black ash (*Fraxinus nigra*).

broad-leaved evergreen Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more; e.g., red mangrove ***(Rhizophora mangle).***

calcareous Formed of calcium carbonate or magnesium carbonate by biological deposition or inorganic precipitation in sufficient quantities to effervesce carbon dioxide visibly when treated with cold 0.1 normal hydrochloric acid. Calcareous sands are usually formed of a mixture of fragments of mollusk shell, echinoderm spines and skeletal material, coral, foraminifera, and algal platelets (e.g., *Halimeda*).

channel "An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri 1960:5).

channel bank The sloping land bordering a channel. The bank has steeper slope than the bottom of the channel and is usually steeper than the land surrounding the channel.

circumneutral Term applied to water with a pH of 5.5 to 7.4.

codominant Two or more species providing about equal area1 cover which in combination control the environment.

cobbles Rock fragments 7.6 cm (3 inches) to 25.4 cm (10 inches) in diameter.

deciduous stand A plant community where deciduous trees or shrubs represent more than 50% of the total area1 coverage of trees or shrubs.

dominant The species controlling the environment.

dormant season That portion of the year when frosts occur (see U.S. Department of Interior, National Atlas 1970:110-111 for generalized regional delineation).

emergent hydrophytes Erect, rooted, herbaceous angiosperms that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant; e.g., bulrushes (*Scirpus* spp.), saltmarsh cordgrass.

emergent mosses Mosses occurring in wetlands, but generally not covered by water.

eutrophic lake Lake that has a high concentration of plant nutrients such as nitrogen and phosphorus.

evergreen stand A plant community where evergreen trees or shrubs represent more than 50% of the total area1 coverage of trees and shrubs. The canopy is never without foliage; however, individual trees or shrubs may shed their leaves (Mueller-Dombois and Ellenberg 1974).

extreme high water of spring tides The highest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme higher high water of mixed semidiurnal tides.

extreme low water of spring tides The lowest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme lower low water of mixed semidiurnal tides.

flat A level Iandform composed of unconsolidated sediments—usually mud or sand. Flats may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water.

floating plant A non-anchored plant that floats freely in the water or on the surface; e.g., water hyacinth (*Eichhornia crassipes*) ***or*** common duckweed (*Lemna* minor).

floating-leaved plant A rooted, herbaceous hydrophyte with some leaves floating on the water surface; e.g., white water lily (*Nymphaea odorata*), floating-leaved pondweed (*Potamogeton natans).* Plants such as yellow water lily (*Nuphar luteum*) which sometimes have leaves raised above the surface are considered floating-leaved plants or emergents, depending on their growth habit at a particular site.

floodplain "a flat expanse of land bordering an old river. " (see Reid and Wood 1976:72, 84).

fresh Term applied to water with salinity less than 0.5‰ dissolved salts.

gravel A mixture composed primarily of rock fragments 2 mm ***(0.08*** inch) to 7.6 cm (3 inches) in diameter. Usually contains much sand.

growing season The frost-free period of the year (see U.S. Department of Interior, National Atlas 1970:110-111 for generalized regional delineation).

haline ***Term*** used to indicate dominance of ocean salt.

herbaceous With the characteristics of an herb; a plant with no persistent woody stem above ground.

histosols Organic soils (see Appendix D).

hydric soil Soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

hydrophyte, hydrophytic Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

hyperhaline Term to characterize waters with salinity greater than 40‰, due to ocean-derived salts.

hypersaline Term to characterize waters with salinity greater than 40‰, due to land-derived salts.

macrophytic algae Algal plants large enough either as individuals or communities to be readily visible without the aid of optical magnification.

mean high water The average height of the high water over 19 years.

mean higher high tide The average height of the higher of two unequal daily high tides over 19 years.

mean **low** water The average height of the low water over 19 years.

mean lower low water The average height of the lower of two unequal daily low tides over 19 years.

mean tide level A plane midway between mean high water and mean low water.

mesohaline Term to characterize waters with salinity of 5 to 18‰, due to ocean-derived salts.

mesophyte, mesophytic Any plant growing where moisture and aeration conditions lie between extremes. (Plants typically found in habitats with average moisture conditions, not usually dry or wet.)

mesosaline Term to characterize waters with salinity of 5 to 18‰, due to land-derived salts.

mineral soil Soil composed of predominantly mineral rather than organic materials (see page 44).

mixohaline Term to characterize water with salinity of 0.5 to 30‰, due to ocean salts. The term is roughly equivalent to the term brackish.

mixosaline Term to characterize waters with salinity of 0.5 to 30‰, due to land-derived salts.

mud Wet soft earth composed predominantly of clay and silt—fine mineral sediments less than 0.074 mm in diameter (Black 1968; Liu 1970).

needle-leaved deciduous Woody gymnosperms (trees or shrubs) with needle-shaped or scale-like leaves that are shed during the cold or dry season; e.g., bald cypress (*Taxodium distichum*).

needle-leaved **evergreen** Woody gymnosperms with green, needle-shaped, or scale-like leaves that are retained by plants throughout the year; e.g., black spruce (*Picea mariana*).

nonpersistent emergents Emergent hydrophytes whose leaves and stems break down at the end of the growing season so that most above-ground portions of the plants are easily transported by currents, waves, or ice. The breakdown may result from normal decay or the physical force of strong waves or ice. At certain seasons of the year there are no visible traces of the plants above the surface of the water; e.g., wild rice (*Zizania aquatica*), arrow arum (*Peltandra virginica*).

obligate hydrophytes Species that are found only in wetlands—e.g., cattail (*Typha latifolia*) as opposed to ubiquitous species that grow either in wetland or on upland-e.g., red maple (*Acer rubrum*).

oligohaline Term to characterize water with salinity of 0.5 to 5.0‰, due to ocean-derived salts.

oligosaline Term to characterize water with salinity of 0.5 to 5.0‰, due to land-derived salts.

organic soil Soil composed of predominantly organic rather than mineral material. Equivalent to Histosol (see page 44).

persistent emergent Emergent hydrophytes that normally remain standing at least until the beginning of the next growing season; e.g., cattails (*Typha* spp.) or bulrushes (*Scirpus* spp.).

photic zone The upper water layer down to the depth of effective light penetration where photosynthesis balances respiration. This level (the compensation level) usually occurs at the depth of 1% light penetration and forms the lower boundary of the zone of net metabolic production.

pioneer plants Herbaceous annual and seedling perennial plants that colonize bare areas as a first stage in secondary succession.

polyhaline Term to characterize water with salinity of 18 to 30‰, due to ocean salts.

polysaline Term to characterize water with salinity of 18 to 30‰, due to land-derived salts.

saline General term for waters containing various dissolved salts. We restrict the term to inland waters where the ratios of the salts often vary; the term haline is applied to coastal waters where the salts are roughly in the same proportion as found in undiluted sea water (see page 25).

salinity The total amount of solid material in grams contained in 1 kg of water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine, and all the organic matter completely oxidized.

sand Composed predominantly of coarse-grained mineral sediments with diameters larger than 0.074 mm (Black 1968) and smaller than 2 mm (Liu 1970; Weber 1973).

shrub A woody plant which at maturity is usually less than 6 m (20 feet) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance; e.g., speckled alder (*Alnus rugosa*) or buttonbush (*Cephalanthus occidentalis*).

sound A body of water that is usually broad, elongate, and parallel to the shore between the mainland and one or more islands.

spring tide The highest high and lowest low tides during the lunar month.

stone Rock fragments larger than 25.4 cm (10 inches) but less than 60.4 cm (24 inches).

submergent plant A vascular or nonvascular hydrophyte, either rooted or nonrooted, which lies entirely beneath the water surface, except for flowering parts in some species; e.g., wild celery (*Vallisneria americana*) or the stoneworts (*Chara* spp.).

terrigenous Derived from or originating on the land (usually referring to sediments) as opposed to material or sediments produced in the ocean (marine) or as a result of biologic activity (biogenous).

tree A woody plant which at maturity is usually 6 m (20 feet) or more in height and generally has a single trunk, unbranched for 1 m or more above the ground, and a more or less definite crown; e.g., red maple (*Acer rubrum*), northern white cedar (*Thuja occidentalis*).

water table The upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body (Langbein and Iseri 1960:21).

woody plant A seed plant (gymnosperm or angiosperm) that develops persistent, hard, fibrous tissues, basically xylem; e.g., trees and shrubs.

xerophyte, xerophytic Any plant growing in a habitat in which an appreciable portion of the rooting medium dries to the wilting coefficient at frequent intervals. (Plants typically found in very dry habitats.)

APPENDIX D

Criteria for Distinguishing Organic Soils from Mineral Soils

The criteria for distinguishing organic soils from mineral soils in the United States (U.S. Soil Conservation Service, Soil Survey Staff 1975:13-14, 65) are quoted here so that those without ready access to a copy of the Soil Taxonomy may employ this information in the classification of wetlands:

For purposes of taxonomy, it is necessary, first, to define the limits that distinguish mineral soil material from organic soil material and, second, to define the minimum part of a soil that should be mineral if the soil is to be classified as a mineral soil.

Nearly all soils contain more than traces of both mineral and organic components in some horizons, but most soils are dominantly one or the other. The horizons that are less than about 20 to 35 percent organic matter by weight have properties that are more nearly those of mineral than of organic soils. Even with this separation, the volume of organic matter at the upper limit exceeds that of the mineral material in the fine-earth fraction.

MINERAL SOIL MATERIAL

Mineral soil material either

1. Is never saturated with water for more than a few days and has <20 percent organic carbon by weight; or
2. Is saturated with water for long periods or has been artificially drained, and has
   a. Less than 18 percent organic carbon by weight if 60 percent or more of the mineral fraction is clay;
   b. Less than 12 percent organic carbon by weight if the mineral fraction has no clay; or
   c. A proportional content of organic cabon between 12 and 18 percent if the clay content of the mineral fraction is between zero and 60 percent.

Soil material that has more organic carbon than the amounts just given is considered to be organic material.

DISTINCTION BETWEEN MINERAL SOILS AND ORGANIC SOILS

Most soils are dominantly mineral material, but many mineral soils have horizons of organic material. For simplicity in writing definitions of taxa, a distinction between what is meant by a mineral soil and an organic soil is useful. In a mineral soil, the depth of each horizon is measured from the top of the first horizon of mineral material. In an organic soil, the depth of each horizon is measured from the base of the aerial parts of the growing plants or, if there is no continuous plant cover from the surface of the layer of organic materials. To apply the definitions of many taxa, therefore, one must first decide whether the soil is mineral or organic.

If a soil has both organic and mineral horizons, the relative thickness of the organic and the mineral soil materials must be considered. At some point one must decide that the mineral horizons are more important. This point is arbitrary and depends in part on the nature of the materials. A thick layer of sphagnum has a very low bulk density and contains less organic matter than a thinner layer of well-decomposed muck. It is much easier to measure thickness of layers in the field than it is to determine tons of organic matter per hectare. The definition of a mineral soil, therefore, is based on thickness of the horizons or layers, but the limits of thickness must vary with the kinds of materials. The definition that follows is intended to classify as mineral soils those that have no more organic material than the amount permitted in the histic epipedon, which is defined later in this chapter.

To determine whether a soil is organic or mineral, the thickness of horizons is measured from the surface of the soil whether that is the surface of a mineral or an organic horizon. Thus, any 0 horizon at the surface is considered an organic horizon, if it meets the requirements of organic soil material as defined later, and its thickness is added to that of any other organic horizons to determine the total thickness of organic soil materials.

DEFINITION OF MINERAL SOILS

Mineral soils, in this taxonomy, are soils that meet one of the following requirements:

1. Mineral soil material <2 mm in diameter (the fine-earth fraction) makes up more than half the thickness of the upper 80 cm (31 in.);
2. The depth to bedrock is <40 cm and the layer or layers of mineral soil directly above the rock either are 10 cm or more thick or have half or more of the thickness of the overlying organic soil material; or
3. The depth to bedrock is>40 cm, the mineral soil material immediately above the bedrock is 10 cm or more thick, and either
   a. Organic soil material is <40 cm thick and is decomposed (consisting of hemic or sapric materials as defined later) or has a bulk density of 0.1 or more; or
   b. Organic soil material is <60 cm thick and either is undecomposed sphagnum or moss fibers or has a bulk density that is <0.1.

ORGANIC SOIL MATERIALS

Organic soil materials and organic soils

1. Are saturated with water for long periods or are artificially drained and, excluding live roots, (a) have 18 percent or more organic carbon if the mineral fraction is 60 percent or more clay, (b) have 12 percent or more organic carbon if the mineral fraction has no clay, or(c) have a proportional content of organic carbon between 12 and 18 percent if the clay content of the mineral fraction is between zero and 60 percent; or
2. Are never saturated with water for more than a few days and have 20 percent or more organic carbon.

Item 1 in this definition covers materials that have been called peats and mucks. Item 2 is intended to include what has been called litter or 0 horizons. Not all organic soil materials accumulate in or under water. Leaf litter may rest on a lithic contact and support a forest. The only soil in this situation is organic in the sense that the mineral fraction is appreciably less than half the weight and is only a small percentage of the volume of the soil.

DEFINITION OF ORGANIC SOILS

Organic soils (Histosols) are soils that

1. Have organic soil materials that extend from the surface to one of the following:
   a. A depth within 10 cm or less of a lithic or paralithic contact, provided the thickness of the organic soil materials is more than twice that of the mineral soil above the contact; or
   b. Any depth if the organic soil material rests on fragmental material (gravel, stones, cobbles) and the interstices are filled with organic materials, or rests on a lithic or paralithic contact; or
2. Have organic materials that have an upper boundary within 40 cm of the surface and
   a. Have one of the following thicknesses:
      (1) 60 em or more if three-fourths or more of the volume is moss fibers or the moist bulk density is <0.1 g per cubic centimeter (6.25 lbs per cubic foot);
      (2) 40 cm or more if
         (a) The organic soil material is saturated with water for long periods (>6 months) or is artificially drained; and
         (b) The organic material consists of sapric or hemic materials or consists of fibric materials that are less than three-fourths moss fibers by volume and have a moist bulk density of 0.1 or more; and
   b. Have organic soil materials that
      (1) Do not have a mineral layer as much as 40 cm thick either at the surface or whose upper boundary is within a depth of 40 cm from the surface; and
      (2) Do not have mineral layers, taken cumulatively, as thick as 40 cm within the upper 80 cm.

It is a general rule that a soil is classed as an organic soil (Histosol) either if more than half of the upper 80 cm (32 in.) [sic] of soil is organic or if organic soil material of any thickness rests on rock or on fragmental material having interstices filled with organic materials.

Soils that do not satisfy the criteria for classification as organic soils are mineral soils.

APPENDIX E

Artificial Keys to the Systems and Classes

Key to the Systems

1. Water regime influenced by oceanic tides, and salinity due to ocean-derived salts 0.5‰ or greater.
  2. Semi-enclosed by land, but with open, partly obstructed or sporadic access to the ocean. Halinity wide-ranging because of evaporation or mixing of seawater with runoff from land .... ESTUARINE
  2. Little or no obstruction to open ocean present. Halinity usually euhaline; little mixing of water with runoff from land 3
    3. Emergents, trees, or shrubs present .... ESTUARINE
    3. Emergents, trees, or shrubs absent ....MARINE
1. Water regime not influenced by ocean tides, or if influenced by oceanic tides, salinity less than 0.5‰.
  4. Persistent emergents, trees, shrubs, or emergent mosses cover 30% or more of the area .....PALUSTRINE
  4. Persistent emergents, trees, shrubs, or emergent mosses cover less than 30% of substrate but nonpersistent emergents may be widespread during some seasons of year 5
    5. Situated in a channel; water, when present, usually flowing. .... RIVERINE
    5. Situated in a basin, catchment, or on level or sloping ground; water usually not flowing 6
      6. Area 8 ha (20 acres) or greater ....LACUSTRINE
      6. Area less than 8 ha 7
        7. Wave-formed or bedrock shoreline feature present or water depth 2 m (6.6 feet) or more ....LACUSTRINE
        7. No wave-formed or bedrock shoreline feature present and water less than 2 m deep .PALUSTRINE

Key *to the* Classes

1. During the growing season of most years, areal cover by vegetation is less than 30%.
  2. Substrate a ridge or mound formed by colonization of sedentary invertebrates (corals, oysters, tubeworms) ....REEF
  2. Substrate of rock or various-sized sediments often occupied by invertebrates but not formed by colonization of sedentary invertebrates 3
    3. Water regime subtidal, permanently flooded, intermittently exposed, or semipermanently flooded. Substrate usually not soil 4
      4. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area .... ROCK BOTTOM
      4. Substrate of organic material, mud, sand, gravel, or cobbles with less than 75% areal cover of stones, boulders, or bedrock. .... UNCONSOLIDATED BOTTOM
    3. Water regime irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Substrate often a soil. 5
      5. Contained within a channel that does not have permanent flowing water (i.e., Intermittent Subsystem of Riverine System or Intertidal Subsystem of Estuarine System) .... STREAMBED
      5. Contained in a channel with perennial water or not contained in a channel 6
        6. Substrate of bedrock, boulders, or stones occurring singly or in combination covers 75% or more of the area .... ROCKY SHORE
        6. Substrate of organic material, mud, sand, gravel, or cobbles; with less than 75% of the cover consisting of stones, boulders, or bedrock ..........................UNCONSOLIDATED SHORE
1. During the growing season of most years, percentage of area covered by vegetation 30% or greater.
  7. Vegetation composed of pioneering annuals or seedling perennials, often not hydrophytes, occurring only at time of substrate exposure 8
    8. Contained within a channel that does not have permanent flowing water. .... STREAMBED (VEGETATED)
    8. Contained within a channel with permanent water, or not contained in a channel .... UNCONSOLIDATED SHORE (VEGETATED)

7. Vegetation composed of algae, bryophytes, lichens, or vascular plants that are usually hydrophytic perennials 9
    9. Vegetation composed predominantly of nonvascular species. 10
        10. Vegetation macrophytic algae, mosses, or lichens growing in water or the splash zone of shores . . . . AQUATIC BED
        10. Vegetation mosses or lichens usually growing on organic soils and always outside the splash zone of shores . . . . MOSS-LICHEN WETLAND
    9. Vegetation composed predominantly of vascular species. 11
        11. Vegetation herbaceous 12
            12. Vegetation emergents . . . . EMERGENT WETLAND
            12. Vegetation submergent, floating-leaved, or floating . . . . AQUATIC BED
        11. Vegetation trees or shrubs 13
            13. Dominants less than 6 m (20 feet) tall . . . . SCRUB-SHRUB WETLAND
            13. Dominants 6 m tall or taller . . . . FORESTED WETLAND

Plate 1.-Classification: SYSTEM Marine, SUBSYSTEM Subtidal, CLASS Rock Bottom, SUBCLASS Bedrock, WATER REGIME Subtidal, WATER CHEMISTRY Euhaline. This underwater photograph shows colonies of common sea fans (*Gorgonia ventalina*) and other gorgonians living on bedrock. Bare rock is visible in the center and lower left corner of the photo. (Monroe County, Florida; July 1969; Photo by E. T. LaRoe)

Plate 2.-Classification: SYSTEM Marine, SUBSYSTEM Subtidal, CLASS Reef, SUBCLASS Coral, WATER REGIME Subtidal, WATER CHEMISTRY Euhaline. This underwater photograph shows corals (*Acropora* and *Porites*) as well as several species of gorgonians. (Monroe County, Florida; August 1970; Photo by E. T. LaRoe)

Plate 3.-Two habitats are shown here. Classification of landward (lighter) zone: SYSTEM Marine, SUBSYSTEM Intertidal, CLASS Rocky Shore, SUBCLASS Bedrock, WATER REGIME Irregularly Flooded, WATER CHEMISTRY Euhaline. Classification of seaward (darker) zone: SYSTEM Marine, SUBSYSTEM Intertidal, CLASS Aquatic Bed, SUBCLASS Algal, DOMINANCE TYPE *Fucus spiralis*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Euhaline. Subordinate plants in the aquatic bed include rockweed (*Fucus vesiculosus*), knotted wrack (*Ascophyllum nodosum*), and Irish moss (*Chondrus crispus*). This photo was taken at low tide. (Newport County, Rhode Island; July 1977; Photo by F. C. Golet)

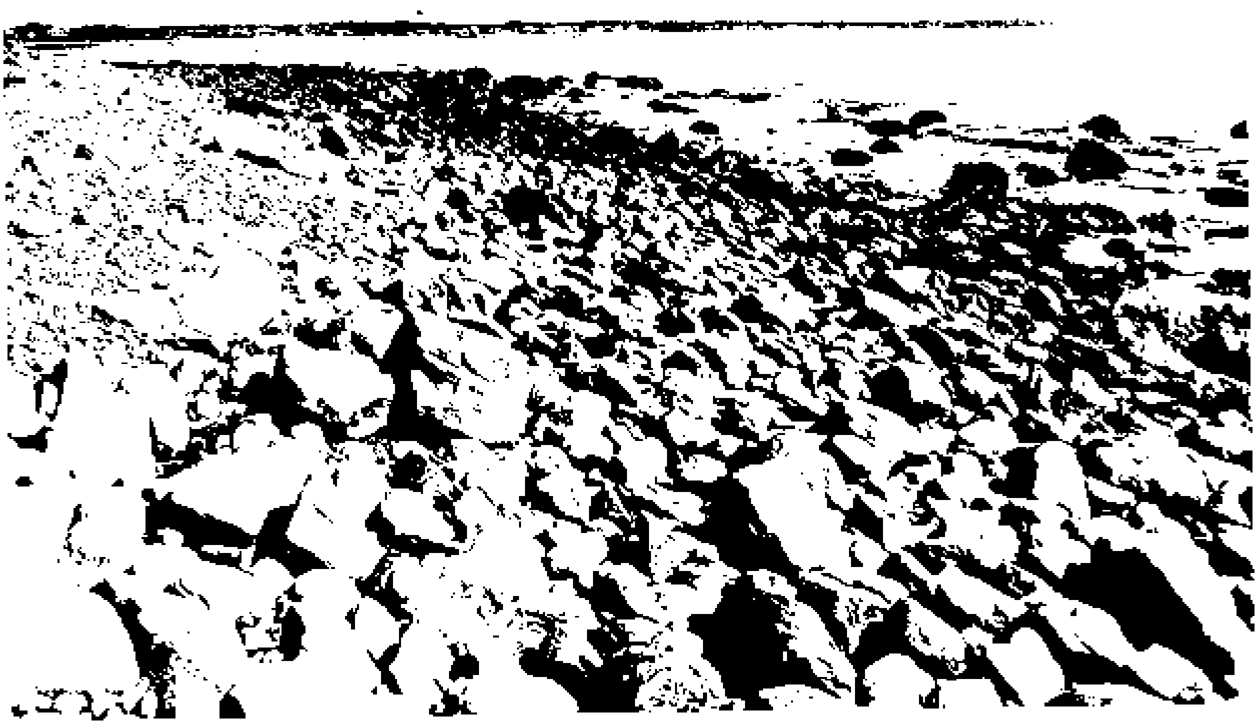

Plate 4.—Two habitats are shown here. Classification of landward (lighter) zone: SYSTEM Marine, SUBSYSTEM Intertidal, CLASS Rocky Shore, SUBCLASS Rubble, WATER REGIME Irregularly Flooded, WATER CHEMISTRY Euhaline. Classification of seaward (darker) zone: SYSTEM Marine, SUBSYSTEM Intertidal, CLASS Aquatic Bed, SUBCLASS Algal, DOMINANCE TYPE *Fucus vesiculosus-Ascophyllum nodosum*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Euhaline. Most stones are larger than 30.5 cm (12 in) in diameter. (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 5.-Classification: SYSTEM Marine, SUBSYSTEM Intertidal, CLASS Unconsolidated Shore, SUBCLASS Sand, WATER REGIMES Regularly Flooded (seaward from the woman to the breaking waves) and Irregularly Flooded (landward from the woman to the base of the sand dunes), WATER CHEMISTRY Euhaline. Lines of wrack (dead *Fucus* spp., *Ascophyllum nodosum,* and *Zostera marina)* on the beach mark the landward limit of various high tides during the past several days. The photo was taken at low tide. (Parker River National Wildlife Refuge, Essex County, Massachusetts; September 1985; Photo by F. C. Golet)

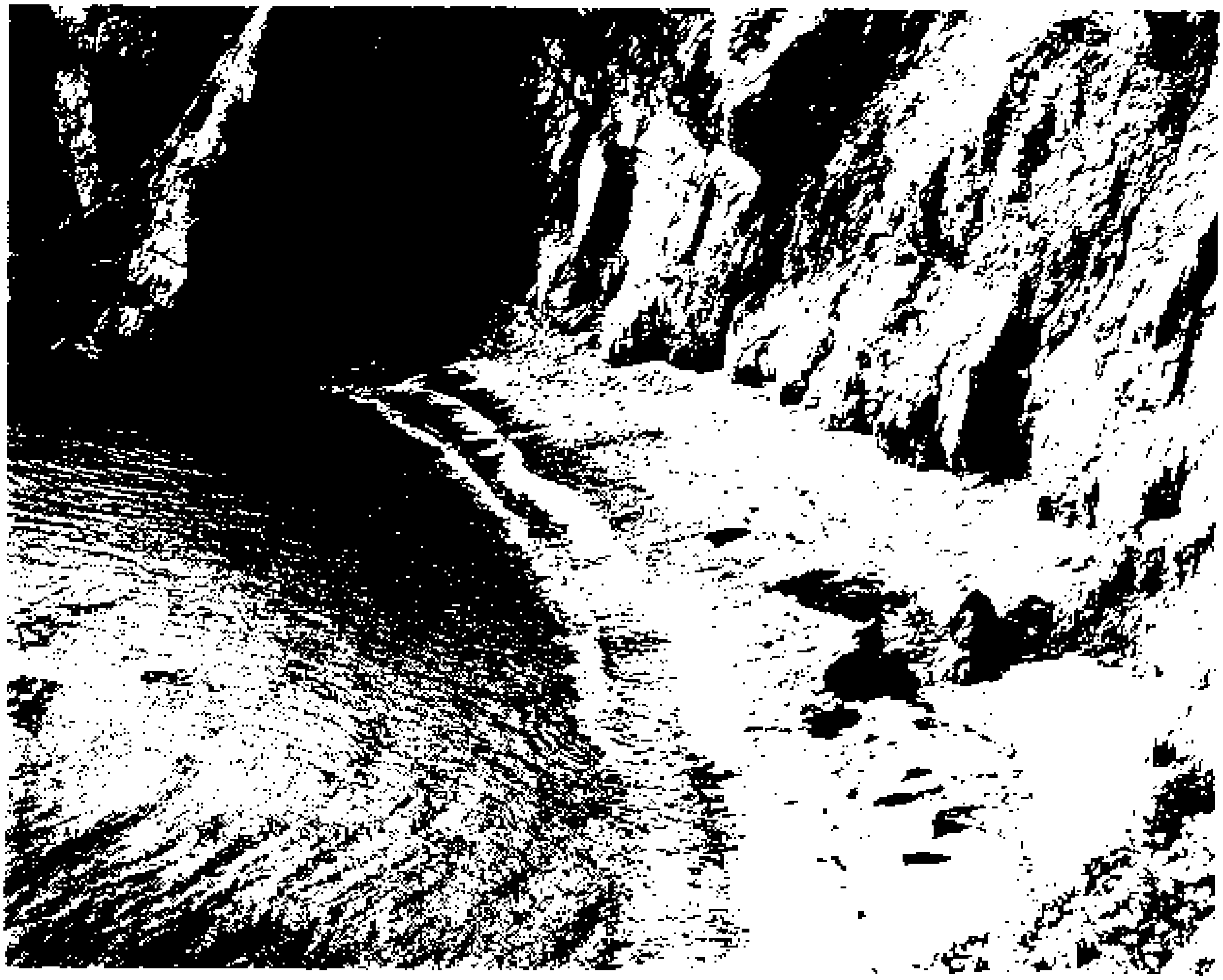

Plate 6.-Classification: **SYSTEM** Marine, **SUBSYSTEM** Intertidal, **CLASS** Unconsolidated Shore, **SUBCLASS** Sand, **WATER REGIMES** Regularly Flooded (lower two-thirds of beach) and Irregularly Flooded (upper one-third of beach near base of cliffs), **WATER CHEMISTRY** Euhaline. (Point Reyes National Seashore, Marin County, California; August 1975; Photo by V. Carter)

Plate 7.—Classification: SYSTEM Estuarine, SUBSYSTEM Subtidal, CLASS Unconsolidated Bottom, SUBCLASS Sand, WATER REGIME Subtidal, WATER CHEMISTRY Mixohaline. An irregularly flooded persistent-emergent wetland dominated by saltmarsh cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*) is shown in the right background (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 8.—Classification: SYSTEM Estuarine, SUBSYSTEM Subtidal, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Subtidal, WATER CHEMISTRY Mixohaline. This site lies within the Fjord Biogeographic Province. Glacier-mantled mountains plunge steeply into water more than 180 m (600 ft) deep. (Lynn Canal, Haines Borough, Alaska; June 1985; Photo by F. C. Golet)

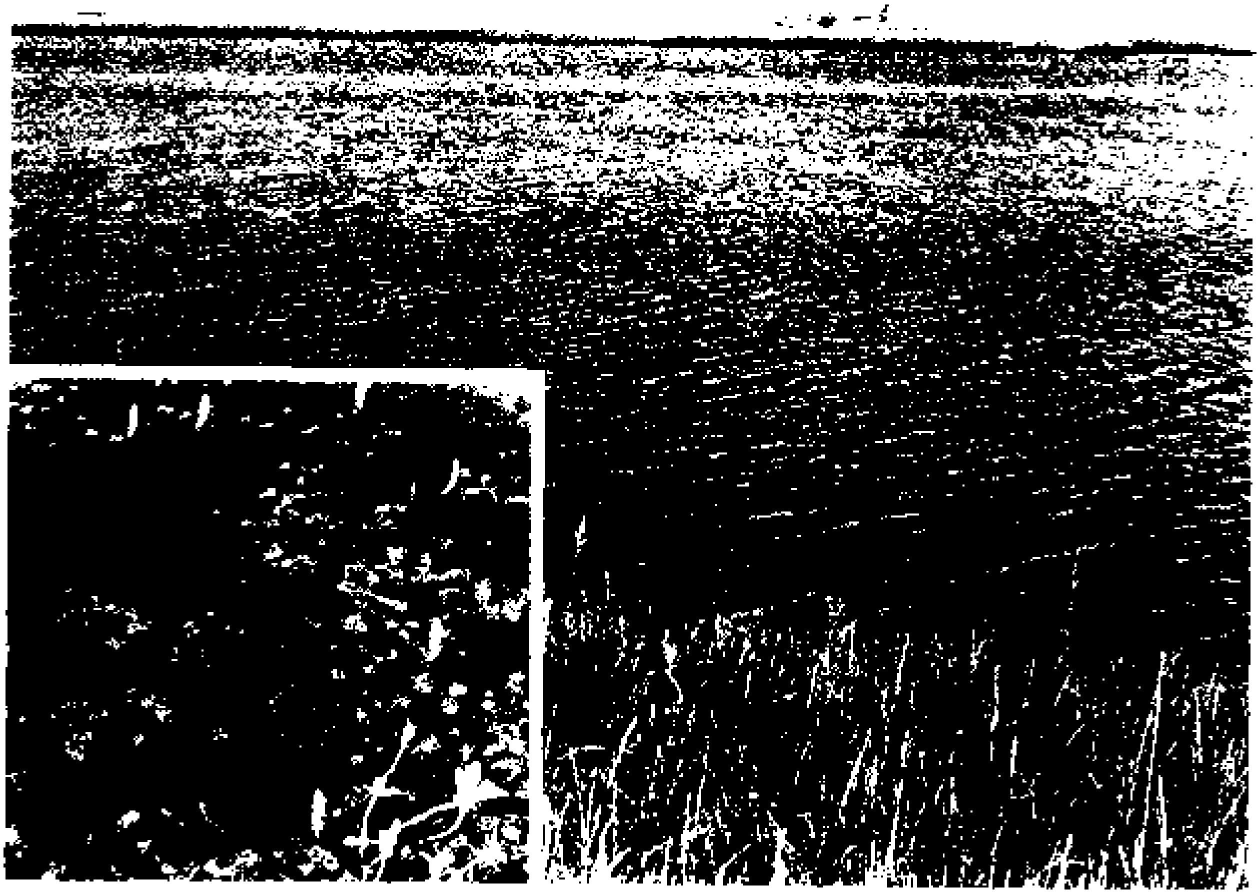

Plate S.-Classification: SYSTEM Estuarine, SUBSYSTEM Subtidal, CLASS Aquatic Bed, SUBCLASS Rooted Vascular, DOMINANCE TYPE *Myriophyllum spicatum,* WATER REGIME Subtidal, WATER CHEMISTRY Mixohaline. Subordinate plant species include mare's tail (*Hippuris tetraphylla*) and crowfoot (*Ranunculus pallasii*). This pond is located on coastal tundra; it is flooded with tidal water only during exceptionally high tides (less often than monthly). Plants characterizing the aquatic bed are shown in the photo-inset. (Between Azun and Narokachik Rivers, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 1O.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Reef, SUBCLASS Mollusk, DOMINANCE TYPE *Crassostrea virginica*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline. An individual red mangrove (*Rhizophora* mangle) has become established on this oyster reef. (Rookery Bay Sanctuary, Collier County, Florida; January 1978; Photo by E. T. LaRoe)

Plate II.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Streambed, SUBCLASS Mud, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline. This photo was taken at low tide; at high tide, the entire channel is flooded. The channel is flanked by irregularly flooded persistent-emergent wetland supporting such plants as: lyme grass (*Elymus arenarius*), beach lovage (*Ligusticum scothicum*), silverweed (*Potentilla anserina*), sedges (*Carex ramenskii*, *C. bipartita*), ovalleaf willow (*Salix ovalifolia*), and Arctic daisy (*Dendranthema arcticum*). This site lies 100 m from Angyoyaravak Bay, on the Bering Sea. (Tutakoke River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 12.—Two habitats lie at the edge of this manmade breakwater. Classification of upper (lighter) zone: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Rocky Shore, SUBCLASS Rubble, WATER REGIME Irregularly Flooded, WATER CHEMISTRY Euhaline, SPECIAL MODIFIER Artificial. Classification of lower (darker) zone: SYSTEM Estuarine, SUBSYSTEM Intertidal. CLASS Aquatic Bed, SUBCLASS Algal, DOMINANCE TYPE *Fucus vesiculosus*. WATER REGIME Regularly Flooded, WATER CHEMISTRY Euhaline, SPECIAL MODIFIER Artificial. (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

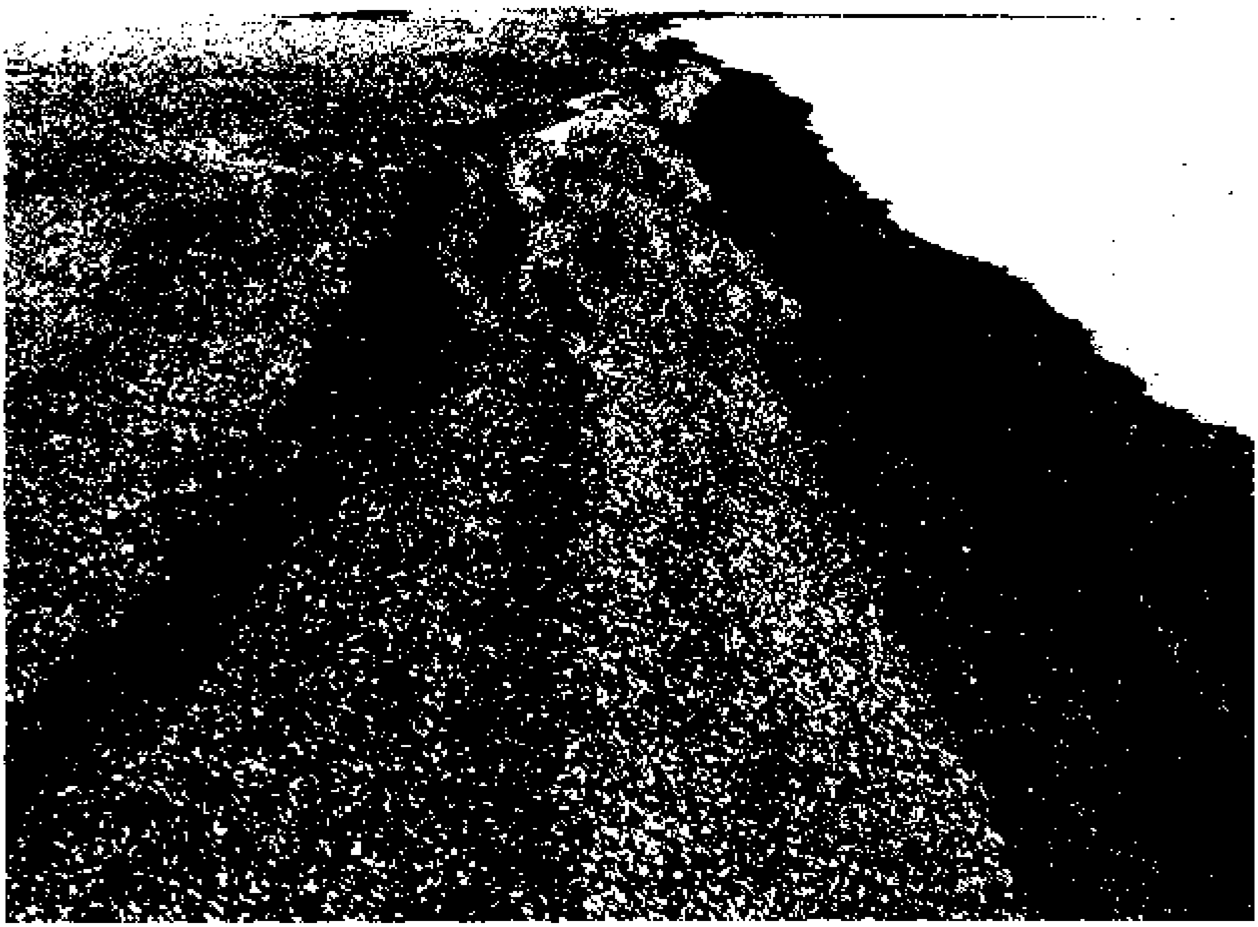

Plate 13.—Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Unconsolidated Shore, SUBCLASS Cobble-Gravel, WATER REGIMES Regularly Flooded (darker zone at edge of water) and Irregularly Flooded (remainder of shore), WATER CHEMISTRY Euhaline. Mean tidal range in this area of the Arctic Ocean is approximately 15 cm (6 in). (Mikkelsen Bay, North Slope Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 14.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Unconsolidated Shore, SUBCLASS Mud, WATER REGIME Regularly Flooded. WATER CHEMISTRY Mixohaline. Turnagain Arm, a large hay off Cook Inlet. is 4-7 km (2.5-4 mi) wide at this location. Mean tidal range is 9.2 m (30 ft), and the entire area shown here is dewatered at low tide. (Municipality of Anchorage. Alaska; June 1985; Photo by F. C. Golet)

Plate 15.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, **CLASS** Unconsolidated Shore, **SUBCLASS** Mud, WATER REGIME Irregularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Mineral. Alkali grass (*Puccinellia grandis*) grows in widely scattered clumps at the right-hand edge of the photo. Mean tidal range at Fire Island (background left) is 7.4 m (24.4 ft). The cracks on these mud flats are evidence of the irregularly flooded tidal regime. (Municipality of Anchorage, Alaska; June 1985; Photo by F. C. Golet)

Plate 16.-Classification: **SYSTEM** Estuarine, **SUBSYSTEM** Intertidal, **CLASS** Emergent Wetland, **SUBCLASS** Persistent, **DOMINANCE TYPE** *Spartina alterniflora*, **WATER REGIME** Regularly Flooded, **WATER CHEMISTRY** Mixohaline, **SOIL** Mineral. Saltmarsh cordgrass is the only plant growing in the regularly flooded zone of this salt marsh. Saltmeadow cordgrass (*Spartina patens*), seaside goldenrod (*Solidago sempervirens*), and the sedge, *Carex paleacea*, grow at the landward edge of the marsh. The photo was taken at high tide. (Essex County. Massachusetts: September 1985; Photo by F. C. Golet)

Plate 17.—Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Spartina foliosa*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Mineral. The most common subordinate plants are glassworts (*Salicornia* spp.). This wetland borders an irregularly flooded emergent wetland dominated by glasswort. The photo was taken at high tide. (San Mateo County, California; August 1976; Photo by V. Carter)

Plate l&-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Carex lyngbyei*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Organic. The photo was taken at low tide. (Coos County, Oregon; May 1977; Photo by D. D. Peters)

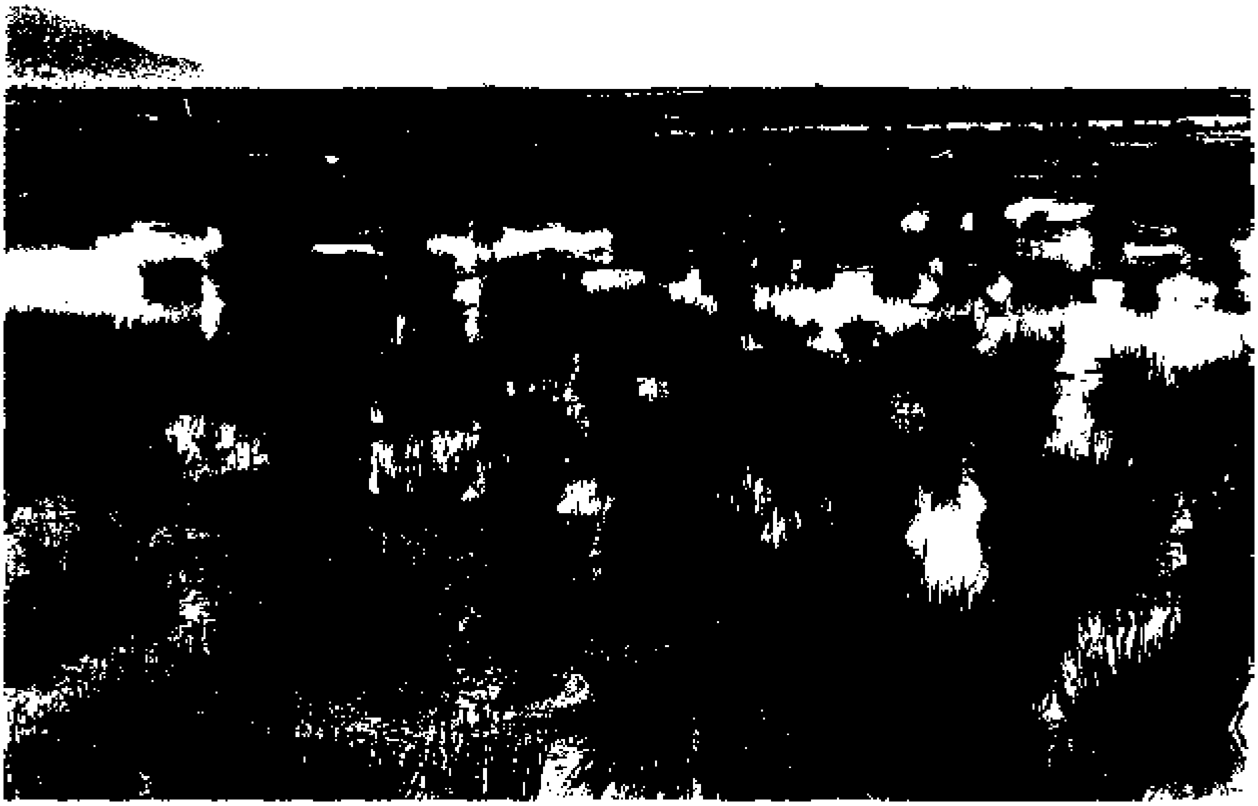

Plate 19.—Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Triglochin maritimum*, WATER REGIME Irregularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Mineral. Subordinate plants include samphirr (*Salicornia europaea*) and seaside plantain (*Plantago maritima*). This stand is located at the seaward edge of the irregularly flooded zone where it is inundated by most, but not all, high tides. Water depth is less than 5 cm (2 in). Slightly more elevated stands of *Triglochin maritimum* contain little or no standing water between periods of inundation. (Municipality of Anchorage, Alaska; June 1985; Photo by F. C. Golet)

Plate 20.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Phragmites australis*, WATER REGIME Irregularly Flooded, WATERCHEMISTKY Mixohaline, SOIL Mineral. Saltmeadow cordgrass (*Spartina patens*) and saltmarsh cordgrass (*Spartina alterniflora*) are subordinate species. (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 21.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Scirpus americanus*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Organic. Subordinate species include saltmeadow cordgrass (*Spartina patens*) and saltmarsh cordgrass (*Spartina alterniflora*); these appear as a fringe at the water's edge. (Dorchester County, Maryland; June 19'74; Photo by V. Carter)

Plate 22.—Classification: **SYSTEM** Estuarine, **SUBSYSTEM** Intertidal, **CLASS** Emergent Wetland, **SUBCLASS** Persistent, DOMINANCE TYPE *Carex lyngbyei*, **WATER REGIME** Irregularly Flooded, **WATER CHEMISTRY** Oligohaline. **SOIL** Mineral. Subordinate species include sedge (*Carex pluriflora*), silverweed (*Potentilla anserina*), arrow grass (*Triglochin maritimum*), and mare's tail (*Hippuris tetraphylla*). Located on the floodplain of a tidal river, this site receives freshwater runoff from the Chugach Mountains and the Twenty-mile Glacier (center background), and is also inundated by exceptionally high tides. Soil salinity during October 1985 was 3.0‰. (Muncipality of Anchorage, Alaska; June 1985; Photo by F. C. Golet)

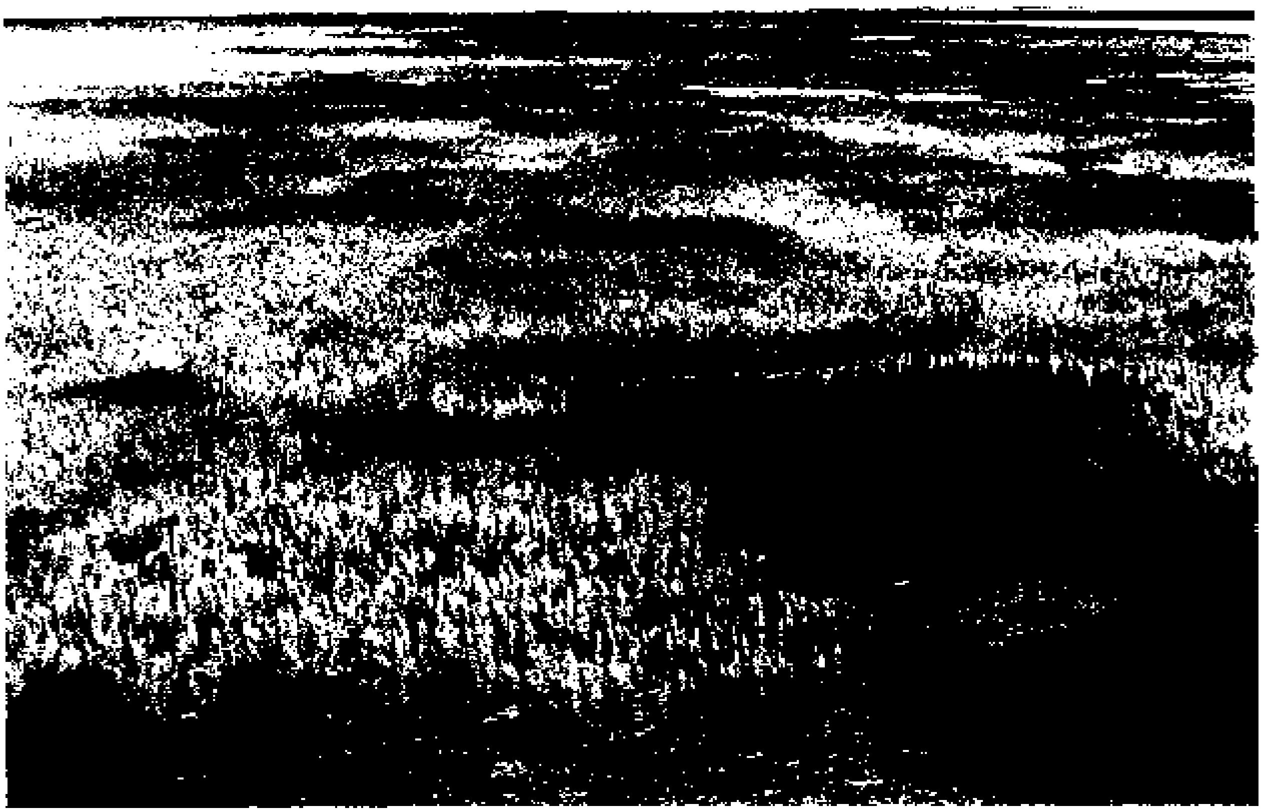

Plate 23.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Hippuris tetraphylla*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Mineral. This stand of mare's tail lies at the landward limit of the regularly flooded zone, where the substrate is covered with several centimeters of water at high tide. The Azun River, source of the tidal water, is just visible at the right-hand edge of the photo. (Mouth of Azun River, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 24.—Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Deciduous, DOMINANCE TYPE *Iva jrutescens,* WATER REGIME Irregularly Flooded, WATER CHEMISTRY Mixohaline, SOIL Mineral. Subordinate plants growing beneath the marsh elder are black grass (*Juncus gerardii*), salt grass (*Distichlis spicata*), and saltmeadow cordgrass (*Spartina patens*). This wetland lies toward the landward edge of an irregularly flooded persistent-emergent wetland dominated by saltmarsh cordgrass (*Spartina alterniflora*), saltmeadow cordgrass, and salt grass (background). (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 25.-Classification: SYSTEM Estuarine, SUBSYSTEM Intertidal, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Evergreen, DOMINANCE TYPE *Rhizophora* mangle, WATER REGIMES Regularly Flooded (along waterways) and Irregularly Flooded (at some distance from waterways), WATER CHEMISTRY Oligohaline, SOIL Organic. This mangrove swamp is located in the southern part of the Florida Everglades. (Dade County, Florida; December 1975; Photo by V. Carter)

Plate 26.—Classification: SYSTEM Riverine, SUBSYSTEM Tidal, CLASS Aquatic Bed, SUBCLASS Rooted Vascular, DOMINANCE TYPE *Myriophyllum spicatum–Hydrilla verticillata–Heteranthera dubia,* WATER REGIME Permanently Flooded-Tidal, WATER CHEMISTRY Fresh-Circumneutral. (Prince Georges County, Maryland; October 1985; Photo by V. Carter)

Plate 27.-Two habitats are shown here. Classification of nonvegetated zone: SYSTEM Riverine, SUBSYSTEM Tidal, CLASS Unconsolidated Shore, SUBCLASS Mud, WATER REGIME Regularly Flooded, WATER CHEMISTRY Fresh-Circumneutral. Classification of vegetated zone: SYSTEM Riverine, SUBSYSTEM Tidal, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Peltandra virginica*, WATER REGIME Regularly Flooded, WATER CHEMISTRY Fresh-Circumneutral, SOIL Mineral. The photo was taken at low tide. (Cecil County, Maryland; July 1972; Photo by V. Carter)

Plate 28.—Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, CLASS Unconsolidated Bottom, SUBCLASS Cobble-Gravel, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. The channel bottom is composed primarily of gravel and sand. The stream meanders through a grassy annual floodplain which is flanked by a more elevated floodplain supporting cottonwoods *(Populus deltoides)*. (Crook County, Wyoming; May 1985; Photo by F. C. Golet)

Plate 29.-Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, CLASS Unconsolidated Bottom, SUBCLASS Sand, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Channel meanders, a typical feature of lower perennial streams, are especially well developed along this section of the Yellowstone River. (Yellowstone National Park, Park County, Wyoming; May 1985; Photo by F. C. Golet)

Plate 30.-Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, CLASS Aquatic Bed, SUBCLASS Rooted Vascular, DOMINANCE TYPE *Nymphaea odorata*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutral, SPECIAL MODIFIER Excavated. This channel was dug by man in an unsuccessful attempt to drain the wetland. Plants in the Palustrine wetland bordering the channel include sedge (*Carex lasiocarpa*), sweet gale (*Myrica gale*), leatherleaf (*Chamaedaphne calyculata*), and Atlantic white cedar (*Chamaecyparis thyoides*). (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

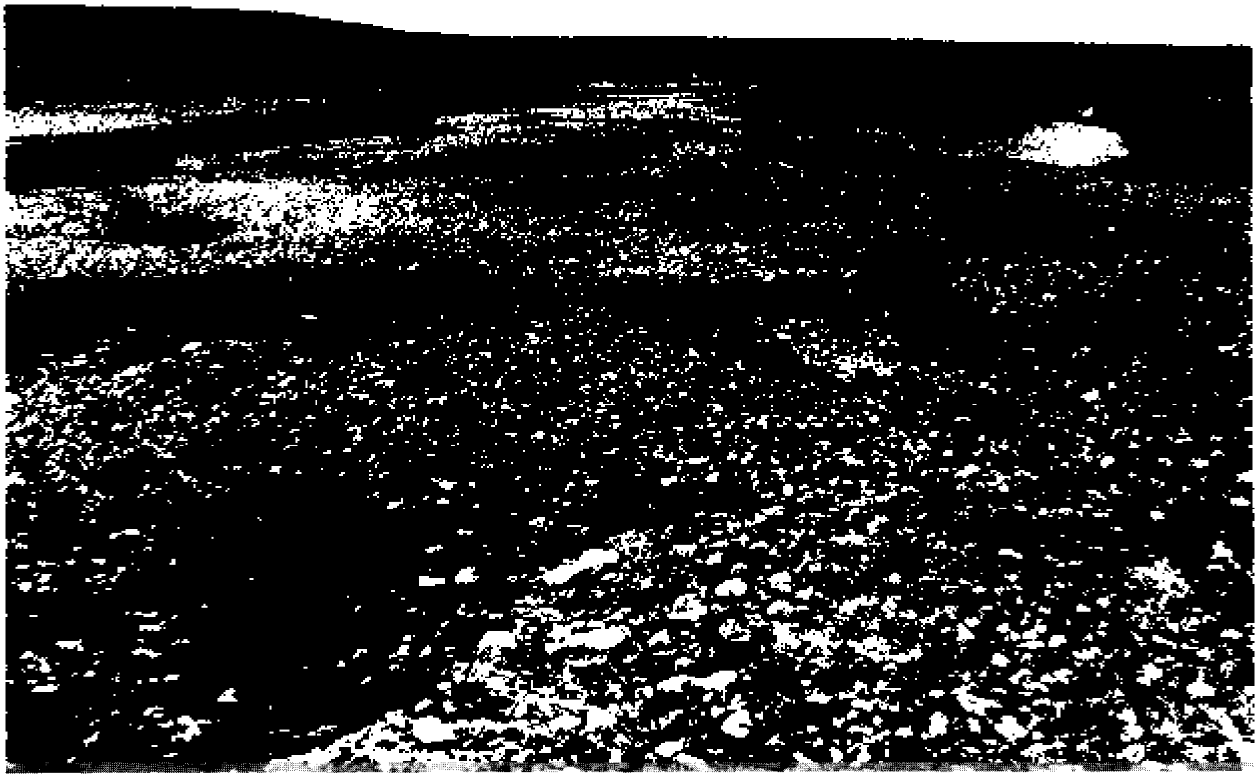

Plate 31.—Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, CLASS Unconsolidated Shore, SUBCLASS Cobble-Gravel, WATER REGIME Temporarily Flooded, WATER CHEMISTRY Fresh. Feltleaf willow (*Salix alaxensis*) grows along the edge of the stream. The entire channel is flooded for only a few weeks after snowmelt each year. (Kavik River, North Slope Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 32.-Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, CLASS Unconsolidated Shore, SUBCLASS Sand, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Mixosaline, SOIL Mineral. Young tamarisk (*Tamarix gallica*) plants are scattered over this sand flat. (Socorro County, New Mexico; April 1978; Photo by P. B. Reed)

Plate 33.-Classification: SYSTEM Riverine, SUBSYSTEM Lower Perennial, **CLASS** Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Peltandra virginica–Pontederia cordata,* WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Fresh–Circumneutral, SOIL Mineral. This wetland lies in a bay of the Chicopee River. (Hampden County, Massachusetts; July 1970; Photo by R. C. Smardon)

Plate 34.-Two habitats are shown here. Classification of channel: SYSTEM Riverine, SUBSYSTEM Upper Perennial, CLASS Rock Bottom, SUBCLASS Bedrock, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Classification of shore: SYSTEM Riverine, SUBSYSTEM Upper Perennial, CLASS Rocky Shore, SUBCLASS Bedrock, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh. (Penobscot County, Maine; October 1977; Photo by R. W. Tiner)

Plate 35.-Classification: SYSTEM Riverine, SUBSYSTEM Upper Perennial, CLASS Rock Bottom, SUBCLASS Rubble, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Many of the boulders in this river exceed 1 m (3.3 ft) in diameter. (Matanuska–Susitna Borough, Alaska; June 1985; Photo by F. C. Golet)

Plate 36.-Classification: SYSTEM Riverine, SUBSYSTEM Upper Perennial, CLASS Unconsolidated Bottom, SUBCLASS Cobble-Gravel, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutral. (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 37.—Classification: SYSTEM Riverine, SUBSYSTEM Upper Perennial, CLASS Unconsolidated Shore, SUBCLASS Cobble-Gravel, WATER REGIME Temporarily Flooded, WATER CHEMISTRY Fresh. This high-gradient mountain stream arises in the Alaska Range. The gravel piled at the left-hand edge of the photo had accumulated in the channel during flood stage and was bulldozed to its present position to prevent flooding of a highway just downstream. (Fairbanks North Star Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 38.—Classification: **SYSTEM** Riverine, **SUBSYSTEM** Intermittent, **CLASS** Streambed, **SUBCLASS** Sand, **WATER REGIME** Intermittently Flooded, **WATER CHEMISTRY** Mixosaline. The average annual discharge for this river, the Rio Salado, is 14.6 hm^3/yr (11,880 acre-ftiyr). (Socorro County, New Mexico; April 19'78; Photo by P. B. Reed)

Plate 39.-Classification: SYSTEM Riverine, SUBSYSTEM Intermittent, CLASS Streambed, SUBCLASS Mud, WATER REGIME Intermittently Flooded. Streambeds such as this are common throughout the arid West. They carry water for brief periods after snowmelt and following rainstorms which are irregular and unpredictable in occurrence. (Badlands National Monument, Jackson County, South Dakota; May 1985; Photo by F. C. Golet)

Plate 40.-Classification: SYSTEM Lacustrine, SUBSYSTEM Limnetic, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. In the narrow Littoral zone of Yellowstone Lake, where water is less than 2 m (6.6 ft) deep, the bottom consists primarily of gravel and sand. (Yellowstone National Park, Teton County, Wyoming; May 1985; Photo by F. C. Golet)

Plate 41.-Classification: SYSTEM Lacustrine, SUBSYSTEM Limnetic, CLASS Aquatic Bed, SUBCLASS Rooted Vascular, DOMINANCE TYPE ***Nymphaea*** *odorata*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutral. Subordinate plants in the Aquatic Bed include bladderworts (*Utricularia* spp.). Yellow-eyed grass (*Xyris smalliana*) grows on floating mats of peat along the shore (foreground). Water depth in this 0.8-ha (2-acre) bog lake exceeds 3 m (10 ft). (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 42.-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Unconsolidated Shore, SUBCLASS Cobble-Gravel, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh, At the time of photography, the level of Yellowstone Lake was near its seasonal low point. Due to snowmelt, the level of the lake rises to a peak in early July and then slowly declines until the following spring. This entire beach is inundated each summer. (Yellowstone National Park, Teton County, Wyoming; May 1985; Photo by F. C. Golet)

Plate 43.-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Unconsolidated Shore, SUBCLASS Sand, WATER REGIME Intermittently Flooded, WATER CHEMISTRY Fresh. Water levels in the Great Lakes generally fluctuate little during a single year, but they may rise and fall considerably over a period of several years. The water level in Lake Michigan was at an all-time high when this photo was taken. As a result of long-term changes in lake levels and seiches produced by storms, lake waters inundate part or all of this beach on an irregular basis. (Indiana Dunes National Lakeshore, Porter County, Indiana; May 1985; Photo by F. C. Golet)

Plate 44.-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Unconsolidated Shore, SUBCLASS Mud, WATER REGIMES Temporarily Flooded and Seasonally Flooded, WATER CHEMISTRY Fresh, SOIL Mineral, SPECIAL MODIFIER Impounded. The flats exposed along the shore of this reservoir are temporarily flooded; the seasonally flooded zone is still inundated at the time of this spring photograph. (Park County, Wyoming; May 1985; Photo by F. C. Golet)

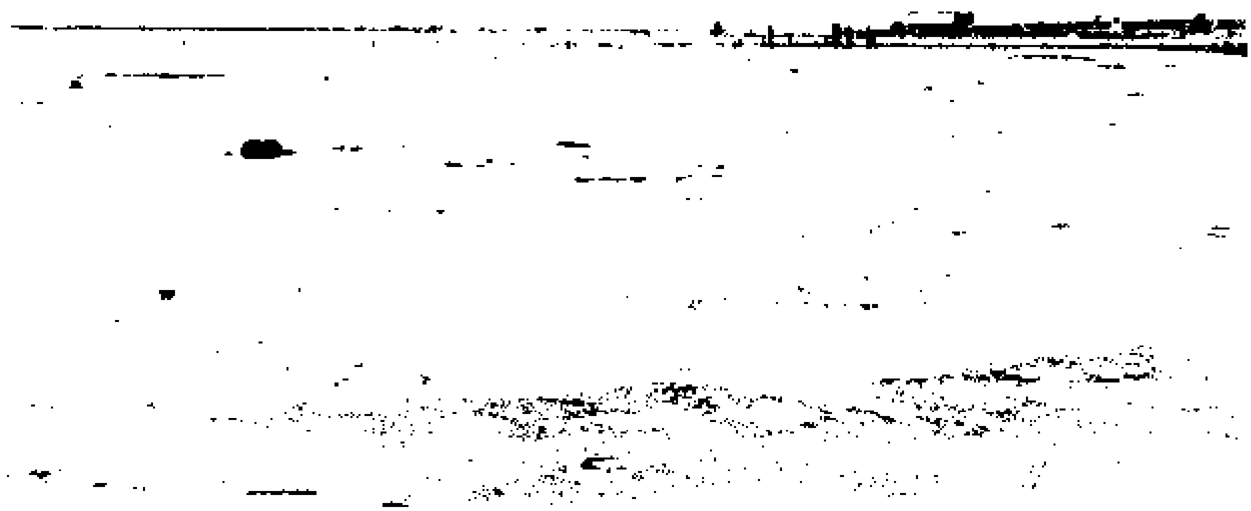

Plate 45.-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, **CLASS** Unconsolidated Shore, SUBCLASS Mud, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Hypersaline. (Salt Lake County, Utah; June 1973; Photo by V. Carter)

Plate 46.-Two habitats are shown here. Classification of exposed areas: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Unconsolidated Shore, SUBCLASS Mud, WATER REGIMES Intermittently Flooded (light-colored soil) and Seasonally Flooded (darker soil along water's edge), WATER CHEMISTRY Mixosaline, SOIL Mineral. Classification of inundated areas: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Mixosaline, SOIL Mineral. Greasewood (*Sarcobatus vermiculatus*), salt grass (*Distichlis spicata*), and rushes (*Juncus* spp.) are scattered across the flats. Because annual precipitation averages only about 18 cm (7 in) here, these wetlands are heavily dependent upon snowpack in the surrounding mountains as a source of water. (Saguache County, Colorado; Photo by R. M. Hopper)

Plate 47.—Classification: **SYSTEM** Lacustrine, **SUBSYSTEM** Littoral, **CLASS** Unconsolidated Shore, **SUBCLASS** Organic, **WATER REGIME** Seasonally Flooded, **WATER CHEMISTRY** Fresh. This beach is only 15 m (50 ft) long and 2 m (6-7 ft) wide. Such organic shores are common in certain areas of the Yukon-Kuskokwim Delta, and many are considerably larger than the one shown here. Evidence of the decline in lake levels over the summer can be seen in the series of low ridges in the peat. Surrounding vegetation includes sedge (*Carex lyngbyei*), bluejoint (*Calamagrostis canadensis*), and willows (*Salix* spp.). (Talik River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate I&-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE Nelumbo *lutea*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutrai, SOIL Mineral, SPECIAL MODIFIER Impounded. Subordinate plants are duckweeds (*Lemna* spp.) and bald cypress (*Taxodium distichum*). (Obion County, Tennessee; September 1975; Photo by V. Carter)

Plate 49.-Classification: SYSTEM Lacustrine, SUBSYSTEM Littoral, **CLASS** Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Juncus militaris*, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Fresh-Circumneutral, SOIL Mineral. Subordinate plants include common threesquare (*Scirpus americanus*) and pickerelweed (*Pontederia cordata*). During the spring, emergent vegetation is not evident at this site, and waves break on the gravel shore visible in the foreground. (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 50.-Classification: SYSTEM Palustrine, CLASS Unconsolidated Bottom, SUBCLASS Sand, WATER REGIME Intermittently Exposed, WATER CHEMISTRY Fresh-Alkaline. Rushes (*Juncus* spp.), spike rush (*Eleocharis* sp.), and smartweed (*Polygonum* sp.) grow in shallow water along the shore of this 0.4-ha (l-acre) pond which occupies a depression amidst sand dunes on the southern shore of Lake Michigan. (Indiana Dunes National Lakeshore, Porter County, Indiana; May 1985; Photo by F. C. Golet)

Plate 51.-Classification: SYSTEM Palustrine, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutral, SPECIAL MODIFIER Impounded. This beaver pond is situated in the San Juan Mountains. (Gunnison County, Colorado; Photo by R. M. Hopper)

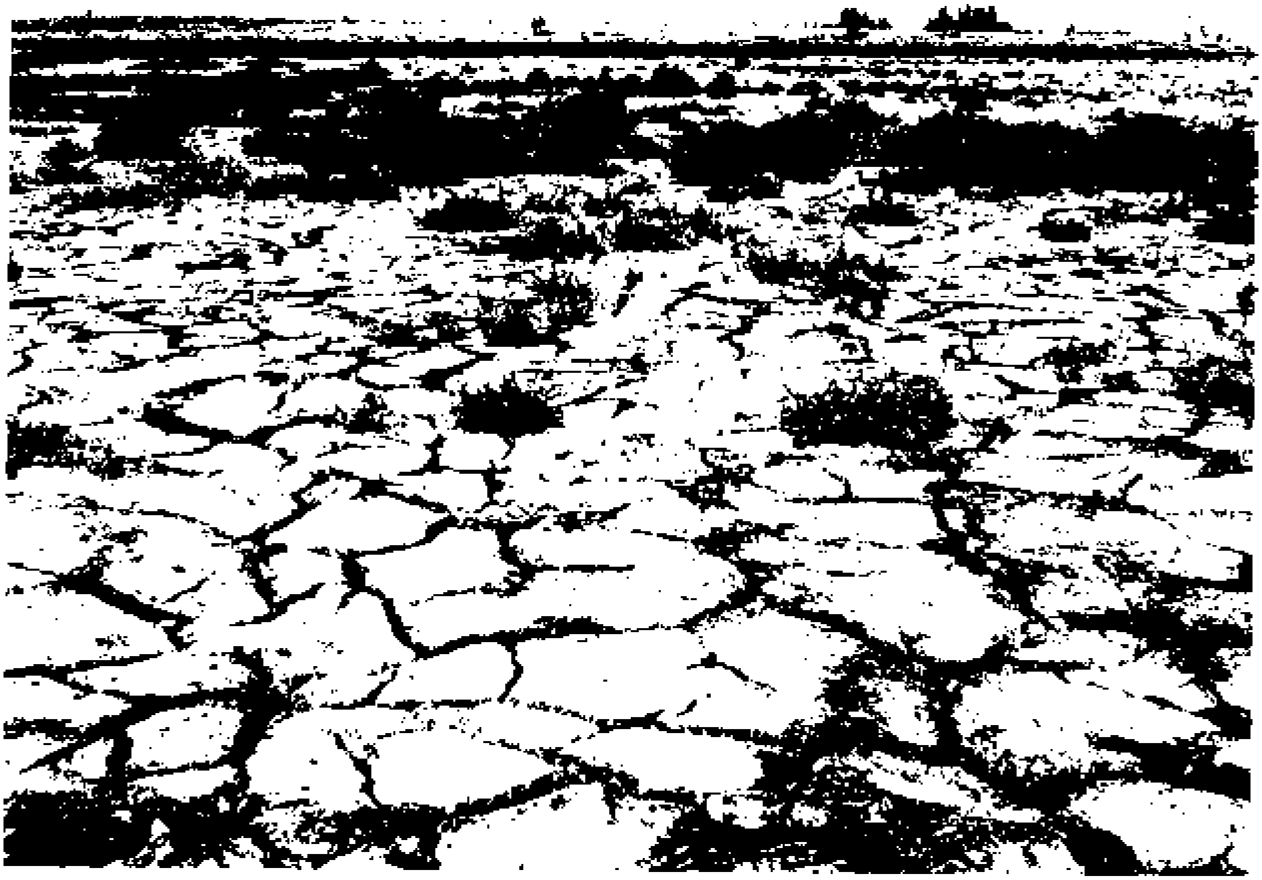

Plate 52.—Classification: SYSTEM Palustrine, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Mesosaline, SOIL Mineral. This photo was taken during drouth conditions; the bottom is being invaded by pioneer species including summer cypress (*Kochia scoparia*), golden dock (*Rumex maritimus*), and goosefoot (*Chenopodium glaucum*). (Stutsman County, North Dakota; August 1961; Photo by R. E. Stewart)

Plate 53.-Classification: SYSTEM Palustrine, CLASS Unconsolidated Bottom, SUBCLASS Mud, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Fresh-Alkaline, SOIL Mineral, SPECIAL MODIFIER Impounded. A sparse stand of water plantain ***(Alisma plantago-aquatica*)** appears along the edge of the impoundment. (Billings County, North Dakota, July 1970; Photo by J. T. Lokemoen)

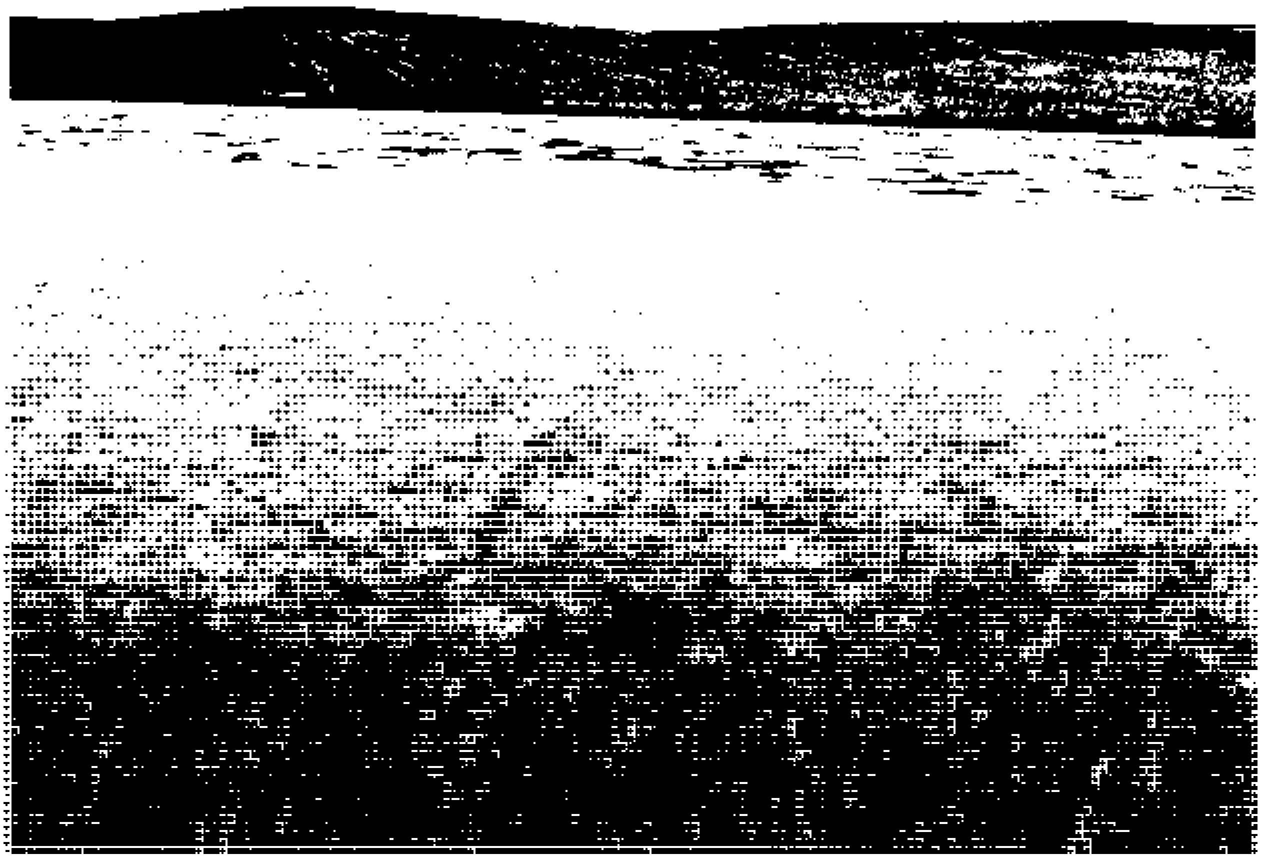

Plate 54.—Classification: SYSTEM Palustrine, CLASS Aquatic Bed, SUBCLASS Rooted Vascular, DOMINANCE TYPE *Ranunculus trichophyllus*, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Oligosaline, SOIL Mineral. (Stutsman County, North Dakota, August 1966; Photo by R. E. Stewart)

Plate 55.-Classification: SYSTEM Palustrine, CLASS Moss-Lichen Wetland, SUBCLASS Moss, WATER REGIME Saturated, WATER CHEMISTRY Fresh-Acid, SOIL Organic. The dominant plant is peat moss (Sphagnum spp.). Subordinate plants include reindeer moss (*Cladina* spp.), leatherleaf (*Chamaedaphne calyculata*), crowberry (*Empetrum nigrum*), and cottongrass (*Eriophorum* spp.). (Campobello Island International Park, Maine-Canada; June 1976; Photo by V. Carter)

Plate 56.—Classification: **SYSTEM** Palustrine, **CLASS** Moss-Lichen Wetland, **SUBCLASS** Moss, **WATER REGIME** Saturated, **WATER CHEMISTRY** Fresh. Peat moss (Sphagnum spp.) is the dominant plant. Subordinate plants include sedges (*Carex rariflora, C. aquatilis*), cottongrass (*Eriophorum russeolum*), and reindeer moss (*Cladina* spp.). While sedges are present, their combined cover is less than 30%. Mosses cover 100% of the area. (Narokachik-Azun Rivers area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate **57.**—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Typha latifolia*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh, SPECIAL MODIFIER Impounded. Persistent emergents such as these cattails remain standing at least until the beginning of the next growing season. Note that the adjacent lake is ice-covered at the time of photography. (Knox County, Maine; April 1978; Photo by P. B. Reed)

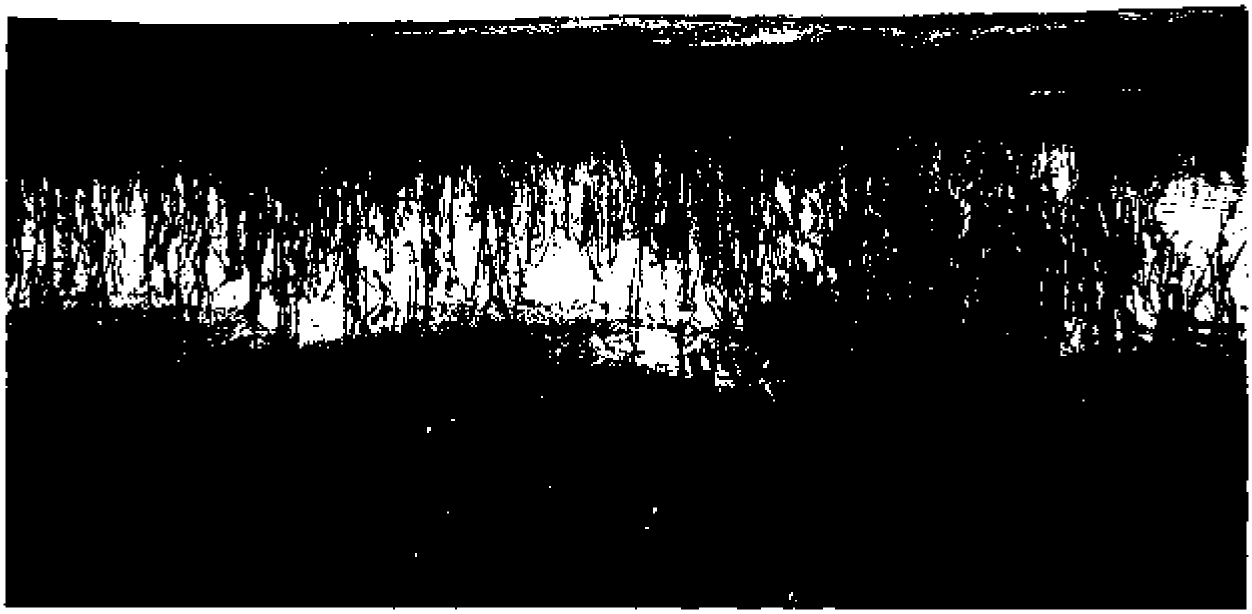

Plate 58.—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Scirpus robustus*–*Scirpus acutus*, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Mixosaline, SOIL Mineral. (Stutsman County, North Dakota; August 1962; Photo by R. E. Stewart)

Plate 59.—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Cladium jamaicense*, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Fresh-Circumneutral, SOIL Organic. This photo was taken in the Florida Everglades. (Dade County, Florida; December 19'75; Photo by V. Carter)

Plate 60.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Carex lasiocarpa*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh-Circumneutral, SOIL Organic. Subordinate plants include sedges (*Carex lacustris*, C. *rostrata*), water smartweed (*Polygonum amphibium*), bladderwort (*Utricularia macrorhiza*), bluejoint (*Calamagrostis canadensis*), and pondweed (*Potamogeton gramineus*). (Chippewa National Forest, Beltrami County, Minnesota; June 1972; Photo by J. H. Richmann)

Plate 61.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Eleocharis palustris*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Polysaline, SOIL Mineral. Subordinate plants include water smartweed (*Polygonum amphibium*), slough sedge (*Carex atherodes*), and foxtail (*Alopecurus aequalis*). (Stutsman County, North Dakota; August 1962; Photo by R. E. Stewart)

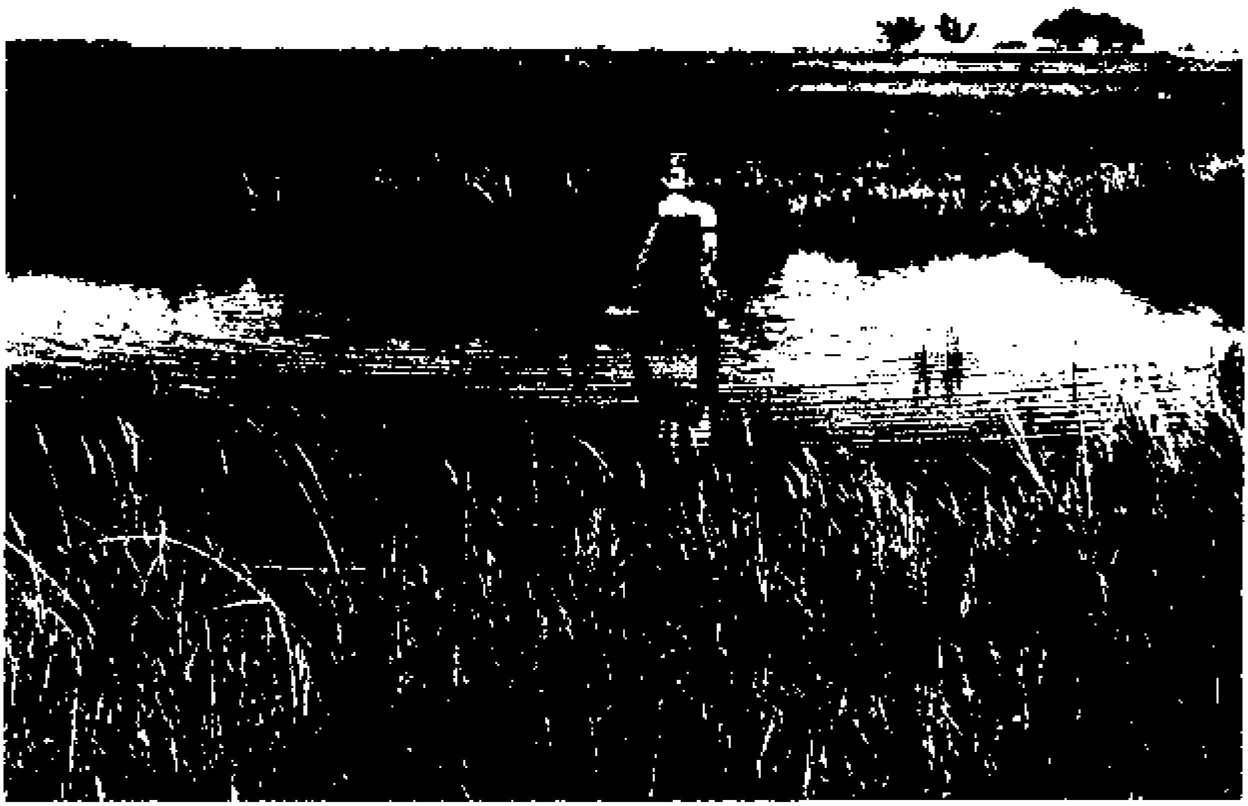

Plate 62.—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Mixosaline, SOIL Mineral. The principal plants are sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), rushes (*Juncus* spp.), and foxtail (*Alopecurus aequalis*). This wetland is typical of irrigated hay in the West. Water may be diverted from rivers or may come from artesian wells as in this photo. (Saguache County, Colorado; Photo by R. M. Hopper)

Plate 63.-Classification: **SYSTEM** Palustrine, **CLASS** Emergent Wetland, **SUBCLASS** Persistent, **DOMINANCE TYPE** *Carex rariflora–Eriophorum russeolum*, **WATER REGIME** Seasonally Flooded, **WATER CHEMISTRY** Fresh. Subordinate plants include marsh cinquefoil (*Potentilla palustris*), bluejoint (*Calamagrostis canadensis*), Alaska bog willow (*Salix fuscescens*), crowberry (*Empetrum nigrum*), dwarf birch (*Betula nana*), and peat moss (Sphagnum sp.). This type of patterned wetland is commonly referred to as "string bog" or "strangmoor." Seasonally flooded troughs alternate with elongated bog-like ridges or "strings." Strings here rise only 30-45 cm (12-18 in) above the troughs. (Manokinak River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 64.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Colocasia esculenta*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh, SOIL Mineral, SPECIAL MODIFIER Farmed. This photograph illustrates a Hawaiian taro field. (Kauai County, Hawaii; September 1972; Photo by E. Krider)

Plate 65.—Classification (foreground): SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Aristida stricta*, WATER REGIME Saturated, WATER CHEMISTRY Fresh-Acid, SOIL Mineral. Subordinate plants include beak rushes (*Rhynchospora* spp.), longleaf pine (*Pinus palustris*), orchids (*Habenaria* spp.), yellow-eyed grasses (*Xyris* spp.), grass pinks (*Calopogon* spp.), and foxtail clubmoss (*Lycopodium alopecuroides*). (Brunswick County, North Carolina; December 19'75; Photo by V. Carter)

Plate 66.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, WATER REGIME Saturated, WATER CHEMISTRY Fresh. The dominant plants in this montane meadow are sedges (Curer spp.). (Lassen County, California; August 1975; Photo by V. Carter)

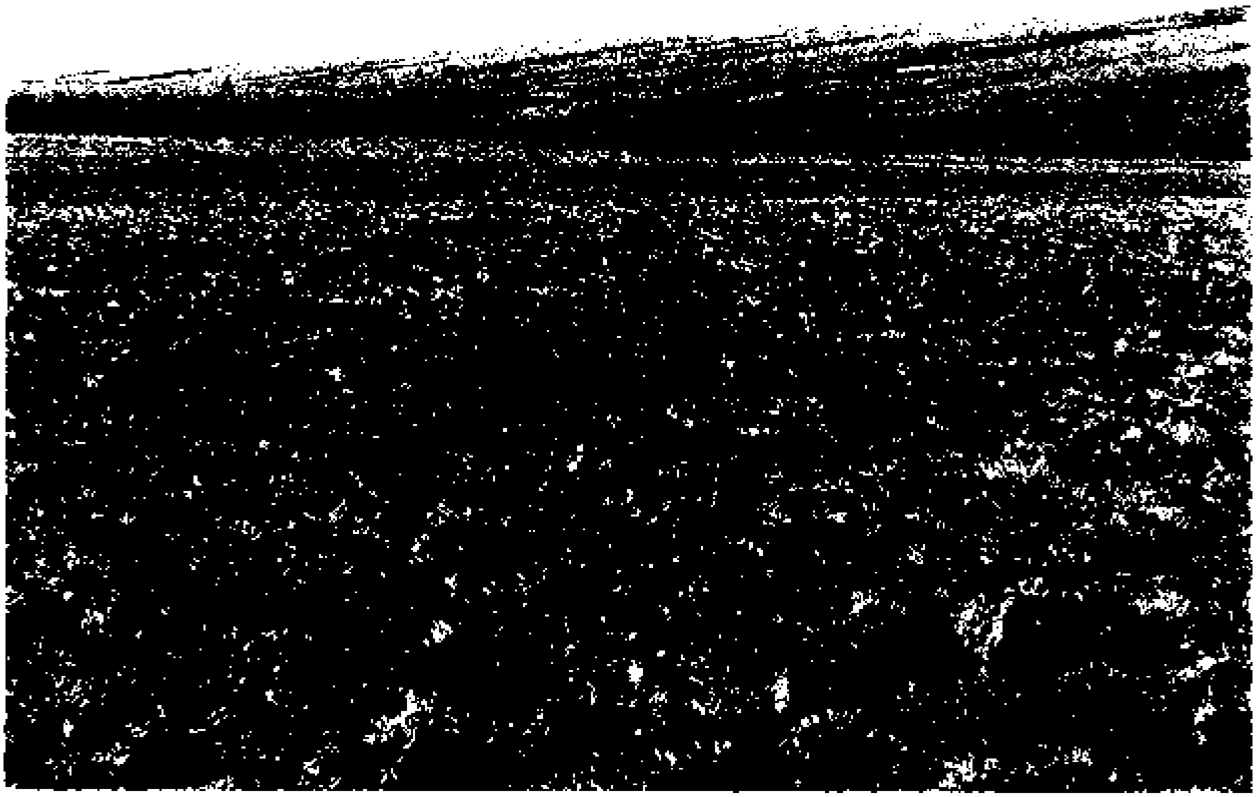

Plate U.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Eriophorum vaginatum*, WATER REGIME Saturated, WATER CHEMISTRY Fresh, SOIL Mineral. Subordinate plants include: netleaf willow (*Salix reticulata*), diamondleaf willow (S. *planifolia*), dryas (*Dryas integrifolia*), bistort (*Polygonum bistorta*), lousewort (*Pedicularis* sp.), chickweed (*Stellaria* sp.), and lapland cassiope (*Cassiope tetragona*). This type of wetland, referred to by Walker (1983) as "moist tussock sedge dwarf shrub tundra," covers much of the North Slope of Alaska. At this site, permafrost lies within 15 cm (6 in) of the surface. All of the land in this photo is wetland. (Franklin Bluffs, North Slope Borough, Alaska; July 1985; Photo by F. C. Golet)

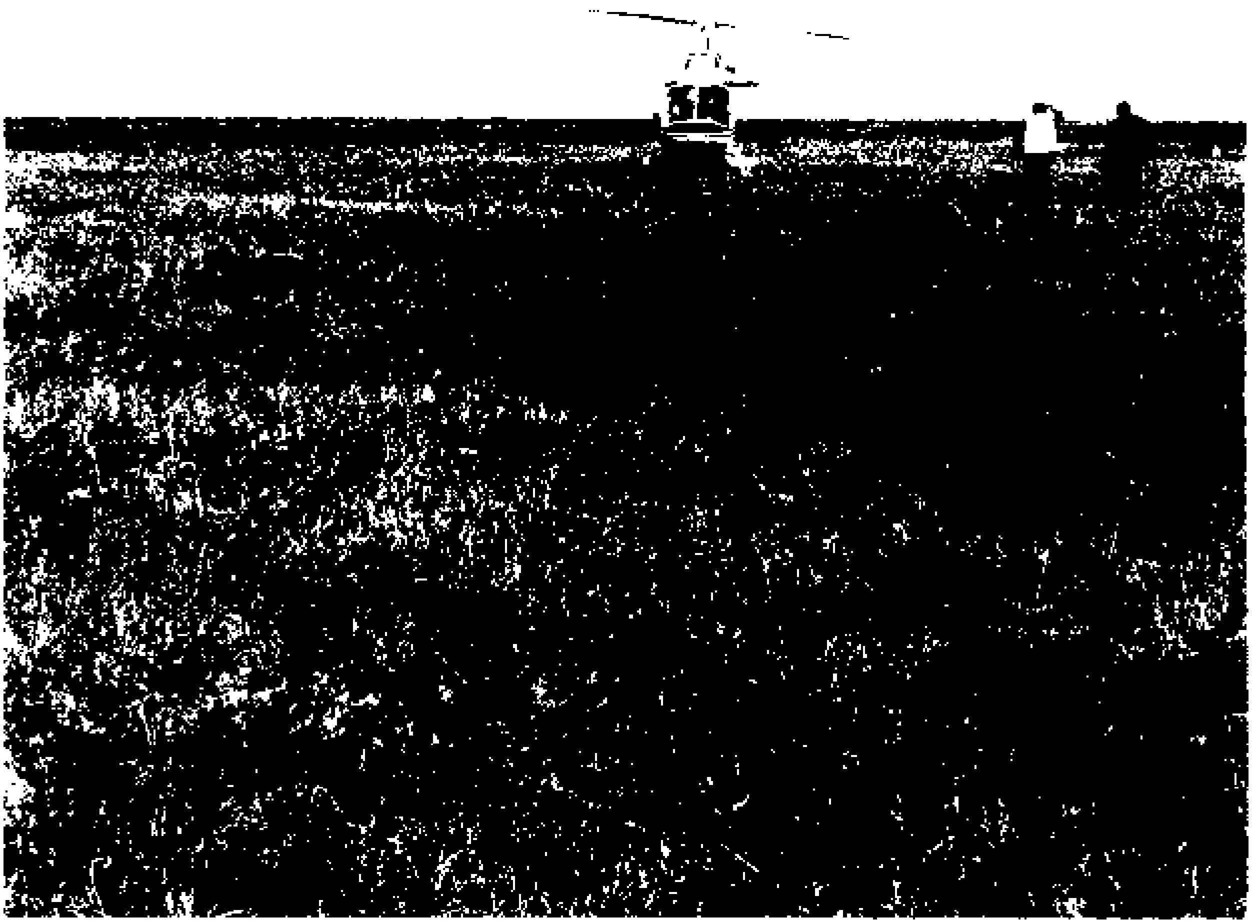

Plate 68.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Carex aquatilis,* WATER REGIME Saturated, WATER CHEMISTRY Fresh. Subordinate plants include: narrowleaf Labrador tea ***(Ledum** decumbens*), dwarf birch (*Betula nana*), small cranberry ***(Vaccinium oxycoccos),*** crowberry (*Empetrum nigrum*), peat moss (Sphagnum spp.), and foliose lichens. (Narokachik River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 69.—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, WATER REGIME Temporarily Flooded, WATER CHEMISTRY Oligosaline, SOIL Mineral, SPECIAL MODIFIER Farmed. All natural vegetation in this wetland has been removed, and water stands in stubble from the previous year's wheat crop. (Stutsman County, North Dakota; March 1967; Photo by H. A. Kantrud)

Plate 70.—Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, WATER REGIME Temporarily Flooded, WATER CHEMISTRY Fresh, SOIL Mineral, SPECIAL MODIFIER Farmed. Principal plants include nut sedge (*Cyperus* sp.), arrow arum (*Peltandra virginica*), and barnyard grass (*Echinochloa crusgalli*). (Dade County, Florida; January 1978; Photo by P. B. Reed)

Plate 71.—Two habitats are shown here. Classification of darker zone (edge of water body): SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Arctophila fulva*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Classification of lighter zone (foreground): SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Persistent, DOMINANCE TYPE *Carex aquatilis*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh. Marsh marigold (*Caltha palustris*) is also present in the seasonally flooded zone. This wetland lies on coastal tundra within 2 km (1.2 mi) of the Arctic Ocean. (Between Canning and Kavik Rivers, North Slope Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 72.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE ***Hippuris tetraphylla***, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. A semipermanently flooded persistent-emergent wetland dominated by sedge (*Carex lyngbyei*) surrounds the *Hippuris* marsh. Burreed (*Sparganium hyperboreum*) grows in shallow water between the ***Hippuris*** and the sedges. (Narokachik River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 73.-Classification: SYSTEM Palustrine, CLASS Emergent Wetland, SUBCLASS Nonpersistent, DOMINANCE TYPE *Nuphar luteum*, WATER REGIME Semipermanently Flooded, WATER CHEMISTRY Fresh. The principal subordinate plant is common duckweed (*Lemna* minor). (Cass County, Michigan; May 1985; Photo by F. C. Golet)

Plate 74.—Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Deciduous, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh-Acid, SOIL Organic. The dominant plants are willows (*Salix* spp.). Subordinate species include Sitka spruce (*Picea sitchensis*) and lodgepole pine (*Pinus contorta*). (Coos County, Oregon; May 1977; Photo by D. D. Peters)

Plate 75.—Classificaton: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Deciduous, DOMINANCE TYPE *Betula nana*, WATER REGIME Saturated, WATER CHEMISTRY Fresh, SOIL Mineral. Subordinate plants include cotton grass (*Eriophorum vaginatum*), peat moss (Sphagnum spp.), cloudberry (*Rubus chamaemorus*), mountain cranberry (*Vaccinium vitis-idaea*), and narrowleaf Labrador tea (*Ledum decumbens*). Shrubs here are less than 20 cm (8 in) tall. This area of moist tundra is underlain by permafrost at a depth of 45 cm (18 in). (Vicinity of Toolik Lake, North Slope Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 76.—Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Deciduous, DOMINANCE TYPE *Alnus tenuifolia*, WATER REGIME Temporarily Flooded, WATER CHEMISTRY Fresh, SOIL Mineral. Subordinate plants include feltleaf willow (*Salix alaxensis*) and balsam poplar (*Populus balsamifera*). Shrubs are nearly 6 m (20 ft) tall, the height that separates Scrub-Shrub from Forested Wetland. This site is flooded only for brief periods after snowmelt and during times of most rapid melting of nearby glaciers. (Tanana River, Fairbanks North Star Borough, Alaska; July 1985; Photo by F. C. Golet)

Plate 77.—Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Needle-leaved Deciduous, DOMINANCE TYPE *Larix laricina*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh. The tamarack saplings are 2-3 m (6.6-10 ft) tall and cover 40-45% of the site. Subordinate plants include: dwarf birch (*Betula nana*), bluejoint (*Calamagrostis canadensis*), black spruce (*Picea mariana*), leatherleaf (*Chamaedaphne calyculata*), diamondleaf willow (*Salix planifolia*), narrowleaf Labrador tea (*Ledum decumbens*), cotton grass (*Eriophorum* sp.), bog blueberry (*Vaccinium uliginosum*), marsh cinquefoil (*Potentilla palustris*), and shrubby cinquefoil (P. *fruticosa*). (Vicinity of Big Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate U-Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Evergreen, DOMINANCE TYPE *Ledum groenlandicum-Kalmia angustifolia—Chamaedaphne calyculata,* WATER REGIME Saturated, WATER CHEMISTRY Fresh-Acid, SOIL Organic. Subordinate plants include peat moss (Sphagnum spp.), crowberry (*Empetrum nigrum*), cloudberry (*Rubus chamaemorus*), and black spruce (*Picea mariana*). (Washington County, Maine; June 1976; Photo by V. Carter)

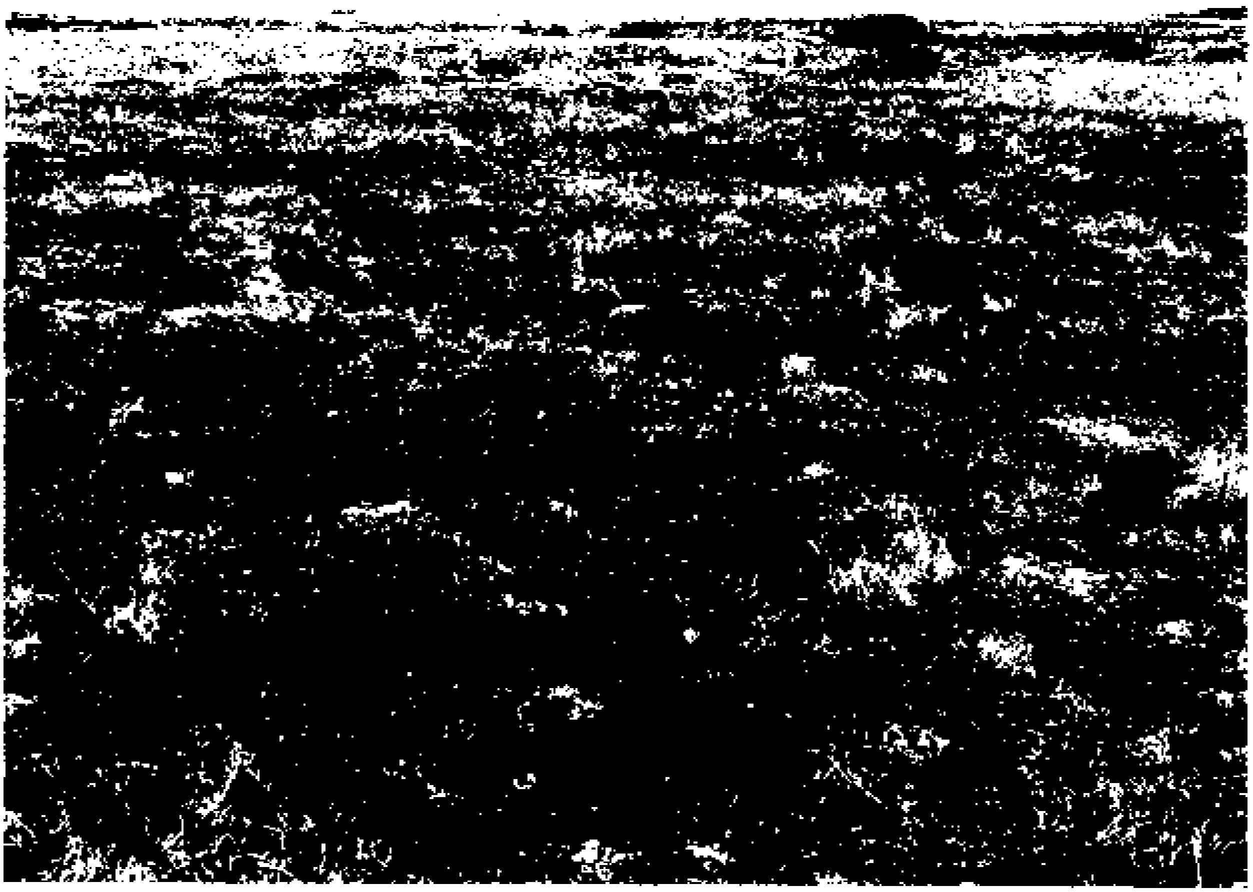

Plate 79.-Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Evergreen, DOMINANCE TYPE *Ledum decumbens*, WATER REGIME Saturated, WATER CHEMISTRY Fresh, SOIL Mineral. Subordinate species include: cloudberry (*Rubus chamaemorus*), mountain cranberry (*Vaccinium vitis-idaea*), crowberry (*Empetrum nigrum*), dwarf birch (*Betula nana*), reindeer moss (*Cladina* spp.), sedge (*Carex aquatilis*), bluejoint (*Calamagrostis canadensis*), and Alaska spiraea (*Spiraea beauverdiana*). Shrubs are less than 20 cm (8 in) tall. Although this site looks like a dry heath, permafrost at a depth of only 15-20 cm (6-8 in) keeps the soil saturated near the surface throughout the growing season. (Talik River area, Yukon-Kuskokwim Delta, Alaska; July 1985; Photo by F. C. Golet)

Plate 80.—Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Broad-leaved Evergreen, DOMINANCE TYPE *Cyrilla racemiflora*, WATER REGIME Saturated, WATER CHEMISTRY Fresh-Acid, SOIL Organic. Subordinate plants include: honeycup (*Zenobia pulverulenta*), leatherleaf (*Chamaedaphne calyculata*), peat moss (*Sphagnum* spp.), highbush blueberry (*Vaccinium corymbosum*), loblolly bay (Gordonia *lasianthus*), pond pine (*Pinus* serotina), and highbush blueberry (*Veccinium corymbosum*). Locally, these wetlands are referred to as evergreen shrub bogs or "pocosins." (Brunswick County, North Carolina; December 1975; Photo by V. Carter)

Plate 81.—Classification: SYSTEM Palustrine, CLASS Scrub-Shrub Wetland, SUBCLASS Needle-leaved Evergreen, DOMINANCE TYPE *Picea mariana*, WATER REGIME Saturated, WATER CHEMISTRY Fresh. Subordinate plants include: dwarf birch (*Betula nana*), cotton grass (*Eriophorum vaginatum*), bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum groenlandicum*), and peat moss (Sphagnum spp.). This wetland type, commonly known as "muskeg," is abundant in the forested regions of Alaska; it also occurs in northern New England and in the Great Lakes States. (Vicinity of Coldfoot, Alaska; July 1985; Photo by F. C. Golet)

Plate 82.—Classification: SYSTEM Palustrine, CLASS Forested Wetland, SUBCLASS Broad-leaved Deciduous, DOMINANCE TYPE *Acer rubrum*, WATER REGIME Saturated, WATER CHEMISTRY Fresh-Acid, SOIL Organic. Subordinate plants in this red maple swamp include black gum (Nyssa *sylvatica),* highbush blueberry *(Vaccinium corymbosum),* great laurel *(Rhododendron maximum),* and wintkrberry (*Ilex verticillata*). (Washington County, Rhode Island; June 1977; Photo by F. C. Golet)

Plate 83.—Two habitats are shown here. Classification of the forested area: SYSTEM Palustrine, CLASS Forested Wetland, SUBCLASS Needle-leaved Deciduous, DOMINANCE TYPE *Taxodium distichum*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Classification of the open area: SYSTEM Palustrine, CLASS Aquatic Bed, SUBCLASS Floating Vascular, DOMINANCE TYPE *Pistia stratiotes*, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh. Emergent plants growing in the bed of water lettuce are arrowheads (*Sagittaria* spp.). (Corkscrew Swamp Sanctuary, Collier County, Florida; January 1978; Photo by E. T. LaRoe)

Plate 84.-Classification: SYSTEM Palustrine, **CLASS** Forested Wetland, SUBCLASS Needle-leaved Evergreen, DOMINANCE TYPE *Chamaecyparis thyoides*, WATER REGIME Seasonally Flooded, WATER CHEMISTRY Fresh-Acid, SOIL Organic. Subordinate plants in this Atlantic white cedar swamp include: highbush blueberry (*Vaccinium corymbosum*), winterberry (*Ilex verticillata*), red maple (*Acer rubrum*), and peat moss (Sphagnum spp.). Low vegetation in the foreground includes leatherleaf (*Chamaedaphne calyculata*) and Virginia chain-fern (*Woodwardia virginica*). (Washington County, Rhode Island; July 1977; Photo by F. C. Golet)

Plate 85.—Classification: SYSTEM Palustrine, CLASS Forested Wetland, SUBCLASS Needle-leaved Evergreen, DOMINANCE TYPE *Picea mariana*, WATER REGIME Saturated, WATER CHEMISTRY Fresh, SOIL Mineral. Subordinate plants in this black spruce forest include Labrador tea (*Ledum groenlandicum*), mountain cranberry (*Vaccinium vitis-idaea*), crowberry (*Empetrum nigrum*), and peat moss (*Sphagnum* sp.). Permafrost is present within 45 cm (18 in) of the surface. (Vicinity of Glennallen, Alaska; July 1985; Photo by F. C. Golet)

Plate 86.-Classification: SYSTEM Palustrine, CLASS Forested Wetland, SUBCLASS Dead, WATER REGIME Permanently Flooded, WATER CHEMISTRY Fresh-Circumneutral, SOIL Mineral, SPECIAL MODIFIER Impounded. (Humphreys County, Tennessee; September 19'75; Photo by V. Carter)

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- Table Bluff Reservation-Wiyot Tribe

A big thanks goes to the Harbor District for providing a venue for the interagency meetings where much of the brainstorming and input took place.

Natural Resources Services would like to thank the following individuals for their contributions to the Signing Program and Signing Manual: Jennifer Graves, Gary Bloomfield, Dr. Carolyn Widner, Brian Ludy, NRS staff (Nathaniel Vaughn Kelsoe, Jeff Bue, Ruth Blyther, Chris Lohefner, Tracie Walker), and the folks at KVO Industries (Keith, Andy and Steve).

Table of Contents

I. The Humboldt Bay Interpretive Signing Program

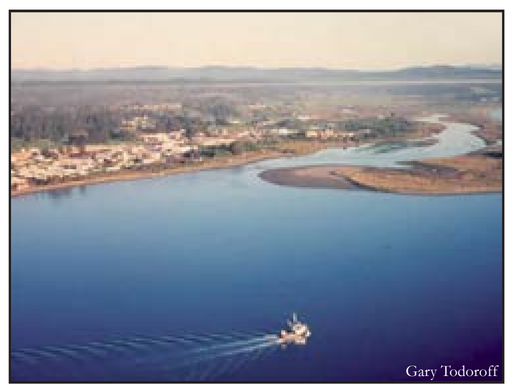
Overview of the Program

The Humboldt Bay Interpretive Signing Program was identfied as a priority project to improve coastal access in the *Humboldt Bay Trails Feasibility Study* conducted in 2001 by the Natural Resources Services (NRS) division of Redwood Community Action Agency (RCAA). This study documented the community's desire for better signage around the bay —signage that would indicate public access sites and provide information to promote bay appreciation.

Interpretive signs are often used by agencies and organzations to meet specific education and management goals.

Humboldt Bay is rich in natural and cultural resources, but lacks any cohesive public education initiatives designed to encourage their stewardship. Development and implementation of interpretive signs is one way that management agencies are able to get educational messages out to the public. Interpretive signs are also an effective way for agencies to meet site-specific management goals. A coordinated signing program at public access sites around the bay will raise awareness of both cultural and natural resources while encouraging safe and responsible public use.

There are numerous opportunities, at many sites around Humboldt Bay to provide site-specific and regional information. With a coordinated sign program, management agencies (and interest groups) will have a consistent, attractive tool that will not only reduce individual and collective sign production costs, but will ensure a more cohesive approach to bay management efforts.



Humboldt Bay attracts thousands of visitors annually. However, many people traveling on US 101 may pass by never knowing the many recreational opportunites available here.

The greater Humboldt Bay region attracts thousands of visitors and travelers to the area every year. Many of these visitors pass through on Highway 101 without exploring the unique natural and cultural resources just west of the highway. A unified system of kiosks and signs at key locations will serve to welcome and orient visitors to the bay —and encourage them to stay and explore some of the many recreational opportunities available in the area. In addition, the development of high-quality interpretive signs will help to improve local residents' connection with the bay.

A Signing Program that promotes attractive, informative, consistent and durable materials, will establish the bay as an accessible destination for locals and visitors. Furthermore, the program will simultaneously promote conservation of one of the region's most scenic and under-appreciated natural features —Humboldt Bay.

Why Create an Interpretive Signing Manual?

Input from the public and over 10 collaborating agencies helped guide the development of the Signing Program.

This Signing Manual outlines the step-by-step process from planning to installation of interpretive wayside signs and welcome kiosks for public access sites around Humboldt Bay. A series of 17 **thematic sign templates** (depicting elements of the area's unique natural and cultural history) and a **Humboldt Bay Map** are presented here along with **sign base structures**. The Signing Manual provides guidelines and suggestions for working with the sign templates and bases so that land agencies around the bay can develop consisent and unified interpretive sites. Sample template layouts are also included.

The contents of the Signing Manual range from tips and techniques on writing interpretive text to working with the templates and finding graphic designers, artists, and fabricators. The **CD-ROMs** provide digitally prepared graphic files of each sign template and additional graphic elements needed to get signs underway.

Planning access sites that include these sign templates and structures will provide the public with a predictable, consistent, and informative system of regulatory, geographic, and interpretive information. This coordinated effort will serve to orient and inform visitors of the diversity of natural and cultural resources, in addition to recreational opportunities, within the Humboldt Bay region. Thank you for being part of a bay-wide commitment to public education and access.

John Ash

One of the goals of the Signing Program is to encourage safe and appropriate public access around the bay.

Program Goals

Development and implementation of the Interpretive Signing Program is intended to:

- Encourage safe and appropriate public access around Humboldt Bay;
- Promote inter-agency collaboration through a series of thematically unified interpretive sign templates;
- Support local artists and businesses (as is possible) throughout the process; and
- Encourage visitors to develop an overall sense of connection to, and stewardship for, Humboldt Bay.

Collaborating Agencies

The success of this program is attributed in part to a coordinated effort on behalf of federal and state agencies as well as local districts and organizations of the Humboldt Bay region. Input from agency representatives was essential in the development and completion of the Signing Manual. From inter-agency meetings to questionnaires and website surveys, agency feedback has guided every step of the process. The development of a series of sign panel templates and structural alternatives is testimony to the level of commitment shown on behalf of agencies involved in this project. The following agencies and organizations via the Humboldt Bay Harbor, Recreation and Conservation District's Interagency Committee helped support and guide the development of the Humboldt Bay Interpretive Signing Program: *(Contact information for agencies is provided in Section 10)*

- State Coastal Conservancy
- Bureau of Land Management
- City of Eureka
- City of Arcata
- County of Humboldt Department of Public Works
- California Department of Fish and Game
- Friends of the Dunes
- Humboldt Area Foundation
- Humboldt Bay Harbor, Recreation and Conservation District
- Humboldt Bay National Wildlife Refuge
- Manila Community Services District
- Table Bluff Reservation-Wiyot Tribe

One of the outcomes of the Signing Program is the development of interpretive sign designs for the Elk River Wildlife Sanctuary (ERWS).

Program Outcomes

- The **Interpretive Signing Manual and CD-ROM** for collaborating agencies to be able to develop site-specific sign plans using the sign templates and bases; and
- Designs for interpretive signage for the **Elk River Wildlife Sanctuary**, based on templates and structural designs from the manual.
- **New interest** in developing interpretive signs by virtually every land management agency around the bay.
- One of the 17 panels was developed **independently** by a group with a specific interpretive objective.
- Other land managers in the **greater bay region** are already utilizing the same unified system.
- A kiosk and one wayside panel are already in the ground as the time of manual completion.

By following the guidelines presented in this manual, agencies can efficiently create site-specific interpretive signage within a greater regional context. The **Signing Manual** provides details for a step-by-step process to create signage: from the planning and writing stages, to fabrication, installation, and maintenance. Included in this manual are a series of artistic sign panel templates to choose from and suggestions for their use. The **CD-ROM** will help guide the graphic design and layout of sign panels. Also included are drawings for sign base structural design and installation.

In addition to the development of the Signing Manual, interpretive signage designs are presented (welcome kiosk and wayside signs) for the **Elk River Wildlife Sanctuary (ERWS)**. Signs for this site were developed using the templates from the manual. Through this process, the practicability of templates and their guidelines were tested.

The Signing Program Website

This manual, sign templates, sign drafts, and sign base structures are all available for preview through the Natural Resources Services website at **www.rcaa.org/baysigns.**

Nuts and Bolts of Sign Development Using the Signing Manual

Creating high-quality interpretive signs can be a significant undertaking. If possible, it is ideal to have a **team** of people assigned to different tasks who can work together on the interpretive plan. Following are the nuts and bolts for the development of signs according to the Signing Manual:

Who and What is Needed For Sign Development:

- A **Permit** granted by the appropriate land jurisdictions (City, County, Coastal Commission) for sign installation
- **Interpretive Text Writers** (to develop thematic interpretation)
- **Photographs or Scientific Illustrations** (to convey messages through graphic representation. May need to consult out)
- **Graphic Design Software** (Adobe Photoshop and Illustrator)
- **Graphic Designers** (to lay out text and graphics on panels)
- **Fabrication Coordinator** (for sign panels and their structures)
- **Installation and Maintenance Crew** (for installation and upkeep)

2. Fundamentals of Interpretation

What is Interpretation?

> *"Through interpretation; education.*
> *Through education; appreciation.*
> *Through appreciation; protection."*
> *Freeman Tilden*

"Interpretation is a communication process designed to reveal meanings and relationships of our cultural and natural heritage to the public (visitors) through first-hand experiences with objects, artifacts, landscapes, or sites" (in Veverka 1998). Interpretation, whether spoken or written, is a communication tool that links people with elements of the natural and cultural resources surrounding them. Essential here is *how* information is presented to visitors, not *what* is presented (Verveka 1998).

When it comes to interpreting the natural and cultural resources of a site, "the story is the thing." Interpretation is about telling a story. What are the stories of the area? How are those stories best communicated to visitors through signs?

Interpretation is also widely used as a management tool. Interpretive signs provide visitors with information about how to appropriately use a site. Recreational opportunites, interpretive information, and overall management goals can be conveyed through signs.

Interpretation creates a link between people and the natural and cultural resources surrounding them. Reading interpretive signs can become a recreational activity unto itself.

Connecting With the Recreational Visitor

Visitors to the Humboldt Bay region are motivated by diverse interests. Walking, hiking, boating, wildlife viewing, and picnicking are just a few of the activities that draw thousands of visitors to the area. Reading signs may not be a priority for many people. However, if interpretive signs are enjoyable and relevant to the visitors' experiences, reading and learning about the area may become another recreational opportunity (Veverka 1998). The signs should be engaging enough for visitors not only to stop and read them, but understand the message as well. Reading and understanding the message should take as little effort as possible. Also bear in mind that visitors will pick and choose what they read based on available time and interest. Techniques routinely used by practitioners in the planning and development of interpretive signs can be found throughout this manual.

Tilden's Principles of Interpretation:

For interpretation to be an effective communication tool, it should follow some basic principles outlined by the broadly considered "father of interpretation," Freeman Tilden. Each principle can be thought of as a *strategy* that will enable visitors to read and understand interpretive messages.

Interpretation should:

- Relate to audience
- Reveal information about the topic
- Be a combination of many arts
- Provoke interest in the topic
- Be a part of a greater whole

Signs at the BLM's Samoa Dunes site draw visitors' attention to the concrete mounds, old ammunition bunkers, just beyond the sign.

1. "Any interpretation that does not somehow **relate** what is being displayed or described to something within the personality or experience of the visitor will be sterile" (Tilden 1967). Find out what visitors already know about the site's cultural and/or natural resources. Know what interests visitors most about the site -what are the most common questions asked? What prominent features exist that need to be interpreted? If possible, ask visitors what interests them most about the site.

Visitors tend to relate to information that directly addresses observable features in the landscape. An example from a sign at the BLM's Samoa Dunes reads, "If you look around the immediate area, you might wonder what these mounds of concrete are. If you guessed World War II, ammunition bunkers, you're right."

Know basic **visitor demographics** (age, group make-up, length of stay, local vs. non-local, use patterns, etc.) and create interpretive signs accordingly. Relate the information to peoples' everyday lives.

2. "Information, as such, is not interpretation. Interpretation is **revelation** based on information"(Tilden 1967). To reveal information, find an element within the content that you can pull out for the sign and put a new spin on. This gives the visitor a unique viewpoint or lens through which the information is seen. Analogies, metaphors and similes can be used to reveal an otherwise difficult concept. To interpret the role of marshes, for example, one sign read, "This marsh is a living sponge -it filters and purifies water…"

3. “Interpretation is an **art**, which combines many other arts, whether the materials presented are scientific, historical or architectural” (Tilden 1967). Graphic layout is an art form unto itself, especially when it is combined with illustrations and photography. Furthermore, creativity can be incorporated into the sign structures (frames and posts) so that they blend into their natural surroundings. (See Sign Base and Kiosk Structures, Chapter 8).

4. “The chief aim of interpretation is **provocation**, not instruction”(Tilden 1967). Graphic signs should be designed in a way that stimulates interest and engages visitors’ attention. Catchy and/or provocative titles and headings grab attention and pique curiosity. A new twist on an old cliché may be enough to provoke visitors to read interpretive signs. One intriguing sign’s title is, “Fish are Far From Finicky” followed by, “What does a 10 pound trout eat?” Artist elements (graphics and illustrations) can be effective interest-provokers as well.

This engaging sign title reads, “Fish are Far From Finicky.” A combination of art and provocation makes this an attention-getting interpretive sign.

5. “Interpretation should aim to **present a whole rather than a part**”(Tilden 1967). Strive to create an overall unifying theme for the area, and then break it apart into separate sub-themes. In other words, tie individual messages into a bigger picture that visitors can relate to and easily understand. People can assimilate information much more readily when they are provided with an overall context or frame of reference. If a sign is about beach verbena, for example, it can be tied into the greater dune ecosystem by showing its relationship or role in the dune community.

3. Telling the Story: Writing Thematically

Why Write Thematically?

Every site has a story. Interpretive signs are a method for telling the story to people visiting that site. Every interpretive sign becomes a piece of the greater story of a site. Because visitors will pick and choose what they want to read based on time and interest, all parts, or levels, of the sign should deliver a complete message. This is why themes and sub-themes, best stated in complete sentences, are essential. The headings may be all the visitor reads. Telling the story of a site in an interesting and engaging way can be a big challenge. The following suggestions will help in organizing information in such a way that will not only be engaging and interesting to the general public, but get the message across as well.

Because people may not have time to read an entire interpretive sign, presenting information thematically allows visitors to quickly scan the main messages, see how they are connected, and pick and choose what they would like to read in more detail. Furthermore, thematic organization will allow the reader to readily see the hierarchy, or order of detail, of information. Remember, visitors to a site are most likely there for recreation, so sign information should be relatively uncomplicated and engaging. (See Section 4, PORT: Pleasurable, Organized, Relevant, and Thematic). **Writing engaging, interpretive text for a diversity of visitors can be challenging; Section 10, the List of Resources provides contact information for text writers.**

"The story is the thing." Interpretation is about telling a story. What are the stories of an area? How are those stories best communicated to visitors through signs?

Developing Thematic Interpretation: Themes and Sub-themes

Organizing information thematically helps the visitor assimilate what they are reading. If visitors are initially exposed to one broad, **overarching theme** that best represents a site, they will be better able to process additional information they read. This general, overarching

A broad, generalized, **overarching theme** on a welcome kiosk will best orient visitors to the site.

Individual signs should deliver a more specific, yet related, **main theme.**

Main themes on a sign are further broken down into supporting **sub-themes** that provide the details.

theme or message, would ideally be placed somewhere on a Welcome Kiosk. An example of an overarching theme for a site is, "The Elk River Wildlife Sanctuary you see today has been shaped, and continues to be shaped, by a mix of both cultural and natural influences." A visitor should be able to readily connect more specific, related, **main themes** on subsequent signs with the overarching theme.

If a site does not have a general welcome kiosk, each individual sign should deliver its own **main theme**. Furthermore, a visitor should be able to readily connect the main themes between signs at a site. If they walk away from an interpretive sign remembering one thing, this should be the main theme.

This sign uses a question "Wetland or Wasteland" as a "hook" to draw visitors in to the sign and introduce the main theme that directly follows.

Sub-themes are subordinate statements that support the main theme. They are also expressed in complete sentences and contain one main idea. Here is where key parts of a site's overall theme is developed by creating specific, detailed messages (pieces of the story). A sub-theme for Elk River Wildlife Sanctuary, for example, is "The ERWS is an important migratory stop for birds along the Pacific Fly-way." The text following this sentence should give detailed specifics about what kinds of birds use this fly-way and during what times of year. Visitors should readily be able to understand how this message relates to, or connects with, the main theme, "The Elk River Wildlife Sanctuary you see today is shaped, and continues to be shaped by, a mix of both cultural and natural influences."

Tips for Creating Effective Themes

"Soggy Abundance" is the "hook" that engages visitors to read this sign. The main theme directly follows this catchy phrase.

Themes are best expressed in complete sentences and contain one broad, main idea. They should also be active and dynamic in order to arouse visitor interest and curiosity to read on. It can also be effective to use a "**hook**" to introduce a theme or main idea. One sign uses a question, "Wetland or Wasteland?" as a hook. This engaging hook is followed by the **main theme** of the sign, "Much more than a link between dry land and bodies of water, wetlands, like marshes and meadows, provide some important functions." Another signs uses the hook "Soggy Abundance." The main theme that follows is, "For dabbling ducks, the marsh is the perfect place to get bogged down." For more tips on theme development, see "In Three Steps, Anybody Can Write a Theme" (Figure 1) and "What is a Theme" (Figure 2) on the following pages.

In Three Steps, Anybody Can Write a Theme

Sometimes interpreters have difficulty writing good themes simply because they aren't yet used to thinking thematically. Expressing a theme is easy, however, if you remember the difference between the topic (subject matter) of the presentation and the theme (the principal message you want to communicate to your audience about the topic). As a communicator, your task is to relate *themes* to your audience, not just information about the topic.

Steps in Theme Writing—An Example

1. Select your general topic (for example, "our soil") and use it to complete the following sentence:

   "Generally, my presentation (talk, exhibit, etc.) is about
   our soil ."
   (put your general topic here)

2. State your topic in more specific terms and complete the following sentence:

   "Specifically, I want to tell my audience about
   the importance of conserving our soil ."
   (put your specific topic here)

3. Now, express your theme by completing the following sentence:

   "After hearing my presentation (or reading my exhibit, etc.), I want my audience to understand that it's necessary to conserve our soil in order to increase our crops and to protect the quality of our water ."
   (put your theme here)

Figure 1. Three easy steps for thinking and writing thematically (Ham 1992).

What Is a Theme?

A theme is the central or key idea of any presentation. When a good presentation has been completed, the audience should be able to summarize it in one sentence. This sentence would be the theme. Development of a theme provides organizational structure and clarity of understanding. Once the theme of a presentation has been decided, everything else usually falls into place. Themes should:

1. Be stated as short, simple, complete sentences.
2. Contain only one idea.
3. Reveal the overall purpose of the presentation.
4. Be specific.
5. Be interestingly worded (if possible using active verbs).

Examples of Themes

1. Our children depend on us to take care of their natural resources.
2. Preserving biodiversity is like having a life insurance policy.
3. Three kinds of frogs live in this forest, and knowing which is which could save your life.
4. Some species are capable of adjusting their behavior to conserve body heat.
5. All life is dependent on the sun.
6. Energy is found in various forms, some very surprising.
7. Energy flows in only one direction, and is neither created nor destroyed.
8. Blue grass makes our water cleaner.
9. Everything is on its way to becoming something else.
10. Careless spelunkers can upset a delicate balance of life.
11. Exploring caves is a sensuous experience.
12. Everything in life is related to everything else.
13. The mosquito plays an important role in nature.
14. Underneath the ground is a fantastic plumbing system.
15. Mosquitos are fascinating insects once you get to know them.
16. Three main factors determine how geysers work.
17. The grizzly bear is a doomed species.
18. Lincoln's life was often marred by tragedy.
19. Charles Manson is a lunatic, but a brilliant one.
20. Much of the literature about the Mayan culture is incorrect.
21. To understand the Mayans, one must understand their fascination with the stars.
22. Robert E. Lee was a famous soldier, but his personal life is poorly understood.
23. Knowing a foreigner's culture is the fastest road to friendship.
24. A tiny rare plant in Mexico saved the U.S. corn crop.
25. Baseball is America's greatest gift to the world.

Figure 2. "What is a Theme?" (Ham 1992)

Levels of Thematic Interpretation

The "4 Levels" approach

1. Theme Title of Sign
2. Five or Fewer Headings/Sub-headings
3. Main Body Text and Illustrations
4. The "Take-Home Message"

Practitioner and researcher Sam Ham (1992) suggests using **4 Levels** while planning the text layout for a sign (Figures 3 and 4 on the following pages). **Level 1**, the theme title, should be active, engaging and a complete message. Ham suggests developing the body of the sign *before* giving it a theme title. **Level 2** consists of five or fewer main headings. Organizing the text into five or fewer main points will allow the visitor to better digest the new information they are reading and readily see how the information is related. Too many main points may overwhelm and distract the visitor from reading on. Also remember that visitors tend to read only the topics that most interest them. A summary of each of these points is best stated in a short paragraph just below the theme title. **Level 3**, the main body text, should support the five or so main headings they are under. Include the specific details and facts using Tilden's Principles and PORT (see Sections 2 and 4). **Level 4** represents the last thing visitors should read before they walk away from the sign. It could be a restatement of the theme, or a suggestion on where they can go and/or what they could do with this new information learned. For example, "To see additional victorian homes, visit..."

Even at a glance, varying levels of information are readily visible. Using the 3-30-3 Rule, the Theme Title is the 3-second message, the top left paragraph is the 30-second message and the remaining body text is the 3-minute message.

The "3-30-3" Rule

- 3 Second theme
- 30 Second sub-themes
- 3 Minute message

Another way to plan the layout of a sign is by using the "**3-30-3 Rule**" (Ham 1992). These numbers reflect how much time, on average, a visitor spends reading interpretive signs. Accordingly, they also represent how long each 'message' should take to read. The numbers represent the 3 second theme, the 30 second sub-themes, and the 3 minute detailed message. If a reader only has **3 seconds**, they should be able to understand the overall main idea or theme of the sign. In **30 seconds**, a reader should be able to read the theme, corresponding sub-themes, and maybe scan some of the body text. In **3 minutes**, a reader should be able to read the entire sign. Again, this is why organizing main messages into complete sentences is essential. If a visitor reads any one of the main headings, they should be able to walk away with a complete message.

In Exhibits, Think Levels—Then Think Design

The 4 Levels

I. *Theme Awareness*—In one or two seconds, the viewer should recognize and understand the theme. Display this level prominently in the theme title of the exhibit. Structure artistic design to complement and support the theme.

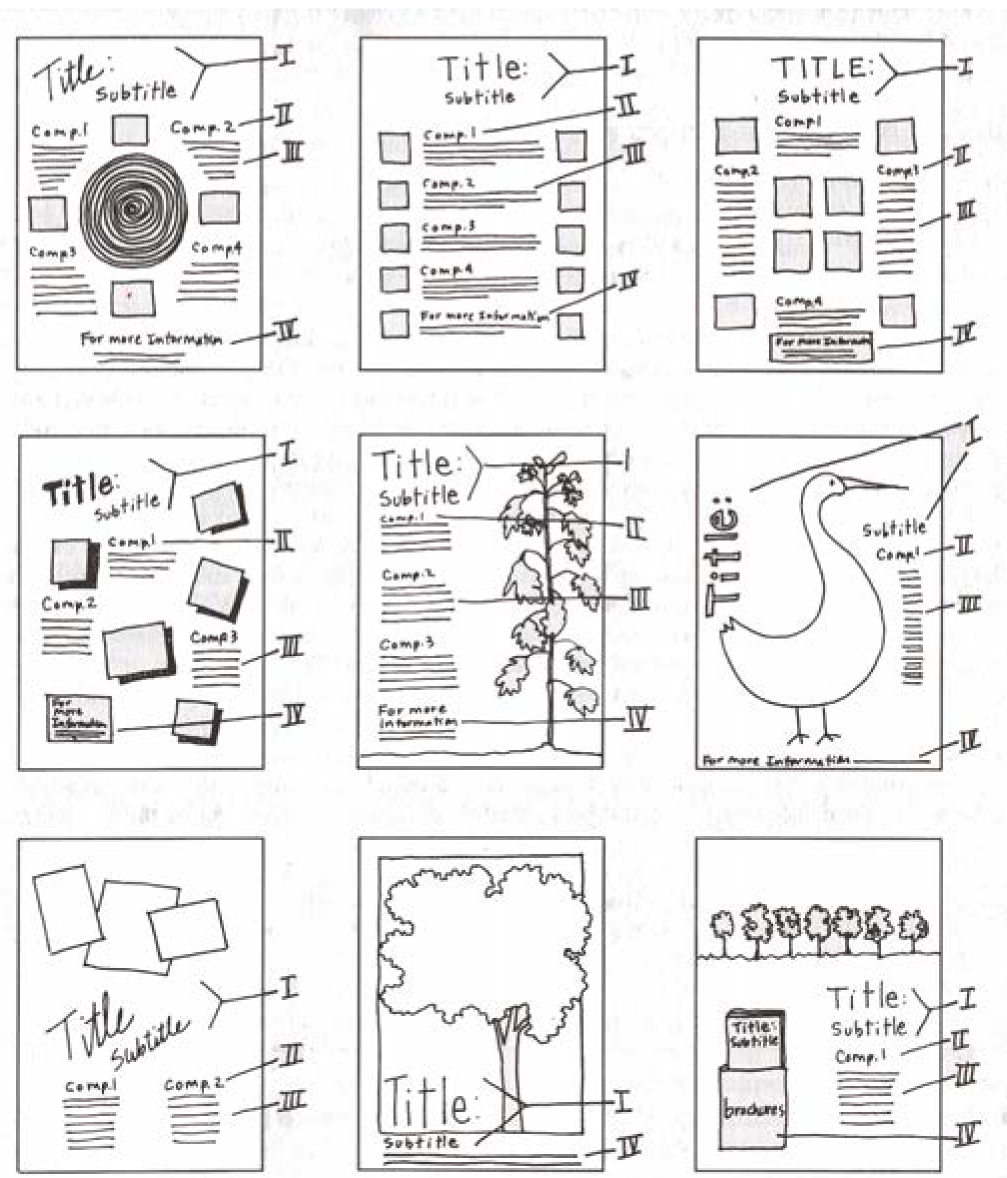
II. *Awareness of the Message Components*—Show no more than five parts or major divisions; the fewer, the better. Accomplish this with conspicuous headings or subheadings, colors, illustrations, or other "visual separators." If headings or subheadings are used, they should be conspicuous but appear less prominent than the title of the exhibit.

III. *Selected Details (Main Body Text and Illustrations)*—Corresponding to each message component, include only those facts, ideas and other information necessary to communicate that part of the theme. The content and tone of this information will determine whether the exhibit is interpretive or merely informational. A viewer ought to be able to read each body of text quickly—the briefer it is, the better—and immediately see its relationship to the theme of the exhibit. Designers sometimes include within this level a simple hierarchy of detail consisting of the main body text (which is intended for everyone) and secondary information that's offered primarily for people who would like even more detail. The second part of this hierarchy is usually separated in the layout from the primary body text, and typically printed in smaller and/or different type. Large, carefully designed exhibits may sometimes contain two or more of these "sublevels," but often at the expense of scaring off more casual readers. In most designs, such a quantity of detail is best saved for level IV.

IV. *How Viewers Can Act on Their New Knowledge*—This level can take many forms depending on the type of exhibit and its intended lifespan. It might be the name of a brochure, pamphlet or book that the viewer could get; it could be a box of brochures or information sheets attached to the display itself; it could be a schedule of future activities related to the topic of the display; it could be the name of an expert on the topic, his/her telephone number or office address; or it could simply be a suggestion of a place to go, a trail to hike, etc. in order to see something related to the topic or theme. Be selective—give only one or two suggestions. (In many exhibits, some of the additional information a viewer might seek is included in the second part of the level III hierarchy.)

Figure 3. Tips on organizing text into four thematic levels of organization.(Ham 1992)

Levels Give a purpose to Each Part of a Sign



Note: Roman numerals correspond to the four levels: I—Theme Awareness; II—Awareness of Message Components; III—Selected Details (Text); and IV—How Viewers Can Act on Their New Knowledge.

Figure 4. Sample sign layouts using four levels of thematic organization (Ham, 1992).

4. Tips & Tricks for Writing Interpretive Text

Writing engaging text can be a challenge. How many interpretive signs are read completely from beginning to end? Research shows that signs that are too text-heavy, or otherwise visually unattractive, will get passed by. In general, *less is more* when it comes to writing text. This section, along with Section 5, gives field practitioners' tips and tricks for increasing the readability of a sign. Keep in mind that the average sign-reader's attention span may be no more than 5-10 seconds! If there is no one on staff to write interpretive, thematic text, **check Section 10's List of Resources for recommended interpretive text writers.**

"PORT"

A basic guideline for developing effective interpretive signs is making them **PORT***:*

- **P***leasurable*
- **O***rganized*
- **R***elevant*
- **T***hematic*

Welcome kiosks and wayside panels are the methods suggested through the Signing Program to communicate educational and management messages to the public. Because it is not feasible to provide roving interpreters at all times, interpretive signs are the next best thing. Effective interpretative signs, in general, should be **PORT**: **P**leasurable, **O**rganized, **R**elevant, and **T**hematic (Ham 1992). Complementary to Tilden's Principles of Interpretation (see Section 2), these four guidelines will encourage visitors to not only read signs, but make meaningful connections as well.

Pleasurable

Making signs pleasurable requires the use of colors, images and carefully chosen text that will engage the reader's attention. A unique sign post or structure can be enough to draw a visitor in. Visitors may initially judge a sign by its text and graphic layout. If the sign panel is too crowded and offers no "white space" (open space that allows the eyes to rest) between text and graphics, the effort outweighs the reward of reading it. Refer to Section 5, 'Laying Out Text and Graphic Elements."

Organized

Thematic organization helps the reader make connections between all the information read at a site. Generally, a welcome kiosk would introduce the **overarching theme** for the site and wayside panels would develop the supporting **main themes**. If there is no Welcome Kiosk, each individual sign would deliver a **main theme** (referred to in Section 3) organized thematically into levels, or **sub-themes**. A thematically organized site helps visitors make meaningful connections and reinforces major concepts. Information that has been reinforced this way is more likely to be remembered and taken away with them.

Relevant

Interpretive messages should connect with something the visitor already knows. While a visitor is reading a sign, they should be able to make meaningful connections between the information and a broader context of understanding. For example, a sign about salt plant adaptations reads, "After a swim in the ocean, you may feel dry due to the salt on your skin." The sign content should also be relevant to what a visitor can see, or imagine in front of them.

Thematic

Again, an interpretive site (or individual signs depending on the site) should be developed around one main theme. This theme should be the one thing visitors should leave knowing. The sub-themes are the additional information visitors should walk away with knowing (see Section 3: Telling the Story: Writing Thematically). Thematic organization greatly increases the readibility of a sign.

Be Personal

One way to engage readers is to use personal, informal language. Words like "We, us, ours, ourselves, you, yours, yourselves, his/hers, their(s)" are all-inclusive and help to sustain visitors' interest and attention. For example, "Have you ever seen a marbled murrelet? If you visually follow the Elk River upstream, you will be looking at Headwaters Forest Reserve, where they nest."

3 C's: Clear, Concise, and Correct (and KISS!)

A general rule to follow when writing text is the 3 C's: Clear, Concise, and Correct. Write clearly in short sentences and paragraphs. "Chunk" out information into smaller text blocks to create a more pleasant, readable layout (keep paragraphs to 3-5 sentences, for example). **Clear** text is jargon free, and scientific or technical words are defined. For example, "...this is a common characteristic of *halophytes*, or plants that can survive in salty soils." or Creating **concise** text means reducing sentences to only the words that convey the most meaningful information. **Correct** text is exactly that. Check with experts in the field to be sure that all the information is accurate. *Maintain content credibility by confirming text with local agencies and local experts* (ie. Table Bluff Reservaion-Wiyot Tribe, biologists, ecologists, etc.) **KISS** is short for **K**eep **I**t **S**hort & **S**imple. Enough said!

This sign at the beginning of the trail "Piecing Together a Watershed" introduces the trail with an analogy of a puzzle.

Engage the Senses

"I see; I forget.
I hear; I remember.
I do; I understand."
(author unknown)

People learn in a diversity of ways. Providing myriad learning opportunities for visitors will increase the likelihood that signs will be read and understood. The best interpretation encourages visitors to make meaningful connections between what they read and what they can experience. Build into text opportunities for visitors to use their senses and **do something**. Direct their attention to the horizon, or the ground beneath their feet. Have them scan the trees for the bird being described. Provide scenarios for them to imagine such as "Look out across the entire bay. Imagine what Humboldt Bay would look like on a busy shipping day in the early 1900's." Draw them in by engaging their sense of smell or touch.

Ask Thought-Provoking Questions

Asking thoughtful questions engages critical thinking. It also encourages visitors to make their own meaningful connections without being right or wrong. Asking questions arouses curiosity and may inspire visitors to seek additional information about the subject. One example is, "Did you know you are standing on a fault line?"

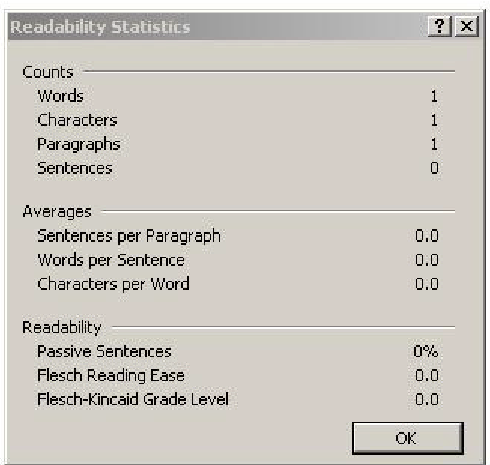
Use Everyday Examples (Analogies & Metaphors)

Analogies, metaphors, and similes are helpful in breaking down complex scientific and technical terms into a language that visitors can readily understand. The use of examples, analogies and other comparisons can help visitors make a connection between the unfamiliar and the familiar. An example is portraying a watershed as a puzzle comprised of interlocking components (refer to picture on left).

This sign at the end of the trail re-emphasizes the analogy of a puzzle by revealing the interlocking components of a watershed: stream, meadow, forest, and marsh.

Use Active Versus Passive Tense

Playing with sentence structure and words can greatly increase message effectiveness. Infinitives can be replaced with more active statements. For example, replace "The ERWS is a great place **to view** migrating birds" with "**Viewing** migrating birds at ERWS is a favorite past-time of local visitors."



Readability Statistics are a helpful tool for managing the amount of text on each sign, the percent of passive sentences used, and the average reading level of the content.

Tailor Vocabulary to the 8th Grade Reading Level

Studies in the field of interpretation have shown that text geared to an 8th grade reading level and vocabulary will reach the greatest number of recreational visitors. Keep words simple and clear, and be sure to define complex concepts. Most computers, have a function to find out the **readability statistics** of a document while working in Microsoft Word.

Click on *Tools* then *Spelling and Grammar* (for both PCs and Macs) then *Options,* and under *Grammar*, click *Readability Statistics*. Then, the the next time the Spelling and Grammer tool is used, and the document is checked, a Readability Statistics dialogue box will appear. This dialogue box provides word counts, averages, and overall readability (refer to box on left). This indicates the average grade level of the text. The size of words, length of sentences, and complexity of words all contribute to calculations of grade level.

5. Essentials for Text and Graphic Layout

This section provides specific text and graphic guidelines that will help create a unified series of interpretive signs around Humboldt Bay. **Text** refers to the headings, paragraphs and captions, and **graphics** refer to images (illustrations or photographs). Both are considered graphic design elements in layout as they equally contribute to a sign's overall appearance.

Type Styles Suggested for the Signing Program

Serif and Sans-Serif Fonts

For simplicity purposes, type styles, or fonts, are generally regarded as serif or san-serif. Serif fonts, like **Garamond,** Dauphin, and Viner Hand have tags at the ends of the letters that guide the eye between letters and words, increasing reading ease. Sans-serif fonts, such as Comic Sans do not have tags at the end of each letter.

Suggested Fonts for the Humboldt Bay Signing Program

Following is a list of serif fonts to use when laying out the text elements on your sign. These fonts have been selected for their ADA compatibility, readability, and overall graphic qualities. See Section 6 for font installation.

Titles and Subtitles:

- Dauphin
  (for all natural history templates)
- Viner Hand ITC
  (for cultural history templates: Ship & Rail and Wiyot)

Body Text:

- Garamond (or another basic serif font like Times)

Captions:

- *Garamond (italics)*

Garamond is a serif font
Dauphin is a serif font
Viner Hand is a serif font

Fonts selected for template development are all serif fonts, they have tags at the end of each letter which increases overall readability.

Text *IS* a Graphic Element

Text should be treated as a graphic element just like any graphic image you place on your sign panel. Carefully selected font sizes and typefaces can greatly increase the readability of your sign. Interpretive signs are generally read **non-linearly**. Readers tend to pick and choose what they read based on interest, so all paragraphs should stand alone and convey complete messages. This section provides suggestions for laying out text and graphic elements in a way that will attract and engage readership.

How Much Text Should Go on an Interpretive Sign?

- Research suggests keeping body text down to about **250-300 words**. This does not include titles, subheadings, or captions. Keep paragraphs to **45-60 words**.
- Sentence structure and paragraph layout can greatly affect overall readability of the sign. Keep sentences to about **10-15 words** and paragraphs to about **3-5 sentences**.
- Ideal line length is **7-8 words**. Research shows that readers comprehend best when making no more than 2 eye movements per line.

Text Size and Format Considerations

Americans with Disabilities Act (ADA) Requirements for Interpretive Signage

Before getting started on text and graphic layout, it is important to consider what is needed to make interpretive exhibits fully accessible to all visitors to your site. **Information in this section is consistent with the Americans with Disabilities Act (ADA) requirements** (for interpretive signage) used by the Bureau of Land Management and the National Park Service. Signs developed with the following guidelines in mind will promote full access to interpretive exhibits for all visitors to Humboldt Bay. Access ADA homepage for links to the Act and other information, http://www.usdoj.gov/crt/ada/adahom1.htm.

Font Size

Research in the field of interpretation suggests creating sign layout for readership between 1-4' from the sign. As a general rule, at this viewing distance, **minimum point size** for the various levels (below) should be:

- **Titles**..72 point minimum
- **Subtitles**..48 point minimum
- **Body Text**.....................................24 point minimum
- **Captions**.......................................18 point minimum

Point or font size will depend on the type of font used and the available text layout space. Dauphin font, for example, is narrow and a range of 95-105 points may be used for a theme title.

Leading

Leading (pronouned like pencil lead) refers to spacing between lines of text. Adjusting the leading can bring lines of text closer together to save space or vice versa. Depending on the typeface and font size, leading can greatly influence text layout. Bear in mind that too much space between lines can make it harder to track between lines whereas too little space can create a very text-heavy appearance. If unsure about leading, select Auto and it will automatically adjust to the default.

This sentence was typed with a
12-point font and a 8-point leading.

This sentence was typed with a
12-point font and a 14.4-point (auto)
leading.

This sentence was typed with a

12-point font and a 24-point leading.

These three sentences show the difference in leading, or space between lines of text. Text lines placed too close together or too far apart may become difficult to read.

Flush Left, Ragged Right

For greater reading ease, do not justify text. Justifying creates awkward spacing between words (as seen in this paragraph of text), whereas ragged right creates a more natural layout.

Hyphens and Solitary Words

If a word gets hyphenated at the end of a line, it is best to shift that word to the next line and avoid awkward reading. For lines that have only one, solitary word (or "hanger"), it is better to shift text around until each line has a balanced amount of text.

CAPITAL LETTERS ARE BEST USED FOR SHORT TITLES AND WORDS YOU CAN READ QUICKLY. THEIR UNIFORMITY IN SHAPE TIRES THE EYE.

Words in all capital letters are best used for short titles and words that can be read quickly.

CAPITAL LETTERS?

WORDS IN ALL CAPITALS share a uniform rectangular shape that makes it harder for the reader to distinguish between them. Using all capital letters is best for titles and headings but use a mix of upper and lower case letters for body text.

Putting Text and Graphics Together

This sign demonstrates UNITY in the consistent use of dark borders on every graphic image.

Generally, it is best to have text written first before seeking supportive graphic images. When selecting images, be aware of copyrights.

ADA Requirements for Color and Images

- Contrast between type and background should be a minimum of 70%. Contrast between white and black is about 100%. Consult a graphic designer.
- Type should be placed over a plain, solid colored background.
- Use font color within text to distinguish between sub-themes and key words or information.
- Use images to illustrate dificult ideas and concepts in the text.

Unity, Emphasis, Balance, and Color

These are four basic artistic qualities that will greatly enhance the visual appeal, and readability of a sign. When used in combination, they give an interpretive sign a clean, professional look. These qualities are applicable to laying out both text and graphic design elements. See Chapter 8 of Sam Ham's book *Environmental Interpretation* for a more detailed explanation about the following:

- **Unity:** Consistency in a design
- **Emphasis:** Tells the eye where to go
- **Balance:** Gives a design stability
- **Color:** Makes a sign attractive and draws attention

This sign demonstrates EMPHASIS through the use of text size and colors that 'guide the eye' through the levels of information.

Unity

An interpretive sign will appear unifed if there are consistent design elements throughout the panel (and among additional panels). The following 6 design elements can help give a sign a unified appearance:

1. **Boundaries:** Borders or white spaces create boundaries.

2. **Type Styles:** Type styles are recommended that will not only unify each individual sign, but all signs that will be placed at public access points around Humboldt Bay (see Section 7). In general, it is best to use just one or two type styles and their variations (italic, bold) per sign then to use myriad type styles. Having all themes and sub-themes in Dauphin type, for example, will unify not only the sign, but the entire site as well.

3. Color Schemes: Addressing color goes beyond the scope of this Signing Manual. For color-related considerations such as topic-related color, color based on environment, use of the color wheel, and color's "temperature" and value, refer to Chapter 8 of Sam Ham's book.

4. Shapes: Pick one or two (ie. circles, squares, or rectangles) and be consistent in their use.

5. Lines and Angles: Whether visible or not, lines and angles create an overall flow to the sign. There should be a subtle **reading flow** from the top left corner to the bottom right corner.

6. Illustrations: Mix and match media, such as photos and illustrations, sparingly.

Emphasis

"All emphasis is no emphasis." Generally, font size, size of graphics, and colors are used indicate a hierarchy of information for the reader. Emphasis helps organize information and visually convey themes.

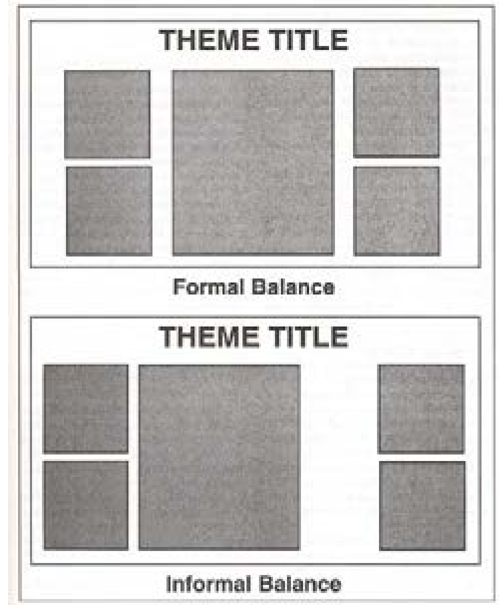
Balance

An interpretive sign appears balanced when the text and graphics elements seem equally weighted. The more an element draws attention, the "**heavier**" it is said to be. Irregularly-shaped objects are heavier than basic circles, squares and rectangles. In general, color is heavier than black and white and photos are heavier than text. Furthermore, balance can be **formal** (symmetrical) or **informal** (asymmetrical). Standing back from a sign is a good way to determine balance. Does one side look heavier than the other? Does it appear top or bottom-heavy?

Research indicates that people tend to read from left to right and top to bottom. Each sign should have a basic **reading flow** from the top left-hand corner to the bottom right-hand corner.

Color

Again, a section about color is beyond the scope of this Manual. Refer to Chapter 8 of Sam Ham's *Environmental Interpretation* for tips on working with color and using the color wheel. In general, when choosing the color schemes sign(s), some options to consider are: **monochromatic** (varying shades of one color), **analogous** (adjacent on the color wheel), complementary (opposite on the color wheel), **triad** (three colors equidistant from one another on the color wheel), and **tetrad** (four colors equidistant from one another).



The sign above is BALANCED in a way that it appears equally weighted. There is also a subtle reading flow from the top left-hand corner to the bottom right-hand corner.

This sign uses analogous COLORS, or colors that are adjacent to each other on the color wheel. With help of a color wheel, color schemes can be analogous, complementary, triad, tetrad, and monochromatic.

6. Working with the Templates: Graphic Files and CD-ROM

This section outlines the step-by-step process for creating interpretive sign panels using the **templates** and corresponding **CD-ROMs**. *A graphic designer may need to be consulted to work with the templates. See Section 10 for suggestions for finding graphic designers.* The templates have been created in an effort to unify the overall appearance of interpretive signs installed around Humboldt Bay. They all contain an illustrated border by local artist Gary Bloomfield, a background color, a Humboldt Bay silhouette in the corner, and space for text, graphics and agency logo(s). Each template depicts a regional cultural or natural history theme. **Template color plates** are included in the back of this manual for previewing.

The following 17 thematic templates have been developed:

1. Agriculture & Geese
2. Beach & Plover
3. Drains to Bay
4. Dunes
5. Eelgrass
6. Fishing
7. Freshwater Marsh
8. Geology
9. Marine
10. Riparian
11. Salt Marsh
12. Ship & Rail
13. Slough
14. Watershed
15. Water Trails
16. Welcome (Kiosk)
17. Wiyot Village

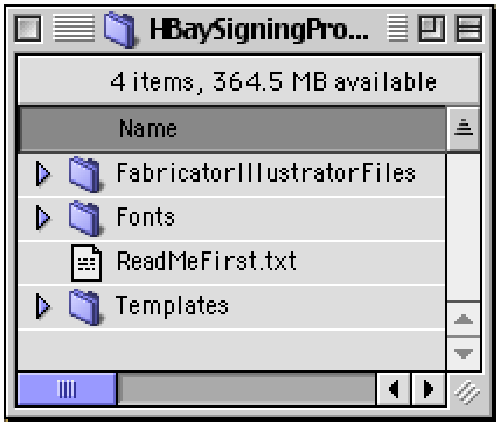
Seventeen templates have been developed at time of publication. **Future templates** may be developed by artist Gary Bloomfield as requested. See "Development of Future Templates" at the end of this section for adding templates to the Signing Program.

In this section:

- Before beginning
- Contents of the CD-ROMs
- About the templates
- Graphic file organization
- Scanning in and saving graphic images
- Installing fonts
- Creating sign panels: Kiosk, Wayside, Map and Rail Mount
- Preparing files for fabrication
- Development of future templates

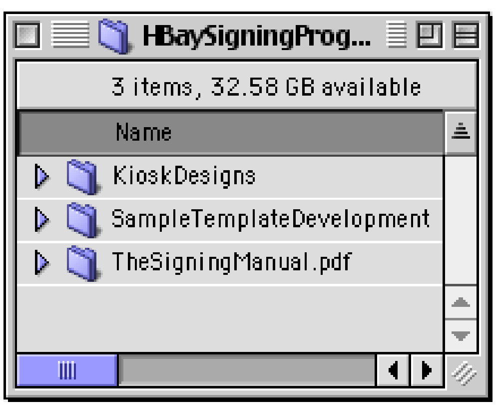
Before Beginning

- Start the Permitting Process. See Section 10 for contact information to find out land jurisdiction(s). Plan a few months in advance.
- **Review Sections 1-5** of this Manual for Signing Program specifics on text and graphic layout.
- Type and save **sign panel text** in Microsoft Word or another word processing program.
- Save **graphic images** (photographs and illustrations) in a



The first CD-ROM is organized into three main folders: Fabricator Illustrator Files, Fonts and Templates. (Note: folder and file names are truncated on actual CD)

The files found in the Fabricator Illustrator Files folder are simply backups to be used as needed by the sign fabricator. (Note: folder and file names are truncated on actual CD)



The second CD-ROM is organized into the following folders: Kiosk Designs, Sample Template Development (sample drafts), and The Signing Manual (pdf format). (Note: folder and file names are truncated on actual CD)

single folder (see next page for saving images).

- Have access to, and working knowledge of, **Adobe Illustrator** (versions 9 or 10) and **Adobe Photoshop** (versions 6 or 7) as the templates have been set up in these software programs.
- Decide what **type of panel** will be created: **Welcome** (vertical and in an upright kiosk structure), a **wayside** (horizontal, angled and *not* in a kiosk structure), a **bay map** (vertical in a kiosk structure), or a **rail-mounted** panel (varies according to site).
- Decide whether the panel will be **framed or unframed** (self-supporting).
- Install **fonts** as needed onto computer (see following).

Contents of the CD-ROMs

The **first CD-ROM** entitled "Humboldt Bay Signing Program: Working with the Templates," contains all the graphic files needed to develop and fabricate interpretive signs. By using these templates, signs (and their structures) installed around Humboldt Bay will be thematically unified. The CD-ROM contents are organized into the following folders:

- **Read Me file:** Gives an overview of working with the CD-ROM and associated files. *Please read first!*
- **Fabricator Illustrator Files:** These are backups for fabrication purposes as needed. (Seen as FabFiles on CD).
- **Fonts:** This is where the suggested fonts for the Signing Program are found. They are easily downloadable (page 30).
- **Templates:** This is where all the Illustrator and Photoshop templates files are found. ***(Please note that all folder names have been truncated on actual CD-ROMs).** Template folders are futher sub-divided into 4 folders:

1) 16 Wayside Templates (horizontal 24" x 36")
2) 1 Humboldt Bay Map Template (vertical 30" x 40")
3) 1 Water Trails Template (24" x 36" standardized)
4) 1 Welcome Kiosk Template (vertical 30" x 40")

The **second CD-ROM** entitled "Humboldt Bay Signing Program: Additions," contains the designs for the 3-sided and 1-sided **kiosk structures**, (Kioskdsn > 1-Sided or > 3-Sided) **sample layout drafts** of Elk River Wildlife Sanctuary signs using the templates (TmpltDeve > Drafts > ElkRvr), and the Humboldt Bay Map (HBayMap), and this entire **Signing Manual** available for download in PDF format (TmpltDev > Way_PDFs). PDFs of the wayside templates are found on this CD too. The **standardized Water Trails** template draft is also on this CD (H20Draft).

About the Templates

Before working with the templates and CD-ROM, it is best to become familiar with some of the file formats found in each template folder. Each of the 17 template folders (15 wayside, 1 Welcome Kiosk and 1 Water Trails template) contain the following files:

1) A Photoshop file (**.psd**). This contains the original artistic border as well as a selected background color. This is where an alternate color background is selected if desired.
2) An Adobe Illustrator (**.ai**) file. This is the working copy where site-specific text and graphics are added. Templates have been saved in both **versions 9 and 10** for software compatibility. The .psd file has been linked to this file.

In addition to the artistic templates, NRS developed a **Humboldt Bay Map template** intended for use with the kiosk structure. This map template is in Illustrator format only as there is no original imported artwork.

General Adobe Illustrator Layout Information

Each template was designed for easy text and graphic layout. Space has been provided at the top of each panel (within the art border) for a **theme title**. The rest of the open space is available for **text and graphic layout**. One-inch borders have been set up on each side of the Illustrator file to guide placement of text and graphics. The **Humboldt Bay silhouette** is on the bottom right-hand corner of every template to help create a consistent and unified look. Review sections 3-5 for text and graphic layout.

The "Shaped-edge" Option

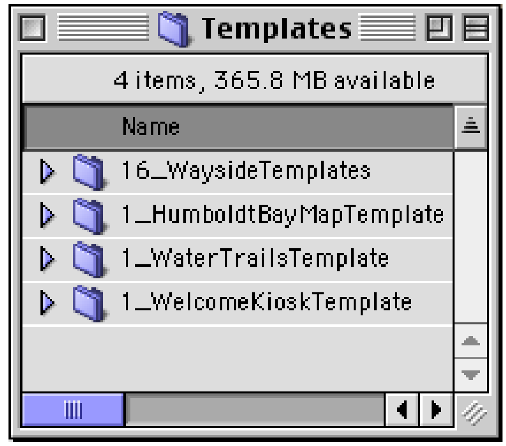
Every Illustrator file (except for the Humboldt Bay Map template) has a "shaped-edge" layer set up in the layers palette. This can be turned on or off for previewing. If desired, fabricators will use this line when cutting a shaped-edge into the sign panel.

Adding Agency Logos

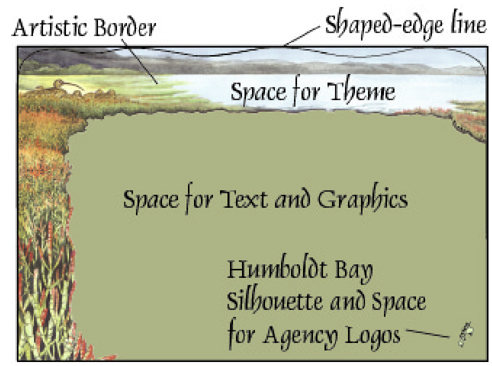
Generally, sign panels indicate funding agencies through logos. Logos should be in an .eps or .tiff format suggested placement is in the bottom-right corner near the Humboldt Bay silhouette.

Changing the Background Color in Photoshop

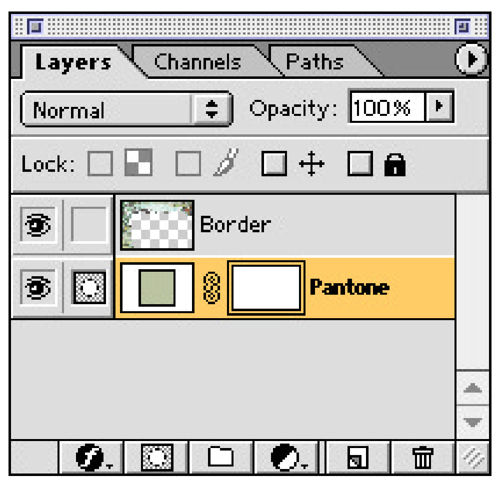
Each template comes with a pre-selected background color. Generally, signs in direct sun exposure (south facing) should have darker



This is what the Templates folder looks like when opened. (Note: folder and file names are truncated on actual CD)



An example of one of the templates for use on the CD-ROM. Each template has an artistic border, optional shaped-edge cut line, selected background color, and bay silhouette in the corner.



There are two layers in the Photoshop file associated with each template. The first is the original artwork, and the second is the Pantone color selected for the template's background.

backgrounds and lighter text for greatest readability. Accordingly, signs in the shade (north facing or in shade) should have a lighter background with darker text for greatest readability. If desired, changing the background color involves opening the original Photoshop file. Once there, simply click on the colored swatch in the layers palette ("Pantone"), and with the color picker tool, sample another color from within the art border. This color should be set up as a custom **Coated Pantone**. Be sure to save this Photoshop document and re-place it into the appropriate working Illustrator file layer. The Humboldt Bay Map template's background color can be changed directly through the Illustrator file.

Garamond is a basic serif font for body text and captions.

Dauphin is a serif font that will be used for natural history template themes.

Viner Hand is a serif font that will be used for cultural-history template themes.

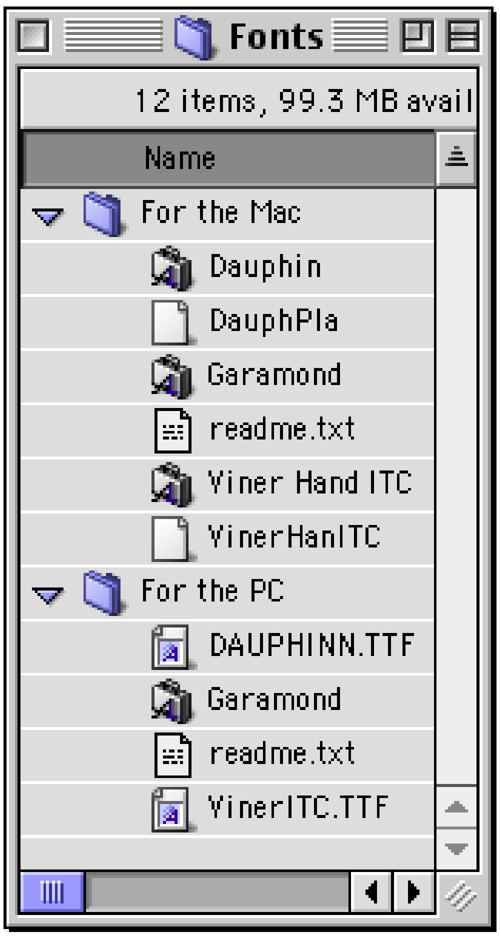
Three recommended fonts are downloadable for text layout: Garamond, Dauphin, and Viner Hand ITC.

Installing Fonts:

The selected fonts for interpretive panels are Dauphin for Natural History topics (majority of templates) and ***Viner Hand ITC*** for Cultural History topics (using Ship & Rail and Wiyot Village templates). If your system does not have these fonts, they are easily downloadable from the first CD-ROM. "Read Me" files are included.

Font Installation For PC/MAC Users:

Copy fonts from the first CD-ROM onto the working computer's Fonts Folder located in the Control Panel > Systems Folder. Consult a system administrator for help with font installation.



Fonts are found in the Fonts folder on the CD-ROM. They are easily downloadable for both Mac and PC. (Note: folder and file names may be truncated on actual CD)

Graphic File Organization

The most important thing to remember during this process is to **stay organized**. Some organizational tips:

- Create a new folder for each interpretive sign.
- Each folder should contain the **selected template folder** and a sub-folder containing all of the selected graphic images for the panel (see following).
- Use **descriptive names** especially with graphic image files.
- Use preset **layers** (in Illustrator design program) to keep all blocks of text and images organized.
- **Save** files OFTEN.
- Communicate with sign **fabricator** for the most recent information or changes.

Scanning In and Saving Graphic Images

Preparing graphic images properly will greatly expedite the fabrication process. Below are some general guidelines for preparing image files, but contacting the panel fabricator to discuss their guidelines is strongly recommended. See pages 37-40 for sample fabrication requirements.

Scanning In Images

- Images, or graphics, need to be scanned in at the size that the final image will be on the sign. For example if a photo is 4 inches by 3 inches, but the final photo needs to be 7 inches by 5 inches on the panel, the scanner should be set to scan the photo at 175%. *All scanning software is different; refer to the scanner's user manual for instructions. Be mindful of copyrights!*
- When scanning in images, resolution dpi (dots per inch) will depend on the difference between the original photo size and desired digital photo size. If there is no difference, 100-150 dpi is fine. If the digital size will be much larger, so should the resolution of the scan. Save the final image in Photoshop between 100-150 dpi for fabrication. *Be sure to check with your fabricator beforehand! Check "Preflight Checklists" on pages 37-40.*

Saving Images

- **Save** your graphic images as EPS (Encapsulated Post Script) or TIFF (Tagged Image File Format) formats. These formats ensure "lossless" compression and preserve all digital information. *Again, check with a fabricator.*
- **Avoid** JPEGs (Joint Photographic Experts Group), PDFs, (Adobe Acrobat) and GIFs (Graphics Interchange Format). These compressed file formats can result in information loss and fabricators cannot color correct these file formats.

Creating a Welcome Kiosk Panel (30"x 40")

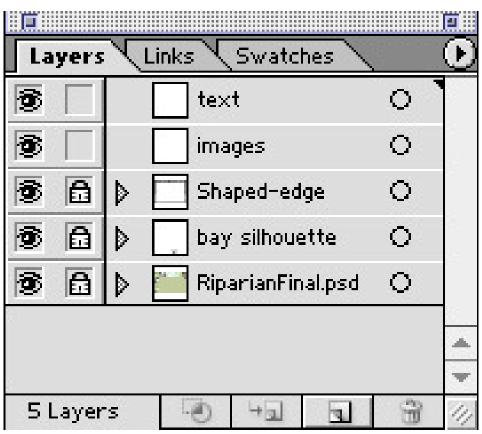
Sample 'Welcome Kiosk Panel' layout (see enlarged Color Plate in Section 11).

The "Welcome Kiosk" template is intended to be used for general welcome and orientation panels in an upright kiosk structure. This panel may be used for every side of the **3-sided kiosk**, or in conjunction with the Humboldt Bay Map Panel (see following), or just once on the **1-sided kiosk** (see Section 8). As a general welcome panel, it can be used to convey a site's main theme, a bay-wide map, a site-specific map, or any overall orientation information. Refer to the **BLM South Spit panels** in Section 11 for sample layouts.

Step 1: Create a new folder entitled "Welcome" for example.
Step 2: Open Adobe Illustrator.
Step 3: Open the Welcome Kiosk Template folder. Templts > WlcKiosk > Wlc_10.ai. The Welcome Kiosk Template contains the following three files:

- Wlc_10.ai **and** 9.ai (the working copy)
- Welcome.psd (for the fabricator and to change background color)

Open and work in the Adobe Illustrator file. (.psd file may need to be re-linked). It will take a moment to read in the linked "Photoshop CMYK File". *When the template opens, it will only have the border and Humboldt Bay silhouette as seen on the top left example on this page. Themes, body text, images, and agency logo(s) will need to be added.*



When the Illustrator file opens, there will be five layers set up in the Layers Palette. Three are locked and will not need modification unless changing the background color is desired.

Step 4: One-inch guides around the edges have already been set up. **Text or images should be placed no greater than one-inch from the edge.** This creates a natural border.
Step 5: Use layers for different sections or elements of the panel. "**Text**"and "**Images**" layers have been set up in the layers palette in addition to a "shaped-edge", "bay silhouette" and "Welcome.psd" layer. Note: the latter three layers have been 'locked' since the images will not need to be modified.
Step 6: **Place** text and images into the appropriate layers to help with organization and layout. This is done through File>Place. Be sure the correct layer is selected first. *Make sure the 'link' checkbox is checked in the 'Place' dialogue box.*
Step 7: See Section 5 for tips on laying out text and graphics. See page 29 for changing the background color.

Creating a Wayside Panel (24" x 36")

Wayside templates include all the natural and cultural history-related templates as well as the water trail template. (Note: the "Welcome Kiosk Template" is the only template designated as an overall orientational/informational template and is meant to be used with an upright kiosk structure). The wayside panel layout is horizontal.

Sample wayside panel template.

The wayside panel folder on the first CD includes 16 templates for use with sign bases described in Section 8 (grass-style, tree-style, NPS-style, or rail-mount). **Elk River Wildlife Sanctuary Drafts** are found in Section 11 (or on the second CD) for sample layout ideas.

Step 1: Create a new folder entitled "Salt Marsh" for example.

Step 2: Open Adobe Illustrator.

Step 3: Locate and open the desired template folder from the CD-ROM. The following files are included in the "Salt Marsh," for example, (and every) template folder:

- SaltMrsh10.ai **and** 9.ai (the working copy)
- SaltMrsh.psd (for the fabricator and to change background color)

Open the Adobe Illustrator file. This will take a few moments as it reads in the linked "Photoshop CMYK File" (.psd file may need to be re-linked). *When the template opens, it will look like the image on the top right of this page. Themes, body text, graphic images, and agency logo will need to be added. See example on bottom right.*

Sample wayside panel layout (without background color). See enlarged Color Plate in Section 11.

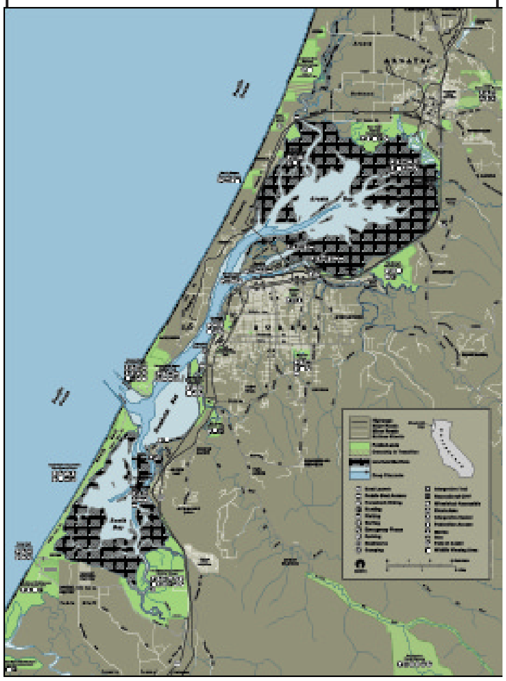
Step 4: One-inch guides around the edges have already been set up. **Text or images need to be placed no greater than one-inch from the edge.** *This creates a natural border with or without the framing option (See Section 8 for Wayside Sign Base structures).*

Step 5: Use layers for different sections or elements of your panel. "**Text**"and "**Images**" layers have been set up in the layers palette in addition to a "shaped-edge", "bay silhouette" and "template.psd" layer. Note: the latter three layers have been 'locked' since the images will not need to be modified.

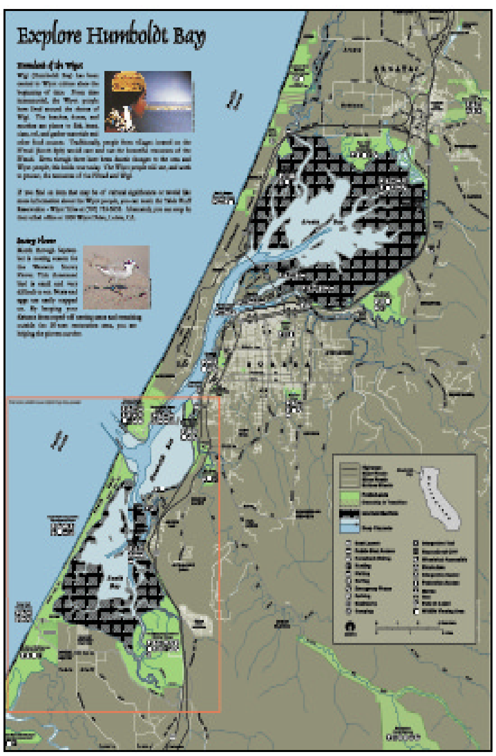
Step 6: **Place** text and images using the different layers to help with organization and layout. This is done through File>Place. Be sure the correct layer is selected first. *Make sure the 'link' checkbox is checked in the 'Place' dialogue box.*

Step 7: See Section 5 for tips on laying out text and graphics. See page 29 for changing the background color.

Creating a Humboldt Bay Map Panel (30" x 40")



This is the basic layout for the Humboldt Bay Map template, for use with the Welcome Kiosk. General orientation information can be placed in the upper left-hand corner. (See enlarged image in Section 11).



This is a sample layout for the Humboldt Bay Map template. This panel is in a kiosk at BLM's South Spit. (See enlarged image in Section 11).

The Humboldt Bay Map Template is intended to convey general map orientational information in either a 1 or 3-sided kiosk structure (*the Welcome Kiosk Template can be used for additional kiosk panels and more generalized information*). The map template DOES NOT have an associated illustrated border, as it would detract from map information. The map shows all of Humboldt Bay, associated recreational areas, and use regulations. View **sample layouts** under "Sample Template Development" in the second CD-ROM.

Some **options** with this panel are: 1) No additional site-map just Welcome-related/orientational text, 2) Highlight corresponding site area on the larger map with a red box and have site-specific map blow-up and regulations on another panel (sample on bottom left) and 3) Add a site-map and regulations in blue space next to larger map (see top left blue space). Highlight corresponding site area on the larger map with a red box.

Step 1: Create a new folder entitled "Bay Map" for example.
Step 2: Open Adobe Illustrator.
Step 3: Open the Humboldt Bay Map Template folder. Templts > HBayMap > HBTemplt.ai. The Map Template folder has the following files:

- HBayTemplt.ai (the working copy)
- Use Regs (Regulation symbols)

Open and work in the Illustrator file. (Disregard the "Font Problems" dialogue box, it is an artifact from an earlier map file.) *When the template opens, it will look like the image on the top left of this page. Themes, body text, regulation symbols and text, and agency logo will need to be added. See sample Humboldt Bay Map panel on the second CD-ROM or Section 11 Color Plates.*

Step 4: Save template.
1. File > Save As
2. Open the "Humboldt Bay Map" folder set up for this panel.
3. Save as an .ai for Adobe Illustrator.
4. Click on Save.

Step 5: Place or type the theme or title for the panel (e.g. Welcome to the Elk River Wildlife Sanctuary). See Section 5 for specific text layout guidelines.

Step 6: Place agency logo(s).
Step 7: Resize the regulations box to accomodate regulation information and regulation symbols.
1. On a new layer, draw a box and put a title at the top (e.g. Elk River Wildlife Sanctuary Use Regulations")
Step 8: Place the site regulation symbols into the regulations box.
1. Place the symbols from the "Use Regs" folder located in the "HBayMap" folder.
2. Use the software's grids and guides to align the symbols.
Step 9: Type out regulation text next to symbols.

Changing the Background Color

Because this file was created in Adobe Illustrator (unlike all other templates), changing background color happens within this file. A graphic designer will be able to help with this process.

Creating a Site-Map

A graphic designer, preferably with map skills, should be consulted if a site-specific map is needed. The Humboldt Bay Map Template Adobe Illustrator file can be used to ensure consistency in color, stroke weights, and overall text and graphics elements. The Welcome Template border can be used for additional site-map information.

Creating a Water Trails Panel

The Water Trails template is a **standardized** panel that will work anywhere around Humboldt Bay. Agencies only need to add a "You are Here" in the associated Illustrator file on the first CD-ROM. A **modified** Water Trails template is also available without the standardized information. This template, with only the border illustration, can be used for boating or general water recreational use activities. The standardized template has its own folder entitled "Water Trails Template." The modified template, without the standardized information, is found on the first CD: Templts > Wayside > WtrTrls

Creating Rail-Mount Panels

If a site requires panels be mounted on various types of railings, a specific rail-mount frame is available (see Section 8). Since sizes will vary greatly, a graphic designer will need to scale templates accordingly to fit site specifications.

Sample 'regulations' box on map panel.

The site map was created for BLM's South Spit kiosk. It is the blow-up area from the highlighted red-box on the general Humboldt Bay Map panel on page 33. (See enlarged map in Section 11).

Preparing Files for Fabrication

The "Preflight Checklist"

The following pages include what fabricators call the "**preflight checklist**," or graphic file guidelines, for fabrication. They are dated to the time this manual was developed (Fall, 2003), so be sure to follow-up with your fabricator for any updated information. Following are some guidelines specific to The Signing Program.

Once you have saved all the working files to a CD-R or zip disk:

1. Open the template that you have saved to the disk
2. Relink the images to the image files that you have saved to the disk, otherwise they will be missing.
3. Save the template one last time.
4. Close the disk so that it can be read on other computers.

The Final CD or Zip Package

The final package to be sent off for fabrication should have the following files and attachments:

- The final Illustrator and Photoshop **template file**(s). For example, "Saltmrsh.ai" and "SaltMrsh.psd." Be sure they are **relinked** together (see above). Also add the Fabricator Illustrator files folder.

- A subfolder with ALL of the **graphic images** that have been placed in Illustrator and are listed in the links palette.

- A subfolder with **font files**. Copy and paste fonts into this folder from the "Fonts" folder on the CD-ROM or the computer's "Fonts"system folder. The text can be converted to outlines instead. With text selected, click Type>Create Outlines.

- Color copies of the appropriate **Template Color Plates** should be sent to the fabricator along the with CD or zip disk for color matching purposes. New color copies must be made from the Photoshop file if the background color was changed.

- Fabricators generally like to have a hard color copy of the **final Illustrator layout** to use as a reference. The Illustrator artboard can be scaled down to a 8.5" x 11" and printed. This is best done at a copy shop to ensure quality color matching.

General Guidelines For

digital file preparation

General Prepress Guidelines:

It is important to understand that regardless of how well your files are set up, KVO will typically need to manipulate your files for the particular manufacturing process being used. These guidelines therefore, outline general issues only. It is always advisable to call us prior to setting up your files in case there are more specific details that need to be addressed. It is also important to understand that KVO offers several sign products, and that there can be differences to consider for each. Again, a simple phone call can go a long way to ensure that your files are set up in a manner that will minimize the amount of work that KVO will need to do to your files prior to the manufacturing process. In any case, KVO will provide the appropriate proofs (as outlined in your quote) prior to manufacturing. These guidelines will be updated as necessary when new information becomes available. If you have any information that you feel would be useful to include, please contact a KVO representative.

Supported Media:

KVO prefers CDs but also can accept 100 mb and 250 mb ZIP discs, and 1 gig JAZ discs. 2 gig JAZ discs will require a $40.00 conversion fee per disc. If your project is small enough to fit on a floppy disc we would prefer you send it via email (prepress@kvoindustries.com). Note to PC users: KVO is a Macintosh environment, so please use the Hybrid ISO option when writing CDs. If this option isn't available with your CD authoring software, please call us before proceeding.

Supported Applications:

The vast majority of files we receive are created in either Adobe Illustrator, Adobe Photoshop, Adobe Pagemaker, Macromedia Freehand or QuarkXpress. We also receive some files created in CorelDraw and Adobe InDesign. If you are using anything other then these applications, or if you are using an outdated version of any of these programs, please contact KVO to discuss how to proceed. KVO maintains the most recent versions of these programs.

Files:

General:

When collecting documents for delivery to KVO please make sure to include all files and fonts (both display and printer fonts) linked to each document. Include a hard copy output of each document being printed with any relevant notes included. When E-mailing files please fax a copy of each layout. Do not embed raster files; this hinders our ability to ensure proper output resolution and to correct color.

Documents:

When possible, please set up documents at full size. If this isn't possible, set them up at either 50% or 25%. It is important to consider how the final product will be installed to ensure your files are set up properly. For example, if your sign is to be mounted into a frame, it is important to know how much of the sign will be covered by the frame so that graphics are not covered. In this case, problems can be eliminated if the "visible opening" and actual panel dimensions are properly identified. If unsure, please contact KVO before sending your files.

Files (cont'd):

Color:

KVO uses a number of different processes to provide our clients with the final product. Each of these processes handles color in it's own unique manner. For this reason we recommend that you use the Pantone Coated Library when specifying colors for your project. If you have used custom colors to create your documents we require a hard copy proof to match to. In either case we will provide you with the best possible color match available; in most cases this is nearly identical. However, depending on the manufacturing process used, there can be certain color limitations. After reviewing your files, KVO will determine if there are any color concerns and will discuss this with you.

Fonts:

Use Postscript fonts when possible. Do not use application based style attributes, such as "bold" or "italic"; use actual bold or italic fonts. Again, remember to include all fonts (both display and printer fonts) with your files. Note to PC users: If you are using an application that allows you convert fonts to artwork, doing so will eliminate font conflicts with the Mac OS.

Raster Images:

If you are placing gray scale, color, or bitmap images in a vector drawing application (Illustrator, Freehand etc.) or page layout application (Quark, Pagemaker etc..) save raster images as either EPS or TIFF. If your entire layout is being executed in Photoshop please provide KVO with a layered native Photoshop file if possible. Do not convert duotones, monotones, quadtones etc. to either RGB or CMYK, leave them as spot colors and make sure to use the Pantone coated library when selecting these colors. All raster images should be at, or near 300 dpi when scaled to their final output size. Please remember to take into account any scaling done in your layout application when determining final output resolution. Simply "adding" resolution to Photoshop files that are of incorrect resolution is not advised. KVO has the ability to properly interpolate images that have been scanned or created at low resolution. The fee is nominal and ensures good results. JPEGs and GIFs are not for print and even if converted to a printable format the final results will be severely compromised.

Scanning:

If you prefer to scan your own images, please call KVO to ensure that you are using the appropriate resolution for the manufacturing process being used. The quality of scanned images not produced by KVO cannot be guaranteed. KVO offers scanning and placement at very competitive prices.

KVO Industries' Preflight Checklist for digital file preparation. (www.kvoindustries.com)

Graphic Requirements

Acceptable Graphic Software (MAC):

- Illustrator 10.0 (preferred)
- PhotoShop 6.0
- Freehand 10.0
- Quark 4.0
- PageMaker 6.5

Not acceptable Graphic Software for production:

- PowerPoint
- Corel Draw (can be exported as an Illustrator file)
- Word Based Art
- InDesign

Sending Files:

- CD
- Zip Drive 100mb
- Jazz Drive 1gb
- Email (zip or stuff files)
- PPI's secure FTP site

PPI's Secure FTP site:

We can setup a secure folder on our FTP site for you to upload your graphic files. Please contact your AE and we will provide you with a username and password for your secure folder.

File Setup for Inkjet production:

1. Build files at final production size or to scale. (i.e. 1/4", 1/2" or 3/4" scale) Note scale on proof.
2. Link images (no embedded images).
3. PhotoShop files need to be TIFF, RGB, 125dpi, flattened (no layers) at final production size.
4. Include layered PhotoShop file for editing text and making color changes.
5. Scanned images need to be TIFF, RGB, 125dpi at final production size.
6. Include PMS colors
7. Include all fonts for editing or convert fonts to outlines.

File Setup for Vinyl production:

1. Build files in a native vector based program, Illustrator or Freehand at final production size or to scale. (i.e. 1/4", 1/2" or 3/4" scale)
2. Placed or embedded raster images can not be reproduced in vinyl.
3. Include PMS colors. Note, not all PMS colors can be matched in vinyl. In special cases we can paint vinyl to match PMS color.
4. Include all fonts for editing or convert fonts to outlines.

General Guidelines:

1. Provide a comprehensive project description on a color proof, including the dimensions, PMS specs, fonts, size and scale the file is built at.
2. No embedded images, double check all links or placed images to ensure the correct version is with the file. Put linked images in the same folder as the layout.
3. Delete any irrelevant files from the disk you send. Label all disks with client name, project name and contact information.

PPI's preflight checklist for digital file preparation. (www.ppinc.com > museum link)

GRAND VISUALS

Large Format Digital Graphic Solutions

Preflight Checklist

To assist us in meeting your deadline, please review your digital artwork and ensure that you have provided the following:

- ❑ An accurate laser proof that reflects the final output requested. (Print your laser comp from the disk or the folder which contains the files you are providing for output.) **All files are assumed to have been converted to CMYK.**
- ❑ The correct page setups and dimensions, including aspect ratios or proportions. (We will ensure proper enlargement to your final size.)
- ❑ **All supporting images and artwork,** (ie.: TIFF, EPS, PICT, etc.) (Please review your picture usage or links to update modifications.)
- ❑ Scanning resolution high enough to capture all the details you wish to see in the final output (**We recommend 100 dpi at final output size, but no smaller than 10MB.**)
- ❑ **The most current supporting images requested by the layout.**
- ❑ All screen and printer fonts included, **converted to outlines,** or confirmed in Grand Visuals library. (**Please use Postscript fonts,** we cannot insure True Type fonts will work properly.)
- ❑ Color references for all important color matches, (ie: color chip, photograph, or Pantone reference.)
- ❑ All proof type and laser settings are turned off in your file, (ie: tiling, tough or low res settings, etc.)

Compatible Layout Software:

We have several versions including the most recent; please call if you are not sure about compatibility or a new version.

We are constantly updating our capabilities and we are experts in file conversion.

MAC (Preferred)

Adobe Illustrator 9.01
Quark Express 4.0
Adobe Pagemaker 6.5
Macromedia Freehand 7.0

Support Software

Adobe Photoshop 6.0
Adobe Streamline

PC

Corel Draw 8.0
Adobe Pagemaker 6.5

File Transfer Media

Zip 100
CD ROM
Jaz 1GB or 2GB
Syquest 88, 200
E-mail:
production@grandvisuals.com

2300 West 2nd Avenue Unit A, Denver CO 80223
Ph: 303-221-3860 - Fax: 303-2216756 - Toll Free: 877-221-3860

Grand Visual's preflight checklist for digital file preparation.

Development of Future Templates

The need may arise for additional templates to be developed. Several steps should be followed to ensure consistency with The Signing Program. Artist Gary Bloomfield will need to be contacted for availability, a contract will need to be signed, and a budget will need to be agreed upon that will cover his hourly rate as well as copyrights to the artwork.

These files will be too big to email to other agencies. Coordinate with NRS so they may update their Signing Program files with the new template and let other Humboldt Bay land managers know about this additional template. CD's will need to be made and distributed.

Once Gary's artwork is scanned into a workable digital format (it should be saved as a **tiff** —tagged image file format), a graphic designer should follow these steps (use pre-existing templates as a reference):

Setting Up the Photoshop File (.psd)

- Open the art border tiff in Photoshop.
- Change the color mode from RGB to CMYK (drafts must be in RGB if needing to be viewed on-line. Finals for printing must be in CMYK)
- Double-click on image (or background layer in palette) and under layer properties change name to Art.
- Use zoom tool and zoom into top crop marks.
- Use measure tool (click on paint dropper tool) shift and drag ruler from top left crop mark to top right crop mark. This adjusts for any misalignment during scanning.
- Go to Image>rotate canvas>arbitrary and let Photoshop adjust angle.
- Save file as **AgFinal.psd** (use appropriate theme name).
- Use crop tool to and follow drawn crop marks. Adjust crop box to just inside the drawn lines. Crop and save.
- Go to image size and adjust so the artboard is 24" x 36" (or 30" x 40" for welcome). Make sure, under canvas size option, that artboard is centered in the middle of canvas.

"Cleaning-up" the Image

- Use magic wand tool and turn on anti-alias and contiguous options on menu bar.
- Set tolerance to about 20 and click on area below artwork. Once this section is selected, click delete. There should be a checkerboard-patterned transparent background.

- Use lasso tool to select transparent space and delete to erase all spots left behind.
- Zoom in to about 200% and follow the inside hand-drawn line, cleaning up any miscellaneous color spots on the outside of the line. Change tolerance number as needed. Use shift-click to delete spots, option-click to add spots
- Use eraser tool set on paintbrush and 100% opacity to clean up rough edges left by magic wand tool
- Save .psd file with cleaned-up edges.

Choosing the Background Color

- In layers palette, create new layer. Under layer properties, save as Pantone.
- Drag pantone layer beneath art layer.
- Click on black/white circle icon in layer palette to create new fill/adjust layer.
- Choose solid color option. Click on custom to get to pantone colors. Use eye dropper on artwork to select out a **coated pantone** color. *Record selected pantone number and the pantone number of the color two shades lighter (see below).*
- When final color is selected, flatten layers in layers palette.
- File is ready to be saved. Save as **AgFinal.psd,** for example.

Setting Up the Illustrator File (.ai)

- Open Illustrator. Create new file with a 24" x 36" artboard.
- Place AgFinal.psd (make sure "Link" checkbox is checked in "Place" dialogue box) and name the layer "AgFinal.psd", for example. Lock this layer.
- Open "BaySilhouette.ai" file and copy>paste it into a layer named "bay silhouette". Lock this layer.
- Open "Humboldt Bay.ai" file and copy>paste it into a layer named "bay silhouette". To change fill color of bay, click on appropriate layer in layers palette. Then click Window>Swatch libraries> Pantone Coated. Enter the pantone number that was recorded from the Photoshop file (see above).
- Set up two additional layers: Text and Images.
- Set up one-inch guides. Save as **AgFinal.ai**, for example. This is the file independent agencies will work with.
- Create a folder entitled Agriculture Template, for example. Inside folder, agencies should find:

1) Ag.Final.psd
2) AgFinal.ai.

7. Sign Panel Material Alternatives

This section provides a number of alternatives for sign panel materials and outlines the advantages, disadvantages, and other considerations when choosing materials. Also included in this section is a list of the companies that fabricate these products and their associated costs.

These are some questions to help guide decision-making:

1. What is the **budget** for the project?
2. Will the exhibit be **temporary or permanent**?
3. Will the exhibit be located in a place with high **vandalism** potential?
4. Will the exhibit have **shaped-edge** and be mounted to a sign base or be a **straight-edge** with a framed base?

Sign Panel Dimensions

Welcome Kiosk Panels

The standard size of the welcome/kiosk panels created with the Signing Program is **30"w x 40"h**. This fits both the 3-sided and 1-sided structures. These panels can be fabricated in any size to meet site needs, but graphic and structural designs will need to be modified accordingly.

Wayside Panels

The standard size of wayside panels created through the Signing Program is **24w" x 36h"**. Panels can be created in other sizes, (i.e. for rail-mounts) however estimates are not provided in this manual.

Shaped or Straight-edge Sign Panel?

Panels can be cut along a pre-designed "shaped-edge" line along the top if desired. The shaped-edge panels will **not** fit a standard frame and must have custom-made bases. Following is a summary of considerations for both options.

Straight-Edge (2 alternatives)

The unframed straight-edged sign panel can come in a variety of thicknessess (1/8" - 1") and be adapted to many styles of sign bases.

Framed

- Looks like a traditional National-Park style sign; does not offer the more creative and interesting look as the shaped-edge
- Must be purchased at 1/8" thick to accommodate standard NPS-style frame structure

Unframed

- Looks more interesting than framed panel
- Must be purchased at at least 1/2" thick to self-supporting on chosen sign base
- Slightly *less* expensive than shaped-top panel

This is a standard NPS-style framed straight-edged sign panel. This panel is 1/8" to fit into the frame.

Shaped-Edge (for CellEx or High Pressure Laminate Panel Material Options Only)

- Creates a unique, artful, and interesting look
- Must be purchased at 1/2" thickness for self supporting ability
- Panels are all **unframed**, but supported by a baseplate which is bolted or welded to a sign base and to the panel itself (from underneath so that bolts are not seen). Welcome Kiosk panels would be bolted into the back from the kiosk structure.
- Slightly *more* expensive than both straight-edge panel alterna tives. Fabricators charge an additional 'per linear foot' cost.

The unframed shaped-edge of this sign gives it a unique, interesting look. This shaped-edge cut is consistent among all the interpretive signs developed through the Signing Program. The bases are similarly unique and made to fit in to the surrounding natural enviornment.

Sign Panel Fabrication Materials

There are **three suggested options** for sign panel materials included in this manual. Following is a summary of each material and advantages and disadvantages for each. Choosing materials should be based on budget and site parameters.

- High Pressure Laminate/Phenolic Resin
- Cell-Ex
- Vinyl Ink Jet

High Pressure Laminate (HPL)

HPL panels are excellent for quality permanent exhibits. The process of fabricating HPL panels includes layering special imaged paper, a UV resistant overlaminate, and kraft stock, then pressing the layers under intense pressure and heat. The process fuses the layers into a durable and solid panel. This is one of the most durable materials on the market for outdoor interpretive exhibits.

Advantages of HPL:

- Excellent for permanent exhibits
- Good photo reproduction capabilities
- Good resistance to vandalism
- Very good resistance to scratches and abrasion
- Excellent UV protection
- Does not need to be covered
- Does not need to be framed if more than ½" thick
- Can be made in a variety of thicknesses to be framed or not framed

Disadvantages of HPL:

- Produced out of area
- Moderately expensive
- 5 year warranty

CELLEX

CellEx is a high resolution graphics sign panel option at a very competitive price. This high density laminate material is very resistant to vandalism, scratching, weathering, and UV rays. A CellEx panel can either be fabricated in 1/8" thick panel which can be accommodated by most standard NPS-style framing systems, or in greater thicknesses which can stand alone without a frame. This ranks next in durability to the HPL panels above.

Advantages of CellEx:

- Good for permanent exhibits
- Good photo reproduction capabilities
- Good resistance to vandalism
- Good resistance to scratches and abrasion
- Good UV protection
- Does not need to be framed if more than 1/2" thick
- Does not need to be covered
- Can be made in a variety of thicknesses (1/8"- 1")
- 10 year warranty

Disadvantages of CellEx:

- Produced out of state
- Moderately expensive
- Materials may delaminate

Inkjet Panels (3M or True Solvent)

Ink jet panels are an excellent lower-budget option for temporary signage or for sites where the vandalism potential is too high to invest a lot of money on interpretive signage. Although graphics can be high resolution, there are many materials involved to make a sign.

Advantages of Inkjet panels:

- Inexpensive
- Produced locally
- Excellent for temporary exhibits

Disadvantages of Inkjet panels:

- Needs to be adhered to an additional surface
- Graphics are susceptible to abrasion/vandalism and surface would need a protective cover (plexi-glass)
- Edges are sharp and would need a frame
- Photo reproduction quality is fair
- Not resistant to weathering and fading from UV rays (would need a protective covering)

Sign Panel Manufacturers and Cost Estimates

The following cost estimates are included to give you an idea of the cost of fabricating sign panels. Getting cost price quotes from fabricators is extremely difficult due to situation-specific variables. **Each order is unique and rates will be quoted accordingly.** The provided estimates are ball-park at best! Bear in mind that rates will *decrease* with the increase in square footage of material ordered. These estimates are subject to change on the basis of project scope and other factors and do not include sales tax. Add 3.5% to estimates for every year after 2003 to adjust for inflation. **See Section 10 for fabricator contact information.**

High Pressure Laminate

KVO Industries (Santa Rosa, CA)

Estimates:

Welcome Kiosk panels (30" x 40"): See attached pricing matrix on following pages. **Wayside panels (24" x 36"):** See attached pricing matrix on page 48. Turn-around time: 4-6 weeks.

PPI Industries, Portland, Seattle, San Francisco

Estimates:

PPI prefers to give estimates on a job to job basis. Their products are top-of-the-line and they have an extremely talented staff of interpretive text writers, graphic designers, and illustrators. Turn-around time: 4-6 weeks.

CellEx

Grand Visuals (Colorado)

Estimates:

1/8" ranges from $40 to $25 per square foot depending on how big the order is. 1/2" ranges from $49 to $31 accordingly. Add $50 per panel for 'image rip charge'. One **wayside** sign would be roughly just about $300 and a **kios**k-size would be about $350. Contour-shape cost not included. Cost includes a color proof. Turn-around time: 4 days for color proof, 10 days for final.

Inkjet (3M or True Solvent)

Agreda Communications (Eureka, CA)

Estimates:

One 34.5" x 24" full color, weather resistant outdoor decal applied to 1/8" Diebond substrate (for support): starting at $200.00. Would need additional protective covering and frame. Warranty: 18 months.

JB Designs (Eureka, CA)

Estimates:

True Solvent vinyl graphics print at $12/sq.ft. A 24"x 36" vinyl sheet would be about $72. This does NOT include the mounting substrate (a range of materials to choose from), the protective plexiglass covering, or the frame.

8. Sign Base and Kiosk Structures

This section provides recommendations for **wayside sign base** and **kiosk structural alternatives** development**.** Refer to Section 10 for a complete list of fabricators. Sign base and kiosk structures are dependent upon the selected sign panel size and material. Hard copies of kiosk designs can be found in the second CD-ROM.

Wayside Sign Base Alternatives

There are **three sign base alternatives** to choose from:

- Grass-style bases (for *unframed* wayside panels, 24" x 36")
- Tree-style bases (for *unframed* wayside panels, 24" x 36")
- NPS-style bases and rail mounts (for *framed* wayside panels, 24" x 36")

ADA Guidelines for Wayside Sign Bases

Americans with Disabilities Act (ADA) Requirements for Interpretive Signage

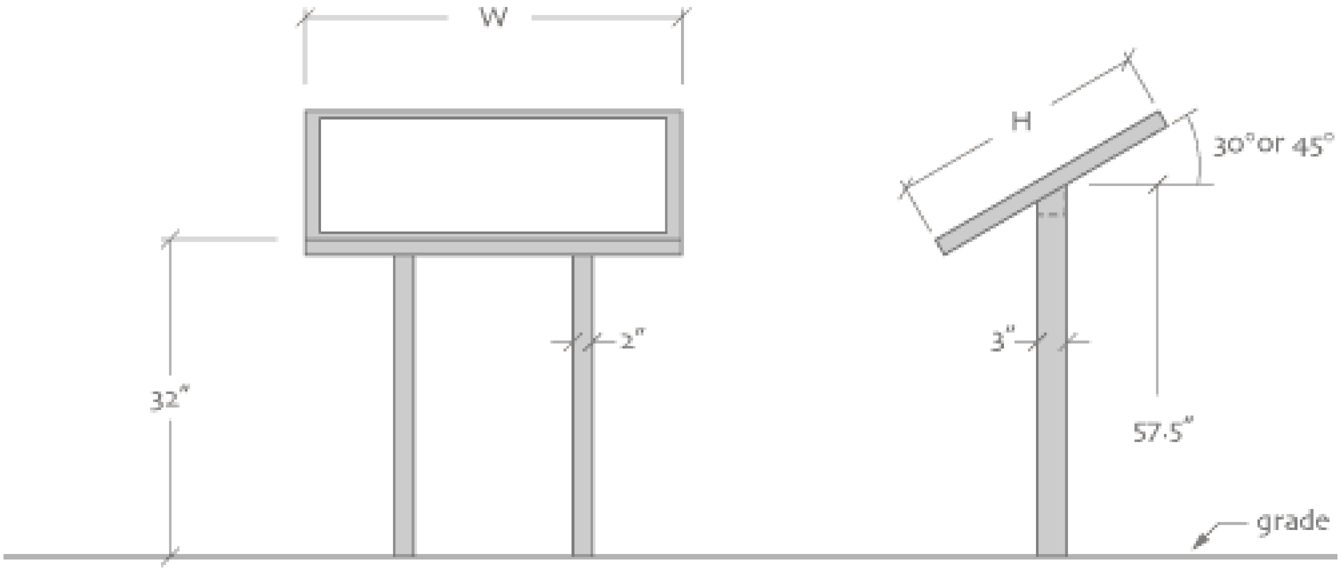
Information in this section is consistent with the Americans with Disabilities Act (ADA) requirements (for interpretive signage) used by the Bureau of Land Management and the National Park Service. Sign structures developed with the following guidelines in mind will promote full access to interpretive exhibits for all visitors to Humboldt Bay. Access ADA homepage for links to the Act and other information, http://www.usdoj.gov/crt/ada/adahom1.htm.

- Sign structures must be located on smooth, level, and hard exhibit pads for easy mobility.
- The recommended height of bottom of sign panel from the ground is 30 inches (except for rail-mounts).
- Sign panels must be set at a 30 or 45 degree angle.
- A clearance of 36" must be provided between two exhibits if visitors are to pass between them.

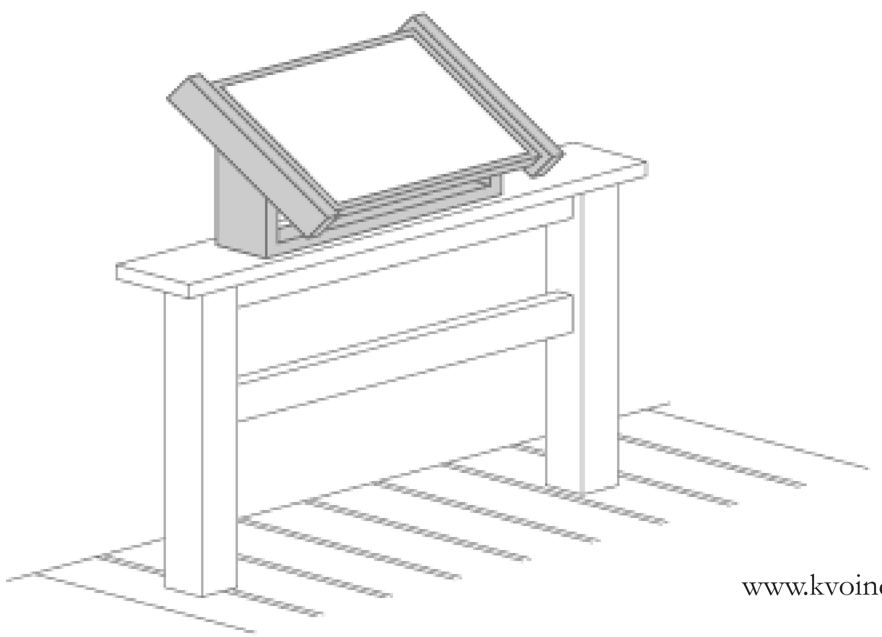
Grass-style base for the unframed sign panel. Sign panels are bolted into the back from a base plate which is welded to the grass-like aluminum rods.

Tree-style base for an unframed sign panel. Sign panels are bolted into the back from a base plate which is welded to the branch-like aluminum rods.

Double Pedestal Model



Rail-Mount



www.kvoindustries.com

Wayside Sign Base Fabricators

The following is a list of sign base fabricators, both local and out-of-town, and what types of products they specialize in.

Grass and Tree Bases: Local

Wright Way Fabrication

Specialty:

Wright Way Fabrication works with metal. They can create grass-style and tree-style bases from aluminum rods, each one unique. Tree-style bases are more expensive due to the creation of a branching effect out of the rods. Expect to pay about $500 for a grass stand and $800 for a tree stand (See below for additional powder-coating costs. Check with Wright Way about shipping finished bases directly to Pacific Powder Coating below.

Pacific Powder Coating

Specialty:

Either base will need to be powder-coated for an additional $75-$100. This local company will apply a colored, protective spray to the sign bases created at Wrightway Fabrication. They have over 100 colors to choose from, and costs may be lowered if they have the color needed is presently stocked in their 'paint guns'.

Grass and Tree Bases: out-of-town

PPI

Specialty:

PPI specializes in artistic, unique sign bases. They fabricate both grass-style and tree-style bases shown on the previous pages, but the cost may be higher in addition to shipping charges. Contact PPI directly for costs and shipping fees (See Section 10 for listing).

Double pedestal Bases And Rail-Mounts:

KVO Industries

Specialty:

KVO, located in Santa Rosa, is somewhere between local and out-of-town. They are geographically out of the local vicinity, but close enough to waive shipping charges by driving to pick up orders. KVO

specializes in double-legged pedestal sign bases and rail mounts. This product is fabricated and powdercoated on-site. See the pricing matrix on page 48 for cost breakdowns.

Kiosk Structure Alternatives

There are 2 kiosk structure alternatives to choose from. Each kiosk is designed to go with the welcome/kiosk sign panel, with a dimension of 30"x40" (see Section 8, "Creating a Welcome or Kiosk Panel"). See the following pages for kiosk designs.

- 3-sided roofed kiosk
- 1-sided upright kiosk
- Eureka Boardwalk kioks (for urban downtown area. Check with City of Eureka)

ADA Guidelines for Kiosk Structures

Just like the sign base structures, kiosk should meet ADA guidelines in order to be fully accessible to all people. The recommended guidelines are:

- Kiosks must be located where accessible on all sides
- Kiosks must be located on smooth, level, and hard surfaces for easy mobility
- The height of the bottom edge of the panel should be about 30-40 inches from the ground with the first line of text no higher than 60 inches from the ground.

Kiosk Fabricators

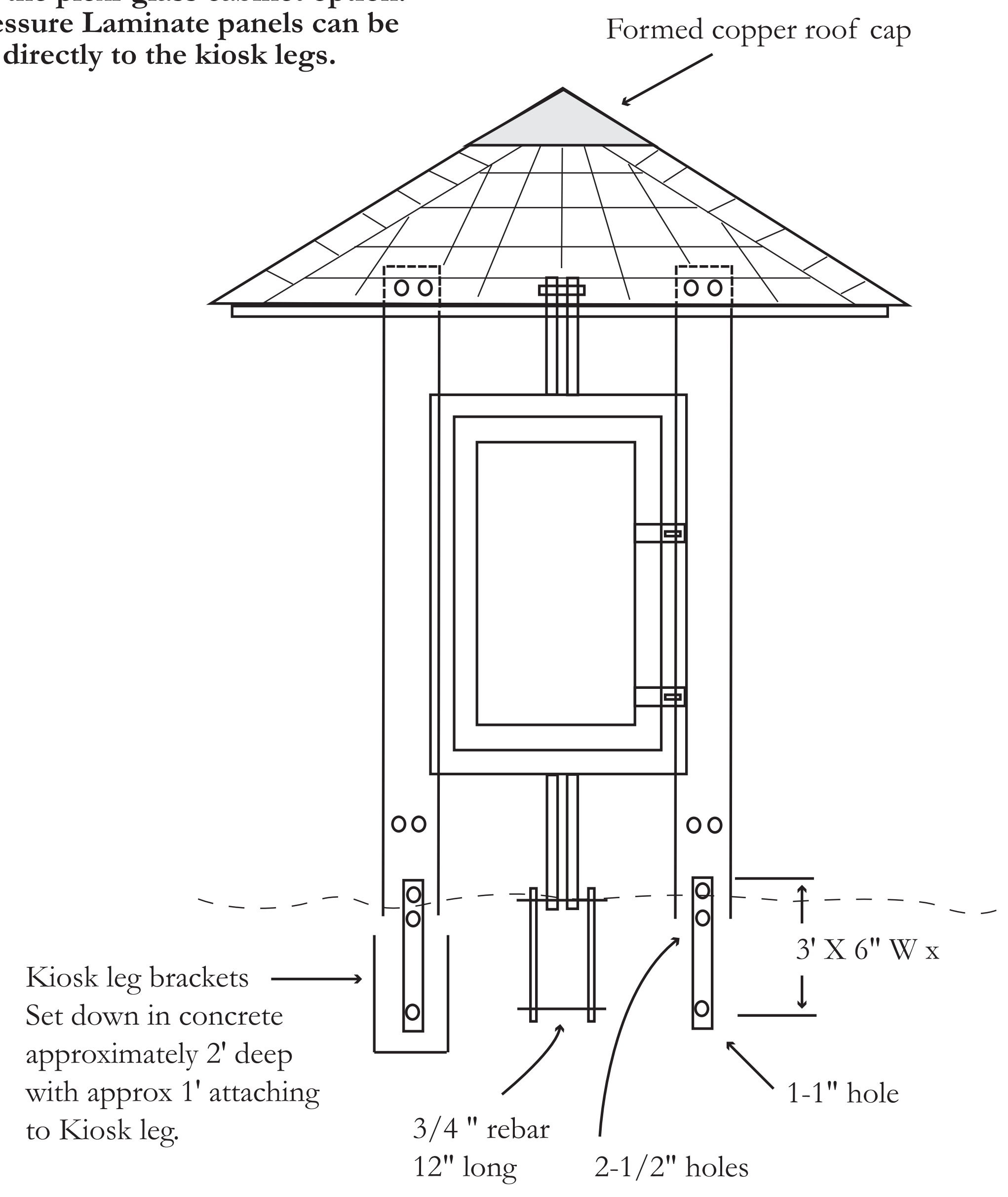
There are no local businesses that specialize in kiosk fabrication. Land agencies with woodshops, local lumber yards, and hardware stores are a good place to look for carpenters and woodworkers. Kiosk designs and materials are provided in this manual and can be used in a bid package. (**Kiosk designs are on second CD-ROM**).

Before the kiosk is built, decisions need to be made regarding sign panel configuration. There are two options:

1) Attach all sign panels (high pressure laminate material at 1/2" thickness) directly to kiosk legs via "L" brackets
2) Build in a plexiglass opening-door cabinet for posting information or for non-high pressure laminate signs.

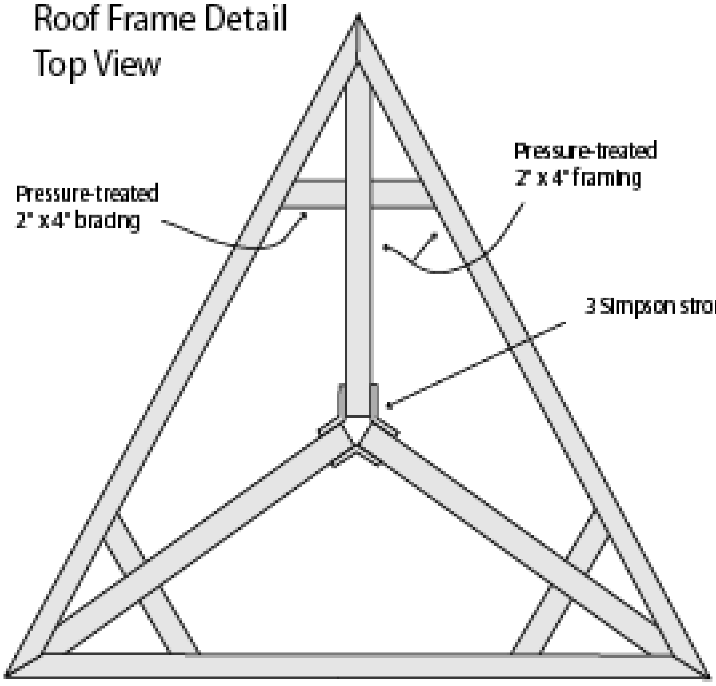
Kiosk Structure Detail

***Shown here (as one side of the 3-sided Kiosk) is the plexi-glass cabinet option. High Pressure Laminate panels can be attached directly to the kiosk legs.**



3-Sided Roofed Kiosk Detail

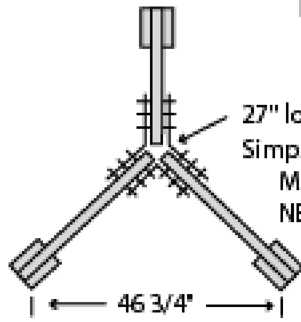
Roof Frame Detail Top View



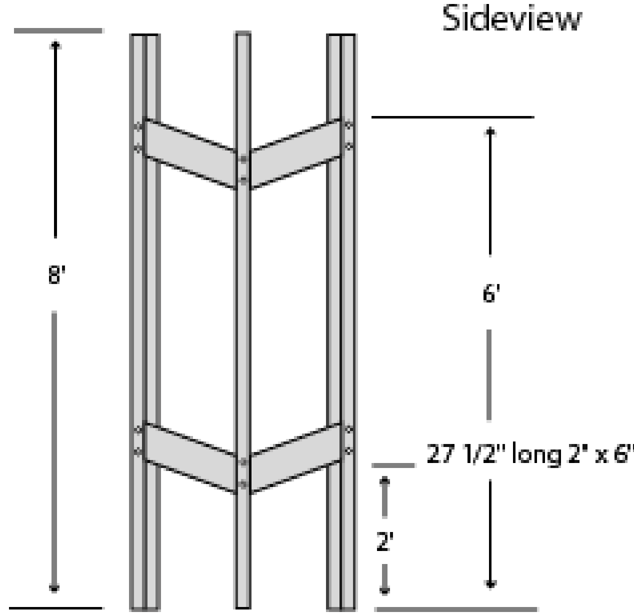
After roof assembly, roof is sheeted with 5/8" plywood, then tar papered and covered with cedar rough-squared shingles.

Peak of completed roof is covered with a formed copper cap (can be shaped easily from a flat sheet).

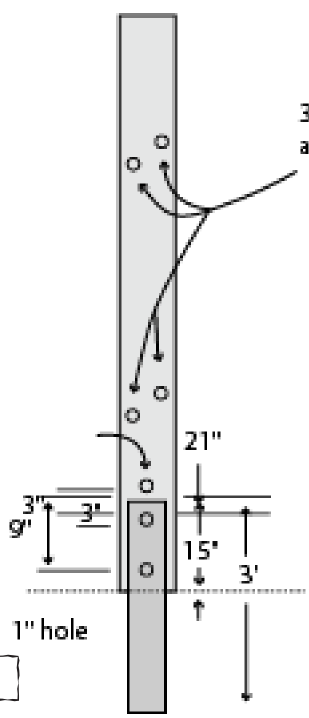
Top View



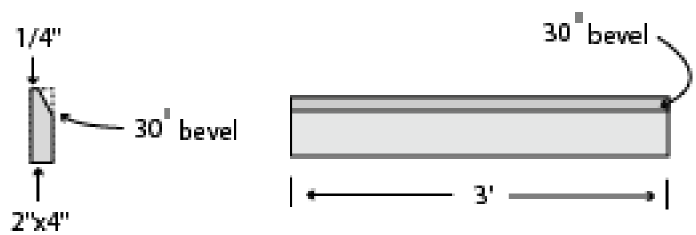
Sideview



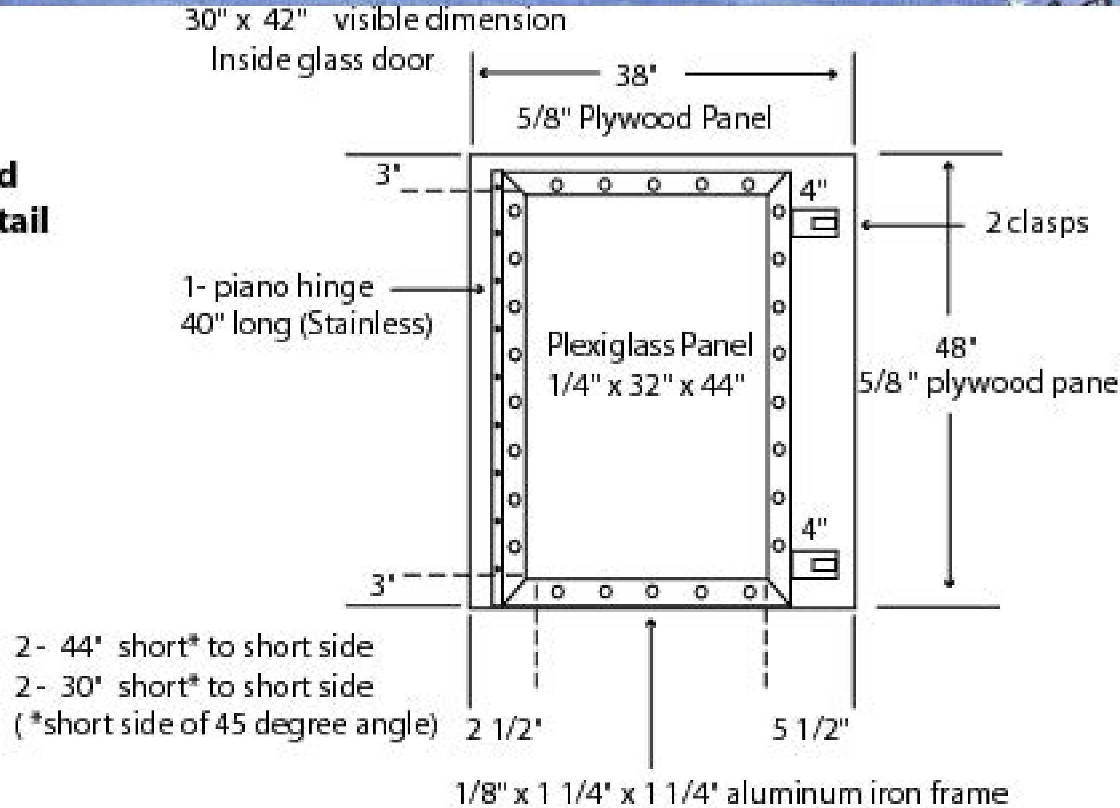
Bolt Pattern Detail for Kiosk Legs



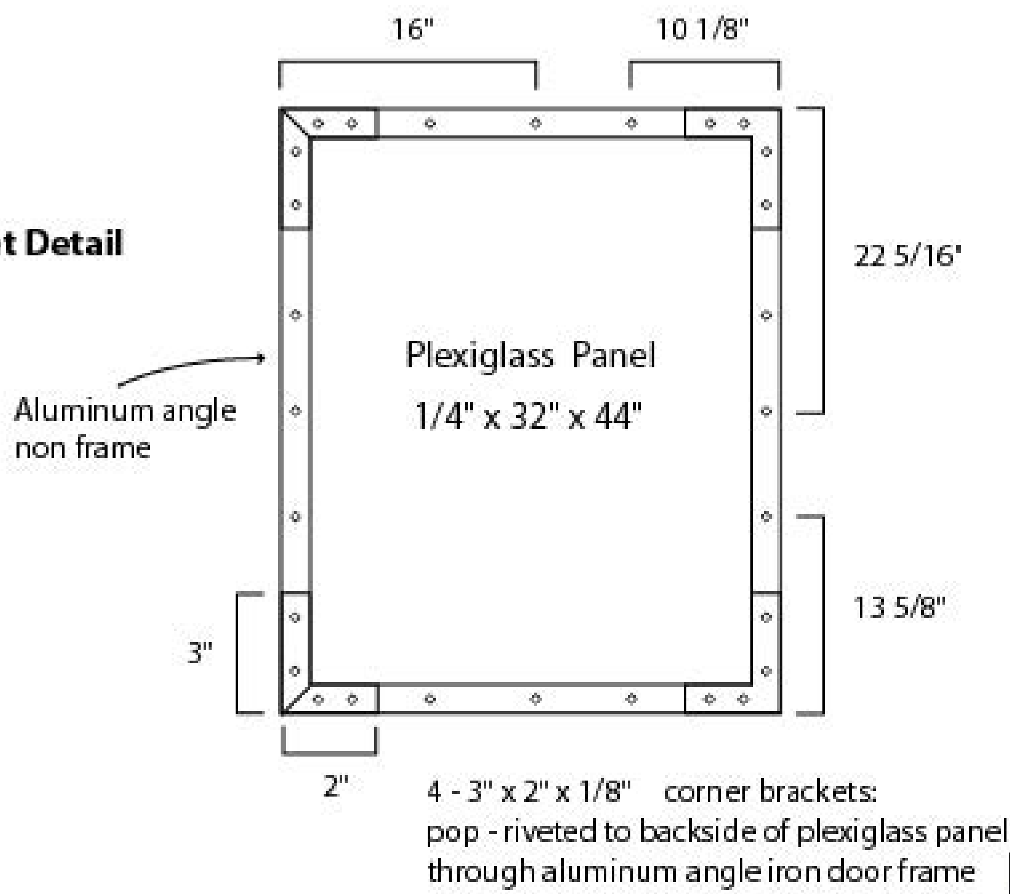
Panel Backing Detail



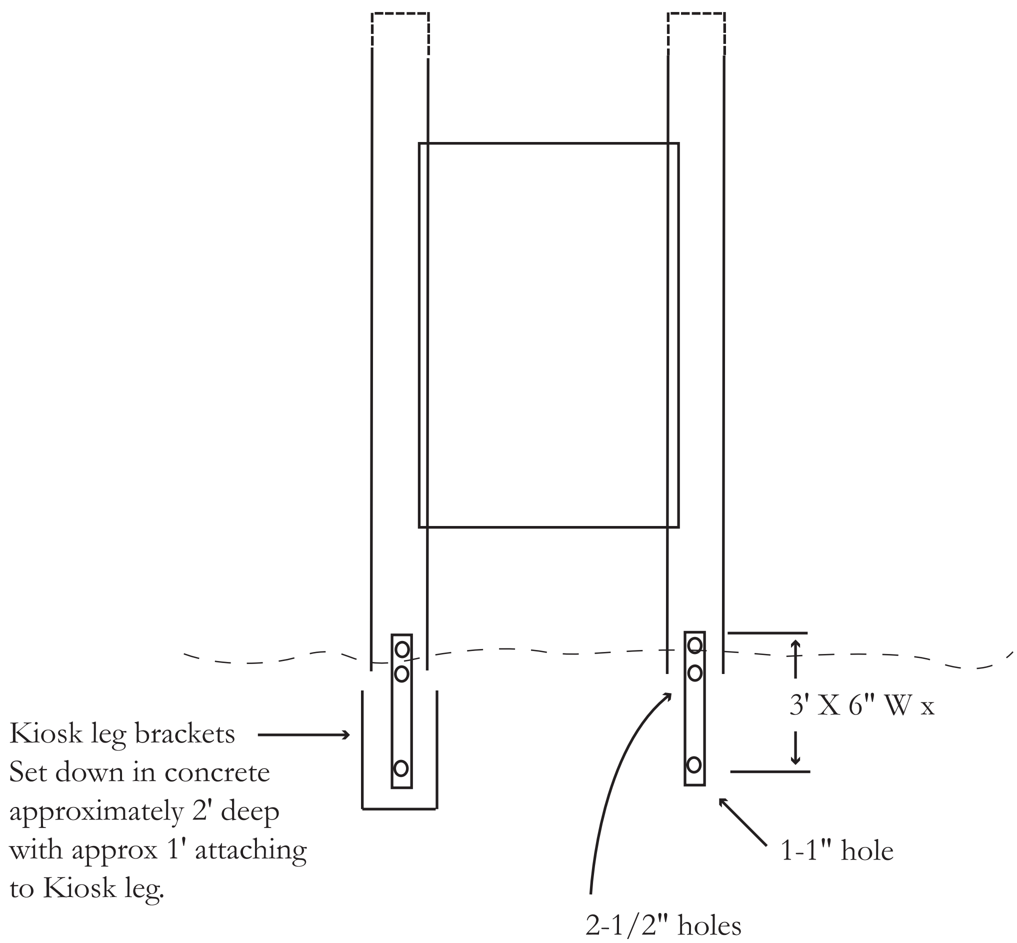
Display Panels and Opening Door Detail



Door Detail (backside) Hole pattern and Bracket Detail



1-Sided Kiosk Structure Detail



9. Permitting, Installation, & Maintenance

This section recommends the basic process for getting interpretive signs in the ground. The final steps involve permitting, installing, and maintenancing the signs.

Permitting

Before any signs go in the ground around Humboldt Bay, a permit application will need to be approved. This process can take a few months, so plan ahead. Permitting processes can vary greatly depending on land jurisdiction(s) and according signage plans. The Coastal Commission has quad maps of the entire bay and can help determine land jurisdicition(s). Contact information for the Coastal Commission can be found in Section 10 "List of Resources."

Installation

Generally, signs will come in two pieces: the **sign panel** and the **sign base**. Confirm that the holes drilled into the back of the sign panel (leaving behind "screw threads") line up *exactly* with the holes drilled into the base plates (connected to the sign base). Check with fabricators for preferred tamper-proof assembly hardware.

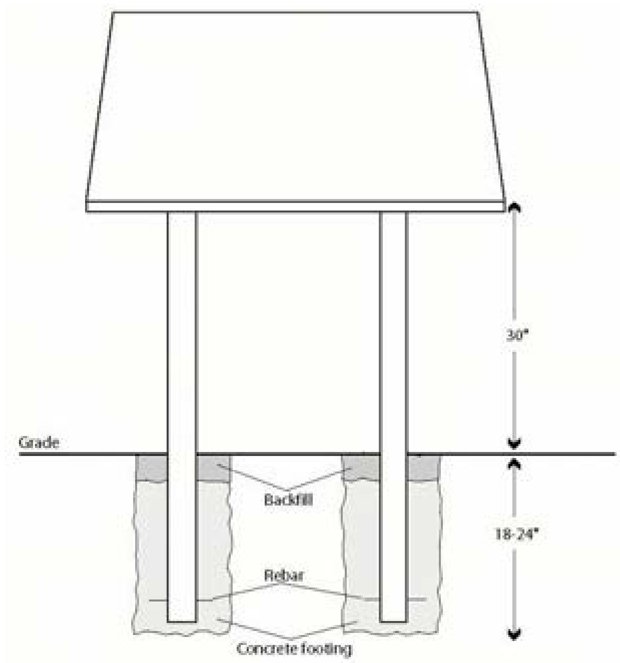
Another important things to consider when installing sign bases is consistency with ADA requirements. Some **associated costs** with ADA-compliant sign installation:

- Site preparation (constructing an smooth-surfaced exhibit pad, digging holes, etc.)
- Concrete (price per bag)
- Rebar or other material for a "dead man" for sinking legs securely into concrete
- Re-landscaping (for public access)

Fabricators generally provide installation guidelines. Most fabricated sign bases will be constructed in a way that the base legs are the right

length for optimal support in the ground and the correct clearance above the ground for ADA compliance.

If constructing custom-made sign bases (tree- or grass-style bases), use the following basic guidelines for installation. Check in with Wright Way fabricators to ensure proper installation.



- Base legs need to be at least 55 inches long.
- A piece of rebar or other material should be put through each leg of the base, close to the bottom) to help hold the base into the concrete.
- Holes, 18 to 24 inches deep, should be dug.
- Place the sign base legs into the holes to a depth where the bottom of the sign panel will be 28 to 30 inches above the ground.
- Pour in concrete until it is about 2 to 3 inches from the top of the hole.
- Construct a device that will hold the sign in place until concrete has set.
- Fill in the rest of the hole with backfill.

Maintenance

Sign panel and base materials will determine the kind of care and maintenence required. Fabricators generally provide basic instructions for maintaining interpretive panels. Maintaining signs is essential to keep them looking like new, to help protect them from the elements, and to avoid having to replace them as often.

Again, fabricators should provide maintenance requirements for their specific products. Nonetheless, it will be useful to have these items on hand for maintenance:

- Touch-up paint (from the fabricator) for aluminum sign bases.
- Polymer-based car wax to put on sign panels.
- An organic *non-abrasive* solvent for graffiti removal.

Replaceability

Overtime, interpretive signs may become outdated or materials may show signs of weathering and vandalism...so save graphic files! Check with the fabricator to see if they will keep the files. It is much less expensive to have signs replaced if the fabricator uses the 'masters' that are already set-up for printing.

Fabricators can quote costs for having **two** of the same sign panels made at one time. Often, fabricators will provide a discount on the second sign if they are to be fabricated at the same time. This saves time; by having a panel already on-hand; the old sign can be replaced right away without having to wait for a new one.

All sign bases recommended in the Signing Program are designed for sign panel replaceability. The tamper-proof hardware (bolts) used to install the signs should be relatively easy to unscrew on the grass, tree, or traditional-style sign bases.

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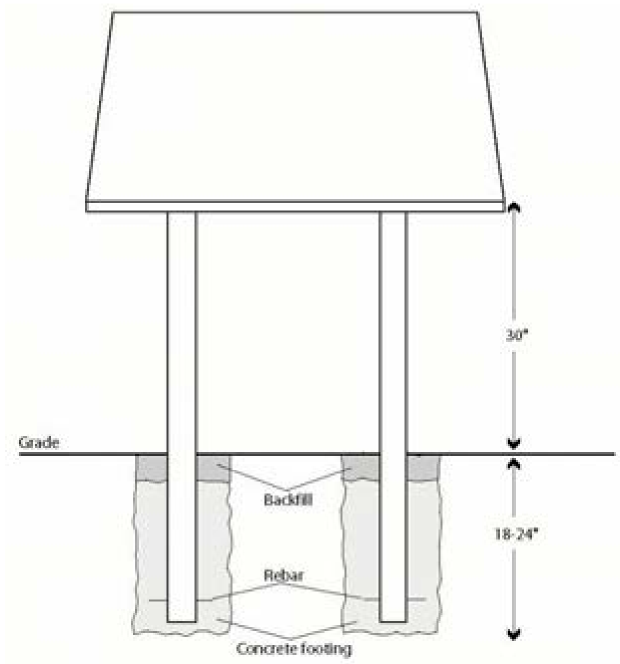

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Overtime, interpretive signs may become outdated or materials may show signs of weathering and vandalism...so save graphic files! Check with the fabricator to see if they will keep the files. It is much less expensive to have signs replaced if the fabricator uses the 'masters' that are already set-up for printing.

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All sign bases recommended in the Signing Program are designed for sign panel replaceability. The tamper-proof hardware (bolts) used to install the signs should be relatively easy to unscrew on the grass, tree, or traditional-style sign bases.

10. List of Resources

This section provides contact information for local and out-of-area fabricators. Every business or individual listed is familiar with the Signing Program and can help facilitate signing projects. Because contact information is subject to change, job titles were provided whenever possible.

This section provides listings for:

- Humboldt Bay Land Managers
- Permitting Information (Coastal Commission)
- Graphic Designers & Interpretive Text Writers
- Fabricators (Sign Panels & Bases)

Humboldt Bay Land Managers (Alphabetical)

Bureau of Land Management
Recreation Manager
Bruce Cann, Arcata Field Office
1695 Heindon Road, Arcata, Ca
825-2300

City of Arcata
Deputy Director of Environmental Services
Mark Andre, City Hall
736 F St., Arcata
822-5951

City of Eureka
City Manager's Office
Gary Bird, City Hall
531 K St., Eureka
441-4100

Department of Fish and Game
Senior Biologist Supervisor
Karen Kovacs
619 2nd St., Eureka
445-6493

Department of Public Works

Deputy Director of Public Works and Parks Maintenence Mgr.
Bob Walsh and Chris Whitworth, County Public Works
1106 2nd Street
Eureka, CA 95501
445-7491

Friends of the Dunes

Carol VanderMeer
P.O. Box 186, Arcata 95521
444-1397

Humboldt Bay Harbor Recreation & Conservation District

Conservation Specialist
Jeff Robinson
601 Startare Dr., Eureka 95501
443-0801

Humboldt Bay National Wildlife Refuge

Refuge Manager and Assistant Refuge Manager
Eric Nelson and Shannon Smith
1020 Ranch Rd., Loleta 95551
733-5406

Manila Community Services District

Linda Lee and Bev Prosser
1611 Penninsula Dr., Manila 95564
445-3309

Table Bluff Reservation-Wiyot Tribe

Cultural Director
Nina Hapner and Marnie Atkins
100 Wiyot Dr., Loleta 95551
733-5055

Permitting Information

The Coastal Commission has information and maps regarding land jurisdiction around Humboldt Bay.

California Coastal Commission

710 E Street, Suite 200
Eureka, CA 95501
445-7833

Graphic Designers & Interpretive Text Writers

Creating informative, engaging, interpretive signs tailored to the general public can be a challenging project. There are many local professionals skilled specifically in interpretive graphic design and text-writing. **RCAA** worked with several consultants during the Signing Program. Their contact information can be obtained by calling RCAA and speaking to one of the interpretive planners (269-2056).

Other great local resources are: Humboldt State University's **Interpretation Department**. Faculty from this department can provide contact information for interested students. (825-5369). Other agencies participating in the Signing Program may know of additional consultants. The **yellow pages** in the phonebook provides listings of local graphic designers. Yet another option, **PPI Industries** (see following page) has an extremely talented staff of interpretive graphic designers and text writers.

Fabricator Contact Information (Alphabetical)

Agreda Communications

Phone: 707-269-0400
Fax: 707-269-0140
Email: info@agreda.com
Address: 4102 Excelsior Rd. Eureka, CA

CellEx

Phone: (303) 221-3860
Fax: (303) 221-6756
Email: sales@grandvisuals.com
Address: 2300 West 2nd Ave. Unit A, Denver, CO 80223

JB Designs

Phone: (707)-443-2816
Fax: (707) 443-2816
Email: JBDoffice@cox.net
Address: 726 2nd St. Eureka, CA

KVO Industries

Phone: (707) 573-6868
Fax: (707) 573-6888
Website/email: sales@kvoindustries.com
Address: 1025 N. Dutton Ave. Santa Rosa, CA 95401

Pacific Powder Coating

Phone: (707) 826-1630
Fax: (707) 826-2135
Contact: Ken or Patti
Address: 148 South G St. Arcata, CA

PPI

Interpretive Project Manager
Phone: (503) 760-2400 or (800) 886-0901
Fax: (503) 762-3780
Website/email: www.ppinc.com (Click on Museum link)
Address: 11601 SE Foster Rd. Portland, OR 97266

Wright Way Fabricators

Phone: (707) 822-3789
Fax: (707) 822-7694
Contact: Mark and Pat
Address: 1250 Giuntoli Lane, Arcata CA 95521

II. Color Plates

This section provides a preview of all the templates developed to date, in addition to sample draft and final layouts. Templates are shown here with color backgrounds and the Humboldt Bay silhouette. Color copies can be made of the art borders and included in the package sent to sign fabricators for color-matching purposes.

The Templates

There are 17 thematic templates in total: one Welcome Kiosk template (vertical orientation) and sixteen wayside templates (horizontal orientation).

They are found on the **first CD-ROM**: Working with the Templates > Templts > WlcKiosk (for #1 below) or > Wayside (for #'s 2-17 below). PDFs are found on the **second CD-ROM**. In Color Plate order:

1. Welcome Kiosk
2. Agriculture & Geese
3. Beach & Plover
4. Drains to Bay
5. Dunes
6. Eelgrass
7. Fishing
8. Freshwater Marsh
9. Geology
10. Marine
11. Riparian
12. Salt Marsh
13. Ship & Rail
14. Slough
15. Watershed
16. Water Trails
17. Wiyot Village

The Water Trails Template

This **standardized** template was developed to orient and inform boaters of specific water-related use regulations. (The **modified** version, without standardized information, is listed above).

The Water Trails Draft template is found on the **second CD-ROM**: Additions > H20Draft. A PDF is also included in this folder.

The Humboldt Bay Map Template

This template was developed to orient and inform visitors of recreational uses and public access areas around the bay. Agencies may design this panel with site-specific information and/or add an additional area map with use regulations. It can be seen below with sample text and graphic layout.

BLM's South Spit Panels

These kiosk panels were developed for BLM's South Spit. They illustrate several ways of working with the Bay Map Panel, including the development of an additional site-specific map panel. Remaining sides of a three-sided kiosk would use the Welcome Kiosk Template.

These examples are found on the **second CD-ROM**: Additions > TmpltDev > HBayMap > So_Spit . PDFs are also included in this CD folder.

1. Bay Map ("Explore Humboldt Bay")
2. Site Map

Elk River Wildlife Sanctuary (ERWS) Drafts

These ERWS drafts were developed by a graphic design consultant. At time of print, the panels were still being finalized, but the drafts provide the overall text and layout design for the following templates.

These drafts are found on the **second CD-ROM**: Additions > TmpltDev > Drafts >ElkRvr > WayDrfts (wayside panels) or > WlcDraft (welcome panel). PDF's are also included here.

1. Welcome Kiosk Template ("Discover the Sanctuary Within City Limits"). Files will need to be re-linked on the CD.
2. Salt Marsh Template ("What it Takes to Survive in a Salt Marsh"). Files will need to be re-linked on the CD.
3. Ship & Rail Template ("Rails Led Timber to the Bay"). Files will need to be re-linked on the CD. Ignore prompt to find Locomotive.psd.

12. What's Next ?

Beautiful, informative signs go in the ground!!

Practically speaking, however, this Manual is a snapshot in the evolution of the Signing Program. There are both short-term and long-term needs to be addressed. In the short-term, we anticipate that **updates and/or corrections to maps and other program information will be necessary** as sign plans get underway. Consideration of **long-term support and guidance** for the program is also encouraged, particularly if updates are necessary and additions are made to sign templates or other program elements. In addition, there are a number of other possibilities to be explored as this concept turns into practice (see below).

Additional Interpretive Possibilities

There are a number of related opportunities beyond the scope of this program which should be mentioned since the ideas were generated during this effort. The following are ideas that could be pursued:

Of course **additional wayside border templates** could be developed for interpretive realms not represented herein. The Agriculture & Geese Template is an example of this process: the Farm Bureau recognized that a specific border would be necessary for their purposes, and created one while the program was still under development. NRS added this template to the Signing Program.

An extension of the border artwork could be developed to encompass an **entire panel** for each. For example, the Riparian Template border artwork could be expanded to show much more detail (in a 36" x 24" format) about the in-stream habitat and riparian environment, with elements of the artwork numbered and defined in a legend on the panel. Examples of this type of artwork can be seen in the Monterey Bay and Elkhorn Slough and Padilla Bay interpretive programs.

Use of the panel border (or full panel) artwork could be expanded to **other media**, including postcards, t-shirts, book-

The Eureka Boardwalk uses rail-mounted panels to convey information about Signal Flags used on boats.

This sign is an example of a site-identification sign that visibly welcomes visitors to a public-access area.

marks, calendars, brochures, posters and other items that even more widely promote awareness of bay ecology and history.

Single-issue, **small rail-mounted signs** could be developed to adorn the Eureka Boardwalk. At the time of Manual production, one such small panel is mounted to the wooden railing at the foot of F Street. Other signs of similar size and material could be developed for the boardwalk regarding common waterfront bird (and fish or mammal) species, fishing and recreational vessel styles, and waterfront history.

Site identification signs are needed around the bay. This is VERY IMPORTANT! During work on the *Humboldt Bay Trails Feasibility Study,* the public very clearly said that they do not know where many bay access sites are located. The Welcome Kiosk serves to orient and inform the visitor once they are there, but a roadside identification sign would further indicate a public access area. Development of a standard roadside site name sign was not attempted here, since most agencies will not want the same style, and some have federal or state format requirements for such signs. For instance, a sign reading 'Arcata Marsh & Wildlife Sanctuary' should not necessarily look identical to a sign reading 'Elk River Wildlife Sanctuary'. These signs should be relatively large, sturdy, aesthetic, site-appropriate and welcoming.

The sign templates and other information in this signing program could be used in other coastal access and coastal watershed regions **beyond Humboldt Bay**. For example, the BLM is using the 'watershed' panel template for a sign system along the Elk River in the Headwaters Forest Reserve at the top of the Humboldt Bay watershed. Humboldt County may use the 'Beach and Plover' template at the other County beaches, and this sign format could be used along the California Coastal Trail in this region.

Because government funding can generally be somewhat limited for interpretive displays, it is recommended that **local sponsorships** are pursued. For instance, the Fisherman's Marketing Association may want to sponsor panels about the commercial fisheries and fishing vessel styles. Arcata businesses may want to sponsor panels about the function of the Arcata Marsh wastewater system and marsh habitats. Business logos could be added to the lower right corner of sign panels and identified as sign sponsor/s.

Management of the Signing Program

Because this program was developed by a non-profit organization with no authority or management responsibility, there is **no inherent mechanism** for encouraging or supporting use of this program. The Humboldt Bay Harbor, Recreation and Conservation District is currently preparing a Management Plan, in which reference to this program and its suggested use by bay region managers could be included.

Where the Signing Program will "live", and how it will be managed, are questions for perhaps the **Interagency Committee** to address. How the agencies would like to manage updates, modifications, and need for technical support should be addressed. For instance, the project website could be a universally accessible location for announcement of updates and availability of new files. The Harbor District is the most likely organization to encourage and facilitate use of the program, however they may not be interested and/or technically suited for this task. It is likely that a small amount of annual funding will be necessary to ensure that updates, additional templates, and technical support are available to all the program cooperators.

Thanks from the Project Team

The project team would like to thank the agencies and organizations involved who lent their support and enthusiasm for this project. We look forward to seeing you utilize this tool!

- State Coastal Conservancy: Moira McEnespy (Project Manager)
- NRS: Jennifer Rice (Projects Coordinator) and Denise Newman (Planning Specialist)
- Jennifer Graves (Graphic Designer for template drafts)
- Gary Bloomfield (Template artist)

References

Ham, Sam H. 1992. *Environmental Interpretation: A Practical Guide for People With Big Ideas and Small Budgets.* Fulcrum Publishing, Golden, Colorado.

Natural Resources Services (NRS).2001. *Humboldt Bay Trails Feasibility Study.* Redwood Community Action Agency, Eureka, California.

Tilden, Freeman. 1967. *Interpreting Out Heritage.* Chapel Hill, University of North Carolina Press, North Carolina.

Veverka, John A. 1998. *Interpretive Master Planning.* Acorn Naturalist, Tustin, California.

PRELIMINARY REVISION TO MARINE AND ESTUARINE HABITATS OF THE CALIFORNIA WILDLIFE HABITAT RELATIONSHIP SYSTEM

KEVIN SHAFFER
California Department of Fish and Game
1807 13th Street, Suite 104
Sacramento, California 95814
(916) 327-0713
kshaffer@dfg.ca.gov

July, 2002

The California Wildlife Habitat Relationship (CWHR) System is a comprehensive information system for California's wildlife. CWHR currently maintains life history and range maps for 675 terrestrial amphibian, reptile, bird and mammal species and the ability to model habitat use. A critical component of CWHR is the habitat classification used for animal use and association. At present, only 4 of the 59 habitats described in CWHR are aquatic. Due to the heightened concern and interest in marine and estuarine species, their habitat associations, and the state of these habitats in California, a more detailed and useful classification of California's marine and estuarine habitats is needed by scientists, resource managers, and the general public for understanding and making decisions about marine wildlife and their environment. A revision of CWHR's single marine and single estuarine habitats has resulted in 22 marine and 19 estuarine habitats and a few additional habitats that will be added to the final revision. The classification is a hierarchy that includes ecological regions, habitats, habitat zones, micro-habitats, and substrata. This classification also includes crosswalks to the 6 other significant, fully or partially, marine classification systems relevant to California waters.

INTRODUCTION

Expanding the California Wildlife Habitat Relationship (CWHR) System

CWHR Version 8.0 currently defines, describes, and models the relationships of 675 species of regularly-occurring terrestrial mammals, birds, reptiles, and amphibians in California to 59 habitats in a standard classification scheme. With reference to aquatic habitats, there currently are four types: marine, estuarine, lacustrine, and riverine. With reference to marine fauna, the existing CWHR includes birds and mammals, although the system does not include models for fully marine taxa such as whales and dolphins.

In 1999, the Department of Fish and Game (DFG) and the California Interagency Wildlife Task Group (CIWTG) undertook a project to expand the marine and estuarine habitats into a more useful and realistic scheme for California. The goals of the expansion project were:

1. Better predict the presence, range and distribution, and use of marine and estuarine wildlife in California;
2. Better predict the changes in habitat use as habitats are altered or impacted (i.e., oil or other chemical contamination, El Nino, dredging);
3. Identify representative and unique marine and estuarine habitat for the purposes of improving conservation and protection;
4. Identify and map the range and distribution of priority species (e.g., sensitive, fisheries, recreational, ecologically significant) for the purposes of improving conservation and management;
5. Develop a wildlife habitat classification that would be appropriate for estuarine and marine fishes and invertebrates as well as birds and mammals.

The primary goal of the expansion is to better delineate and describe those regions that represent functional habitat to estuarine and marine wildlife.

The Draft Expansion of Marine and Estuarine Habitats under CWHR

The ensuing habitat classification and description represents the preliminary, marine-estuarine expansion of CWHR. Existing and developing classifications, scientific literature and data, and professional expertise and opinion were used to develop the expansion. Three review teams were established, and each sequential critiqued the draft classification as it was developed. The development and review took two years and six revisions, and over 70 scientists and marine resource managers, from universities, state and federal agencies, and fisheries and marine conversation organizations took part in the review.

Integrating CWHR with Other Classification and Modeling Systems

The expansion of CWHR was accomplished in such a way to ensure the expansion would be comparable or complimentary with several other schemes. Those schemes and their reference to CWHR are listed below:

1. Wetlands of the Central and Southern California Coast and Coastal Watersheds: A methodology for their classification and description. W.R. Ferren Jr., P.L. Fiedler, and R.A. Leidy, 1996.

This publication was produced in 1996 for the United States Environmental Protection Agency and is a hydro-geomorphological classification for lacustrine, riverine, estuarine, and marine habitats, and geomorphic and hydromorphic phenomena in central and southern California.

Though it contains much detail regarding hydrology and geomorphology that may not pertain to functional habitat for wildlife, CWHR is integrating classification criteria, hierarchy, and terminology from this classification. Also, it should be noted that this classification is more appropriate than the CWHR system for objectives beyond wildlife relationships.

2. Bayland Ecosystem Habitat Goals: a report of habitat recommendations, 1999.

This report was prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. It identifies habitats and species present in the greater San Francisco Bay-Delta area.
Two of the report's primary focuses, habitat delineation and wildlife use, are identical to the goals of CWHR.

3. A classification scheme for deep sea floor habitats, 1999.

This scheme evaluates benthic habitat in deeper marine waters. It is arranged in 4 primary tiers: mega-, meso-, macro-, and micro-habitats. The classification incorporates geomorphology, substratum type and aspect, and chemical and biological modifying characteristics. It is the goal of CWHR to integrate its benthic habitats as much as possible with this classification. The outstanding issue is whether and how to incorporate moderate to large-scale geomorphological features into CWHR's marine benthic habitats.

4. The national scheme for marine and estuarine ecosystems and habitat classification, 2000.

The national scheme was published in July 2000 by the National Oceanographic and Atmospheric Administration. It is meant to be applicable to all the marine and estuarine waters of the United States and is a hierarchal system, incorporating thirteen "levels" ranging from life zone (i.e., temperate, tropical) to a region's local modifiers and eco-units.

Goals of this classification are: (1) provide a consistent system; (2) focus on distinguishing natural communities and their physical environment, (3) identify and map eco-types, and (4) accommodate limited data and available technology.

The expansion of CWHR was done is such a way to nest into the national scheme.

5. Habitat classification for habitats of the Channel Islands, drafted summer 2000.

The Channel Island National Marine Sanctuary (CINMS) developed a habitat classification for significant and unique habitats of and off the Channel Islands. One of the primary reasons for this effort was to aid in identifying and prioritizing areas for protection as reserves. The State of California and Department of Fish and Game, under the Marine Managed Areas Act and Marine Life Protection Act, have the identical goal and responsibility of identifying and protecting marine habitats and their respective species.

6. Wildlife-Habitat Relationships in Oregon and Washington, 2001.

Thirty-three organizations worked for almost five years on this project. A book and CD-Rom version were published in 2001. Because this system is similar in content and purpose of CWHR, the three states may work to integrate the classifications, terminology, and hierarchies.

The publication includes information on 593 wildlife species and their relationships with the 32 terrestrial, freshwater, and marine habitats of Oregon and Washington. It includes photographs of each habitat, as well as hundreds of maps, diagrams, and other illustrations. The accompanying CD-ROM contains additional wildlife data and color maps, and seven matrixes that link wildlife species with their respective habitats.

Scale or Resolution

An important component for interpreting natural landscapes that has not been addressed for the marine and estuarine environments is a relatively complete range of scale (= resolution). Such systems do exist for other landscapes (e.g., terrestrial vegetation), and in California, one may use a system[1] that allows one to choose the scale that is of most interest or significance.

Different resolutions are important for different types of organisms and life-forms (see above), and scale is different and crucial for different efforts related to marine conservation, fisheries management, and scientific endeavors. Therefore, it is necessary to have a series of resolutions for marine and estuarine eco-regional and habitat delineation.

For marine classification, the national system is tackling the issue of a complete range of scale for all marine and estuarine ecosystems. Ferren et al. (1996) has done so for nearshore environments for central and southern California, while Greene et al. (1999) has done so for offshore benthic habitats. In addition, there is an effort, only now in its infant stages, to address appropriate scales for the marine

[1] One can use the Ecological Subregions of California: Section and Subsection Descriptions (1997) for broader resolution and A Manual of California Vegetation (1995) for finer resolution of plant communities.

and estuarine environments of California, Oregon, and Washington (personal communication, David Fox). The proposed habitat revision for CWHR does not include some of the resolutions other classifications.

Marine Ecological Regions

Oregonian (Oregon border to Point Arena)
Northern Californian (Point Arena to Año Nuevo)
Central Californian (Año Nuevo to Point Conception, including San Miguel and Santa Rosa islands)
Southern-Baja Californian (Point Conception to Mexican border, including all other Channel Islands)

Habitat: A physical area characterized by a unique assemblage of species that constitute the biotic community that utilizes and/or inhabits area and which provides some subset of essential or preferred ecological and biological needs (i.e., reproduction, feeding/foraging, cover/shelter) for each of those species.

Habitat Zone A vertical or horizontal subarea of a habitat representing a measurable change in physical or biological condition that results in the changes in species use or occurrence within that habitat.

Microhabitat A unique or unusual biological or geological object or array within a habitat that is essential for either a species to be present or a particular ecological function of a species.

Substratum A physical substance, defined by size-class and/or base material that comprises or contributes to the surface of a habitat.

KEY TO HABITATS

Water Body and Salinity

A. Body of sea water bounded landward by shoreline; no measurable influence of freshwater influx (=**Marine**)

B. Restricted body of a mixture of seawater and freshwater bounded (1) landward by shoreline and a daily or seasonal freshwater influx and (2) seaward by a salinity front from the marine environment (=**Estuarine**)

A. MARINE HABITATS:

1. Seaward of continental shelf-slope transition (=**Offshore**)
2. Landward of continental shelf-slope transition (=**Nearshore**)

1. Offshore

    a. Habitat components are entirely aquatic; without a relationship to a benthic (substrate) environment (=**Pelagic**)

    b. Habitat components are both aquatic and solid (substrate). This includes habitation (1) on the top of or associated with the benthic substrata (epibenthic) and (2) in or beneath the substrata (inbenthic) (=**Benthic**)

2. Nearshore

    a. Ocean wave action has a varying effect, ranging from subtle to substantial, on shoreline form and composition; the arrangement of shoreline does not result in a semi-protected body of water with a more limited access to the ocean (=**Coast**)

    b. Ocean wave action is not an essential component of the shoreline-water interface; the formation of the shoreline does result in a semi-protected water body with relatively restricted access to the open ocean (=**Embayment**)

    Coast

    i. Coastline relatively protected from direct wave-action; may be concave in shape or otherwise protected (i.e., buffered by headland, island, underwater reef) from the direct impact/effect of wave-action (**=Protected**)

ii. Coastline exposed to direct wave-action; usually linear or convex in shape, thus, affected directly by energy of wave- and wind-energy (=**Exposed**)

i. Protected

Inland of the effects of seawater and spray; no inundation by water (=Shores and beaches)
Seaward of the effects of seawater and spray; variable cycle of exposure-water inundation (=Inter- and subtidal)

a. Shorelines and beaches — Narrow strip of terrestrial environment between the intertidal and fully terrestrial habitats and is affected substantially by the marine or estuarine environment. Primary substrate components are sand, pebble, cobble, rock, and/or boulders.

b. Intertidal — Nearshore region where there are periods of water inundation and exposure to the air environment. The dynamic of water cover/exposure ranges from predominant exposure and rare inundation (e.g., supratidal) to rare exposure and predominant inundation (e.g., lower intertidal); upward displacement of the zonal characteristics occurs as a gradient with progression from protected to exposed coast.

c. Subtidal — Nearshore region below the intertidal, where water inundation is continuous, to the continental shelf-slope interface. Water depth reaches approximately 150-200 meters.

1. Habitat is totally aquatic (=Neritic)
Open waters of the marine, nearshore environment. It includes the surface zone and water column extending to the benthic environment.

2. Habitat components are both aquatic and solid (see above OFFSHORE)

d. Kelp forest Nearshore region physically and ecologically defined and influenced by canopy-forest forming species of kelp (e.g., *Macrocystis integrifolia, M. pyrifera, Nereocystis luetkeana*)

e. Surf-grass bed

Nearshore, subtidal habitat physically and ecologically defined and characterized by the presence of *Phyllospadix* spp.

f. Eel-grass meadow

Nearshore, subtidal habitat physically and ecologically defined and characterized by the presence of *Zostera pacifica*.

ii. Exposed (see above PROTECTED COAST)

a. Shoreline and Beach

b Intertidal

c. Subtidal

1. Neritic
2. Benthic

d. Kelp Forest

e. Surf-grass Bed

iii. Embayment[2]

Nearshore, restricted body of marine water with restricted, yet continual, access seaward and where the energy of wave-action is lessened because of the restricted access. Embayment habitats are bordered landward by shoreline and/or estuarine habitats

a. Shoreline and Beach (see above)

b. Intertidal (see above)

c. Marine Shallow Waters

Inland marine water environment where water depths do not exceed 5.5-6 meters (18-20 feet).

- Neritic (see above)
- Benthic (see above)

Marine Deeper water bay

Inland marine water environment where water depth exceeds 5.5-6 meters.

- Neritic
- Benthic

B. ESTUARINE HABITATS:

1 Water body has constant exchange and interaction with ocean water or marine embayment. Separation from seawater may occur but is infrequent and unusual and never persists, breaching occurring within days or weeks from enclosure (= **Estuary, Tidal Flat, Tidal Marsh, and Eel-grass Meadow**)

2 Water body is often separated from ocean water exchange, and enclosure is a defining characteristic; breaching is infrequent and unusual and may not occur annually or for several years (= **Coastal Lagoon**)

[2] Some examples of embayments are Tomales, San Diego, Morro, San Francisco, and Humboldt.

For both Estuary and Tidal Marsh habitat designations:

Bay:

Enclosed estuarine waters associated with and inland from shallow marine embayment waters.

River mouth:

Coastal point of discharge of a river, stream, or creek; discharge may be into a marsh, estuary, bay, or directly into the ocean.

Canyon mouth:

The coastal opening of an incised chasm with steep cliff walls; runoff discharge may be into a marsh, estuary, bay, or directly into the ocean.

Coastal dune:

Coastal, terrestrial habitats characterized by exposed shoreline systems of one of more sand ridges derived from wind- and wave- transported material.

1 a. Habitat conditions not characterized by vascular plants; vascular plants absent (**Estuary** and **Tidal Flat**)

b. Habitat conditions dependent and characterized by vascular plants (**Tidal Marsh** and **Eel-grass Meadow**)

a. - Habitat characterized by inundation of water, except for rare exposure at the lowest tidal levels annually (= Estuary)

- Habitat characterized by daily cycle of water inundation and air exposure (= Tidal Flat)

i. Estuary

A semi-enclosed body of water that has a free connection with the open sea and within which seawater is diluted measurably with freshwater that is derived from land drainage(s); habitat occurring at freshwater-sea water interface, especially an arm of the sea at the lower end of a river, coastal canyon, coastal dune system, or bay.

ii. Tidal flat

Saltwater wetlands that are characterized low profile below water elevations that will support emergent plant communities, substratum usually of mud, sand, and/or detritus, and daily tidal cycling of inundation and exposure.

b - Frequently or continually inundated tidally influenced wetland characterized by emergent vegetation (grasses, cattails, and other monocotyledons) adapted to saturated soil conditions; salinities range from mixo- to euryhaline (= Tidal Marsh)

- Frequently or continually inundated, tidally influenced habitat defined by the presence of beds or meadows of eel-grass (*Zostera* spp.)(= Eel-grass Meadow)

Tidal Marsh habitats[3]:

i. Tidal Saltwater Marsh

Tidally influenced marsh that occurs along estuaries with salinities equal or approximate to sea water; a coastal habitat consisting of salt-resistant plants residing in an organic-rich sediment accreting toward sea level.

ii. Tidal Brackish Water Marsh

Tidally influenced marsh with mixohaline salinities; may be transitional between freshwater marshes or frequent freshwater source and saltwater marshes and tidal flats. Emergent vegetation not adapted to higher salinities found in saltwater marshes.

Eel-grass Meadow

Shallow water, bay-estuary habitat and community defined and ecologically influenced by the presence of many to thousands of *Zostera marina* (bay/estuary eel-grass).

2	Coastal Lagoon	Shallow lake or pond connected with the ocean; an area of shallow water of various and often fluctuating salinities separated from the sea by a strip of terrestrial substratum such as sand dunes, gravel or cobble beaches, or mud berm. This water body is infrequently breached and is temporarily contiguous with marine, coastal water.

3 Freshwater tidal marsh will be added to the habitat classification.

DESCRIPTION OF HABITATS

Habitat 1 Marine Offshore Pelagic

Marine open-water habitat starting at continental shelf-slope interface; depth is usually 150 meters or greater. Zonation and microhabitat defined by ocean current, water temperature, nutrient concentration and availability, light-penetration, and water-column depth. Species and biotic communities are neither associated with nearshore waters nor the benthic environment.

Marine-Offshore-Pelagic Habitat; Surface Layer zone.
Marine-Offshore-Pelagic Habitat; Epipelagic zone.
Marine-Offshore-Pelagic Habitat; Mesopelagic Photic zone.
Marine-Offshore-Pelagic Habitat; Mesopelagic Aphotic zone.
Marine-Offshore-Pelagic Habitat; Bathypelagic zone.
Marine-Offshore-Pelagic Habitat; Abyssopelagic zone.

Surface layer	Layer of the ocean or estuary extending from the surface to a depth above which is homogeneous due to wind mixing;
Epipelagic	Of or relating to the ocean depth below the surface layer to 200 meters (m).
Mesopelagic	Of or relating to the ocean depths from 200-2,000 m.
Bathypelagic	Of or relating to the ocean depths between 2,000-4,000 m.
Abyssopelagic	Of or relating to the ocean depths between 4,000-6,000 m.
Photic zone	Surface layer to the compensation zone; where photosynthesis equals or exceeds respiration (≈800 m); the compensation zone occurs within the mesopelagic.
Aphotic zone	Below the compensation depth, where operative photosynthesis is absent

Significant Microhabitat considerations:

Surface currents/eddies.	Upwelling	Salinity
Water density	Water temperature	Turbidity
Plankton communities/blooms	Haloclines	Thermoclines

Habitat 2 Marine Offshore Benthic

Marine near-bottom or bottom habitat initiating at continental shelf-slope interface; water depth is 150 meters or greater. Zonation and microhabitat defined by water temperature, depth, and density, nutrient concentration and availability, substrate composition, and presence and type of geomorphic features. Photo-penetration is a factor to approximately 100 meters and is partially a function of turbidity. Species and biotic communities are associated with or dependent on the epibenthic and benthic conditions.

Marine-Offshore-Benthic Habitat; Archi-Epibenthic zone.
Marine-Offshore-Benthic Habitat; Archi-Inbenthic zone.

Marine-Offshore-Benthic Habitat; Abysso-Epibenthic zone.
Marine-Offshore-Benthic Habitat; Abysso-Inbenthic zone.

Archi-benthic	Related to the continental slope.
Abyssobenthic	Related to the rise and abyssal plan.
Benthic	The bottom (substrate and substance composition) of a water body.
Continental shelf	A shallow, submarine plain of varying width forming a border to a continent and typically ending in a steep slope (=continental) to the oceanic rise (=abyssal plain).
Continental slope	Steep-sloping bottom extending seaward from the edge of the continental shelf and downward toward the rise.
Epibenthic	Living attached or on the surface of the bottom.
Inbenthic	Buried just beneath or burrowed into the benthic surface.
Rise	Bottom of low relief at the base of the continental slope.

Significant microhabitat considerations:

Benthic rock-outcrops	Trenches	Caves
Ridges	Canyons	Sea mounts

Habitat 3 Marine Nearshore Exposed Coast Shoreline and Beach[4]

Terrestrial habitat adjacent to the supratidal zone of the intertidal habitat of the exposed coastline. Marine environment still has important ecological effect on this habitat. Wind energy has an important role in the composition and arrangement of this habitat. Wave and tidal action may affect indirectly the structure and composition of substrata, if only seasonally. This habitat is frequently or infrequently utilized by terrestrial vertebrates.

Significant microhabitat considerations:

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4 Beach, Shorelines, Banks: Necessary to link terrestrial with aquatic habitats; most significant for mammals and birds coming down to the water and for shore and wading birds.

cliffs and bluffs	sand dunes	vegetation types
boulders	ponds	

Habitat 4 Marine Nearshore Exposed Coast Intertidal[5]:

This coastline habitat is characterized by three primary factors: 1) exposure to full or moderate effects of wave and wind energy, 2) exposure to air, and 3) a proximate relationship to the shore. This region ranges from the shore to water depths of approximately 7 to 10 meters. Coastal marine waters between mean highest-high and mean lowest-low tide elevations and along coastline that is exposed to surf and wind. Such exposure may be due to the convex or straight-line shape of the coastline and lack of shielding by headlands, nearshore islands, or underwater reefs and bars. The time of exposure to drying factors such as wind, air, and sun varies greatly, ranging from perpetual except for the input of ocean spray only (supratidal) to exposed only on lowest low tides (lower). Species occupying the higher reaches of this habitat are capable of long-term and consistent exposure to air, while species nearing subtidal levels are capable of only minimal and infrequent exposure. The zonation scheme here is adopted from *Between Pacific Tides*. The numbers in parentheses represent this scheme.

Marine-Nearshore-Exposed Coast Intertidal; Supratidal zone (I).
Marine-Nearshore-Exposed Coast Intertidal; Upper Intertidal zone (II).
Marine-Nearshore-Exposed Coast Intertidal; Middle Intertidal zone (III).
Marine-Nearshore-Exposed Coast Intertidal; Lower Intertidal zone (IV).

Significant Microhabitat consideration:

tide pools	surf-grasses	coralline algae community
Laminarian algae community	caves	haul-out sites
rookeries	'other' algae community (to be determined)	

Habitat 5 Marine Nearshore Exposed Coast Subtidal Neritic

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5 No decision has been made regarding human-made structures, such as buoys (at sea or in bays), piers/docks (nearshore, bay, estuary), platforms (nearshore and offshore) with regard to habitat vs. microhabitat, etc.

Open water habitat of nearshore, exposed coast environment constantly inundated, zero exposure to air. Begins at the lowest lower-low tidal elevations. These waters lie over the continental shelf. Laminarian algae and *Phyllospadix* spp. are good indicators of the transition from intertidal to subtidal habitats.

Marine-Nearshore-Exposed Coast Subtidal Neritic; Surface Layer zone.
Marine-Nearshore-Exposed Coast Subtidal Neritic; water column zone.

Significant Microhabitat considerations:

surf action	reefs	eddies
haloclines	thermoclines	rock outcrops
rookeries	haul-out sites	

Habitat 6 Marine Nearshore Exposed Coast Subtidal Benthic

Substrate or substrate-associated habitat of the nearshore, exposed coast extending out on the continental shelf up to the shelf-slope transition.

Marine-Nearshore-Exposed Coast Subtidal Benthic; Epibenthic zone.
Marine-Nearshore-Exposed Coast Subtidal Benthic; Inbenthic zone.

Significant microhabitat considerations:

reefs	caves	algal community X
rock outcrops	tidal elevation	Laminarian algae community
surf-grasses		coralline algae community

Habitat 7 Marine Nearshore Exposed Coast Kelp Forest

Unique biotic habitat of the subtidal exposed coast physically and ecologically defined by the presence of a kelp community (i.e., *Nereocystis*, *Macrocystis*).

Macrocystis integrifolia	Oregon border to central coast; infrequent in tidal channels, gently sloping, rocky ledges of lower intertidal to upper subtidal; perennial.
M. pyrifera	Entire coast; dominant forest kelp, attached to rocky or even course sandy substrata 6-80 meters deeps.
Nereocystis luetkeana	Common Monterey Peninsula north; attached to rock substratum 1-17 meters; annual to 18 month life-span.

Marine Nearshore Exposed Coast Kelp Forest; *Macrocystis pyrifera* community.

Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.

Marine Nearshore Exposed Coast Kelp Forest; *Nereocystis luetkeana* community.

Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.

Marine Nearshore Exposed Coast Kelp Forest; *Macrocystis integrifolia* community.

Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.

Canopy	Upper reaches of forest where kelp species defining community is predominant or exclusively present.
Holdfast	Benthic environment of substrate (i.e., sand, rock) and holdfasts of kelp species.
Interior	Completely enclosed region of forest where forest algae are all-surrounding.
Periphery	Perimeter region of forest interfacing the open water with the forest.
Subcanopy	Middle to lower reaches of forest where intermix of algae predominates.

Significant microhabitat considerations:

Habitat 8 Marine Nearshore Exposed Coast Surf-grass Bed

Unique biotic habitat of the subtidal surf zones and rocky, exposed coast (just below low tide level) physically and ecologically defined by the presence of a surf-grass (*Phyllospadix* spp.) community.

Phyllospadix scouleri Surf zone and rocky shores below low-tide elevations; occurs along entire coast of California.

Phyllospadix torreyi Surf zone and rocky shores below low-tide elevations; occurs along entire coast of California.

Marine Nearshore Exposed Coast Surf-grass Bed; *Phyllospadix scouleri* community.
Marine-Exposed Coast Surf-grass Bed; bed surface zone.
Marine-Exposed Coast Surf-grass Bed; bed zone.
Marine-Exposed Coast Surf-grass Bed; periphery zone.
Marine-Exposed Coast Surf-grass Bed; root mass zone.
Marine Nearshore Exposed Coast Surf-grass Bed; *Phyllospadix torreyi* community.
Marine-Exposed Coast Surf-grass Bed; bed surface zone.
Marine-Exposed Coast Surf-grass Bed; bed zone.
Marine-Exposed Coast Surf-grass Bed; periphery zone.
Marine-Exposed Coast Surf-grass Bed; root mass zone.

Significant microhabitat considerations:
burrows

Habitat 9 Marine-Nearshore-Protected Coast Shoreline and Beach[6]

Terrestrial habitat adjacent to the supratidal zone of the intertidal habitat of the protected coastline. Marine environment still has important ecological effect on this habitat. Wind has a lesser role here than on exposed coastal areas. Wave and tidal action may affect indirectly the structure and composition of substrata, if only seasonally. This habitat is frequently or infrequently utilized by terrestrial vertebrates.

Significant microhabitat considerations:
cliffs and bluffs sand dunes vegetation types
boulders ponds

Habitat 10 Marine-Nearshore-Protected Coast Intertidal

This coastline habitat is characterized by three primary factors: 1) exposure to air, 2) some level of protection from the energy of wave-action, and 3) a proximate relationship to the shore. This region ranges from the shore to water depths of approximately 7 to 10 meters. Coastal marine waters between mean highest-high and mean lowest-low tide elevations and along coastline that is protected to semi-protected by the energy of direct wave-action. Such insulation may be due to the concave shape of the coastline or shielding by headlands, nearshore islands, or underwater reefs and bars. The time of exposure to drying factors such as wind, air, and sun varies greatly, ranging from perpetual except for the input of ocean spray only (supratidal) to

[6] Beach, Shorelines, Banks: Necessary to link terrestrial with aquatic habitats; most significant for mammals and birds coming down to the water and for shore and wading birds.

exposed only on lowest low tides (lower). Species occupying the higher reaches of this habitat are capable of long-term and consistent exposure to air, while species nearing subtidal levels are capable of only minimal and infrequent exposure. The zonation scheme here is adopted from *Between Pacific Tides*. The numbers in parentheses represent this scheme.

Marine-Nearshore-Protected Coast Intertidal; Supratidal zone (I).
Marine-Nearshore-Protected Coast Intertidal; Upper Intertidal zone (II).
Marine-Nearshore-Protected Coast Intertidal; Middle Intertidal zone (III).
Marine-Nearshore-Protected Coast Intertidal; Lower Intertidal zone (IV).

Significant Microhabitat consideration:

tide pool	surf- and eel-grasses	coralline algae community
Laminarian algae community caves		haul-out sites
rookeries	'other' algae community (to be determined)	

Habitat 11 Marine-Nearshore-Protected Coast Subtidal Neritic

Protected subtidal habitat is primarily characterized by 1) total relationship to marine water, that is, no exposure to air and 2) protection from the energy of wave-action. This habitat starts at the edge of the intertidal zone and stretches from the shore to water depths of approximately 150-200 meters, up to the continental shelf-slope transition. The habitat spans vertically from the surface layer to the benthic environment. This habitat may be protected by a convex shaped shoreline or by headlands, nearshore islands, or underwater reefs and bars. Species or biotic communities are adapted to constant coverage by seawater and occur in the waters that are the predominant zone of marine photosynthesis and productivity.

Marine-Nearshore-Protected Coast Subtidal Neritic; surface layer zone.
Marine-Nearshore-Protected Coast Subtidal Neritic; water column zone.

Significant microhabitat considerations:

surf action	reefs	eddies
haloclines	thermoclines	rock outcrops
rookeries	haul-out sites	

Habitat 12 Marine Nearshore Protected Coast Subtidal Benthic

Substrate or substrate-associated habitat of the nearshore, protected coast along the continental shelf. The more protected and calmer water conditions result in, substrata that is finer or more transportable settling out in various locations, resulting in the presence of species and communities requiring one of more of these conditions. (see above, EXPOSED COAST)

Marine-Nearshore-Protected Coast Subtidal Benthic; Epibenthic zone.
Marine-Nearshore-Protected Coast Subtidal Benthic; Inbenthic zone.

Significant microhabitat considerations:

reefs	caves	Laminarian algae community
rock outcrops	tidal elevation	coralline algae community
surf- and eel-grasses	bars/benches	‘other’ algae community

Habitat 13 Marine Nearshore Protected Coast Kelp Forest

Unique biotic habitat of the subtidal protected coast defined by the presence of a kelp community (i.e., *Nereocystis*, *Macrocystis*) (see KELP FOREST HABITAT above)

Marine Nearshore Protected Coast Kelp Forest-*Macrocystis integrifolia* community
Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.
Marine Nearshore Protected Coast Kelp Forest-*Macrocystis pyrifera* community
Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.
Marine Nearshore Protected Coast Kelp Forest-*Nereocystis leutkeana* community
Marine-Kelp Forest; forest surface zone.
Marine- Kelp Forest; forest canopy zone.
Marine-Kelp Forest; subcanopy zone.
Marine- Kelp Forest; forest periphery zone.
Marine- Kelp Forest; forest interior zone.
Marine-Kelp Forest; holdfast zone.

Significant microhabitat considerations:

Habitat 14 Marine Nearshore Protected Coast Surf-grass Bed

Unique biotic habitat of the subtidal protected coast defined by the presence of a surfgrass (*Phyllospadix* spp.) community. (see SURF-GRASS BED HABITAT above)

Marine Nearshore Protected Coast Surf-grass Bed; *Phyllospadix scouleri* community.
Marine-Protected Coast Surf-grass Bed; bed surface zone.
Marine-Protected Coast Surf-grass Bed; bed zone.
Marine-Protected Coast Surf-grass Bed; periphery zone.
Marine-Protected Coast Surf-grass Bed; root mass zone.
Marine Nearshore Protected Coast Surf-grass Bed; *Phyllospadix torreyi* community.
Marine-Protected Coast Surf-grass Bed; bed surface zone.
Marine-Protected Coast Surf-grass Bed; bed zone.
Marine-Protected Coast Surf-grass Bed; periphery zone.
Marine-Protected Coast Surf-grass Bed; root mass zone.

Significant microhabitat considerations:
burrows

Habitat 15 Protected Coast Eel-grass Meadow

Subtidal water (5-17 meters below mean low tide), marine community physically and ecologically defined by the presence of a *Zostera pacifica* (subtidal eel-grass) community. Range spans the entire coast of California.

Marine Nearshore Protected Coast Eel-grass Meadow; *Zostera pacifica* community.
Marine-Protected Coast Eel-grass Meadow; bed surface zone.
Marine-Protected Coast Eel-grass Meadow; bed zone.
Marine-Protected Coast Eel-grass Meadow; periphery zone.
Marine-Protected Coast Eel-grass Meadow; root mass zone.

Significant microhabitat considerations:
burrows

Habitat 16 Marine Nearshore Embayment Shoreline and Beach

Terrestrial habitat adjacent to the supratidal zone of the intertidal habitat of the bays. The marine bay environment still has important ecological effect on this habitat. Wind has a lesser role here than on exposed coastal areas. Wave and tidal action may affect indirectly the structure and composition of substrata, if only seasonally. This habitat is frequently utilized by terrestrial vertebrates, especially shore and wading birds.

Significant microhabitat considerations:

cliffs and bluffs	sand dunes	vegetation types
boulders	ponds	mud banks

Habitat 17 Marine Nearshore Embayment Intertidal

Marine intertidal habitat along protected bay but not affected by freshwater influx as would be present in an estuary (see INTERTIDAL habitats above).

Marine-Nearshore-Embayment-Intertidal; supratidal zone.
Marine-Nearshore-Embayment-Intertidal; upper intertidal zone.
Marine-Nearshore-Embayment-Intertidal; middle intertidal zone.
Marine-Nearshore-Embayment-Intertidal; lower intertidal zone.

Significant Microhabitat consideration:

tide pool	eel-grass	caves
algae community X	haul-out sites	rookeries

Habitat 18 Marine Nearshore Embayment Eel-grass Meadow

Subtidal water, marine bay community physically and ecologically defined by the presence of a *Zostera pacifica* (subtidal eel-grass) community.

Marine Nearshore Embayment Eel-grass Meadow; *Zostera pacifica* community.
Marine-Embayment Eel-grass Meadow; bed surface zone.
Marine-Embayment Eel-grass Meadow; bed zone.
Marine-Embayment Eel-grass Meadow; periphery zone.
Marine-Embayment Eel-grass Meadow; root mass zone.

Significant microhabitat considerations:
burrows

Habitat 19 Marine Nearshore Embayment Shallow Water Neritic

Subtidal open, marine waters within an embayment adjacent to intertidal or estuarine waters and up to 5.5-6 meters (18-20 feet) in depth.

Marine-Nearshore-Embayment-Shallow Water Neritic; Surface Layer zone.
Marine-Nearshore-Embayment-Shallow Water Neritic; water column[5] zone.

Significant Microhabitat considerations:

haloclines	thermoclines	rock outcrop
haul-out sites	rookeries	

Habitat 20 Marine Nearshore Embayment Shallow Water Benthic

Substrate or substrate-associated habitat of the marine, shallow waters of a bay. Bottom is predominantly silt, mud, sand, or mixed.
Marine-Nearshore-Embayment-Shallow Water-Benthic; Epibenthic zone.
Marine-Nearshore-Embayment-Shallow Water-Benthic; Inbenthic zone.

Significant Microhabitat considerations:

boulders/rock outcrops	algae community X	channels
reefs	bars/benches	

Habitat 21 Marine Nearshore Embayment Deeper Water Neritic

Subtidal open waters within an embayment deeper than 5.5-6 meters (18-20 feet).

Marine-Nearshore-Embayment-Deeper Water-Neritic; surface layer zone.
Marine-Nearshore-Embayment-Deeper Water-Neritic; water column zone.

Significant Microhabitat considerations:

haloclines	thermoclines	rock outcrop
haul-out sites	rookeries	

Habitat 22 Marine Nearshore Embayment Deeper Water Benthic

Substrate or substrate-associated habitat of the marine, deeper waters of a bay. Bottom is predominantly silt, mud, sand, or mixed.

Marine-Nearshore-Embayment Deeper Water Benthic; Epibenthic zone.
Marine-Nearshore-Embayment-Deeper Water Benthic; Inbenthic zone.

Significant Microhabitat considerations:

boulders/rock outcrops	algae community X	channels
reefs	bars/benches	

Habitat 23 Estuarine Bay Estuary

Embayment with a mixture of fresh and saltwater where there is not water mass/ component that is fully seawater, such as with shallow or deepwater marine embayments.

Estuarine-Bay Estuary; surface layer zone.
Estuarine-Bay Estuary; water column zone.
Estuarine-Bay Estuary; channel epibenthic zone.
Estuarine-Bay Estuary; channel inbenthic zone.

Channel Component of aquatic environment that contains continuously or periodically flowing water that is confined by banks and a substrate bed; excavation created and maintained by the flow of water.

Significant microhabitat considerations:

rookeries	haul-out sites	sloughs
boulder/rock-out crops	bars/benches	burrows

Habitat 24 Estuarine Bay Tidal Flat

Tidal flats are characterized by low aspect and the cycle of tidal exposure-inundation. Substrate composition is predominantly silt, mud, and sand. The flats are intermixed with channels at lower elevations and marshes at higher elevations.

Significant microhabitat considerations:

eel-grass	oyster beds	channels
sloughs	burrows	

Habitat 25 Estuarine Bay Eel-grass Meadow

Shallow water (0-2 meters below mean low tide), bay-estuary habitat physically and ecologically defined by the presence of a *Zostera marina* (bay/estuary eel-grass) community. Range spans the entire coast of California and the Channel Islands.

Estuarine Bay Eel-grass Meadow; *Zostera marina* community.
Estuarine Bay Eel-grass Meadow; bed surface zone.
Estuarine Bay Eel-grass Meadow; bed zone.
Estuarine Bay Eel-grass Meadow; periphery zone.
Estuarine Bay Eel-grass Meadow; root mass zone.

Significant microhabitat considerations:
burrows

Habitat 26 Estuarine Bay Tidal Saltwater Marsh[7]

Bay estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur that can tolerate higher concentrations of salinity. This habitat is affected both by fresh- and brackish water marshes and more saline regimes from adjacent estuarine and marine waters.

Estuarine-Bay Tidal Saltwater Marsh; upper marsh zone.
Estuarine-Bay Tidal Saltwater Marsh; lower marsh zone.

Significant microhabitat considerations:

Habitat 27 Estuarine Bay Tidal Brackish Water Marsh

Bay estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur that cannot tolerate higher concentrations of salinity. This habitat has a seasonal to continual source(s) of freshwater influx.

Estuarine-Bay Tidal Brackish Marsh; upper marsh zone.
Estuarine-Bay Tidal Brackish Marsh; lower marsh zone.

Significant microhabitat considerations:

Habitat 28 Estuarine River Mouth Estuary

Coastal habitat of river or stream discharge, where fresh and saltwater mixing occurs.

Estuarine-River Mouth Estuary; surface layer zone.
Estuarine-River Mouth Estuary; water column zone.

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[7] I have not yet depicted marshes by vegetation types latitudinally. If/when I do, there is likely to be 2 to 3 habitats from south to north based on the unique plant species. Vertical zonation may also change. I have used 2 vertical zones, where others (i.e., Ferren et al. 1996) have used 3.

Estuarine-River Mouth Estuary; channel epibenthic zone.
Estuarine-River Mouth Estuary; channel inbenthic zone.

Significant microhabitat considerations:

rookeries	haul-out sites	sloughs
boulder/rock-out crops	bars/benches	burrows

Habitat 29 Estuarine River Mouth Tidal Flat

Tidal region of river-mouth estuary characterized by low aspect and a cycle of exposure-inundation due to the tides. Substrate composition is predominantly silt, mud, and sand. The flats are intermixed with channels at lower elevations and marshes at higher elevations.

Significant microhabitat considerations:

eel-grass	oyster beds	burrows
channels	sloughs	

Habitat 30 Estuarine River Mouth Tidal Saltwater Marsh.

River mouth estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur and that tolerate higher concentrations of salinity. This habitat is affected both by fresh- and brackish water marshes and more saline regimes from adjacent estuarine and marine waters.

Estuarine- River Mouth Tidal Saltwater Marsh; upper marsh zone.
Estuarine- River Mouth Tidal Saltwater Marsh; lower marsh zone.

Significant microhabitat considerations:
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Habitat 31 Estuarine River Mouth Tidal Brackish Water Marsh

River mouth estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur that cannot tolerate higher concentrations of salinity. This habitat has a seasonal to continual source(s) of freshwater influx.

Estuarine-River Mouth Tidal Brackish Marsh; upper marsh zone.
Estuarine-River Mouth Tidal Brackish Marsh; lower marsh zone.

Significant microhabitat considerations:

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Habitat 32 Estuarine Canyon Mouth Estuary

Open-water habitat at coastal discharge of a canyon creating a mixture of fresh and saltwater.

Estuarine-Canyon Mouth Estuary; surface layer zone.
Estuarine-Canyon Mouth Estuary; water column zone.
Estuarine-Canyon Mouth Estuary; channel epibenthic zone.
Estuarine-Canyon Mouth Estuary; channel inbenthic zone.

Significant microhabitat considerations:

rookeries	haul-out sites	sloughs
boulder/rock-out crops	bars/benches	burrows

Habitat 33 Estuarine Canyon Mouth Tidal Flat

Tidal region of canyon-mouth characterized by low aspect and a cycle of exposure-inundation due to the tides. Substrate composition is predominantly silt, mud, and sand. The flats are intermixed with channels at lower elevations and marshes at higher elevations.

Significant microhabitat considerations:

burrows eel-grass

Habitat 34 Estuarine Canyon Mouth Tidal Saltwater Marsh

Canyon mouth estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur can occur that can also tolerate higher concentrations of salinity. This habitat is affected both by fresh- and brackish water marshes and more saline regimes from adjacent estuarine and marine waters.

Estuarine-Canyon Mouth Estuary-Tidal Saltwater Marsh; upper marsh zone.
Estuarine- Canyon Mouth Estuary-Tidal Saltwater Marsh; lower marsh zone.

Significant microhabitat considerations:
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Habitat 35 Estuarine Canyon Mouth Tidal Brackish Water Marsh

Canyon-mouth estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur that cannot tolerate higher concentrations of salinity. This habitat has a seasonal to continual source(s) of freshwater influx.

Estuarine-Canyon Mouth-Tidal Brackish Marsh; upper marsh zone.
Estuarine-Canyon Mouth-Tidal Brackish Marsh; lower marsh zone.

Habitat 36 Estuarine Coastal Dune Estuary

Dune system-coastal stream discharge resulting in an open water body/mixture of fresh and saltwater.

Estuarine-Coastal Dune Estuary; surface layer zone.
Estuarine-Coastal Dune Estuary; water column zone.
Estuarine-Coastal Dune Estuary; channel epibenthic zone.
Estuarine-Coastal Dune Estuary; channel inbenthic zone.

Significant microhabitat considerations:

rookeries	haul-out sites	sloughs
boulder/rock-out crops	bars/benches	burrows
saline pond		

Habitat 37 Estuarine Coastal Dune Tidal Flat

Tidal region of canyon-mouth characterized by low aspect and a cycle of exposure-inundation due to the tides. Substrate composition is predominantly silt, mud, or sand. Tidal flats are intermixed with channels at lower elevations and marshes at higher elevations.

Significant microhabitat considerations:

burrows	eel-grass

Habitat 38 Estuarine Coastal Dune Tidal Saltwater Marsh

Coastal dune estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur can occur that can also tolerate higher concentrations of salinity. This habitat is affected both by fresh- and brackish water marshes and more saline regimes from adjacent estuarine and marine waters.

Estuarine-Coastal Dune-Tidal Saltwater Marsh; upper marsh zone.
Estuarine- Coastal Dune-Tidal Saltwater Marsh; lower marsh zone.

Significant microhabitat considerations:
Saline pond

Habitat 39 Estuarine Coastal Dune Tidal Brackish Water Marsh

Coastal dune estuarine habitat at higher tidal elevations where emergent, hydrophilic, vascular plants occur that cannot tolerate higher concentrations of salinity. This habitat has a seasonal to continual source(s) of freshwater influx.
Estuarine-Coastal Dune-Tidal Brackish Marsh; upper marsh zone.
Estuarine-Coastal Dune-Tidal Brackish Marsh; lower marsh zone.

Significant microhabitat considerations:
Brackish-water dune pond

Habitat 40 Estuarine Lagoon Shoreline and Beach

Terrestrial habitat adjacent to and affected by lagoons.

Significant microhabitat considerations:
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Habitat 41 Estuarine Lagoon

Shallow lake or pond connected with ocean water; an area of shallow water of various and often fluctuating salinity separated from the sea by a strip of terrestrial substratum such as sand dunes, gravel/cobble beaches or mud berms; this water body is infrequently breached such that (1) what was lagoon waters are now freely influenced by the tide, (2) beach and berm materials are completely or partially washed out to sea, and (3) there existed an estuary environment of freshwater source(s) interfacing with marine tidal waters until the beach or berm begins to reform. This habitat is frequented by terrestrial vertebrates, and when breached and upon initial re-closure (until, and if, reaching hypersaline conditions), is occupied by marine and estuarine aquatic species.

Estuarine-Lagoon; surface layer zone.
Estuarine-Lagoon; water column zone.
Estuarine-Lagoon; epibenthic zone.
Estuarine-Lagoon; inbenthic zone.

Habitat Zone Substratum

Significant microhabitat considerations:

boulders/rock outcrops emergent vegetation community X

hypersaline regime

APPENDIX I. *Habitat-zone-substratum hierarchy*

Habitat	Zone	Substratum		
Marine				
Offshore				
Pelagic				
	Surface layer			
	Epipelagic			
	Mesopelagic			
	Photic			
	Aphotic			
	Bathypelagic			
	Abyssopelagic			
Benthic..		bedrock	gravel	silt
	Archibenthic	boulder	sand	detritus
	Archi-epibenthic	cobble	mud	sand
	Archi-inbenthic			
	Abyssobenthic			
	Abysso-epibenthic			
	Abysso-inbenthic			
Nearshore				
Exposed Coast				
Shoreline and Beach		sandy	rocky	mixed
Intertidal..	for all:	bedrock	gravel	silt
	Supratidal	boulder	sand	detritus
	Upper intertidal	cobble	mud	

Habitat	Zone		Substratum			
	Middle intertidal					
	Lower intertidal					
	Subtidal					
	-Neritic					
	Surface layer					
	Water column					
	-Benthic..	for both:	bedrock	gravel		silt
	Epibenthic		boulder	sand	detritus	
	Inbenthic		cobble	mud		
	Kelp Forest					
	Surf-grass Bed					
	Eel-grass Meadow					
Protected Coast						
	Shoreline and Beach		sandy	rocky		mixed
	Intertidal..	for all:	bedrock	gravel		silt
	Supratidal		boulder	sand	detritus	
	Upper intertidal	cobble	mud			
	Middle intertidal					
	Lower intertidal					
	Subtidal					
	-Neritic					
	Surface layer					
	Water column					
	-Benthic..	for both:	bedrock	gravel		silt
	Epibenthic		boulder	sand	detritus	

Habitat	Zone	Substratum		
	Inbenthic	cobble	mud	
	Kelp forest			
	Surf-grass Bed			
	Eel-grass Meadow			
Marine				
Embayment				
Shoreline and Beach		sandy	rocky	mixed
Intertidal .... for all:		bedrock	gravel	silt
	Supratidal	boulder	sand	detritus
	Upper intertidal	cobble	mud	
	Middle intertidal			
	Lower intertidal			
Inland Marine Shallow Waters				
	-Neritic			
	Surface layer			
	Water column			
	-**Benthic** .... for both:	bedrock	gravel	silt
	Epibenthic	boulder	sand	detritus
	Inbenthic	cobble	mud	
Inland Marine Deeper Waters				
	-Neritic			
	Surface layer			
	Water column			
	-**Benthic** .... for both:	bedrock	gravel	silt
	Epibenthic	boulder	sand	detritus
	Inbenthic	cobble	mud	

Habitat	Zone		Substratum		
Estuarine					
Bay Estuary					
	Surface layer				
	Water column				
	Channel- .... for both:		cobble	gravel	sand
	Epibenthic		silt	mud	detritus
	Inbenthic				
Bay Tidal Flat			sand	silt	clay
			mud	detritus mixed	
Bay Eel-grass Meadow					
Bay Tidal Saltwater Marsh					
	Upper marsh				
	Lower marsh				
Bay Tidal Brackish Water Marsh					
	Upper marsh				
	Lower marsh				
River Mouth Estuary					
	Surface layer				
	Water column				
	Channel- .... for both:		cobble	gravel	sand
	Epibenthic		silt	mud	detritus
	Inbenthic				
River Mouth Tidal Flat			sand	silt	clay
			mud	detritus mixed	
River Mouth Tidal Saltwater Marsh					
	Upper marsh				

Habitat	Zone	Substratum		
	Lower marsh			
River Mouth Tidal Brackish Water Marsh				
	Upper marsh			
	Lower marsh			
Canyon Mouth Estuary				
	Surface layer			
	Water column			
	Channel- .... for both:	cobble	gravel	sand
	Epibenthic	silt	mud	detritus
	Inbenthic			
Canyon Mouth Tidal Flat		sand	silt	clay
		mud	detritus mixed	
Canyon Mouth Tidal Saltwater Marsh				
	Upper marsh			
	Lower marsh			
Canyon Mouth Tidal Brackish Water Marsh				
	Upper marsh			
	Lower marsh			
Coastal Dune Estuary				
	Surface layer			
	Water column			
	Channels .... for both:	cobble	gravel	sand
	Epibenthic	silt	mud	detritus
	Inbenthic			
Coastal Dune Tidal Flat		sand	silt	clay
		mud	detritus mixed	
Coastal Dune Tidal Saltwater Marsh				

Habitat	Zone		Substratum			
	Upper marsh					
	Lower marsh					
Coastal Dune Tidal Brackish Water Marsh						
	Upper marsh					
	Lower marsh					
Lagoon Shoreline and Beach				mud	sandy	rocky
Lagoon						
	Surface layer					
	Water column					
	Epibenthic	for both:		cobble	gravel	sand
	Benthic		silt	mud	detritus	
				clay	mixed	

APPENDIX II. *Crosswalks to existing marine and estuarine schemes applicable to California*

Ferren, W.R., Jr., P.L. Fiedler, and R.A. Leidy. 1996. Wetlands of the Central and Southern California Coast and Coastal Watersheds: a methodology for their classification and description. Final Report for United States Environmental Protection Agency (EPA). February 6, 1995; revised August 1996. A detailed classification and description using water system, water regime and chemistry, hydro-geomorphology, and type characteristics for classifying wetlands in central and southern California.

Goals Project. 1999. Baylands Ecosystem Habitat Goals: A report of habitat recommendations. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. United States EPA and San Francisco Bay Regional Water Quality Control Board; 295 pages. An assessment of past and present conditions of the San Francisco baylands ecosystem, with a detailed habitat description, including geo-referenced maps.

Greene, H.G., M.M. Yoklavich, R.M. Starr, V.M. O'Connell, W.W. Wakefield, D.E. Sullivan, J.E. McRea, and G.M. Cailleit. 1999. A classification scheme for deep sea floor habitats. Oceanologica Acta 22(6):663-678. A classification system for marine benthic habitats in deepwater using geophysical data in situ biological and geologic observations.

Allee, R., M. Dethier, D. Brown, L, Deegan, R.G. Ford, T.F. Hourigan, J. Maragos, C. Schoch, K. Sealey, R. Twilley, M.P. Weinstein, and M. Yoklavich. 2000. Marine and Estuarine Ecosystem and Habitat Classification. National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/SPO-43, July 2000; 43 pages. A hierarchal system including 13 levels and encompassing life zones (i.e., polar, temperate, tropical) to ecotypes and biotic communities. Number/character codes are NOAA's and are described in the publication.

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
MARINE				1a-temperate; 2a-terrestrial or b-water; 3a-marine
Offshore	System Marine-Subsystem Subtidal	NA[8]		2b; 4b-non-continental

[8] NA: Not applicable

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
Pelagic	Marine-Subtidal; Ocean	-	NA	5b-water column; 6a-shallow, b-mid-depth, or c-deep; 10a-photic or b-aphotic
Benthic	Marine-Subtidal; Ocean	-	System: Marine Benthic Subsystems (mega- and meso- habitat levels as defined within paper): · continental shelf-outer · continental slope-upper, -intermediate, and -lower · continental rise · abyssal plain · trenches · submarine canyons · sea mounts	5a-bottom; 6b or c
Nearshore Exposed Coast	System Marine-Subsystems Inter- and Subtidal	NA		4a-continental; 5a or b; 6a; 7a-exposed/open
Shoreline & Beach	Marine-Intertidal-Classes rocky- and unconsolidated shore; Ocean: (a) -beach; (b) -shore; (c) -bench	-	NA	2a-terrestrial; 8a-shoreline; 11-beach face, dunes; 12b (ecotype)-beach
Intertidal	Marine-Intertidal; Classes rocky- and unconsolidated shore; a) ocean, (b) cove, and (c) tide pool	-	Subsystem continental shelf-intertidal	2b; 5b; 8a-nearshore; 9a-supratidal or b-intertidal
	Marine-Subtidal; a) Ocean, (b)			2b; 5b; 8a-inshore; 9c-

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
Subtidal Pelagic	cove, and (c) sea cave	-	NA	subtidal or d-circulation features; 10a or 10b
Subtidal Benthic	Marine-Subtidal; Classes rocky-, unconsolidated-, aquatic bed- and reef; a) Ocean, (b) cove, (c) tide pool, (d) sea cave	-	Subsystem continental shelf-shallow subtidal	2b; 5a; 8a; 9c or 9d; 10a or 10b
Kelp Forest	Marine-Subtidal; Class aquatic bed; a) Ocean, (b) cove, and (c) tide pool	-	Subsystem continental shelf-shallow subtidal; Modifiers for biological process-kelp understory, -kelp forest	2b; 5a; 8a; 9c or d; 10a or b; 12b-kelp bed
Surf-grass Bed	Marine-Subtidal; Class aquatic bed; a) Ocean, (b) cove, and (c) tide pool	-	Subsystem continental shelf-shallow subtidal; Modifier for biological process-sea grasses	2b; 5a; 8a; 9c or d; 10a or b; 12b-seagrass bed
Eel-grass Meadow	Marine-Subtidal; Class aquatic bed; a) Ocean, (b) cove, and (c) tide pool		Subsystem continental shelf-shallow subtidal; Modifier for biological process-sea	2b; 5a; 8a; 9c or 9d; 10a or b; 12b-seagrass bed
Nearshore Protected Coast	System Marine	NA		4a-continental; 5a or b; 6a; 7b-protected/bounded
Shoreline & beach	Marine-Intertidal; Classes rocky- and unconsolidated shore; Ocean: a) -beach, (b) -shore, and (c) -bench	-	NA	2a; 8a-shoreline; 11-beach face, dunes; 12b (ecotype)-beach
Intertidal	Marine-Intertidal Classes rocky- and unconsolidated shore; a) Ocean, (b) cove, (c)	-	Subsystem continental shelf-intertidal	2b; 5b; 8a-nearshore; 9a or b

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
	tide pool, (d) surge channel, (e) fissure, and (f) sea cave			
Subtidal Pelagic	Marine-Subtidal; a) Ocean, (b) cove, and (c) sea cave	-		2b; 5b; 8a-inshore; 9c or d; 10a or b
Subtidal Benthic	Marine-Subtidal; Classes rocky-, unconsolidated-, aquatic bed- and reef; a) Ocean, (b) cove, (c) tide pool, (d) surge channel, (e) fissure, and (f) sea cave	-	Subsystem continental shelf-shallow subtidal	2b; 5a; 8a; 9c or d; 10a or b
Kelp Forest	Marine-Subtidal; Class aquatic bed; a) ocean and (b) cove	-	Subsystem continental shelf-shallow subtidal; Modifiers for biological process-kelp understory, -kelp forest	2b; 5a; 8a; 9c or d; 10a or b; 12b-kelp bed
Surf-grass Bed	Marine-Subtidal; Class aquatic bed; a) ocean, (b) cove, (c) tide pool, (d) surge channel, (e) fissure, and (f) sea cave	-	Subsystem continental shelf-shallow subtidal; Modifier for biological process-sea	2b; 5a; 8a; 9c or d; 10a or b; 12b-seagrass bed
Eel-grass Meadow	Marine-Subtidal; Class aquatic bed; a) ocean, (b) cove, (c) tide pool, (d) surge channel, (e) fissure, and (f) sea cave		Subsystem continental shelf-shallow subtidal; Modifier for biological process-sea	2b; 5a; 8a; 9c or d; 10a or b; 12b-seagrass bed
Nearshore Embayment	System Marine	-variable-		2a or b; 3a; 4a; 5a or b; 6a; 7b
Shoreline & Beach	Marine-Intertidal; Exposed Bay: (a)	1. Rocky Shore, 2. Beach	NA	8a-shorelines; 11-beach face; 12b-beach

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
	-shores, (b) -beaches, (c) -benches			
Intertidal	Marine-Intertidal; Exposed Bay;	Tidal Flat	Subsystem continental shelf-intertidal	5b; 8a-embayment; 9a or b
Shallow Water Pelagic	Marine-Intertidal; (a) Exposed Bay, (b) Harbors/Ports	Shallow Bay & Channel	NA	5b; 8a-embayment; 9c; 10a
Eel-grass Meadow	Marine-Subtidal; (a) Exposed Bay, (b) Harbors/Ports			5b; 8a-embayment; 9c; 10a; 12b-seagrass bed
Shallow Water Benthic	Marine-Intertidal; (a) Exposed Bay, (b) Harbors/Ports	Shallow Bay and Channel	Subsystem continental shelf-shallow subtidal	5a; 8a-embayment; 9c; 10a
Deeper Water Pelagic	Marine-Intertidal; (a) Exposed Bay, (b) Harbors/Ports	Deep Bay & Channel	NA	5b; 8a-embayment; 9c; 10a or b
Deeper Water Benthic	Marine-Intertidal; (a) Exposed Bay, (b) Harbors/Ports	Deep Bay & Channel	Subsystem continental shelf-shallow subtidal	5a; 8a-embayment; 10 a or b
ESTUARINE	System Estuarine			1a; 2a or b; 3a; 4a-continental; 5a or b; 6a; 7b-protected/bounded
Bay Estuary	Estuarine-Subtidal; Estuaries; (a) Bay-estuaries, (b) Surge channels, (c) estuarine channels; Exposed bay: (d) -shores, (e) -beaches, (f) -banks, (g) -benches, (h) -terraces	Shallow Bay and Channel	NA	2b; 8a-estuary; 9b or c; 10 a or b

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
Bay Eel-grass Meadow	Estuarine-Intertidal; (a) flats, (b) deltas	Tidal Flats	NA	2b; 9c; 10a; 12b-seagrass bed
Bay Tidal Flats	Estuarine-Intertidal; (a) flats, (b) deltas	Tidal Flats	NA	2b; 8a-estuary or delta; 9b; 10a; 12b-mud flat
Bay Tidal Saltwater Marsh	Estuarine-Intertidal; (a) tidal marsh channel, (b) salt marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 12b-salt marsh
Bay Tidal Brackish Water Marsh	Estuarine-Intertidal; (a) tidal marsh channel, (b) brackish marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 12b-wetland
River Mouth Estuary	Estuarine-Subtidal; (a) Estuaries; River-Mouth; (b) tidal-river channels: main stem and tributary	Shallow Bay and Channel	NA	2b; 8a-estuary; 9b; 10a; 11-riverine
River Mouth Tidal Flats	Estuarine-Intertidal; (a) flats, (b) deltas	Tidal Flats	NA	2b; 8a-estuary or delta; 9b; 10a; 11-riverine; 12b-mud flat
River Mouth Tidal Saltwater Mar	Estuarine-Intertidal; (a) tidal marsh channel; (b) salt marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-riverine; 12b-salt marsh
River Mouth Tidal Brackish Wate	Estuarine-Intertidal; (a) tidal marsh channel, (b) brackish marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-riverine; 12b-wetland
Canyon Mouth Estuary	Estuarine-Subtidal; (a) Estuaries; Canyon-Mouth, (b)	Shallow Bay and Channel	NA	2b; 8a-estuary; 9b; 10a; 11-riverine

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
	tidal-stream channel: canyon stream			
Canyon Mouth Tidal Flats	Estuarine-Intertidal; (a) flats, (b) deltas	Tidal Flats	NA	2b; 8a-estuary or delta; 9b; 10a; 11-riverine; 12b-mud flat
Canyon Mouth Tidal Saltwater	Estuarine-Intertidal; (a) tidal marsh channel; (b) salt marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-riverine; 12b-salt marsh
Canyon Mouth Tidal Brackish W	Estuarine-Intertidal; (a) tidal marsh channel; (b) brackish marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-riverine; 12b-wetland
Coastal Dunes Estuary	Estuarine-Subtidal; (a) Estuaries; Dune-Stream, (b) tidal-stream channel: dune stream	Shallow Bay and Channel	NA	2b; 8a-estuary; 9b; 10a; 11-dunes; 12b-wetland
Coastal Dunes Tidal Flats	Estuarine-Intertidal; (a) flats, (b) deltas	Tidal Flats	NA	2b; 8a-estuary or delta; 9b; 10a; 11-dunes; 12b-wetland or mud flat
Coastal Dunes Tidal Saltwater Marsh	Estuarine-Intertidal; (a) tidal marsh channel; (b) salt marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-dune; 12b-salt marsh
Coastal Dunes Tidal Brackish Wa	Estuarine-Intertidal; (a) tidal marsh channel; (b) brackish marshes	Tidal Marsh	NA	2b; 8a-estuary; 9b; 10a; 11-riverine; 12b-wetland
Lagoon Shoreline & Beach	Estuarine- Intertidal; Lagoon:	Lagoon	NA	2a; 8a-lagoon or shoreline

Proposed CWHR	South/Central California (1996)	Baylands Report (1999)	Deepwater Benthic (1999)	National (2000)
	(a)-shores, (b) -beaches, (c) -benches			
Lagoon	Estuarine-Intertidal; Lagoons	Lagoon	NA	2b; 8a-lagoon; 9b; 10a; 11-riverine, beach face, or dune; 12b-wetland

APPENDIX III. *Crosswalks to draft marine and estuarine habitat schemes applicable to California*

Channel Island National Marine Sanctuary. Drafted in the summer 2000. The number codes are CINMS's.

Wildlife-Habitat Relationships in Oregon and Washington. D.H. Johnson and T.A. O'Neil. 2001. Oregon Press. A final version [classification scheme, habitat descriptions, animal assemblages, model, and CD] was released in February 2001. The publication compiles and synthesizes a vast amount of diverse information on 593 wildlife species and their relationships with the 32 terrestrial, freshwater, and marine habitats of Oregon and Washington. It includes photographs of each habitat, as well as hundreds of maps, diagrams, and other illustrations. The accompanying CD-ROM contains additional wildlife data and color maps, and seven matrixes that link wildlife species with their respective habitats. The 88 contributing authors include experts in wildlife, botany, fisheries, conservation biology, vegetation mapping, and the ecology of forest, rangeland, and marine environments. The information is intended for use by natural resource managers and planners, scientists, conservationists, educators, and other individuals with a deep interest in wildlife species and their habitats.

Proposed CWHR	CINMS (2000) (habitat number/name)	Oregon/Washington WHR (2001)
MARINE		
Offshore		*Oceanic*
Pelagic	15 Open Water Zone	Oceanic
Benthic	13 Canyon 14 Continental Slope/Basin	Oceanic
Nearshore Exposed Coast	NA	-variable-
Shoreline & beach	1 Exposed Rocky Cliffs-Steep Intertidal	Marine Nearshore (MN)
Intertidal	1 Exposed Rocky Cliffs-Steep Intertidal	Marine Nearshore

Proposed CWHR	CINMS (2000) (habitat number/name)	Oregon/Washington WHR (2001)
Subtidal Pelagic	8 Shallow Rocky Shelf 10 Deep Rocky Shelf 11 Shallow Non-Rocky Shelf 12 Deep Non-Rocky Shelf	Marine Shelf
Subtidal Benthic	8 Shallow Rocky Shelf 10 Deep Rocky Shelf 11 Shallow Non-Rocky Shelf 12 Deep Non-Rocky Shelf	Marine Shelf
Kelp Forest	9 Kelp Forest	MN or Marine Shelf
Surf-grass Bed	7 Seagrass Beds	Marine Nearshore
Eel-grass Meadow	7 Seagrass Beds	Marine Nearshore
Nearshore Protected Coast	NA	-variable-
Shoreline & Beach	2 Sandy Beaches 3 Rocky Beaches	Marine Nearshore
Intertidal	2 Sandy Beaches 3 Rocky Beaches	Marine Nearshore
Subtidal Pelagic	8 Shallow Rocky Shelf 10 Deep Rocky Shelf 11 Shallow Non-Rocky Shelf 12 Deep Non-Rocky Shelf	Marine Shelf
Subtidal Benthic	8 Shallow Rocky Shelf 10 Deep Rocky Shelf 11 Shallow Non-Rocky Shelf 12 Deep Non-Rocky Shelf	Marine Shelf

Proposed CWHR	CINMS (2000) (habitat number/name)	Oregon/Washington WHR (2001)
Kelp Forest	9 Kelp Forest	MN or Marine Shelf
Surf-grass Bed	7 Seagrass Beds	Marine Nearshore
Eel-grass Meadow	7 Seagrass Beds	Marine Nearshore
Nearshore Embayment	NA	-variable-
Shoreline & Beach	6 Estuaries	Bays & Estuaries
Intertidal	6 Estuaries	Bays & Estuaries
Eel-grass Meadow	7 Seagrass Beds -or- 6 Estuaries	Bays & Estuaries
Shallow Water Pelagic	6 Estuaries	Inland Marine Deeper Water
Shallow Water Benthic	6 Estuaries	Inland Marine Deeper Water
Deeper Water Pelagic	6 Estuaries	Inland Marine Deeper Water
Deeper Water Benthic	6 Estuaries	Inland Marine Deeper Water
ESTUARINE		
Bay Estuary	6 Estuaries	Bays & Estuaries
Bay Eel-grass Meadow	7 Seagrass Beds -or- 6 Estuaries	Bays & Estuaries
Bay Tidal Flats	4 Tidal Flats	Bays & Estuaries
Bay Tidal Saltwater Marsh	5 Marshes	Bays & Estuaries
Bay Brackish Water Marsh	5 Marshes	Bays & Estuaries
River Mouth Estuary	6 Estuaries	Bays & Estuaries

Proposed CWHR	CINMS (2000) (habitat number/name)	Oregon/Washington WHR (2001)
River Mouth Tidal Flats	4 Tidal Flats	Bays & Estuaries
River Mouth Tidal Saltwater Marsh	5 Marshes	Bays & Estuaries
River Mouth Tidal Brackish Water Marsh	5 Marshes	Bays & Estuaries
Canyon Mouth Estuary	6 Estuaries	Bays & Estuaries
Canyon Mouth Tidal Flats	4 Tidal Flats	Bays & Estuaries
Canyon Mouth Tidal Saltwater Marsh	5 Marshes	Bays & Estuaries
Canyon Mouth Tidal Brackish Water Marsh	5 Marshes	Bays & Estuaries
Coastal Dunes Estuary	6 Estuaries	Bays & Estuaries
Coastal Dunes Tidal Flats	4 Tidal Flats	Bays & Estuaries
Coastal Dunes Tidal Saltwater Marsh	5 Marshes	Bays & Estuaries
Coastal Dunes Tidal Brackish Water Marsh	5 Marshes	Bays & Estuaries
Lagoon Shoreline & Beach	6 Estuaries	Bays & Estuaries
Lagoon	6 Estuaries	Bays & Estuaries

APPENDIX V. ***Glossary***

Abyssal plain	The deep ocean floor, an expanse of low relief at depths of 4,000-6,000 meters.
Abyssopelagic	Of or relating to the ocean depths between 4,000-6,000 meter depth zone, seaward of the continental shelf-slope break.
Bathypelagic	Of or relating to the ocean depths between 1,000-4,000 meter depth zone, seaward of the continental shelf-slope zone.
Bay	- SEE Embayment-
Beach	Terrestrial habitat adjacent to estuarine and marine tidal environments.
Bedrock	Solid rock that lies beneath mud, sand, boulder, loose sediments, or other unconsolidated substrate material- may be exposed and thus the direct benthic substratum in some circumstances.
Benthic	Living on, under, or in the solid materials at the bottom of a body of water.
Boulder	A large substrate particle that is larger than cobble (> ≈ 250 mm in diameter).
Brackish water	Generally, water containing dissolved minerals in amounts that exceed normally acceptable standards for municipal, domestic, and irrigation uses. Considerably less saline that sea water; waters with mixohaline salinity (.5-30 due to ocean water). Water containing 1,000-4,000 ppm total dissolved solids (TDS).
Brackish water marsh	Tidally influenced marsh with mixohaline salinities; transitional between freshwater marsh and/or frequent freshwater source and saltwater marsh and tidal flats. Emergent vegetation not adapted to higher salinities found in saltwater marshes.
Canyon	A water-cut, narrow chasm, the sides of which rise from the stream bed to a cliff or series of cliffs (= gorge).
Channel	Component of aquatic environment that contains continuously or periodically flowing water that is confined by banks and a substrate bed; excavation created and maintained by the flow of water.
Clay	Sedimentary substratum smaller than silt and generally less than 0.2 mm in diameter; fine-grained earth material that is plastic when wet and hardens when dried, consisting primarily of hydrated silicates of aluminum.
Coastal dune	Coastal, terrestrial habitat dominated by sand; wind energy dictates composition and arrangement of dune structure and substructure.
Cobble	Rock-fragment substratum between 7.6-25.4 cm (3-10 inches); smaller than boulder and larger than gravel.
Community	A naturally occurring aggregation of organisms belonging to a number of different species occupying a common habitat and interacting with each other within that habitat; a naturally occurring, distinct group of different organisms which inhabit a common environment, interact with each other, and are relatively independent of other community groups.
Continental plate	Major section of the earth’s crust, bounded by such features as mid-ocean ridges.
Continental shelf	A shallow, submarine plain of varying width forming a border to a continent and typically ending in a steep slope (=continental) to the oceanic abyssal plain; a broad expanse of ocean bottom sloping gently and seaward from the shoreline to the continental shelf-slope break a depth ranging form 100-200 meters; the submerged shelf of land the slopes gradually form the exposed edge of a continent for a variable distance to the point where the steeper descent (slope) to the ocean bottom begins.

Continental slope	The region between the continental shelf and oceanic abyssal plain; 2) a steep-sloping bottom extending seaward from the edge of the continental shelf and downward toward the rise.
Deeper water	In reference to embayments: bay marine water starting at the contour of greater than 5.5-6 meters' deep.
Detritus	Undissolved detritus and inorganic matter, such as small pieces of vegetation, and animal remains, that result from decomposition and that form the base of the food chain; particulate material that enters into a marine or aquatic system. If derived from decaying organic matter, it is organic detritus;
Eelgrass bed	Aquatic estuarine community defined by the presence and ecological contribution of species of *Zostera*.
El Nino-Southern oscillation (ENSO)	Condition in which warm surface water moves into the eastern Pacific, collapsing upwelling and increasing surface-water temperatures and precipitation along the west coast of North and South America.
Embayment	Inlet of the sea usually smaller than a gulf; a portion of the ocean indenting the coastline where wave and tidal energy are reduced but there is the predominant influence of seawater and complete association with the marine environment.
Emergent vegetation	
Epibenthic	Living on, attached, or in association with the surface of the bottom of a body of water.
Epipelagic	Of or relating to the ocean depth just below the surface to 200 meters (600 feet); usually in reference to seaward of the continental shelf-slope interface.
Epipelic	Relating to organisms that inhabit the surfaces of water or substrate.
Estuarine	Large coastal water regions that have geographic continuity, are bordered landward by a stretch of coastline with freshwater input, and are bounded seaward by a salinity front.
Estuary	A water passage where the tide meets a freshwater source, especially an arm of the sea at the lower end of a river; a semi-enclosed body of water that has a free connection with the open sea and within which seawater is diluted measurably with freshwater that is derived from land drainage part of the marine coast over which the tide ebbs and flows.
Exposed coast	Coastline characterized by exposure to full or moderate wind and surf energy
Gravel	Rock-fragment substratum between 2-7.6 cm (0.08-3 inches), usually occurring as a mixture with sand.
Gulf	A part of the ocean extending into the land.
Habitat	The locality or external environment, and its existing physical and ecological conditions, in which an organism lives.
Halocline	Depth zone within which salinity changes maximally.
Human structures	Habitat or habitat surrogate of human origin. Examples include piers and docks, ocean platforms, boat hulls, jetties, buoys, artificial reefs, pilings.
Inlet	A narrow water passage between two peninsulas and/or islands.
Inbenthic	Of or related to living in or under the benthic substratum of a body of water.
Intertidal	Nearshore region where tidal fluctuation results in periods of water inundation and exposure to the air environment. The dynamic of water cover/exposure ranges from predominant exposure and rare inundation (e.g., supratidal) to rare exposure and predominant inundation (e.g., lower intertidal). Note: Upward displacements of the zonal characteristics occur as an area progresses from protected to exposed coast (see Ricketts et al. 1968).

Kelp forest	Marine subtidal biotic community characterized by the presence and ecological influence of species of kelp (i.e., *Macrocystis*, *Nereocystis*).
Lagoon	Shallow lake or pond connected with ocean water; an area of shallow water of various and often fluctuating salinity separated from the sea by a strip of terrestrial substratum such as sand dunes, gravel/cobble beaches or mud berms; this water body is infrequently breached such that (1) what was lagoon waters are now freely influenced by the tide, (2) beach and berm materials are completely or partially washed out to sea, and (3) there existed an estuary environment of freshwater source(s) interfacing with marine tidal waters until the beach or berm begins to reform.
Lower intertidal	Intertidal zone from 0 to -0.6 meter tide levels. Below is the subtidal. This zone is exposed only a few hours per month. Corresponds to Zone 4: low intertidal of Ricketts et al., 1968. This represents the upper limits of *Phyllospadix* and the Laminarian algae zone, as well as some subtidal animals.
Mainstream flow	The flow in a part of the fluid that is well above the bottom or well away from a surface and essentially not under the influence of the boundary layer.
Marine	Of or pertaining to the sea and saltwater.
Mesopelagic	Of or relating to the ocean depths from 200-2,000 meter depth zone (600-6,500 feet), seaward of the continental shelf-slope break.
Middle intertidal	Intertidal zone from higher low to mean lower-low tide, approximately +0.8-0m. This zone is typically exposed twice a day and corresponds to Zone 3: middle intertidal of Ricketts et al., 1968. This zone represents the lower reach of balanoid barnacles and the upper reach of *Mytilis* beds.
Mud	Earthen substratum composed predominantly of clay and fine silt.
Nearshore	Marine waters and benthic environment contiguous with the terrestrial environment extending to the continental shelf-slope interface; the belt or region of shallow water adjoining the coast; of or associated with marine environments and habitats landward of the continental shelf-slope break.
Neritic	Of or relating to aquatic organisms that live in the nearshore, open ocean water, without direct dependence on the shore or bottom; living in the water column landward of the continental shelf-slope break.
Oceanic	- SEE Offshore -
Oceanic ridge	A sinuous ridge rising from the deep-sea floor.
Offshore	Of or associated with marine environment and habitats seaward of the continental shelf-slope break; (=oceanic).
Organic	Unconsolidated substratum composed predominantly of organic versus mineral material and with a radius smaller than cobble and gravel.
Pelagic	Of or relating to aquatic organisms that live in the offshore, open ocean waters, without direct dependence on the shore or bottom; living in the water column seaward of the continental shelf-slope break.
Photic zone	The depth zone in the ocean extending from the surface to that depth permitting photosynthesis, extending from the surface to approximately 30meters, depending on turbidity.
Plankton	Organisms living suspended in the water column and incapable of moving against water currents.
Pond	A body of standing water smaller than a lake.
Protected coast	Marine coast characterized by semi-enclosure or underwater topography (i.e., reef, bar) that results in protection from the wind- and/or surf-energy.

Pycnocline	Depth zone within which sea-water density changes maximally.
Rise	Bottom of low relief at the base of the continental slope.
Saltwater marsh	Tidal saltwater wetland that occurs along ocean coastline; a coastal habitat consisting of salt-resistant plants residing in organically rich sediment accreting toward sea level.
Sand	Predominantly coarse-grained, mineral substratum larger than silt and smaller than gravel and is less than 2mm and greater than 0.07 mm in diameter.
Sessile	Attached or stationary; immobile because of an attachment to a substratum.
Shallow water	In reference to embayment environment: bay marine environment from the mean lower low tide contour to the 18' contour.
Shelf-slope break	Interface demarcating the change from the gently inclined continental shelf to the much steeper depth gradient of the continental slope.
Shoreline	The narrow strip of terrestrial environment (1) between the intertidal and fully terrestrial habitats and (2) that is affected substantially by the marine or estuarine environment.
Silt	Sedimentary substratum larger than clay (.2mm) and smaller than sand.
Slough	Estuarine region of deep mud or mire; sluggish channel; swamp, bog, or marsh, especially one that is part of an inlet or backwater.
Sublittoral zone	- SEE Subtidal-
Submerged plants	Plants growing with their root, stems, and leaves completely under the surface of the water.
Subtidal	The aquatic environment from the extreme low-water level of the intertidal zone to approximately 200 meters; from the edge of the lowest tide level to the edge of the continental shelf; (= Sublittoral).
Supratidal	Of or relating to the shore area adjoining and just above the high-tide level of the intertidal zone; predominantly an exposed environment receiving the minimalist of salt water contribution from the tide; (≈ spray zone; splash zone; supralittoral; uppermost horizon).
Surface layer	Layer of the ocean or estuary extending from the surface to a depth above which is homogeneous due to wind mixing.
Temperate	Pertaining to the latitudinal belt between 23°27' and 66°33' north or south latitude.
Thermocline	Depth zone within which temperature changes maximally.
Tidal current	A water current generated by regularly varying tidal forces.
Tidal flat	Saltwater wetlands that are characterized low profile, by substratum usually of mud or sand, and daily tidal cycling of inundation and exposure.
Trench	Deep and sinuous depression in the ocean floor, usually seaward of a continental margin or a group of volcanic islands.
Turbidity	The weight of particulate matter per unit volume of sea water.
Upper Intertidal	Intertidal zone from mean high to the mean higher of the 2 daily low tide levels, approximately +1.5-0.8m. It corresponds to Zone 2: high intertidal of Ricketts et al., 1968. This zone is the upper reach of balanoid barnacles and is above the zone of *Mytilis* beds [≈ high intertidal].
Upwelling	The movement of nutrient-rich water from a specified depth to the surface.
Wash zone	The depth zone in which sediments are distributed by wave action near the shoreline.
Watershed	The land area that is drained by a river or estuary and its tributaries.

APPENDIX IV. Key References

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South Spit

Interim Management Plan

July 10, 2002

Bureau of Land Management
Arcata Field Office
1695 Heindon Road
Arcata, CA 95521

TABLE OF CONTENTS

BACKGROUND

The 800-acre South Spit is a four and one-half mile long, narrow strip of land located between Humboldt Bay's entrance and Table Bluff. The area has been used by the public for many years for a wide variety of activities. Its history is both unique and diverse. The South Spit is the homeland of the Wiyot people. During the 1980's and 1990's, the area was inhabited by transients and long-term homeless campers whose presence adversely affected both recreational opportunities and natural resource values. In 1997, Humboldt County's Health Department initiated a relocation program for those living on the South Spit, and the area is now open on a limited basis for a variety of recreation and other uses in accordance with County ordinances.

Most of the South Spit (600 acres) was recently gifted from Pacific Lumber Company to the State of California. Other ownerships include Humboldt County (17 acres), U.S. Fish and Wildlife Service (FWS) (160 acres), Texaco Corporation (19 acres), and U.S. Army Corps of Engineers (10 acres).

Through a Deed of Conservation Easement, the State of California conveyed to the Bureau of Land Management (BLM) an "interest" in and the "right" to manage the South Spit in all aspects of its use in perpetuity. To accomplish the purpose of this Easement, the following rights and interests are conveyed to BLM:

> <u>Purpose</u>: It is the purpose of this Easement to preserve, protect, enhance, and restore the conservation values of the Property; to provide dispersed recreation for the general public; and to prevent any use of the Property that will significantly impair or interfere with such conservation values.
>
> <u>Affirmative Rights and Interests Conveyed</u>:
>
> (a) To manage the Property in all aspects of its use in perpetuity, including the right to enforce the laws of the State of California and the United States of America;
>
> (b) To inspect, observe, and study the Property for the purposes of identifying the current uses and practices thereon and the baseline condition thereof, and monitoring the uses and practices regarding the Property to determine whether they are consistent with this Easement;
>
> (c) To perform habitat restoration in order to ensure the long-term viability of the conservation values of the Property and its ecological resources;
>
> (d) To manage the Property for dispersed recreational purposes of the general public, subject to such use being consistent with preservation of the conservation values of the Property;
>
> (e) To prevent any activity on or use of the Property that is inconsistent with the purpose of this Easement and to require the reasonable restoration of such areas or features of the Property that may be materially damaged by any inconsistent activity or use.

The South Spit will be designated a State of California *Wildlife Management Area* pursuant to California Department of Fish and Game Code, Chapter 5, Article 2, Sections 1525-1530. This designation is used for management purposes to protect and enhance habitat for wildlife species and to provide the public with wildlife-related and other recreational uses.

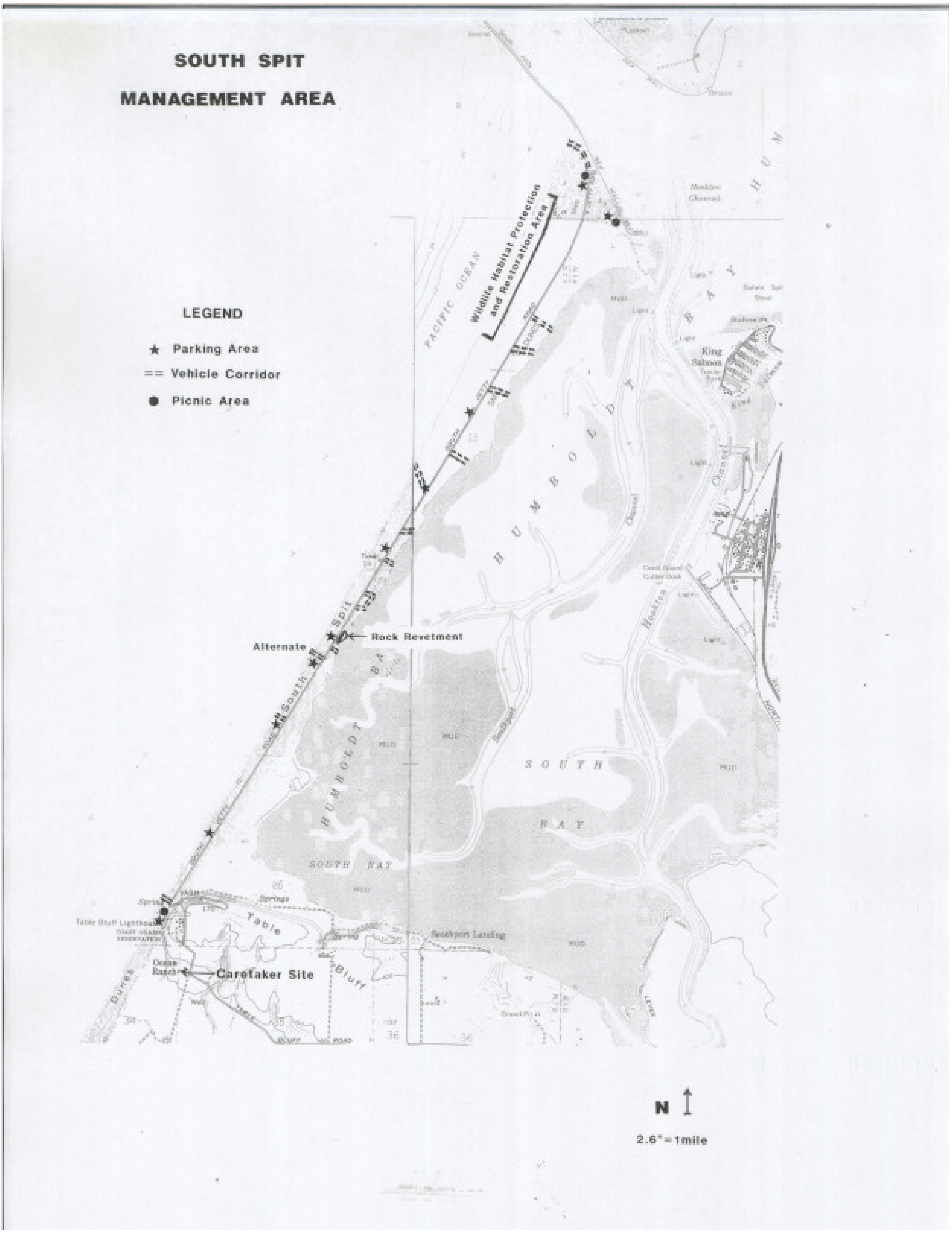
INTERIM MANAGEMENT

This Interim Management Plan is intended to provide interim management and allow for a baseline level of services, public uses, resource protection, and habitat restoration until the long-term plan is being developed (see Map A, page 3).

A comprehensive Humboldt County *Beach and Dunes Management Plan* was completed in 1995, which recommended actions for resource protection and provisions of public recreation use on both the North and South Spits. As a result of this effort, and as a requirement of California Senate Bill 39, the California Coastal Conservancy completed the *South Spit Management Plan* in October, 1997. This plan evaluated the public acquisition, actions for habitat restoration, development of recreational improvements, and related management options of the South Spit. The Coastal Conservancy issued a $500,000 grant for initial implementation of this plan, which is now administered by Redwood Community Action Agency. The plan also outlined priorities for allocating the grant monies directed towards implementation of its vision and recommendations.

The concept of adaptive management will be incorporated where appropriate and necessary to achieve the highest levels of public service and resource protection. The key to adaptive management is the willingness of management to let new information drive adaptation to changing conditions and information. To be successful, the plan must have the flexibility to adapt and respond to new information. With an initial level of knowledge and technology, and a baseline inventory, implementation will begin, followed by monitoring and evaluation of activities, their outcomes, and use levels. Using new knowledge and information, management actions can be modified to best meet the overall objectives of the plan. Most on-the-ground adjustments will fall within the realm of administrative change. Others may require formal NEPA documentation, Endangered Species Act compliance, and/or concurrence with State and Federal regulatory agencies. An example of an adaptive management practice is the proposal to create western snowy plover habitat using heavy mechanical equipment.

MAP A


SOUTH SPIT
MANAGEMENT AREA
LEGEND
★ Parking Area
== Vehicle Corridor
● Picnic Area
Wildlife Habitat Protection and Restoration Area
PACIFIC OCEAN
HUMBOLDT BAY
King Salmon
South Spit
Rock Revetment
Alternate
SOUTH BAY
Table Bluff Lighthouse
Caretaker Site
Table Bluff
Southport Landing
N
2.6"=1mile

VISION STATEMENT

The South Spit is a unique and significant area to the people of Humboldt County. Due to the area's natural diversity, cultural resource values, and populations of sensitive species, protection of these resources is necessary and will require active management. The South Spit has provided, and will continue to provide, a variety of recreation activities and other uses including hiking, wildlife viewing, hunting (waterfowl, snipe and coot), picnicking, surfing, fishing, horseback riding, and vehicle access to the waveslope.

During the long-term management planning process, individuals, groups, and organizations will have the opportunity to assume their place as stakeholders in the development of the plan in concert with local, state, and federal agencies who will play a role in management. Such a private/public partnership will be fostered through a collaborative planning process where each stakeholder is given the opportunity to participate in a consensus-built, community-driven management approach, embracing multi-agency, multi-species, and multi-jurisdictional boundaries. The long-term planning process will be developed over the next three years and provide for future management of the South Spit.

GOALS AND OBJECTIVES

1. Management policies and direction will be consistent to the maximum extent possible with the *Humboldt Beach and Dunes Management Plan*, 1995, and the *South Spit Management Plan*, 1997;

2. Manage for the protection and enhancement of threatened and endangered plant and animal species and their habitats;

3. Eradicate invasive non-native vegetation, including European beachgrass, iceplant, yellow bush lupine, and others;

4. Inventory and monitor plants, animals, and cultural resources to provide an information base to support both short-term and long-range management goals, objectives, on-the-ground activities, and feedback to use for adaptive management;

5. Respect and provide for the cultural heritage of the Wiyot people for access and use. Fully protect all sensitive Tribal areas;

6. Manage for recreation opportunities and uses such as waterfowl hunting, wildlife/wildlands observation, photography, fishing, surfing, environmental education, and vehicle access to the waveslope;

7. Provide for limited recreational facilities necessary to accommodate the public health and safety;

8. Provide an active management presence, including visitor services and law enforcement

personnel. Develop a cooperative effort by various law enforcement agencies, including the County Sheriff's Office (HCSO), California Department of Fish and Game (DFG), Bureau of Land Management (BLM), and U.S. Fish and Wildlife Service (FWS).

EXISTING RESOURCE CONDITION

Recreation Uses and Facilities

The South Spit is currently accessible to the public. Access is limited to individuals who have purchased a key that opens a locked gate located on Table Bluff County Park. Several thousand keys have been issued since the gate was installed. It is often left open, allowing visitors without keys to access the area. Other existing facilities are limited to two information kiosks at the bottom of the hill on county park property, and several signs placed along South Jetty Road, the northern boundary to the Eel River Wildlife Area, and at the jetty. The access road is partially paved and graveled, and numerous potholes exist. Over 25 graveled turnouts exist at various locations on the west side of the road. Nearly 20 undeveloped access routes extend from the east side of the road out to the bayshore. The Army Corps of Engineers has stored some large rocks at the jetty area that are surrounded by a chain link fence.

The area is used for many recreational activities involving the consumptive and non-consumptive use of wildlife. Birdwatching, brant, duck, snipe and coot hunting, clamming in the bay and on the beach, fishing for surf perch and surf smelt off the beach, and bottom fish and salmon off the jetty are the major uses of wildlife on the spit. The spit is also used for commercial fishing for surf perch and surf smelt. Other existing recreation activities include hiking, sightseeing, picnicking, surfing, and off-highway vehicle (OHV) use. Much of the current OHV activity occurs in the dunes and near the bayshore, which are designated closed to vehicle use. Total annual recreation use is estimated at 25,000 visits. Firewood cutting of driftwood is a popular non-recreation activity that occurs frequently.

Law enforcement patrols now occur on a weekly basis by both the BLM Law Enforcement Ranger and Humboldt County sheriff deputies. DFG wardens and the FWS Law Enforcement Ranger patrol the area occasionally. For a detailed evaluation of existing laws, rules and regulations pertinent to the South Spit, refer to Appendix A. Specific laws related to cultural resources are discussed in Appendix B.

Cultural and Native American Concerns

The Humboldt Bay region including the South Spit has been occupied for at least the last 1,500 years by Algonquian speaking people now referred to as Wiyot. Descendants of these people, the Wiyot Tribe, now reside at Table Bluff Reservation and other places in Humboldt County. An early ethnographer, Llewellyn L. Loud, collected information from surviving Wiyot informants about the ethnogeography and archaeology of the Humboldt Bay area in 1913; his report was published in 1918. Loud listed two modern village sites and five archaeological village sites on the South Spit plus a trail system connecting the southernmost site to Table Bluff where many more occupation sites were located. The South Spit was not occupied to the density of other areas around the Bay; Loud suggests the Wiyot favored the upper bluffs and hillsides with their forests and less harsh environment as opposed to the South Spit's unprotected, low-lying open dunes and marshy bayside (Loud 1918:277). The present day Wiyot Tribe feel a strong connection to the South Spit as part of their aboriginal territory, and it has a great significance to them as part of their heritage and is still used for hunting, fishing, and gathering shellfish and vegetal resources. There are also reported sensitive Tribal areas.

The Sea Wall and South Spit Jetty are also historic resources as their construction by the Army Corps of Engineers began in 1889. Both Humboldt Harbor Jetties are registered as California Historic Civil Engineering Landmarks and the Humboldt Harbor Historical District is listed as California Historic Landmark Number 882. The Jetties are two of the oldest man-made structures on the Pacific Coast subject to extreme wave action.

Under an educational cooperative agreement between the BLM Arcata Field Office and Humboldt State University Foundation's Native American Ethnic Studies Program, six preliminary archaeological surveys of about 400 acres of the approximate 800 acres of the South Spit (including the Eel River Wildlife area) were undertaken in 1998 between June and October and one test excavation unit was placed to explore for subsurface materials. Oral histories were also gathered from living descendants during the project and Wiyot representatives participated in the survey work. However, not a single ethnographic or archaeological site was found and the reported burial ground could not be relocated. Previous limited cultural surveys (ACOE 1976, Bramlette and Lerner, 1988) were also conducted with negative results. The historic remains were not surveyed or recorded. However, an intensive Class III archaeological and cultural survey is presently underway on the South Spit by cultural resources staff from Table Bluff Reservation - Wiyot Tribe and the BLM. One proto-historic site, 8 prehistoric sites, and one prehistoric Isolate, ten historic period sites, and one historic isolate have now been identified on the South Spit and site records are presently being prepared. It is expected that several more such sites will be recorded when the cultural survey of the remaining acreage is completed.

Most of these sites have poor integrity which may have been caused over the last one hundred-fifty plus years by large storm events, accretion of sand, the construction and maintenance of the South Jetty over the years, and the active disturbance from modern encampments which have washed away, covered, eradicated and/or removed many traces of prehistoric and historic use by the Wiyot. Therefore, extra caution must be used for any proposed projects and undertakings on the South Spit. Any areas to be disturbed by recreational activities or impacted by ground disturbing activities should be monitored by a qualified archaeologist and a representative of the Wiyot Tribe if desired by Table Bluff Reservation Tribal officials. Once the survey is complete and all sites have been identified, cultural resources should be evaluated, sensitive areas protected, and a site monitoring program developed under the long-term management plan to aid in their protection and preservation.

<u>Caretaker Site/DFG Property</u>: The first land surveys of the South Spit took place as early as 1854 and were officially recorded in 1855. The Government Land Office's official Plats for 1855 and 1866 show two houses and a barn belonging to J. Clark and G. Langdon in Sections 34 and 35, Township 4 North, Range 2 West, HUM. The barn structure is still standing while the only remains of the adjacent house are concrete piers, slabs, foundations, bricks from the fireplace,

some water pipes, and scattered household debris. There are daffodils and a remnant Cypress shelter wood upslope from the house ruins that are part of the cultural landscape.

Vegetation

The South Spit is currently in a severely degraded vegetative condition with the majority of the spit consisting of invasive, non-native plant types. European beachgrass (*Ammophila arenaria*), iceplant (*Carpobrotus edulis*), and yellow bush lupine (*Lupinus arboreus*) now dominate the foredunes where once they were absent, as seen from sets of air photos dating from the late 1930-1940's. Most of the west side of the spit is a very young land form and is a direct artifact of the construction of the south jetty at the turn of the 20th century. Although difficult to see in the air photos, native species were present on the spit in the 1940's but not uniformly distributed or abundant due to wave over-wash events that maintained the spit sands in an actively moving state over much of the area, particularly near the south end (1992, Pacific Watershed Associates). Much more native vegetation is visible in the 1978 set of air photos. As a result of the explosive spread of invasive weeds, many native plant habitats have degraded as a result of the effects of the weed-induced over-stabilization of sand.

Common native dune mat species that have persisted on the South Spit include beach pea (*Lathyrus littoralis*), beach morning glory (*Calystegia soldanella*), beach layia (*Layia carnosa*), beach evening primrose (*Camissonia cheiranthifolia*), beach strawberry (*Fragaria chiloensis*), silver beach bur (*Ambrosia chamissonis*), dark-eyed gilia (*Gilia millefoliata*), sea thrift (*Armeria maritima*), dune goldenrod (*Solidago soldanella*), coast buckwheat (*Eriogonum latifolia*), yellow sand verbena (*Abronia latifolia*), and sand dune blue grass (*Poa douglasii*), among others.

On the bay margin of the spit, there are several native plant communities including salt marsh and its subset of community associations such as pickleweed (*Salicornia spp.*), cordgrass (*Spartina densiflora*), and mixed marsh, the most species rich; native dunegrass (*Leymus mollis* and *Leymus vancouverensis*); brackish marsh (where seasonal flooding of salt water through dikes and intertidal channels mixes with freshwater and saltwater influencing species composition); and reaching further inland from the bay margin, woody and herbaceous swales, which can become seasonally flooded. Taken together, the salt marsh, brackish marsh, and woody and herbaceous swales provide important perennial and ephemeral resources to waterfowl and wildlife.

In the early 1990's, two native species, Humboldt bay wallflower and beach layia, became federally listed as endangered but still occupy some sites on the South Spit. Beach layia, an endangered pioneering annual, occupies areas with bare to semi-stabilized sand; examples include infrequently used foot or vehicle access ways, recovering blow-outs, road margins, or remnant patches of native plant communities known as dune mat. Humboldt Bay wallflower occupies one remnant dune mat site on Texaco Inc. property, currently at-risk due to encroaching invasive weeds and wildlife (presumably deer) predation. According to the *1998 Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly (Recovery Plan)*, this South Spit population of Humboldt Bay wallflower is the southern most occurrence for this subspecies. Several other special status species occur on the South Spit. These plants include California Native Plant Society (CNPS) List 1B plants; pink sand verbena (*Abronia umbellata* ssp.

breviflora) and dark-eyed gilia (*Gilia millefoliata*) found in the semi-stabilized open sand to dune mat plant community types; and Humboldt Bay owl's-clover (*Castilleja ambigua* ssp. *humboldtiensis*); Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*); and CNPS List 2 plant, western sand spurrey (*Spergularia canadensis* var. *occidentalis*) found in the mixed-saltmarsh plant community type.

Current vegetative mapping resources available on the South Spit depict all existing vegetation communities as of July 2002, existing and historical salt marsh communities, eel grass beds associated with the bay, population maps of Humboldt Bay owl's-clover and Point Reyes bird's-beak, and very generalized depictions of sensitive habitats and rare plant locations by Tom Duebendorfer.

Further, there has been limited research or monitoring completed on native plant resources compared to research or monitoring conducted or ongoing on the North Spit. The isolated population of Humboldt Bay wallflower has been sporadically monitored since its discovery in 1991 by Tom Duebendorfer. Examples of research that is ongoing on the North Spit or that could take place on the South Spit include the study of genotypes of endangered plant populations, native pollinator presence, invasive weed dynamics and edge effect on native habitat, and cryptogamic crust composition, distribution, and soil impacts on native dune mat.

Wildlife

The South Spit has a wide variety of wildlife resources both within and adjacent to its borders and provides many opportunities for both consumptive and non-consumptive wildlife uses. The exotic vegetation and recent use of the area by unauthorized human residences has allowed for unnatural increases in native as well as exotic (feral cat) species to the detriment of some native fauna.

The western snowy plover, one of many species on the South Spit, is probably of the most immediate importance because of its potential for extirpation. The Pacific coast population of the western snowy plover was federally listed as threatened in March of 1993 (USDI 1993). General population decline and a decrease in numbers of breeding locations were the basis for listing. The declines are attributed to loss and modification of habitat resulting from European beachgrass, encroachment and urban development, extensive human recreational activity in plover habitat, and predation exacerbated by human disturbance. Designation of critical habitat was proposed in 1995 (USDI 1995) with final designation being published in 1999. The South Spit was not designated critical habitat.

According to the Draft *Western Snowy Plover Pacific Population Recovery Plan* (USDI 2001), total numbers of breeding plovers and nest locations have decreased in Humboldt, Del Norte and Mendocino Counties over the last 10 years or so, but because of variations in levels of survey effort, it is difficult to compare past with current bird numbers. Five beaches where nesting plovers were detected by Page and Stenzel (1981) or Fisher (1992-94) have had no nesting activity in the past few years. The majority of Humboldt County plover nesting has shifted to Eel River gravel bars (Colwell et al. 2001). On the South Spit, plover nesting has been documented in 1983 (three nests detected by Paul Springer), and one nest in 1993 during Fisher's surveys of 1992 - 1994 (Fisher 1994). In 1999, two nests and six chicks were observed (LeValley 1999).

Due to the current degree of dune habitat degradation, only about 30 to 50 acres of nesting habitat occurs on the approximately four and one-half miles of beach on the South Spit. LeValley (1999) has documented detrimental recreational vehicle interactions with plovers and has observed numerous predators. He has also documented wave wash effects on a plover nest on the narrow beach of the adjacent Eel River Wildlife area.

The brown pelican (federally listed as endangered in 1970) feeds in the waters surrounding the spit. Allegedly a night roost exists on the northeast corner of the spit, but we have yet to confirm it. Past human activity on the spit has probably discouraged or eliminated the roost. Pelicans may use the jetty rocks as a day roost when fishing activities are minimal.

The spit and its immediately vicinity are rich with bird life. The beaches, in addition to the western snowy plover, are occupied by the sanderling, semi-palmated plover, killdeer, whimbrel, dunlin, black-bellied plover, gulls, Caspian tern, western and least sandpiper. The bay and channel are occupied by the grebe (five species), cormorant (Brandt's, double-crested, and pelagic), scoter (surf, white-winged, black), gull (western, glaucous-winged, ring-billed, black-legged kittiwake, Heermann's gull, Forester's tern, elegant tern), loon (4 species), common murre, marbled murrelet, rhinocerous auklet, pigeon guillemot, willet, marbled godwit, brown pelican, and many species of waterfowl. Black turnstones, black oystercatchers, rock sandpipers and surfbirds can be found on the rocky jetty. Dune habitats contain many terrestrial birds as well. Northern harriers and black-shouldered kites are commonly seen on the spit and sightings of the American peregrine falcons and merlins are not unusual.

The common raven and American crow are ubiquitous and are likely to affect plover survival, both adults and young. A spring migration of merlins stop off at the spit and are suspected to be plover predators as well.

The adjacent bay contains vast eelgrass meadows important as spawning and nursery habitat for fish and essential forage for thousands of black brant. The east edge of the spit, and especially the northeast corner are important grit gathering sites for black brant (Black, pers. com.).

Marine mammals such as the gray whale and the harbor porpoise can be seen offshore from the spit. Terrestrial mammals that can be found in the area are coyotes, gray foxes, raccoons, weasels, skunks, voles, woodrats, mice (deer, harvest, and jumping), shrews, moles, brush rabbits, jackrabbits, and the introduced opossum and feral cat. Flying mammals probably include the big brown bat, California myotis and Yuma myotis.

INTERIM MANAGEMENT ACTIONS

This interim planning document is intended to disclose the full range of management actions anticipated to occur prior to completion of the long-term management plan. It is the intent to manage the South Spit under an interim strategy that does not foreclose future options for management or commit resources in a manner that would jeopardize potential alternatives in future planning.

This interim management plan provides a starting point for management of the South Spit that includes the initial period of implementation of protection measures and use restrictions. Management is anticipated to be fluid and adaptive, detecting changing resource conditions, management successes and failures, public and wildlife responses to management and use levels, and quickly responding with improved management practices. The interim plan provides a management scenario that will establish a baseline of information over a two to three period against which subsequent planning can be based.

Recreation Opportunities

Interim management provides for a variety of recreational opportunities that recognize present as well as historical activities on the South Spit. Recreational uses will include day use activities such as fishing, clamming, picnicking, sightseeing, beachcombing, hiking, horseback riding, wildlife viewing, and waterfowl, snipe and coot hunting. Vehicle access to the waveslope will be allowed for recreation uses and commercial fishing. Rules guiding some of these activities include:

1. The area will be open to day use only, with no nighttime general public use allowed. The entrance gate will be opened one hour before sunrise and closed one hour after sunset. Open hours will be extended during waterfowl hunting season (October - January);

2. Designated vehicle access corridors will provide access to the waveslope. In accordance with county ordinances for the South Spit and Table Bluff County Park, vehicles will be allowed on the waveslope with a speed limit of 15 miles per hour;

3. All public uses within a designated plover protection area during the nesting season are not allowed. The following restrictions apply to waveslope activities adjacent to fenced and posted plover nesting, temporary brooding, and seasonal habitat protection areas:

   a) Dogs must be leashed
   b) No kites or model airplanes
   c) No campfires

No waveslope activity restrictions apply to the temporary wintering protection areas. Plover protection areas are described in detail beginning on page 16 under "Plover Protection Actions";

4. Dogs must be under the owner's control at all times. Owners must carry a leash. See #3 for use restriction;

5. Equestrian use is provided for on the west side of South Jetty Road;

6. Firewood cutting is allowed by permit from September 16^{th} to March $1^{st;}$

7. Firearms (shotguns only) are only allowed for hunting of waterfowl, snipe, and coot;

8. Target shooting is not allowed (includes bow and arrows);

9. Fireworks are not allowed.

10. If fish are cleaned on the South Spit, then all entrails shall be carried off-site, or buried a minimum of 12 inches deep, or wrapped and disposed of in a proper receptacle: but in no case shall the entrails be left lying open on the beach.

A brochure and map will be developed and include information about the area's historic and cultural values, recreational opportunities, endangered plants and animals, restoration efforts, and will provide rules and regulations.

In cooperation with Humboldt State University, a visitor survey will be conducted to gather information about preferred recreation activities, how people would like the area to be managed, perceived problems and user conflicts, and visitor demographics. The survey would involve a questionnaire and possibly a telephone poll sampling of Humboldt County residents. A traffic counter will be installed at the entrance gate to document overall visitor use.

Law enforcement efforts will be implemented under a cooperative program between BLM, FWS, DFG, and HCSO. BLM patrols will occur at a minimum of two days per week with one of the days being on the weekend. Patrol summaries and incident reports will be prepared annually.

Special events held during the plover use periods will require a separate consultation under Section 7 of the Endangered Species Act.

A Memorandum of Understanding (MOU) between the BLM, Humboldt County, and DFG will be developed to provide consistency with visitor management rules and regulations.

Commercial Uses

Commercial fishing will be allowed under a special use permit, by BLM, for hours outside of the day use period.

Facility Developments

1. Caretaker Site: A volunteer resident caretaker will open and close the entrance gate, provide information to visitors, and perform light maintenance duties. The preferred site is located on DFG property just south of Lighthouse Ranch. The site will include a graveled access route to a graveled pad. The site will also include a storage shed, developed drinking water well,

electricity and telephone service, and a septic tank with leach field.

2. Parking Areas and Access Routes: Eight existing graveled parking areas on the west side of the road will be improved; one for multiple uses at the southern end on County Park property, six at intervals along South Jetty Road, and one multiple use parking area at the north end next to the jetty (See Map A for locations). The north and south sites will each have a single vault restroom, picnic tables, trash receptacles, and an information kiosk.

Each of the parking areas along South Jetty Road will be expanded and graveled to accommodate at least four vehicles, and delineated by a post and cable barrier or driftwood logs. Three will be designated for pedestrian parking, two for vehicle access to the waveslope, and one for a combination of both.

Four vehicle access corridors will be provided for vehicle access to the waveslope. The two corridors along South Jetty Road will be delineated by post and cable barriers. The other two are located at each end of the spit where multiple use parking and picnic areas will be developed. The southern access corridor will be delineated using driftwood logs. The northern access corridor will require signing only, as the corridor is easily recognizable. An alternate vehicle corridor will be developed and used only if one of the other two sites needs to be closed for reasons associated with the snowy plover. Signs will be displayed on these corridors to inform visitors these are the only routes to the beach and all other unsigned routes are closed, and about potential difficulties while traveling at high tides, and that non-street legal ATV and motorcycle riders need to use the same route to and from the beach to avoid driving on South Jetty Road.

Vehicle access routes extending to the bayshore from the east side of South Jetty Road will be left undeveloped. Vehicle use on nine of these short access routes will be allowed only for loading and unloading supplies during waterfowl hunting season (October - January). During the remainder of the year these routes and surrounding lands will be closed to all vehicle use. Several existing corridors will be physically blocked using driftwood logs to prevent further vehicle use. To facilitate the access routes on the east side, 11 existing turnouts will be improved. The turnouts are located along South Jetty Road and will eliminate parking near the bay side of the area.

An area will be located at the northeastern corner of the management area on the north side of the spur road for small watercraft launching, picnicking, beachcombing, and wildlife viewing. This area will be developed as a picnic site, with tables, cooking grills, and trash receptacles. The spur road beyond this site will be closed to vehicle use to protect a cultural and wildlife sensitive area. An existing four wheel-drive access route paralleling the sea wall will connect the picnic site to the jetty parking area. This route is used heavily by fishermen and will continue to be open to street legal vehicles.

3. South Jetty Road: This road will be repaired and improved by scarifying the base course of the road, re-compacting, and repaving areas where large potholes have formed. Portions of the road will be graveled and graded. As funding allows, a short 100-foot section of road will be rip-rapped and re-paved along the eastern edge to prevent erosion. The spur road leading to the proposed picnic site mentioned above will be graveled and graded. Traffic calming techniques

such as speed bumps may be installed. Roads will be maintained as necessary during interim management. The speed limit will be 25 miles per hour and open for street legal vehicles only.

A small section of road on County property has been impacted by erosion from the bluff above. The gully will be stabilized by constructing terraces and re-vegetating the area.

4. Signing: A variety of informational, educational, directional, and regulatory signs will be developed and installed. The information kiosks will display interpretive themes related to endangered plants and animals, and historical and cultural resource values. Information on types and locations of the various recreation activities will also be provided along with warning signs that beach areas in front of plover nest protection fences may not be passable during high tide. Adjacent to each kiosk will be a sign displaying the rules and regulations for the area. Many of the existing signs will be replaced with new ones that are more attractive looking. A sign plan with specific wording will be developed cooperatively between the Redwood Community Action Agency (RCAA) and BLM.

All facilities (including signs) will be designed to prevent, as much as reasonable possible, use as predator perches. All trash receptacles will be scavenger proof and emptied as necessary to prevent corvids from being attracted to these areas.

Prior to allowing public use of the area, two small piles of earthen materials containing potentially hazardous waste will be removed from the area. These sites are located near the proposed northernmost parking and picnic area adjacent to the jetty.

To provide for public safety and enhance the scenic quality at the jetty area, the chain link fence surrounding the large rocks that were stockpiled for jetty maintenance will either be removed or repaired.

Cultural Resources

During the interim management period, comprehensive archaeological surveys including subsurface test excavations in suspect areas are necessary to ensure any and all cultural resources are located, recorded, evaluated, and protected from facility developments and recreation use. Table Bluff Reservation - Wiyot Tribe will be contacted and given the opportunity to review the proposed interim management planning effort and share their ideas. Wiyot representatives will be included in all aspects of archaeological survey, monitoring, and test excavations. A Class III archaeological survey of the entire South Spit will be completed with participation by Wiyot tribe representatives and a comprehensive report prepared. The survey report will be used in developing long-term management plans.

The preferred location for the caretaker site on DFG lands coincides with the archaeological and historic house ruins and barn site that dates back to 1855. Some historic evaluation of this property has been done by Susie Van Kirk (1998) for the California Department of Fish and Game, however, no archaeological site records were prepared nor was a prehistoric survey conducted. An intensive archaeological survey of this area and complete recordation of the historic resources must take place before any ground disturbing activity occurs under interim management. Evaluation of the historic resources and recommendations for their treatment will be included in the report to assist in proper long-term management of the area.

The development of graveled parking areas, vehicle access routes, two restrooms, and placement of information kiosks and other signs will only be done in conjunction with an intensive archaeological survey of the proposed sites where ground disturbing activities will occur. Special attention will be paid to the area adjacent to the northeast area of the South Spit near the sea wall and the old wharf remains to prevent disturbance to the burial grounds located somewhere in the vicinity. An archaeologist will be present to monitor every ground disturbing action to ensure that no cultural resources are disturbed. A Wiyot tribal representative should also be present if so desired by Table Bluff Reservation Tribal officials.

An Agreement will be developed jointly between the BLM Arcata Field Office and Table Bluff Reservation - Wiyot Tribe wherein tribal members will be given the free use of the South Spit for their traditional use and gathering of resources. These activities will include the following: surf fishing, clamming, eeling, gathering seaweed, bay grass, firewood, mushrooms, berries, basketry materials such as hazel, and waterfowl hunting. A tentative seasonal gathering schedule will be developed but may vary according to annual fluctuation of resources. Tribal members utilizing the South Spit will carry and present identification upon request by BLM staff and other law enforcement officers.

Vegetation

Consistent with the 1998 *Recovery Plan for Seven Coastal Plants and the Myrtle's Siverspot Butterfly*, which includes recovery plans for both the Humboldt bay wallflower and beach layia, interim management of native plant habitats and areas of endangered species occupation will focus on prevention of native plant and habitat loss, and the restoration of native dune habitat. Restoration methods employed will consist of manual removal of weeds that threaten further degradation of suitable habitat. Driftwood barriers and/or post and cable fencing may be used to prevent and discourage chronic or high intensity human impacts by foot, horse, or vehicle disturbance in inappropriate and sensitive plant habitat areas.

The BLM will continue to work with the Wildlife Conservation Board toward the public acquisition of the Texaco property to better manage and conserve its valuable plant resources including the threatened populations of Humboldt Bay wallflower and rare salt marsh species. The property will be posted as private on its north and west boundaries to dissuade public trespass.

Vegetative types, and endangered and rare plant species populations will be mapped and monitored. The mapping will provide valuable recreation, restoration, and wildlife planning assistance. Habitat features valuable to wildlife, such as ephemeral wetlands, will be included in the mapping.

Monitoring will occur for beach layia on the South Spit to meet these objectives 1) to collect data to provide occupied habitat area for comparable use in the future, 2) to establish baseline population estimates with which to establish overall population trends in the future, and 3) to observe habitat changes with respect to recreation impacts.

Monitoring for the Humboldt Bay wallflower may occur on the South Spit. If permission can be obtained from Texaco Inc. to enter private property, vegetative and reproductive individuals will be counted and the overall population photo-documented. The BLM is willing to participate with the USFWS and Texaco Inc. to develop and implement a conservation and restoration strategy for the South Spit population, particularly if the USFWS finds that this population is genetically unique to other Humboldt Bay populations. In the event that the BLM is not granted permission to monitor and enhance the wallflower population from Texaco Inc., then, the BLM will patrol the property boundaries to dissuade trespass.

Research proposals will be considered by an interagency research team during the interim management period. Proposals will be evaluated and approved based on the following criteria: 1) they cannot alter natural resource values; 2) they should not compete with other approved projects; and 3) they must contribute to the management and conservation of native populations and habitats on the South Spit.

The BLM recognizes that the South Spit provides geographical range suitable for the subsistence of endangered beach layia and Humboldt Bay wallflower. The immediate objective of the *Recovery Plan* "is to minimize the threats to the species and the habitats upon which they depend." The BLM will work in the interim to conserve these species and minimize threats by removing invasive weeds adjacent to existing threatened populations, managing types and levels of human use such that the species are not negatively impacted, and by working towards developing a conservation strategy by working collaboratively with the local FWS and interested parties during the long-term management planning process.

<u>Wildlife</u>

As a federal agency, the BLM is required to consult with the FWS as directed by the Endangered Species Act, as amended, and receive a biological opinion on the actions proposed in this draft interim plan. It is imperative that BLM modify this plan, as necessary, to comply with terms and conditions of the biological opinion to ensure that the continued existence of the western snowy plover is not jeopardized and that the plan would contribute to the recovery of the species. According to the FWS *Western Snowy Plover Pacific Coast Population Draft Recovery Plan* USDI (2001), the only federally administered land in the Northern California sub-population "Recovery Unit 2" that has documented recent plover nesting attempts, is the South Spit of Humboldt Bay.

1. <u>Surveys and Monitoring</u>
Conduct plover searches along the 4½ miles of the South Spit beach at least once per month during the winter to identify areas of use and numbers of birds and noting actions adversely impacting the birds. Coordinate with Humboldt State University (HSU) researchers (Colwell) and Humboldt County representatives to minimize overlaps and maximize efforts.

Conduct plover searches along the 4½ miles of the South Spit beach at least once per week during the nesting season. Make note of paired birds and nest scrapes and request nest protection actions where appropriate. Monitor nest attempts, nest failures, presence of banded birds, brood numbers, brooding areas, brood failures, adult and brood harassment, and interaction with recreational activities. Record locations of bird activity and attempt to determine failures, abandonments, mortalities, and other incidents. Coordinate with HSU (Colwell) and Humboldt County representative to minimize overlaps and maximize efforts.

Monitor visitor compliance with rules guiding recreational activities and document non-compliance. Document acts of vandalism or tampering with temporary protective fencing or predator exclosures. Document observations of deliberate take of plovers or plover eggs. Coordinate with HSU researchers (Colwell) and Humboldt County representative to minimize overlaps and maximize efforts. All monitoring and protective actions will be conducted by people who hold a recovery permit that covers such actions.

2. <u>Plover Protection Actions</u>

<u>Temporary Nest Protection Area</u>
Upon verification of an active plover nest, a plover protection area will be closed to all recreational activity during the nesting season (3/1 to 9/15). The plover protection area will run along the beach, just above the seasonal high tide line, for a distance of 600 feet on each side of the nest, then proceed eastward to a line 200 feet inland from the nest. Temporary "symbolic" fencing will be erected to delineate the perimeter of the plover protection area. Preventive measures will be taken so as not to create additional perches for avian predators. The proposed plover protection area configuration is designed to:

a) Protect nests from vehicle run-overs and still allow vehicle passage;

b) Protect an area wide enough to make it difficult for predators or vandals to key in on the nest site;

c) Provide a wide enough buffer from unleashed dogs and kite or model airplane types of disturbances;

d) Protect an area deep enough to screen nesting plovers from activities in the back dunes without closing off a large area.

<u>Temporary Brood Protection Area</u>
If an area is discovered where one brood appears to be frequenting for one week, a plover protection area may be established which will be closed to all recreational activity until fledging. Temporary "symbolic fencing" will be erected, above the seasonal high tide line to delineate the concentrated use area of the broods and removed after birds fledge.

<u>Seasonal Habitat Protection Area</u>
In order to provide a dry-sand area of relatively disturbance-free habitat for plovers to initiate nesting activities, a seasonal (3/1 to 9/15) plover protection area will be established near the north end of the South Spit. The area will run from a point approximately 500 yards south of the Jetty for approximately 3,000 feet south along the beach at a level approximately 40 feet inland from the seasonal high tide line. The protection area will extend inland approximately 300 feet into the dunes creating a plover protection area of about 20 acres. The placement of the protection area at this location was chosen for several reasons. The site is toward the north end of the spit where visitor intensity is lower, but with a 500-yard buffer from the concentrated

fishing-sightseeing area at the jetty. The site is where wintering birds were observed in early 2002 and where a pair of plovers were seen as late as mid-April 2002. The beach is at its greatest distance from the access road and would potentially have the least amount of foot traffic by visitors. The site is located where the spit averages about one-half mile in width where plover habitat restoration actions could be implemented without potentially affecting the access road by sand movement. Temporary "symbolic" fencing will be erected to delineate the perimeter of the plover protection area. Preventive measures will be taken so as not to create additional perches for avian predators. The proposed plover protection area configuration is designed to:

a) Protect nests from vehicle run-overs and still allow vehicle passage;

b) Protect an area wide enough to make it difficult for predators or vandals to key in on the nest site;

c) Provide a wide enough buffer from unleashed dogs and kite or model airplane types of disturbances;

d) Protect an area deep enough to provide for the implementation of future habitat restoration activities.

Based on the recommendation of appropriate recovery permit holders, predator-proof exclosures will be constructed at nest sites after the departure of migrating merlins.

Temporary Wintering Protection Area

If an area is discovered where numerous plovers are wintering, a plover protection area may be established which will be closed to all recreational activity until the birds leave the area. A "picket line" of warning signs will be erected to delineate the concentrated use area and will be removed when the birds disburse.

3. Public Education and Enforcement

During the plover nesting season, an interpreter/maintenance person will update kiosk material, perform minor maintenance on fences and signs, and remove garbage which will otherwise be available for potential plover predators. This person will also be used to monitor visitor compliance with rules and document vandalism.

This interpreter/maintenance person will also erect informational and warning signs that will inform the public of plover resources and closure areas. The BLM will coordinate with other agencies to standardize plover signs as much as possible. This will serve to decrease public confusion over plover closures.

If plovers are present, additional staff will be on-site during high use periods (official opening of the area, holiday weekends of Memorial Day, Fourth of July and Labor Day), to act as interpretive/maintenance personnel to greet visitors at the South Spit entrance and to provide educational as well as current information on the presence of snowy plover nesting areas. Direct contact will assist in the visitor being well informed and able to watch for and avoid plovers on the beach.

4. Western Snowy Plover Habitat Restoration

As a part of the Interim Management Plan, a program of western snowy plover habitat restoration is planned. The program would provide an opportunity to increase suitable plover habitat by 80-150 percent over the existing situation.

The establishment of European beachgrass, ice plant and other invasive plants, have interrupted the functioning of natural systems on the spit, to the detriment of the western snowy plover. The stabilization of foredunes by beachgrass has eliminated low-gradient shifting dunes preferred by nesting plovers. The amount of suitable plover habitat available above the high tide line has dramatically narrowed to 30-50 acres. The remaining plover habitat is adjacent to a thatch of continuous vegetative ground cover convenient as ground predator ambush sites.

The most efficient and effective method for restoring a meaningful amount of plover habitat is to use heavy equipment (bulldozers, excavators, etc.) to bulldoze the beachgrass-covered dunes to the natural gradient of the unvegetated beach, disposing of spoils and vegetative material into the winter surf at low tide. The work would be performed at low tide prior to a winter storm so the natural power of the ocean could be used to mobilize and move the material in a natural way as storm drift when large amounts of beach in other local areas are also being mobilized by the storm. An archaeologist and a threatened/endangered plant specialist would be on site during the heavy equipment work to make sure those resources are not adversely impacted by the project. The flattened and exposed sand would then be available to natural wind and water-caused sand movement to maintain a natural dynamic system. Similar projects in degraded dune systems in Oregon have resulted in dynamic increases in plover nesting (Heany, Palermo, Segotta, Frounfelker pers. comm.). Further habitat enhancement may include dumping oyster shell hash on the project site, improving the effectiveness of the cryptic plover plumage and decreasing their vulnerability to predators (Kritz 1999). Resprouting of beachgrass is inevitable and annual maintenance for several years would be required to maintain appropriate landscape conditions. Permits would be required by the, Corps of Engineers, and possibly others.

The current project design would initially treat over one-half mile of foredune ocean-frontage to a distance of 300 feet east of the primary dune and grading it to the natural rise of the beach. This project configuration and location was chosen to treat a large area nearest the existing plover habitat on the widest portion of the spit while not impacting seasonal wetlands or encroaching on the paved access road to the east. The area treated would amount to approximately 20 acres and would be seasonally fenced with cable or rope and removable posts for the duration of each plover nesting season. The current proposed location of the project is in the 20-acre plover protection area mentioned in the “Plover Protection Actions”.

COST ESTIMATES

Following is a list of management actions and projects that will be constructed and/or installed, using Coastal Conservancy grant funds, under interim management of the South Spit.

1. Potential Hazardous Waste Disposal	$ 20,000
2. Stabilize / Re-vegetate old bluff trail	$ 15,000
3. South Jetty Road Repair	$ 70,000
4. Parking and Picnic Areas (includes grading, graveling, tables, restrooms, trash bins, corridors, barriers)	$120,000
5. Caretaker Site	$ 35,000
6. Signing (includes 2 kiosks)	$ 30,000
7. Brochure / Publication	$ 15,000
8. Cultural, Wildlife, Vegetation Inventory (in-house)	$ 0
9. Remove invasive vegetation	$ 20,000
10. Plover Protection Areas	$ 20,000
11. Native American Consultation	$ 5,000
12. Call Boxes (2)	$ 15,000
13. Vehicle Barriers	$ 40,000
14. HSU Visitor Survey	$ 20,000
15. RCAA Overhead	$ 75,000
TOTAL	**$500,000**

Many of the projects and/or management actions listed above may need to be implemented prior to opening the area to the public. They include the following:

- removal of the potential hazardous waste;
- site specific resource inventories for cultural resources, wildlife, and vegetation;
- consultation with the Table Bluff Reservation;
- installation of signs that provide information as well as interim management rules and regulations; and
- construction of vehicle access corridors and barriers.

Development of the caretaker site would not have to be fully completed if a nearby resident is available to serve as a BLM volunteer caretaker.

The following management actions are discussed in the interim plan but not part of the Coastal Conservancy funding at this time:

1. South Jetty Road Rock Revetment (Rip-Rap)	$ 20,000
2. Creating Plover Habitat with Heavy Equipment	$ 75,000

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APPENDIX A: Law Enforcement of the South Spit

Approximately 627 acres of land on the south spit of Humboldt Bay have been acquired by the State of California for purposes of resource conservation and public recreation. Fee title to these lands is to be held by the State of California, with management authority delegated to the Bureau of Land Management.

The acquired lands include most of the land on the south spit, but do not include several parcels of land that are owned privately or by other governmental entities. The newly acquired lands are bounded at the south end of the spit by lands owned by the County of Humboldt at Table Bluff County Park, and by lands owned by the US Fish and Wildlife Service as part of the Humboldt Bay National Wildlife Refuge. Additionally, a parcel of land owned by the Texaco Corporation exists near the south end of the spit, and a parcel owned by the US Army Corps of Engineers exists at the north end of the spit, near the jetty and seawall.

SOURCES OF AUTHORITY

Federal Laws and Regulations

Exercise of federal law enforcement authority by BLM Rangers on the South Spit derives from language in the Deed of Conservation Easement with the California Department of Fish and Game (DFG), Wildlife Conservation Board (DFG), and the United States of America, acting by and through the Bureau of Land Management. The conservation easement applies to approximately 627 acres of land on the south spit owned by the DFG, and conveys to BLM the right to manage that property in perpetuity to protect, preserve, and restore the beach dune habitat, open space, recreational, and scenic values (defined as “conservation values”) of the property.

Acceptance of the conservation easement by BLM is authorized under Section 205 (acquisitions) of the Federal Land Policy and Management Act of 1976 (FLPMA). While DFG remains owner of fee title to the subject lands, grant of the conservation easement conveys to BLM an “interest” in the subject lands. Acquisition of such an interest makes the subject lands “public lands” as defined in Section 103 of FLPMA, and makes applicable to those lands the enforcement provisions authorized pursuant that law, including those contained in Title 43 of the Code of Federal Regulations.

In the conservation easement, the DFG and BLM agree that the purpose of the easement is to “preserve, protect, enhance and restore the conservation values of the property; to provide dispersed recreation for the general public; and to prevent any use of the property that will significantly impair or interfere with such conservation values.” Section 2 (a) of the conservation easement, “Affirmative Rights and Interests Conveyed”, grants to BLM the right “to manage the Property in all aspects of its use in perpetuity, *including the right to enforce the laws of the State of California and the United States of America”*.

California Laws and Humboldt County Regulations
As authorized by Section 303(d) of FLPMA, the BLM has entered into a Memorandum of Understanding (MOU) with the Humboldt County Sheriff granting to BLM law enforcement personnel authority to enforce applicable state law or county ordinances within Humboldt County, CA.

Section III. E. of the MOU defines United States Property as “any land and interest in land owned by the United States within the several states and administered by the Secretary of the Interior through the BLM, and those Federal lands where a MOU or interagency agreement exists allowing the BLM to assist in law enforcement services”.

Section IV. B. 1. (b) of the MOU specifies that designated BLM law enforcement personnel may enforce applicable state law or county ordinances “on property owned or possessed by the United States Government *and on any street, sidewalk, or property adjacent thereto*”.

Section IV. B. 2.(c) of the MOU provides that BLM enforcement personnel will “Issue citations and release persons suspected of misdemeanor and infraction violations of California State laws and County ordinances violations *which relate to natural resource protection or visitor safety protection*.” Section IV. B. further provides, in general and dependent upon individual circumstances, that BLM enforcement personnel will respond to requests for assistance from the Humboldt County Sheriff’s Office, will arrest and transport persons with active arrest warrants, and will arrest or detain persons suspected of violations of state or county laws.

BLM Manual 9260, Law Enforcement General Order number 3, V. C. 2., stipulates that the exercise of state or local law enforcement authority by BLM law enforcement personnel “must involve activities that are necessary for the protection of the public lands or resources administered by the BLM”.

Discussion
In accord with the Deed of Conservation Easement to BLM, the full scope of federal laws and regulations applicable to the public lands apply to those lands which are the subject of the grant of easement. Generally speaking, BLM regulations contained in 43 CFR are applicable only to the public lands, and are not applicable on adjacent parcels of land owned privately, by other federal agencies, the state of California, or the County of Humboldt. In some cases, the BLM has identified the scope of its law enforcement program as extending to related lands and waters. Title 43 CFR regulations involving such extension and which may have applicability to the South Spit relate to closures (sec. 8364) and fire (sec. 9212).

BLM law enforcement activities on lands in which the BLM has no property interest are authorized pursuant to the MOU with the Humboldt County Sheriff. In accord with policy direction contained in BLM Handbook 9260, and consistent with the purpose of the MOU between BLM and the Humboldt County Sheriff, exercise of state enforcement authority by BLM officers on the south spit will involve activities that are necessary for the protection of the public lands resources and visitor safety.

Pursuant to the MOU with the sheriff, BLM officers are authorized to enforce state and county laws on all lands subject to the conservation easement. The MOU further provides authorization for BLM officers to enforce state and county laws on parcels of land meeting the "adjacent thereto" definition with regard to lands on the south spit subject to the conservation easement. These adjacent lands include the Humboldt County Table Bluff County Park, the parcel owned by the Texaco Corporation, the parcel owned by the U.S. Army Corps of Engineers, adjacent lands in the Humboldt Bay National Wildlife Refuge, and tidal lands at and below the mean high tide line (the "waveslope").

With specific regard to Title 50 CFR, wildlife and resource related enforcement issues on lands on the South Spit owned and managed by the FWS in the Humboldt Bay National Wildlife Refuge (HBNWR), an interagency MOU exists within the U.S. Department of the Interior which authorizes cross designation of law enforcement authority between the BLM and FWS. Such cross designation is authorized in circumstances where the designation may be "mutually beneficial, economical, and advantageous to the public interest", and where written local operational agreements have been established by the appropriate managers in charge. Entry into such an agreement by the BLM Arcata Field Office and the HBNWR would likely enhance resource protection efforts on the South Spit.

SPECIFIC ENFORCEMENT ISSUES

Management direction for the South Spit will be consistent with the Humboldt Beach and Dunes Management Plan. Since existing federal regulations do not specifically address a number of activities proposed in this interim management plan, BLM law enforcement personnel will need to utilize a number of state and county regulations in order to achieve effective management of human activity on the spit. These regulations are, for the most part, already in place within the Humboldt County Codes and/or Title 14 of the California Code of Regulations. It is anticipated that, concurrent with development of a long term management plan for the area, federal supplemental rules will be proposed which will enable BLM Rangers to achieve enforcement and management objectives within the framework of Code of Federal Regulations. Specific non-federal regulations anticipated to be necessary for effective management of the South Spit are outlined below.

Off Road Use of Motor Vehicles

Existing Humboldt County regulations address issues of off-highway vehicle use on the South Spit and at Table Bluff County Park. Separate county regulations exist for county park areas. Dependent upon location, i.e., whether within the boundaries of the county park or elsewhere along the spit, different regulations related to vehicle use may apply. It should be noted, however, that for purposes of BLM enforcement related to motor vehicle use on the south spit, the Humboldt County Beach and Dunes Planning Area (and the HCC 917 regulations promulgated thereunder) includes the full length of the South Spit from the county park northward to the south jetty.

Regulations are summarized as follows:

The South Spit, generally:

HCC 917-3**:** Motor Vehicles Prohibited on Beach and Dune Areas:
All motor vehicles, including four-wheel drives, ATVs, and motorcycles, are prohibited from operation except on roads, parking areas, designated beach access routes, and the waveslope of the ocean beach. (Waveslope defined (HCC 917-2): "The area of the beach that shows evidence of having been washed by waves during the last tidal cycle.")

HCC 917-6: Speed Limits:
Driving on the waveslope is limited to 15 miles per hour.

HCC 917-5: Vehicles Prohibited - Snowy Plover Habitat:
All vehicle use is prohibited during the snowy plover nesting season at any posted site, as necessary to protect the seasonal nesting area of the endangered snowy plover.

Within Table Bluff County Park:

HCC 271-13: Speed Limit:
The maximum speed limit on any County park beach area is 15 mph except upon such roads as the Director may designate for higher or lower speed limits.

HCC 271-14: Vehicle Types Allowed, Where Allowed, Speed Limit, Vehicle Play
All types of vehicles allowed. Vehicles allowed on waveslope only. The waveslope shall be accessed only by the designated access route. No driving in dunes. No person shall operate any motor vehicle for the purpose of vehicle play. The speed limit is 15 miles per hour.

Overnight Camping:
Existing Humboldt County regulations prohibit overnight camping on the South Spit and at Table Bluff County Park, as follows:

South Spit, generally:

Humboldt County Zoning Ordinance A311-4:
This county zoning ordinance prohibits uses that are inconsistent with an area's zoning designation, e.g., camping in areas that area not designated for camping. The south spit is not designated to permit overnight camping.

Table Bluff County Park:

HCC 271-9: Length of Stay:
No person shall reside, remain, or park overnight in any park not designated for overnight camping.

Firearms Possession and Use:
Existing county regulations address issues related to possession and use of firearms only within county park areas, i.e., only within Table Bluff County Park. Existing regulations do not

specifically prohibit such possession and/or use of firearms except as follows:

HCC271-5: Hunting, Fishing and Use of Firearms and Other Weapons:
No person in a park shall hunt, harm, kill...any mammal, amphibian, reptile, or bird.
No person in a park shall use any firearm of any size or description, air rifle, pellet gun, bow and arrow, sling, or any weapon or instrument which when so used creates a significant risk of harm to wildlife or human safety...

It is anticipated that, consistent with the stated objectives of the interim management plan for the South Spit, regulations prohibiting use of firearms and other weapons will be promulgated by the CFG under Title 14.

Dogs and Animal Control:
Humboldt County has an animal control ordinance currently in effect:

HCC 541-21(a): Confined to Owner's Premises:
Requires that any dog owned, harbored, or controlled by a person be kept under the control of the owner or other authorized person when the dog is not on the premises where owned, harbored, or kept.

APPENDIX B: Cultural Resource Laws and Regulations

There are multiple federal laws and regulations governing the management of cultural resources and Indian relationships as pertains to the South Spit. The Federal Land Policy and Management Act of 1976 (FLPMA)(43 USC 1701; 90 STAT.2743) Section 307 (a) provides that the Secretary of the Interior may conduct investigations, studies and experiments, on his/her own initiative or in cooperation with others, involving management, protection, development, acquisition and conveyance of public lands and (b) may enter into cooperative agreements for these purposes, subject to applicable law; and Section 202 (b) provides Tribal officials an opportunity to raise issues and comment on BLM's land use plans. FLPMA also sets policies under Section 102 (a) (2) that public lands and their resources should be periodically and systematically inventoried with present and future use designated through a land use planning process coordinated with other Federal and State planning efforts and Section 102 (a) (8) managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values.

E.O.13084 of 1998 orders federal agencies to consult and coordinate with Indian tribal governments and mandates government-to-government relationships between Indian tribes and federal agencies. The 1998 Protocol Agreement between California BLM and State Historic Preservation Office (SHPO) requires each field office to develop a government-to-government protocol with the Federally recognized Indian tribes within their jurisdiction or who historically occupied the area.

The National Environmental Policy Act (NEPA) of 1969 provides Tribal officials a 30-day opportunity to review and comment on EA's and 45 days on EIS's that may contain resources of interest or importance to them. Federal agencies are encouraged to coordinate compliance with NHPA's Section 106 and its procedures to meet the requirements of NEPA. EO 11593 of 1971 furthers the purposes and policies of NEPA and mandates Federal agencies to provide leadership in preservation, restoration, and maintenance of the Nation's historic and cultural environment and to inventory, evaluate, and nominate qualifying historic properties to the National Register of Historic Places.

The National Historic Preservation Act of 1966, as amended, and its Guidelines lay out the BLM's responsibilities under both Section 106 (protection of historic properties and response to proposed undertakings) and Section 110 (integrates historic preservation into BLM programs and missions and is proactive) and is applicable to BLM controlled or managed properties such as the South Spit. Sections 110(a)(1) and 110(b) and 110 (2) of the National Historic Preservation Act of 1966, as amended, directs the federal government to preserve the heritage of the United States in cooperation and partnership with States, local governments, Indian tribes...; to document, record, and report heritage resources; and to work with other agencies, Indian tribes, local governments, and SHPO's to advance the Act's purposes .

There are two main purposes of the Archaeological Resources Protection Act of 1979 (P.L. 96-95; 93 Stat. 721; 16 USC 470aa-ll) as applied to the South Spit. The first is to protect cultural resources from "unauthorized excavation, removal, damage, alteration, or defacement." The second is to "increase communication and exchange of information among governmental authorities, the professional archaeological community, and private individuals having collections of archaeological resources and data which were obtained prior to enactment of the Act." Under ARPA, the BLM must notify Tribal officials 30 days in advance of issuing a permit that may harm or impact an "Indian religious or cultural site on public lands."

The American Indian Religious Freedom Act (AIRFA) of 1978 sets goals relating to the preservation of Indian religious sites and practices that may be impacted or interfered with by federal development of natural resources and requires consultation with concerned Indian tribes which in this case would be Table Bluff Reservation - Wiyot Tribe.

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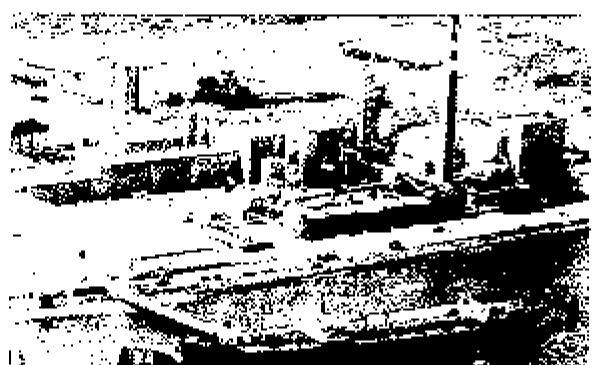

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By

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U.S. Department of the Interior
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Washington, D.C. 20240

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Preface

This estuarine profile is one of a series of profiles that synthesize current ecological and other pertinent information on selected estuaries of the United States. The data in this profile on Humboldt Bay provide a scientific reference on the bay's natural resources and will aid in the management and protection of the estuary. Humboldt Bay is one of the most valuable coastal resources on the west coast of the United States.

The profile provides current and historical information on the geographic setting of Humboldt Bay; describes geological, climatological, hydrological, and physicochemical aspects of the bay environment; describes the biotic communities and their relationships; compares and contrasts other west coast estuaries to Humboldt Bay; provides management considerations in terms of procedures, socioeconomic factors, and environmental concerns; and identifies research and management information gaps important to proper management and protection of the bay.

The information in this profile should also be useful to educators, students, and interested laypersons. The style and format are designed to make the profile useful to many different interests.

Conversion Table

Metric to U.S. Customary

Multiply	By	To obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters (m)	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers (km)	0.5396	nautical miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (L)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons (t)	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (° C)	1.8 (° C) + 32	Fahrenheit degrees

U.S. Customary to Metric

Multiply	By	To obtain
inches (in)	25.40	millimeters
inches (in)	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
square miles (mi^2)	2.590	square kilometers
acres (a)	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
pounds (lb)	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (° F)	0.5556 (° F -32)	Celsius degrees

Humboldt Bay estuary, California, looking east from the Pacific Ocean (from an infrared color photograph).

The Ecology of Humboldt Bay, California: An Estuarine Profile

by

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Abstract. Humboldt Bay is one of California's largest coastal estuaries, second only to San Francisco Bay in size. The bay is important ecologically, serving as habitat for many invertebrates, fishes, birds, and mammals. The bay attracts many recreational users and because it is an important shipping port also attracts industry, particularly that related to forest products. This report summarizes and synthesizes scientific data on the ecological relationships and functions of the estuary, including information on geological, climatological, hydrologic and physical-chemical aspects of the bay environment; describes the biotic communities and their relationships; compares and contrasts other west coast estuaries to Humboldt Bay; provides management considerations in terms of procedures, socioeconomic factors and environmental concerns; and identifies research and management information gaps. Portions of the bay are managed as a national wildlife refuge. Management issues for this ecosystem include loss of habitat and degradation of the environment by additional industrial development and nonpoint source pollution.

Key words: Estuaries, wetlands, ecology, geology, hydrology, nekton, benthos, plants, invertebrates, vertebrates, contaminants.

Chapter 1. Introduction: The Ecology of Humboldt Bay

Humboldt Bay is one of California's largest coastal estuaries and is the only harbor of commercial importance for major shipping between San Francisco Bay, 372 km south, and Coos Bay, Oregon, 335 km north. The bay, located at latitude 40°46'N and longitude 124°14'W, consists of three arms: South Bay, a wide, shallow southern arm; Entrance Bay, a relatively narrow, deeper central area; and Arcata Bay, the largest arm to the north, also wide and shallow (Fig. 1.1). Humboldt Bay is 22.5 km long and 7.2 km wide at its widest point; its area is 62.4 km^2 at mean high tide (MHW) and 28.0 km^2 at mean low tide (MLLW), according to Proctor et al. (1980).

Both South and Arcata bays consist of extensive mud flats interlaced with drainage channels. More than half of the surface area of these two bays is exposed at low tide. Arcata Bay has a total of six islands: Indian (Gunther), Woodley, and Daby islands are in the southwest corner, just north of the separation between Eureka and Arcata channels; Bird, Sand, and Little Sand islands are all located just north of the separation between Mad River Slough and the old Arcata Wharf pilings (Skeesick 1963). Entrance Bay has one deep connecting channel (Samoa Channel) that joins the two major arms and also leads to the ocean, providing daily exchanges of seawater. The entrance to the bay is maintained by concrete and rock jetties, 2 km or more long.

Humboldt Bay is a "normal" or "positive" type of estuary according to the classification system of Emery and Stevenson (1957). These authors pointed out, however, that a large estuary opening to the sea near the middle is a complex environment and is not easily classified. Costa (1982) characterized Humboldt Bay as a multibasin, tide driven coastal lagoon with limited fresh water input. True estuarine conditions occur only where bay waters are measurably diluted by fresh water from major winter storms events.

Humboldt Bay is separated from the ocean by long sand spits. South Spit is narrow with low sand dunes and sparse vegetation. During extreme high tides and high seas, the ocean surf may pass over South Spit into the bay (Monroe 1973). The northern spit (Samoa Spit) is much higher and wider than South Spit and, although there is a dune community remaining, much of the spit has been developed for industrial and residential use.

Humboldt Bay's 578 km^2 drainage basin lies in the foothills of the Coast Range. The bay is immediately surrounded by lowlands, formerly marshy extensions of the bay, which were diked and drained for agricultural use, primarily grazing, beginning in the 1880's. The lowlands are intersected by low foothills of the Coast Range, which extend nearly to the bay shore at several locations (Monroe 1973). No large rivers enter the bay; major sources of fresh water are Jacoby Creek and Freshwater Creek in Arcata Bay, Elk River in Entrance Bay, and Salmon Creek in South Bay. In September 1971 portions of South Bay and Arcata Bay were set aside to form the Humboldt Bay National Wildlife Refuge, primarily to preserve and enhance migratory birds and their habitats.

Two cities, Eureka and Arcata, and five smaller communities are located on or near the bay, resulting in a total population of about 70,000 for the bay area. Much of the shoreline of Entrance Bay is occupied by port facilities for shipping, commercial fishing, and associated services. A number of other industrial sites are situated at various locations on Humboldt Bay. The remaining shoreline is used for agricultural purposes or remains undeveloped (Fig. 1.2).

During the recent geological past, before 2000–3000 years ago, the Mad River probably emptied into Humboldt Bay (Vick 1988; Vick and Carver 1988). The three embayments of Humboldt Bay occupy the seaward edge of a river valley drowned by increasing sea levels. This valley over time filled

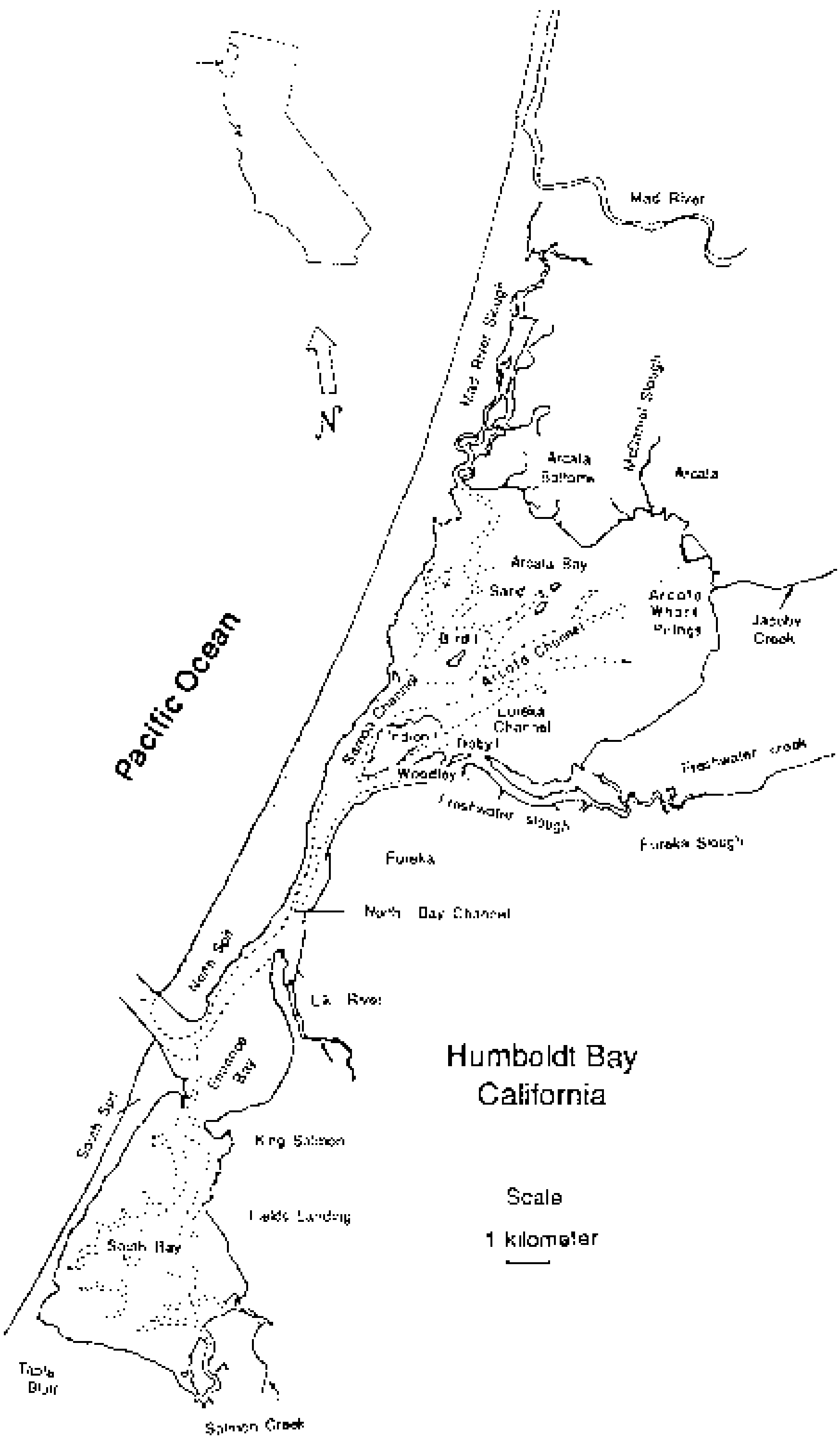

Fig. 1.1. Humboldt Bay, California, and environs (modified from Costa 1982).

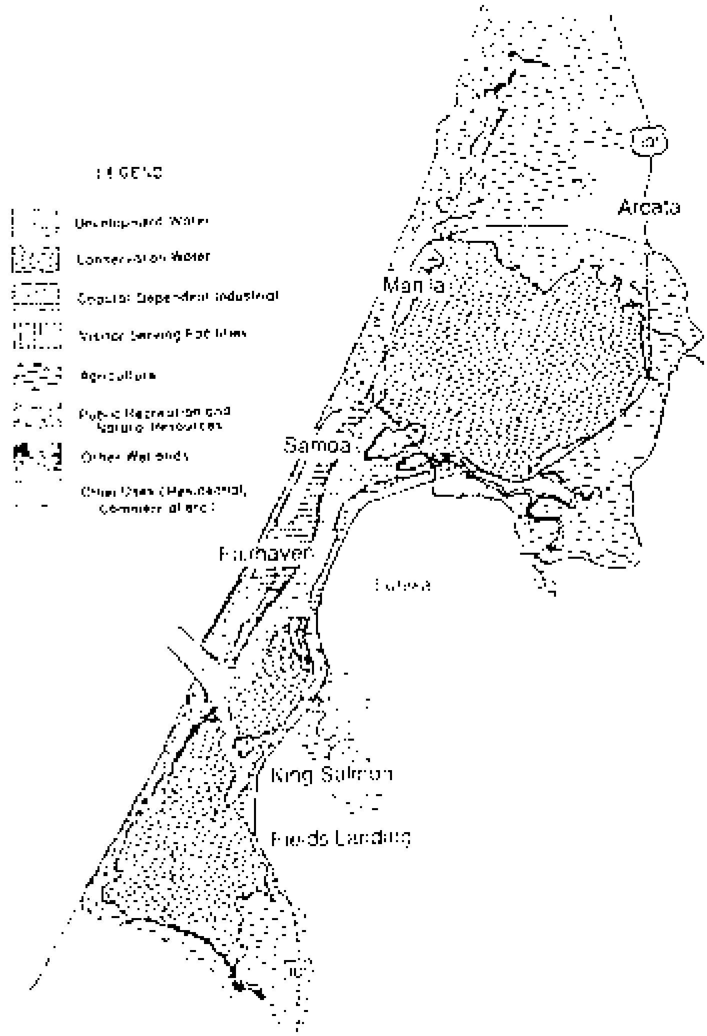

Fig. 1.2. Land-use patterns, Humboldt Bay environs (from Ray 1982).

with recent flood plain, tidal flat, and marsh deposits. Bay sediments contain buried salt-marsh deposits that represent episodic rapid subsidence of low-lying areas due to large magnitude subduction zone earthquakes during the Upper Holocene period resulting in the present configuration of Humboldt Bay (Vick 1988; Vick and Carver 1988).

The bay was discovered in 1806, but no settlement took place until the 1850's, when Humboldt Bay became a point of embarkation and supply for the gold mines of Trinity and Siskiyou Counties (Monroe 1973). Settling of early bay communities led to the immediate displacement of the resident Wiyot Indian population, which was estimated to be about 1,000 persons in 1850 (Glatzel 1982). The lumber industry soon developed and shipping facilities were built to export wood and agricultural products. Secondary harbors were developed in the bay by Finnish fishermen who settled in the Fairhaven area.

Land-use changes in the bay itself resulted primarily from the expansion of shipping. Docks were built in Eureka and Fields Landing and sailing vessels even reached upper Arcata Bay at a point near McDaniel Slough, where the city of Arcata maintained a dock. Ancillary shipping services, such as boat building and repair, were quite extensive in the bay from 1870 to 1946 (Glatzel 1982). In 1881, Congress authorized the U.S. Army Corps of Engineers (Corps) to dredge the navigation channel in front of Eureka to a depth of 3.3 m, and a channel at the Arcata wharf to a depth of 2.6 m. Currently the Corps maintains the entrance channel at 12.2 m deep; North Bay, Samoa, and lower Eureka

Fig. 1.3. Jetties define the entrance to Humboldt Bay.

channels at 10.7 m deep; and upper Eureka and Fields Landing channels at 7.9 m deep by periodic dredging. Maintenance of the Arcata channel has been discontinued due to nonuse. The entrance channel to Humboldt Bay was stabilized by the construction of jetties in 1889–99 (Fig. 1.3).

There was a period of rapid wetland change after the completion of the Northwestern Pacific Railroad along the eastern margins of Humboldt Bay in 1901. The railroad functioned as a dike in most locations, and tide gates were placed at almost all slough crossings. Many wetlands were converted to agricultural land, and seasonal wetlands were used for grazing. By 1927, with the construction of Highway 101 and the associated filling, most of the marshes east of Humboldt Bay had been diked and drained (Fig. 1.4; Ray 1982).

Development of Woodley Island first occurred with the placement of dredge spoils on a tidal marsh. Later, the island was used for building and repairing ships and for log storage. Commercial use of the island was abandoned between the 1950's and 1979; some minor residential use and goat grazing still occur. In 1971, the Humboldt Bay bridge was completed, connecting Eureka with the north spit. Part of the bridge construction involved filling mud flats, salt marsh and a small freshwater

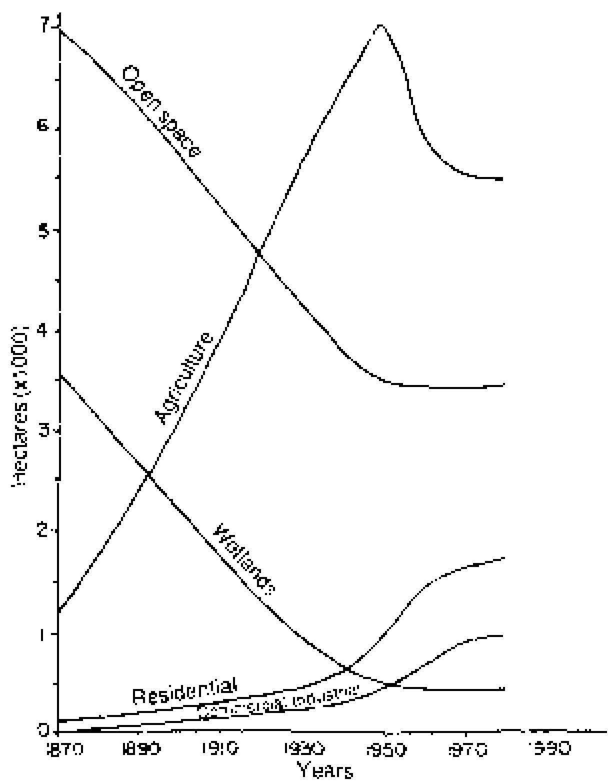

Fig. 1.4. Humboldt Bay land-use changes, 1870–1980 (modified from Shapiro and Associates, Inc. 1980).

Fig. 1.5. Commercial crab boats at dock in Humboldt Bay.

pond on Woodley Island. Road access to Woodley Island allowed for planning and completion of the Woodley Island Marina in 1980. This project affected approximately 1,000 m of shoreline, where intertidal and subtidal mud flats were dredged and adjacent salt marsh and higher ground were filled to provide access, parking, and facility construction sites.

Originally, Humboldt Bay encompassed about 10,931 ha (Monroe 1973). Because of diking, drainage, filling, and other developments continuing to the present, the bay has been reduced to about 7,290 ha at mean high tide (calculated from Shapiro and Associates, Inc. 1980). Nevertheless, Humboldt Bay continues to be vital habitat for many fish and wildlife species. To date, 110 species of fishes have been recorded from the bay (Gotshall et al. 1980). Annual runs of chinook salmon (*Oncorhynchus kisutch*), coho salmon (*O. tshawytscha*), and rainbow trout (*O. mykiss*) still ascend major bay tributaries. The bay is an important nursery area for several commercial species including English sole (*Parophrys vetulus*), Pacific herring (*Clupea harengus pallasi*), lingcod (*Ophiodon elongatus*), some surfperches (Embiotocidae), and some rockfishes (Scorpaenidae). The bay is also an important nursery ground for at least three species of commercially or recreationally valuable crabs (Figs. 1.5 and 1.6): market or Dungeness crab (*Cancer magister*), rock crab (*C. antennarius*), and red crab (*C. productus*). At least 110 species of birds regularly frequent the various wetland habitats that occur in the Humboldt Bay area (Springer 1982). Springer extrapolated data by Hoff (1979) to estimate the average annual bird-days on agricultural lands in the entire Humboldt Bay area at 310,000 waterfowl, 2,700,000 shorebird, 650,000 other waterbird, 36,000 raptor, 17,000 upland gamebird, and 6,500,000 songbird bird-days. The bay is also important habitat for mammals; over 30 species have been found in and around Humboldt Bay (Shapiro and Associates, Inc. 1980). The bay also continues to be of considerable importance for shipping of forest products, commercial fishing, and seafood processing (Fig. 1.7).

Fig. 1.6. Processing the dungeness crab for market.

Fig. 1.7. Processing shrimp caught outside Humboldt Bay.

Chapter 2. Environmental Setting

Geological Aspects

Regional Geology

Humboldt Bay is situated approximately 50 km northeast of a Gorda-Pacific-North American triple junction. This triple junction represents the intersection of three crustal plates: the Pacific plate to the south, the Gorda plate to the northwest, and the North American plate to the east. The region is tectonically active, with the Gorda plate being subducted beneath the North American plate. The relative motion between these plates has produced a number of northwest-southeast trending faults in the vicinity of Humboldt Bay. River valleys cut through the various formations also trend northwest-southeast, along the fault lines. Rocks formed from marine sediments have been planed down by wave action and subsequently uplifted and folded to form marine terraces. This uplifting and folding, the differential motion at the various fault lines, and erosion have exposed a wide range of rock formations in a complex pattern around the Humboldt Bay area.

Geologic History

Four main geologic formations are exposed in the Humboldt Bay region. The oldest is the Franciscan Formation, Late Jurassic to Late Cretaceous in age (Ogle 1953). This mixture of graywacke, sandstone, shale, chert, altered basalt, and some limestone is overlain by the Yager Formation, consisting of interbedded shale, graywacke, and conglomerate. The Wildcat Group is younger (Late Cenozoic in age) and consists predominantly of weakly lithified mudstones, along with weakly consolidated siltstone, sandstone, conglomerate, and some interbedded limestone, tuff, and lignite. The Hookton Formation is younger still (Pleistocene in age) and is made up of continental and shallow marine deposits of variable lithology. These sediments are characteristically yellow-orange in color and consist of gravels, sands, silts, and clays. The most recent deposits are river channel and floodplain deposits, beach and dune sands, tidal flat deposits, and landslide debris. These deposits are 5–7 m thick and consist mainly of gravel, sand, and silt deposited by the Mad and Eel rivers.

Tectonics and Faulting

Cape Mendocino, where the San Andreas fault bends abruptly and follows the seismically active Mendocino fracture zone, lies 50 km south of Humboldt Bay. It is one of the most seismically active areas of California and has been the location of several earthquakes that caused damage to the Humboldt Bay area this century.

Major structural patterns are chiefly controlled at Cape Mendocino. Regional north-south compression has resulted in a radial pattern of right-lateral strike-slip faults trending in a west-northwesterly direction towards the Gorda Basin. The Mad River fault zone and the Russ Fault–False Cape shear zone, both active, bound the Tertiary sediments of the Eel River syncline.

Bay Morphology and Probable Formation

As mentioned previously, Humboldt Bay consists of three subbays, each situated at the seaward end of one or more stream valleys (Fig. 1.1). Arcata Bay (North Bay), the largest subbay, has Jacoby Creek flowing into the northeast corner and Freshwater Creek flowing into the southeast corner. Entrance Bay is found at the mouth of the Elk River valley; Salmon Creek flows into South Bay. The subbays are linked by relatively narrow channels constricted between the valley interfluves on the east (Eureka area and Humboldt Hill) and the barrier spit on the west. A very short channel connects South Bay and Entrance Bay, while the relatively long (approximately 9.7 km) and narrow North Bay Channel connects Entrance Bay and North Bay. The north end of North Bay Channel forks at Indian Island; the west fork is called Samoa Channel and the east fork Eureka Channel.

Fig. 2.1. Intertidal mudflats in Arcata Bay.

Arcata Bay and South Bay are characterized by three distinct morphologic subdivisions (Thompson 1971). The first subdivision, approximately 19% of the MHW area of Humboldt Bay, is tidal channel, which is the deepest part of the Bay, situated almost entirely below MLLW. The channels shoal in an up-bay direction from as deep as 9 m near the entrance to 2–3.5 m deep in the upper reaches of Arcata and South bays. There they form a complex tributary system and ultimately converge with the second morphologic subdivision, the intertidal mudflats, which occur as a more or less continuous apron around the flanks of Arcata and South bays. Mudflats are a dominant feature during periods of low tide (Fig. 2.1). The mudflats make up 77% of the MHW area of Arcata Bay, 81% of the MHW area of South Bay, and 65–70% of the total area of the bay. They extend from slightly below MLLW up to MHW, a relief of about 2 m. They are further subdivided morphologically into two fairly distinct parts: the high flats, which are steeper and run from MLLW to MHW; and the low flats, which are fairly flat and are found just below MLLW. About 61 km^2 of tidal mudflats are exposed at MLLW tidal levels or lower. The low flats are dissected by numerous small tidal gullies and are the regions of the most luxuriant growth of eelgrass, *Zostera marina*. Both low flats and eelgrass are most common in South Bay. The third morphologic subdivision is the salt marshes, which occur around the fringes of the tidal flats. Salt marshes currently cover approximately 4% of the Humboldt Bay area.

Unlike the other two subbays, Entrance Bay does not have broad expanses of tidal flats (less than 10%) and the surface area remains approximately constant over a tidal cycle. This is because Entrance Bay consists of a single deep channel with generally steep sides (Entrance Channel) that connects Humboldt Bay with the ocean. The channel is approximately 1,829 m long and 671 m wide at the seaward end and is flanked by twin jetties that extend 1,250 m offshore.

Humboldt Bay is apparently a bar-built estuary, formed from three distinct coastal plain estuaries that have been linked by the growth of the North and South spits. The present shape of Humboldt Bay probably developed during and since the last rapid rise of sea level, which occurred between 15,000 and 4,000 years B.P. (before present). One possible scenario is as follows: at the beginning of this period, sea level was 100–200 m below the present level. The Elk River and Jacoby, Freshwater, and Salmon creeks all likely flowed seaward of their present extent and occupied valleys located at the present site of the bay. From approximately 15,000 to 5,000 years B.P., sea level rose rapidly to within 5 to 10 m of its present position. As a result, the stream valleys became flooded, forming coastal plain estuaries over land that is now exposed (e.g., Sunnybrae and Arcata bottoms). The entire region extending from the McKinleyville Terrace in the north to Table Bluff in the south became a single open coastal embayment. As the rise in sea level slowed about 4,000-5,000 years B.P., the streams entering the arms of the embayment began pushing the shoreline seaward by first depositing estuarine and then deltaic sediment near their mouths. The Mad River, which may once have flowed into the embayment, is now separated from Humboldt Bay by the floodplain called Arcata Bottoms. Barrier islands extending across this coastal embayment were formed by wave activity concentrated along the shore seaward of its present position. With the subsequent rise in sea level, wave action moved the barrier island spits and eroded the cliffs of the McKinleyville Terrace and Table Bluff to their present position. Eventually, a single bay entrance, approximately in the present location, was developed and maintained.

Bottom Sediments

Sediment Sources

The sediments in Humboldt Bay are derived from three main sources: runoff, oceanic input, and biological activity. Biological activity is the least important of the three. The creeks and small rivers carrying sediments into the bay may produce localized effects (i.e., at the mouth of Jacoby Creek), but since the watershed leading directly into Humboldt Bay is quite small (approximately 578 km^2), direct sediment input from runoff is also of limited importance. Much of the silt and clay in Humboldt Bay, and probably much of the sand as well, enters the mouth of the bay during flood tides. Thompson (1971) estimated a yearly oceanic sediment input of $5.4 \cdot 6.7 \times 10^5$ m^3 as compared to only 9.0×10^4 m^3 of sediment per year from rivers and creeks. Most of this oceanic sediment is probably derived indirectly from river sources, however, particularly the Eel River, which discharges 15 km south of the mouth of Humboldt Bay. The Eel River has one of the highest sediment yields per unit area in the world and has the highest sediment yield per unit area of any major drainages in the United States (Judson and Ritter 1964; Brown and Ritter 1971; Jones and Stokes Associates, Inc. 1981). The nearshore currents tend to be towards the north (Davidson Current) during periods of high runoff, when the sediment load in the Eel River is extremely high. The Eel River plume is then carried into the bay during flood tides; Carlson (1973) has observed this from satellite imagery. Some of these sediments settle during the subsequent slack tide and remain in the bay. The Mad River, located to the north of Humboldt Bay, probably also contributes sediments in the same fashion during periods of southward-flowing nearshore currents. But it does so to a much lesser degree because the sediment load of the Mad is only about 9% of that of the Eel, and because the periods of southward flow do not tend to coincide with periods of high river runoff.

Distribution Patterns

Thompson (1971) produced the most complete description of the Humboldt Bay sediments (Figs. 2.2 and 2.3). Boyd et al. (1975) and Burdick (1976) provided additional information on sedimentation rates and the composition of the channel sediments. Thompson noted that the textural variations of the surface sediments are generally correlated with the morphologic subdivisions of the bay floor (tidal channels, mudflats, and salt marshes).

The sediment distribution pattern is produced mainly by tidal currents (Thompson 1971). The coarsest sediments are found in the channels near the mouth of the bay, where tidal currents scour the bottom and leave only coarse sands, gravels, and shell fragments. The sediments decrease in size as one moves up the channels and onto the mudflats because of reduced current activity and because fine sediments settle more slowly than coarse sediments. In addition, sediment from runoff may influence the grain size distribution in certain areas of the bay. This is most noticeable at the mouth of Jacoby Creek in the northeast corner of Arcata Bay, where the sediments are an even mixture of sand, silt, and clay (Thompson 1971; Figs. 2.2 and 2.3).

Once sediments are deposited, wind plays a role in redistributing them. Certain areas of the bay are protected from wind waves by the short fetch for north and northwest winds and therefore tend to have fine-grained (silty clay) sediments. Other areas, such as the south and east margins of Arcata Bay, tend to have slightly coarser-grained sediments (clayey silt) because the fetches leading into

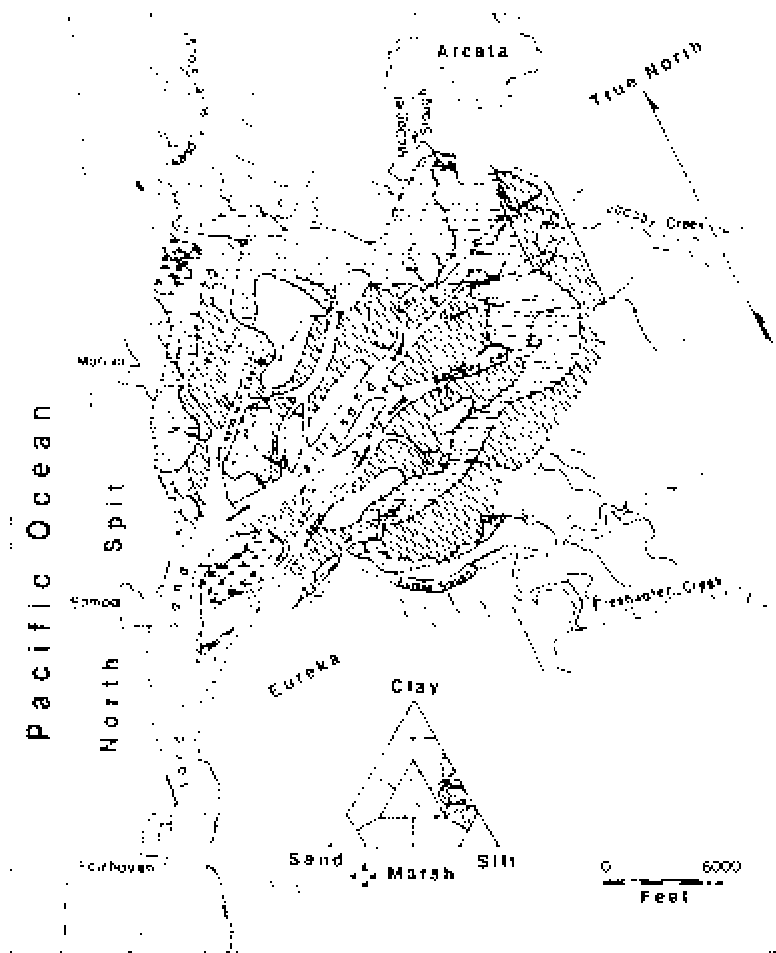

Fig. 2.2. Sediment distribution in Arcata Bay (from Thompson 1971).

them are sufficiently long to allow formation of wind waves capable of resuspending the finer sediments. The resuspended sediments are then transported away from these areas by tidal and wind-generated currents. The finest sediments (silty clays) are found around the wind- and wave-protected margins of the mudflats and in the salt marshes (Figs. 2.2 and 2.3). Thompson (1971) noted organic concentrations as high as 80% in marsh sediments. Material that is not immediately added to the bay is often buried and compressed, forming peat deposits.

Overall, the sediments in Arcata Bay tend to be finer than those in South Bay. There are a number of factors contributing to this difference. First, sediments in estuaries tend to become finer with distance from the mouth because of decreased flushing rates (less disturbance of the bottom) and the fact that fine particles have slower settling velocities than coarse particles. Arcata Bay, located at the end of a relatively long channel, is farther from the bay mouth and so receives less sediment but proportionately more clay than South Bay, which receives considerable amounts of silt and clay. Second, sediments in estuaries also tend to become finer with decreasing water depth, and Arcata Bay has relatively more high flats than South Bay.

The low flats of South Bay are covered with finer sediments than the low flats of Arcata Bay. Thompson (1971) attributed this mainly to oyster harvesting, which takes place in Arcata Bay but not in South Bay. The harvesting resuspends the substrate of the low flats, allowing fine sediments to be preferentially removed. In addition, coarse shell material is added to the low flats as part of the

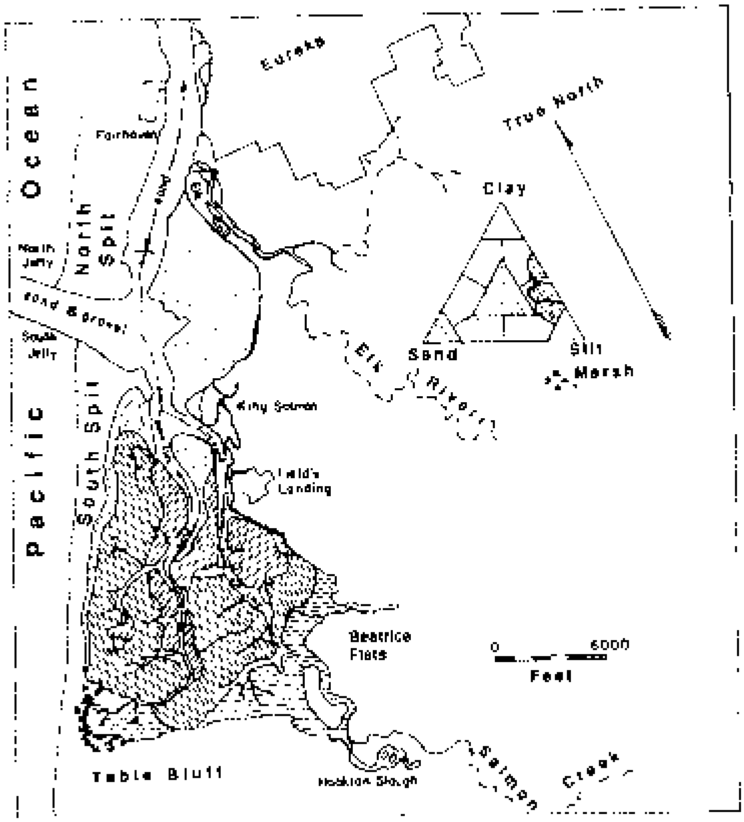

Fig. 2.3. Sediment distribution in South and Entrance bays (Thompson 1971).

oyster-culturing process. The dredging operations associated with oyster harvest have probably decreased the distribution and amount of eelgrass on the low flats in Arcata Bay (Waddell 1964; Keller and Harris 1966; Thompson 1971; Harding and Butler 1979); the low flats of South Bay have extensive eelgrass stands, which slow the current action and trap fine sediments.

Modification of Bay Morphology

The change in sediment distribution associated with oyster harvesting is but one example of how human activities in and around Humboldt Bay have changed the character of the bay during the last 100 years (Waddell 1964; Thompson 1971). The installation of jetties at the entrance of Humboldt Bay and the dredging of the channels to improve ship access and navigation have changed the circulation and sedimentation patterns in the bay (Noble 1971; Pequegnat 1988). Diking and filling in much of the salt marsh in both Arcata and South Bays have resulted in changes in circulation and nutrient cycling. In addition, deforestation in the watersheds of the bay and of the Mad and Eel rivers has dramatically increased the input of sediment into the bay by accelerating erosion of the surrounding fields, streambanks, and shores (Thompson 1971).

Jetties

The northern California coast is noted for its rugged features and rough seas. As the only deep-water harbor between San Francisco Bay and Coos Bay, Oregon, Humboldt Bay provides important shelter to marine vessels, especially during rough weather. Despite the construction of two jetties (Fig. 1.3), the entrance to Humboldt Bay remains quite dangerous to navigate (Bascom 1980).

The building of jetties at the mouth of Humboldt Bay was first proposed as part of the Rivers and Harbors Act in 1884, and the first jetties were completed in 1899 (Noble 1971). The south jetty deteriorated to the point where it had to be rebuilt between 1911 and 1915, and the north jetty had to be rebuilt shortly thereafter (Bascom 1980). The work was completed in 1927, but further repairs were needed by 1932 and again in the 1940's. After the heavy storms of the "El Nino" year of 1957–58, the jetties needed to be repaired again, and yet again after the winter storms of 1964–65. In 1971 there was a major rehabilitation of both jetties involving the placement of 246 reinforced concrete dolosses at the ends of the jetties (U.S. Army Corps of Engineers 1976). These 38-t dolosses have a shape designed to absorb wave energy and to resist movement, but they tend to promote water currents that cause scouring at the ends of the jetties and subsequent settling of the structure. The ends of the jetties were built up by placing additional dolosses on top of the others in 1987, but it is likely that settling of the dolosses will be a continuing problem.

Dredging

In 1881 Congress authorized the Corps to dredge a navigation channel in Humboldt Bay extending to Eureka and the Arcata wharf (University of Washington 1955; Reilly 1966). The work was performed in 1881 and 1882. All subsequent dredging has involved the deepening and widening of existing channels (Reilly 1966). Entrance Channel, North Bay Channel, Samoa Channel, and Eureka Channel are currently the principal commercial waterways of North Bay and are maintained by the Corps to depths of 7.9–10.7 m. Only one channel in South Bay, the Fields Landing Channel (Hookton Channel), is used commercially and maintained by the Corps. This channel was first dredged in 1883.

Prior to 1976, an average of 6.2×10^5 m^3 of sediment was removed from Humboldt Bay yearly because of ongoing widening and deepening of the channels (Thompson 1971; U.S. Army Corps of Engineers 1976). Between 1977 and 1982, between 4×10^5 and 8×10^5 m^3 of sediment were periodically removed from the bay and disposed of at the offshore disposal site (Borgeld and Pequegnat 1986). There has also been periodic dredging in the vicinity of Woodley Island Marina on the Eureka Inner Reach; the most recent was during the spring of 1988.

Diking and Filling

Extensive areas around Eureka and Arcata to the north and east of the bay are lowlands, consisting of creek and river floodplains and former tidal marshes that were drained and converted to agricultural uses. Due to diking, the salt marshes around Humboldt Bay were reduced from approximately 2,833 ha to about 393 ha (10–15% of the original area; Fig. 2.4), decreasing the tidal prism of the Bay and markedly changing fish and wildlife habitat (Shapiro and Associates, Inc. 1980).

Numerous parts of the bay have also been filled for various reasons. Bracut Lumber and Arcata Redwood created the most notable fills on the eastern perimeter of Arcata Bay by using fill dirt from a hill in the Bracut area. The site of Mid-City Motors and the Murray Field Airport, also on the eastern side of Arcata Bay, are other regions that have been created by filling parts of Humboldt Bay.

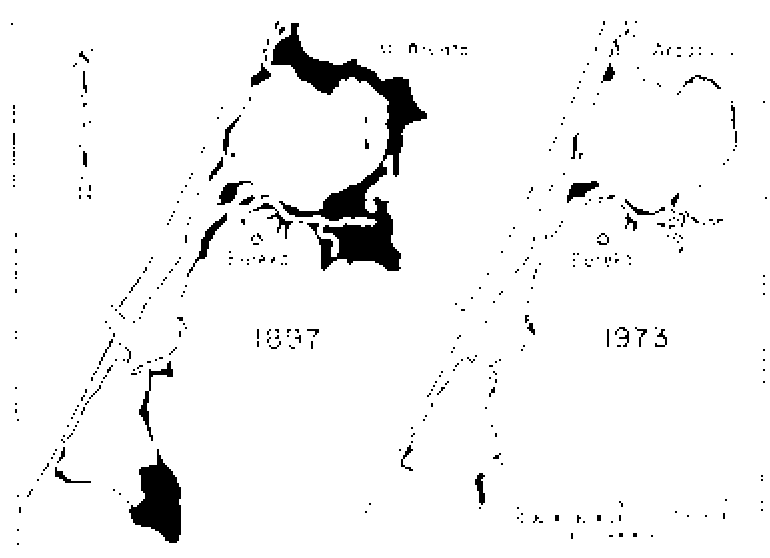

Fig. 2.4. Decrease in Humboldt Bay marshland distribution from 1897 to 1973 caused by diking (MacDonald 1977).

Other human activities have added sediments to Humboldt Bay as well. For example, wood fragments from various timber industry operations located on the shores of the bay are present in the bay water and are probably common in the sediments. Riprap, sand, and other construction materials used in levees, bulkheads, and other structures may also become estuarine sediments. There are presently 25 to 50 million oysters being raised in Arcata Bay and Mad River Slough. As previously mentioned, oyster harvesting operations are believed to have increased the grain size of the sediments on the low flats in Arcata Bay by adding shell fragments, reducing the amount of eelgrass, and resuspending the fine sediments. The harvesting process also disturbs the benthic communities.

Erosion and Deposition

Certain areas within Humboldt Bay are undergoing active erosion or accretion. Some of the erosion and deposition is naturally occurring, but some can be attributed directly to human modification of the natural system. For example, the building of jetties and dredging of Entrance Channel have significantly changed the morphology of Humboldt Bay, even in areas not directly modified by these projects. These projects have been correlated with high-energy waves in Entrance Bay and concentrated tidal currents that have almost completely eroded Red Bluff (next to the power plant in the King Salmon area) and Buhne Point (Tuttle 1982). To arrest this erosion, a project involving the placement of groins (small jetties) and the addition of sand between the groins was recently completed. Another example of the effect of jetties and the resultant wave patterns in Entrance Bay is the northward growth of the Elk River spit. The Elk River previously emptied into the center of Entrance Bay, but it now enters to the north in North Bay Channel (Fig. 1.1). This spit is still growing.

The salt marshes along the bay margins and on Indian Island are also undergoing active erosion. Thompson (1971) indicated that the marshes in the southeast corner of Arcata Bay adjacent to the Eureka Slough retreated at an average rate of 0.6–1.2 m/year from 1911 to 1966, primarily because of wave action. However, the marshes adjacent to McDaniel Slough and Jacoby Creek showed no erosion during the same time period. This is probably due to the protection from significant wave action in the McDaniel Slough area and the relatively high sediment input from Jacoby Creek, which is actively building an outwash fan on the high flats in this area. In South Bay, the northward migration of sand has resulted in sediment accumulation to form an east-trending recurved spit on the bayward side of South Jetty. This sediment may also contribute to the shoaling of Fields Landing Channel and the shoal lying across the north end of Southport Channel.

Climate

The Humboldt Bay region typically has two distinct seasons. The fall and winter season is mild but wet, characterized by a series of storms passing through the area; spring and summer is cool and dry, with fog in the summer. The monthly mean temperature varies by only 5.2° C through the year (Fig. 2.5), being lowest in January (8.5° C) and highest in August (13.7° C).

The Humboldt Bay region is noted for high precipitation; however, because most days during the winter receive little rainfall, the high precipitation is associated with occasional storms (Fig. 2.6). Eighty-five percent of the precipitation in the area usually occurs during a 7-month period from mid-October to mid-May (Elford and McDonough 1974). The annual precipitation in Eureka, located on Humboldt Bay, averages 97.8 cm, which is the lowest amount recorded for Humboldt County (Elford and McDonough 1974). Mean annual precipitation for the Humboldt Bay area is indicated in Fig. 2.7. This value more than doubles as one moves into the coastal and inland mountain valleys of the area; however, since the drainage basin leading into Humboldt Bay is quite small (578 km^2), runoff entering the bay is episodic and small (Jones and Stokes Associates 1981).

Fall and winter storms are spawned in the region of the Aleutian Low and travel through the Humboldt Bay area from west to east. These low-pressure storm systems, characterized by cyclonic (counterclockwise in the northern hemisphere) circulation, result in intense winds from the south and southwest as the storm passes through the area. Between the winter storms, the winds tend to be less intense and frequently come from the north and northwest (Pequegnat and Hodgson 1976).

During the spring and summer, the Aleutian Low disappears as the North Pacific High moves in to dominate the North Pacific. Since wind travel is anticyclonic (clockwise in the northern hemi-

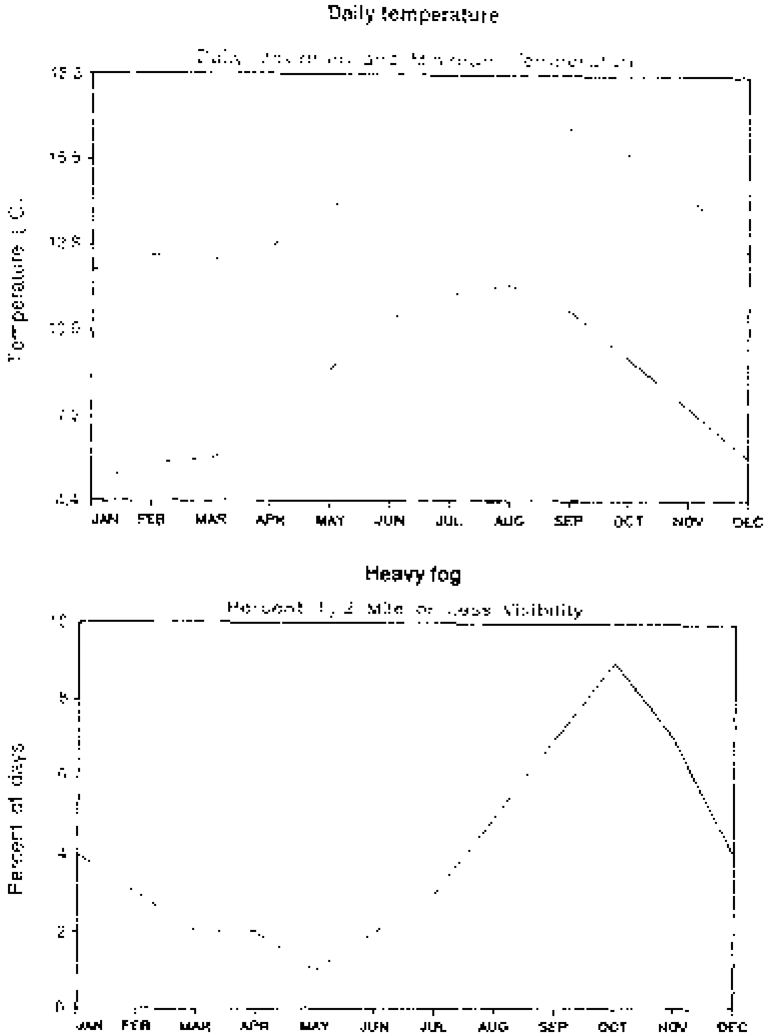

Fig. 2.5. Average daily maximum and minimum air temperatures, by month, and mean percent days of heavy fog (visibility 1/2 mile or less), by month, Eureka, California, 1941-70 (from USDC 1977).

sphere) around high pressure systems, the prevailing winds during the spring and summer tend to be from the north and northwest. These northwest winds, though persistent, tend to increase in velocity in the early afternoon and die in the late evening (Pequegnat 1975). They are caused by the interaction of two pressure systems: the North Pacific High and a thermal low in the central valley of California caused by local heating of the land during the day and a concomitant rise of the valley air. The winds have a diel nature because of the daily heating of the central valley. They persist through the night, although at lower intensity, because the North Pacific High is a semipermanent feature.

Coastal upwelling results from north and northwest winds in the Humboldt Bay region. Although it can occur during any time of the year, upwelling is most intense during the spring and tends to taper off during the summer as the responsible winds decrease in intensity. Since upwelling brings cold water from depth to the surface in the nearshore region, coastal fog is common during this period. Fog is more common during the summer and early fall than in spring since the winds are less intense, allowing the air to cool and water vapor to condense as the air mass moves over the area (Fig. 2.5). However, dense coastal fog can occur in the Humboldt Bay region during any time of the year.

Hydrology

Freshwater Input

The drainage basin affecting Humboldt Bay is quite small for a bay of this size, approximately

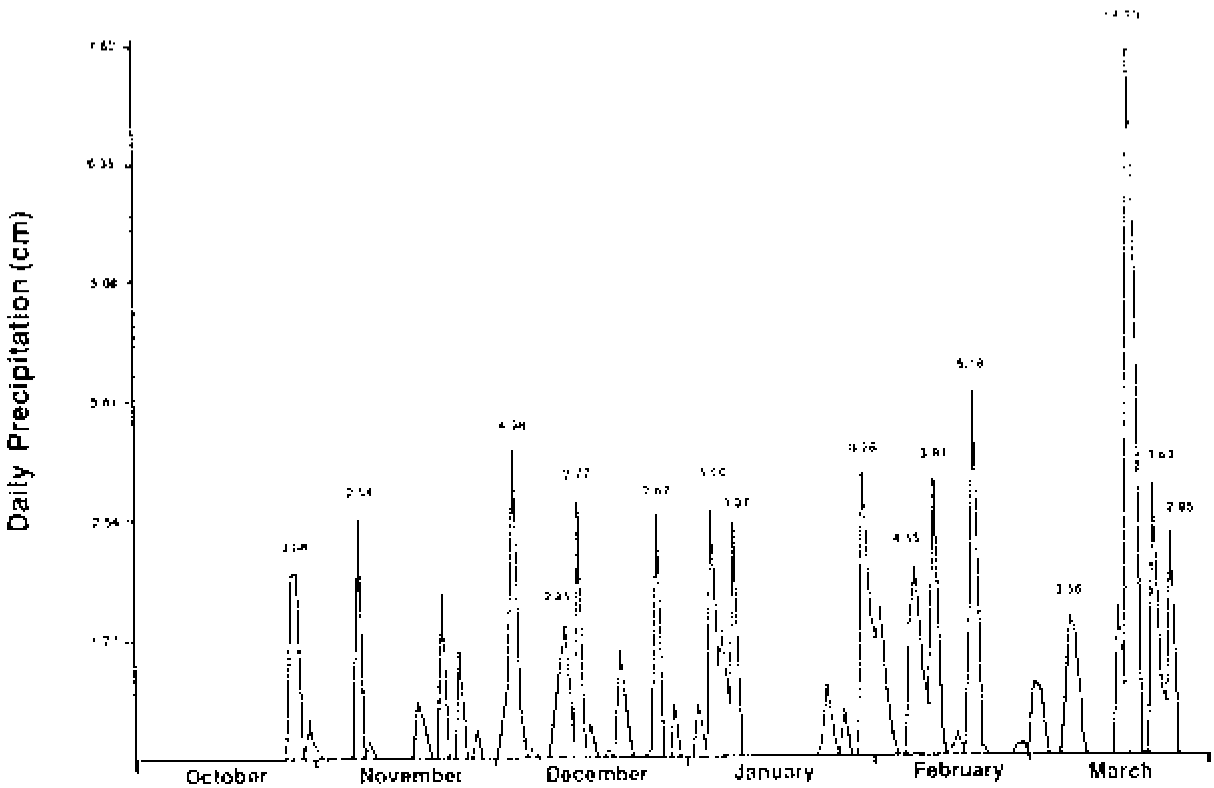

Fig. 2.6. Daily precipitation in Eureka, California, October 1974 to March 1975. Total precipitation in inches for each storm is noted (from Proctor et al. 1980).

678 km^2 (less than 1% of the Eel River watershed located south of Humboldt Bay), of which 62.4 km^2 is represented by the bay itself. Of the fresh water entering Humboldt Bay, 12% falls as precipitation directly on the bay, 85% is river drainage into Arcata Bay and North Bay Channel (Elk River); and the remainder is runoff into South Bay. The major rivers in the region do not drain into Humboldt Bay. Fresh water enters from point sources via Jacoby Creek, Elk River, Freshwater-Eureka Slough, McDaniel Slough, Mad River Slough (not associated with the Mad River), and other small sloughs and creeks (Costa 1964). The Mad River apparently has not flowed naturally into Humboldt Bay in historic times (although a canal to transport logs was built and maintained for a short period in the late 1800's) except during floods, when it spills over into Mad River Slough and thus into the bay.

The amount of runoff fluctuates widely and rapidly (as much as a 100-fold difference in 2 days), depending on precipitation. The volume of monthly runoff follows monthly precipitation quite closely: runoff is high from November to April and is lowest during the late summer. The only exception is at the beginning of the rainy season in fall, when the soil of the drainage basin retains a higher percentage of the precipitation following the summer drought.

Freshwater discharges into the bay are minor influences in terms of hydrology or hydraulics (Costa 1984). Thompson (1971) estimated the annual flow for Jacoby Creek at 1.31×10^7 m^3, Elk River at 7.31×16^7 m^3, and Freshwater and Salmon creeks at 9×10^6 m^3. The U.S. Army Corps of Engineers (1977) estimated the maximum flows for Jacoby Creek to be 21 m^3/sec and Elk River to be 43-97 m^3/sec. Musselman et al. (1978) estimated flow through the mouth of the Bay to be 3,450 m^3/sec (tide stage not indicated). Thus, runoff represents very little of the daily tidal exchange in the bay and can therefore have only a localized and transient effect on its hydrography.

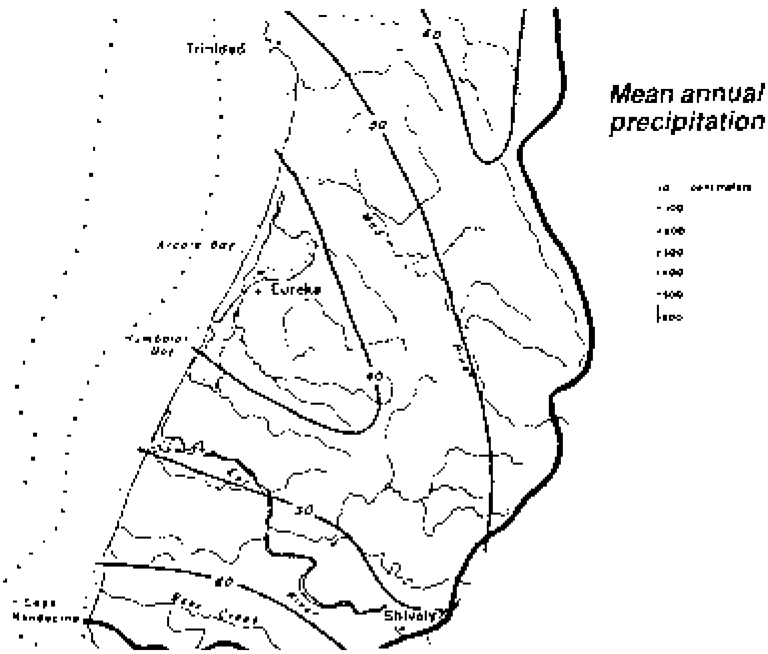

Fig. 2.7. Mean annual precipitation (inches), Humboldt Bay environs (from Proctor et al. 1980).

Tides and Flushing Characteristics

The tides in Humboldt Bay are characterized by a semidiurnal inequality; that is, successive high or low tides have different elevations (Fig. 2.8). On extreme tides this inequality may amount to as much as a 1.2 m difference in successive lows or a 0.8 m difference in successive highs (National Oceanographic and Atmospheric Administration 1988). Mean tide range and mean tide level increase with distance from the inlet into Arcata Bay, but not significantly in South Bay (Costa 1984). The tide moves more slowly into Arcata Bay than South Bay. In addition, low tide at Eureka lags significantly behind low tide at Samoa. Finally, the mean tidal range appears to have increased at several stations within the bay over the last 60 years. This increase may have resulted from the deepening of the channels, which could increase the volume of water flowing through them (Costa 1984). The general warming of the ocean and subsequent worldwide rise in sea level may cause tide-related flooding problems in the low-lying regions of the bay in the next few decades.

The three subbays differ significantly from each other in terms of hydrography; the differ-

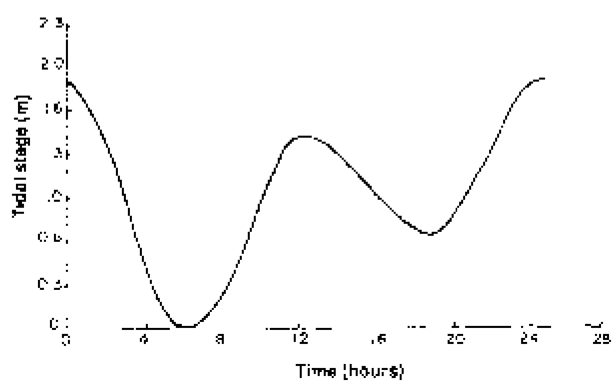

Fig. 2.8. Mean tide curve for South Jetty, Humboldt Bay (Costa 1982).

ences are mostly related to the degree of isolation from nearshore waters. Both South Bay and Arcata Bay have extensive mudflats with a complex pattern of channels (Figs. 2.2 and 2.3); consequently each of these subbays has a large tidal prism (Table 2.1). From MHW to MLLW, the volume of South Bay changes from 3.70×10^7 to 1.24×10^7 m^3 (while the area increases from 1.83×10^7 to 7.1×10^6 m^2). This yields an average tidal prism of 60% of the MHW volume. Arcata Bay changes in volume from 8.51×10^7 to 4.80×10^7 m^3 and in area from 3.45×10^7 to 1.19×10^7 m^3, resulting in an average tidal prism of 44%. Gast and Skeesick (1964) estimated that 44% of the Arcata Bay waters are replaced each lunar day (41% for the entire bay) and that 99% replacement takes approximately 7 lunar days or 14 tidal cycles. Gast and Skeesick (1964) estimated 15 tidal cycles (7.5 lunar days) for complete replacement, but noted that flushing time varies considerably with tidal prism and freshwater input. These estimates, based on a simple model that assumes considerable mixing within the bay, suggest that the flushing rate is rapid compared with other bays. However, the flushing rate appears to vary with distance from the mouth and the volume of the joining channels. Costa (1981), using a model based on tide height distributions, estimated the flushing time of the relatively isolated Mad River Slough to be nearly 85 tidal cycles, while Casebier and Toimel (1973) estimated the flushing time for the major channels in Arcata Bay to be 2.1 tidal cycles; their estimate was based on the movements of drogues within the channels.

The waters of Arcata Bay and South Bay do not rapidly assume the character of the nearshore waters, as would be expected with complete mixing and large tidal prisms; rather, the bay waters are sufficiently isolated from the nearshore and the flushing time is such that the bay waters take on chemical and biological characteristics of their own, including separate zones within the bay itself (Beittel 1975; Pequegnat and Butler 1982). For example, zooplankton communities in the subbays differ from each other and from those in the nearshore waters (Pequegnat and Butler 1982; J. E. Pequegnat and N. Haubenstock, Department of Oceanography, Humboldt State University, Arcata, Calif., unpublished data). Also, the gradients of several chemical and physical parameters within the bay, including temperature and salinity, show that the waters nearest the bay mouth at low tide most closely assume the characteristics of the nearshore (J. Brandes and J. E. Pequegnat, Department of Oceanography, Humboldt State University, Arcata, California, unpublished data), and confirm that some of the peripheral areas within the bay do not flush as rapidly as the main channels. This effect is especially pronounced in Arcata Bay because it is isolated from the nearshore by a long, deep channel (North Bay Channel) with a volume similar to the tidal prism, which inhibits the flushing process. South Bay, having a much less extensive channel system and being connected

Table 2.1. *General characteristics of Humboldt Bay (Shapiro and Associates, Inc. 1980).*

Characteristic	South Bay	Entrance Bay	Arcata Bay	Humboldt Bay
Area, 10^7m^2, MLLW[a]	0.71	0.73	1.19	2.63
Area, 10^7m^2, MHW[b]	1.83	0.79	3.45	6.07
Volume, 10^7m^3, MLLW	1.24	3.21	4.80	9.25
Volume, 10^7m^3, MHW	3.70	4.44	8.51	16.65
Tidal prism, 10^7m^3	2.46	1.23	3.71	7.40
Tidal prism/vol., MLLW	1.98	0.38	0.77	0.87
Tidal prism/vol., MHW	0.66	0.28	0.44	0.44
Average depth, m	1.70	6.10	4.00	3.50
Annual river discharge, 10^7m^3	3.20	0	26.40	31.60
River discharge/vol., MLLW	2.60	0	5.90	3.40
River discharge/tidal prism	1.30	0	7.12	4.27

[a] Mean lower low water (0 feet).

[b] Mean high water (5.7 feet).

to the nearshore waters by a much shorter channel, has a shorter flushing time and more closely assumes the characteristics of the nearshore environment (Pequegnat and Butler 1982).

Even within Arcata Bay and South Bay, mixing appears to be limited; the waters of these subbays are found in two well developed compartments (Beittel 1975; Pequegnat and Butler 1982). Bay compartment water is found over the mudflats at high tide and moves into the channels at low tide. Nearshore compartment water consists of nearshore water advected into the channels during flood tide; it is found in the channels at high tide and is advected offshore during ebb tide. Because conditions in the nearshore fluctuate dramatically between upwelling and nonupwelling periods (in a matter of days), the waters of these subbays are continually approaching, but seldom reaching, some sort of equilibrium (J. Brandes and J. E. Pequegnat, unpublished data).

In contrast to the waters of the other subbays, the water in Entrance Bay is quite transient and well mixed. It appears that Entrance Channel and Entrance Bay function as mixing areas, receiving water through the bay mouth and from North Bay Channel (Arcata Bay) and South Bay (Beittel 1975; Costa 1982). This region is an extremely energetic area; water entering Entrance Bay is probably vigorously mixed before being transported north, south, or west. Turbulence causes mixing in this location as nearshore water enters the bay during flood tide and impinges on the shallow area on the east side of Entrance Bay, sending a divergence to the north and south along the eastern shore. Much, if not all, of the vertical stratification of the nearshore water column is disrupted by turbulent water rushing into Entrance Channel and Entrance Bay. Because the subsurface nearshore water is usually colder than the surface water, this mixing results in water temperatures within the bay which are 0.2–0.3° C lower than the nearshore surface temperatures.

Currents and Circulation

The circulation of Humboldt Bay is almost completely tidally driven (Costa 1982, 1984). The large change in volume with tide results in a very energetic system with high-velocity tidal currents and considerable vertical mixing in the channels. Fresh water, normally an important driving force in estuaries, has little influence because freshwater input to Humboldt Bay is episodic and small relative to the tidal prism of each subbay (Table 2.1). The total annual freshwater input to Humboldt Bay is approximately equal to the exchange during only four tidal cycles (approximately 2 days).

The basic circulation pattern in Humboldt Bay is fairly straightforward and has been described by Gast and Skeesick (1964; Fig. 2.9). The currents follow the major channels, are strongest in the channels, and decrease with increased distance from the bay mouth. Gast and Skeesick (1964) noted little change in velocity with depth in the water column, with the exception that surface waters moved slightly faster than the deep waters. R. L. Beittel and J. E. Pequegnat (Department of Oceanography, Humboldt State University, Arcata, California, unpublished data) and Pequegnat and Butler (1982) found that the nearshore water moved up the axis of North Bay Channel and intruded into the channels of Arcata Bay when the tidal change was greater than 1.8 m. They found that the water moved in the major channels approximately 1.6 km per 0.3 m of tidal change.

There is relatively little current velocity data. J. E. Pequegnat and M. C. Landsteiner (Department of Oceanography, Humboldt State University, Arcata, California, unpublished data) found peak current velocities to be approximately 1.3 m/sec in North Bay Channel, 1 m/sec at the entrance to South Bay, and slightly faster than 1.7 m/sec in Entrance Channel. Beech (1977) studied the currents in Eureka Slough and in North Bay Channel leading to Arcata Bay. He found peak velocities of 0.5 m/sec in the channel between Eureka and Woodley Island adjacent to the marina (Eureka Inner Reach); the channels between Woodley Island and Indian Island had peak velocities of 0.75 m/sec. Beech (1977) found that 75% of the water entering and exiting Arcata Bay passed through Samoa Channel. The velocity pattern and volume transport for the various channels is not well understood (Costa 1982).

The most dangerous currents undoubtedly occur in the Entrance Channel, particularly during outgoing tides, when the water leaving the Bay interacts with the incident ocean waves. The Pacific Northwest experiences the most severe wave conditions in the continental United States (Costa 1984). It is not uncommon for waves to break across the entire bay mouth during such times, especially during spring tides when the tidal range is large. The hazard is further increased by the fact that the waves offshore are often so large that they break over the jetties.

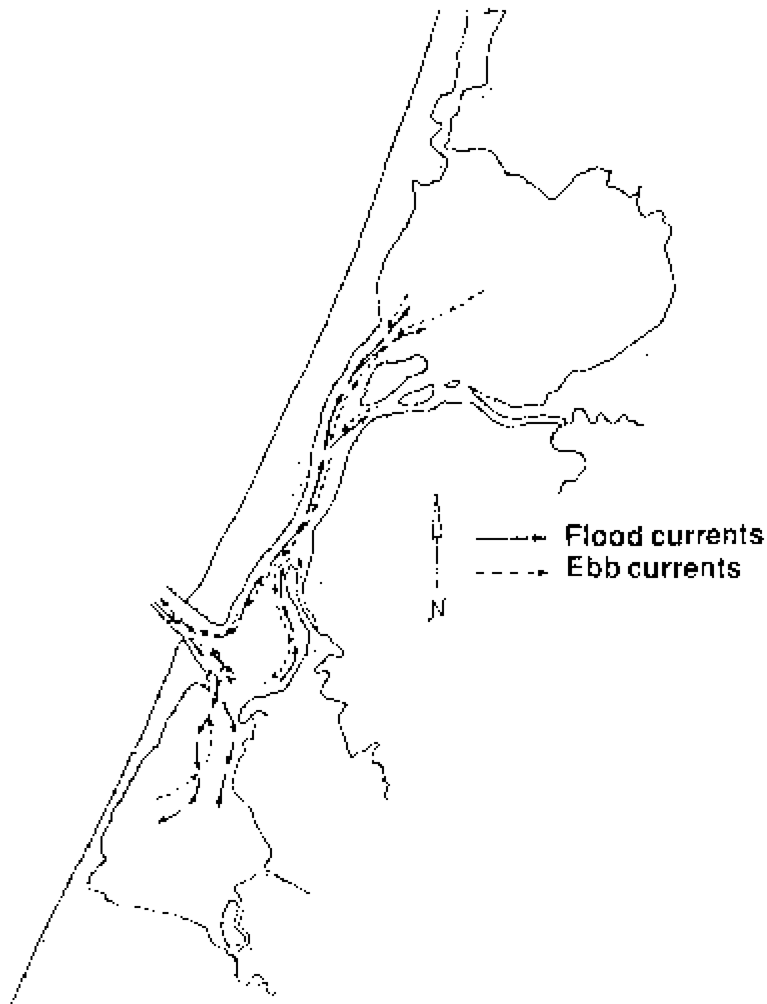

Fig. 2.9. Ebb and flood tidal current patterns for the major channels in Humboldt Bay (from Costa 1982).

Physicochemical Aspects

Because of the presence of both nearshore compartment waters and bay compartment waters in each subbay, the water characteristics in Humboldt Bay at a given point change dramatically with tidal stage and are determined by a combination of processes occurring in the nearshore (e.g., upwelling), in the bay itself (e.g., evaporation), and episodically on the land surrounding the bay (e.g., runoff from the small watershed). The extensive movement of water in the channels with the ebb and flood of the tides results in turbulent mixing, which rapidly breaks down any vertical stratification in the channels of the bay; however, horizontal gradients up the channel axes separate the nearshore compartment waters from the bay compartment waters (note movement of the 11° C isotherm in Figs. 2.10 and 2.11). These gradients are seen in temperature, salinity, and nutrient and chlorophyll concentrations, with the water near the bay mouth at low tide being most similar to, but still distinct from, the conditions in the nearshore (Beittel 1975; Pequegnat and Butler 1982; J. Brandes and J. E. Pequegnat, unpublished data).

Seasonal Changes in the Nearshore Water

The coast of northern California is noted for upwelling, but there are actually three basic oceanographic conditions, with associated water types, possible in the nearshore environment. These conditions are dictated by the winds, and the vagaries of the winds are such that any of these conditions can occur at any time of the year.

Upwelling periods. These periods, common during spring and early summer, are characterized by strong winds from the north and northwest and a southerly current set. High nutrient concentrations, low oxygen concentrations, low water temperatures, and moderately high salinities are found in the nearshore waters during upwelling periods.

Low wind periods. Such periods, with light winds from no predominant direction, are common in late summer and early fall. During these periods, the California Current, normally offshore with a slow southerly set, moves closer to shore and brings low nutrient concentrations, high temperatures, and moderate salinities to the nearshore environment.

Stormy periods. These are common in late fall and winter and are characterized by strong south and southwest winds and a northerly current set (the Davidson Current). During these periods the nearshore water is characterized by low salinities, high sediment loads, moderate nutrient concentrations, and oxygen saturation.

Pirie and Steller (1977) have given names to three hydrographic seasons as follows: the upwelling period from March to August, the oceanic period from August to November, and the Davidson Current period from November to March. Although these periods are characterized by the hydrographic conditions given for upwelling, stormy, and low wind periods, their divisions are statistically derived and the conditions can change rapidly any time of the year. In the spring and summer, for example, the characteristics of the nearshore water have been observed to rapidly oscillate from those associated with upwelling periods to those associated with nonupwelling periods and back within a few weeks (Pequegnat 1975; Pequegnat and Butler 1982; J. Brandes and J. E. Pequegnat, unpublished data). In late January of most years, there is a calm period when conditions more typical of the oceanic period are observed. During a drift-card study of the nearshore cur-

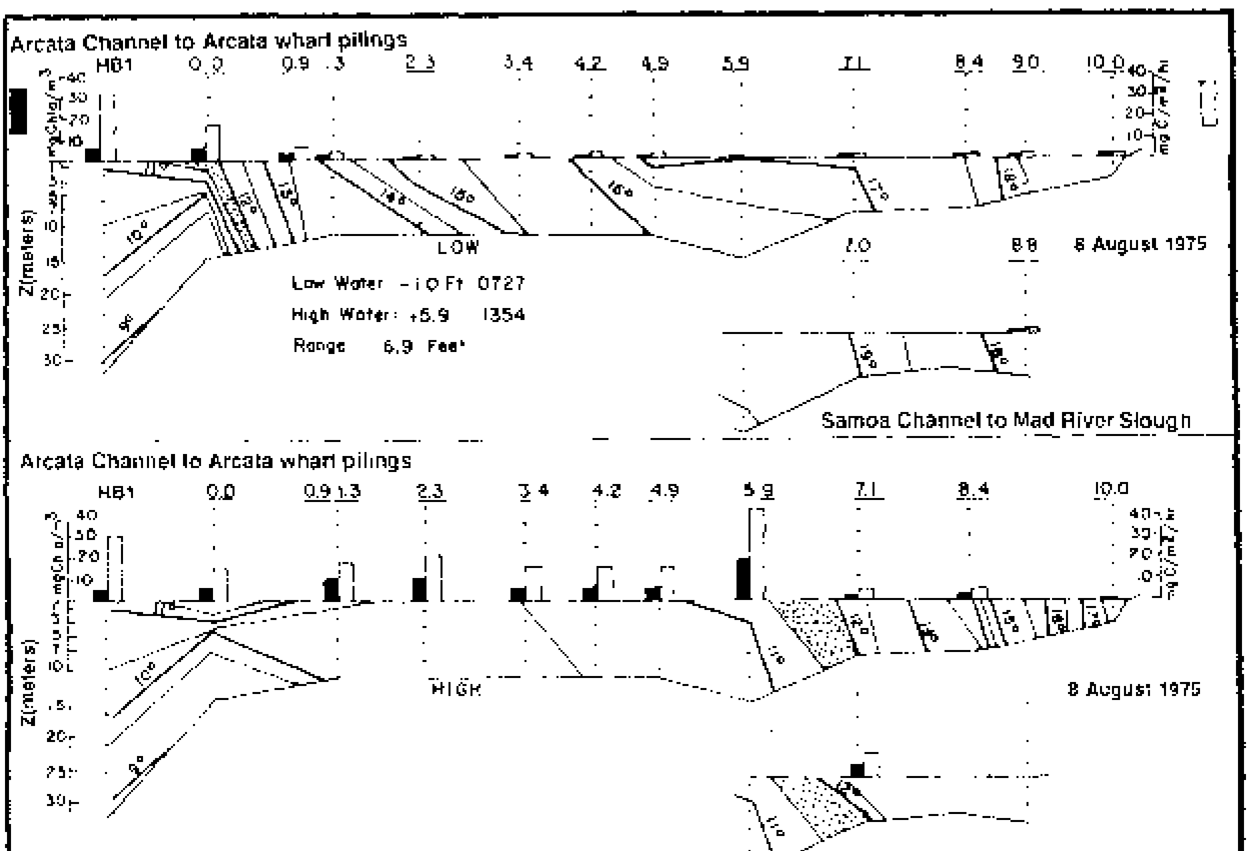

Fig. 2.10. Temperature, chlorophyll (*black bar*), and productivity distribution (*white bar*) at low and high tides in channels from Humboldt Bay entrance into Arcata Bay, 8 August 1975. Station HB1 is marker buoy 1 nmi off shore; station 0.0 is at mouth of Humboldt Bay; and all other stations are indicated by distance in nautical miles up bay from mouth (Pequegnat and Butler 1982).

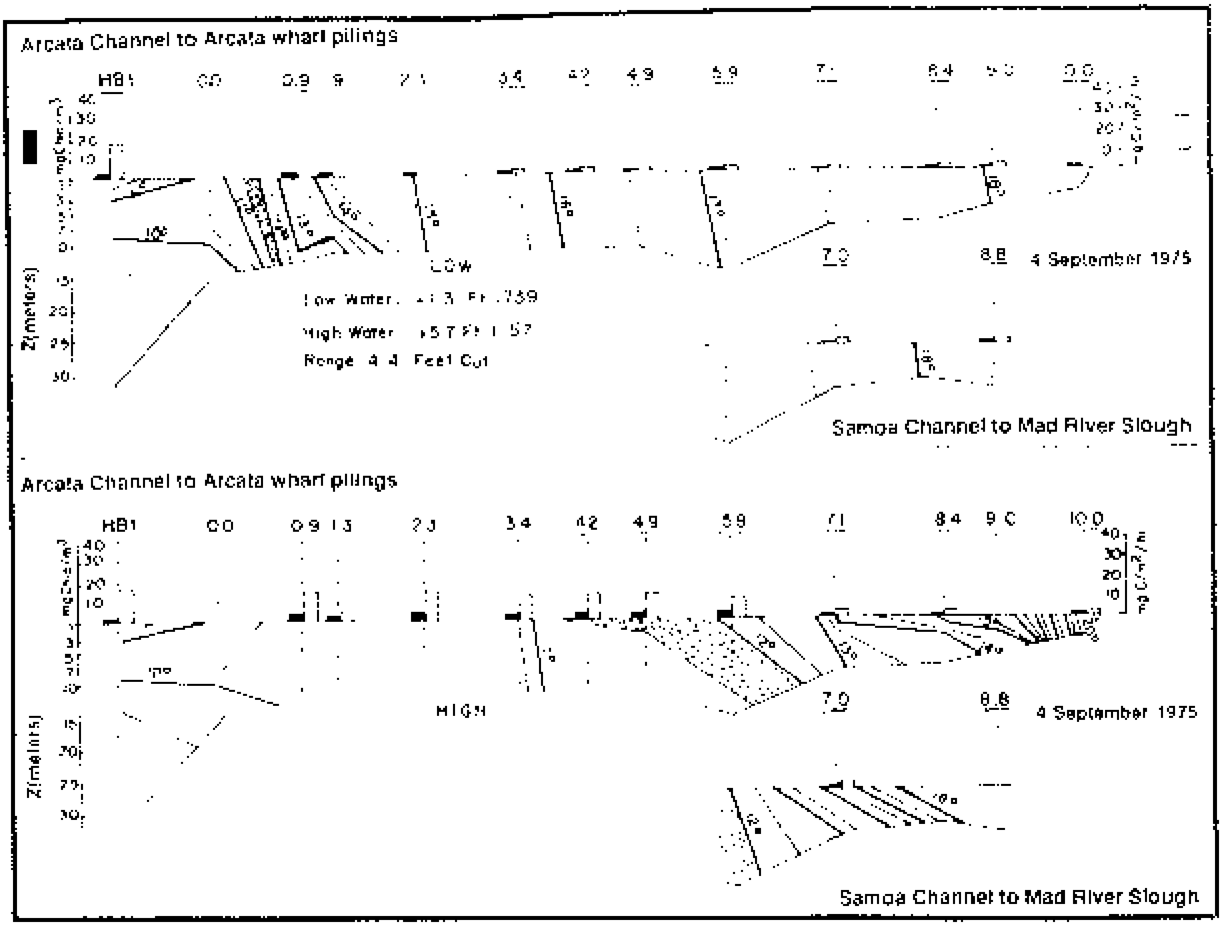

Fig. 2.11. Temperature, chlorophyll (*black bar*), and productivity distribution (*white bar*) at low and high tides in channels from Humboldt Bay entrance into Arcata Bay, 4 September 1975. Station HB1 is marker buoy 1 nmi off shore; station 0.0 is at mouth of Humboldt Bay; and all other stations are indicated by distance in nautical miles up bay from mouth (Pequegnat and Butler 1982).

rents conducted in 1975, all three oceanographic conditions were observed in the nearshore within a 6-week period (Pequegnat and Hodgson 1976).

Temperature and Salinity Patterns

The temperature of the nearshore waters of northern California has a normal range of 9–14° C, with occasional episodes of up to 2° C outside this range. The range of temperatures in Humboldt Bay is considerably wider, from 9° C to more than 20° C (Pequegnat and Butler 1982; J. Brandes and J. E. Pequegnat, unpublished data). Nearshore and bay salinities range from less than 25 parts per thousand (ppt) during periods of high runoff to greater than 34 ppt when deeper water is advected to the surface during periods of intense upwelling. In both cases the lower salinities are associated with periods of moderate runoff, but higher salinities are associated with periods of high evaporation rather than upwelling. Of course, the distribution of properties within the bay depends greatly on the stage of the tide, and the patterns of temperature and salinity in the nearshore waters and in Humboldt Bay can vary rapidly with changing wind regimes. Nevertheless, sampling at various locations in the bay (Fig. 2.12; Tables 2.2 and 2.3) has indicated patterns associated with nearshore hydrographic conditions (upwelling and low wind [nonupwelling]).

Upwelling periods. During upwelling periods, the nearshore water temperature drops to below 11° C and the salinity rises to over 33 ppt. During intense upwelling periods the sea surface temperature may drop to less than 8° C, with salinities greater than 34.1 ppt. Since upwelling is associated with north and northwest winds and clear skies, runoff is low, and evaporation within the Bay tends to be high. During these periods there is a marked increase in temperature with distance up the main channels of Humboldt Bay (Figs. 2.10 and 2.11;

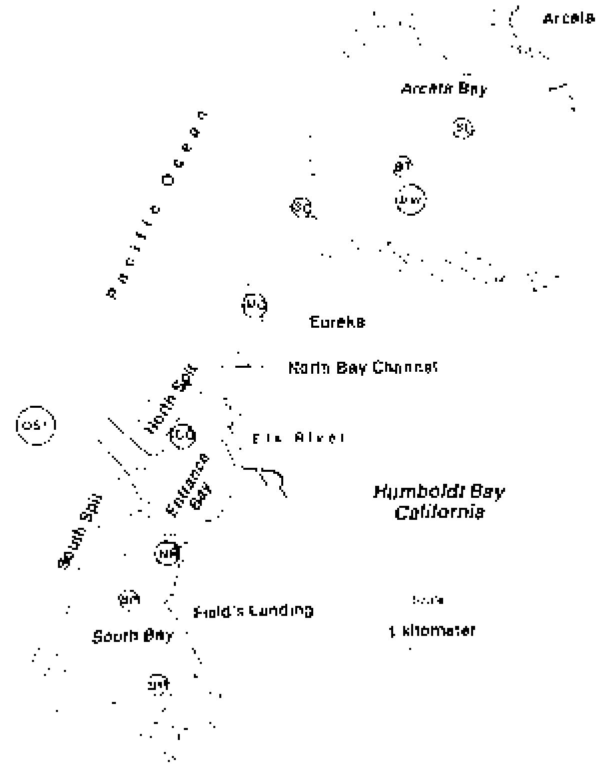

Fig. 2.12. Location and designation of Humboldt Bay physicochemical sample stations. Data are presented in Tables 2.2 and 2.3 and Fig. 2.15 (Pequegnat and Butler 1981).

Tables 2.2 and 2.3) and the salinity tends to be high throughout the Bay (i.e., more than 33.6 ppt).

Low wind periods. During periods of calm wind, the warm surface water offshore tends to move onshore. Concurrently, the sea surface temperature typically rises higher than 13° C and the salinity is usually less than 33.5 ppt. The waters may be vertically stratified with respect to both temperature and salinity. During periods of low wind in the late summer and fall, both the temperature and salinity tend to increase up the channel axes of each subbay; conversely, when the winds subside in winter, both temperature and salinity decrease up the channel axes.

Stormy periods. Because the northerly flowing Davidson Current is associated with winter storms, the nearshore surface waters tend to be cool (less than 11° C) with low salinity (less than 32 ppt) because of high runoff. The nearshore waters also tend to be highly stratified, primarily because of vertical salinity gradient. Since this stratification tends to be destroyed by turbulent mixing in the channels of the bay, the salinity of the bay waters tends to be higher (greater than 33 ppt) than the nearshore surface waters. Runoff can cause stratification within the bay compartment waters, but because of the relatively small amount of runoff entering the bay and turbulent mixing, the bay compartment waters are strati-

Table 2.2. *Temperature, salinity, Secchi depth, dissolved oxygen, pH, and chlorophyll-a measurements during upwelling and nonupwelling conditions in Humboldt Bay, June and September 1980 (Pequegnat and Butler 1981).*

Station[a]	Distance from bay mouth (km)	Temperature (° C)	Salinity (ppt)	Secchi depth (m)	Dissolved oxygen (ml/L)	Dissolved oxygen Saturation (%)	pH	Chlorophyll-a (mg/L)
				26 June 1980 (nonupwelling)				
NH	5.6	15.5	33.48	1.10	4.35	76	8.37	6.04
SP	5.6	15.2	33.53	1.10	4.29	75	8.42	5.59
OS	−1.6[b]	12.4	33.34	4.00	4.17	69	8.33	13.27
MC	7.4	15.7	33.47	1.00	3.24	57	8.13	11.38
SC	11.1	17.3	33.29	0.90	2.93	53	8.01	6.38
I/W	12.6	—	33.54	0.80	2.60	—	8.03	5.90
				24 September 1980 (upwelling)				
NH	5.6	14.2	33.48	1.00	2.04	35	7.97	2.31
SP	5.6	13.3	—	1.44	1.96	—	7.95	—
OS	−1.6[b]	10.9	33.46	2.20	1.75	28	7.92	3.40
MC	7.4	15.3	33.66	1.40	2.00	35	7.94	3.54
SC	11.1	16.4	33.68	1.00	1.61	29	7.98	3.16
I/W	12.6	16.9	33.80	1.30	2.17	39	7.96	2.90

[a] See Fig. 2.12 for station locations.

[b] Nearshore station approximately 1.6 km offshore.

Table 2.3. *Temperature, salinity, Secchi depth, dissolved oxygen, pH, and chlorophyll-a measurements during upwelling and nonupwelling conditions in Humboldt Bay, July 1986 (J. Brandesand J. E. Pequegnat, Department of Oceanography, Humboldt State University, Arcata, California, unpublished data).*

Station[a]	Distance from bay mouth (km)	Temperature (° C)	Salinity (ppt)	Secchi depth (m)	Dissolved oxygen (ml/L)	Dissolved oxygen Saturation (%)	pH	Chlorophyll-a (mg/L)
				10 July 1986 (upwelling)				
SH	7.1	17.2	33.76	0.90	4.93	90	8.09	3.50
NH	5.6	16.2	33.76	1.00	5.10	91	8.10	3.41
SP	5.6	14.7	33.70	1.15	5.48	95	8.09	3.50
CG	3.3	15.2	33.71	1.30	2.41	42	7.91	4.48
MC	7.4	16.8	33.76	1.10	4.68	83	7.95	3.31
SC	11.1	17.6	33.85	1.00	4.77	88	7.95	3.50
BT	13.0	17.3	33.87	0.90	4.75	87	7.93	3.71
SI	15.0	18.0	33.96	0.75	4.36	81	7.83	4.16
VW	12.6	18.3	34.06	0.90	4.73	88	8.06	3.49
TB	0.0[b]	9.8	33.52	3.10	5.12	80	7.83	2.59
				24 July 1986 (nonupwelling)				
SH	7.1	14.6	33.84	0.80	5.19	90	7.92	1.55
NH	5.6	13.7	33.83	0.90	5.03	85	7.96	1.54
SP	5.6	13.0	33.80	1.15	5.53	93	7.90	1.23
CG	3.3	14.9	33.93	1.15	5.32	93	7.97	2.45
MC	7.4	16.3	34.07	1.00	5.12	92	7.98	1.06
SC	11.1	17.1	34.13	1.25	5.05	92	7.80	0.88
BT	13.0	17.2	34.19	0.90	4.96	91	7.99	0.88
SI	15.4	17.3	34.14	0.70	3.81	70	7.81	0.65
VW	12.6	17.4	34.35	1.10	4.93	91	8.02	0.50
TB	0.0[b]	12.6	33.67	1.75	7.40	123	8.30	5.37

[a] See Fig. 2.12 for station locations.
[b] Trinidad Bay, 22 km north of Humboldt Bay, was used for nearshore control.

fied only episodically, immediately following periods of high runoff (Beittel 1975).

Oxygen and pH

The oxygen concentration in the nearshore water is inversely correlated with the intensity of upwelling; during intense upwelling, the oxygen concentration may be less than 50% of the saturation concentration. As a result, the concentration of dissolved oxygen in the channels of Humboldt Bay at high tide is often quite low. On the other hand, because the bay compartment waters are spread out over the mudflats in a thin layer at high tide, and because the exchange velocity of oxygen between water and air is fairly high (Broecker and Peng 1982), the concentration of oxygen in the bay compartment waters is always near saturation. This is in agreement with Gast and Skeesick (1964), who recorded their highest and lowest oxygen concentration at the bay entrance (11.97 mg/L during nonupwelling periods and 4.26 mg/L during upwelling periods) and found the most stable oxygen concentrations in the northeast quadrant of Arcata Bay (8–9.6 mg/L). Pequegnat and Butler (1982) and J. Brandes and J. E. Pequegnat (unpublished data) found dissolved oxygen concentrations in Arcata Bay close to the expected saturation values based on temperature and salinity (Tables 2.2 and 2.3).

The pH values found in Humboldt Bay waters have not shown any unusual patterns (Tables 2.2 and 2.3); recorded values range from 7.7 to 8.1, with the lower values being associated with similar pH values in the nearshore waters during periods of upwelling (J. Brandes and J. E. Pequegnat, unpublished data).

Nutrients

Pequegnat (1988) suggested that the three major sources of nutrients to the Bay are runoff, the nearshore waters, and municipal wastewater. Pequegnat and Butler (1981) estimated that in 1979 the wastewater from Eureka contributed 20–50% of the fixed nitrogen found in the bay compartment waters of Arcata Bay during the 150-day period of low runoff in summer and early fall. Since then, the amount of nutrients entering the Bay from wastewater sources has been decreased by measures enacted between 1982 and 1986 by the municipalities surrounding the bay. In June of 1984, Eureka began diverting its partially treated wastewater into a freshwater marsh for further treatment, then pumping the marsh water into North Bay Channel on outgoing tides. Since July of 1986, Arcata has diverted its wastewater into an innovative freshwater marsh system before it is released into Arcata Bay.

Before these changes, both the nearshore waters and wastewater were important sources of nitrate and other nutrients to the bay. This is illustrated by nutrient concentration data collected at locations in the nearshore and the North Bay Channel, and at two locations in Arcata Bay before (1980) and after (1986) cessation of wastewater input (Fig. 2.13; Pequegnat 1988). In 1980 the concentration of nitrate was high in the nearshore during upwelling periods and decreased with distance up the channel into Arcata Bay, while during nonupwelling periods the concentration of nitrate was low in the nearshore waters, lower in the channels, but not much different in Arcata Bay. It is interesting to note that the same general patterns were found in 1986, after the wastewater nutrients were diverted from the bay, but that the actual nitrate concentrations were lower than previously (Fig. 2.13; Tables 2.4 and 2.5; Pequegnat 1988; J. Brandes and J. E. Pequegnat, unpublished data).

The diversion of wastewater leaves runoff and the nearshore waters as the primary sources of nutrients to Humboldt Bay. Runoff tends to be episodic, occurring mainly during the late fall and winter. Therefore, nutrient contributions to the bay from runoff may be significant during the winter, when runoff is high, but not during the summer. The amount of nutrients available to the bay from the nearshore varies with the hydrographic regime in effect. As previously noted, there are three basic water types found in the nearshore, depending on wind conditions, each with characteristic nutrient concentrations. The highest nutrient concentrations in the nearshore are associated with upwelling periods, while the stormy periods are associated with moderate nutrient concentrations and the low wind periods with low nutrient concentrations. Since the hydrographic regime depends on the local wind, which can change rapidly at any time of the year, the nearshore may at times act as either a source of nutrients or a sink for nutrients. Because upwelling can be quickly triggered by a short period of high wind following a period of storms, offshore conditions may be in a state of flux unless a long period of stable weather occurs. This constantly changing nearshore environment is reflected in the nitrate concentrations found in the nearshore and in North Bay Channel which leads to Arcata Bay (see stations CG, MC, and SC in Tables 2.4 and 2.5). A time lag between the nearshore and channel water characteristics indicates that the channel waters reflect not what is occurring at the moment in the nearshore waters, but what was present a few days earlier (in effect, two sinusoidal curves, with one being driven by the other).

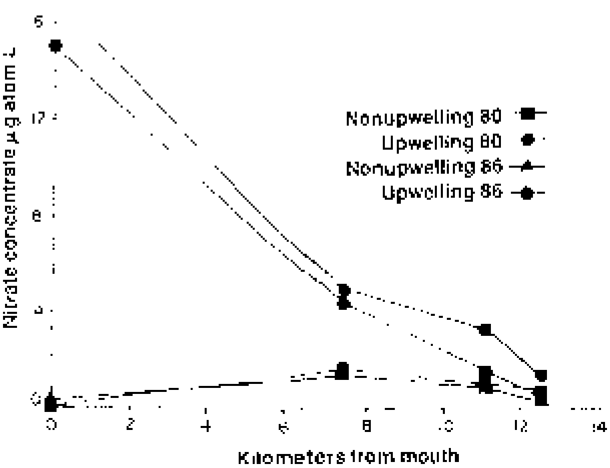

Fig. 2.13. Nitrate concentrations in Humboldt Bay waters during periods of upwelling and nonupwelling (Pequegnat 1988).

That the nearshore waters may be a sink for certain nutrients in the bay as well as a source for others is implied by the phosphate, nitrate, and ammonium gradients between the bay and the nearshore waters.

Phosphate

Pequegnat and Butler (1981) and J. Brandes and J. E. Pequenat (unpublished data) measured phosphate concentrations in the bay at low and high tides and found the concentrations at low tide to be

Table 2.4. *Nutrient concentrations and total nitrogen-to-phosphorus ratios during upwelling and nonupwelling conditions in Humboldt Bay, June and September 1980 (Pequegnat and Butler 1981).*

Station[a]	Distance from bay mouth (km)	NO_2 (µg-atoms/L)	NO_3 (µg-atoms/L)	NH_3 (µg-atoms/L)	PO_4 (µg-atoms/L)	Si (µg-atoms/L)	N:P
			26 June 1980 (nonupwelling)				
NH	5.6	0.03	0.49	0.17	0.79	8.9	0.9
SP	5.6	0.06	0.00	0.46	0.73	7.7	0.7
OS	-1.0[b]	0.03	0.23	0.00	0.03	2.1	8.7
MC	7.4	0.07	0.48	0.81	1.27	13.5	1.1
SC	11.1	0.13	0.55	1.14	2.04	22.9	0.9
LW	12.6	0.16	0.93	1.27	1.57	22.9	1.3
			24 September 1980 (upwelling)				
NH	5.6	0.19	4.01	2.97	1.56	21.5	4.6
SP	5.6	0.22	5.23	2.98	1.58	21.1	5.4
OS	-1.0[b]	0.36	16.90	2.41	1.70	26.0	12.0
MC	7.4	0.25	4.96	4.22	2.10	22.2	4.5
SC	11.1	0.20	3.30	3.56	2.28	21.8	3.1
LW	12.6	0.14	1.39	2.78	2.38	21.4	1.8

[a] See Fig. 2.12 for station locations.
[b] Nearshore station approximately 1.0 km offshore.

Table 2.5. *Nutrient concentrations and total nitrogen-to-phosphorus ratios during upwelling and nonupwelling conditions in Humboldt Bay, July 1986 (J. Brandes and J. E. Pequegnat, Department of Oceanography, Humboldt State University, Arcata, California, unpublished data).*

Station[a]	Distance from bay mouth (km)	NO_2 (µg-atoms/L)	NO_3 (µg-atoms/L)	NH_3 (µg-atoms/L)	PO_4 (µg-atoms/L)	Si (µg-atoms/L)	N:P
			10 July 1986 (upwelling)				
SH	7.1	0.21	0.79	1.9	1.6	18.4	1.8
NH	5.6	0.29	2.21	2.0	1.5	19.3	3.0
SP	5.6	0.23	2.67	1.3	1.2	19.9	3.5
CG	3.3	0.44	9.90	1.9	1.6	30.4	7.7
MC	7.4	0.37	4.80	2.4	1.7	29.3	4.5
SC	11.1	0.28	3.22	2.3	1.6	31.9	3.6
BT	13.0	0.38	2.70	2.3	1.9	38.7	2.8
SI	16.4	0.37	1.00	3.8	2.5	30.8	2.1
LW	12.6	0.23	0.40	1.8	1.8	30.6	1.4
TB	0.0[b]	0.68	21.50	1.6	1.5	41.8	16.0
			24 July 1986 (nonupwelling)				
SH	7.1	0.38	1.77	2.98	2.02	13.0	2.5
NH	5.6	0.27	2.65	2.75	1.69	13.6	3.6
SP	5.6	0.22	2.40	1.96	1.37	13.8	3.3
CG	3.3	0.35	4.03	2.96	1.73	13.7	4.3
MC	7.4	0.24	4.39	2.63	1.56	14.6	4.7
SC	11.1	0.17	1.57	2.96	1.80	14.5	2.6
BT	13.0	0.18	1.22	1.72	1.90	14.3	1.6
SI	16.4	0.34	0.34	2.71	2.75	20.1	1.2
LW	12.6	0.14	0.50	1.65	1.81	14.2	1.3
TB	0.0[b]	0.00	0.04	0.41	0.30	1.7	1.5

[a] See Fig. 2.12 for station locations.
[b] Trinidad Bay water was used for the nearshore control.

greater than at high tide and greater than the high tide concentrations that Gast and Skeesick (1964) found. The phosphate gradient runs from low to moderate in the nearshore waters to relatively high in the upper bay waters. Wastewater is a likely source of phosphate within the bay, as are the bay sediments, because, according to Burton and Liss (1976), estuarine sediments can act as phosphate buffers, maintaining high phosphate concentrations in an estuary by sediment leaching for some time after discontinuation of wastewater input. The excess phosphate in the bay can then act as a source of phosphate to the adjacent nearshore waters.

Nitrate

The nitrate gradient is the reverse of the phosphate gradient, ranging from high to moderate concentrations in the nearshore waters to very low concentrations in the upper bay waters. Therefore, the bay acts as a sink for nitrate, most likely through plant production and denitrification. Loss of nitrogen compounds through denitrification is suggested by the ratio of nitrogen to phosphate in the bay, which is relatively low compared to the 16:1 ratio suggested by Redfield (1956).

Ammonium

Although the nearshore waters are the main source of nitrate-nitrogen during summer, they tend to be low in ammonium and may act as a sink, along with plant production inside the bay. Nitrogen in the form of ammonium has several potential sources within the bay; wastewater and recycling of plant nitrogen by animals, especially oysters, are the two most important ammonium sources.

Chlorophyll

The chlorophyll concentrations, which reflect productivity, are generally low in both Humboldt Bay and the nearshore waters during the winter (Fig. 2.14), although the concentrations within the bay are considerably higher than in the nearshore (Pequegnat and Butler 1982). This is probably because at high tide, the phytoplankton in the bay are held over the mudflats in a shallow water column, allowing them to remain in the sunlit layer where they receive sufficient light to grow and reproduce. The phytoplankton in the nearshore, in contrast, are mixed to considerable depth, out of the sunlit layer. During the early spring, chlorophyll concentrations in both the bay and the nearshore waters increase as the nearshore waters stratify (thus reducing the depth of mixing), and neither light nor nutrients are limiting. The chlorophyll concentration in the nearshore generally remains high during the spring and summer because of the upwelling of nutrients, but chlorophyll concentration in the bay typically decreases during the summer months (Fig. 2.14).

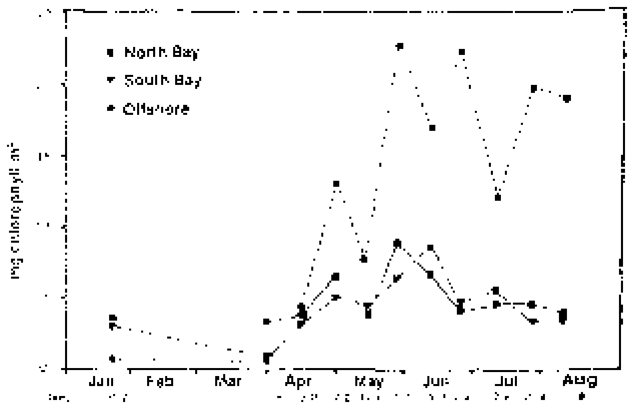

Fig. 2.14. Chlorophyll concentrations and water temperatures for offshore, North Bay (Arcata Bay), and South Bay during an 8-month period in 1979 (Pequegnat and Butler 1982).

Pequegnat and Butler (1981) suggested that wastewater nutrients were important to the bay's sustained productivity and that the removal of this source could decrease the productivity of the bay; recent chlorophyll data confirm this possibility (Fig. 2.15). Chlorophyll concentrations measured at two stations in the channels of Arcata Bay during the summer of 1980, when wastewater was being discharged into the bay, were consistently higher than those measured in the same locations during the summer of 1986, after cessation of wastewater input (J. Brandes and J. E. Pequegnat, unpublished data). Although the chlorophyll concentrations were lower in the bay compartment waters in June and early July of 1986 than in 1980, there was a dramatic drop in late July and early September of 1986. This drop coincided with the mid-July diversion of Arcata's wastewater flow from the bay to the freshwater marsh project and indicated a lowering in primary productivity in the bay associated with this diversion (J. Brandes and J. E. Pequegnat, unpublished data). It is likely that the wastewater nutrients were playing a part in the bay's nutrient budget and may have been important to its sustained productivity. The loss of these nutrients eventually may result in reduced zooplankton and ben-

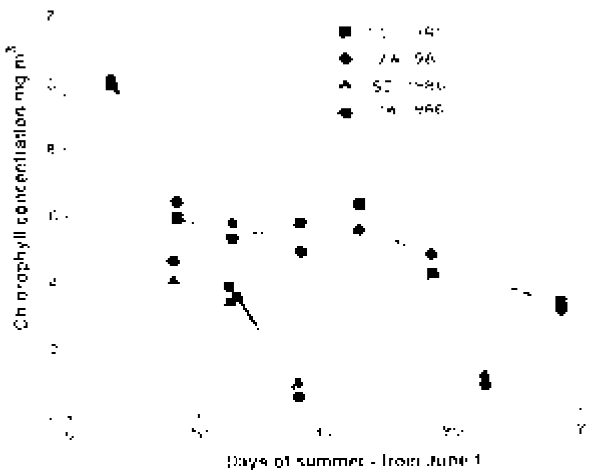

Fig. 2.15. Chlorophyll concentrations before (1980) and after (1986) cessation of wastewater discharge into Arcata Bay (Pequegnat 1988).

thic productivity, especially filter feeders such as the commercially raised oysters.

Turbidity

The waters of Humboldt Bay are quite turbid. Assuming that k, the extinction coefficient, is related to D, the depth of disappearance of a Secchi disk, by the equation $k = 1.6/D$ (Idso and Gilbert 1974), the water depth to which 1% of the surface illumination reaches varies from less than 2 m to about 6 m, with the norm being near 3 m (Tables 2.2 and 2.3). The turbidity of the bay water is due mainly to suspended sediments (both from runoff and those resuspended from the mudflats by wind waves) and from phytoplankton found in the water column during periods of high productivity.

Water Quality

With increased shipping and fishing, Humboldt Bay has been exposed to typical pollutants such as petroleum, antifouling bottom paints, and untreated human and fish-processing wastes. Most of these problems are being addressed (i.e., by wastewater treatment and removal). Until recently there were sanitary waste disposal landfills at each end of the bay, and although they are now closed and the Arcata landfill is covered by impervious muds, there is still a potential for these two regions to introduce a suite of toxins to the bay in their leachates.

Since there is relatively little heavy industry in the region surrounding the bay (the largest being two pulp mills that discharge to the ocean rather than the bay), there are few sources of toxic metals other than natural mining in the small watershed. The State Mussel Watch program found Humboldt Bay to be one of the least polluted bays in the state (M. Martin and M. D. Stephenson, Marine Resource Laboratory, California Department of Fish and Game, Monterey, unpublished data). In oysters tested from all enclosed bays in California as part of the Mussel Watch program, the overall concentration of anthropogenic indicator trace metals (silver, zinc, and lead) was lowest in Humboldt Bay. Concentrations were similar in Humboldt Bay oysters and in those from Drakes Estero, the open coast control station (Table 2.6). However, the concentrations in oysters of trace metals indicative of terrestrial influence were generally higher in Humboldt Bay than in Drakes Estero samples (Table 2.6).

Table 2.6. *Metal concentrations (mean ppm ± 95% C.I.) in oysters from Drakes Estero (an open coast control station) and Humboldt Bay (M. Martin and M.D. Stephenson, Marine Resources Laboratory, California Department of Fish and Game, Monterey, unpublished data).*

Metal	Drakes Estero	Arcata sewer outfall	Central Arcata Bay	South Humboldt Bay
Silver	0.16±0.06	0.68±0.42	0.52±0.40	0.33±0.32
Zinc	316±37	347±159	390±300	430±521
Aluminum	52±17	106±37	196±179	144±77
Iron	25±0	407±172	450±131	450±131

Chapter 3. Biological Habitats and Communities

The wide variety and complexity of habitat in and around Humboldt Bay provide the necessary living space and life requirements for many species of plants, invertebrates, fishes, birds, and mammals. Monroe (1973) presented a generalized view of Humboldt Bay habitats (Fig. 3.1).

Marshes, Fringing Wetlands, and Grass Beds

Wetland habitats were classified according to the criteria presented by Cowardin et al. (1979). Humboldt Bay is the only area of appreciable acreage of salt marsh between San Francisco Bay and Coos Bay, and it links the two floristically. Although MacDonald (1977) distinguished three groups of California salt marshes—northern, San Francisco Bay, and southern, Holland (1986) recognized only a northern and a southern group. While Humboldt Bay contains plant species common to both southern and northern salt marshes, its flora is distinct from the central and southern California marshes.

In the Humboldt Bay area, nearly 90% of the original salt marsh areas have been either diked or filled. Only 393 ha of the original estimated 2,833 ha of salt marsh remain (Monroe 1973; Shapiro and Associates, Inc. 1980). Other remaining wetland habitats around Humboldt Bay include 101 ha of brackish marsh, 111 ha of freshwater marsh (not including grazed seasonal wetlands, which total 2,697 ha), and 69 ha of woody freshwater swamp (according to a draft Humboldt Bay wetlands mitigation needs and restoration goals study, conducted in 1984 by Humboldt County, Eureka, Calif.).

Three main factors influence the vegetation of all wetlands: duration of inundation, water chemistry, and site history. Currently, the salt marshes exist largely as remnants in a narrow perimeter around the bay. Notable exceptions include the large areas of salt marsh on low islands in the middle of Entrance Bay and islands included in Mad River Slough. Brackish and freshwater wetlands most often occur contiguously with the salt marshes and with the exception of the extensive areas of grazed seasonal wetlands, are usually narrow remnants along sloughs and near riparian woodlands.

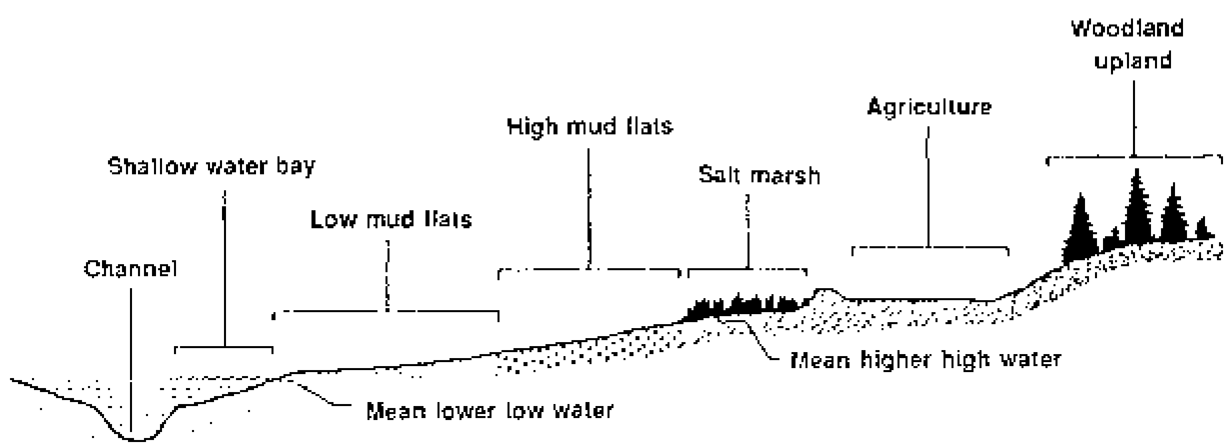

Fig. 3.1. Profile of Humboldt Bay habitats (modified from Monroe 1973).

Fig. 3.2. Humboldt Bay tidal marsh border with unique mixture of cordgrass and pickleweed. Note pickleweed at lower elevation than cordgrass.

Salt Marshes

Dominant Species

Humboldt Bay salt marshes are dominated by three vascular plant species: pickleweed (*Salicornia virginica*), Humboldt cordgrass (*Spartina densiflora*), and saltgrass (*Distichlis spicata*; see Appendix A). Autecological information on pickleweed and saltgrass can be found in Mahall and Park (1976), MacDonald (1977), Newby (1980), Rogers (1981), Zedler (1982), and Josselyn (1983). Similar data on *Spartina densiflora* can be found in Newby (1980), Rogers (1981), and Spicher and Josselyn (1985). While central and southern California salt marshes are also dominated by pickleweed and salt grass, the large areas dominated by *Spartina densiflora* are unique to Humboldt Bay.

Until 1984, *Spartina densiflora* was referred to as a local ecotype of *Spartina foliosa*, which attains its northernmost extension in Bodega Bay and is common from San Francisco Bay south to Baja California (Spicher and Josselyn 1985). *Spartina densiflora* occurs at a higher intertidal position than *S. foliosa* and exhibits a tufted or clumped habit (tussocks), as opposed to the solitary, evenly spaced culms of *S. foliosa* stands. Researchers noted the difference in growth form and intertidal distribution (MacDonald 1977; Rogers 1981; Josselyn 1983), but this taxon was not recognized as a different species until 1984. Ecological and taxonomic evidence compiled by Spicher and Josselyn (1985) documented that the Humboldt Bay cordgrass is an exotic species introduced from South America. Lumber was exported to Chile from the north coast during the mid-1800's and it is speculated that *S. densiflora* found its way to Humboldt Bay as ballast (Spicher and Josselyn 1985). *Spartina densiflora* occurs in only one other location in North America, in Marin County, California, where it was initially introduced as part of a revegetation experiment in 1976. In Marin County, it has spread and currently grows at Creekside Park Marsh, Corte Madera Creek, Muzzi Marsh, and Greenwood Cove.

Humboldt Bay cordgrass maintains its higher intertidal position in the Marin marshes where it occurs with *S. foliosa*, demonstrating that its elevational range is an autecological response rather than a unique situation of Humboldt Bay. The intertidal position of *S. densiflora* results in the bimodal distribution of pickleweed that has been noted by many researchers, including MacDonald (1977), Rogers (1981), Claycomb (1983), and Eicher (1987). In salt marshes that form a gradual interface with the bay waters, pickleweed dominates the lower intertidal and upper intertidal elevations, while cordgrass attains dominance in between (Fig. 3.2). Cordgrass becomes less important in higher elevation marshes, where it may be limited by phosphorus (Newby 1980).

Environmental factors that affect salt marsh species distribution include time and duration of tidal inundation, soil and water salinity, soil aeration, soil type and development, air and water temperature, drainage patterns, nutrient availability, water table height, precipitation, and light (Chapman 1938; Morgan 1961; Adams 1963; Waits 1967; Phleger 1971; Keefe 1972; Squiers 1973; Valiela et al. 1975; Nestler 1977; Parrondo et al. 1978; Gallagher et al. 1980; Newby 1980; Smart and Barko 1980; Rogers 1981). The salt marsh species grow along intermixed environmental gradients. The most obvious gradient, and the one that is most often measured in salt marshes, is elevation (Chapman 1938; Adams 1963; Eilers 1975; Claycomb 1983; Eicher 1987; Fig. 3.3). The elevational gradient, however, more often than not is an indication of other factors, such as inundation, soil salinity, and soil texture (Zedler 1977). Therefore, the term "tide elevation complex," as defined by Clarke and Hannon (1969), best describes the various ecological factors that interact to produce the elevational gradient within a marsh.

Quantitative measurements of the intertidal distribution of the most common species found in salt marshes around Humboldt Bay have been few. Eicher (1987) gathered data on the intertidal position of salt marsh species at five different bay locations predominantly in North Bay; Claycomb (1983) and Newton (1989) measured elevational data associated with mitigation projects on Eureka Slough.

Plant Associations

Three to four plant associations have been recognized in the Humboldt Bay salt marshes (Claycomb 1983; Koplin et al. 1984; Newton 1987, 1989; Eicher 1987). At the lowest elevations, the *Salicornia* type occurs and is composed of pure stands of pickleweed. Above this zone, monotypic stands of *Spartina densiflora* make up the *Spartina* type. Both of these associations contain few to no other vascular plant species but are commonly entangled with algae such as *Enteromorpha* and *Ulva* (Fig. 3.4). A variety of small gastropods, crustaceans, and polychaete worms feed on algal mats.

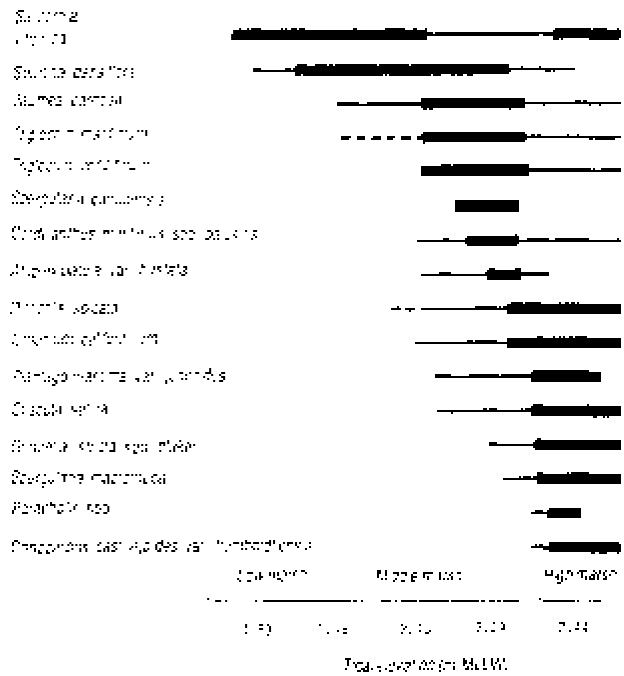

Fig. 3.3. Distribution of major salt marsh plant species across the tidal elevation gradient in North Humboldt Bay, California. Wider bands indicate the range in which each species had its peak cover, as assessed within 7.6 cm elevation classes. Broken bands indicate sporadic occurrence (Eicher 1987).

The marshes above the *Spartina* stands have been lumped (Eicher 1987) or separated into two associations (Claycomb 1983; Koplin et al. 1984; Newton 1987, 1989). Koplin et al. (1984) recognized a *Salicornia–Jaumea* type and a *Salicornia–Distichlis* type. The *Salicornia–Jaumea* type is floristically diverse and in this respect is similar to San Francisco high marshes (*Salicornia–Jaumea–Distichlis* in MacDonald 1977). With the exception of cordgrass, the salt marsh species listed in Appendix A attain their highest abundances in this vegetation type. The *Salicornia–Distichlis* type is depauperate, containing few if any other species, and is often found at the highest elevations or in hypersaline conditions caused by restricted tidal flows and impounding (Newton 1989).

Rare Species

In addition to the different plant associations represented in Humboldt Bay salt marshes, there are three rare salt marsh plant species: Humboldt Bay owl's clover (*Orthocarpus castillejoides* var. *humboldtiensis*), Point Reyes bird's beak (*Cordylanthus maritimus* ssp. *palustris*), and Humboldt

Fig. 3.4. Midlevel tidal salt marsh showing dense growth of pickleweed surrounding cordgrass culms. Note algal mat in foreground.

Bay gumplant (*Grindelia stricta* ssp. *blakei*). The owl's clover and the gumplant are endemic to Humboldt Bay, while the bird's beak is found from Morro Bay, San Luis Obispo County, California, to Coos Bay, Oregon. All three species are on the California Native Plant List 1b, a list containing species which qualify for State listing as rare and endangered throughout their range (California Native Plant Society 1984).

Humboldt Bay owl's clover is an annual member of the family Scrophulariaceae and likely employs haustorial connections as do other owl's clovers. It is distinguished by its two-celled anthers, purple bracts, and bright pink flowers on a large showy spike. Point Reyes bird's beak is also an annual species of the Scrophulariaceae and is known to employ haustorial connections. It is distinguished by the oblong shape of its leaves and bracts and by its purple flower. The Humboldt Bay gumplant is a perennial member of the family Asteraceae. It is distinguished by recurved phyllaries and reddish, erect stems.

The taxonomy of Point Reyes bird's beak is in question. Chuang and Heckard (1973) separated it from the southern California subspecies *C. m. maritimus* based on geography. An outlying population of a *Grindelia* that closely resembles Humboldt Bay gumplant also raises taxonomic questions. This population is located at approximately 457 m elevation on what is locally known as the Mattole Road; currently this population is not being treated as the rare subspecies.

Populations of the three rare species of Humboldt Bay are most common in the high elevation salt marshes, where the *Salicornia jaumea* and the *S. distichlis* associations are frequently disturbed or have been largely destroyed. The gumplant has wider habitat requirements and can be found along berms and dikes adjacent to as well as in salt marshes. Populations of the two annual species have been found to fluctuate widely from year to year (Koplin et. al. 1984; Newton 1987). The role that disturbance plays in the distribution of all three species is not clear. Open habitat within a salt marsh tends to favor germination and growth. Therefore, disturbance, such as light trampling that decreases the cover of pickleweed without destroying the marsh, will encourage the growth of the rare species (Newton 1987, 1989).

Transitional Habitats

Brackish and Freshwater Marshes

The delineation between freshwater and brackish marshes is often not as well defined as the distinction between salt and brackish marshes. There is much overlap, with species common to brackish marshes occurring well into the freshwater marshes and riparian woodlands.

Brackish marshes form at the interface between the salt marshes and the freshwater marshes, and species composition slowly changes along the environmental gradients between them. Qualitative and quantitative descriptions of brackish and freshwater marsh vegetation can be found in Monroe (1973), Shapiro and Associates, Inc. (1980), Koplin et al. (1984), and Newton (1989).

Three plant species common throughout the various brackish marshes are salt rush (*Juncus lesueurii* var. *lesueurii*), pacific silverweed (*Potentilla egedii* ssp. *grandis*), and water parsley (*Oenanthe sarmentosa*). Most of the brackish marsh species appear to separate into monotypic patches probably because of vegetative expansion. The following brackish marsh assemblages are delineated by species composition and structure and defined by the dominant species.

The ecotone between the salt marsh and brackish marsh contains components of both, often including salt marsh species such as saltgrass and tufted hairgrass (*Deschampsia caespitosa*), either of which can dominate large areas, and brass buttons (*Cotula coronopifolia*), which occurs in disturbed locations. In areas that are inundated well into the growing season, three-corner (*Scirpus americanus*) or slough sedge (*Carex obnupta*) dominate. Saltmarsh bulrush (*Scirpus maritimus*) and large populations of the disputed Lyngby's sedge (*Carex lyngbyei*) are most often found in remnant sloughs and adjacent depressions that receive both tidal and freshwater input.

Josselyn (1983) reported that San Francisco brackish marshes are dominated by cattails (*Typha latifolia*) and *Scirpus acutus*. Many Humboldt Bay marshes contain *T. latifolia* at the brackish-freshwater interface, with large stands being quite common. However, while *Scirpus acutus* is found in Humboldt Bay marshes, it does not dominate large areas, except in the artificial ponds created as part of the Arcata marsh project.

Freshwater marshes often contain species similar to brackish marshes. One evident change is in the dominant rush species, which changes from salt rush to common rush (*Juncus effusus* var. *brunneus*; Koplin et al. 1984; Newton 1989). Species that occur in freshwater marshes but not brackish marshes include reed canary grass (*Phalaris arundinacea*), willowherb (*Epilobium watsonii* var. *franciscanum*), speedwell (*Veronica scutellata*), bedstraw (*Galium trifidum*), and monkey flower (*Mimulus guttatus* ssp. *litoralis*).

Small seeded bulrush (*Scirpus microcarpus*) can dominate large areas of freshwater marsh, as can cattails. Both of these species can also be found near brackish marshes. They may form monotypic stands or may grow in open stands with various incidental species occurring underneath.

Water parsley, marsh pennywort (*Hydrocotyle ranunculoides*), floating fern (*Azolla filiculoides*), duckweed (*Lemna* spp.), pondweed (*Potamogeton* spp.), mare's tail (*Hippurus vulgaris*), and water foxtail (*Alopecurus geniculatus*) grow in small ponds and relict freshwater sloughs.

Diked Seasonal and Grazed Wetlands

By far the largest contributor to the loss of tidal wetlands in Humboldt Bay is the diking associated with agricultural development (see Fig. 2.4). While these grazed seasonal wetlands afford winter habitat to waterfowl, their plant associations are largely dominated by introduced grass species, with few species unique to brackish and freshwater wetland systems. Most of the area currently converted to agricultural land was reclaimed between 1880 and 1910. The salt marsh habitat is permanently altered by these activities, resulting in dramatically different species composition. Salt marsh species remain only along relict sloughs, tidally influenced drainages, and isolated hypersaline ponds. Quantitative vegetation analysis of the grazed seasonal wetlands can be found in Koplin et al. (1984) and Newton (1989).

The agricultural areas are dominated by introduced grass species such as velvet grass (*Holcus lanatus*), annual bluegrass (*Poa annua*), perennial and annual ryegrass (*Lolium perenne* and *L. multiflorum*), vernal grass (*Anthoxanthum odoratum*), bentgrass (*Agrostis tenuis* and *A. stolonifera*), orchard grass (*Dactylis glomerata*), meadow fescue (*Festuca arundinacea*), red brome (*Bromus rubens*), and blando brome (*Bromus mollis*). Other herbaceous species commonly associated with these areas include cat's ear (*Hypochoeris radicata*), dandelion (*Taraxacum officinale*), perennial trefoil (*Lotus corniculatus*), and curly dock (*Rumex crispus*). Common clovers are creeping white clover (*Trifolium repens*) and cow's clover (*T. wormskioldii*). Areas within the pastures often support dense stands of common rush. In the shallow freshwater drainage ditches or depressions, rush (*Juncus* spp.), spikerush (*Eleocharis macrostachya*, and occasionally *E. bella* and *E. acicularis*), water foxtail, and pacific silverweed dominate.

Willow Swamps and Riparian Woodlands

Two major types of riparian habitats, willow swamps and riparian woodlands, are present around Humboldt Bay. They are distinguishable from each other by species composition and structure, but they often intermix, with the willow swamps forming the edge of a riparian woodland. More specific information on these vegetation types can be found in Monroe (1973), Shapiro and Associates, Inc. (1980), Koplin et al. (1984), and Newton (1989).

Riparian woodlands occur in areas that receive perennial to annual fresh water; therefore, the species composition is more closely linked to freshwater marshes than to brackish marshes. Remnants of these woodlands occur at the base of conifer forests, or of what was historically forest, around the perimeter of the bay. The dominant tree species are red alder (*Alnus oregona*) and willow (*Salix lasiandra*), which can attain heights of 20 m. The understory can be open, usually from grazing pressure, but more often is closed.

The shrub layer is usually composed of willow species similar to those of the swamps, and the herbaceous layer contains species similar to those of freshwater marshes. In addition, the shrub layer usually contains salmon berry (*Rubus spectabilis*), cascara sagrada (*Rhamnus purshiana*), and elderberry (*Sambucus callicarpa*). The herbaceous layer, which is often over 2 m in height, includes skunk cabbage (*Lysichiton americanum*), slough sedge, water parsley, watercress (*Nasturtium officinale*), chain fern (*Woodwardia fimbriata*), lady fern (*Athyrium filix-femina*), small-seeded sedge, and mannagrass (*Glyceria declinata*).

Willow swamps are located around the edges of freshwater and brackish water marshes and in dune hollows. The most common species are dune willow (*Salix piperi*) and Hooker's willow (*Salix hookerana*), with an occasional wax myrtle (*Myrica californica*) reaching about 7 m in height. The understory is most often related to the adjacent herbaceous marsh. Commonly associated are blackberry and himalaya berry (*Rubus vitifolius* and *R. procerus*), slough sedge, salt rush, common rush, and cattail.

Eelgrass Beds

The eelgrass bed is an important marine habitat type in Humboldt Bay. Arcata Bay and South Bay combined have 1,221 ha of eelgrass beds, with 435 ha in Arcata Bay and 786 ha in South Bay (Harding and Butler 1979). In total, eelgrass beds account for about 20% of the intertidal habitat of the bay. Eelgrass beds in Arcata Bay are not as dense as those of South Bay, a fact apparently related to the dredging for oysters on commercial beds in Arcata Bay (Waddell 1964). Eelgrass is characteristically found near the level of mean low water in Humboldt Bay, and it exerts an important influence on the sedimentary regime, distribution of infaunal organisms, and occurrence of fish and birds.

Phillips (1984) included Humboldt Bay eelgrass flats in his comprehensive discussion of eelgrass meadows of the Pacific Northwest of the United States. He recognized Humboldt Bay as having one of the three largest stands of eelgrass in the region (the other two were Padilla Bay in northern Washington and the Willapa Bay–Grays Harbor area in southwestern Washington). The features of the eelgrass beds at Humboldt Bay are unique.

Eelgrass at Humboldt Bay grows in muddy to silty sediments and has a significant influence on the sedimentary regime in parts of the bay where growth is luxuriant. The sediments in the beds are very fine (Thompson 1971), particularly in South Bay, making it difficult to sample infaunal and epifaunal organisms except from boats.

Marsh Restoration

Marsh restoration as mitigation for wetland destruction is becoming increasingly common in California and on Humboldt Bay. Of the monitored wetland restoration projects on Humboldt Bay (Koplin et al. 1974; Miner and Moore 1980–87; Stopher et al. 1981; Base 1982; Claycomb 1983; Gearheart 1983; Jacobson 1984; Newton 1989), most have been left to revegetate naturally. The common trend is for the area to experience a dramatic die-off of the previously dominant species, followed by increased importance of opportunistic exotic halophytes, such as fat hen (*Atriplex patula* ssp. *hastata*), sicklegrass (*Parapholis incurva* and *P. strigosa*), brass buttons, and rabbitfoot grass (*Polypogon monspeliensis*). Over time, the appro-

Table 3.1. *Marsh restoration projects on Humboldt Bay.*

Project name	Date	Size (acre)	Preconstruction conditions	Present status	Monitoring reports
Park Street	1979	9.5	Old log pond with some marsh vegetation	Saltwater marsh	Claycomb 1983 Chamberlain 1988
Elk River	1980	20	Wetland with restricted tidal flow and high areas	Increasing dominance by *Salicornia*	Stopher et al. 1981 Miner and Moore 1980–87 Base 1982
Arcata Marsh project	1981	175	Largely intertidal mudflat	Freshwater ponds	Gearheart 1983
Elk River Wildlife Area	1982	124	Grazed seasonal wetlands, brackish marsh, uplands, and riparian	Seasonal freshwater wetlands, tidal marsh riparian, and uplands	Koplin et al. 1984 Chrisney 1988 Newton 1989
Bracut Marsh	1981	6	Filled tidal wetland	Open area and salt marsh	None formal
Second Slough	1986	1	Salt marsh and upland berm	Salt marsh	Newton 1989

priate salt marsh species become dominant on the site. However, the presence of vegetation alone should not be construed as a decisive measure of success. Other ecological factors need to be considered, including vegetational structure and composition, soil conditions, invertebrate populations, and bird and mammal usage. Table 3.1 summarizes the data from the Humboldt Bay restoration and mitigation projects.

Invertebrates

Invertebrates of Marshes

Both the diversity and biomass of benthic invertebrates in the marshes of Humboldt Bay are relatively low (Appendix B). The abundant plant cover present in the marsh is in a state relatively inedible by benthic invertebrates, which are deposit feeders and grazers of microalgae on the surface of the marsh. MacDonald (1967, 1969a, 1969b) sampled invertebrates in a number of salt marshes along the Pacific coast of North America, excluding insects. Cameron (1972) and Lane (1969) used different methods to sample insects in marshes at San Francisco Bay, but insects of Humboldt Bay salt marshes have been sampled only in a preliminary manner (Boyd 1982). Insects probably use more marsh plant production than benthic invertebrates do, but even so, only a small part of the plant production is directly consumed (Teal 1962; Cameron 1972).

Benthic invertebrate populations in marshes are dominated by gastropods, crustaceans, and polychaetes. Species are present year-round and fluctuate little in abundance seasonally (Boyd 1982). The gastropods *Assiminea californica* and *Ovatella myosotis* are commonly encountered within the marsh, and *Alderia modesta* is found on the fringes of marshes at Humboldt Bay. Considerably less abundant at Humboldt Bay is the gastropod *Littorina newcombiana*, a species reportedly more common in salt marshes of Oregon (MacDonald 1977). Four infaunal polychaete species are found in the topmost sediments of the low marsh and at midrange elevations—*Eteone californica, Streblospio benedicti, Polydora ligni*, and *Pseudopolydora kempi*—and all probably deposit microflora feeders or grazers on the immediate surface of marsh sediments. Crustaceans in the marshes are a mixture of those with greater affinities to the adjacent uplands and species that are more typically found on the upper mudflats of the bay. *Armadilloniscus coronocapitalis, Porcellio* sp., and *Littorophiloscia richardsonae* are three isopod species from the uplands that have been found in the marshes. *Gnorimosphaeroma oregonensis, Anisogammarus confervicolus*, and *Corophium spinicorne* are crustacean species more characteristic of high intertidal mudflats adjacent to the marshes. Only the amphipod *Orchestia traskiana* reaches its greatest abundance in marshes, rather than in adjacent habitats. In other coastal marshes in California, the green shore crab *Hemigrapsus oregonensis* frequently burrows into the banks of marsh channels, but only occasionally lives in Humboldt Bay marshes. The pattern of species occurrences among the benthic invertebrates supports the concept of the marsh as a transitional environment between the uplands around the bay, and the tidally emergent mudflats that form much of Humboldt Bay.

The importance of the marshes in the trophic economy of the bay is not well understood. A variety of birds find refuge in the marshes at high tides (Springer 1982), but many species feed on intertidal flats during low tides as well. Fish are known to move onto the flooded marshes at high tide, but the importance of feeding activities there has been difficult to assess (Chamberlain 1988). The major contribution of the marshes to the trophic economy of the bay is the export of detrital plant material. Unfortunately, the significance of this detrital export is difficult to estimate. The plant material is first subjected to microbial decomposition and becomes available to potential consumers in the form of dissolved organic carbon (DOC), and smaller particles of plant material that are colonized by bacteria. Sediments of the adjacent mudflats are rich in organic material, some of it originating in the marshes. This organic matter is certainly significant in providing food to the deposit- and suspension-feeding animals on and in the mudflat sediments.

Invertebrates of Intertidal Sand and Mud Flats

The physical environment of the bay exerts a profound impact on the plants and animals that occupy the intertidal habitats. The bay covers a large enough area (62.4 km^2; Proctor et al. 1980) to present a diversity of habitat types, from those that are wholly marine in salinity conditions to others that are typically estuarine for a significant period of time each year. The sedimentary environment is similarly diverse, with a general pattern of coarse sands and shell fragments in the entrance area of the bay, grading both north and south into finer sands and then muds (with various percentages of sand), and finally silts in the upper reaches of both South Bay and Arcata Bay (Thompson 1971). The salinity regime also exerts a profound effect on the settlement, survival, and growth of benthic invertebrates. The complex pattern of species distribution within Humboldt Bay is thus the result of many factors, the most significant of which are relative intertidal height (usually expressed in relation to MLLW, the 0.0 tidal datum), sedimentary structure of the substrate that animals live on or in, and seasonal salinity regime. Two major intertidal habitat types exposed on a daily basis are high intertidal flats from approximately 2.15 m to 1.16 m above MLLW, and low intertidal flats from 45 cm to 116 cm below MLLW.

High Intertidal Flats

Primary producers on the surface of the high flats are a variety of microscopic and macroscopic algae (see Appendix A). Relatively little is known about the microscopic algae, but they do include phytoplankton species that settle from the water column during high tides and remain on the surface of the flats, benthic diatoms, and some blue-green algae (Cyanobacteria). Surface sediments that are examined microscopically are always rich in these microscopic forms, but relative abundances of the particular species involved have not been determined. The two major species of macrosopic algae present are *Enteromorpha intestinalis* and *Ulva* sp., with *Fucus distichus* growing on debris, emergent rocks, and even larger pebbles.

The abundance of macroalgae on the high flats fluctuates greatly on a seasonal basis. The largest standing stocks are observed during the summer and early fall, usually declining rapidly with the onset of winter storms in late fall or early winter. The predominantly northwesterly winds accompanying these storms produce wave turbulence in surface waters that dislodge the algae and transport plant material to other bay locations or to nearshore habitats outside the bay. In these various sites, the macroalgae become part of the detritus foodweb of the bay and nearshore waters.

Polychaetes, crustaceans, and mollusks are the significant invertebrates of the high intertidal flats. A large number of fish and birds feed on these invertebrates, moving onto the flats according to the tidal regime. The abundant populations of invertebrates support impressive populations of vertebrate predators, suggesting that the secondary (animal) production of the flats is relatively high. Just below the line of salt marsh vegetation, the burrows of both small and larger invertebrates are apparent in examining the surface of the mudflat. Complex, deep burrows of ghost shrimp (*Callianassa gigas*, with only an occasional *C. californiensis*) are found on the high flats at many locations in both Arcata Bay and South Bay. These animals are relatively long-lived and, once the adults have dug their deep burrows, probably secure from predation. Much more abundant smaller crustaceans are found on the surface of the flats associated with macroalgae, finding refuge under debris, and in shallow, impermanent burrows at the surface of the flats. Fish feed on these crustaceans during high tides (Toole 1978) and shorebirds probably consume them at low tide (Carrin 1973).

The most abundant organisms of the high flats are a variety of polychaetes that tend to be distributed widely in the bay. Some differences in polychaete abundance are determined by seasonal salinity regimes near creeks that enter the bay. Smaller polychaetes reproduce annually, seldom reach lengths of more than a few centimeters, and are probably fairly short-lived (Dales 1967). Capitellids, spionids, and syllids are the most abundant species encountered (Appendix B). Under conditions of varying salinity, oligochaetes can also be somewhat abundant. Toole (1978) found that juvenile English sole fed on capitellid polychaetes as an increasing percentage of their diets during the first year of growth in Humboldt Bay. Shorebirds are also undoubtedly significant predators of these high intertidal polychaete species (Carrin 1973), but quantitative or experimental data to demonstrate the relative importance of these worms in shorebird diets are lacking.

The small bivalve *Transennella tantilla* is abundant on the high mudflats. This species is found just below the surface of the flat and is probably important in the diets of both fish and shorebirds (Carrin 1973; Collins 1978). *Macoma nasuta* is occasionally found on the high flats but is typically more abundant on lower intertidal flats. The small grazing gastropod *Alderia modesta* feeds on the macroalgae or microalgae on the surface of the flats, particularly near marsh vegetation. In areas where creeks enter both Arcata Bay and South Bay, and when estuarine conditions prevail at least seasonally, *Mya arenaria* can be abundant on the higher flats. Recruitment to these populations has been sporadic when studied elsewhere (Warwick and Price 1975) and seems to follow a similar sporadic recruitment pattern at locations in Humboldt Bay (Simel 1980). In the estuarine areas of the bay, the small bivalve *Macoma balthica* occurs and can be locally abundant.

Barnacles (*Balanus glandula, Chthamalus dalli*), algae (*Fucus distichus, Enteromorpha intestinalis*), and the native oyster *Ostrea lurida* colonize emergent rocks, logs, and small bits of debris on the high flats. The overall importance of these small patches of solid substrate to the overall economy of the bay is probably minor.

Low Intertidal Flats

The character of the fauna and flora of the mud and sandflats in the bay changes at about 91 cm to 61 cm above MLLW. There is considerably less exposure during low tides at these elevations, and the abundance of infaunal organisms increases considerably. Many species that occur to −61 cm in the lower intertidal and subtidal sediments of the bay first occur on low intertidal flats. Many plant and invertebrate species occur on these flats (see Appendix B).

The sedimentary environment in different parts of the bay affects the distribution of low intertidal plants and animals on the mudflats. Typically sands and gravels predominate in the central part of the bay, grade gradually into fine sands, and eventually into muds and silts away from the central part of the bay into South Bay and Arcata Bay. There are also small areas of silt deposition near the mouths of creeks and rivers that enter the bay, often accompanied by an estuarine salinity regime. Midintertidal silts and sands do not allow the free movement of water into the sediments, resulting in an anoxic condition (with the characteristic accumulation of H_2S) that develops just below the sediment surface. The animals living in sediments must possess appropriate behavioral or physiological adaptations to withstand these anoxic conditions. These adaptations can involve burrows that open to the surface (e.g., *Upogebia pugettensis, Pista pacifica, Urechis caupo*), feeding structures that have a dual function in respiration (phoronids, pectinarid polychaetes), or specialized respiratory pigments (several mollusks and polychaete worms).

Sandy substrates at low intertidal levels in the central portion of the bay contain a rich fauna dominated by mollusks and polychaetes. During any low tides of zero or lower, these areas of the bay are visited by many people in search of edible clams; they most commonly take gaper clams (*Tresus capax*, occasionally *T. nuttallii*), Washington clams (*Saxidomus nuttalli, S. giganteus*), littleneck clams (*Protothaca staminea*), and cockles (*Clinocardium nuttallii*). *Tresus* spp. are more common in sandy substrates, and *Saxidomus* spp. in muddier sands, but there is no clear demarcation line between the two. A wide variety of smaller bivalves (including several tellinids) also occurs at low intertidal levels. The siphons of these smaller bivalves can form a significant component in the diets of bottom feeding fish (Collins 1978; Toole 1978).

The polychaete worms of these substrates are abundant and important in the diets of fish and shorebirds. Both sandy and muddy substrates contain large nereids that many who fish on the bay use as bait. Other polychaetes—capitellids, cirratulids, spionids, terebellids, and oweniids—are smaller in size but often number up to several thousands per square meter, depending on the part of the bay where samples are taken (Boyd et al. 1975; Bott and Diebel 1982).

Invertebrates of Eelgrass Beds

Phillips (1984) indicated a lack of definitive information about distinctive assemblages of infaunal species in sediments of eelgrass beds. Unpublished investigations of infaunal organisms in eelgrass beds at Humboldt Bay and a survey of the literature suggest that eelgrass sediments do not usually contain unique assemblages of infaunal organisms. The sediments do contain a rich fauna of mollusks and polychaetes that flourish in this biotope. The polychaetes are mostly deposit feeders, suggesting that they feed on decaying vegetation and sediments rich in organic matter. The mollusks probably also benefit from the dissolved organic carbon released from eelgrass blades, roots, and algal epiphytes (Phillips 1984).

The animals and plants found on eelgrass blades represent a distinctive assemblage of organisms. Dykhouse (1976) found that five species of invertebrates were dominant occupiers of blade space on eelgrass in South Bay: the hydrozoans *Obelia longissima* and *Tubularia marina*, the bryozoan *Hippothoa hyalina*, and the colonial ascidians *Diplosoma macdonaldi* and *Botrylloides* sp. None of these species is restricted to eelgrass blades in Humboldt Bay, but populations flourish seasonally on the blades. The aplysid gastropod *Phyllaplysia taylori* is highly adapted in coloration and morphology for growth and survival on eelgrass blades. The larvae undergo direct development (Bridges 1975) and begin browsing on the surfaces of eelgrass blades as juveniles. This is perhaps the only species in the bay that can be said to depend exclusively on eelgrass blades as a habitat, although even in this species individual animals are sometimes found on other substrates. The relationship between eelgrass and its epiphytes is facultative in Humboldt Bay, but populations growing on the blades are certainly much increased by seasonally flourishing there.

A wide variety of motile invertebrates and fish frequent eelgrass meadows of the Pacific Northwest (see Phillips 1984). In Humboldt Bay, three species of commercially important crabs, Dungeness crab (*Cancer magister*) and rock crabs (*C. antennarius* and *C. productus*) are relatively common in dense eelgrass beds of South Bay. The rock crabs have recently been the basis for a small commercial fishery, while Dungeness crab is the basis of a large fishery in coastal nearshore waters. Dungeness crabs are taken regularly in the bay by sport fishing. Other crab species, various shrimps, amphipods, nudibranchs, brittle stars, nemerteans, flatworms, sea cucumbers, snails, and flatfishes are also commonly found in eelgrass beds of the bay.

Invertebrates of Subtidal Marine Habitats

The subtidal channels in the central part of Humboldt Bay were sampled in 1974 before a major dredging operation (Boyd et al. 1975) and again in 1980 (Bott and Diebel 1982) to determine the nature of recolonization of sediments after dredging. Little is known about the fauna of shallow, irregularly dredged channels in South Bay and Arcata Bay. Thompson (1971) described the sediments in shallow channels as containing progressively more silt in their upper reaches, and the different sediment composition can be expected to exert some influence on the composition of infaunal assemblages.

Boyd et al. (1975) enumerated 141 species of invertebrates taken at 65 stations in Entrance Bay, North Bay Channel, Samoa Channel, and Eureka Channel. With the exception of the Entrance Bay stations, Bott and Diebel (1982) revisited 56 stations in the same area and enumerated 188 species of benthic invertebrates. In both surveys, polychaetes dominated the fauna, followed by mollusks and crustaceans. These three groups accounted for approximately 90% of the species present in 1974 and 1980. Polychaetes were the most numerous, accounting for 49% of all species collected in 1974 and 54% of all species taken in 1980. Mollusks accounted for 19% of the species in 1974 and 21% of the species in 1980. About 22% of the species taken in 1974 were crustaceans, but this group declined slightly to 16% of the species in 1980. Benthic organisms were classified as "characteristic" of the sampled area if they occurred at 50% or more of the sampled stations. There were nine polychaete species, six mollusk species, two nemertean species, and a phoronid that fit this criterion in both the 1974 and 1980 sampling periods (Table 3.2). The presence and abundance of these and several other species collected in both surveys indicates that the faunal composition of benthic subtidal assemblages

Table 3.2. *Characteristic species (taken at >50% of stations sampled) in benthic subtidal habitats of the central portion of Humboldt Bay in 1974 and 1980 (Boyd et al. 1975; Bott and Diebel 1982).*

Family	1974	1980
Polychaetes	*Glycinde polygnatha*[a] *Haploscoloplos elongatus*[a] *Lumbrineris tetraura* *Lysilla labiata*[a] *Mediomastus californiensis*[a] *Owenia collaris*[a] *Phloe tuberculata*[a] *Platynereis bicanaliculata*[a] *Polydora socialis*[a] *Spiophanes bombyx*[a] *Spiophanes berkeleyorum*	*Amaeana occidentalis* *Eumidia bifoliata* *Exogone lourei* *Glycinde polygnatha*[a] *Haploscoloplos elongatus*[a] *Lysilla labiata*[a] *Mediomastus californiensis*[a] *Nephtys caecoides* *Ophelia assimilis* *Owenia collaris*[a] *Phloe tuberculata*[a] *Platynereis bicanaliculata*[a] *Polydora socialis*[a] *Sphaerosyllis californiensis* *Spiophanes bombyx*[a] *Tharyx monilaris* *Tharyx multifilis*
Crustaceans	*Crangon nigricauda* *Diastylis* sp. *Lamprops* sp. *Photis brevipes* *Protomedia* nr. *articulata* *Tritella pilimana*	None
Mollusks	*Adula diegensis*[a] *Clinocardium nuttallii*[a] *Lyonsia californica* *Macoma inquinata* *Mysella tumida*[a] *Protothaca staminea*[a] *Saxidomus* sp. *Transennella tantilla*[a] *Tresus capax*[a]	*Adula diegensis*[a] *Alvinia compacta* *Clinocardium nuttallii*[a] *Mysella tumida*[a] *Protothaca staminea*[a] *Transennella tantilla*[a] *Tresus capax*[a]
Nemerteans	*Paranemertes californica*[a] *Tubulanus pellucidus*[a]	*Cerebratulus californiensis* *Paranemertes californica*[a] *Tubulanus pellucidus*[a]
Phoronids	*Phoronopsis viridis*[a]	*Phoronopsis viridis*[a]

[a] Species found in >50% of samples in both 1974 and 1980.

in the bay is relatively constant, even following significant disturbances. There were some surprising findings in the 1980 survey, however. In that year, no crustacean species were found at 50% or more of the sampled stations, whereas six relatively motile crustacean species had been characteristic of the sampled stations in 1974. Although these motile species appear to be able to move freely over subtidal substrates and quickly recolonize exposed sediment surfaces, this apparently had not occurred throughout the area sampled. The six crustacean species characteristic of all samples in 1974 were collected again in 1980 but were more sporadic in occurrence. This could reflect sampling error (possible), insufficient time for crustacean species to fully reoccupy dredged areas (unlikely), or greater habitat heterogeneity than had been present prior to dredging (probable). The five mollusk species that occurred at more than 50% of the stations in 1974 and 1980 may represent remnant populations. These animals, deeply burrowed into the sediments, would remain in areas where dredging had taken place. Their presence appears to indicate little change, but actually the absence of motile and selective crustaceans indicates that a major change had occurred. The crustacean and polychaete distribution patterns indicate the existence of more restricted and heterogeneous sediment types.

A significant change in the faunal composition of the dredged channels was the increased abundance of the polychaete *Owenia collaris*. This species was present throughout the study area in 1974, but accounted for over half the number of individual animals collected at all stations in 1980. Apparently, *Owenia* was able to recolonize the newly dredged areas of the channels with a high degree of success, becoming the numerically dominant species throughout the area.

In both 1974 and 1980, the distribution of benthic animals was related to the sediment composition in the central part of the bay. In general, "clean sands" with little or no silt present contained a species-poor assemblage with the polychaete *Glycera oxycephala*, the bivalve *Tellina nuculoides*, and the sand dollar *Dendraster excentricus* in both sampling periods. In 1974, two other polychaete species, *Ophelia assimilis* and *Spiophanes bombyx*, were also present in the assemblage. It seems unlikely that the character of the sediment itself determines the fauna contained, but rather, that the sediment composition and the fauna are both responding to some other determining factor, probably the speed of water movement over the bottom. Water currents of relatively high speed transport smaller sediment particles away from heavier sand particles, and also require that sessile animals possess adaptations that allow them to remain in place. Sand dollars possess adaptations that allow individuals to remain stably positioned in fairly dynamic benthic habitats (Chia 1973), and *Tellina nuculoides* occupies shallow inshore habitat not subject to direct forces of bottom currents. The polychaete *Glycera oxycephala* is more difficult to characterize in relation to bottom currents and the sedimentary regime. Morphologically, the proboscidial organ would suggest a predatory life style, with small crustaceans and other small polychaetes as prey. Alternatively, the species could be a deposit feeder, but the lack of much organic matter in the sands would argue against that conclusion.

The species-poor assemblage was found in 1974 and 1980 off the southwestern tip of Indian Island at the confluence of the Samoa and Eureka channels. Another species-poor area lies between the North Spit and the Elk River Spit, where North Bay Channel is narrowly confined as it joins Entrance Bay (Fig. 1.1). In both areas identified as species poor in 1974, dredging activities in 1977–78 appear to have resulted in the expansion of the assemblage (Fig. 1.1). The species-poor area between North Spit and Elk River Spit was significantly larger in 1980 than it had been in 1974, and the area to the southwest of Indian Island had also increased in size following dredging.

Other areas in the central part of the bay have been characterized as species-rich or of mixed faunal composition. These areas had more silt present in sediments, or are mixed sediments with various amounts of silt, gravel, and biogenous material. The species-rich assemblage contains more species and a greater abundance of organisms at each station. Polychaetes and mollusks (Table 3.2) are characteristic of species-rich areas. The feeding types of the polychaetes in particular indicate that suspension feeding and surface-deposit feeding are the successful trophic strategies in areas occupied by this assemblage. These strategies suggest moderate to slow-moving currents over bottom areas where the assemblage is encountered, with resultant deposition of finer particles of sediment and organic matter during periods of low tidal water movement.

It would be of considerable interest to extend investigations of benthic assemblages into the less frequently disturbed shallow channels of Arcata Bay and South Bay. It is known that commercially important fish species move into these channels (Misitano 1970) and probably feed there (Toole 1978). It is not known if the faunal assemblages of the shallow channels are similar to those found in the deeper channels of the central bay. Maintaining the conditions necessary to support abundant populations of benthic invertebrates is directly related to the continuation of commercial fisheries for English sole and speckled sanddabs.

Mariculture and Introduced Species

A number of attempts have been made over the past century to introduce potentially valuable invertebrates into Humboldt Bay. The most notable success has been the introduction of Pacific oysters (*Crassostrea gigas*), grown most extensively on beds in Arcata Bay. A number of other introduced species failed to flourish on a commercial basis (e.g., the Atlantic oyster *Crassostrea virginica* and the Atlantic quahog, *Mercenaria mercenaria*). With the introduced species have come a variety of incidental species that have sometimes flourished, although the species with which they originally were introduced have had to be maintained by continual introduction. Introduced estuarine species are not nearly as common in Humboldt Bay as they are in other Pacific coastal bays, probably because true estuarine conditions prevail in only a part of the bay during above-normal runoff periods. San Francisco Bay in particular has come to support a veritable potpourri of introduced estuarine species from around the world as a result of the more extensive estuarine conditions, the commercial shipping entering the bay from all over the world, and numerous attempts at culturing exotic species. The invertebrate fauna there is now dominated by non-native species (Carlton 1979). In contrast, relatively few exotic species have become successfully established in Humboldt Bay.

Oyster culture in Arcata Bay is carried out primarily on raised beds that are harvested by dredging. There is also a small tray culture and suspended lantern net operation in Mad River Slough, but that fishery is of minor economic significance compared to oysters taken from Arcata Bay. Oyster harvesting is the largest commercial fishery in the bay, with a yearly production of 397,000 kg and a market value of $1.7 million (Shapiro and Associates, Inc. 1980). Oyster culturing has apparently caused major changes in the biological communities of Arcata Bay, the most evident of which has been the reduction of eelgrass beds. The growth of eelgrass in Arcata Bay is sparse compared to growth in South Bay, apparently a result of oyster culture on the raised beds, with consequent reduction in bottom area on which eelgrass can grow. There has also been speculation that finer sediments are continually resuspended by harvesting oysters with dredges, with resulting increases in water turbidity and decrease in growth of eelgrass (Waddell 1964). Native bivalve species (notably littleneck clams, *Protothaca staminea*) also flourish in the oyster beds, but the biological character of Arcata Bay has obviously been modified by oyster-culturing activities.

The softshell clam (*Mya arenaria*) has been notably successful in estuarine areas of Arcata Bay and in a small area of South Bay near Whites Slough. It is not known whether this species was intentionally introduced or accompanied the introduction of some other species. It was often the practice in the late nineteenth and early twentieth centuries to pack seed cultch bearing young oysters in algae from the source area, and this apparently accounted for the introduction of many incidental species, softshell clams possibly among them. Softshells are relatively abundant in Mad River Slough and along the northern intertidal areas of Arcata Bay. The species is able to reproduce in the bay (Simel 1980) and supports a small sport fishery.

A number of other less conspicuous species are apparently of foreign origin, although essentially nothing is known of their influences on the bay ecosystem. The snail *Ovatella myosotis*, found in salt marshes, is of Atlantic coastal origin. Pilings in the bay are eventually riddled by gribbles, the Atlantic boring isopods *Limnoria tripunctata* and *L. quadripunctata*. The polychaetes *Pseudopolydora kempi* and *Streblospio benedicti* were probably introduced to the bay. Although the Humboldt Bay fauna has not been greatly modified by these introductions, there is no doubt that many introductions have occurred as a result of commercial shipping activities and oyster culture. It would be difficult to assess now what impact these introductions have had on the bay ecosystem.

Fishes

Humboldt Bay has a diverse fish fauna composed of estuarine and marine forms. Appendix C, modified from Gotshall et al. (1980), and Shapiro and Associates, Inc. (1980), lists 110 species recorded for the bay.

Sharks and Rays

The most common sharks in the bay are the brown smoothhound (*Mustelus henlei*), the leopard shark (*Triakis semifasciata*), and the sevengill shark (*Notorynchus maculatus*). These sharks inhabit the deep tidal channels at low tide, but swim into small channels and over the mudflats to feed at high tide. Sharks are most numerous in the bay during the summer months. The bay supports a minor commercial fishery for the sevengill and leopard sharks, which are caught by hook and line and in drift gill nets. These sharks are quite palatable and some sport anglers specialize in bay shark fishing. The Eureka office of the California Marine Advisory Extension Service distributes a brochure on shark angling in Humboldt Bay. Sharks are high-level carnivores, but most species are omnivorous (Shapiro and Associates, Inc. 1980). Smaller inshore species (i.e., the brown smoothhound and leopard shark) feed largely on crustaceans and mollusks.

Bat rays (*Myliobatis californica*) are common in Humboldt Bay channels and over the mudflats at high tides. In bays and sloughs, bat rays feed heavily on clams, oysters, shrimp, and crabs (Baxter 1960). Commercial oyster beds in Arcata Bay are commonly fenced or "staked" to protect them from bat rays, which can severely damage an oyster bed in a short time. Humboldt Bay oyster companies are periodically given special reduction permits to seine channels adjacent to oyster beds to remove rays. Bat rays are often caught by sport anglers. The meat filleted from the pectoral fins or wings is edible, but most anglers catch and release rays because they are unaware of their palatability.

Herrings and Anchovies

Humboldt Bay is an important spawning and nursery area for the Pacific herring. Adult herring enter the bay and spawn from December to March. In winters 1974–75 and 1975–76, 80% of all spawning in the bay took place in eelgrass beds in Arcata Bay (Fig. 3.6; Rabin and Barnhart 1986); spawning herring biomass was estimated at 337 t in 1974–75 and 210 t in 1975–76. Herring larvae, collected from January through May, were second in abundance in a 1969 larval survey of Humboldt Bay (Eldridge and Bryan 1972). Herring juveniles have been collected in the bay by trawl and seine during the spring, summer, and fall (Samuelson 1973; Sopher 1974; Waldvogel 1977).

There is commercial gill-net fishing each winter in Humboldt Bay for adult herring, primarily to obtain roe for export to Japan (Barnhart 1986a). The quota since 1983 has been 54 t and each year the catch approaches the quota. The fishery is located primarily in Arcata Bay.

Herring eggs deposited on eelgrass are consumed by birds, primarily gulls, *Larus* spp. (Spratt 1981; Barnhart 1986a), although bird predation in Humboldt Bay is probably not significant (Rabin and Barnhart 1986). Subadult and adult herring in schools appear to be one of the major forage fishes of the sea, providing food for salmon, sharks, lingcod, waterfowl, sea lions, and whales (Hart 1973).

Schools of subadult and adult northern anchovy (*Engraulis mordax*) migrate into Humboldt Bay in spring and summer, primarily to feed (Peters 1970; DeGeorges 1972; Sopher 1974; Waldvogel 1977). Estimates of summer (July–August) biomass of anchovies in Humboldt Bay for the years 1976, 1979, 1980, 1983, 1984, and 1986 averaged 82 t (Barnhart 1986b). These fish are important as food for other fish and birds; in some years anchovy

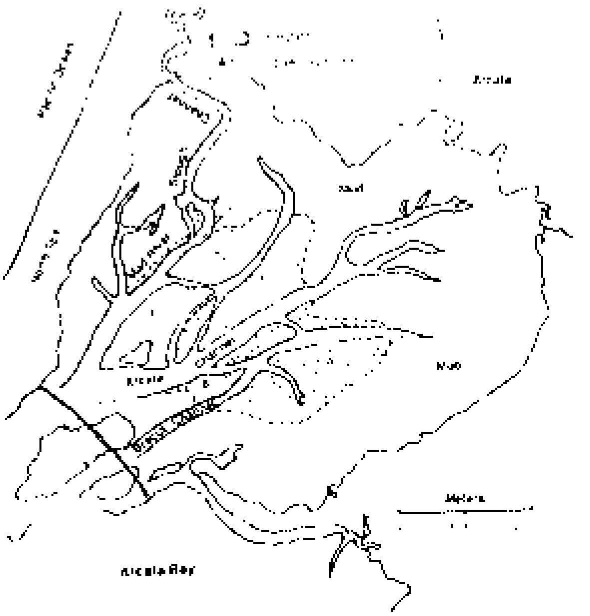

Fig. 3.6. Eelgrass and Pacific herring spawning distributions in Arcata Bay during the winters of 1974–75 and 1975–76 (from Rabin and Barnhart 1986).

schools apparently attract salmon into the bay, providing a salmon sport fishery (Monroe 1973; Warner 1982).

There is a live-bait fishery for northern anchovy by albacore (*Thunnus alalunga*) fishermen in Humboldt Bay, with a quota of 13.6 t and a season of September 1–December 1. The number of albacore-bait boats that fish the bay varies considerably from year to year.

Misitano and Peters (1969) examined the stomach contents of herring and anchovy from Humboldt Bay. Anchovy fed largely on benthic copepods, other benthic crustaceans, and diatoms (69% of the total diet), whereas herring fed predominantly on pelagic copepoda (69% of the total diet).

Salmons and Trouts

Chinook salmon (*Oncorhyncus tshawytscha*), coho salmon (*O. kisutch*), rainbow trout (*O. mykiss*), and cutthroat trout (*O. clarki*) are anadromous species that enter Humboldt Bay tributaries as adults to spawn. The most important tributary streams are Jacoby Creek and Freshwater Creek in Arcata Bay, Elk River in Entrance Bay, and Salmon Creek in South Bay. Several bay tributaries support remnant resident populations of cutthroat trout. Bay tributaries historically supported larger populations of anadromous fish that contributed significantly to a bay fishery, but stream-habitat degradation has severely limited these populations (Monroe 1973). Young salmonids, after spending varying lengths of time in fresh water, migrate into saltwater to grow further and mature. Humboldt Bay provides a nursery area for juvenile salmonids (Monroe 1973).

Since 1964 the Humboldt Fish Action Council, a citizens' action group, has worked with the California Department of Fish and Game, Humboldt County, the California Conservation Corps, and the Pacific Lumber Company on a number of salmon and steelhead rearing and stocking programs to restore fish populations in the Humboldt Bay area (Miller 1982). The Council currently has a fish trap and fish-rearing facilities on Freshwater Creek. Since 1963, the Arcata Wastewater Aquaculture facility has operated on Arcata Bay. Several ponds adjacent to a city of Arcata's large wastewater oxidation pond are used to rear salmonids for release into Humboldt Bay. Some fish are released directly into the bay and others into nearby Jolly Giant Creek. A projected system will use an existing 6.9 ha recreational lake to produce a totally self-sustaining run of salmonids to be released into a small, artificially created drainage on Arcata Bay.

At present, the recreational fishery for salmonids on Humboldt Bay consists largely of salmon fishing during the summer in Entrance Bay, particularly from the jetties or by boat between the jetties. However, large numbers of salmon anglers leave from the bay to fish nearshore waters outside. Smith (1966) estimated that 10,000–15,000 anglers operating from about 5,000 boats fish out of Humboldt Bay annually. The Pacific Fishery Management Council (1986) reported that in 1971–75, recreational salmon anglers fished an average of 40,000 angler-days annually out of Humboldt Bay and averaged about 10,000 chinook salmon caught. Salmon anglers took 26,000 chinook in 1985, fishing from ports on Humboldt Bay. Three licensed party boats operate from

Fig. 3.8. Salmon caught by party boat anglers fishing outside Humboldt Bay.

Humboldt Bay; the majority of their clients fish for salmon (Fig. 3.6). One party boat operator estimated that he charters 1,000-1,500 anglers each season (Walters 1982).

Commercial fishing has historically been a major industry for the Humboldt Bay area and salmon fishing has always sustained a large portion of the commercial fishery. From 1971 through 1975, fishermen averaged 276,000 salmon annually landed at Eureka docks (Pacific Fishery Management Council 1986). In recent years, however, landings have been greatly reduced due to declines in salmon populations and coincident restrictions on commercial seasons.

Smelts

Smelts are important forage fishes in Humboldt Bay. Longfin smelt (*Spirinchus thaleichthys*) larvae were third in abundance in a larval fish survey of Humboldt Bay (Eldridge and Bryan 1972) and longfin smelt juveniles and adults were fourth in abundance in a trawl survey of Arcata Bay (Sopher 1974). The most abundant incidentally caught fish while fishing for anchovies with a lampara seine were three species of smelts: longfin, night (*S. starksi*), and surf smelt (*Hypomesus pretiosus*; Waldvogel 1977). The longfin smelt, classified as weakly anadromous by Fry (1973), probably enter Humboldt Bay tributaries to spawn. Smelt in marine waters feed on small crustaceans, but will eat a variety of polychaete worms, larval fish, jellyfish, and other suitable food organisms (Shapiro and Associates, Inc. 1980). They, in turn, are taken by predatory fishes, seabirds, and marine mammals.

Surfperches

Seven species of surfperches are abundant or common in Humboldt Bay (Appendix C). In Sopher's 1974 trawl survey of Arcata Bay, these species accounted for 45% of the total catch and the shiner perch (*Cymatogaster aggregata*), the smallest species, ranked first numerically. A South Bay trawl survey gave similar results; the same seven surfperch species made up almost 50% of the total catch and the shiner perch accounted for 31% of the total (Samuelson 1973).

Surfperch species are important recreationally in Humboldt Bay and are caught from shore, piers, jetties, and skiffs all year. A sport-fish survey of Humboldt Bay (1957-60) revealed that surfperch made up almost 53% of the catch (Gotshall 1966). From March to June most of the redtail surfperch (*Amphistichus koelzi*) catch in Humboldt Bay is females whereas from July to October the sex ratio is 1:1 (Ngoile 1978). Female redtails enter estuaries in the spring to give birth to young (Miller and Gotshall 1965; Bennett and Wydowski 1977; Ngoile 1978).

There is also a minor commercial fishery for surfperches in Humboldt Bay, primarily for the redtail surfperch. These fish are captured by beach seine and hook and line. Surfperch landings for Humboldt Bay from 1981 to 1985 averaged 9,230 kg annually (California Department of Fish and Game, Eureka, unpublished data). The diet of redtail surfperch in Humboldt Bay consisted of decapods, amphipods, mollusks, polychaetes, isopods, cirripeds, bryozoans, and fish, with decapods first in importance (Ngoile 1978). The diet of surfperches in general consists of small crustaceans and other small invertebrates (Baxter 1960). In turn, surfperch serve as forage for carnivorous fish species, seabirds, and marine mammals.

Scorpionfishes (Rockfishes)

As indicated by trawl surveys (Samuelson 1973; Sopher 1974) and sport-fish surveys (Gotshall 1966) the black rockfish (*Sebastes melanops*) is probably the most abundant rockfish in Humboldt Bay. Rockfish are commonly caught by anglers fishing from jetties. Gotshall (1966) stated that juvenile rockfish are common in Humboldt Bay channels; the trawl surveys verified this and indicated that the bay serves as a rockfish nursery area. Prince (1972) reported that rockfish inhabiting an artificial reef in South Bay fed primarily on arthropods associated with the reef: Dungeness crab, gammarid amphipods, and bay shrimp. Fish is important in the diet of rockfish. Rockfish are caught by commercial anglers outside Humboldt Bay and from 1981 to 1985 made up 25-31% of the commercial landings at Humboldt Bay (California Department of Fish and Game, Eureka, unpublished data).

Greenlings

Humboldt Bay provides spawning and nursery areas, particularly the areas around the entrance, seawalls, and jetties, for four species of greenlings. Jetty anglers fish for the kelp greenling (*Hexagrammos decagrammus*) and most highly prize the lingcod because it attains large size and is very palatable. Greenling feed on a variety of crustaceans, polychaete worms, and small fish. Lingcod feed chiefly on other fishes, including herring, flounders, and rockfish, and perhaps incidentally on squid and various crustaceans (Shapiro and Associates, Inc. 1980).

Flatfishes

The two most common bottom-feeding fish species in Humboldt Bay are English sole (*Parophrys vetulus*) and speckled sanddab (*Citharichthys stigmaeus*). The English sole, a commercially important flatfish, uses Humboldt Bay extensively as a nursery area. In trawl surveys of South Bay and Arcata Bay (Samuelson 1973; Sopher 1974), English sole were second in abundance, making up 24% and 26% of the catches, respectively. This species spawns offshore and the pelagic larvae are carried into the bay by tidal currents. Upon metamorphosis to the benthic form, the larvae settle or migrate to shallow, sandy areas in the bay. Most juvenile sole leave the bay and emigrate to deeper waters during the fall of their first year, although some remain in the bay through their first winter (Misitano 1970; Samuelson 1973; Sopher 1974).

On the basis of comparisons between available prey items and composition of prey organisms in stomach contents, juvenile English sole in estuarine channels are considered nonselective feeders (Collins 1978). Recently metamorphosed English sole inhabit intertidal and shallow subtidal sand, sand–eelgrass, and mud–eelgrass habitats, where they feed primarily on small epibenthic crustaceans such as calanoid and harpacticoid copepods and cumaceans (Toole 1980). Older juvenile English sole feed primarily on polychaetes, bivalves, amphipods, and other infaunal organisms.

Speckled sanddabs are abundant in Humboldt Bay; they accounted for 8% of the total trawl catch in Arcata Bay (Sopher 1974) and 9% of the trawl catch in South Bay (Samuelson 1973). Sopher's (1974) length-to-frequency data suggested three age classes present in the bay. Speckled sanddabs are somewhat selective bottom feeders, with small crustaceans accounting for the majority of prey items taken, in both number and volume (Collins 1978). There is some degree of overlap between the diets of English sole and speckled sanddabs, although not enough to cause significant competition for prey (Fig. 3.7).

The starry flounder (*Platichthys stellatus*) is also common in Humboldt Bay and is sometimes caught by bay anglers. It is a euryhaline species known for its tolerance of low salinities and has been known to move far upstream into fresh water.

Dover and English soles are commercially important outside Humboldt Bay (Fig. 3.8). Flatfishes averaged 31–42% of the total landings for Humboldt Bay from 1981 to 1985 (California Department of Fish and Game, Eureka, unpublished data).

Amphibians and Reptiles

Shapiro and Associates, Inc. (1980) compiled a list of amphibians and reptiles thought to occur in the Humboldt Bay area and their occurrence by

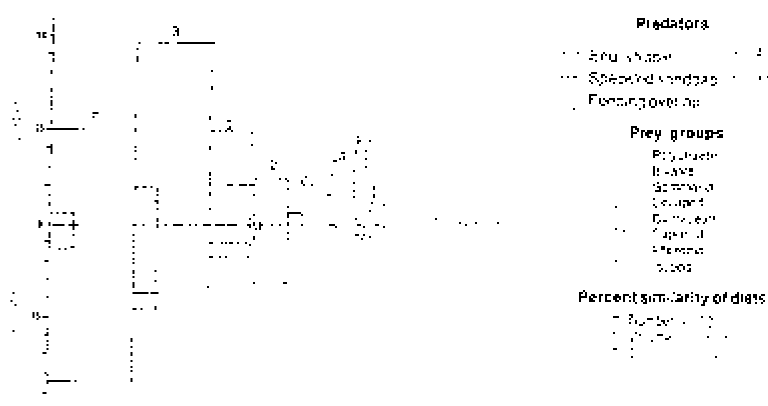

Fig. 3.7. Percentage composition of prey groups in the diets of English sole and speckled sanddab collected from all sections of Humboldt Bay in October 1974 (from Collins 1978).

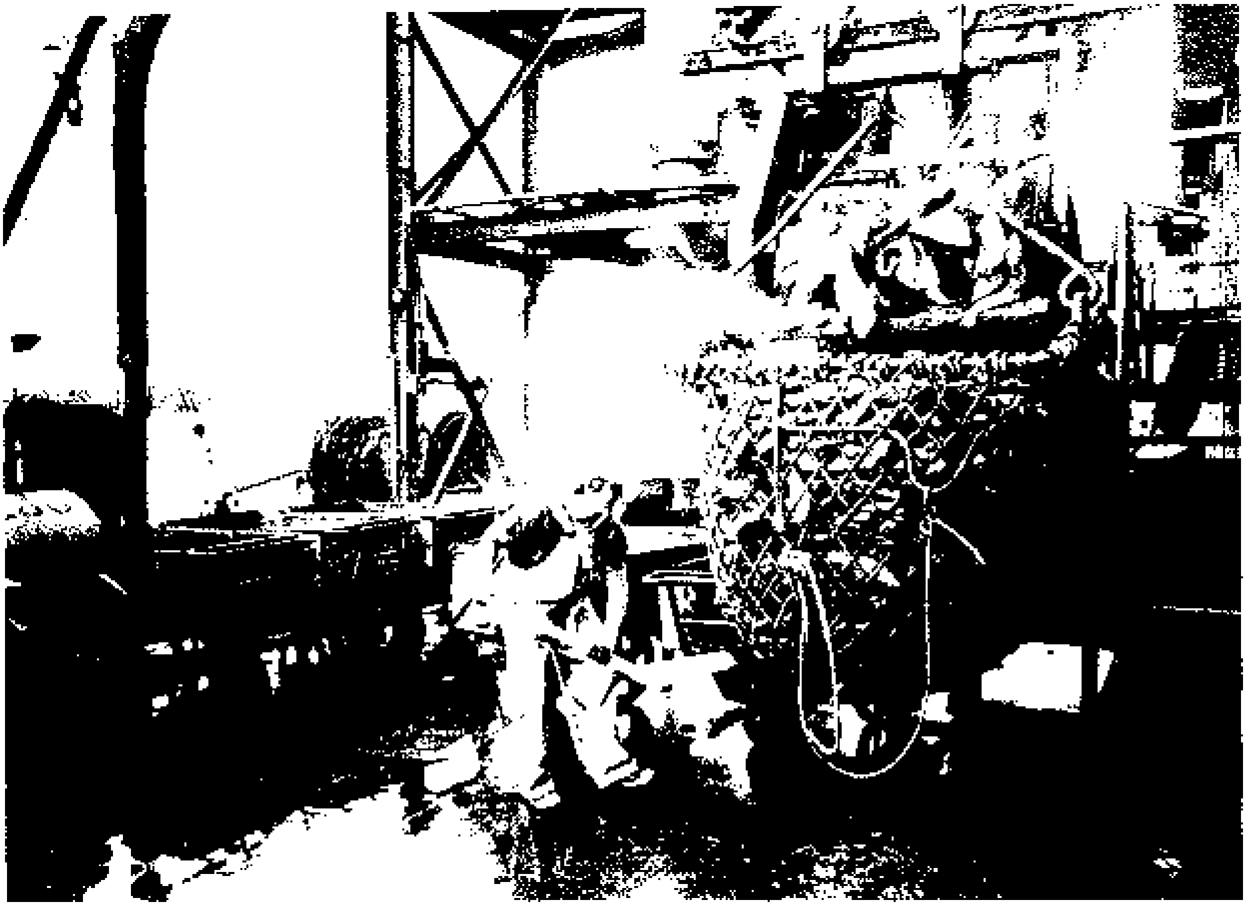

Fig. 3.8. A catch of sole being processed at a Humboldt Bay seafood processing plant.

habitat types. Published literature on herptiles of the bay region is scarce. Salt marsh and brackish marsh habitats are reportedly inaccessible to herptile species because of the difficulty they encounter in maintaining internal water balance. The Oregon garter snake, *Thamnophis couchii hydrophila*, is reported to occur in brackish areas occasionally (Stebbins 1966). No threatened or endangered species of amphibians or reptiles occur in the Humboldt Bay region.

Birds

The most visible and at times spectacular wildlife of Humboldt Bay are the birds. Most of the millions of fall and winter birds migrating southward along the Pacific coast pause to rest and feed on, or in areas adjacent to, the bay for varying periods of time (Monroe 1973). Humboldt Bay is a major wintering area for over 100 species of migrating water birds (Harris 1966). The bay also supports a variety of resident birds. A total of 251 species of birds have been noted for Humboldt Bay (Appendix D).

Waterfowl

Humboldt Bay, as an ecological unit, is most important to the waterfowl (Monroe 1973). Counts of 124,000 ducks have been recorded for Humboldt Bay (Proctor et al. 1980), but midwinter counts generally range from 20,000 to 60,000 (Springer 1982). The American widgeon (*Anas americana*) is consistently the most abundant duck during the hunting season (October–December) with the greater scaup (*Aythya marila*), white-winged scoter (*Melanitta fusca*), northern pintail (*Anas acuta*), redhead (*Aythya americana*), mallard (*Anas platyrhynchos*), and green-winged teal (*A. crecca*) present in high numbers during this period (Shapiro and Associates, Inc. 1980). Waterfowl hunting is estimated to provide over 25,000 hunter–days of recreation annually (Monroe 1973).

Ducks mostly use open-water areas of the bay and water-covered mudflat and eelgrass areas. Diet studies by Yocum and Keller (1961) showed plant foods to be more important to puddle ducks (widgeons, pintails, mallards, and green-winged teal), with clams and gastropods the principal animal foods. With the exception of the ruddy duck (*Oxyura jamaicensis*), the diving ducks—canvasback (*Aythya valisineria*), lesser scaup (*A. affinis*), greater scaup, bufflehead (*Bucephala albeola*), and scoter—were more dependent on animal foods. Diets varied somewhat by species, location, and food availability.

Mallards and gadwalls are not abundant but are present all year and nest locally. Cinnamon teal (*Anas cyanoptera*) also nest on Humboldt Bay and are generally observed during the spring and summer. Approximately 19,770 ha of suitable nesting area are available within the bay area (Monroe 1973). Mallards seem to prefer tall stands of hairgrass to shorter cover for nesting (Wheeler and Harris 1970); cinnamon teal nest more frequently in short vegetation. No diving ducks nest locally. Arcata Bay supports over 70% of the duck use in Humboldt Bay (Monroe 1973).

Although all three species of mergansers or fish ducks are found in Humboldt Bay, only the common merganser (*Mergus merganser*) nests locally. Foreman (1975) reported that flocks of the common merganser averaged 2.7 individuals during the spring mating season and 8.2 during the brooding season, and occasionally were quite large during the winter. Mergansers feed almost entirely on animal matter, with small fish making up the bulk of their diet along with mollusks, crustaceans, and insects (Monroe 1973).

A bird dependent on Humboldt Bay is the black brant (*Branta bernicla nigricans*), a small marine goose. Pacific Flyway brant nest in the Arctic and winter in estuaries of southern California and Mexico. Humboldt Bay is located approximately halfway between suitable brant habitat in Washington and Mexico, and indications are that the bay is an important rest and feeding stop. An estimate that 25% of the total brant population, or about 35,000 birds, pause in Humboldt Bay during northward spring migration may be low because constant ingress and egress of migrants make an accurate estimate difficult (Henry 1980). Brant numbers and brant-use days have declined greatly for the bay (Springer 1982). Henry (1980) concluded that human disturbance and hunting have been the principal cause of the decreases. One objective for the formation of the Humboldt Bay National Wildlife Refuge was to provide a sanctuary for brant and to restore a wintering population of brant on the bay. At one time, as many as 10,000 brant wintered there (Moffitt 1934), but the number has now declined to less than 100 birds (Springer 1982). Recently, the peak migrant brant numbers for Humboldt Bay have been only 900 in fall and 11,000 in spring, and brant-use days were about 350,000 in 1981–82 (Springer 1982). Brant prefer to eat eelgrass (>80% of diet), and brant feeding habitat roughly aligns with eelgrass beds in the bay. For short periods when eelgrass is limited, brant will subsist on grasses from agricultural lands adjacent to the bay. South Bay is by far the most important brant area, with more than 90% of the brant use recorded there (Monroe 1973).

A breeding colony of double-crested cormorants located on the abandoned remains of the old Arcata wharves in Arcata Bay is thought to be the largest in California and the second largest on the Pacific coast (Ayers 1975). Cormorants fish mostly in the deep channels of the bay.

Fig. 3.9. Shorebirds over Humboldt Bay (*photograph by Eureka Times Standard*).

Shorebirds

Humboldt Bay has been known historically as one of the most important shorebird concentration areas in California (Fig. 3.9), hosting plovers, avocets, phalaropes, and shorebirds. Feeding areas are primarily intertidal mudflats, pastures, beaches, sandflats, shoreline eelgrass wracks, and marshes. They feed extensively on invertebrates, usually extracting them from the soft mud or sandy substrate by various ways of probing or pecking. Holmberg (1975) examined food in the digestive tracts of seven species of shorebirds collected from Arcata Bay mudflats and pastures.

During the summer, small numbers of nonbreeding shorebirds are present in Humboldt Bay. Southward migrating birds begin arriving in late July and peak from September through April when the daily average shorebird count exceeds 26,000. Counts are consistently higher for Arcata Bay than for South Bay.

The common snipe (*Gallinago gallinago*) is a shorebird game species. White and Harris (1966) found that salt marshes were most important to the snipe, with upland pasture, plowed land, and lowland pasture less important. Snipe eat both plant and animal material; plant fibers, insects, and seeds appeared most frequently in stomach samples (White and Harris 1966).

Wading Birds

Herons, egrets, and bitterns are regularly seen on Humboldt Bay, and a 1.6 ha grove of trees on Indian Island is a rookery for the great egret (*Casmerodius albus*), great blue heron (*Ardea herodias*), black-crowned night-heron (*Nycticorax nycticorax*), snowy egret (*Egretta thula*), and cattle egret (*Bubulcus ibis*; Fig. 3.10). As many as 256 pairs of great egrets (the most northerly nesting group along the Pacific coast), 67 pairs of great blue herons, 23 pairs of snowy egrets, and 3 pairs of cattle egrets (first reported nesting in the rookery in 1978) have been counted (Springer 1982). A rookery used only by black-crowned night-herons is located on the Samoa Spit.

Great egrets forage in groups in mudflats and salt marshes and singly along tide channels and highway margins (Schlorff 1978). Wading birds feed primarily on small fish, crustaceans, amphibians, and other water-associated organisms; herons and egrets will also take small mammals and reptiles (Monroe 1973). Schlorff (1978) found that although small mammals made up only 1% of the overall diet of great egrets, they contributed 15% of the biomass and 10% of the energy they consumed annually.

Raptors

The most common raptors observed for Humboldt Bay are the osprey (*Pandion haliaetus*), red-tailed hawk (*Buteo jamaicensis*), and American kestrel (*Falco sparverius*). The peregrine falcon (*Falco peregrinus*), an endangered species, is thought to breed in the vicinity of Humboldt Bay but there are no recent nesting records. The osprey's principal fishing ground is South Bay, where several species of fish are taken; surfperches are probably the most important (Ueoka 1974). The red-tailed hawk hunts over bay marshes and adjacent agricultural land, taking primarily rodents and other small mammals. The kestrel is more common in spring, fall, and winter (S.W. Harris, Department of Wildlife, Humboldt State University, Arcata, California, unpublished data). Kestrels hunt in pastures, marshes, and shrubby riparian areas of the bay, catching a variety of invertebrates and small vertebrates. These birds are commonly observed hunting from the tops or wires of utility poles.

Miscellaneous Birds

Humboldt Bay is important habitat to a number of gulls and terns; 24 species of the family Laridae have been observed on the bay (S.W. Harris, Department of Wildlife, Humboldt State University, Arcata, California, unpublished data). Over 100 pairs of Caspian terns (*Sterna caspia*) formerly nested on Sand Island (Yocum and Harris 1975), but no nesting terns have been reported in recent years.

Other studies on bird use of the Humboldt Bay environs were reported by Burton (1972) for Gunther Island, Hill (1977) and Sorensen and Springer (1977a) for dune habitat, Hoff (1979) for Arcata bay pasture land, Spitler (1985) for newly created wetlands, Sorensen and Springer (1977b) for diked coastal salt marsh, and Nelson (1989) for south Humboldt Bay.

Mammals

Over 37 species of mammals are commonly found in the Humboldt Bay area, and at least 32 other species can be found at times (Appendix E). Shapiro and Associates, Inc. (1980) divided Humboldt Bay mammals into five categories: big game,

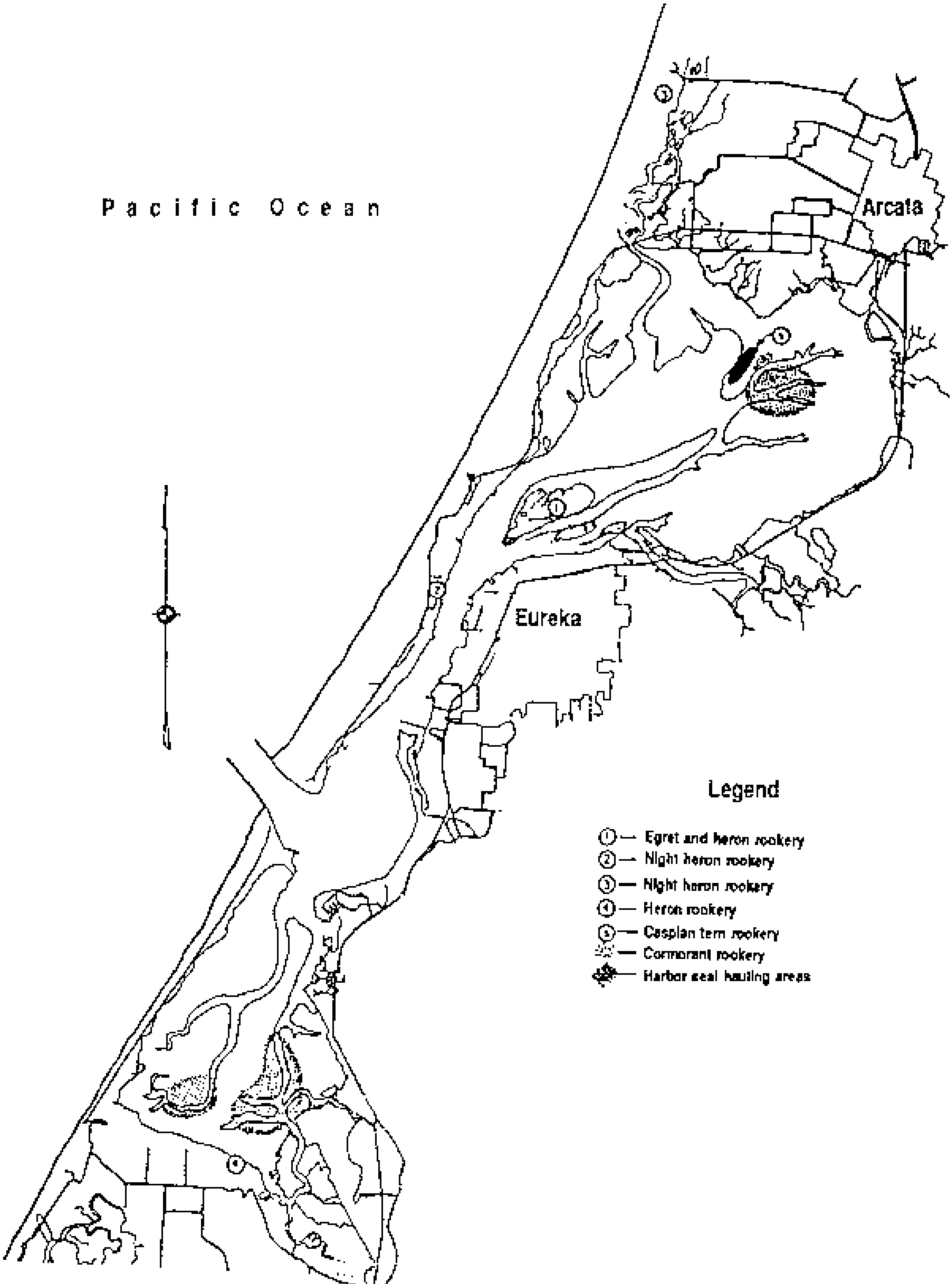

Fig. 3.10. Special wildlife use areas on Humboldt Bay. The cormorant rookery is denoted by the small *shaded patch* between the tern rookery and a seal hauling area (from Monroe 1973).

carnivores, furbearers, small mammals, and marine mammals.

Blacktailed mule deer (*Odocoileus hemionus columbianus*), the most common of the big-game animals, occur on Gunther and Woodley islands and in the lowland agricultural areas around the bay. Deer browse on shoots of shrubs and young trees, preferring leaves of blackberry (*Rubus* spp.) and salal (*Gaultheria shallon*), and twigs and stems of huckleberry (*Vaccinium* spp.), cascara (*Rhamnus purshiana*), and Douglas fir (*Pseudotsuga menziesii*) seedlings (Crouch 1966). Elk (wapiti, *Cervus elaphus*) occasionally stray into agricultural areas around the bay where they graze on meadow grasses.

Large carnivores most likely to be found around Humboldt Bay are gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus fasciatus*), and coyote (*Canis latrans*), though all are uncommon. These carnivores feed on small mammals, birds, and insects. Mustelid weasels and skunks are small carnivores common to the bay environs. Weasels commonly eat other small mammals, birds, snakes, and insects. Skunks feed principally on insects, rodents, small birds, and possibly bird eggs (Ingles 1965).

Furbearers commonly observed near Humboldt Bay are river otter (*Lutra canadensis brevipilosus*) and raccoon (*Procyon lotor*). The river otter generally inhabits tributary streams but is sometimes seen in tidal sloughs of the bay. Food items include fish, amphibians, and various aquatic invertebrates.

Small mammals include all species of nonfurbearers up to the size of a jack rabbit. Shrews consume large quantities of insects to meet a very high metabolic demand. They may be important in limiting certain insect populations and are susceptible to bioamplification of environmental toxins (Shapiro and Associates, Inc. 1980).

A diverse group of small rodents inhabits the bay area, many of them part of the complex food chain supporting the larger forms of flesh-eating birds and mammals. Ground squirrels, chipmunks, gophers, rats, mice, and voles are common in wetland areas with good cover. These animals eat a variety of insects and plant foods. Among lagomorphs, black-tailed jack rabbit (*Lepus californicus*) and brush rabbit (*Sylvilagus bachmani ubericolor*) are common in agricultural and riparian areas around Humboldt Bay and provide some small-game hunting opportunities. Both mammals eat a variety of plant foods.

At least nine species of bats are common to the bay area, but little is known about their roosting sites and feeding habitat preferences. Bats can be important in limiting certain insect populations and are susceptible to the toxic effects of insecticides concentrated in the food chain (Shapiro and Associates, Inc. 1980).

The harbor seal (*Phoca vitulina*) is the most common marine mammal of Humboldt Bay and is a seasonal resident. Monroe (1973) reported that over 500 seals have been counted on a single day. Breeding populations reach a maximum of about 300 animals in late spring when pupping occurs, mainly in South Bay. The average annual population is around 200 seals. Harbor seals leave the water (haul out) for short periods of time to rest and give birth to young, primarily from April to June (Rosenthal 1968). Seals haul out onto mudflats exposed during ebb tides, primarily adjacent to small tidal channels in upper Arcata and South bays (Fig. 3.10). They feed on fish and, occasionally, invertebrates; in Humboldt Bay they feed on flatfish, surfperch, greenling, and tomcod (Shapiro and Associates, Inc. 1980). Jones (1981) found that surfperch constituted 41.9% of the harbor seal diet.

All the marine mammals are migratory, and local populations fluctuate. The harbor porpoise (*Phocoena phocoena*), a regular visitor, is the porpoise that most commonly uses Humboldt Bay. It is usually observed in deepwater channels (Monroe 1973). There are no endangered mammals inhabiting Humboldt Bay or its surrounding area.

Chapter 4. Ecological Relationships

The various ecological communities of Humboldt Bay interact with each other and with the physical environment of the bay. The potential relationships are many and the degree of interaction between species ranges from casual to essentially obligate. The model that will be followed here is related to the availability of nutrients that enable plant photosynthetic processes to occur, and to subsequent trophic interactions of major groups of organisms.

It is obviously an oversimplification to assign individual species or even groups of species to definite trophic levels. Generalizations about feeding strategies are difficult to make for even a single species. Among polychaete species of the bay, many function at more than one trophic level and may change trophic levels depending upon life stage or availability of trophic resources (Fauchald and Jumars 1979). Among higher-level vertebrate predators, chiefly fishes and birds, prey selection is wide and heavily dependent upon abundance (Collins 1978; Toole 1978; Baird et al. 1985). Nevertheless, a trophic model in which major groups of species are assigned to particular levels offers the best method of developing an understanding of significant interactions and focusing attention on where energy relations must be investigated further.

Nutrient Availability

Nutrients enter the bay from several sources, the most significant of which are runoff waters from the surrounding watershed (including agricultural lands adjacent to the bay), anthropogenic sources (in particular the two major wastewater treatment facilities serving the communities of Arcata and Eureka), and nearshore waters adjacent to the bay (particularly during periods of upwelling). Pequegnat and Butler (1981, 1982) suggested that patterns of nutrient availability and phytoplankton productivity are different in the three major compartments of Humboldt Bay (North Bay, Entrance Bay, South Bay), where nitrogen can be significantly limiting to plant growth during periods of high productivity in the summer months. Biologically available nitrogen may fall to such low levels that phytoplankton production is significantly reduced, particularly when upwelling ceases during summer months (Pequegnat and Butler 1981). Although the effects of low nitrogen levels on macrophytes have not been tested, it can be assumed that their production is also significantly impaired.

Other potentially limiting nutrients (phosphate, silicate, iron) have been added to samples of bay water taken at several locations to determine if they were potentially or actually at values low enough to limit phytoplankton productivity (Pequegnat and Butler 1981). These nutrient levels apparently do not fall low enough to limit phytoplankton growth. Pequegnat and Butler (1981) concluded that nitrogen is the nutrient that will first limit plant growth in bay waters.

It seems unlikely that nutrient levels in the bay are significantly limiting to plant growth during winter months, when seasonal rainfall is high and coliform contamination of bay oyster beds indicates the magnitude of runoff (presumably with nutrients) from adjacent agricultural lands. Production in salt marsh plants and eelgrass (*Zostera*) is also strongly seasonal in the bay (Rogers 1981; Bixler 1982), and it is probable that both mudflat algae and phytoplankton have similar patterns of seasonal productivity. During late fall, winter, and early spring, decreased light availability is probably the significant limiting factor to plant growth in bay waters (Raymont 1963). Another important factor during that same time period could be strong northwesterly winds that accompany storms beginning in the fall. Masses of mudflat algae and *Zostera* blades are piled up on the windward shores of the bay following the first storms of the season, suggesting that wind-driven waves dislodge the plant material from tenuous attachments on the mudflats. Thus, low light levels and dislodgment by surface waves are probably the most significant factors limiting plant growth in late fall, winter, and early spring.

Virtually nothing is known about nutrient cycling in bay waters. Tidal exchange with adjacent nearshore waters is a major factor in nutrient exchange, both in removing nutrients from the bay and in contributing them, particularly during periods of upwelling in coastal waters. Both bay and nearshore waters are low in plant productivity until the onset of longer days, greater intensity of solar insolation, and upwelling in mid-April (Pequegnat and Butler 1982). At that time, phytoplankton blooms begin in both bay and nearshore waters. Since rainfall and runoff are declining during the same period, it is probable that upwelling nutrients, particularly nitrogen, trigger the blooms in both the bay and the nearshore phytoplankton. Phytoplankton productivity then levels off in the bay but continues to increase in nearshore waters, probably fluctuating depending on the dynamics of upwelling, until late summer (Fig. 2.13). This suggests that nutrients from nearshore waters and those from autochthonous sources are being rapidly incorporated into plant material in the bay during this period of maximum productivity. The lower level of chlorophyll in bay phytoplankton compared to nearshore phytoplankton (Fig. 2.14) may indicate that competition for nutrients from mudflat microalgae and macroalgae, and from *Zostera*, causes limitation of the primary productivity of bay phytoplankton during this period. The phytoplankton in nearshore waters may reach a higher level of productivity because those populations have immediate access to upwelled nutrients, and there is no competition from attached macrophytes and benthic microflora for nutrients, as is true in the bay. The late summer months are thus periods of maximum productivity for all aquatic plant populations in the bay, and nutrient availability is probably significant in limiting primary productivity during that period.

It seems likely that factors other than nutrient limitations (reduced light, possibly reduced salinity, storm waves that cause mudflat algae to be removed from the substrate) are significant limitations to plant growth from late fall to early spring. During that period, massive amounts of plant material leave the bay on ebb tides or become stranded in the upper reaches of bay tidal flats. At this time, much of the plant material is undergoing decomposition, with two significant results: nutrients are probably released into the surrounding waters and then exported from the bay, and decomposing plant material with associated bacterial microflora becomes available to a variety of consumers. In both instances, nutrients are released into the surrounding waters, and the bay probably functions as a net nutrient exporter from late fall to early spring. It should again be emphasized that these are highly speculative statements, based on relatively little available data. The net nutrient status of the bay, covering at least an entire annual cycle, is largely unknown.

Plant Primary Productivity

Four major compartments of plant productivity can be recognized in the bay. These are plant production from the salt marshes that are found at higher tidal elevations around the bay, microscopic and macroscopic algae growing on tidal mudflats, production from eelgrass beds (primarily but not exclusively from *Zostera marina*), and production from bay phytoplankton. These plant materials differ greatly in their accessibility to potential consumers and suitability as food. At one extreme, direct grazing on salt marsh rooted vegetation is probably insignificant and involves only a few insect species (Cameron 1972). Much of the plant productivity of the marshes is exported as material of differing energetic quality (much of it is highly resistant to easy assimilation by consumers), which becomes available only through bacterial decomposers to the major consumers in the bay (Tenore 1977). At the other extreme, suspended phytoplankton may be readily available to many filter feeders and is probably relatively easy to process and digest. Eelgrass, benthic microflora, and macrophytic algae probably lie between these extremes.

Rogers (1981) studied the productivity of *Spartina densiflora*, *Distichlis spicata*, and *Salicornia virginica*. He chose two sites, both bordering North Bay, where study areas supported essentially monocultures of one of these species, and used three methods to calculate the aboveground net annual primary productivity of the plants. Eicher (1987) presented a more complete list of salt marsh species at several sites around the bay, but the data on primary productivity reported by Rogers (1981) remains the best available and thus were used to estimate annual net productivity components in Humboldt Bay (Table 4.1).

Rogers (1981) was fortunate in sampling during a year of much reduced rainfall in 1977, and 2 years of near-average rainfall in 1976 and 1978. All three

Table 4.1. *Primary productivity from various Humboldt Bay sources.*

Source	Area (hectare)	Productivity (g dry wt/m²/yr)	Annual production (10^6 kg)
Salt marshes			
Spartina dominated	223	1,251 [a]	2.790
Salicornia + *Distichlis*-dominated	167	731 [a]	1.220
Mudflat microalgae and macroalgae	2,878	315 [b]	9.066
Eelgrass beds (mostly *Zostera*)	1,178	1,012 [c]	11.920
Phytoplankton	2,205 [d]	136 [b]	3.000
Bay total	6,651	3,445	27.996

[a] Rogers 1981.
[b] Pequegnat and Butler 1982.
[c] Bixler 1982.
[d] Area of shallow and deep channels.

species of salt marsh plants showed decreased annual net productivity in 1977 because of reduced precipitation, and Rogers (1981) attributed the decrease to osmotic stress caused by ion accumulation in marsh sediments. The estimates of annual net primary productivity in Table 4.1 are averages of the three methods and 3 years of data that Rogers (1981) presented. Because these estimates are based on net productivity for only the above ground portions of plants and include a year in which essentially drought conditions prevailed, the estimates must be viewed as fairly conservative. The productivities of salt marsh plant species other than those studied by Rogers (1981) are also unknown and could modify the estimates shown in Table 4.1.

The fate of plant material produced in the marshes is not certain. All of the marshes in the bay are adjacent to mudflat areas, suggesting that dead plant material would be transported onto the flats, where it would enter the food chain as detritus. Direct consumption of salt marsh plants is virtually unknown among invertebrates. The microflora on the surface of the dead plant material could be significant in the diets of both polychaetes and crustaceans of the flats (Fauchald and Jumars 1979; Morris et al. 1980), and decomposition would also release dissolved organic matter (DOM) into the surrounding water, where it might contribute to the nutrition of soft-bodied invertebrates (Stewart 1979). These pathways of energy use are not as efficient as direct consumption of plant material by herbivores, so the amount of energy that the salt marshes contribute to the bay ecosystem probably cannot be large.

The estimates of primary productivity from mudflat microalgae and macroalgae are preliminary and will require further investigation (Pequegnat and Butler 1982). Two algae species, members of genera *Enteromorpha* and *Ulva*, are obvious and abundant on the flats during the late spring through the early fall of each year. The first winter storms, with high winds from the northwest, usually result in the removal of these algae from the surface of the flats to other parts of the bay or out of the bay. The benthic microflora are essentially unknown but certainly are important in estimating the annual net primary productivity of the bay. Some species of polychaetes browse on benthic diatoms (Fauchald and Jumars 1979), and crustaceans feed on both microalgae and macroalgae (Morris et al. 1980).

Algae growing on the mudflats are more readily assimilated than marsh plants; thus, this compartment of bay productivity probably contributes much more to bay consumers than salt marsh vegetation (Table 4.1). Additionally, macrophytic algae readily leak DOM, with those compounds potentially also contributing to the nutrition of bay invertebrates. Plants are only seasonally available to consumers and their usage is therefore significantly limited. It would be unlikely that any consumer in the bay could specialize on the mudflat macroalgae as a food source, since productivity from late fall through early spring is almost nil. As with plant production from the salt marshes, a significant fraction of the mudflat algal production must pass through microbial decomposers, resulting in reduced energy transfer to bay consumers.

Eelgrass beds (mostly *Zostera marina*) are a third major compartment of primary production in Humboldt Bay (Table 4.1). Harding and Butler (1979) attempted to estimate the productivity of eelgrass in the bay by measuring oxygen evolution, a technique that is greatly hindered by entrapment of evolved O_2 in the tissues of the plant. Bixler (1982) used a direct method of leaf marking and measurement to improve the estimate of eelgrass primary productivity in the bay; the relatively conservative estimate of annual net primary productivity obtained is the one used in Table 4.1. In estimating the production of eelgrass beds in the bay, possible contributions from other plants have been ignored. This probably results in a serious underestimate of production from the eelgrass beds, since the contribution of other epiphytes and microphytic and macrophytic algae can match or exceed the production of the eelgrass itself (Phillips 1984).

The production of eelgrass in North Bay was reduced significantly following the beginning of commercially successful oyster culture there in the mid-1950's (Waddell 1964). Scattered eelgrass beds (406 ha; Shapiro and Associates, Inc. 1980) remain in North Bay, however, and contribute significantly to the primary productivity of the bay. The greatest extent (769 ha) of eelgrass is in South Bay, where it grows more densely and luxuriantly than in North Bay. A small amount of eelgrass grows in scattered locations along the shipping channels in Entrance Bay. South Bay, Entrance Bay, and North Bay are qualitatively different in eelgrass growth. The dense beds of South Bay are some of the most important locations of eelgrass growth in the Pacific Northwest (Phillips 1984), while the more scattered growth of eelgrass in Entrance and North Bays suggests that it is less significant in the energy budgets of those portions of the bay. There are marked seasonal differences in the production dynamics of eelgrass, with summer growth rates approximately twice as great as growth rates in winter, apparently because of increased insolation (Bixler 1982).

The major consumers of living *Zostera* blades are several species of aquatic birds, including black brant, American widgeon, scaup, Canada goose (*Branta canadensis*), and northern pintail (Phillips 1984). Invertebrate herbivores apparently find that the toughness of the blades renders them unpalatable or impossible to digest. In contrast to tropical seagrasses, living *Zostera* blades are not known to be consumed by invertebrates (Phillips 1984). Thus, most of the production of eelgrass at Humboldt Bay must enter a pathway to microbial decomposers during much of the year. Black brant populations have declined markedly in recent years and are only seasonally present during migrations to feed on eelgrass, with the result that even less eelgrass is probably now being consumed directly by herbivores than was true in past years. Following the onset of winter storms, massive quantities of eelgrass blades are thrown up on high intertidal flats or can be seen floating out of the bay on ebb tides. Bixler (1982) observed significant declines in standing stocks of eelgrass beginning in early winter and reaching a low point in late winter and early spring, apparently caused by storm waves breaking off blades.

Phytoplankton production in the bay is also highly seasonal, with a low point during the winter and a buildup to a high in early summer (Pequegnat and Butler 1982). Productivity (as measured by chlorophyll concentration) in North Bay and South Bay waters is generally equivalent to and sometimes lower than the productivity of nearshore oceanic waters (Fig. 2.14). The relationship of phytoplankton production to nutrient availability has been noted earlier, emphasizing the contribution of upwelled nutrients (chiefly nitrogen) to the bay during late spring and early summer. It seems likely that much of the phytoplankton is consumed directly by zooplankton or benthic filter feeders in the bay. What proportion goes to each of these major consumer groups is unknown.

The productivity estimate for phytoplankton in Table 4.1 is conservative because it was assumed that production occurs only in the shallow and deep channels of the bay (estimated at 2,205 ha by Shapiro and Associates, Inc. 1980). The actual areal coverage of water varies from this low figure to the maximum covered at high tide.

In summary, although eelgrass beds and mudflat algae appear to be the largest sources of plant production in the bay, the importance of these sources directly to consumers is probably less than for phytoplankton. Plant biomass produced in salt marshes must enter a cycle of microbial decomposition before becoming available to the bay food chain. Mudflat algae, *Zostera* blades, and salt marsh plants produce material that is too tough to be directly consumed by invertebrate herbivores of the bay. Although birds, notably black brant, can directly consume eelgrass, they are only seasonally present in the bay. Much of the plant production occurring in the bay must therefore enter an energy pathway involving microbial decomposition and animals feeding on detritus. The abundant populations of deposit feeders in the bay support this conclusion.

Primary Consumers

Primary consumers, or herbivores, are generally defined as those animals that feed directly on living plant material (Crawley 1983). That definition is too restrictive to allow an understanding of the various energy flow pathways in Humboldt Bay. As defined in our treatment, primary consumers include deposit and detritus feeders along with the strict herbivores. These animals may not feed on the resistant plant material at all, but instead digest the surface bacterial microflora (Adams and Angelovich 1970). No convenient way to separate these microbial consumers from the strict herbivores and other detritivores is available, and since the energy they consume comes ultimately from plant primary production, their inclusion with herbivores can be justified.

Two major groups of benthic infaunal animals are present in the sediments of the bay: filter feeders that draw their trophic resources from the overlying water, consuming mostly phytoplankton; and detritus feeders that have varying ability to select food particles from the surface sediments. Epifaunal animals are found at the sediment surface–water interface, selectively feeding on both plant and animal material. Many of these epifauna are small amphipod crustaceans. There can be overlap between these major feeding groups, as in the terebellid polychaetes, where feeding tentacles are spread widely on the surface, but most of the animal remains within a tube in the sediments. Another example of the same kind involves the bay bivalve *Macoma nasuta*, which extends its siphon above the surface and sucks in material from the sediment surface.

Among the filter feeders, the bivalves are the dominant group in sediments of the bay. Two major ecological categories of bivalves can be recognized, the deep burrowers (*Saxidomus* and *Tresus*) and the shallow burrowers (*Macoma*, *Protothaca*, *Clinocardium*, and several smaller species). These two groups may form functional feeding guilds, with competition between dominant species for trophic and spatial resources (Fauchald and Jumars 1979; Onuf 1987).

There are four species of large, deep-burrowing bivalves: *Tresus nuttallii*, *T. capax* (much more abundant in the bay than *T. nuttallii*), *Saxidomus giganteus*, and *S. nuttalli* (more abundant than *S. giganteus*). The species in the genus *Tresus* are known as "gaper clams," while those in the genus *Saxidomus* are known as "Washington clams." The bay once supported a small commercial fishery for Washington clams (Morris et al. 1980). There continues to be an active sport fishery involving the four species. *Tresus* spp. and *Saxidomus* spp. are often found together in the bay, with possibly some differences in the depth where they are positioned in the substrate (Morris et al. 1980). Peterson (1977) felt that *S. nuttalli* and *T. nuttallii* might compete for spatial resources in sediments at Mugu Lagoon, although that could not be demonstrated statistically. All four species occur in sand to muddy sand sediments in Humboldt Bay, particularly throughout much of South Bay and as far north as Indian Island (Sasaki 1967; Wendell et al. 1976). It is possible that mud and silt sediments are resistant to the burrowing (or reburrowing) activities of these large species, thus resulting in distributions restricted to predominantly sand sediments (Wendell et al. 1976; Peterson and Andre 1980). There is no doubt that these animals are important phytoplankton consumers.

Although the most important factor influencing competition for resources among these four species may be space in the sediments (Peterson and Andre 1980), trophic resources are also significant. The animals grow only when phytoplankton are abundant in bay waters, or from late spring to early fall (Wendell et al. 1976). The seasonal decline in phytoplankton standing stocks (Fig. 2.14) apparently results in the animals entering a physiological maintenance phase from late fall to early spring, during which trophic resources are not sufficiently abundant to sustain growth.

Another major association of filter-feeding consumers of bay phytoplankton are the more shallow-burrowing bivalves *Clinocardium nuttallii*, *Protothaca staminea*, *Macoma* spp., and other relatively small bivalves (*Lyonsia californica*, *Mysella tumida*, *Transennella tantilla*). In several respects, this group of bivalves forms a second layer of filter feeders, ecologically distinct from the deeper bivalves (Fig. 4.1). Unfortunately, rela-

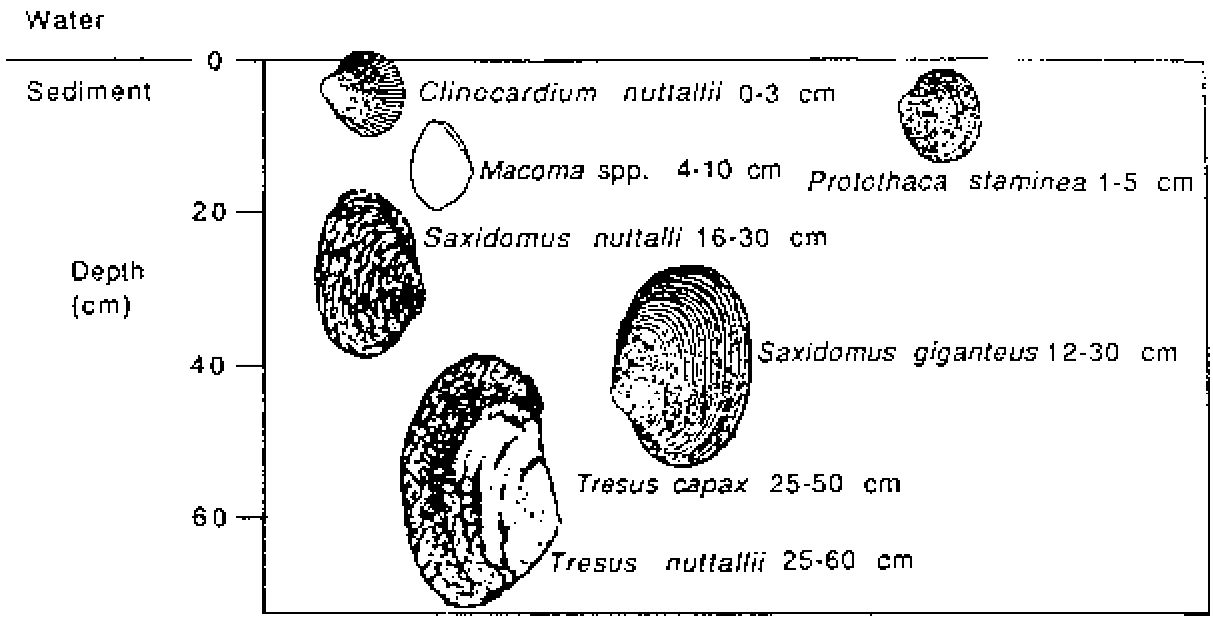

Fig. 4.1. Depth distribution of common bivalves (size not to scale) in sand and mud sediments of Humboldt Bay (M. J. Boyd, Humboldt State University; field data).

tively little quantitative information exists on the importance of these animals in the overall energy cycling of the bay. There may be a partitioning of trophic resources between the species of *Protothaca* and *Clinocardium*, with *P. staminea* consuming more benthic diatoms than phytoplankton (Peterson 1982).

Commercial oyster beds cover 324–365 ha of North Bay (Shapiro and Associates, Inc. 1980) and constitute a large fraction of the phytoplankton consumers. The estimated several million oysters in North Bay are capable of relatively efficient filter feeding and retention of food particles. Pequegnat and Butler (1982) estimated that it might be possible for oysters in North Bay to filter as much as 50% of the high-tide water volume, although they felt this figure was probably high. The pattern of seasonal growth of the oysters is similar to that seen in *Tresus* (Melvin 1980), suggesting that the seasonal availability of phytoplankton has an important influence on oyster growth.

A second major group is shallow burrowers that consume detritus on the surface and fresh plant material when it is available. Amphipods, crustaceans, and polychaetes feed on plant detritus of varying age and nutritional value. The large amount of resistant plant material (macroalgae, eelgrass, salt marsh plants) produced in the bay but not used directly by consumers suggests a diverse and abundant group of deposit-feeding consumers could be supported. In organically rich marine sediments, this assemblage is typically dominated by polychaetes (Whitlatch 1980). The increase in mud present in sediments of the flats along the wide intertidal margins of North and South bays apparently results in a decrease in the abundance of burrowing bivalves; thus the deposit-feeding assemblage may increase and ecologically dominate these habitats (Carrin 1973; authors', personal observations).

A deposit-feeding assemblage dominated by polychaetes has been in evidence for some time along the sides and bottoms of the channels in the central portion of the bay (Boyd et al. 1975; Bott and Diebel 1982). Without doubt, this area of the bay experiences some disturbance because of periodic maintenance dredging. Many of the same species that were abundant in 1974 had recolonized the dredged channels in 1980, suggesting that slumping of material from the channel margins and larval recolonization were both important mechanisms in maintaining this assemblage of polychaetes (Boyd et al. 1975; Bott and Diebel 1982).

The most abundant polychaete in the assemblage is a filter-feeding herbivore (Table 4.2). This is to be expected in an environment where tidal currents are strong and constant. Following the herbivorous species in abundance are deposit feeders, either on the surface of or in the sediments. Carnivorous species are much less abundant, as would be predicted by general ecological theory (Pianka 1988).

The abundance of deposit-feeding worms throughout a significant portion of Humboldt Bay

Table 4.2. *Approximate abundance and feeding guild (Fauchald and Jumars 1979) of widely distributed polychaetes in the central portion of Humboldt Bay, 1980 (data from Bott and Diebel 1982).*

Species	Abundance (number/m^2)	Feeding guild
Owenia collaris	8,569	Filter-feeding, discretely motile, tentaculate
Mediomastus californiensis	789	Surface deposit-feeding, motile, nonjawed
Lysilla labiata	409	Surface deposit-feeding, discretely motile, tentaculate
Tharyx monilaris	386	Surface deposit-feeding, motile, tentaculate
Spiophanes bombyx	232	Surface deposit-feeding, discretely motile, tentaculate
Glycinde polygnatha	179	Carnivore, discretely motile, jawed
Platynereis bicanaliculata	169	Surface deposit-feeding, discretely motile, jawed
Tharyx multifilis	157	Surface deposit-feeding, motile, tentaculate
Sphaerosyllis californiensis	135	Carnivore, motile, jawed
Polydora socialis	124	Surface deposit-feeding, discretely motile, tentaculate
Haploscoloplos elongatus	123	Burrowing, motile, nonjawed
Eumidia bifoliata	87	Carnivore, motile, jawed
Exogone sp.	56	Carnivore, motile, jawed
Phloe tuberculata	36	Carnivore, motile, jawed
Amaena occidentalis	31	Surface deposit-feeding, sessile, tentaculate
Nephtys caecoides	21	Carnivore, motile, jawed
Ophelia assimilis	21	Burrowing, motile, nonjawed

emphasizes the importance of detritivores in this system. It would be difficult to characterize more definitely the nature of the food material that is consumed. Obviously, most of the material is of plant origin, although it may be heavily colonized by bacteria (Tenore 1977). There may also be a small percentage of animal detritus, which must be much less abundant and only sporadically available. Several of the surface-feeding polychaetes, however, will take animal material if it becomes available (Fauchald and Jumars 1979). Within the bay, detritivores must consume much of the vast quantity of plant material that is seasonally produced on the mudflats and in salt marshes. This plant material, initially resistant to direct consumption, is eventually converted to animal and microbial biomass primarily as a result of consumption (perhaps several times) by the deposit-feeders of the benthos.

Meiofaunal animals (those that will pass through a 0.50-mm screen) may also be important consumers of detrital material in bay sediments (Tenore 1977). Although these organisms can account for a substantial portion of benthic community respiration (Fenchel 1978), nothing is known of their importance in the energy relationships of the bay. Findings in other temperate estuaries suggest that the meiofauna could account for perhaps 10–20% of benthic community respiration (Tenore 1977).

The third major group of primary consumers in Humboldt Bay includes some epifaunal species. Wherever hard surfaces occur in intertidal or subtidal habitats of the bay, a diverse assemblage of both sessile and motile invertebrates becomes established (Prince 1972). These surfaces are often associated with docks, bulkheads, or other structures of human origin. A small amount of primary production from macroalgae (*Fucus distichus*, *Ulva lactuca*, *Enteromorpha intestinalis*) occurs on these surfaces, but is insignificant in magnitude compared to production on intertidal flats. Similarly, primary consumers (mainly feeding on phytoplankton) are abundant on heavily colonized (fouled) surfaces, but would account for only a minor amount of the overall energy flow in the bay. The numerically dominant primary consumers in these assemblages are acorn barnacles (*Balanus* spp.), sabellid and serpulid polychaetes, numerous bryozoan species, several species of sponges, and colonial tunicates (especially *Botrylloides* sp.).

Brant migrants feed mainly on eelgrass and occasionally on other plants, including pickleweed (*Salicornia*) and algae, during fall and spring stopovers at Humboldt Bay (Henry 1980). These are periods of generally low plant primary productivity, and it is unknown whether the feeding activities of the brant have any significant impact on populations of the plants. The strictly seasonal feeding activities and relatively short residence time of the brant suggest that feeding activities have minimal impact on plant populations.

Despite the many primary consumers in the bay, actual measurements of growth, respiration, reproductive cycles, or other physiological correlates of energy consumption have been few. Data suggest that the bay supports an abundant and trophically complex assemblage of consumers. Seasonal patterns of primary productivity are important in influencing the growth and reproduction of many bay consumers. Both direct consumption (mainly of phytoplankton) and indirect consumption (by detritivores) of plant material are highly significant in an energy flow model of the bay. An unknown amount of the plant material produced in the bay is exported from it, with some probable correlation to the onset of late fall storms with high winds. Material transported into nearshore waters is of unknown importance in sustaining populations of both planktonic and benthic consumers there.

Predators

Many predatory species in Humboldt Bay feed on the abundant primary consumers. The major categories of secondary consumers recognized here are invertebrates (*e.g.*, starfish, many crab species, predatory snails, and smaller predators), fish, and birds. Within each of these major groups of predators, it is often difficult to state unequivocally the actual prey species consumed. Larger predators in temperate and boreal marine habitats are often generalists in their diets, with prey size greatly influencing selection because of the energy constraints involved in capture (Schoener 1971). In several respects, the feeding activities of predaceous birds and fish are complementary in exploitation of the trophic resources of the bay. In tidal cycles, feeding fish move onto the flats during rising tides as birds retreat to higher areas adjacent to the bay for rest and digestion. Conversely, the birds actively probe bay sediments as the tide falls, and at low tide scatter widely over the mudflats while feeding.

The relative magnitude of benthic secondary production consumed by predators in the bay is unknown. Other than making the statement that feeding by birds (easily observed), invertebrates, and fish (not easily observed) is a constant occurrence over the bay flats, little quantitative information exists on the flow of energy to major predators. A recent review of energy flow patterns in temperate zone estuaries (Baird et al. 1985) supports the following generalities: birds consume about 20% of the annual secondary production from shallow estuaries and embayments, fish consume 20%, and invertebrates 12%. These estimates vary, however, from one area to another. In European and South African estuaries, 6–44% of the energy in secondary consumer production went to shorebirds. While it is disturbing to note this degree of variation, the outlying values are believed to be somewhat atypical (Baird et al. 1985). Available data suggested that 50–60% of the total secondary production passes to predators in shallow water marine systems, a much higher ecological efficiency than is typical of terrestrial or oceanic systems (Whittaker 1975).

There are a number of potentially important predaceous invertebrates in the bay. Dungeness crab juveniles may be seasonally abundant and are known to feed on crustaceans, bivalves, polychaetes, and fish (Wendell et al. 1976; Gotshall 1977). Probably the most significant large predaceous asteroid is *Pisaster/brevispinus*, although *P. ochraceous* is also abundant in Entrance Bay. *Pisaster ochraceous* is essentially confined to feeding on prey items attached to solid substrates (Morris et al. 1980). *Pisaster/brevispinus* is capable of taking bivalves from sediments (Mauzey et al. 1968), and probably preys on both large and small bivalves in sand and mud. Predatory snails are frequent in benthic samples (Boyd et al. 1975; Bott and Diebel 1982) and are important predators of both small and larger macroinvertebrates (Wendell et al. 1976). Numerous species of predatory polychaetes occur in the bay (Appendix B), but their significance in terms of energy flow is unknown. Their chief prey items are most likely other polychaetes and a variety of small crustaceans (Fauchald and Jumars 1979).

Speckled sanddabs and juvenile English sole are two significant predators on benthic infauna and epifauna of the bay. Shiner perch appear to feed opportunistically on epifaunal organisms, with the majority of prey items taken from the nekton. Speckled sanddabs take prey primarily from the sediment–water interface; they then prey on organisms burrowed into the sediments. Juvenile English sole concentrate their feeding activities primarily on animals buried in the sediments and then on those on the sediment surface. Collins (1978) was able to compare prey selection to prey availability on and in sediments of the central

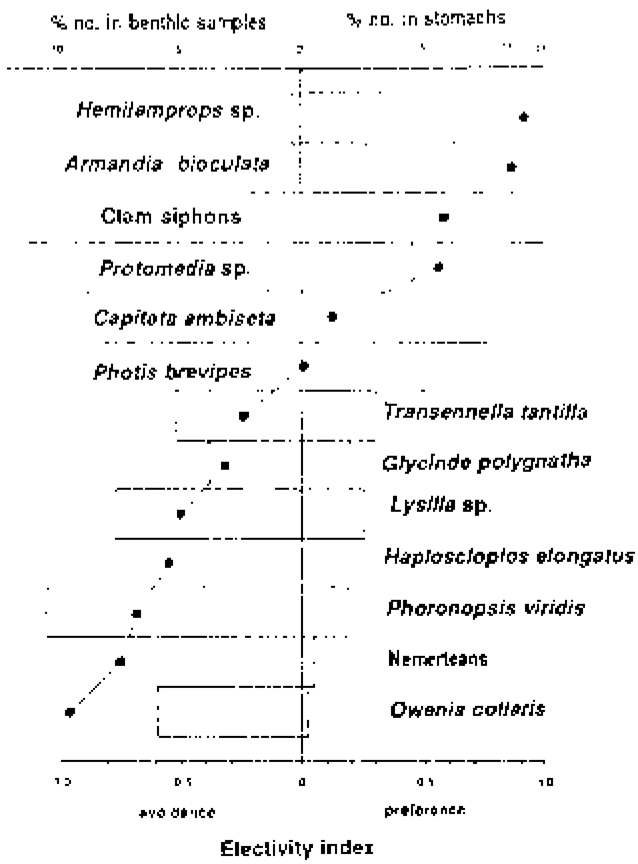

Fig. 4.2. The relative abundance of the 10 most numerous prey taxa found in 54 benthic grab samples; the relative abundance of the 10 most numerous prey taxa found in the stomachs of 99 speckled sanddab; and Ivlev's index of electivity (from Collins 1978).

portion of the bay (Figs. 4.2 and 4.3) and determined relationships between prey availability and selection by speckled sanddabs and English sole. It appears that these two species ecologically partition the benthic food resources available to them. As the juvenile English sole grow during the first year, changes in gut and external morphology accompany a gradual switch from feeding on copepods to feeding on burrowing polychaetes. Toole (1980) hypothesized that this change in prey preference with growth (Fig. 4.4) was a result of the increasing energy demands placed on the fish by a switch in predation strategy from "sit and wait" to active pursuit (Schoener 1971).

Oysters and shallow-burrowing bivalves in sandy substrates are preyed on by the bat ray (*Myliobatis californica*). The importance of predation by bat rays in Humboldt Bay has not been quantitatively assessed.

Smelt, Pacific herring, and northern anchovy are seasonally quite abundant in Humboldt Bay. These fish, during their residence in Humboldt Bay, are primarily phytophagous and should be assigned to a low trophic level. In turn, they provide a forage base for larger predaceous fish (salmon, rockfishes, sharks), some birds (pelicans, cormorants), and harbor seals. Predaceous birds and fish are attracted to Pacific herring spawn deposits and contribute significantly to egg loss. In Tomales Bay, diving birds greatly reduce the density of eelgrass in herring spawning beds,

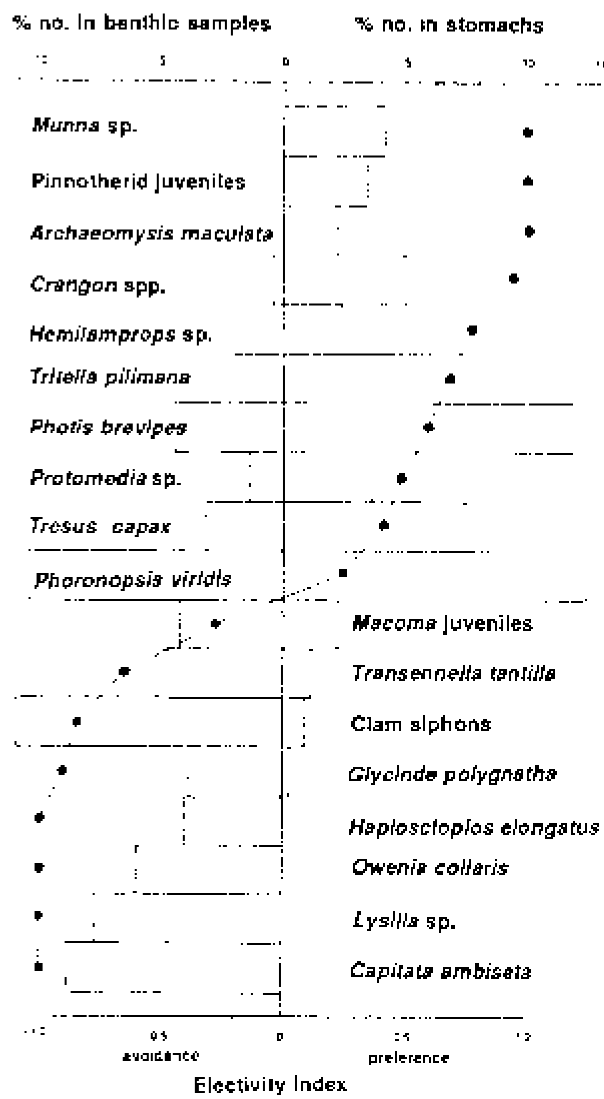

Fig. 4.3. The relative abundance of the 10 most numerous prey taxa found in 54 benthic grab samples; the relative abundance of the 10 most numerous prey taxa found in the stomachs of 142 English sole; and Ivlev's index of electivity (from Collins 1978).

cropping the grass to obtain the deposited eggs (Spratt 1981). No information is available on energy or biomass transfer for these species. Hay and Fulton (1983) estimated that the carbon contribution of herring milt and eggs to the ecosystem is high relative to primary production. This material is a source of energy for secondary producers, particularly microzooplankton, which in turn serve as food for larval herring, anchovy, and smelt.

The feeding activities of shorebirds are highly seasonal, coinciding with the annual migrations of millions of birds (Springer 1982). Despite the obvious predatory activities of shorebirds, their influence on benthic populations remains controversial. Quammen (1984) studied the influence of predaceous fishes, invertebrates, and birds on benthic organisms in two southern California estuaries and concluded that benthic populations are influenced most by shorebird predation, followed by crabs (*Pachygrapsus crassipes*); fishes had the least impact on benthic populations. The long-term impact of all predators on benthic community structure and populations of individual

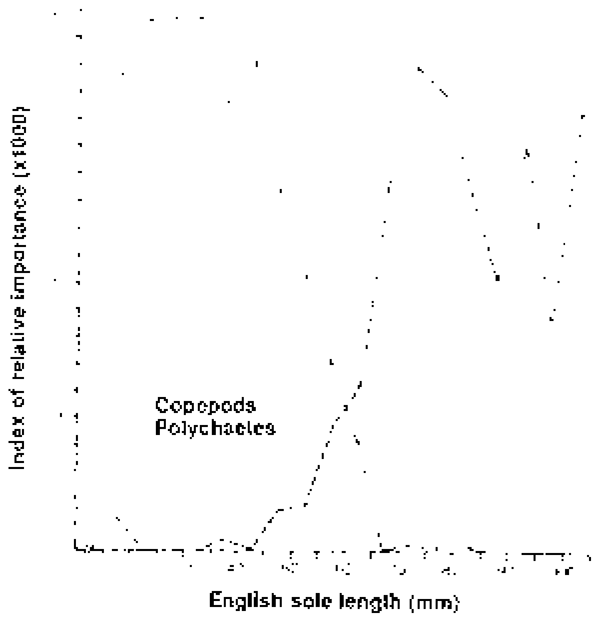

Fig. 4.4. Index of Relative Importance for copepods and polychaetes in stomachs of English sole captured intertidally, June 1976 through May 1977 (Toole 1980).

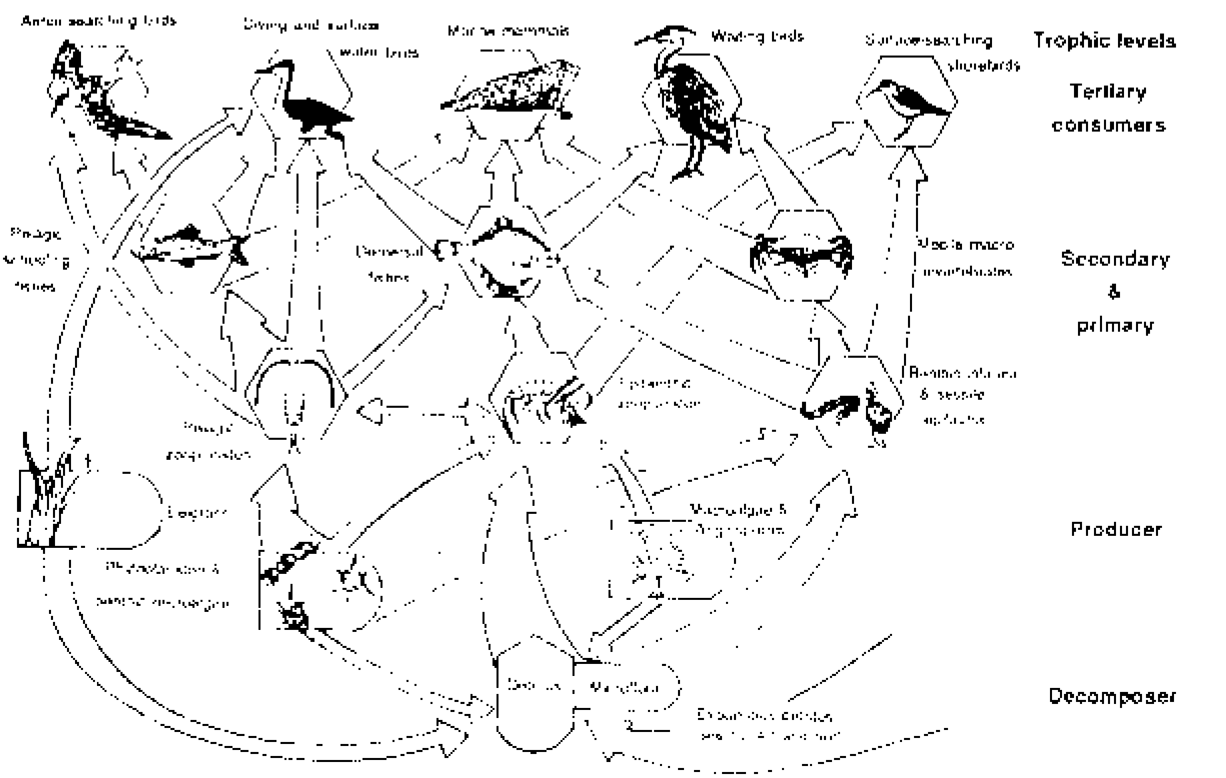

Fig. 4.5. Generalized food web for Humboldt Bay; size of linkage arrows illustrates relative biomass transfer (modified from Simenstad 1983).

species was less significant than physical factors (sediment composition). Baird et al. (1985) hypothesized that the effects of predaceous birds and fishes are complementary, with migratory birds arriving in European estuaries just as predatory invertebrates are leaving the shallow waters to spend the winter in deeper adjacent waters. Predaceous fish species (English sole and speckled sanddabs) as well as predaceous invertebrates leave Humboldt Bay to forage in nearshore waters just as major numbers of migratory shorebirds are arriving in late fall and winter.

Adult harbor seals are opportunistic feeders on fish and larger crustaceans, consuming about 5 kg (6,000 Kcal) of prey items per day (Scheffer 1958). Significant prey items in Humboldt Bay are anchovies, herring, small crabs, and occasionally octopus or bottom fishes.

The fauna and flora of Humboldt Bay are integrally linked through trophic and other ecological relations. However, no quantitative data on the carbon or energy flow through the food web are available. Figure 4.5 is an adaptation of a generalized food web for estuarine channels of the Pacific Northwest coast (Simenstad 1983); with the addition of an eelgrass component, this food web is a probable representation of the general trophic relations in Humboldt Bay.

Chapter 5. Comparison with Other Estuaries

Humboldt Bay ranks fifth in size for west coast estuaries from Grays Harbor on the central coast of Washington to San Diego Bay at the southern tip of California; in California it is second only to San Francisco Bay (Table 5.1; Fig. 5.1). Estuarine areas in Oregon are size-limited: all of Oregon's estuaries combined would fit into Willapa Bay, Washington (Lauman et al. 1972). Humboldt Bay is somewhat unusual because it has relatively low freshwater inflow for its size. Because of this and a shallow average depth, it is a tidally driven, well mixed estuary, as indicated by its flow ratio of 0.013 (Table 5.1). According to Schultz and Simmons (1957), a flow ratio >1.0 indicates a highly stratified estuary, around 0.25 indicates a partially mixed estuary, and about <0.1 indicates a well mixed estuary. Although the dynamic mixing in tidal channels reduces temperature and salinity extremes, tidal marshes with little freshwater input are subjected to higher temperatures and salinities. Such conditions exist in Willapa Bay, Humboldt Bay, and all southern California estuaries. In estuaries with larger drainage areas, such as the Columbia River, Winchester Bay (Umpqua River), and San Francisco Bay, there is a greater dilution of the seawater and more variability in channel salinities and temperatures. Estuaries north of Humboldt Bay have more precipitation annually, and estuaries to the south experience lower rainfall (Table 5.1).

The characteristics of nearshore ocean water influence estuary dynamics because of the semidiurnal tidal exchange that brings ocean water into the bays. Point Conception, approximately 210 km north of Los Angeles, is recognized as a transition area for marine biota, many of whose northern or southern boundaries coincide with this landmark. The California current parallels the Oregon and California coast, but flows offshore at Point Conception, creating a countercurrent that brings warm southern waters to southern California estuaries. During summer months, strong northwest winds along Oregon and northern California cause the surface water of the California current to move westward; near shore, the water is replaced from below by upwelling of nutrient-enriched colder water that flows into adjacent estuaries. Further north, upwelling is masked on the surface by the Columbia River plume, which produces its own river-induced upwelling by pushing surface water seaward, thus

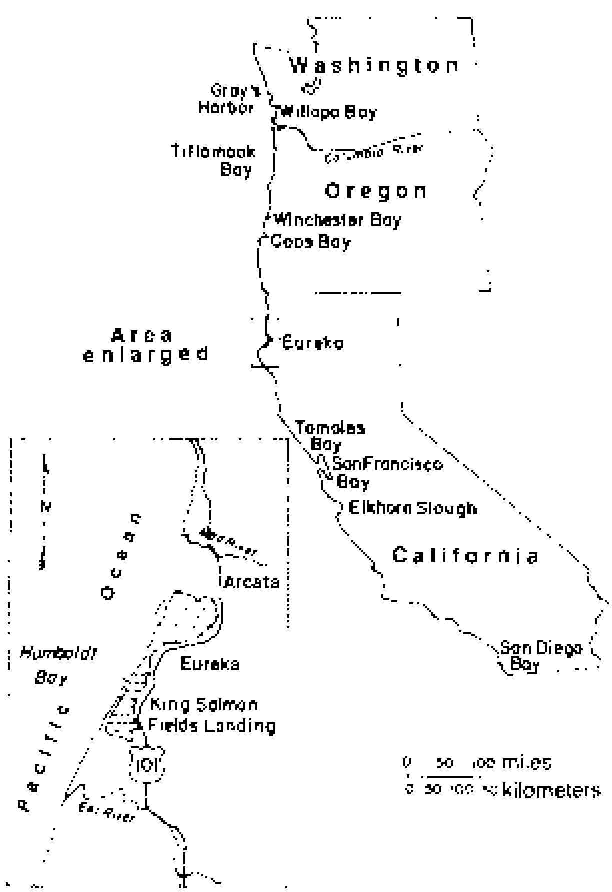

Fig. 5.1. Location of west coast estuaries and bays of Washington, Oregon, and California in relation to Humboldt Bay.

Table 5.1. *Comparison of physical and hydrologic characteristics of selected estuaries along the west coast of the United States (Proctor et al. 1980; National Oceanic and Atmospheric Administration 1985).*

Estuary	Distance[a] (km)	Relative size	Size (km^2)	Flow rate[b] (m^3/sec)	Flow ratio[c]	Tide range[d] (m)	Average depth (m)	Precipitation (cm)	Urban (%)
Grays Harbor	725	4	223	382	0.045	2.1	4.3	178	2
Willapa Bay	675	3	347	167	0.015	1.9	3.2	203	1
Columbia River	635	2	380	7,715	0.567	1.7	7.3	203	9
Tillamook Bay	555	8	34	—	—	1.7	—	229	—
Yaquina Bay	450	11	16	—	—	1.8	—	178	—
Winchester Bay	357	10	28	263	0.317	1.6	3.7	178	1
Coos Bay	335	6	50	82	0.072	1.6	4.0	152	3
Humboldt Bay	0	5	62	20	0.013	1.4	3.3	102	7
Tomales Bay	305	9	29	—	—	—	3.7	76	—
San Francisco Bay	370	1	1,240	917	0.032	1.3	6.8	51	17
Elkhorn Slough	500	12	4	—	0.003	1.1	—	58	21
San Diego Bay	1,125	7	46	3	0.0005	1.1	5.9	28	23

[a] Air-kilometers north or south of Humboldt Bay.
[b] Long-term average daily flow (m^3/sec).
[c] Proportion of fresh water entering estuary during tidal cycle to the tidal prism volume.
[d] Mean difference in tidal elevation between flood tide and ebb tide near entrance station.

allowing nutrients to come close to the surface. In the winter, the Columbia River plume flows northward and greatly affects the estuarine waters of Grays Harbor and Willapa Bay.

A comparison of ecological characteristics of Pacific coast estuaries is difficult because comprehensive studies are lacking on many of the estuaries and because of the variability in sampling design and methods among studies that have been done. The phytoplankton productivity of Humboldt Bay tidal channels is low compared to most Atlantic and Gulf of Mexico coastal estuaries, but compares well with the productivity of San Francisco Bay waters (Table 5.2). Although the net productivity of Humboldt Bay phytoplankton is not high, the large area occupied by phytoplankton in deep channels, tidal channels, and shallow bays makes phytoplankton an important contributor to Humboldt Bay food webs.

Humboldt Bay salt marshes are floristically distinct from other Pacific coast marshes, yet contain many species common to both northern and southern marshes (Eicher 1987). *Spartina densiflora*, the dominant salt marsh plant around Humboldt Bay, has not been reported anywhere else in North America except for a small patch in San Francisco Bay, where it was introduced from Humboldt Bay in 1976 (Spicher and Josselyn 1985). North of Humboldt Bay, salt marshes on the Pacific coast do not have *Spartina* (Eilers 1975), except for the introduction of exotic species in spots. Most of the other species found in Humboldt Bay are also found in San Francisco Bay, with four notable exceptions: the two rare Humboldt Bay endemics, Humboldt Bay owl's clover (*Orthocarpus castillejoides* var. *humboldtiensis*) and Humboldt Bay gumplant (*Grindelia stricta* ssp. *blakei*); a species of *Carex* that has previously been listed as *Carex lyngbyei*; and *Parapholis strigosa*, an Old World introduction.

Carex lyngbyei dominates Oregon salt marshes. A form that was previously identified as *C. lyngbyei* is also common in Humboldt Bay; however, its taxonomic determination is currently in question. The plant does not fit the characteristics given in the literature for *C. lyngbyei*; its leaves are not flat, but channeled, similar to *C. obnupta*. While this taxon is being studied, the old name continues to be used. Another form, *Parapholis strigosa*, appears to have been mistaken by some authors as a species of *Puccinellia*, to which it is similar in overall appearance.

In addition to the presence of unique species, Humboldt Bay is distinct because of the absence of some species common to central California marshes (notably San Francisco Bay), including *Frankenia grandifolia*, *Suaeda californica*, *Puccinellia* sp., and *Salicornia europaea*. *Limonium californicum*, however, reaches its northern extension in Humboldt Bay.

The number of fish species recorded as present in other estuaries is small when compared to Humboldt Bay, probably due in part to the limited amount of sampling (Table 5.3). Major groups of fishes using Pacific coast estuaries from the central coast of Washington to southern California are quite similar (Table 5.3). Surfperches, gobies, and flatfishes are common. The shiner perch, which ranges from Port Wrangell, Alaska, to San Quintín Bay, Baja California (Odenweller 1975), usually ranks among the most numerous of fishes taken by seine or trawl except for estuaries in the extreme southern portion of California. The English sole, a commercially important species using estuaries as nursery areas, ranks high in numbers as far south as Elkhorn Slough. Commercial flatfish most often cited as using estuarine channels as nursery grounds in southern California (Zedler 1982) are the California halibut (*Paralichthys*

Table 5.2. *Comparison of phytoplankton net primary productivity of selected estuaries; Humboldt Bay data from Harding (1973), data for all other locations from Nixon (1983).*

Estuary	Productivity ($g/m^2/yr$)	Rating
Humboldt Bay	300–450	Low
San Francisco Bay		
Suisun Bay	210	Low
San Pablo Bay	220–290	Low
South Bay	330	Low
Chesapeake Bay	990	Medium
Apalachicola Bay	500	Medium

Table 5.3. *Comparison of juvenile and adult fish assemblages of Pacific coast estuaries from trawl and seine surveys.*[a]

Bay	Distance[a] (km)	Number of species	Rank of most numerous fishes 1	2	3	4	5
Tillamook Bay[b]	555	56	Northern anchovy	Surf smelt	Shiner perch	Pacific herring	English sole
Yaquina Bay[c]	450	29	Surf smelt	English sole	Shiner perch	Buffalo sculpin	Pacific herring
Humboldt Bay[d]	0	110	Shiner perch	English sole	Speckled sanddab	Longfin smelt	Staghorn sculpin
San Francisco Bay[e]	370	60	Northern anchovy	Longfin smelt	Pacific herring	Shiner perch	Striped bass
Elkhorn Slough[f]	500	81	Shiner perch	White seaperch	Black surfperch	Speckled sanddab	English sole
Morrow Bay[g]	600	66	Surfperch spp.	Flatfish spp.	Northern anchovy	Goby spp.	Staghorn sculpin
Anaheim Bay[h]	965	57	Topsmelt	Shiner perch	Deepbody anchovy	Goby spp.	Staghorn sculpin
Tijuana Estuary[i]	1,140	--	Arrow goby	Cheekspot goby	California killifish	Topsmelt	Striped mullet

[a] Air-kilometers north or south of Humboldt Bay.
[b] Forsberg et al. 1977.
[c] Pearcy and Myers 1974.
[d] Sopher 1974.
[e] Brown 1986.
[f] Nybakken et al. 1977.
[g] Fierstine et al. 1973.
[h] Lane and Hill 1975.
[i] Zedler 1982.

Table 5.4 *Comparison of larval fish assemblages of Pacific coast estuaries.*

Estuary	Distance[a] (km)	Number of families	Dominant fish: Groups	Dominant fish: % of total
Columbia River[b]	635	18	Eulachon, longfin smelt	90
Yaquina Bay[c]	450	17	Pacific herring, bay goby	90
Humboldt Bay[d]	0	17	Bay goby, Pacific herring	82
San Francisco Bay[e]	370	20	Pacific herring, goby spp.	91
Elkhorn Slough[f]	500	16	Northern anchovy, goby spp.	65
Tijuana Estuary[g]	1,140	—	Goby spp., silverside spp.	96

[a]Air kilometers north or south of Humboldt Bay.
[b]Laroche 1976.
[c]Pearcy and Myers 1974.
[d]Eldridge and Bryan 1972.
[e]Eldridge 1977.
[f]Nybakken et al. 1977.
[g]Zedler 1982.

californicus) and the diamond turbot (*Hypsopsetta guttulata*).

Larval and juvenile northern anchovy and Pacific herring are common in Pacific coast estuaries during the summer except in extreme southern California (Table 5.4). Osmerids (smelts) are common, mostly as larvae or juveniles, in estuaries along the coast of Washington, Oregon, and California, but are replaced primarily by atherinids (topsmelt, grunion) in estuaries south of Point Conception. Reproducing populations of striped bass occur in San Francisco Bay and in Coos Bay and Winchester Bay, the only three such populations on the west coast; Humboldt Bay lacks a river with high enough volume and sustained velocity for successful spawning of this anadromous species. In a larval fish survey of Humboldt Bay, Eldridge and Bryan (1972) reported that larvae of the bay goby and Pacific herring composed 82% of the total larvae collected. In similar studies, Pearcy and Myers (1974) found that Pacific herring and the bay goby ranked first and second, respectively, and made up 90% of all larvae sampled from Yaquina Bay, Oregon. Eldridge (1977) reported that Pacific herring and species of gobies comprised 91% of larvae taken from San Francisco Bay (Table 5.4).

Humboldt Bay is an important ecological unit in the Pacific Flyway for migratory waterfowl. It is the largest bay and supports the greatest number of wetland wildlife species and the largest populations of those species along the Pacific coast between San Francisco Bay and the Columbia River (Springer 1982), a distance of 1,005 km. Table 5.5, which compares numbers of brant and ducks counted in early January from 1985 to 1987, helps to substantiate the importance of Humboldt Bay. Table 5.5 also demonstrates the importance of San Francisco Bay to the south and Willapa Bay and Grays Harbor north of the Columbia River to waterfowl.

Although brant numbers and brant-use days have declined markedly for Humboldt Bay, the bay remains an important resting area for the birds as they travel northward in the spring. Brant-use days were estimated to be 240,000 in 1984–85; 315,000 in 1985–86; and 270,000 in 1986–87 (Nelson, Humboldt Bay National Wildlife Refuge, personal communication). Brant use is greater in Willapa Bay, averaging about 490,000 for the same year (Willapa National Wildlife Refuge, unpublished data), but is much less in Oregon estuaries.

Table 5.5. *Early January counts of black brant and ducks on west coast estuaries, 1985–87.*[a]

	Black brant			Ducks					
				Dabblers			Divers		
Estuary	1985	1986	1987	1985	1986	1987	1985	1986	1987
Grays Harbor	0	114	350	284	10,683	2,322	33	373	802
Willapa Bay	2,413	950	856	3,646	4,989	5,509	453	836	1,087
Tillamook Bay	134	76	320	1,410	3,511	6,080	160	968	533
Yaquina Bay	105	427	382	347	4,313	227	264	1,816	934
Winchester Bay	0	0	0	260	538	400	201	1,780	1,525
Coos Bay	0	0	1	3,243	2,873	2,030	957	2,742	4,380
Humboldt Bay	50	0	86	6,150	3,035	5,639	8,135	4,071	2,339
Tomales Bay	145	186	0	1,242	315	145	13,922	7,766	4,416
San Francisco Bay	0	0	0	42,893	86,746	26,239	117,979	166,989	42,803

[a] From U.S. Fish and Wildlife Service national wildlife refuges, unpublished data.

Chapter 6. Management Considerations

Bay Management and Protection

Humboldt Bay is a valuable resource to its surrounding communities and much of its value relates to its biological resources. The Northcoast Region Comprehensive Basin Plan, adopted by the State Water Resources Control Board in 1975, identified 13 beneficial uses for Humboldt Bay, 10 of which are directly related to biological resources: shellfish harvest, ocean commercial and sport fishing, marine habitat, wildlife habitat, fish spawning, fish migration, nonwater-contact recreation, (bird watching, boating, marine life study, hunting), water-contact recreation (fishing, clamming, swimming, surfing), preservation of rare and endangered species, cold freshwater habitat, navigation, agricultural supply, and industrial service supply.

There are a number of federal, state, county, municipal, and special agencies whose functions include making management decisions regarding uses of Humboldt Bay resources. These agency roles were reviewed in some detail by Shapiro and Associates, Inc. (1980).

Projects or activities that might affect habitat or alter bay resources generally require permits. The permitting process usually involves the U.S. Army Corps of Engineers, the California Coastal Commission, Humboldt Bay Harbor, Recreation and Conservation District; and Humboldt County, or the cities of Eureka or Arcata. It may also involve the Regional Water Control Board, the U.S. Environmental Protection Agency, the California Department of Fish and Game, and the North Coast Unified Air Quality Management District. Other agencies such as the U.S. Fish and Wildlife Service and the National Marine Fisheries Service may also be involved as referral agencies for required environmental review.

The U.S. Army Corps of Engineers (Corps), pursuant to Section 404 of the Federal Water Pollution Control Act, has permit jurisdiction for diking, dredging, filling, shoreline structure building, and other activities in and adjacent to the navigable waters in the United States. The Corps determines whether granting a permit would be in the public interest. Under the Fish and Wildlife Coordination Act of 1934, any federal agency proposing to modify or control any body of water must first consult with the U.S. Fish and Wildlife Service (Service). The Service evaluates the possible effects of the activities on fish and wildlife resources. This required consultation is typically carried out through the Corps permit process. Both the Corps and Service have guidelines that limit the impacts that various uses have on wetlands. Where alteration or conversion of wetland habitat is allowed, replacement habitat is typically required.

The California Coastal Commission is usually the lead state agency to review development permits in and around Humboldt Bay. In administering the California Coastal Act, the State Coastal Commission has retained permit authority on most of the lands immediately adjacent to Humboldt Bay. The policies of the California Coastal Act were used to prepare Local Coastal Programs (LCP's) for each of the local jurisdictions around Humboldt Bay (Humboldt County, Eureka, and Arcata). The LCP's provide the standards and guidelines by which decisions are made by both the local jurisdictions and the State Coastal Commission. In exercising permit jurisdiction, both local governments and the State Coastal Commission use the California Department of Fish and Game as a referral agency on matters affecting fish and wildlife resources of the state.

The Humboldt Bay Harbor, Recreation and Conservation District, established in April 1973, is empowered by state statutes to develop Humboldt Bay to its ultimate potential as a harbor and a port while conserving the natural resources of the area. The Harbor District has adopted Ordinance Number 7, the Humboldt Bay Master Plan, which designates land and water areas and uses of the bay as follows: conservation water, development water, public open-space land, agricultural land, service-commercial land, port-related industrial land, water-related industrial land, nonwater-related industrial land. The designations are defined and their locations given in Shapiro and Associates, Inc. (1980). The Humboldt Bay Harbor District currently owns and operates a 237-slip marina that was constructed in 1981, owns 17 ha of developable land, and holds 32 ha of land in reserve for mitigation or conservation. The Harbor District has actively supported the deepening of ship channels in Humboldt Bay to a depth of 12.2 m for new maritime business, the improvement and modernization of commercial fishing facilities, and the improvement or expansion of waterfront facilities.

The Humboldt Bay Wetlands Review and Baylands Analysis carried out for the U.S. Army Corps of Engineers by Shapiro and Associates, Inc. (1980), summarized its findings by providing advisory categories for the lands and waters of the Humboldt Bay environs based on their resource values:

- *Areas of importance.* Those areas unique or so important to the functioning of the Humboldt Bay ecosystems and its aquatic resources that potential destruction or alteration should be discouraged unless found to be in the best public interest. Areas of importance are especially critical areas which should generally be maintained in their present state.
- *Areas of environmental concern.* Those areas that are environmentally sensitive, in which any use or activity should be carefully controlled. Areas of environmental concern may have multiple uses consistent with maintenance of their habitat values.
- *General areas.* Those areas in which new development would cause minimal impacts on wetlands and other valuable habitat types. Such areas might include already altered or damaged areas or expansions of existing development modes.

In addition to providing federal consultation on permit applications, the U.S. Fish and Wildlife Service also manages the Humboldt Bay National Wildlife Refuge, which is authorized to encompass approximately 3,162 ha. To date, only 843 ha of the approved refuge area has been acquired. The completed refuge would encompass most of South Bay and portions of North Bay. The refuge will protect key wildlife habitat associated with migratory birds, fish nursery grounds, shellfish, and marine life. A principal objective of refuge managers is to restore wintering brant populations on the bay. About 226 ha of diked pasture may ultimately be returned to salt marsh or fresh ponds.

Permit jurisdictions, policies, and guidelines of the various local, state and federal agencies can serve to protect critical natural resource habitat in Humboldt Bay. These policies should provide adequate protection for the open-water areas of South Bay, North Bay, and the areas around various bay islands. Other areas of Humboldt Bay with less restrictive designations are more subject to alteration. As pointed out in the Humboldt County Industrial Siting Study (Humboldt County 1981), it is important for various agencies involved in reviewing permit activities and formulating permit conditions in the study area to agree on which ecosystem characteristics are important to maintain—a difficult task because agencies have different policies and responsibilities. Hofweber (1982) stated that although a variety of management goals exist for individual projects, there is no overall management plan regarding Humboldt Bay wetland resources. Woodruff (1982) pointed out that proposed projects are currently handled on a case-by-case basis with neither long-term goals nor objectives for planning wetlands mitigation. Compensation is the replacement or creation of habitat types lost due to development activities. The Humboldt County Industrial Siting Study (Humboldt County 1981) suggested the formation of a compensation area land bank, consisting of developmental agencies and industries interested in purchasing compensation land; each member would be assessed according to its compensation needs. A large compensation site would allow for coordination of habitat evaluation and environmental impact assessment and offer the possibility of developing an area with greater diversity and greater habitat value than several smaller, isolated sites.

Socioeconomic Factors

The most significant obstacle to economic development of the Humboldt Bay region is its remote location. The economic base of Humboldt County is primarily dependent upon natural resources; related industries are timber and wood products, fisheries, agriculture (primarily dairy products), and tourism. From 1965 to 1975, the lumber and wood products manufacturing sector supplied the highest private insured employment. However, these industries have been slowly declining in actual total employment. The major industrial facilities of the forest industry, particularly those in the Humboldt Bay area, however, are expected to continue at their present level of operation, with some modernization of equipment, but without significant additional land-use demands (Table 6.1). It is anticipated that some smaller facilities may close down, making additional land available for industrial use (Humboldt County 1981).

Agriculture has historically been one of the major economic resources of Humboldt County. Related employment was estimated at 1,900 jobs in 1977, down from 2,500 in the early 1960's (QRC Corporation 1978), a decrease Dean et al. (1973) forecasted because of advances in agricultural technology. Agricultural land-use study of the Humboldt Bay area (California Department of Water Resources 1978) showed that of 7,392 ha in agricultural use, 6,967 ha (94%) was in pasture.

Of the natural resource-dependent industries important in Humboldt County, fishing appears to be one with significant expansion potential (Humboldt County 1981). Since 1981, the Humboldt Bay Harbor Recreation and Conservation District has completed construction of the Woodley Is-

Table 6.1. *Projected employment and growth rates by industry, Humboldt and Del Norte Counties, 1976, 1980, and 1985 (Humboldt County 1981).*

	Number of employed individuals			Compound annual average growth rate	
Industry	1976	1980	1985	76-80	80-85
Agriculture, forestry, fisheries	3,200	3,800	4,000	4.4	1.0
Construction and mining	2,200	2,500	2,900	3.3	3.0
Manufacturing	10,800	10,800	10,200	0	-1.1
Lumber and wood products	8,700	8,500	7,700	-0.6	-2.0
Food and kindred products	900	1,000	1,100	2.7	1.9
Other manufacturing	1,200	1,300	1,400	2.0	1.6
Transportation, communications and utilities	3,100	3,200	3,300	0.8	0.6
Transportation	1,800	1,800	1,800	0	0
Communications and utilities	1,300	1,400	1,500	1.9	1.4
Trade	9,800	11,200	12,800	3.4	2.7
Wholesale trade	1,300	1,500	1,500	3.6	1.3
Retail trade	8,500	9,700	11,200	3.4	2.9
General merchandise, apparel	1,400	1,500	1,500	1.7	1.3
Food and dairy stores	1,300	1,400	1,000	1.9	2.7
Auto dealers, gas stations	1,300	1,400	1,500	1.9	1.4
Eating and drinking places	2,600	3,200	3,900	5.3	4.0
All other retail trade	1,900	2,200	2,600	3.7	3.4
Finance, insurance, and real estate	1,400	1,600	1,900	3.4	3.5
Finance	700	800	1,000	3.4	4.6
Insurance	300	300	400	0	5.9
Real estate	400	500	500	5.7	0
Services	16,700	18,800	21,900	3.0	3.1
Hotels and lodging places	1,400	1,700	2,100	5.0	4.3
Medical, other health	3,700	4,100	5,000	2.6	4.1
Education	5,600	6,300	7,200	3.0	2.7
All other services	6,000	6,700	7,600	2.8	2.6
Public administration	2,400	2,700	3,000	3.0	2.1
Federal public administration	400	500	500	5.7	0
State public administration	300	300	300	0	0
Local public administration	1,700	1,900	2,200	2.8	3.0
Total, all industries	49,500	54,500	59,900	2.4	1.9

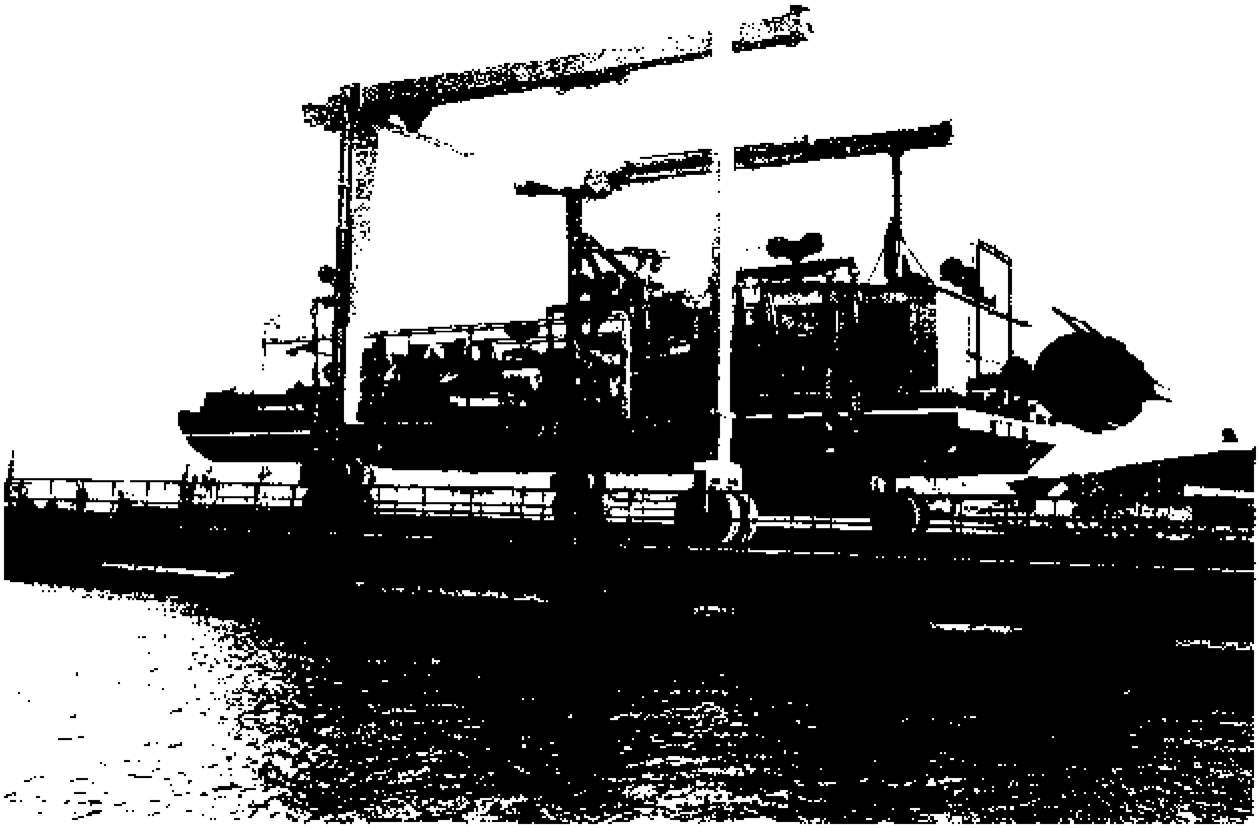

Fig. 6.1. Marine lift in South Humboldt Bay launching a commercial oyster dredge.

land Marina, which has significantly expanded boat-berthing facilities on the bay. In addition, a boat building and repair yard with a 150-ton marine lift has been built in South Bay (Fig. 6.1). The Pacific Coast Fisheries Information Network (PACFIN) listed 38 trawling vessels and 267 trolling vessels that made the majority of their income from fish landings in Humboldt County in 1983. With the exception of the Pacific oyster, all of the major fish species harvested in the commercial fishery are taken outside Humboldt Bay. The primary fish groups are groundfishes (flatfishes and rockfishes), albacore, Dungeness crab, and salmon (Table 6.2). The

Table 6.2. *Commercial fishery landings and ex-vessel value in Humboldt Bay (Eureka–Fields Landing), 1981–85 (California Department of Fish and Game, unpublished data).*

	Landings per year (1,000 kg)					1981–85 average	Average value/year
Species	1981	1982	1983	1984	1985	(1,000 kg)	($1,000)
Flatfishes	5,376	4,678	3,746	4,036	4,962	4,560	2,487
Rockfishes	5,213	4,592	3,017	2,655	3,248	3,745	1,782
Dungeness crab	1,324	498	356	656	772	721	1,440
Albacore	1,662	82	172	278	1,130	665	1,006
Salmon	422	389	116	52	21[a]	200	991
Other	3,027	4,660	2,006	2,005	2,655	2,909	1,736
Total	17,024	14,899	9,411	9,682	12,788	12,800	9,441

[a] No commercial salmon season in Eureka–Trinidad zone in 1985.

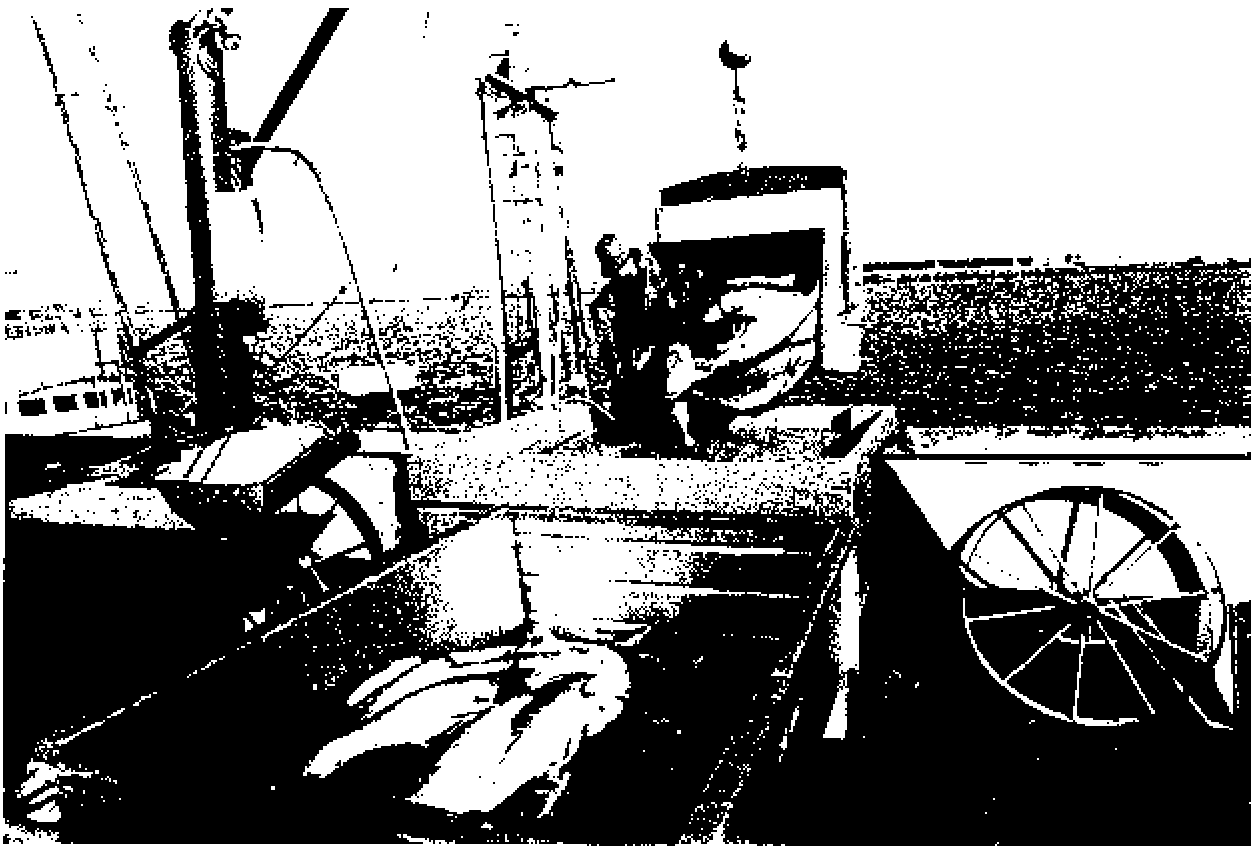

Fig. 6.2. Commercial troll-caught salmon are bought by several Humboldt Bay seafood processors.

average annual value of fish landed in Humboldt Bay from 1981 to 1985 was almost $9.5 million. Salmon is the most valuable finfish on a per-pound basis; in 1985 the average price per pound paid to commercial fishermen was $2.44 for chinook salmon and $1.54 for coho salmon (University of California Cooperative Extension Sea Grant Advisory Program, Eureka, California, unpublished data; Fig. 6.2). However, salmon landings have declined markedly since the late 1970's, and only in 1986 and 1987 were there indications of increase in salmon stocks (Table 6.3). The largest commercial fishery inside Humboldt Bay is oyster farming. In 1985, over 907,000 kg (live weight) of oysters were harvested, representing a value of approximately $864,000 (University of California Cooperative Extension, unpublished data).

Although the fishery industry is an important business, it is not a large employer; annual insured employment in the fisheries and agriculture sector was about 10% of the annual insured employment in the lumber manufacturing sector in 1975. Expansion of the fishing industry is faced with formi-

Table 6.3. *Eureka-Trinidad troll-caught chinook and coho salmon landings. (Pacific Fishery Management Council 1987; J. Lesh, California Department of Fish and Game, personal communication).*

Year	Landings (thousands)	
	Chinook	Coho
1971-75 Average	142.1	133.9
1976	165.4	204.8
1977	161.2	19.3
1978	155.2	140.3
1979	218.4	66.0
1980	131.3	19.6
1981	99.7	35.9
1982	96.0	28.6
1983	35.2	26.6
1984	14.0	3.7
1985[a]	3.7	0.3
1986[b]	47.4	5.2
1987[b]	70.5	12.0

[a] No commercial salmon season in Eureka-Trinidad zone in 1985

[b] Unpublished preliminary data, California Department of Fish and Game.

dable constraints; marketing and seasonal fluctuations are major problems, and negative economic impacts have been associated with fishery closures imposed by Pacific Fisheries Management Council. A basic problem in expanding shellfish culture in the bay is pollution from human sewage and nonpoint sources. Presently, if more than 1.27 cm of rain falls within 24 h, the bay is closed to harvesting for the next 5 days. During wet winters, significant long periods of closure can occur; for example, in 1981 Coast Oyster Company lost 82 working days. These closures result in an unreliable supply to the wholesaler.

The importance of tourism and recreation to the Humboldt County economy is difficult to estimate because secondary indicators must be used. Dean et al. (1973) forecasted significant growth for tourism-related sectors of the economy for the period 1975–85. The Redwood Economic Development Commission (1987), using motel revenue figures, estimated a 13% average annual growth rate for Eureka in 1980–85. The same reports stated that during the summer months of 1985, approximately 12,000 campers were turned away at Prairie Creek State Park, a few kilometers north of Eureka, because all campgrounds were full. The Eureka–Humboldt County Convention and Visitors Bureau 1986–87 annual report estimated the dollar impact from motorcoach tours in 1987 to be $1,080,000.

Humboldt Bay and its natural resources are important in attracting people to the area. Water-related recreational activities include sport fishing, waterfowl hunting, clam digging, crabbing, sailing, small-craft boating, surfing, skin diving, birdwatching, and beachcombing. Van Kirk and Ahern (1984) surveyed nonresident anglers visiting Humboldt and Del Norte Counties in 1982. The mean length of stay by all visiting anglers was 42 days with an average expenditure of $31/day. Most of these anglers fished for salmon. In a survey from 1957 to 1960, Miller and Gotshall (1965) determined that an average of 27,144 angler-days was expended annually in Humboldt Bay. The Pacific Fishery Management Council (1987) estimated 33,700 days were expended in recreational fishing for salmon by anglers fishing out of Eureka from May to September 1985. In 1986 a new public boat ramp was completed in Eureka Channel directly opposite the Woodley Island Marina to improve boating access to the bay. A 1985 planning advisory committee report to the Humboldt Bay Harbor Recreation and Conservation District recommended the development of fishing piers and fishing "parks" and the promotion of sport-fishing opportunities for Humboldt Bay.

Shipping facilities in Humboldt Bay primarily serve the forest products and petroleum industries. Commodity flows in and out of the bay are principally the export of forest products and the import of petroleum products for local consumption and chemicals for wood pulp processing by the two pulp mills located on the Samoa Spit (Figs. 6.3 and 6.4). The number of vessels calling on Humboldt Bay average about 350 per year (Shapiro and Associates, Inc. 1980). Deep-draft navigation uses and related industrial areas occupy about 182 ha of land, about 1.3% of the total land in the Humboldt Bay area, and about 10% of the bay's shoreline parcels. Ray (1982) stated that significant increase in deep-draft navigation is unlikely in the near future.

One area of potential new coastal-dependent industrial development on Humboldt Bay is support facilities for Outer Continental Shelf (OCS) oil and gas development. Through the exploratory drilling phase, the only facility required would be a temporary service base to serve as a materials storage and transfer site to the offshore drilling location. If commercial quantities of oil or gas were found, onshore facilities that could be required are a permanent service base, pipelines from OCS facility to shore, gas processing facilities, and an oil export terminal. Such facilities would boost the local economy, but at the same time would require dredging and pier or dock construction at selected sites in Humboldt Bay (Humboldt County 1981).

Environmental Concerns

A report by the California Department of Health Service (1988) gave the status of Humboldt Bay water quality since the completion of wastewater treatment projects in Eureka and Arcata (1982–87). Improvements made by these projects virtually eliminated a chronic wet-weather problem associated with the discharge of raw or partially treated sewage. Commercial shellfish-growing areas with a conditionally approved classification, such as Humboldt Bay, are usually closed to harvesting during and after rain storms. These closures are necessary because bay water quality degrades following rainfall from surface runoff, surface turbulence, and overloading of wastewater collection facilities. Until 1987, the closure rule stated that whenever there was

Fig. 6.3. Export log storage area located adjacent to south Humboldt Bay.

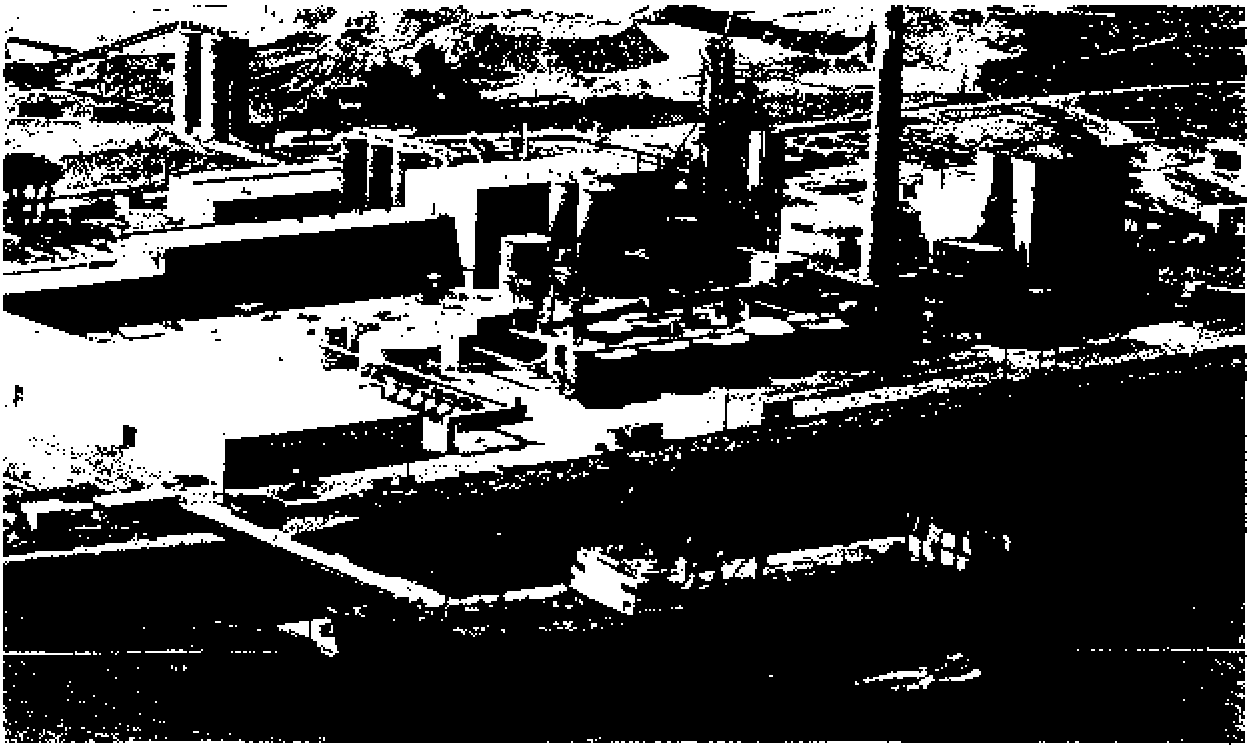

Fig. 6.4. One of two pulp mills located on the North Spit of Humboldt Bay.

1.27 cm of rainfall or more in any 24-h period, the bay would be closed to shellfish harvesting for 5 days afterwards. With the completion of the wastewater treatment projects in 1987, the rule was modified; the 5day closure time was reduced to 2 days for 1.27–2.54 cm rainfall and 3 days for rainfall exceeding 2.54 cm in 24 h.

The 1988 report stated that land surveys of the Humboldt Bay area revealed many locations where livestock animals pastured along bay tributaries with little to prevent their wastes from being washed into the bay during rainy periods. Two areas of prime concern were the Elk River valley and the Arcata Bottoms between the city of Arcata and Mad River Slough. Changes in farm management practices may help to alleviate this problem. Included in the report were the results of a study on the impacts of seagull concentrations on water quality. During winter months, thousands of seagulls congregate on the bay mudflats at low tide to feed on herring eggs deposited on eelgrass. During high tide periods, the gulls move to the local solid waste landfill where they feed on various waste materials or to the Arcata wastewater treatment plant where they feed on raw sewage entering the plant at the primary clarifiers. Data indicate that seagulls returning to the mudflats after these feeding excursions contribute significant levels of fecal coliform to bay waters. In 1988, Arcata screened the primary clarifiers to prevent gull access.

Tributylin (TBT), an effective antifouling agent used in marine paints, is also highly toxic to most aquatic life. Stallard et al. (1987) monitored TBT in California coastal waters and noted that where TBT concentrations are above 100 parts per trillion (pptr), there are usually absences of fauna, especially mussels and macrophytes. In general, California coastal waters contain less than 20 pptr TBT. Except for a sample taken from a shipyard in South Bay, all 1986 Humboldt Bay water samples were well below 20 pptr TBT. The shipyard has installed a particulate separator through which all water used to clean boats passes. This has helped to alleviate the TBT problem and oysters are now being grown commercially at the shipyard boat dock. Since 1987, most boats less than 24.4 m cannot use TBT as an antifouling agent.

At the Woodley Island Marina in Humboldt Bay, storage tanks are located below each dock into which tenants are allowed to pump oil and water from boat bilges. These tanks are periodically emptied and the oil and water separated; the water is directed to Eureka's sewer system, and the oil is sent to the local recycling center. In addition, trash cans are provided on all docks near the water so that plastic and other wastes are less likely to end up in the bay (Jack Alderson, Humboldt Bay Harbor Recreation and Conservation District, personal communication).

Other possible pollutants in Humboldt Bay are pesticides from agriculture runoff and synthetic organic chemicals from industrial discharge. Pentachlorophenols (PCP's) and possibly dioxin, an unintentional contaminant associated with PCP's, can enter the bay during storm events from lumberyards that use PCP's as a fungicide. Dioxin also occurs in the wastewater of the two pulpmills on the North Spit. Even though this wastewater is discharged on the ocean side of the North Spit, aerial photographs of the effluent plume indicate that the plume is sometimes carried by currents and the incoming tide into Humboldt Bay (Frank Palmer, Regional Water Quality Control Board, personal communication).

Selenium (Se) concentrations in water and in the tissues of scoters were compared for Humboldt Bay and Suisun and San Pablo bays (part of the San Francisco Bay-Delta complex; White et al. 1989). Surf scoters from Humboldt Bay average 0.60 parts per million (ppm) Se in muscle and 2.5 ppm in liver. These levels were significantly lower than those from Suisun and San Pablo bays, which, in early winter, averaged 5–6 times higher than Humboldt Bay in muscle and 10–11 times higher in liver. By late winter, Suisun and San Pablo samples were 10–14 times higher than Humboldt Bay samples in muscle and 14–22 times higher in liver samples. Water collected from Humboldt Bay in January 1988 contained 0.05 parts per billion (ppb) and 0.06 ppb dissolved total Se on low and high tide, respectively. All water samples from Suisun Bay and 14 of 16 samples from San Pablo Bay contained Se concentrations higher than in Humboldt Bay. Maximum concentrations were 3–4 times higher than in Humboldt Bay. Dissolved Se concentrations of 0.05–0.06 ppb indicated that there is no Se enrichment of Humboldt Bay waters from anthropogenic sources.

Despite past human activities that have altered the pristine character of Humboldt Bay, the bay is still cleaner and healthier than any enclosed bay in California (Pequegnat and Butler 1982). Current environmental laws and requirements regarding proposed bay projects provide opportunities to make the most effective use of bay resources while preserving the biological integrity of the bay.

Chapter 7. Research and Management Information Needs

Despite the efforts of academic, agency, and other researchers, information on biological communities and their structure in Humboldt Bay is rudimentary. Available evidence suggests that the distribution of many plants and animals is linked to the occurrence and distribution of various sediments. The sources of sediment, the general physical profile, and distribution of sediments in the bay are known in broad terms. To provide detailed information on the relations of the physical and chemical characteristics of bay sediments with the various plants and animals that live on and in them, a sediment study should be made of three compartments of the bay; sediment pH, oxidation–reduction potential (Eh), organic content, biological oxygen demand (BOD), presence of potentially toxic metals or compounds, and factors, including human, which influence the sedimentary environment should be determined.

Although several years of sampling have resulted in a reasonably accurate list of macroscopic plants and animals for Humboldt Bay, there is still little understanding of how these biological entities interact. Common patterns of competition and predation are known from general ecological principles and studies in other temperate marine embayments. Important estimates of primary and secondary productivity are mostly dependent on extrapolations of data from marine estuaries of the Atlantic coast and even the coast of Europe. Detailed investigations should be focused on precisely how numerically abundant species interact. Such investigations will require field and laboratory approaches and should use technical advances such as remote monitoring devices to document interactions.

The ecological energetics of the bay can be sketched only in general terms. A significant part of the primary productivity of the bay appears to pass through important microproducers (bacteria, algae, diatoms) and microconsumers (bacteria, protozoans, meiofaunal organisms) before it becomes available to other consumers. It would be useful to document the fate of primary plant productivity and the relationship of macroscopic plant productivity to microbial processes. Such information would improve our understanding of the population dynamics of deposit-feeding animals found in benthic sediments, which are fed upon by many secondary consumers.

The navigational channels of the bay are periodically dredged. There are proposals to deepen these channels an additional 1.5 m for use by larger, deeper-draft commercial shipping. Deepening the Entrance Channel will allow more wave energy to reach Entrance Bay, which will likely cause additional erosion problems in the King Salmon area. Deepening the channels will change the low tide holding capacity of the bay, which will influence circulation patterns and flushing characteristics. Velocity of the tide wave moving up and down the channels will change significantly. All these changes will have an impact on the chemistry and biology of the bay. An understanding of circulation and flushing, the nutrient budget, and bay productivity is necessary to assess changes caused by deepening the channels.

Humboldt Bay has extensive mudflats, marshes, and adjacent diked agricultural fields. In the next few decades, sea level will continue to rise, and although the predicted rise is small (5–50 cm), it, too, will cause changes in circulation and flushing patterns, accelerate erosion of marsh lands, dikes and sand spits, and cause flooding in some areas. These problems should be addressed now to protect bay resources for the future. Bay development, restoration, and mitigation projects should take into account future changes in sea level and attendant problems.

As the Humboldt Bay National Wildlife Refuge expands through acquisition of land adjacent to the bay, opportunities for the addition of freshwater, brackish water, and saltwater marshes will be available. Each kind of marsh provides optimal conditions for some species of flora and fauna but is limiting to others. Refuge managers need information on marsh productivity, species interactions, and marsh design and construction to best use land management opportunities.

Humboldt Bay is experiencing a steady increase in use for various types of recreation as well as for certain types of commercial enterprise. Increased use may be causing negative changes in the abundance and distribution of some plants and animals. One activity may cause only a slight change, but combined, the negative impacts of many uses can be cumulative and perhaps multiplicative. For example, what effect does increased boating (fishing, hunting, sailing, clamming, sightseeing, commercial) have on the distribution, abundance, and use patterns of waterfowl, particularly brant? How do increases in commercial oyster-growing operations affect eelgrass abundance and distribution and organisms associated with the eelgrass community? From a management perspective, the California Department of Fish and Game would like additional abundance, distribution, and life history information on commercially important fish species, particularly sharks, surfperches and Pacific herring populations (J. Spratt, R. Warner, and A. Petrovitch, California Department of Fish and Game, personal communications).

As use of Humboldt Bay and the surrounding area increases, incidences of pollution will probably also increase. The California Department of Fish and Game (Klein and Gulling, Eureka, California, unpublished data) cataloged 177 outfalls as possible pollution sources into Humboldt Bay. That survey should be updated and samples from suspected sources should be collected and analyzed periodically. The contamination of bay water, bottom sediments, and organisms is a major concern, and studies to test contaminant effects on the system and its function should be carried out.

Decisions concerning the bay are now being made without the information previously discussed. Many actions taken may be irreversible, and some may have long-term adverse impacts on fish, birds, mammals, and other biota of the bay. Addressing these information needs in the near future is important to the preservation and enhancement of bay resources and to the region's economy as well.

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Appendix A. Plants of Humboldt Bay

Appendix data are from reports and records compiled by Monroe (1973), Shapiro and Associates, Inc. (1980), Eicher (1987), and R. [illegible] Rasmussen (Department of Biological Sciences, Humboldt State University, unpublished data).

Taxa	Common name	Abundance[a]	Habitat[b]	Remarks
Algae				
Chlorophyta				
Bryopsis hypnoides	Moss alga	O	Ro	Near bay mouth
Enteromorpha intestinalis	Green alga	A	Ro,Pi,Sa,Mu	
Spongomorpha coalita	Sponge alga	O	Ro,Pi	Near bay mouth
Ulva lactuca	Sea lettuce	A	Ro,Pi,Sa,Mu	
Phaeophyta				
Alaria marginata	Wing kelp	C	Ro	Near bay mouth
Egregia menziesii	Feather boa kelp	C	Ro	Near bay mouth
Fucus gardneri	Rock weed	C	Ro,Pi	
Fucus distichus	Rock weed	C	Ro,Pi	
Fucus spiralis	Rock weed	R	Ro	Near bay mouth
Pelvetiopsis limitata	Rock weed	C	Ro	Near bay mouth
Sargassum muticum	Grape kelp	O	Ro	Introduced
Rhodophyta				
Botryoglossum farlowianum	Grape tongue alga	O	Ro	Near bay mouth
Botryoglossum ruprechtianum	Grape tongue alga	O	Ro	Near bay mouth
Corallina spp.	Coralline alga	C	Ro	Jetties by bay mouth
Endocladia muricata	Red alga	C	Ro,Pi	
Gigartina papillata	Grapestone alga	C	Ro,Pi	
Gracilaria verrucosa	Slender red alga	C	Ro,Sa	In eelgrass beds
Iridaea cordata	Iridescent red alga	C	Ro,Pi	Near bay mouth
Microcladia borealis	Red alga	O	Ro	Near bay mouth
Microcladia coulteri	Red alga	O	Ro	Near bay mouth
Polysiphonia paniculata	Red alga	C	Ro	Near bay mouth
Polysiphonia pacifica	Red alga	C	Ro	
Porphyra lanceolata	Laver, nori	C	Ro	Near bay mouth
Porphyra perforata	Laver, nori	C	Ro,Pi	
Porphyra sanjuanensis	Laver, nori	R	Ro	Near bay mouth
Rhodomela larix	Red alga	O	Ro	Near bay mouth

Taxa	Common name	Abundance[a]	Habitat[b]	Remarks
Rhodophyta *(continued)*				
Rhodymenia oweniae	Red alga	O	Ro	Near bay mouth
Chrysophyta				
Vaucheria longicaulis	Yellow-brown alga	O	Sa,Mu	Intertidal
Flowering plants (Anthophyta)				
Atriplex patula var. *hastata*	Fat hen	C		In salt marshes
Carex lyngbyei	Lyngby's sedge	A		In salt marshes, brackish
Cordylanthus maritimus var. *palustris*	Point Reyes bird's beak	C		In salt marshes
Cuscuta salina	Dodder	A		In salt marshes
Deschampsia caespitosa var. *beringensis*	Tufted hairgrass	A		In salt marshes
Distichlis spicata	Saltgrass	A		In salt marshes
Grindelia stricta ssp. *blakei*	Humboldt Bay gumplant	C		In salt marshes
Jaumea carnosa	Jaumea	C		In salt marshes
Juncus lesueurii var. *lesueurii*	Salt rush	A		In salt marshes
Limonium californicum	Sea lavender	C		In salt marshes
Orthocarpus castillejoides var. *humboldtiensis*	Humboldt Bay owl's clover	C		In salt marshes
Parapholis incurva	Sicklegrass	C		In salt marshes
Parapholis strigosa	Sicklegrass	C		In salt marshes
Plantago maritima var. *juncoides*	Sea plantain	C		In salt marshes
Salicornia virginica	Pickleweed	A		In salt marshes
Scirpus maritimus	Saltmarsh bulrush	A		In salt marshes, brackish
Spartina densiflora	Cordgrass	A		In salt marshes
Spergularia macrotheca	Sand spurry	C		In salt marshes
Triglochin concinnum	Arrow grass	O		In salt marshes
Triglochin maritimum	Arrow grass	C		In salt marshes
Zostera marina	Eelgrass	A	Sa,Mu	Forms dense beds

[a] A = abundant, C = common, O = occasional, R = rare.
[b] Ro = rocks, Pi = pilings or other artificial structures, Sa = sand, Mu = mud.

Appendix B. Selected Aquatic Invertebrates of Humboldt Bay

Appendix data are from reports and records compiled by Monroe (1973), Boyd et al. (1975), Shapiro and Associates (1980), and Bott and Diebel (1982). Nomenclature follows usage of the American Fisheries Society for mollusks (Turgeon et al. 1988) and decapods (Williams et al. 1989).

Taxa	Common name	Abundance[a]	Habitat[b]	Remarks
Porifera				
Haliclona permollis	Sponge	C	Ro,Epi	
Haliclona sp.				
Cliona sp.	Sponge	C	Sym	On shells
Cnidarians				
Aequorea sp.	Hydromedusa	C	Pk	
Campanularia integra	Hydroid	C	Sym	With other hydroids
Obelia borealis	Hydroid	A	Ro,Epi,Pi	
Obelia longissima	Hydroid	A	Pi	
Plumularia spp.	Hydroid			
Sertularia spp.	Hydroid	C	Epi	On algae
Thularia similis	Hydroid			
Tubularia crocea	Hydroid	A	Ro,Pi,Epi	
Tubularia marina	Hydroid	A	Ro	
Velella lata	By-the-wind sailor	A	Pk	
Aurelia spp.	Jellyfish	C	Pk	
Chrysaora sp.	Jellyfish	O	Pk	
Pelagia sp.	Jellyfish	O	Pk	
Anthopleura artemisia	Sand anemone	C	Sa	
Anthopleura elegantissima	Aggregating anemone	C	Ro	
Anthopleura xanthogrammica	Great green anemone	C	Ro	
Cerianthus sp.	Burrowing anemone	O	Sa, Mi	
Diadumene spp.	Orange striped anemone	C	Ro,Pi	
Epiactis prolifera	Brooding anemone	C	Ro,Pi	
Gersemia rubriformis	Sea strawberry	O	Ro	Near bay mouth
Haliplanella luciae	Anemone	C	Pi	
Metridium senile	White anemone	C	Pi	
Nematostella vectensis	Salt marsh anemone	C	Mu	In salt marshes
Tealia crassicornis	Splotched anemone	C	Ro,Pi	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Ctenophora				
Pleurobrachia bachei	Comb jelly	A	Pk	
Nemertea				
Amphiporus imparispinosus	Ribbon worm	C	Ro,Pi	
Carinoma mutabilis	Ribbon worm	C	Sa,Mu	
Carinomella lactea	Ribbon worm	O	Sa,Mu	
Cerebratulus californiensis	Ribbon worm	C	Sa,Mu	
Emplectonema sp.	Ribbon worm	O	Sa	On shell fragments
Paranemertes californica	Ribbon worm	C	Sa,Mu	
Tubulanus pellucidus	Ribbon worm	C	Sa,Mu	
Tubulanus polymorphus	Ribbon worm	C	Sa,Mu	
Annelida				
Polychaeta				
Abarenicola antebranchia	Lugworm	O	Mu	
Abarenicola humboldtensis	Lugworm	O	Mu	
Abarenicola pacifica	Lugworm	O	Sa	
Amaena occidentalis	Hairy-gill worm	O	Mu	
Ampharete arctica	Bristle worm	O	Sa	
Anaitides groenlandica	Paddle worm	R	Sa	
Anaitides williamsi	Paddle worm	C	Sa,Mu	
Aricidea suecica	Paranoid worm	O	Sa,Mu	
Armandia brevis	Bristle worm	C	Sa,Mu	
Autolytus sp.	Bristle worm	C	Sa,Mu	
Boccardia berkeleyorum	Spionid worm	O	Sym	Bores *podoesmus* shells
Brania sp.	Bristle worm	R	Sa	
Capitella capitata	Tube worm	A	Mu	
Caulleriella alata	Thread worm	O	Sa	
Caulleriella hamata	Thread worm			
Caulleriella sp.	Thread worm	O	Sa	
Chaetozone setosa	Hairy-gill worm	C	Sa,Mu	
Chaetozone sp.	Hairy-gill worm	C		
Cheilonereis cyclurus	Hermit crab worm	C	Sym	With hermit crabs
Chone gracilis	Paddle worm	O	Sa	
Chone sp.	Paddle worm			
Cirratulus cirratus	Bristle worm	R	Sa	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Polychaeta *(continued)*				
Cistenides brevicoma	Tube worm	O	Mu	
Cossura pygodactylata	Bristle worm	R	Mu	
Dodecaceria concharum	Bristle worm	R	Sa	
Drilonereis falcata	Bristle worm	C	Sa,Mu	
Eteone californica	Paddle worm	C	Sa,Mu	
Eteone dilatae	Paddle worm	C	Sa	
Eteone pacifica	Paddle worm	C	Sa,Mu	
Euclymene delineata	Polychaete worm	C	Sa,Mu	
Eulalia aviculiseta	Paddle worm	O	Sa	With shell debris
Eumidia bifoliata	Paddle worm	C	Sa,Mu	
Eumidia sanguinea	Paddle worm	C	Sym	With algae
Eunereis sp.	Mussel worm			
Eupolymnia crescentis	Terebellid worm	R	Sa,Mu	
Eusyllis assimilis	Paddle worm	O	Sa	
Euzonus mucronata	Bristle worm	C	Sa	
Exogone lourei	Bristle worm	A	Sa,Mu	
Exogone sp	Bristle worm		Sa,Mu	
Glycera americana	Bristle worm	O	Sa	
Glycera capitata	Bristle worm	O	Sa	
Glycera oxycephala	Bristle worm	C	Sa,Mu	
Glycera tenuis	Bristle worm	A	Sa	
Glycinde polygnatha	Bristle worm	A	Sa,Mu	
Glycinde sp.	Bristle worm			
Gyptis brevipalpa	Bristle worm	O	Sa,Mu	
Halosydna brevisetosa	Scale worm	O	Sa,Mu	
Halosydna latior	Scale worm	O	Sa	
Haploscoloplos elongatus	Orbinid worm	A	Sa,Mu	
Harmothoe imbricata	Scale worm	A	Ro	
Harmothoe lunulata	Scale worm	A	Sa,Mu	
Harmothoe priops	Scale worm	O	Sa	
Hemipodus borealis	Slaty blue worm	O	Sa,Mu	
Hemipodus imbricata	Slaty blue worm			
Hesperone adventor	Scale worm	O	Sym	In *Urechis* burrows
Heteromastus filobranchus	Capitellid worm	A	Mu	
Lumbrineris californiensis	Bristle worm	O	Mu	
Lumbrineris japonica	Bristle worm	O	Sa,Mu	
Lumbrineris tetraura	Bristle worm	A	Sa,Mu	
Lumbrineris zonata	Bristle worm	C	Mu	
Lysilla labiata	Polychaete worm	A	Sa,Mu	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Polychaeta *(continued)*				
Magelona pacifica	Bristle worm	O	Mu	
Magelona pitelkai	Bristle worm	O	Sa,Mu	
Magelona sacculata	Bristle worm	O	Sa	
Mediomastus californiensis	Lugworm	A	Sa,Mu	
Mellina oculata	Polychaete worm			
Mesochaetopterus taylori	Bristle worm	O	Sa	In eelgrass beds
Nainereis sp.	Bristle worm	R	Sa	
Neanthes sp.	Bristle worm	C	Sa,Ro	
Nephtys caecoides	Bristle worm	C	Sa,Mu	
Nephtys californiensis	Bristle worm	C	Sa	
Nephtys ferruginea	Bristle worm	R	Mu	
Nephtys parva	Bristle worm	C	Sa,Mu	
Nereis procera	Bristle worm	C	Sa,Mu	
Nereis sp.	Bristle worm	O	Sa	
Nothria sp.	Bristle worm	O	Sa	
Notomastus tenuis	Thin red worm	O	Mu	
Ophelia assimilis	Bristle worm	A	Sa,Mu	
Ophelia magna	Bristle worm		Sa,Mu	
Owenia collaris	Tube worm	A	Sa,Mu	
Paleonotus bellis	Bristle worm	C	Sa,Mu	
Paraonis gracilis	Bristle worm	R	Sa,Mu	
Phloe glabra	Polychaete worm	O	Sa,Mu	
Phloe tuberculata	Polychaete worm	A	Sa,Mu	
Pholoides aspera	Polychaete worm	O	Sa,Mu	
Phragmatopoma californica	Tube worm		Ro	
Pilargis maculata	Polychaete worm	R	Sa,Mu	
Pisione remota	Polychaete worm	R	Sa	
Pista cristata	Bristle worm	O	Sa	
Pista pacifica	Bristle worm	C	Sa,Mu	
Platynereis agassizi	Bristle worm			
Platynereis bicanaliculata	Tube worm	A	Sa,Mu,Ro	
Polydora brachycephala	Spionid worm	A	Sa,Mu	
Polydora ligni	Spionid worm			
Polydora pygidialis	Spionid worm	R	Sa	
Polydora socialis	Spionid worm	A	Sa,Mu	
Polydora websteri	Spionid worm		Sym	Bores in shell
Prionospio cirrifera	Spionid worm	R	Sa	
Protodorvillea gracilis	Bristle worm	O	Sa	
Pseudopolydora kempi	Spionid worm	O	Sa,Mu	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Polychaeta *(continued)*				
Sabellaria cementarium	Plume worm	C	Ro	Attached to shell debris
Sabellaria gracilis	Plume worm	C	Ro	Attached to shell debris
Scalibregma inflatum	Bristle worm	O	Sa,Mu	
Schistomeringos longicornis	Polychaete worm	A	Sa,Mu	
Scolelepis sp.	Spionid worm	R	Mu	
Scoloplos sp.	Bristle worm		Sa,Mu	
Serpula vermicularis	Plume worm	C	Ro	On shell debris
Sphaerosyllis californiensis	Syllid worm	A	Sa,Mu	
Spio filicornis	Spionid worm	O	Sa	
Spiophanes anoculata	Spionid worm			
Spiophanes berkeleyorum	Spionid worm	O	Sa,Mu	
Spiophanes bombyx	Spionid worm	A	Sa,Mu	
Sternapsis fossor	Bristle worm	R	Mu	
Sthenelais berkeleyi	Bristle worm	C	Sa,Mu	
Sthenelais tertiaglabrata	Bristle worm	R	Mu	
Streblosoma crassibranchia	Bristle worm	R	Mu	
Streblospio benedicti	Spionid worm	O	Mu	
Tenonia kitsapensis	Polychaete worm	O	Sa,Mu	
Tharyx monilaris	Bristle worm	A	Sa,Mu	
Tharyx multifilis	Bristle worm	A	Sa,Mu	
Trochochaeta franciscanum	Bristle worm	R	Mu	
Typosyllis fasciata	Syllid worm	C	Sa,Mu	
Typosyllis hyalina	Syllid worm	C	Sa,Mu	
Archiannelida				
Polygordius sp.		O	Sa	
Saccocirrus sp.		O	Sa	
Sipuncula				
Goldfingia hespera	Peanut worm	C	Mu	Among eelgrass rhizomes
Echiura				
Listriolobus pelodes	Spoon worm	R	Mu	In eelgrass beds
Urechis caupo	Fat innkeeper	C	Sa	
Phoronida				
Phoronopsis viridis	Green plume worm	A	Sa,Mu	
Phoronis pallida	Plume worm	R	Sym	In *Upogebia* burrows

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Crustacea				
Amphipoda				
Allorchestes angusta	Beach hopper	C	Sa	Intertidal on algae
Anisogammarus confervicolus	Gammarid	C	Mu	In intertidal marshes
Anisogammarus pugettensis	Gammarid	C	Mu	In marshes
Aoroides columbiae	Gammarid	C	Sa,Mu	In tubes
Atylus tridens	Gammarid	O	Sa,Mu	Nestles in algae and debris
Caprella angusta	Skeleton shrimp	C	Epi	
Caprella californica	Skeleton shrimp	C	Epi	
Caprella equilibra	Skeleton shrimp	C	Epi	
Caprella gracilior	Skeleton shrimp	C	Epi	
Caprella laeviuscula	Skeleton shrimp	C	Epi	
Corophium acherusicum	Gammarid	A	Epi	On pilings, algae
Corophium spinicorne	Gammarid	A	Mu	Estuarine
Corophium stimpsoni	Gammarid	A	Mu	Estuarine
Cymadusa sp.	Gammarid			Builds tubes on algae
Eohaustorius sp.	Gammarid	O	Sa	
Ischyrocerus anguipes	Gammarid	O	Sa	
Jassa falcata	Gammarid	C	Sa	
Megamphopus martesia	Gammarid		Epi	Builds tubes on algae
Melita dentata	Gammarid	C	Sa	
Metacaprella kennerlyi	Skeleton shrimp	C	Epi	
Orchestia traskiana	Beach hopper	C	Mu	Intertidal marshes
Orchestoidea benedicti	Beach hopper	C	Sa	Intertidal
Orchestoidea californiana	Beach hopper	C	Sa	Intertidal
Paraphoxus spp.	Gammarid	O	Sa	
Photis brevipes	Gammarid	C	Sa,Mu	
Podoceros cristatus	Gammarid	O	Sa	
Protomedia articulata	Gammarid	C	Sa,Mu	
Synchelidium rectipalmum	Gammarid	O	Sa,Mu	
Synchelidium shoemakeri	Gammarid	O	Sa,Mu	
Tritella pilimana	Skeleton shrimp	O	Epi	
Cirripedia				
Balanus crenatus	White barnacle	A	Ro,Pi	
Balanus glandula	Chalky white barnacle	A	Ro,Pi	
Balanus nubilus	Piling barnacle	O	Pi	
Chthamalus dalli	Gray barnacle	A	Ro,Pi	
Pollicipes polymerus	Goose barnacle	C	Ro,Pi	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Cirripedia (*continued*)				
Semibalanus cariosus	Thatched barnacle	C	Ro,Pi	
Copepoda				
Acartia clausi	Copepod	A	Pk	
Acartia logiremis	Copepod	A	Pk	
Acartia tonsa	Copepod	A	Pk	Estuarine
Calanus finmarchicus	Copepod	C	Pk	
Clausidium vancouverense	Copepod		Sym	On *Callianassa*
Corycaeus affinis	Copepod		Pk	
Eucalanus bungii	Copepod		Pk	
Eurytemora affinis	Copepod		Pk	Estuarine
Mytilicola orientalis	Copepod	O	Sym	In gut of *Mytilus edulis*
Oithona similus	Copepod		Pk	
Oithona spinirostris	Copepod		Pk	
Paracalanus parva	Copepod		Pk	
Pseudocalanus minutus	Copepod		Pk	
Tortanus discaudatis	Copepod		Pk	
Cumacea				
Cumacea sp.	Cumacean			
Cumella vulgaris	Cumacean	O	Mu	
Diastylis sp.	Cumacean	C	Sa,Mu	
Diastylopsis dawsoni	Cumacean	C	Sa	
Eudorella pacifica	Cumacean	C	Mu	
Lamprops sp.	Cumacean	C	Sa,Mu	
Decapoda				
Callianassa californiensis	Ghost shrimp	O	Mu	
Callianassa gigas	Ghost shrimp	O	Sa,Mu	
Cancer antennarius	Rock crab	C	Sa,Mu	
Cancer anthonyi	Yellow crab	O	Ro	
Cancer gracilis	Slender crab	O	Sa	
Cancer magister	Dungeness crab	C	Sa	
Cancer productus	Red crab	C	Sa,Mu	
Crangon franciscorum	Bay shrimp	C	Sa,Mu	
Crangon nigricauda	Black-tailed shrimp	C	Sa	
Crangon nigromaculata	Black-tailed shrimp	C	Sa,Mu	
Crangon stylirostris	Bay shrimp	O	Sa	
Emerita analoga	Sand crab	O	Sa	Intertidal, beaches
Hemigrapsus nudus	Purple shore crab	C	Sa	Intertidal

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Decapoda *(continued)*				
Hemigrapsus oregonensis	Green shore crab	C	Sa,Mu	Intertidal
Heptacarpus brevirostris	Grass shrimp	O	Sa	
Hippolyte californiensis	Grass shrimp	C		On eelgrass blades
Lophopanopeus bellus	Pebble crab	R	Ro	Near bay mouth
Pachycheles rudis	Porcelain crab	C	Ro	
Pachygrapsus crassipes	Lined shore crab	C	Ro	
Pagurus spp.	Hermit crabs	C	Ro	Intertidal
Pandalus danae	Coon stripe shrimp	O	Sa	
Petrolisthes cinctipes	Porcelain crab	C	Ro	Intertidal
Pinnixia franciscana	Pea crab	O	Sym	In burrows of *Urechis*
Pugettia producta	Kelp crab	C	Ro,Pi	Among large algae
Upogebia pugettensis	Blue mud shrimp	O	Mu	
Isopoda				
Alloniscus perconvexus	Isopod	C	Sa	Intertidal beaches
Armadilloniscus coronacapitalis	Isopod	O	Mu	Intertidal marshes
Cirolana harfordi	Isopod	C	Ro,Pi	Intertidal
Gnorimosphaeroma oregonensis	Isopod	C	Mu	Intertidal marshes
Idotea stenops	Isopod			
Idotea wosnesenskii	Isopod	C	Epi	On eelgrass, algae
Limnoria quadripunctata	Isopod	C	Pi	Bores into wood
Limnoria tripunctata	Isopod	C	Pi	Bores into wood
Littorophiloscia richardsonae	Isopod	O	Mu	Intertidal marshes
Munna sp.	Isopod	O	Sa	
Porcellio sp.	Isopod	C	Mu	Intertidal marshes
Synidotea sp.	Isopod	O	Sa	
Mysidacea				
Archaeomysis grebnitzkii	Mysid	O	Sa	
Tanaidacea				
Leptochelia dubia	Cheliferan	C	Sa,Mu	
Tanais sp.	Cheliferan	O	Sa	
Pycnogonida				
Achelia chelata	Sea spider	O	Sa,Ro	
Achelia nudiuscula	Sea spider	O	Sa	
Halosoma viridintestinale	Green sea spider		Epi	On eelgrass and hydroids

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Mollusca				
Bivalvia				
Adula diegensis	Mytilid	A	Sa,Mu	Bores in shale, mudstone
Axinopsida serricata		O	Mu	
Bankia setacea	Pacific shipworm	C	Pi	Bores into pilings, wood
Clinocardium nuttallii	Basket cockle	C	Sa,Mu	
Crassostrea gigas	Giant Pacific oyster	A	Sa,Mu	Introduced, harvested
Gemma gemma	Gem clam	A	Mu	
Hinnites giganteus	Rock scallop	C	Ro,Pi	
Lyonsia californica	California lyonsia	A	Mu	
Macoma balthica	Baltic macoma	O	Mu	Estuarine, possibly introduced
Macoma identata	Identate macoma	O	Mu	
Macoma inquinata	Inquinate macoma	C	Sa,Mu	
Macoma nasuta	Bent-nose clam	A	Sa,Mu	
Mercenaria mercenaria	Quahog clam	R	Mu	Introduced
Mya arenaria	Soft-shell clam	A	Mu	Introduced
Mysella tumida	Clam	A	Sa,Mu	
Mytilus edulis	Bay mussel	A	Ro,Pi	
Mytilus californianus	California mussel	C	Ro,Pi	
Ostrea lurida	Native oyster	C	Ro,Pi	
Ostrea edulis	European oyster	O	Ro,Pi	Introduced, cultured
Panopea generosa	Geoduck	O	Mu	Very deep burrowing
Penitella penita	Common piddock	O	Ro	Bores in mudstone
Petricola carditoides	Petricolid clam	R	Mu	
Pododesmus cepio	Rock oyster	O	Ro	
Protothaca staminea	Pacific littleneck	A	Sa,Mu	
Protothaca tenerrima	Thin-shelled littleneck	O	Sa,Mu	
Saxidomus giganteus	Smooth Washington clam	C	Sa,Mu	
Saxidomus nuttalli	Common Washington clam	C	Sa,Mu	
Siliqua patula	Razor clam	O	Sa	Near bay mouth
Solen sicarius	Sickle razor clam	O	Sa,Mu	
Tagelus californianus	Jackknife clam	R	Sa,Mu	
Tapes japonica	Manila clam	R,C	Mu	Introduced, cultured
Tellina bodegensis	Bodega tellin	O	Sa	
Tellina modesta	Modesta tellin	C	Sa,Mu	
Tellina nuculoides	Tellin clam	C	Sa,Mu	
Transennella tantilla	Little transennella	A	Sa,Mu	
Tresus capax	Gaper clam	A	Sa,Mu	
Tresus nuttallii	Gaper clam	O	Sa,Mu	

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Bivalvia *(continued)*				
Zirfaea pilsbryi	Rough piddock	O	Ro,Mu	Bores in rock, mudstone
Gastropoda				
Acmaea mitra	Dunce cap limpet	O	Ro	Near bay mouth
Aglaja diomedea	Sea slug	A	Sa,Mu	
Alvinia compacta	Snail	C	Sa,Mu	
Anisodoris nobilis	Sea lemon nudibranch	O	Ro	Near bay mouth
Assiminea californica	Translucent assiminea	A	Mu	In *Salicornia* marshes
Calliostoma canaliculatum	Top shell	O	Ro	Near bay mouth
Collisella asmi	Limpet	O	Sym	On *Tegula funebralis*
Collisella digitalis	Common limpet	O	Ro	Near bay mouth
Collisella pelta	Sheild limpet	C	Ro	Near bay mouth
Collisella scabra	Rough limpet	C	Ro	Intertidal near bay mouth
Cyclostremella sp.	Snail	R	Sa	
Cylichna alba	Snail	O	Sa	
Dendronotus giganteus	Giant nudibranch	O	Ro	
Diaulula sandiegensis	Nudibranch	O	Ro	
Diodora aspera	Rough keyhole limpet	O	Ro	
Dirona albolineata	Nudibranch	O	Ro	
Epitonium sawinae	Snail	O	Sa	
Fartulum occidentale	Snail	R	Sa	
Haminoea vesicula	Snail	R	Sa	
Hermissenda crassicornis	Nudibranch	A	Ro,Sa	
Lacuna sp.	Snail	C	Sa,Mu,Ro	
Littorina newcombiana	Newcomb's littorine	R	Mu	In salt marshes
Littorina planaxis	Periwinkle	C	Ro	Near bay mouth, intertidal
Littorina scutulata	Periwinkle	C	Ro	Near bay mouth, intertidal
Mitrella gouldii	Snail	C	Sa,Mu	
Nassarius fossatus	Channeled dog whelk	A	Sa,Mu	
Nassarius mendicus	Lean dog whelk	C	Sa,Mu	
Nucella emarginata	Dog winkle	O	Ro	Near bay mouth
Nucella lamellosa	Dog winkle	O	Ro	Near bay mouth
Odostomia sp.	Snail	A	Sa,Mu	
Olivella biplicata	Purple olive shell	C	Sa	Near bay mouth
Olivella pycna	Olive shell	C	Sa	Near bay mouth
Ovatella myosotis	Mud snail	A	Mu	In salt marshes
Phyllaplysia taylori	Tectibranch	A	Epi	On eelgrass
Polinices lewisii	Moon snail	C	Sa,Mu	
Rictaxis punctocaelatus	Barrel shell	R	Sa,Mu	Sporadic recruitment
Searlesia dira	Snail	O	Ro	Near bay mouth

Species	Common name	Abundance[a]	Habitat[b]	Remarks
Gastropoda *(continued)*				
Tegula brunnea	Brown tegula	O	Ro	Near bay mouth
Tegula funebralis	Black tegula	O	Ro	Near bay mouth
Turbonilla sp.	Snail	R	Sa	
Octopoda				
Octopus dolfleini	Octopus	O	Ro	Near bay mouth
Polyplacophora				
Ischnochiton regularis	Blue chiton	R	Ro	Near bay mouth
Katharina tunicata	Black chiton	O	Ro	Near bay mouth
Mopalia ciliata	Notched chiton	C	Ro,Pi	
Mopalia lignosa	Hairy chiton	C	Ro,Pi	
Echinodermata				
Amphiodia occidentalis	Brittle star	C	Sa,Mu	
Amphipholis sp.	Brittle star	O	Sa	
Dendraster excentricus	Sand dollar	C	Sa	Near bay mouth
Eupentacta quinquesemita	White sea cucumber	C	Ro,Pi	
Leptasterias pusilla	Six-rayed sea star	C	Ro	
Leptosynapta albicans	Sea cucumber	O	Sa	
Pisaster brevispinus	Short spined sea star	C	Sa	
Pisaster ochraceous	Common sea star	C	Ro	Near bay mouth
Pycnopodia helianthoides	Sun star	O	Ro	Near bay mouth
Strongylocentrotus purpuratus	Purple urchin	O	Ro	Near bay mouth
Bryozoa				
Bowerbankia gracilis	Bryozoan	C	Ro, Epi, Pi	
Bugula pacifica	Bryozoan	C	Ro	
Crisia occidentalis	Bryozoan	C	Ro,Epi	
Membranipora membranacea	Bryozoan	C	Epi	On eelgrass blades
Schizoporella unicornis	Bryozoan	C	Pi,Epi	
Tricellaria occidentalis	Bryozoan	C	Ro,Epi,Pi	

[a] A = abundant, C = common, O = occasional, R = rare.
[b] Epi = epifaunal or epiphytic, Mu = mud, Pi = pilings or other artificial structures, Pk = planktonic, Ro = rocks, Sa = sand, Sym = symbiotic.

Appendix C. Fishes of Humboldt Bay

Data on relative abundance, life history, habitat use, and season of occurrence are adapted from reports and records compiled by Gotshall et al. (1980) and Shapiro and Associates, Inc. (1980). Nomenclature follows usage of the American Fisheries Society (Robins et al. 1980), as updated.

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Petromyzontidae									
Lampetra tridentata	Pacific lamprey	C			X	X	TCSFW, CR	SP, S	Spawns in bay tributaries
Family Hexanchidae									
Notorynchus maculatus	Sevengill shark	C				X	DTS, STS	SP, S, F	Current small commercial and recreational fishery
Family Carcharhinidae									
Galeorhinus zyopterus	Soupfin shark	R							One record, caught by angling
Mustelus henlei	Brown smoothhound	C			X	X	STS, MF	All	
Triakis semifasciata	Leopard shark	C			X	X	DTS, STS, MF	All	Current small commercial and recreational fishery
Family Squalidae									
Squalus acanthias	Spiny dogfish	O			X	X	STS, MF	S	
Family Rajidae									
Raja binoculata	Big skate	O			X	X	STS, MF	SP, S	Sometimes taken from TCSSW piers by anglers
Family Dasyatidae									
Urolophus halleri	Round stingray	R				X	DTS, MF	SP, S	One record
Family Myliobatidae									
Myliobatis californica	Bat ray	C			X	X	DTS, STS, MF	SP, S, F	Sometimes taken from piers by anglers; preys on commercial oysters in bay

Taxa	Common name	Abundance[a]	Life history type[b]				Habitat[c]	Season of occurrence[d]	Remarks
			E	L	J	A			
Family Chimaeridae									
Hydrolagus colliei	Spotted ratfish	R					DTS		One record, dipnetted
Family Acipenseridae									
Acipenser medirostris	Green sturgeon	O			X	X	DTS, STS, MF	S, F, W	
Family Ophichthidae									
Ophichthus zophochir	Yellow snake eel	O			X	X	DTS, STS	W	One record
Family Clupeidae									
Alosa sapidissima	American shad	O			X	X	STS, MF, CR	SP, S	Not known to spawn in bay tributaries
Clupea harengus pallasi	Pacific herring	A	X	X	X	X	DTS, STS, MF, P	All	Spawn on eel grass in winter; larvae and juveniles in bay to fall; small commercial fishery on adults
Dorosoma petenense	Threadfin shad	O				X	STS	S	Only three recorded from the bay
Family Engraulidae									
Engraulis mordax	Northern anchovy	A	X	X	X	X	DTS, STS, P, J	All	Throughout the bay in scattered schools in summer and fall; fewest in winter; eggs and larvae in spring; important forage fish
Family Salmonidae									
Oncorhynchus clarki	Cutthroat trout	O			X	X	TCSSW, CR, TCSFW	All	Remnant populations in bay tributary streams; numbers severely depressed

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Salmonidae (*continued*)									
Oncorhynchus kisutch	Coho salmon	C			X	X	DTS, STS, TCSFW, CR	All	Adults migrate through bay to spawning tributaries; juveniles use bay as nursery habitat; summer adults move in with tides to feed; anglers take from jetties
Oncorhynchus mykiss	Rainbow trout	C			X	X	TCSSW, CR, TCSFW	All	Adult migrate through bay to spawning tributaries; juveniles may use bay as nursery habitat for short time; abundant in tributaries
Oncorhynchus tshawytscha	Chinook salmon	C			X	X	DTS, STS, TCSFW, CR, J	All	Same as coho salmon
Family Osmeridae									
Allosmerus elongatus	Whitebait smelt	O			X	X	STS, DTS	F, W, S	Spawning habits unknown
Hypomesus pretiosus	Surf smelt	C		X	X	X	STS, DTS	All	Spawns in marine waters on exposed sandy beaches
Spirinchus starksi	Night smelt	C		X	X	X	STS, DTS	All	Same as surf smelt
Spirinchus thaleichthys	Longfin smelt	A	X	X	X	X	STS, DTS, CR	All	Probably spawns in freshwater tributaries on Humboldt Bay
Thaleichthys pacificus	Eulachon	O				X	STS, DTS	W	Ascends freshwater streams to spawn but not reported in Humboldt Bay tributaries
Family Gonostomatidae									
Cyclothone acclinidens	Benttooth bristlemouth	R		X			DTS	W	Mesopelagic species
Family Myctophidae									
Stenobrachius leucopsarus	Northern lampfish	O		X			DTS	W, SP	Oceanic species, probably carried into Humboldt Bay during very high tides
Tarletonbeania crenularis	Blue lanternfish	O		X			DTS		Same as northern lampfish

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Gadidae									
Microgadus proximus	Pacific tomcod	A			X	X	DTS, STS, MF	All	Use the bay as a nursery area
Family Ophidiidae									
Chilara taylori	Spotted cusk-eel	O			X	X	DTS	W, S	
Family Atherinidae									
Atherinops affinis	Topsmelt	C			X	X	DTS, STS, MF	All	Spawns over mudflats, though eggs and larvae have not been collected in Humboldt Bay
Atherinopsis californiensis	Jacksmelt	C	X	X	X	X	STS, TCSW, MF P, J	All	Spawns over vegetation in shallow tidal channels and mudflats; adults commonly taken by pier and jetty anglers
Family Trachipteridae									
Trachipterus altivelis	King-of-the-salmon	R					DTS		One record
Family Gasterosteidae									
Aulorhynchus flavidus	Tube-snout	C			X	X	DTS, STS	All	
Gasterosteus aculeatus	Threespine stickleback			X	X	X	STS, TCSW, TCFW, CR	All	
Family Syngnathidae									
Syngnathus leptorhynchus	Bay pipefish	C	X	X	X	X	STS, MF, TCSW	All	
Family Percichthyidae									
Morone saxatilis	Striped bass	R							One record, angler caught
Stereolepis gigas	Giant sea bass	R							One record, angler caught
Family Sciaenidae									
Atractoscion nobilis	White seabass	O		X			DTS, STS	W	
Genyonemus lineatus	White croaker	O				X	DTS, J	S, F	

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Embiotocidae									
Amphistichus koelzi	Calico surfperch	O			X	X	DTS, J	W, SP, S	
Amphistichus rhodoterus	Redtail surfperch	C			X	X	DTS, STS, P	All	Popular recreational fish in Humboldt Bay
Cymatogaster aggregata	Shiner perch	A			X	X	DTS, STS, TCSW, P, J	All	One of most abundant species in Humboldt Bay
Embiotoca lateralis	Striped seaperch	C			X	X	DTS, STS, P, J	All	Recreational species
Hyperprosopon anale	Spotfin surfperch	R				X	J		One record
Hyperprosopon argenteum	Walleye surfperch	A			X	X	DTS, STS, P, J	All	Recreational species
Hyperprosopon ellipticum	Silver surfperch	C			X	X	STS, DTS, TCSW, P, J	All	Recreational species
Phanerodon furcatus	White seaperch	A			X	X	DTS, STS, P, J	All	Recreational species
Rhacochilus vacca	Pile perch	C			X	X	DTS, STS, P, J	All	Recreational species
Family Trichodontidae									
Trichodon trichodon	Pacific sandfish	O			X	X	DTS, STS		One record
Family Stichaeidae									
Anoplarchus purpurescens	High cockscomb	O			X	X	DTS, STS	Sp	
Cebidichthys violaceus	Monkeyface prickleback	R				X	J, DTS		
Chirolophis decoratus	Decorated warbonnet	R					J		One record
Lumpenus sagitta	Snake prickleback	O			X	X	DTS, STS	Sp, S	
Family Pholidae									
Apodichthys flavidus	Penpoint gunnel	C			X	X	DTS, STS, MF	All	
Pholis ornata	Saddleback gunnel	C			X	X	DTS, STS, MF, J	All	
Family Anarhichadidae									
Anarrhichthys ocellatus	Wolf-eel	R			X	X	J, DTS		All
Family Cryptacanthodidae									
Delolepis gigantea	Giant wrymouth	O			X	X	DTS, STS	W	One record

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Ammodytidae									
Ammodytes hexapterus	Pacific sand lance	C		X	X	X	DTS, STS	All	Important food item for salmon at times
Family Gobiidae									
Clevelandia ios	Arrow goby	C		X	X	X	MF, TCSW, STS, DTS	All	Strongly euryhaline
Coryphopterus nicholsi	Blackeye goby	O			X	X	STS, DTS	All	
Eucyclogobius newberryi	Tidewater goby	O			X	X	STS, DTS	All	
Lepidogobius lepidus	Bay goby	A	X	X	X	X	MF, TCFW, TCSW, STS	All	One of most abundant species in Humboldt Bay; strongly euryhaline
Family Luvaridae									
Luvarus imperialis	Louvar	O				X	DTS		One record
Family Stromateidae									
Icichthys lockingtoni	Medusafish	O			X	X	DTS, STS	F	One record
Peprilus simillimus	Pacific pompano	O			X	X	DTS, STS		
Family Scorpaenidae									
Sebastes auriculatus	Brown rockfish	C		X	X	X	DTS, STS	All	
Sebastes caurinus	Copper rockfish	C		X	X	X	DTS, STS, J, P	All	
Sebastes flavidus	Yellowtail rockfish	O			X		DTS, STS		One record
Sebastes melanops	Black rockfish	C		X	X	X	DTS, STS, P, J	All	Common recreational species off jetties
Sebastes miniatus	Vermilion rockfish	O			X		DTS, STS		One record
Sebastes mystinus	Blue rockfish	O			X	X	DTS, STS, J	S, F, W	
Sebastes paucispinis	Bocaccio	O			X	X	DTS, STS	S, F, W	
Sebastes rastrelliger	Grass rockfish	C		X	X	X	DTS, STS, P, J	All	
Family Hexagrammidae									
Hexagrammos decagrammus	Kelp greenling	C	X	X	X	X	DTS, STS MF, J, P	All	Common recreational species off jetties
Hexagrammos lagocephalus	Rock greenling	O	X	X	X	X	DTS, STS	All	

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Hexagrammidae (*continued*)									
Ophiodon elongatus	Lingcod	C	X	X	X	X	DTS, STS, J, MF	All	Popular recreational species because of large size
Oxylebius pictus	Painted greenling	C	X	X	X	X	DTS, J		All
Family Cottidae									
Artedius fenestralis	Padded sculpin	C		X	X	X	DTS, STS, P, J	All	
Artedius harringtoni	Scalyhead sculpin	O				X	DTS, STS	Sp	
Artedius notospilotus	Bonehead sculpin	R				X	DTS		One record
Ascelichthys rhodorus	Rosylip sculpin	O		X	X	X	DTS, STS, J	All	
Blepsias cirrhosus	Silverspotted sculpin	R				X	DTS		One record
Clinocottus acuticeps	Sharpnose sculpin	R							One record
Cottus aleuticus	Coastrange sculpin	R				X	CR		One record, freshwater sculpin
Cottus asper	Prickly sculpin	O				X	CR		Freshwater sculpin occasionally carried into bay by tributary floods
Enophrys bison	Buffalo sculpin	C	X	X	X	X	DTS, STS, P, J	All	
Hemilepidotus hemilepidotus	Red Irish lord	C	X	X	X	X	DTS, STS, J	All	
Hemilepidotus spinosus	Brown Irish lord	C	X	X	X	X	DTS, STS, J	All	
Leptocottus armatus	Pacific staghorn sculpin	A	X	X	X	X	DTS, STS, TCSW, TCFW, P, J	All	Strongly euryhaline
Nautichthys oculofasciatus	Sailfin sculpin	O			X	X	TS, STS, J	All	
Oligocottus snyderi	Fluffy sculpin	R			X				Two specimens, taken in bayside pool
Scorpaenichthys marmoratus	Cabezon	C	X	X	X	X	DTS, STS, P, J	All	Important bay sportfish, particularly off jetties
Family Agonidae									
Odontopyxis trispinosa	Pygmy poacher	O		X	X		DTS, STS	W	
Pallasina barbata	Tubenose poacher	R				X	DTS	W	
Stellerina xyosterna	Pricklebreast poacher	O		X	X	X	DTS, STS	S, F, W	

Taxa	Common name	Abundance[a]	Life history type[b] E	L	J	A	Habitat[c]	Season of occurrence[d]	Remarks
Family Cyclopteridae									
Liparis fucensis	Slipskin snailfish	O	X	X	X	X	DTS, STS MF	All	
Liparis pulchellus	Showy snailfish	R				X	DTS, STS, MF	All	
Liparis rutteri	Ringtail snailfish	R				X	J		One record
Family Bothidae									
Citharichthys sordidus	Pacific sanddab	O			X	X	DTS, STS, MF	All	
Citharichthys stigmaeus	Speckled sanddab	A	X	X	X	X	MF, STS, DTS, J	All	
Paralichthys californicus	California halibut	R			X	X	DTS, STS	S, F	
Family Pleuronectidae									
Isopsetta isolepis	Butter sole	O			X	X	DTS, STS	W, S	
Microstomus pacificus	Dover sole	O			X	X	DTS, STS		Important commercial species outside the bay
Parophrys vetulus	English sole	A		X	X	X	DTS, STS, MF	All	Juveniles very abundant in bay; important commercially outside bay
Platichthys stellatus	Starry flounder	C	X	X	X	X	DTS, STS, MF, TCSW, TCFW	All	
Pleuronichthys coenosus	C-O sole	O			X		DTS, STS	W	
Pleuronichthys decurrens	Curlfin sole	O			X	X	DTS, STS	All	
Psettichthys melanostictus	Sand sole	O			X	X	DTS, STS, J	All	
Family Cynoglossidae									
Symphurus atricauda	California tonguefish	O			X	X	DTS, STS	F, W	
Family Molidae									
Mola mola	Ocean sunfish	O			X				One record

[a] Abundance: A = abundant, C = common, O = occasional, R = rare.

[b] Life history type: E = egg, L = larva, J= juvenile, A = adult.

[c] Habitat: DTS = deep tidal channel; STS = shallow tidal channels; MF = mudflats; TCSSW = tidal creeks and sloughs, salt water; TCSFW = tidal creeks and sloughs, fresh water; CR = creeks and rivers; P = piers; J = jetties.

[d] Season of occurrence: SP = spring, S = summer, F = fall, W = winter.

Appendix D. Birds of Humboldt Bay Environs

Appendix data are from reports and records compiled by Shapiro and Associates, Inc. (1980) and S.W. Harris (Department of Wildlife, Humboldt State University, Arcata, California, unpublished data). Nomenclature follows usage adopted by the U.S. Fish and Wildlife Service (Banks et al. 1987).

		Status[a]				Habitat use[b]												
Taxa	Common name	Sp	S	F	W	Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Gaviidae																		
Gavia stellata	Red-throated loon	C	Ca	C	C	P	P	S				S					S	
Gavia pacifica	Pacific loon	C	R	C	R	P	P	S				S					S	
Gavia immer	Common loon	C	U	C	C	P	P	S				S					S	
Gavia adamsii	Yellow-billed loon	—	—	Ca	Ca	P	P	S				S						
Family Podicipedidae																		
Podilymbus podiceps	Pied-billed grebe	U	U	U	U			S				S					P	
Podiceps auritus	Horned grebe	C	Ca	C	C	S	P	P				P					S	
Podiceps grisegena	Red-necked grebe	U	Ca	U	U	P	S											
Podiceps nigricollis	Eared grebe	C	—	C	C		S	S				S					P	
Aechmophorus occidentalis	Western grebe	C	U	C	C	P	P	S				S					S	
Aechmophorus clarkii	Clark's grebe	Ca	—	Ca	Ca	P	P	S				S					S	
Family Procellariidae																		
Fulmarus glacialis	Northern fulmar	—	—	Ac	Ac	S						S						
Family Hydrobatidae																		
Oceanodroma furcata	Fork-tailed storm-petrel	—	Ac	Ac	—	S	S											
Oceanodroma leucorhoa	Leach's storm-petrel	Ac	—	—	—		S											
Family Pelecanidae																		
Pelecanus erythrorhynchos	American white pelican	Ca	—	Ca	Ca						S	S						
Pelecanus occidentalis	Brown pelican	R	C	C	R	P	P	S				S			P		S	S
Family Phalacrocoracidae																		
Phalacrocorax auritus	Double-crested cormorant	C	C	C	C	S	P	P			S	S			S		S	P
Phalacrocorax penicillatus	Brandt's cormorant	C	C	C	R	P	P	S									S	S
Phalacrocorax pelagicus	Pelagic cormorant	C	C	C	C	P	P											P

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Enc	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Fregatidae																		
Fregata magnificens	Magnificent frigatebird	—	Ca	Ca	—	S	S											
Family Ardeidae																		
Botaurus lentiginosus	American bittern	R	R	R	R												P	
Ardea herodias	Great blue heron	C	C	C	C		S	P	P	S	S	P	S		S	P	P	S
Casmerodius albus	Great egret	C	C	C	C			P	P	S	P	P	S		S	P	P	S
Egretta thula	Snowy egret	C	C	C	C			P	P	S	P	S	S		S	P	P	S
Bubulcus ibis	Cattle egret	C	Ca	C	C										S	S	S	S
Butorides striatus	Green-backed heron	U	U	U	R											S	S	S
Nycticorax nycticorax	Black-crowned night-heron	C	C	C	C			S	S	S	S	S	S		S	P	P	S
Family Threskiornithidae																		
Plegadis chihi	White-faced ibis	—	—	Ac	Ac						S						S	
Family Anatidae																		
Cygnus columbianus	Tundra swan	R	—	R	R							S					S	
Anser albifrons frontalis	Greater white-fronted goose	—	—	R	R						S							
Chen c. caerulescens	Lesser snow goose	—	—	R	R							S						
Chen rossii	Ross' goose	—	—	R	R							S					S	
Chen canagica	Emperor goose	Ac	—	Ac	Ac				S			S						
Branta bernicla nigricans	Black brant	C	Ca	U	R	S	S	S	P	P	S	P		S	S			
Branta canadensis	Canada goose	Ca	—	Ca	Ca							S					S	
Aix sponsa	Wood duck	R	—	R	R							S					S	
Anas crecca carolinensis	Green-winged teal	C	Ca	C	C				S	S	P	S	S	S	S		P	
Anas platyrhynchos	Mallard	C	U	C	C	S	S	S	S	S	S	S	S		S		P	
Anas acuta	Northern pintail	C	R	C	C	S	S	S	S	S	P	P	S		S		S	
Anas discors	Blue-winged teal	R	R	Ca	Ca												P	
Anas cyanoptera	Cinnamon teal	C	C	C	R							S			S		P	
Anas clypeata	Northern shoveler	C	Ca	C	C				S		S	S	S		S		P	
Anas strepera	Gadwall	R	Ca	R	R							S					S	
Anas penelope	Eurasian wigeon	R	—	R	R			S	P		S	P	S		S		S	
Anas americana	American wigeon	C	Ca	C	C			S	P		S	P	S		S		S	

		Status[a]				Habitat use[b]												
Taxa	Common name	Sp	S	F	W	Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Anatidae (*continued*)																		
Aythya valisineria	Canvasback	U	Ca	U	U			S	S		S	P					P	
Aythya americana	Redhead	U	Ca	U	U	P	S	S	P			P					S	
Aythya collaris	Ring-necked duck	U	Ca	U	U			S	S			S					P	
Aythya fuligula	Tufted duck	Ca	Ca	Ca	Ca			S	S			S					P	
Aythya marila	Greater scaup	C	R	C	C	P	S	P	S	S	S	P	S		S		S	
Aythya affinis	Lesser scaup	U	R	U	U	S	S	S	S	S	S	P	S		S		P	
Somateria spectabilis	King eider	—	—	Ac	Ac		S											
Polysticta stelleri	Steller's eider	—	—	Ac	—		S											
Histrionicus histrionicus	Harlequin duck	Ca	Ca	Ca	Ca	S	S											S
Clangula hyemalis	Oldsquaw	R	Ca	R	R	P	P	S				S					S	
Melanitta nigra	Black scoter	R	Ca	R	R	P	S											
Melanitta perspicillata	Surf scoter	C	U	C	C	P	P	S				S					S	
Melanitta fusca	White-winged scoter	C	U	C	C	P	P	S				S					S	
Bucephala clangula	Common goldeneye	R	—	R	R	S	P	S				S					S	
Bucephala islandica	Barrow's goldeneye	—	—	Ca	Ca												S	
Bucephala albeola	Bufflehead	C	Ca	C	C	S	S	P				P					P	
Lophodytes cucullatus	Hooded merganser	Ca	Ca	Ca	Ca												S	
Mergus merganser	Common merganser	Ca	—	Ca	Ca		S										S	
Mergus serrator	Red-breasted merganser	C	Ca	C	C	P	P	S				P					S	
Oxyura jamaicensis	Ruddy duck	C	R	C	C	S	S	P				P					P	
Family Cathartidae																		
Cathartes aura	Turkey vulture	C	C	C	R								S	S	S	S	S	
Family Accipitridae																		
Pandion haliaetus	Osprey	C	C	C	Ca	S	P	P				P					P	S
Elanus caeruleus	Black-shouldered kite	U	U	U	U								S		S	S	S	
Circus cyaneus	Northern harrier	U	U	U	U								S		S	S	S	
Accipiter striatus	Sharp-skinned hawk	U	R	U	U											S	S	
Accipiter cooperii	Cooper's hawk	R	R	R	R											S	S	
Buteo lineatus	Red-shouldered hawk	U	R	U	U											S	S	
Buteo jamaicensis	Red-tailed hawk	C	U	C	C								S		S	S	S	
Buteo lagopus	Rough-legged hawk	U	—	U	U								S		S	S	S	

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Falconidae																		
Falco sparverius	American kestrel	C	U	C	C										S	S	S	
Falco columbarius	Merlin	U	–	U	U				S	S	P				P	S	P	
Falco peregrinus	Peregrine falcon	U	R	U	U				S	S	P				P		P	
Falco mexicanus	Prairie falcon	Ca	–	Ca	Ca					S	S				S		S	
Family Phasianidae																		
Callipepla californica	California quail	R	R	R	R											S		
Family Rallidae																		
Rallus limicola	Virginia rail	C	U	C	C							P					P	
Porzana carolina	Sora	U	R	U	U							P					P	
Fulica americana	American coot	C	U	C	C			S	P	S	S	P	S	S	S		P	
Family Charadriidae																		
Pluvialis squatarola	Black-bellied plover	C	R	C	C				S	S	P		S	S	P		S	P
Pluvialis dominica	Lesser golden-plover	Ca	–	Ca	Ca					S	S				S			
Charadrius alexandrinus	Snowy plover	R	R	R	Ca					S				S				
Charadrius semipalmatus	Semipalmated plover	U	Ca	U	U					P	S			S	S		S	
Charadrius vociferus	Killdeer	C	C	C	C								S	S	S		S	
Family Haematopodidae																		
Haematopus bachmani	Black oystercatcher	Ca	Ca	Ca	Ca													P
Family Recurvirostridae																		
Himantopus mexicanus	Black-necked stilt	R	R	R	R												P	
Recurvirostra americana	American avocet	Ca	Ca	C	C					S	P	P	S		P		S	
Family Scolopacidae																		
Tringa melanoleuca	Greater yellowlegs	C	R	C	C				S		S	S	S		S		P	
Tringa flavipes	Lesser yellowlegs	R	Ca	C	R						S						P	
Tringa solitaria	Marsh sandpiper	Ca	Ca	Ca	—												S	
Catoptrophorus semipalmatus	Willet	C	Ca	C	C				S	S	P	S	S	S	P		S	S

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smel	Eelg	Sand	Mudf	Open	Salt	Wrec	Dike	Shrub	Pond	Jett
Family Scolopacidae (*continued*)																		
Heteroscelus incanus	Wandering tattler	U	R	U	U												P	
Actitis macularia	Spotted sandpiper	U	U	U	R					S				S	S		S	S
Numenius phaeopus	Whimbrel	C	U	U	R				S	S	S		S	S	S		S	S
Numenius americanus	Long-billed curlew	U	R	U	U				S	S	P		S	S	S		S	S
Limosa haemastica	Hudsonian godwit	Ac	Ac	Ac	—						S						S	
Limosa lapponica	Bar-tailed godwit	—	Ac	Ac	—						S				S			
Limosa fedoa	Marbled godwit	A	U	A	A				P	S	P	P	S	S	P		S	S
Arenaria interpres	Ruddy turnstone	U	R	U	R					P	S		S	S	S		S	S
Arenaria melanocephala	Black turnstone	C	R	C	C				S	S	S		S	S	S		S	P
Aphriza virgata	Surfbird	U	R	U	U													P
Calidris canutus	Red knot	U	Ca	U	Ca				S	S	P		S	S	P			
Calidris alba	Sanderling	U	Ca	C	C					P					S			S
Calidris pusilla	Semipalmated sandpiper	Ca	Ca	Ca	—									S			S	
Calidris mauri	Western sandpiper	A	U	A	C				S	S	P		S	S	P		S	S
Calidris ruficollis	Red-necked stint	Ac	Ac	—	—						S						S	
Calidris minutilla	Least sandpiper	C	U	C	C				S	S	P		S	P	P		P	S
Calidris bairdii	Baird's sandpiper	Ca	Ca	U	—						S				S		P	
Calidris melanotos	Pectoral sandpiper	Ca	Ca	C	—												P	
Calidris acuminata	Sharp-tailed sandpiper	—	—	Ca	—												P	
Calidris ptilocnemis	Rock sandpiper	R	—	R	R													P
Calidris alpina	Dunlin	A	Ca	A	C				S	S	P		S	S	P		P	S
Calidris himantopus	Stilt sandpiper	—	R	R	—						S						S	
Philomachus pugnax	Ruff	—	Ac	R	—												P	
Limnodromus griseus	Short-billed dowitcher	A	C	A	R			S	S	S	P		S	S	P		S	
Limnodromus scolopaceus	Long-billed dowitcher	C	—	C	U				S		S		S		S		P	
Gallinago gallinago	Common snipe	C	Ca	C	C								S				P	
Phalaropus tricolor	Wilson's phalarope	R	R	R	—												P	
Phalaropus lobatus	Red-necked phalarope	C	Ca	C	—		S	S				S					P	
Phalaropus fulicarius	Red phalarope	U	Ca	U	R		S	S				S					P	
Family Laridae																		
Stercorarius pomarinus	Pomarine jaeger	—	—	U	—	P	P	S				S						
Stercorarius parasiticus	Parasitic jaeger	—	—	U	—	P	P	S				S						
Larus atricilla	Laughing gull	—	Ac	Ac	—												S	
Larus pipixcan	Franklin's gull	R	Ca	R	Ca							S					S	
Larus minutus	Little gull	Ac	—	Ac	Ac							S					S	

		Status[a]				Habitat use[b]												
Taxa	Common name	Sp	S	F	W	Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Laridae (*continued*)																		
Larus ridibundus	Common black-headed gull	Ac	Ac	—	Ac							S					S	
Larus philadelphia	Bonaparte's gull	C	R	C	R		S	S	P			P			S		S	S
Larus heermanni	Heermann's gull	Ca	C	C	Ca	P	P	S	S	S	S	P			S		S	S
Larus canus	Mew gull	C	—	C	C	S	S	S	S	S	S	S			S		S	
Larus delawarensis	Ring-billed gull	C	R	C	C	S	S	S	S	S	S	S	S	S	S		S	
Larus californicus	California gull	C	R	C	U	S	S	S				S			S			S
Larus argentatus	Herring gull	R	Ca	R	R	S	S	S				S			S			S
Larus thayeri	Thayer's gull	Ca	—	Ca	Ca	S	S	S				S			S			S
Larus occidentalis	Western gull	A	C	A	A	S	S	P	P	S	S	P	S	S	P		S	P
Larus glaucescens	Glaucous-winged gull	C	U	C	C	S	S	P	P	S	S	P	S	S	P		S	P
Larus hyperboreus	Glaucous gull	R	—	R	R	S	S	S	S		S	S	S		S		S	S
Rissa tridactyla	Black-legged kittiwake	R	Ca	R	R	S	S					S						P
Xema sabini	Sabine's gull	—	—	Ac	—												S	
Sterna caspia	Caspian tern	C	C	C	—	P	P	P				P	S		P		S	S
Sterna elegans	Elegant tern	—	Ca	R	—	S	P	S		P		P			S		S	
Sterna hirundo	Common tern	U	R	U	—	S	P	S		P		P			S		S	S
Sterna forsteri	Forster's tern	R	R	U	Ca	S	S	S				P			S		P	S
Sterna antillarum	Least tern	Ac	Ac	Ac	—							S			S			
Chlidonias niger	Black tern	Ca	Ca	Ca	—							S					S	
Family Alcidae																		
Uria aalge	Common murre	U	C	U	Ca	P	P	S				S						
Cepphus columba	Pigeon guillemot	R	U	R	—	P	S											
Brachyramphus marmoratus	Marbled murrelet	R	R	R	Ca	P	S											
Family Columbidae																		
Columba livia	Rock dove	C	C	C	C													P
Zenaida macroura	Mourning dove	R	R	R	—											S	S	
Family Tytonidae																		
Tyto alba	Common barn-owl	U	U	U	U								S			S		
Family Strigidae																		
Bubo virginianus	Great horned owl	R	R	R	R													
Nyctea scandiaca	Snowy owl	Ca	—	Ca	Ca								P		S	S		

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Strigidae (*continued*)																		
Athene cunicularia	Burrowing owl	Ca	—	Ca	Ca										S			
Asio flammeus	Short-eared owl	U	—	U	U								S		S			
Family Apodidae																		
Chaetura vauxi	Vaux's swift	C	C	U	—											S	S	
Family Trochilidae																		
Calypte anna	Anna's hummingbird	U	U	U	R											S		
Selasphorus sasin	Allen's hummingbird	C	C	U	—											S		
Family Alcedinidae																		
Ceryle alcyon	Belted kingfisher	C	C	C	C		S	S				S			S		S	P
Family Picidae																		
Sphyrapicus ruber	Red-breasted sapsucker	R	R	R	R											S		
Picoides pubescens	Downy woodpecker	R	R	R	R											S		
Picoides villosus	Hairy woodpecker	R	R	R	R											S		
Colaptes auratus	Northern flicker	C	C	C	C											S		
Family Tyrannidae																		
Empidonax traillii	Willow flycatcher	R	Ca	R	—											S		
Empidonax difficilis	Western flycatcher	C	C	U	—											S		
Sayornis nigricans	Black phoebe	C	C	C	C									S	S	S	P	S
Myiarchus cinerascens	Ash-throated flycatcher	R	R	R	—											S		
Family Alaudidae																		
Eremophila alpestris	Horned lark	Ac	—	Ac	Ac										S			
Family Hirundinidae																		
Progne subis	Purple martin	U	U	U	—												S	
Tachycineta bicolor	Tree swallow	C	C	C	R								S	S	S	S	S	
Tachycineta thalassina	Violet-green swallow	C	C	C	R								S	S	S	S	S	
Stelgidopteryx serripennis	Northern rough-winged swallow	U	U	U	—								S	S	S	S	S	
Riparia riparia	Bank swallow	Ac	Ac	Ac	—												S	

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Hirundinidae (*continued*)																		
Hirundo pyrrhonota	Cliff swallow	C	C	C	—								S	S	S	S	S	
Hirundo rustica	Barn swallow	C	C	C	R								S	S	S	S	S	
Family Corvidae																		
Corvus brachyrhynchos	American crow	C	C	C	C										S	S	S	
Corvus corax	Common raven	C	C	C	C								S	S	S	S	S	S
Family Paridae																		
Parus rufescens	Chestnut-backed chickadee	C	C	C	C											S		
Family Aegithalidae																		
Psaltriparus minimus	Bushtit	R	R	R	R											S		
Family Sittidae																		
Sitta canadensis	Red-breasted nuthatch	Ca	—	Ca	Ca											S		
Family Certhiidae																		
Certhia americana	Brown creeper	R	R	R	R											S		
Family Troglodytidae																		
Thryomanes bewickii	Bewick's wren	U	U	U	U											S		
Troglodytes troglodytes	Winter wren	U	U	U	U											S		
Troglodytes aedon	House wren	Ca	Ca	Ca	—											S		
Cistothorus palustris	Marsh wren	C	C	C	C								P		S	S	P	
Family Muscicapidae																		
Regulus calendula	Ruby-crowned kinglet	C	—	C	C											S		
Regulus satrapa	Golden-crowned kinglet	U	R	U	U											S		
Catharus guttatus	Hermit thrush	R	—	U	C											S		
Catharus ustulatus	Swainson's thrush	R	U	R	—											S		
Turdus migratorius	American robin	C	C	C	C										S	S	S	
Chamaea fasciata	Wrentit	R	R	R	R											S		

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jets
Family Motacillidae																		
Anthus spinoletta	Water pipit	C	—	U	C									S	P		P	
Family Bombycillidae																		
Bombycilla cedrorum	Cedar waxwing	U	U	U	Ca											S		
Family Laniidae																		
Lanius excubitor	Northern shrike	R	—	R	R											S		
Lanius ludovicianus	Loggerhead shrike	Ca	—	Ca	Ca											S		
Family Sturnidae																		
Sturnus vulgaris	European starling	A	C	A	A								S	S	S	S	S	S
Family Vireonidae																		
Vireo solitarius	Solitary vireo	R	R	R	—											S		
Vireo huttoni	Hutton's vireo	R	R	R	R											S		
Vireo gilvus	Warbling vireo	R	R	R	—											S		
Family Emberizidae																		
Vermivora peregrina	Tennessee warbler	Ac	—	Ac	—											S		
Vermivora celata	Orange-crowned warbler	C	C	C	R										P			
Vermivora ruficapilla	Nashville warbler	R	R	R	Ca											S		
Dendroica petechia	Yellow warbler	R	R	C	—											S		
Dendroica tigrina	Cape May warbler	—	Ac	—	—											S		
Dendroica coronata	Yellow-rumped warbler	C	—	C	C											P		
Dendroica nigrescens	Black-throated gray warbler	R	R	R	—											S		
Dendroica townsendi	Townsend's warbler	R	—	R	R											S		
Dendroica palmarum	Palm warbler	R	—	R	R										S	S	S	
Dendroica castanea	Bay-breasted warbler	—	Ca	—	—											S		
Dendroica striata	Blackpoll warbler	—	—	Ca	—											S		
Mniotilta varia	Black-and-white warbler	Ca	—	Ca	Ca										S			
Seiurus aurocapillus	Ovenbird	—	—	Ca	—											S		
Seiurus noveboracensis	Northern waterthrush	—	—	Ca	—											S		
Oporornis tolmiei	MacGillivray's warbler	R	Ca	R	—											S		

Taxa	Common name	Status[a]				Habitat use[b]												
		Sp	S	F	W	Ent	Deep	Smal	Estg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Emberizidae *(continued)*																		
Geothlypis trichas	Common yellowthroat	C	C	C	R								P		S	S	P	
Wilsonia pusilla	Wilson's warbler	C	C	C	Ca											S		
Piranga ludoviciana	Western tanager	U	U	U	—											S		
Pheucticus melanocephalus	Black-headed grosbeak	R	R	R	—											S		
Pipilo erythrophthalmus	Rufous-sided towhee	U	—	U	U											S		
Spizella passerina	Chipping sparrow	U	U	U	—											S		
Spizella pallida	Clay-colored sparrow	—	—	Ca	—											S		
Pooecetes gramineus	Vesper sparrow	Ca	U	Ca	—										S		S	
Chondestes grammacus	Lark sparrow	Ca	Ca	Ca	—										S		S	
Passerculus sandwichensis	Savannah sparrow	C	C	C	C								P	S	S	S	S	
Passerella iliaca	Fox sparrow	U	—	U	U										S			
Melospiza melodia	Song sparrow		C	C	C	C							P	S	S	P	S	
Melospiza lincolnii	Lincoln's sparrow	U	—	U	U								S	S	S	S	S	
Melospiza georgiana	Swamp sparrow	Ca	—	Ca	Ca								S	S	S	S	S	
Zonotrichia albicollis	White-throated sparrow	R	—	R	R											S		
Zonotrichia atricapilla	Golden-crowned sparrow	C	—	C	C									S	S			
Zonotrichia leucophrys	White-crowned sparrow	C	C	C	C										S	S		
Junco hyemalis	Dark-eyed junco	C	—	C	C											S		
Calcarius lapponicus	Lapland longspur	—	—	Ac	Ac										S			
Plectrophenax nivalis	Snow bunting	—	—	Ac	Ac										S			
Dolichonyx oryzivorus	Bobolink	Ca	Ca	R	—								S		S	S		
Agelaius phoeniceus	Red-winged blackbird	C	C	C	U								P	S	S	S	P	
Sturnella neglecta	Western meadowlark	U	U	U	U								S	S	S	S	S	
Euphagus cyanocephalus	Brewer's blackbird	C	C	C	C								S	S	S	P	S	
Euphagus carolinus	Rusty blackbird	—	—	Ca	—												S	
Molothrus ater	Brown-headed cowbird	C	C	C	R								S		S	S	S	
Xanthocephalus xanthocephalus	Yellow-headed blackbird	Ca	—	Ca	—												S	
Icterus galbula	Northern oriole	U	U	U	Ca											S		
Family Fringillidae																		
Fringilla montifringilla	Brambling	—	—	Ac	—											S		
Carpodacus purpureus	Purple finch	U	R	U	U											S		
Carpodacus mexicanus	House finch	C	C	C	C								S	S	S	P	S	
Carduelis pinus	Pine siskin	R	—	R	R										S	S	S	
Carduelis psaltria	Lesser goldfinch	U	U	U	Ca										S	S	S	
Carduelis tristis	American goldfinch	U	C	U	Ca										S	S	S	
Loxia curvirostra	Red crossbill	R	—	—	—											S		

Taxa	Common name	Status[a] Sp	S	F	W	Habitat use[b] Ent	Deep	Smal	Eelg	Sand	Mudf	Open	Salt	Wrac	Dike	Shrub	Pond	Jett
Family Passeridae																		
Passer domesticus	House sparrow	C	C	C	C										P	P	S	

[a] Status: Sp = spring; S = summer; W = winter; F = fall; A = abundant; C = common; U = uncommon; R = rare; Ca = casual; Ac = accidental.
[b] Habitat use: Ent = entrance bay; Deep = deep channels; Smal = small, shallow channels; Eelg = eelgrass beds; Sand = sand flats; Mudf = mud flats; Open = open waters; Salt = salt marsh; Wrac = shoreline eelgrass wracks; Dike = dikes and elevated islands; Shrub = shrub and tree patches; Pond = fresh and brackish ponds; Jett = jetties, piers and ruins; P = primary use; S = secondary use.

Appendix E. Mammals of Humboldt Bay Environs

Appendix data are from reports and records compiled by Monroe (1973) and Shapiro and Associates, Inc. (1980). Nomenclature follows usage adopted by the U.S. Fish and Wildlife Service (Banks et al. 1987).

			Habitat designation[b]							
Taxa	Common name	Status[a]	Agri	Ripn	Salt	Frsw	Mudf	Smal	Open	Jett
Family Didelphidae										
Didelphis virginiana	Virginia opossum	?	?	?						
Family Soricidae										
Sorex pacificus	Pacific marsh shrew	U								
Sorex vagrans	Vagrant shrew	U		+						
Sorex bendirii	Marsh shrew	U		+						
Sorex trowbridgii	Trowbridge's shrew	U		+						
Family Talpidae										
Neurotrichus gibbsii	Shrew-mole	U		+						
Scapanus townsendii	Townsend's mole	C	+	?						
Scapanus orarius	Coast mole			+						
Family Vespertilionidae										
Myotis lucifugus	Little brown bat	C	+	+	?	+	+	?	?	
Myotis thysanodes	Fringed myotis	U?	+	+	?	+	+	?	?	
Myotis californicus	California myotis	C	+	+	?	+	+	?	?	
Myotis volans	Long-legged myotis	C?	+	+	?	+	+	?	?	
Myotis evotis	Long-eared myotis	C?	?	+	?	+		?		
Myotis yumanensis	Yuma myotis	C?	?	+	?	+		?		
Lasiurus cinereus	Hoary bat	C?	?	+	?	+	?	?	?	
Lasionycteris noctivagans	Silver-haired bat	C?	?	+	?	+		?		
Plecotus townsendii	Townsend's big-eared bat	C?	+		?	+	?	?	?	
Eptesicus fuscus	Big brown bat	C?	+	?	?	+	?	?	?	
Family Leporidae										
Lepus californicus	Black-tailed jack rabbit	C	+	+						
Sylvilagus bachmani	Brush rabbit	C	+	+						

Taxa	Common name	Status[a]	Habitat designation[b]							
			Agri	Ripa	Salt	Fresw	Mudf	Smal	Open	Jett
Family Aplodontiidae										
Aplodontia rufa	Mountain beaver	U		X						
Family Sciuridae										
Spermophilus beecheyi	California ground squirrel	C	+	+						
Tamias townsendii	Townsend's chipmunk	C								
Sciurus griseus	Western gray squirrel	C		+						
Tamiasciurus douglasii	Douglas' squirrel	C								
Glaucomys sabrinus	Northern flying squirrel	U		?						
Family Geomyidae										
Thomomys bottae	Botta's pocket gopher	C	+							
Family Castoridae										
Castor canadensis	Beaver	U		+						
Family Muridae										
Reithrodontomys megalotis	Western harvest mouse	C	?	?	?					
Peromyscus truei	Piñon mouse	C?								
Peromyscus maniculatus	Deer mouse	C?	+	+						
Neotoma fuscipes	Dusky-footed woodrat	C								
Arborimus albipes	White-footed vole	R								
Arborimus longicaudus	Red tree vole	U								
Clethrionomys californicus	Western red-backed vole	C?								
Microtus longicaudus	Long-tailed vole	U		+						
Microtus oregoni	Creeping vole	U		+						
Microtus californicus	California vole	C	+							
Microtus townsendii	Townsend's vole	U	?							
Rattus norvegicus	Norway rat	C	+							
Rattus rattus	Black rat	C	+	+						
Mus musculus	House mouse	C	+							
Family Dipodidae										
Zapus trinotatus	Pacific jumping mouse	C?								

Taxa	Common name	Status[a]	Habitat designation[b]							
			Agri	Ripn	Salt	Frew	Mudf	Smal	Open	Jett
Family Erethizontidae										
Erethizon dorsatum	Porcupine	C	+	+						
Family Delphinidae										
Delphinus delphis	Saddle-backed dolphin	U								
Lagenorhynchus obliquidens	Pacific white-sided dolphin	C								
Family Phocoenidae										
Phocoena phocoena	Harbor porpoise	C							X	
Phocoenoides dalli	Dall's porpoise	C								
Family Eschrichtiidae										
Eschrichtius robustus	Grey whale	R*								
Family Otariidae										
Eumetopias jubatus	Northern sea lion	C								
Zalophus californianus	California sea lion	C								
Family Phocidae										
Phoca vitulina	Harbor seal	A					X		X	
Family Canidae										
Urocyon cinereoargenteus	Gray fox	U	?	?						
Canis latrans	Coyote	U	+	+	?					
Family Ursidae										
Ursus americanus	Black bear	U		+						
Family Procyonidae										
Procyon lotor	Raccoon	C	+	+	+		+			
Bassariscus astutus	Ringtail	U		+						

Taxa	Common name	Status[a]	Habitat designation[b]							
			Agri	Ripn	Salt	Frsw	Mudf	Smal	Open	Jett
Family Mustelidae										
Martes americana	Marten	U								
Martes pennanti	Fisher	R								
Mustela vison	Mink	U		+						
Mustela frenata	Long-tailed weasel	U		+						
Mustela erminea	Ermine	U								
Mephitis mephitis	Striped skunk	C		+						
Spilogale putorius	Spotted skunk	O								
Lutra canadensis	River otter	C		X		X		X	X	
Family Felidae										
Felis concolor	Mountain lion	U		+						
Lynx rufus	Bobcat	U		+						
Family Cervidae										
Odocoileus hemionus	Mule deer	C	+	+						
Cervus elaphus	Elk (wapiti)	U	+							

[a] Status: C = common; U = uncommon; R = rare; R* = protected by federal law = rare.
[b] Habitat Designation: Agri = agricultural land; Ripn = riparian brush and forest; Salt = salt marsh; Frsw = freshwater marsh; Mudf = mud flats; Smal = small tidal channels, creeks, sloughs; Open = open baywaters; Jett = jetties, reefs, ruins; X = for species use based on voucher material or published records.

Appendix I

Public Comments

KUIPER MARICULTURE, INC.
led Kuiper
P.O. Box 507
Bayside, Ca. 95524

Informal comments to HB Management Plan Task Force

As per agenda items.

9 April 2002

Thank you for the opportunity to comment on the HB Master Plan. Our company is Kuiper Mariculture a producer of single oyster and clam seedlings for sale to about 70 farms in the Pacific NW and internationally. We have operated in Humboldt Bay since 1978 on leased tideland from the HbHRCD. We have two shore sites for setting and early culture of 1.2 billion eyed larvae, two raft culture sites, and intertidal off-bottom site and an industrial site for intensive culture of clam and oyster seedlings. We have a continuous annual disease certification since 1978. To prevent transfer of invasive species, such as the green crab we soak all our seed in a 10 ppm chlorine bath for shipments outside California We comply with import regulations from several international agencies including the European Economic Union.

The success of our business is credited to innovators and risk takers in industry and government that have preceded us. Some examples are biologists, Walt Dalstrom, Ron Warner, John Modin, Don Manzer with California Department of Fish and Game. Jack Alderson with the Harbor District and several commissioners, including Dr. James Gast, and Dr. Richard Ridenhour
Those that worked hard to protect Humboldt Bay water quality to develop both the regional plant and improvements in Arcata include: Dr. George Allen, Dr. Bob Gearhardt. Mr. Frank Klopp and Mr. Frank Phillios with State Health Services, and Bill Rodrigues and
John Hannum with the Regional Water Quality Control Board. Although, the industry in the 70's and early 80's ridiculed our efforts to innovate and produce single seed, we received strong-local support from Francis Douglas and Leonard LaBranche from Coast Seafoods, The vision we had was before its time, but due to the support from those individuals mentioned and incredible innovation in the remote setting of shellfish larvae by Lee Hanson of Whiskey Creek in Oregon and Vance Lepovsky of Coast Oyster, the shellfish market is mostly now driven by single seed. I mention that, for what may appear today to be a impossible vision by new aquaculture companies may be the industry standard in a decade. Other examples, that some of you are now participating include: a shift to off bottom culture in Humboldt Bay to protect intertidal resources and compatible-multiple use of industrial locations for intensive culture, such as paddle-wheel flupsies.

Humboldt Bay continues to play an important role in California shellfish culture in the production of Pacific oysters both seed and adults and manila clam seedlings for growout in B.C, Washington and Europe.

Several aquaculture industry innovations have part of their origin from the Humboldt Bay region, including:

1) Salmon farming: last year's landings exceed 1 million metric tons worldwide; much of the early work was done by Dr. George Allen. Worldwide, aquatic animal production in 1999 were estimated at 125 million metric tons. Of that capture fisheries were 92 million Metric tons and aquaculture reached 32 million metric tons. It is unknown whether capture fisheries can be sustained at that level. Aquaculture will grow to about 40 million metric tons by 2010.

Aquaculture accounts for about 30% of worldwide fisheries landings.The dominant aquaculture species are from freshwater including channel catfish, tilapia and trout. Tilapia has the highest increase in tonnage cultured in tropical countries worldwide, but is also being cultured in closed recirculating systems including, British Columbia and several other Canadian provinces. Salmon farming has been strongly rejected by Humboldt County stakeholders. You should rest easy that salmon farming is NOT likely to be proposed for Humboldt Bay in the future for several reasons including high turbidity, variable salinity, shallow depth, and the sewage discharges at the mouth of the bay and at Arcata. Worldwide, salmon farming is projected to reach 2 million tons in the next decade. Commercial fishermen should not view that supporting aquaculture is a disguise for supporting salmon farming. There are too many high quality sites in Norway, Chile, Scotland, BC, and Washington for there to be serious consideration for Humboldt Bay. Other marine finfish farming is certainly possible at Humboldt using technology developed in Europe or by the NOAA, Manchester, Washington aquaculture center, including Ling Cod, Black Cod and flat-fish.

2) CLAM FARMING : seed and techniques developed at Humboldt with the assistance of Mr. Ron Warner and Jack Alderson now account for over 17,000 Metric tons in Europe employing over 8,000 processors and fishermen in that industry. Warner and Alderson received a community development award from a region in Northern Italy. These culture techniques are now widely copied in Washington, British Columbia, Atlantic Northeast, and Florida with their own logical innovations, About 300 fisherman in the Indian River area of Florida are now farming hard clams due to an extension program initiated by Sea Grant and Harbor Branch Oceanographic. Landed value of that new industry is about $15M. Even though clam seed production is both an important business for both Coast seafoods and ourselves, farming of clams will NOT be viable in Humboldt due to potential impacts on benthic resources.

3) MUSSEL farming: Humboldt was a leader in single mussel seed production that was widely ridiculed. Those techniques are now used in Australia, NZ and is the basis for two companies success in Washington. Essentia! cooperation was received from Cal Fish and Game, George Trevelyan of UC Davis and Dr.Ralph Elston. Mussel production requires large rafts, which will NOT be permitted at Humboldt.

4) several other innovations have come from the industry vision at Humboldt include, geoduck clam settlement, kumamoto oyster culture and most surprisingly Sumonoe oyster culture. Coast Seafood has been the leader in kumamoto oyster culture. Geoduck clam culture has been a large R&D project in Washington, but due to the potential impact on the benthic environment, it is DOUBTFUL the geoducks will ever be cultured here.

You might enjoy the irony of the suminoe oyster story. This is an oyster that sets and grows well in a low salinity environment , there is a very low population of that oyster in the wild in Humboldt. An early innovator in developing the spawning and culture techniques for that species in Humboldt Bay is Ron Zebal. Ron Zebal is now working with a VIMS project that is part of a $100 million program to re-establish the American oyster in the Chesapeake. So far restoration has had mixed results due to disease. The suminoe is disease resistant and although it is a non-indigenous species, the multi-agency task force views that the water quality benefits(oyster filter and clarify a large amount of water down to 1 micron), may outweigh the concerns over a non-indigenous species. I

The vision that some groups now have to force out the shellfish industry because of concerns over view shed scenic resources, jet ski traffic or other imagined conflicts, may result after we are gone in a publicly supported restoration program because of the water quality benefits that are now not fully appreciated which oysters provide.

Speaking of water quality benefits, during the regional plant and Arcata project hearings I attended in the 70's, the preservation of the oyster industry was consistently named as the # 1 reason to discontinue dumping sewage into Humboldt Bay. The vision at that time was to improve water quality for recreation, commercial fishing, wildlife and sport and commercial shellfish culture. Since that time the industry has invested over $100,000 in water quality monitoring, the municipalities have spent over $40 million in sewage treatment improvements, and ongoing projects to improve and maintain municipal plants are significant. The health agency overhead to monitor the California coastal estuaries for sport and commercial harvest is data I do not have, but it must be several million per year. Should the vision by some groups to force the shellfish industry out of Humboldt Bay be successful, the on-going monitoring of bacteriological quality and capital improvements for the sewage facilities are of a lessor priority.

What is a vision for the future of Humboldt Bay as it relates to the management plan and aquaculture?

a) the Harbor District has already demonstrated it support for shellfish culture in the form of CEQA review through the multi-agency Mariculture Monitoring Committee, assisting Coast Seafoods in the permit process to convert its culture techniques to off-bottom! permitting and leasing tidelands for low impact culture techniques, and sponsonng studies by the multi agency, industry, and university- Western Regional Aquaculture Consortium. Without the Harbor Districts vision of a sustainable industry there would be no Humboldt Bay aquaculture industry. Speaking of sustainability, a fact of about aquaculture in Humboldt that may not be clear is that we are not shellfishermen. We are growers of product that we plant as seed, culture to an appropriate size and condition and then harvest. Our industry is 100% sustainable, because we harvest NO wild product. Our broodstock is now 100% from cultured stock, we nurture and harvest on!y cultured product. Provided we have sites to culture our products, and bacteriological water quality continues to improve, the Humboldt Bay shellfish industry is sustainable for the several centuries. We do not rely on any tax payer support in the form of hatcheries, fisheries management or land based infrastructure. We are entirely privately funded with no public funds. Public support is substantial, however, in the form of highly technical sewage treatment plants, the health agencies to monitor there effectiveness and university research Our view is that the phytoplankton resource(the small single celled and multiple chained flagellate and diatoms) are extremely abundant in Humboldt and can sustain a larger biomass of cultured shellfish. We back up that view with the high nutrient run-off from ag lands, and the macrophytic algae that any layman can see growing on the tidelands as the bright green or brown smudge you see on the mudflats as you drive around the bay. Much of that algae is Ulva and Enteromorpha. If the vision that some groups have of forcing out the shellfish industry succeeds, then llumboldt will likely feel the over eutrophication of macrophytes that several estuaries face in

Europe where bulldozers remove Ulva and Enteromorpha to prevent anoxia and algae fly infestations. Eutrophication will also lead to reduced habitat for migrating birds, not more. Commercial shellfish are now an important component for Humboldt Bay water quality and the view of some of "returning to the old days of a natural ecosystem", does not take into account the nutrient run-off from creeks, ag land and municipalities. Oysters are a useful species in that they remove the results of eutrophication(single cells microalgae), and convert it to a product that can be sold in Denver. The macrophytic plants including Ulva and Enteromorpha remove the nutrients from the water, die, and then re-release the nutrients into the water when they decompose. We spoke about the the presence of anoxia from macrophyte decomposition during the last meeting.

b) In order to sustain and expand the aquaculture industry in a environmentally sound manner, the existing shellfish leases should be mapped and those areas that are now not in patented private ownership or under lease should be opened up to lease. The model for this is the methodology used by California Department of Fish and Game tidelands in Tomales Bay. This is of course easier said that done, since the trustee tidelands are now under the jurisdiction of at least three authorities: City of Eureka, Arcata, and Harbor District. In addition there are some patented tideland deeds that may be honored by Calf State Lands. As part of the management plan, MAPPING should be a priority.

c) A part of the NOAA aquaculture plan a goal is to increase aquaculture production in light of the balance of trade deficit on fisheries products at present over 7 billion annually second only to oil. In order to implement that goal, a NOAA policy is to " conserve existing aquaculture facilities". My vision is that existing aquaculture land that has been in production sometime in the last 25 years is not sold or removed from leasehold by transferring ownership to a government agency.
A statement, such as the Humboldt County general plan ____________, regarding no net loss of agricultural land be included in the master plan as a policy guideline. This would be consistent with the NOAA plan and the Local Coastal Plan regarding coastal dependent uses. Para 14951 of the California Water Code declares that commercial shellfish harvesting is a beneficial use of the state's water and under the Shellfish Protection Act of 1993, protection of shellfish growing areas are a high priority. Conversion of areas that are now designated as a shellfish growing areas under the Health and Safety Code Section 112170 to uses that would not allow shellfish culture is not in the interest of the goals of the HB Management Plan.

d) in light of the beneficial use cited in the Shellfish Protection Act and the the goals of the NOAA Aquaculture Plan, my vision is that the shellfish growing areas in North Bay that are now administered by the Department of Health Services and under the jurisdiction of the NCRegional Water Quality Control Board be designated as "AQUACULTURE ZONES ". This designation would acknowledge that aquaculture is a beneficial use for those areas, and that future permitting for those areas, provided that the culture practices are consistent with previously addressed issues under CEQA(protection of eel grass ect) that permitting be streamlined.

e) for aquaculture sites outside the Health and Safety administered areas, that may lie within historic INDUSTRIAL locations(commercial docks, pilings, or tideland), aquacultue be designated as an acceptable secondary use to the priority industrial activities. This allows for several sites that do not meet bacteriological quality to put into production, provided the owner or primary tideland industrial leaseholder finds that aquauculture may be a compatible use. This would also streamline permitting for those innovators that choose to locate there facilities inside the boundaries of light or heavy commercial activities(eg. municipal docks, marinas, pump mills, bulk oil storage facilities). This is a common practice in Virginia where financial incentives are awarded to shellfish culturist who locate upwells systems under existing marina docks. No financial incentives are requested here, just friendly wording in the HB Master Plan.

e) to keep my comments brief, a final vision comment is that in the "sphere of influence" of the Master Plan, a designation that aquaculture is a permitted activity within existing on-land commercial or industrial sites should be included. For example, the HEATED wastewater from Fairhaven Power, PG &E, Samoa Pacific Cellulose, the proposed coal fired plant, Bayshore Mall and others may be the sites for new innovative aquaculture. Examples of this are the proposed white shrimp facility in Fort Bragg, the widespread closed system tilipia farming in such places as Ontario and Vancouver, Canada. Since these are non-indigenous species, they are now not welcome at Humboldt Bay, but those innovators that successfully demonstrate their economic viability with environmentally sound techniques should be provided for in the Master Plan. Many ideas we have implemented over the years were disparaged at the beginning as impossible. One thing we can all count on is that future views of the importance of food resources will change. The aquaculture field welcomes risk takers and innovators, so I am confident what I think is impossible today will be standard practice in 50 years. The management plan should allow for those future innovators.

2. I will move on to Item 2. In the vision section I mentioned some specific projects including: aquaculture ZONING, acceptable SECONDARY uses, and the sphere of influence comments.

Other projects;

a) During the recreational meeting, CHANNEL markers in North Bay were requested. The industry will cooperate in placing channel markers, by providing labor and vessels at no charge. However, markers are an additional potential anvironmental conflict as a disturbance to the view shed, so we will take no action on this matter until the process is completed. We are happy to cooperate.

b) The jet skier was concerned about access to all parts of the bay with high speed personal watercraft. Since navigation is an important beneficial use and aquaculture is presently permitted along the edges on minor channels, we as an industry can post WARNING placards as approved by the management plan. Again, the disturbance to the view shed of posting warning signs may not be appropriate under the management plan.

c) Recreational fishing according to a recent article in the Times Standard citing the California Department of Fish and Game blue book is valued at about $550 million in Ca. CDFG in now producing about 100,000 white sea bass juveniles at Carlsbad for partial growout in net pens by recreational sport group partners at a cost of about $15 per fish with a 20% return to the sport fishery. The cost per fish is about $75 per fish when landed. The value in tackle, lodging, fuel and travel may exceed $150 per fish. Other coastal areas, including Homer, Alaska, Port Angeles, Wa., and Tillamook, Oregon have recognized the value of sport salmon fishing to the local economy especially in light of the endangered species act and the concern about dilution of genetic vigor associated with escapement past hatcheries and interbreeding with wild stocks. Many of you may have read about the slaughter of coho at Oregon hatcheries and the controversy in the courts.

Some coastal areas that have hatcheries nearby like Mad River have elected to establish TERMINAL sport fisheries in their ports in lieu of a complete release of smolts into the parent rivers or streams. Humboldt is well situated with the several net pen sites for imprinting of Mad River smolts for 5-7 days in Humboldt Bay prior to release. The recent sport fishery for salmon inside the mouth of Humboldt Bay has shown the interest for a summer salmon bay sport fishery. Although anything to do with salmon aquaculture is high controversial, the components for successful sport terminal fishery are in place and worth investigating. In Homer, Alaska their terminal fishery is located alongside some of the most important wild salmon rivers. Their sports terminal fishery lands about 7000 fish per year. At a value of over $150 per fish, the economic benefits to the Humboldt economy would be significant. I have included a copy of a paper on this subject for your review. The shellfish industry has nothing to gain from this type of proposal, however, any reason to continue to protect water quality does benefit the shellfish industry.

Another project that should be mentioned in the master plan is a PUBLIC oyster bed. This has been successful in other areas including the Dosewallips State Park at Brinnon, Wa. The economic benefit of locating a public bed with open and closed seasons,bag limits, and health closures may have a benefit to South Bay communities including King Salmon, Fields Landing and Loleta if a public sport fishing oyster bed were developed near the South Spit.

One of the first documented shellfisherman in the bay was Ned a Weott Indian that was murdered while clam digging near Bucksport shortly after the Indian Island massacre. The master plan should allow for CEREMONIAL shellfish areas at their site along the Eureka Channel. Coast and our company cooperates with several tribal groups in Washington and Canada with seed and technology. We will assist any tribal members who want to grow shellfish in Humboldt Bay.

Agenda Item # 3

Projects or activities not to be included:

1. As I mentioned in the Commercial fishing meeting, projects proposed for the MAD River should be examined carefully for their future impact on silt deposition in Humboldt Bay by flooding.

2. CONVERSION of shellfish growing lands to government projects that do not provide for aquaculture production should be discouraged.

3. REMOVAL of pilings in the commercial areas of Humboldt should be evaluated for their loss of a future aquaculture site. Piling placement costs about $5000 each, plus extensive administrative and regulatory expense.

4. BUNKERING of ships with barge supplied black oil(bunker c) should not be considered.

5. Shellfish purification plants will undoubtedly be an important component to US shellfish aquaculture in the future, and potential sites should be cited, however, any plant construction should only be considered after a FULL financial commitment by industry.

6. Estuarine reserves have been mentioned as part of the Master Plan. They are also mentioned as a component of the NOAA aquaculture plan. However, further layers of agency jurisdiction over Humboldt Bay make an already lengthy permit process(the Abalone farm at Fort Bragg is into its 4th year of the permit process) even more CUMBERSOME. Since the agencies are already the main land owner around the bay, a further layer of bureaucracy including Marine Protect Areas make a confusing process even more complicated.

#4 Conflicts- mentioned above

#5 Regional Issues:

1. Aquaculture can continue to be a viable local industry provided the state shellfish growing waters(Cal Water Code 14951) continue to have conditional or open water quality. The municipalities, Water Q Board and Health Services continue to invest millions in enhancing and preserving HB Water Quality.

The new EPA effluent guidelines for aquaculture will be finalized in 2004, which should have little impact on shellfish culture since we enhance water quality through sediment filtration.

Aquaculture INCUBATOR sites have been popular in several bays to help new people get established at a site that has been fully permitted.

Thank you for the opportunity to comment. When you have discussions at future meetings about what to include in the HB Master Plan please consider the following:

1. mapping of leases, identification of vacant lease sites for new farmers.
2. aquaculture zones(this is being discussed nationally)
3. aquaculture incubator site
4. ceremonial shellfish sites
5. heated wastewater
6. state growing waters
7. public oyster bed
8. investigating a terminal sport fishery
9. conversion of growing waters(by code) to government ownership
10. secondary use by aquaculture in industrial areas

William c. Matson
287 S. Westhaven Drive
Trinidad, CA 95570

March 13, 2002

Mr Jeff Robinson
HBHR&CD
P O Box 1030
Eureka, CA 95502

Dear Jeff:

I enjoyed the exchanges last night at the stakeholder meeting. Its been a while since I was involved in fisherman politics, but I have a few observations.

I was involved in the early negotiations to manage the Salmon fishery. At the time none of us could ever conceive of a time when the fishery would be taken away from us. If we had known how far it would go we would have had more community support. At the time local support for our fight was weak. None of the communities realized how much the fishery contributed to the local economy until it was gone; then it was too late.

I write because I am encouraged by the stakeholder involvement. I don't know if the fishery will ever be healthy again, but a strong stand and message from you will help. Let me share a few thoughts of my own about Humboldt bay.

First never underestimate the power and resolve of the environmental community. I work with them everyday in my restoration business. They are constantly looking for leverage to accomplish their goals and are not concerned about the economy. Use of the endangered species act is the best example, but they also like to take land out of production to return it to a natural state. Most recently Del Norte County has felt the loss. (And they are well funded)

From my viewpoint the first and best use of Humboldt Bay must be commercial/industrial. To protect for this purpose will probably require a fight because environmental, recreational and land development groups may argue it decreases natural beauty, is noisy, dirty or a safety problem for recreational users.

We have come a long way since the years of careless dumping and pollution of the bay. We still have problems, and will always have to be on the lookout for polluters, but none of us want to see a return to the early days of using it as a dump. Industrial use must take precedence. I never want to see recreational use discouraged. I do think we want to protect the Bay from development projects similar to Alsea Bay in Oregon, or become another Sausalito Houseboat Subdivision.

In closing let me say I see four main uses of the bay.

1. Economic/Industrial - Which includes commercial fishing and port development.
2. Recreation - Everything from sport fishing to sailing.
3. Environment - Protection of the marine habitat and biomass that uses the bay.
4. Aesthetic - The natural beauty can and should be considered in use decisions, but must never be used to stop commercial use.

You have tough challenge ahead of you and I wish you well. I look forward to a time when fishing boats once again have a place to fish and the fishing fleet becomes a viable part of our local economy and the infrastructure for the fleet is rebuilt. I hope I live long enough.

Sincerely,

Bill Matson

c.c. Paul Pellegrini
Humboldt Fishermans Marketing Association

RECEIVED
MAR 15 2002
H.B.H.R.& C.D

Humboldt Bay Harbor Commission -- Recreation meeting
12 Feb 2002

Birding community:

Redwood Region Audubon Society	about 550 members
Active birders in the area	est. 65
Other non member bird aware people	10,000 (10% of 100,000)
Humboldt Co	about ~~400~~ 300 species of birds
Humboldt Bay Harbor Commission sphere of influence	about 250 species

Humboldt Bay is a destination for birders around the world.
When rare birds such as last fall's Greenshank or the Rustic Bunting or White-winged tern show up, birders come from all over the nation to see them. An estimated 400 birders came from around the nation to see the Grenshank. They buy food, gas, and lodging. If each person only spent $50 in Humboldt County, that comes to $20,000 just for that one bird. That doesn't count the tax-derived revenues from those who flew in from the east coast.

Regularly Redwood Region Audubon offers field trips 52 weekends a year at Arcata Marsh. Each trip averages about 12 people, that comes to 624 people. From October thru April we offer field trips monthly at Eureka Marsh and Hookton Slough. Those usually have about 20 people; the math comes to about 280 people. We probably offer a dozen other field trips each year at probably 10 people per trip- 120 people. Each Christmas Bird Count averages 50 people helping out- 100 people. About 4000 birding hours for organized trips.

In the 1980s and 1990s according to several outdoor and recreation magazines, Birdwatching was the fastest growing hobby in the nation. According to the information by ABA below, each birder spends an average of $163 per year. That amounts to at least $145,000 spent each year by birders in our area.

The following figures are based on the tables prepared by American Birding Association.

7% of U.S. population are hunters. $10,150,000 spent by hunters in our area each year if we spend at the national average. Based on 7% at $1450 per hunter each year. 17% of US population are anglers. $18,000,000 spent by anglers each year if we spend at the national average. Based on 17% of our population spending $1079 per angler each year.

This doesn't include bicyclers, kayakers and canoers, and surfers in our area.

BUT WE MAT BE ABOVE THE NATIONAL AVERAGE IN BOTH ANGLERS AND HUNTERS IN OUR AREA.

Businesses serving the birding, fishing, and hunting community in our county: based on Humboldt Co. yellow pages.

There may be some overlap between businesses

Feed and grain stores	8
Garden/Nursery	15
Sporting goods	13
Optics/Cameras	9
Bookstores	10
Bait and tackle	many

That amounts to over $28 MILLION each year spent in our area on birding, hunting and fishing.

Prepared by Chet Ogan, Redwood Region Audubon Society

FAST FACTS http://www.americanbirding.org/programs/consecond4.htm

From American Birding Association:

63.1 m feed wildbirds at home
24.7 m took at least one trip a year (casual birders)
One half of one per cent are 'serious birdwatchers', giving us a total of around
123,500 highly committed birders
Wildlife watchers spent $18.1 bn in 1991.
Birdwatchers form 80% of this group.
$14.4 bn spent by birdwatchers
$6 bn on trip related expenses (food, lodging, transportation)
$7.6 bn for equipment (special vehicles, bird food, feeders, baths and houses; photography, binoculars, scopes, clothing, packs, camping equipment)
$240 m for magazines
$60 m for membership dues

FAST FACTS http://www.americanbirding.org/programs/consecond5.htm

From the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation

Fishing

35.2 million U.S. residents age 16 and older fished in 1996 (17 percent of the U.S. population)
days spent fishing: 626 million
fishing trips taken: 507 million
dollars spent on fishing-related expenses: $38 billion
percent of anglers who are women: 27; men: 73
number of freshwater anglers: 29.7 million; saltwater anglers: 9.4 million
five states with the most anglers, in descending order: Florida, California, Texas, Michigan, New York
top three most-fished species
freshwater areas other than the Great Lakes: black bass, trout, panfish
Great Lakes: walleye/sauger, perch, salmon
Salt water: flatfish (flounder, halibut), bluefish, striped bass

Hunting

14 million people 16 years old and older hunted in 1996 (7 percent of the U.S. population)
days spent hunting: 257 million
hunting trips taken: 223 million
dollars spent on hunting-related expenses: $20.6 billion
percent of hunters who are women: 9; men: 91
five states with the most hunters, in descending order: Michigan, Texas, Pennsylvania, Wisconsin, New York
number of big game hunters: 11.3 million
small game: 6.9 million
migratory birds: 3.1 million
other game: 1.5 million
three most popular species hunted:
big game: deer, wild turkeys, elk
small game: squirrels, rabbits and hares, pheasants
migratory birds: doves, ducks, geese

(over)

Wildlife Watching

62.9 million people 16 years old and older engaged in wildlife-watching (observing, feeding, and photographing wildlife) in 1996 (31 percent of the U.S. population)
dollars spent on wildlife-watching-related expenses: $29.2 billion
residential wildlife-watchers (those who watch wildlife within a mile of their homes): 60.8 million
nonresidential wildlife watchers (those who watched wildlife more than a mile from their homes): 23.7 million
percent of residential wildlife watchers who are women: 54; men: 46
percent of nonresidential wildlife watchers who are women: 50; men: 50
five states with the most wildlife watchers, in descending order: California, Florida, Pennsylvania, Texas, Illinois
top three residential wildlife-watching activities: feeding wild birds, observing wildlife, feeding other wildlife top three types of animals enjoyed by nonresidential wildlife-watchers: birds, land mammals, fish and other wildlife

Comparisons to 1991 Survey Results
[* No change at the 95-percent level of significance.]

		1991	1996	Difference
Angling				
	Anglers	35.6 million	35.2 million	*
	Angling days	511 million	626 million	22%
	Expenditures	$27.6 billion	$37.7 billion	37%
Hunting				
	Hunters	14.1 million	14 million	*
	Hunting days	236 million	257 million	*
	Expenditures	$14.2 billion	$20.3 billion	43%
	Wildlife-Watching			
	Participants	76.1 million	62.9 million	(17%)
	Expenditures	$21.2 billion	$25.7 billion	21%

U.S. Fish and Wildlife Service Press Release

Please acknowledge the American Birding Association as your source of this information, but always quote the original reference also.

January 22, 2002

Humboldt Bay Management Plan Task Force
Humboldt Bay Harbor Recreation and Conservation District.
P.O. Box 1030, Eureka, CA 95502-1030

Dear Task Force representatives,
Thank you for providing the opportunity to comment.

A. If you could have anything you wanted in and around Humboldt Bay, with regard to the environment, what would it be?

I want the Harbor District to pro-actively protect the biological resources of the Humboldt Bay during planning and project review period, as the State law requires. The Harbor District should use sustainable development as its guide.

The Harbor District should support sustainable development as a top priority over economic development. Here I defined sustainable development as firstly protecting Humboldt Bay's land, water, wildlife habitat, and biological resources and secondly using Humboldt Bay in ways that protect it's land, water, wildlife habitat, and biological resources. In the long run, sustainable development will provide the most beneficial uses of the Bay to the public thus maximizing the public good.

Here is a list of Humboldt Bay's land, water, wildlife habitat, and biological resources

1. Eelgrass beds, and associated biota
2. anadromous salmonids, herring, native crabs, black brant, marine mammals, and shorebirds
3. Wetlands
4. Humboldt Bay is national treasure of global significance, and a critical nursery ground for many species commercial importance

Projects that are not sustainable development and do not protect Humboldt Bay's land, water, wildlife habitat, and biological resources include the following:

1. Mariculture activities that harm, restrict, or impair the eel grass beds or the sea life that use them
2. Filling of wetlands for any purpose
3. Point pollution of sediment or hazardous substances from dumping or caused from the erosion process and subsequent runoff from construction sites or other projects
4. Non-point pollution of sediment or hazardous substances from the erosion process and subsequent runoff caused from forestry and grazing operations thereby significantly increasing the sedimentation of wetlands, marshes, eelgrass beds, and the Bay, causing significant cumulative effects to the environment.
5. Shipping activity that will cause or an increase in the probability of introductions of invasive aquatic nuisance organisms, from the ballast water or freight on the ship, that may threaten the ecology integrity of the Bay or the forests surrounding the Bay.

I also request that the Harbor District to reconsider supporting designation of Humboldt Bay as a National Estuarine Research Reserve (NERR). Humboldt is the healthiest bay in California. It is essential that it is designated a National Estuarine Research Reserve to keep it ecologically intact into the future.

epic

January 22, 2002

Humboldt Bay Management Plan Task Force.
Humboldt Bay Harbor Recreation and Conservation District,
P.O. Box 1030, Eureka, CA 95502-1030.

Dear Task Force representatives,

Thank you for providing the opportunity to share our visions, issues, and concerns for Humboldt Bay. While stakeholder meetings may provide valuable information from different user groups, we think that specific areas of Humboldt Bay should also be the focus of some of the meetings. We believe that you may be missing important issues by focusing on user groups without also considering hydrographic areas. We encourage you to add three additional meetings, one on each of the three bays (South Bay, Entrance Bay, and North Bay) open to everyone. At these meetings there would be the opportunity to share input from all user groups about the different geographic areas of interest together with the landscape as the focus, rather than just the user groups.

The following comments are presented for the environmental stakeholder meeting of the Humboldt Bay Management Plan task force. The five topics that were provided prior to the meeting are used as the framework for discussion of issues below.

1. *If you could have anything you wanted in and around Humboldt Bay, with regard to the environment, what would it be?*

We would like to see the Harbor District take a more pro-active role in protecting the public trust resources of Humboldt Bay, as mandated by the state, during planning and project review.

Protecting public trust resources of Humboldt Bay should include the following:

1. Protecting important biological resources, such as eelgrass beds, and associated biota, as well as anadromous salmonids, herring, native crabs, black brant, marine mammals, and shorebirds, salt marsh, etc. identify key areas to restore representing all estuarine habitat types.
2. The Harbor District as the trustee of the public trust resources needs to take responsibility for ensuring that mariculture activities are conducted in a manner consistent with aquatic resource values within Humboldt Bay.
3. Preventing illegal fill from occurring in the public trust lands and marshes of Humboldt Bay
4. Preventing invasions of aquatic nuisance species from ballast water and other sources that may threaten the bay ecology.
5. Reducing sediment and nonpoint source runoff causing cumulatively impacts on bay resources and beneficial uses.
6. Reducing point source runoff of hazardous substances into Humboldt Bay that threaten the beneficial uses and the bay environment.

Environmental Protection Information Center
P.O. Box 818 • Arcata, CA 95518 • 707-822-1343
P.O. Box 397 • Garberville, CA 95542 • 707-923-2931 • www.wildcalifornia.org

We encourage the Harbor District to reconsider supporting designation of Humboldt Bay as a National Estuarine Research Reserve (NERR). NERR status for Humboldt Bay could provide additional funding and status for Humboldt Bay through the Office of Ocean and Coastal Resource Management of the National Oceanic and Atmospheric Administration (NOAA). Designation of Humboldt Bay as a NERR would make Humboldt Bay more eligible for grant funding, while also increasing its profile as an eco-tourist destination.

2. *What topics should the HBMP address? Include specific projects, activities, or details that should be included.*

The HBMP will be based largely upon the Shapiro and Associates report that was completed in 1980, which is now over 20 years old. While this report is an excellent historical reference, we believe that using such out-of-date information may create problems for planning and implementation because a great deal of change has occurred over the last 20 years. The HBMP should identify critical information needs for the bay, and develop an action plan for acquiring that information in a timely manner. Some of the critical information needs include sedimentation rates within Humboldt Bay, the importance of estuaries for anadromous salmonids, as well as tidal fluxes and channel dynamics, to name a few.

We are concerned that the Harbor District is taking a fragmented approach towards planning within Humboldt Bay. The waterfront revitalization plan, the strategic plan, and the Humboldt Bay Management Plan are being developed in completely separate processes, and it is not clear whether they will be consistent with each other, and what information they will cover. The Harbor District is essentially undergoing a general plan revision similar to Humboldt County (who is preparing an EIR). Given the scope of the discretionary action being considered by the Harbor District - the waterfront revitalization plan, the strategic plan, and the Humboldt Bay Management Plan - an Environmental Impact Report (EIR) subject to the California Environmental Quality Act (CEQA) should be prepared.

We believe the Harbor District should aggressively pursue whatever measures are necessary to ensure that Humboldt Bay is protected from Aquatic Nuisance Species (ANS) introductions that occur largely from ballast water. We encourage the Harbor District to investigate the environmental impacts of using nitrogen as a means for controlling ANS, and if the environmental impacts are within acceptable levels, to require nitrogen treatment for all vessels entering Humboldt Bay with ballast tanks. It is important that all vessels, including those operating within the economic exclusive zone of the United States, be required to treat their ballast water, because San Francisco Bay now harbors so many ANS, and is one of the closest major ports.

The Harbor District should place more emphasis on supporting small boat owners in Humboldt Bay by improving the existing infrastructure they require, such as a small boat fueling dock, bilge pump improvements, and other measures that would provide better support for small boat use while also improving water quality.

The HBMP should address the feasibility of establishing Humboldt Bay as part of the NERR system. All the studies that are currently needed on Humboldt Bay could be funded out of the program, tapping into federal funding sources for facilities, research, and interpretation. The Harbor District should also support the Humboldt Bay Wildlife Refuge boundary, and promote acquisition within the defined areas.

3. *What specific projects or activities should not be included?*

We do not support the Harbor District channeling precious funds and resources into high-risk port development. We believe the Harbor District should support more sustainable, economically feasible projects that can provide a more secure future for Humboldt Bay. These projects should be concentrated within Entrance Bay. We do not want to see any more development in North Humboldt Bay. We do not want to see any more development in South Humboldt Bay, including dredging, fill, or any other activities at Fields Landing. South Humboldt Bay is a national treasure of global significance, and a critical nursery ground for many species of commercial importance. We believe South Humboldt Bay and North Humboldt Bay should be protected to the maximum extent feasible, with development concentrated in Entrance Bay.

We do not want any more diking or filling of wetlands around and within Humboldt Bay, which has already lost approximately 90% of its wetlands. As a result, we do not support permit streamlining for agriculture, although we do support agriculture as an open space use when it is done in a sustainable way. We do not support mariculture activities that are environmentally destructive to eelgrass beds in Humboldt Bay. We do not support any permit streamlining for mariculture. We hope that mariculture activities can be conducted in more harmony with bay in the future.

4. Where do you see potential conflicts between your interests and the interests of other users?

We see potential conflicts occurring with the Harbor District over the protection of public trust resources in Humboldt Bay, because we believe they are not carrying out their mandated responsibilities. At present, the major conflicts that are occurring concern aquaculture impacts on eelgrass beds, dredging, illegal filling of public trust tidelands, and degraded water quality due to point and nonpoint source runoff.

We do not want a marine terminal sited at Fields Landing or at Humboldt Bay Forest Products, a business located on illegal fill within state tidelands. We do not support any dredging in South Humboldt Bay. We believe future development should be sited at more appropriate locations in Entrance Bay.

5. Are there regional issues you believe the HBMP needs to address?

Humboldt Bay is not situated well for serving as a major import/export harbor for heavy cargo and industry; it is located too far away from other urban centers, and the environmental coast to the bay would be unacceptable. We believe the highest and best use of Humboldt Bay is as a major research facility on estuarine systems, as well as a tourism and recreation destination center for northern California. Humboldt Bay is extremely well positioned to serve this function.

Thank you for the opportunity to comment.

Sincerely,

Christine Ambrose
Coastal Advocate

April 29, 2001

Dear Jeff:

I wish to thank you for the opportunity to attend and speak at the Humboldt Bay Management Plan Task Force Meeting on Mariculture. It is was interesting to hear the comments from the different growers in the Bay. I would like to document my comments about the future of Mariculture in the Bay, some of which were said at the meeting and some are new.

1) I feel that Humboldt Bay has great potential for mariculture expansion but based on public opinion, number of permits needed, plus large number of agencies involved I doubt that there will be much expansion of mariculture in the Bay. I noticed the Greg Dale is a panel member and could elaborate about this problem. He had to change his whole system of growing oyster due to permit problems, envionrmental concerns, fishermen's objections, and a HSU MS study. Fortunately, Coast Seafood was able to survive but any new company initiating mariculture in the Bay would more than likely not even be able to get started.

2) I believe pen rearing of fish could be done in the Bay but public outcry would probable kill it especially if it is Salmonids. Canada is pen rearing steelhead which are sold at our local grocery stores. This could be done in the Bay.

3) I believe we should pen rear Chinook salmon smolts in pens to imprint them. The fish would then be released and two or three years later they would come back to the Bay for sportfishing (See attached article related to this). Actually, this is being done in

Freshwater Creek by the Fish Action Council. The young chinooks are released in the creek and they return several years later. This is called ocean ranching.

4) We should look at the possibility of reseeding our sport clam flats. Ted Kuipere's operation could be involved. Also you should look into the opening of some of South Bay to mariculture.

5) Look at the possibility of farming California Halibut. This would be a land bases operation since this species is not grown in floating pens. Research on this species would first be done by HSU Master students using the excellent HSU faculty at Trinidad. In fact HSU should be more involved with mariculture. I noticed that not one HSU fishery instructor was at the meeting.

6) I am not sure how much more oysters can be grown commercially in the bay. Studies need to be done on the carrying capacity of the Bay. There is only so much phytoplankton out there and if we increase oyster production we might not have enough natural food.

7) The establishment of a public oyster bar is an interesting concept but working out the logistics might be a nightmare.

8) Finally, get rid of all the cows grazing in our local coastal zone. They are polluting the bay with their e-coli after every rain.

Sincerely,
Bill Shaw
William N. Shaw

College of the Redwoods

Aqua/Fish Program

HBHR&CD

MAY 01 2002

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Appendix J

Public Comments on the Humboldt Bay Management Plan Draft, March 2005

Written comments received from the public on the Humboldt Bay Management Plan Draft, March 2005 are presented in their entirety in this Appendix J.

Comments were received from the following individuals:

Milton J. Boyd
Pete Oringer
Christine Ambrose, *Environmental Protection Information Center*
Susan C. Schlosser, *University of California Cooperative Extension Sea Grant*
Andrea Z. Davis, *Table Bluff Reservation Wiyot Tribe*
David Ammerman
Margaret Herbelin & Robert Rasmussen, *The Humboldt Bay Stewards*
Jennifer Kalt, *California Native Plant Society*
Dan Hauser, *City of Arcata*
The Humboldt Surfriders
Gordon Leppig
Sharon Kramer & Susan Schlosser, *Humboldt Bay Scientific Advisory Committee for Estuarine Restoration*
Rodney R. McInnis, *National Marine Fisheries Service*
Patty Clary & Noelle Johnson, *Californians for Alternatives to Toxics*
Robert Frye
Kelley Reid, *United States Army Corps of Engineers*
Scott Sterner, *North Bay Shellfish*
Aldaron Laird
Craig Spjut
Pete Nichols, *Humboldt Baykeeper*
Chet Ogan, *Redwood Region Audubon Society*
David Elsebusch
Kyle Wear, *Center for Natural Lands Management*
Chet Ogan
Todd Van Herpe, *Humboldt Bay Oysters*
Lisa D. Shikany, *City of Eureka*
Leslie Heald, *Humboldt Heritage Professionals Network*
Mike Wilson
Ted Kuiper, *Kuiper Mariculture, Inc.*
Peter La Vallee, *City of Eureka Resolution 05-10*
Tera Prucha
Martha Spencer, *County of Humboldt*
Christine Ambrose, *Environmental Protection Information Center*
Michael M. Long & Eric Nelson, *United States Department of Interior Fish and Wildlife Service Humboldt Bay National Wildlife Refuge Complex*
Tamara Gedik, *The Dunes Forum*
Ruth Blyther, *Natural Resources Services Redwood Community Action Agency*
Diane Fairchild Beck, Melvin McKinney & Tim McKay, *Sierra Club*
Andy Colonna
Vivian Helliwell, *Pacific Coast Federation of Fishermen's Association*

Milton J. Boyd, Ph. D.
1400 Hilfiker Drive
Arcata, CA 95521-5113

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MAR 17 2005
H.B.H.R.& C.D.

Humboldt Bay Harbor, Recreation, and Conservation District
P. O. Box 1030
Eureka, CA 95502-1030

March 17, 2005

Attn: Jeff Robinson, Conservation Specialist

Dear Jeff:

I was most pleased to receive the Draft Humboldt Bay Management Plan last week and plan to attend the Workshop today at 7 p.m. Unfortunately, I have had little opportunity to do more than a rapid scan of the 3 volumes that comprise the Draft Plan.

I am very hopeful that there will be a number of other opportunities to comment on the Draft Plan. The cover letter accompanying the Plan seems to suggest that comments should be sent to you up until the meeting today. I do hope many more opportunities will be scheduled for public input.

Yours most sincerely,

Milton J. Boyd

Comments from Pete Oringer
Revised: March 17, 2005
Phone: 707-822-0783; e-mail: oringer@humboldt1.com

Additional Inclusions for the Humboldt Bay Management Plan

The following are ideas that need to be incorporated in to the Management Plan. These were garnered from the Humboldt Bay Symposium, HSU March 14-15, 2005.

General ideas to convey within the Management Plan:

- Humboldt Bay region is relatively small and unspoiled and hence still manageable.
- We have a great deal of local expertise to help us make environmental and recreational management decisions.
- Periodic review of the Plan.
- Periodically measure how well goals meet objectives with in the Plan.
- Integrate the CEQA/NEPA thinking process into the Plan process.

Exotic (invasive) species:

Work with other agencies to:

- Prevent arrival.
- Block spread.
- Reduce/eliminate population.
- Mitigate impacts.
- Vector identification.
- Develop a decision tree to help guide management in dealing with an invasive species alert.

Reminder Memo: Ask Chad about:

1. Keeping an eye on Carex (sp?), which is locally present and has been observed locally to have the potential to clog channels. Although this is a CNDDB listed sensitive species, it has the potential to cause problems locally.
2. Location where Carex may become a potential problem.

Barging:

- Upgrade Ballast water inspection programs.
- Periodic inspection programs for barging operations.

Need to build Trust

- Need to build trust between the Harbor Commission, stakeholders, public and most of all, the people in the environmental communities (includes both general the general public and professionals).

Comments from Pete Oringer
Revised: March 17, 2005
Phone: 707-822-0783; e-mail: oringer@humboldt1.com

Recommendations for the Humboldt Bay Draft Management Plan

The following are recommended modifications to the March 2005 Draft Management Plan

Executive Summery

- In the mission statement page (ES-6) add "recreation" "*Provide framework for balancing and integrating conservation* <u>*and recreation goals with*</u> *economic opportunities…etc. This addition had been previously been agreed to at a taskforce meeting.*
- The Ex. Summery should be an overview that summarizes the overall findings, policy and philosophy of the master document like a book review does. This seems to be an introduction that includes a roadmap in the format of a table of contents. If is the *Document Format* information included in the Exec. Summery it needs be included in a much-abbreviated form. Maybe it should be abbreviated and moved and included as a Prolog to the V 1 Introduction. The Summery section clearly needs to be appropriately beefed up to be a more traditional "Summery".
- Incorporate the bulleted (•) outlines of the three parts of the Plan and also the outlined format used to describe the Vol. 1, 2 and 3 in the *Document Format* in the Ex Summery into V. 1; 10.4 Plan Organization (p 1-30).

Volume II

- 4.1.2 use the term European and pre-European:
  - Add post-European (page 4-5 ¶-2 line 7) *The salt marshes present at the time of European settlement…etc.*
  - (page 4-5 ¶-4 line 6) Replace "pre-settlement" with pre-European settlement.
  - IBID on the underlined paragraph headings of page 4-5 ¶ 5
  - IBID……………………………………………………page 4-6 ¶ 3

Phone: 707-822-0783; e-mail: oringer@humboldt1.com

Volume III

- 4.5.2 Policies
  - RSA-2 ¶ 2 & 3 on p 4-11. Divide into two sentences.
  - IBID RSA –4 Policy statement.
  - RSA-9 page 4-12 under Policy add to the last line: "and shall encompass appropriate environmental consideration".
- Vol III 5.1.0 Many of the Policies address the narrower subject of the "aquatic ecosystem". Should we just be saying "ecosystem" and not restricting our statements to the "aquatic ecosystem"?
  - Remove the word "*aquatic*" from the titles of: CAE-1, CAE-3 pages 5-4 and 5-5.
  - CAE-3b page 5-5 IBID (remove Aquatic)
  - CAE-3 d page 5-6 IBID (remove Aquatic)
  - 5.3.0 "*Aquatic Species Management*" page 5-7 IBID (remove Aquatic)
  - 5.3.1 CAS-2 has a citation error. The last sentence of the Discussion should cite "Section 3.5 of this Plan" not Section 2.5
  - CAS-4 page 5-9 Discussion. Remove the last four words in the first line. Remove the words: "*in the receiving waters*". There is no reason to restrict this to "*the receiving waters*"
- 5.4.0 Humboldt Bay Ecosystem Management Program Elements: Consider including:
  - It would be appropriate to instill the concept of investigating, fostering, sanctioning or establishing a "Mitigation Bank"
- 5.4.2 CEP-1 Policy. Add the word " other areas or" to the last section of the first line of the Policy statement so that it reads: " ….*and other areas or open coastal waters under the District's jurisdiction only for the following*" This would allow the District to include filled, developed and upland areas that are under the District's control.
- 5.4.2 CEP-1 Discussion. Remove the word "*aquatic*" from the end of the last line of the Discussion section.
- 5.4.1 Goals are OK but the objectives don't foot well with the Goals
- 5.4.2 does not correlate or foot well with 5.4.1

March 17, 2005

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MAR 17 2005
H.B.H.R.& C.D.

Jeff Robinson
HarborDistrict Board of Commissioners
Humboldt Bay Harbor Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

ATT: Jeff Robinson, Resource Specialist

epic

RE: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners:

The Environmental Protection Information Center (EPIC) would like to offer the following comments on the Draft Humboldt Bay Management Plan for your consideration. The March 2005 Draft Humboldt Bay Management Plan (hereafter referred to as the "Draft Plan") contains three volumes outlining the background and history, the setting, and the proposed policies by the Humboldt Bay Harbor Recreation and Conservation District (hereafter referred to as the Harbor District) for Humboldt Bay, along with supporting appendices. The actual policies in the Draft Plan for Humboldt Bay are contained in Vol. III, the Policy Document. This document also incorporates by reference the Harbor Revitalization Plan and the Strategic Plan.

GENERAL COMMENTS

1. Public Input Process

The period for public comment is inadequate. It has not been properly noticed and insufficient time has been provided. According to one written announcement of availability and request for comments provided with the Executive Summary at the Humboldt Symposium, comments are due on the Draft Plan to Jeff Robinson and the Harbor Commission by March 17, 2005. While your consultant Chad Roberts verbally stated on March 15, 2005 that the comment period does not end March 17, and that review under the California Environmental Quality Act will take place, it was not clear if he had authority to speak on behalf of the Harbor District. The poorly defined and rather ambiguously stated public comment period pursuant to applicable laws for this Draft Plan has left many members of the public, including the Environmental Protection Information Center, unclear as to when and how public input will be formally considered, and left us no alternative but to submit abbreviated comments due to the extremely short time frame by March 17, 2005. We are not able to fully identify issues and provide evidence as to the environmental impacts which may occur from this project given the inadequate opportunity for public review and comment. Nor is EPIC able to provide sufficient comment on other legal issues. EPIC is providing these comments in a good faith attempt to participate in the process, but wants to underscore that a meaningful opportunity to provide review has not been given. EPIC and the public cannot provide meaningful comment in such a short time frame, and therefore request that at a minimum, the comment period be extended for an additional 30 days. We also reserve the right to submit supplemental comments in the future.

We also believe that the public input process has been flawed from conception, in violation of the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), the California Coastal

Act. The Federal Clean Water Act of 1977 (CWA) (33 USC § 1251 *et seq.*), the Federal Endangered Species Act (FESA), the California Endangered Species Act (CESA), and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996. We are not clear as to how the Harbor District proposes to comply with CEQA/NEPA and the other above mentioned laws. Given the substantial public investment has been made in providing both federal and state funds (USEPA grant funds & state Coastal Conservancy funds) for completion of this draft plan, we believe that clarification on this point is in order. We are also concerned that the Draft Plan (similar to the Harbor Revitalization Plan and the Strategic Plan) will be completed prior to any formal comment review periods, making it difficult if not impossible to provide any meaningful public input to either the Draft Plan itself or the environmental review required by law. The intent is for environmental review of a given plan to occur concurrently with plan development so that the environmental review can inform development of the plan. We question the segmented nature of the review. In sum, the Harbor District is putting the proverbial cart before the horse.

If in fact there is to be an additional opportunity for public input, please provide the timeline for formal review of the Draft Plan, the Harbor Revitalization Plan, and the Strategic Plan pursuant to CEQA and NEPA, and place EPIC and the undersigned on all "interested persons" lists to receive any and all notices related to these planning processes.

3. NEPA and CEQA Review

We believe the Harbor District has taken a fragmented and truncated approach to public input and environmental review of the least damaging alternatives within the Humboldt Bay Management Plan, the Strategic Plan, and the Harbor Revitalization Plan. We have repeatedly asked for clarification as to how the Harbor District plans to comply with CEQA in particular (Harbor Revitalization Plan Comments - June 23, 2003, Humboldt Bay Management Plan Task Force meeting comments - January 22, 2002, Strategic Planning Comments - August 24, 2001 herein incorporated by reference). We believe that an EIR/EIS is required for the Draft Plan, the Strategic Plan, and the Harbor Revitalization Plan due to potential substantial adverse impacts on the environment including the potential visual, terrestrial, air, water, wildlife, fish, sensitive, threatened, or endangered species, biodiversity, long-term productivity of the environment, and biological impacts that could occur as a result of the proposed policies. In addition, we are concerned that public health and safety, quality of life, irretrievable and irreversible commitment of resources, endangered species impacts, marine and fisheries issues, archaeological issues, transportation, circulation, introduction of aquatic nuisance species (ANS) and cumulative effects issues have not been adequately addressed.

The Harbor District is proposing policies in the Harbor Revitalization Plan, the Strategic Plan, and the Humboldt Bay Management Plan which support transformation of Humboldt Bay into a large, heavy industrial port. There has been little if any discussion about the cumulative environmental impacts of changing Humboldt Bay from a largely resource and recreation based economy into a heavy industrial Port based on global economies. Nor do these plans consider the additional and cumulative effect of the policies provided in the Humboldt County General Plan update which is currently taking place. Many of the adverse environmental effects would be unavoidable, yet there has also been little if any analysis of what irretrievable commitments of resources might be for Humboldt Bay. The Harbor District must identify and evaluate in its analysis of environmental effects the likely scenarios for port development being considered so that the public can adequately weigh the costs and benefits of a realistic development scenario. The draft plans fail to provide meaningful presentation of alternatives to a heavy industrial port, such as developing a restoration based economy, or capitalizing on the recreational and science potential of the bay. Given the size, location, depth of channels and hazardous conditions, fog, lack of rail, and relative isolation of Humboldt Bay from other major ports, there clearly are other more reasonable and appropriately scaled alternatives for the Bay. The short-term uses of a heavy industrial Port could potentially destroy the fragile and environmentally sensitive bay habitats in a relatively short time, well before it would be known if development as a major industrial Port is successful or not. There has been little if any discussion about what resource values would be lost permanently in Humboldt Bay.

2. Harbor District Authority

We believe that the Harbor District has overstepped its authority within the Draft Plan in areas outside of the navigable waters of Humboldt Bay, as stated in the following section,

"Under section 4 of Chapter 1 of Appendix II of the Harbors and Navigation Code the District, as a specialized agency and a political subdivision of the State of California, the District is granted police power authority to regulate the tidelands and lands lying under the ***inland navigable waters*** of Humboldt Bay for the promotion of commerce, navigation, fisheries and recreation thereon, and for the development and protection of the natural resources of the area." (emphasis added).

Based on the above section, it could reasonably be argued that the Harbor District is only authorized to exercise police power authority over "inland navigable waters. We believe that the Harbor District Plan regulatory and planning boundary is drawn incorrectly and should be redrawn to reflect its regulatory and police power authority to the navigable extent of Humboldt Bay, not Mean Higher High Water (MHHW). At a minimum, we believe that the Harbor District has overstepped their authority as authorized by the State Lands Commission and their implementing legislation to plan or propose any activities above the MHHW elevation. It is clear that the Harbor District only has regulatory authority to this MHHW elevation and cannot dictate the future planned uses or policies above this elevation. The Humboldt Bay Area Plan of the Humboldt County Local Coastal Program is the policy document that supercedes any and all proposed land use changes or designations that the Harbor District has outlined within the Draft Plan on lands outside of navigable waters. The Draft Plan should be rewritten to reflect this distinction and the limits of the Harbor District authorities. At the same time, there is little recognition of the fact that Harbor District policies and plans are subject to consistency review with the California Coastal Act and that the Draft Plan must be reviewed and approved by the California Coastal Commission before it can be implemented.

SPECIFIC COMMENTS ON VOL. III, POLICY DOCUMENT

In general, the policy document is vague, lacking sufficient detail about the impacts from the Draft Plan. In addition, the draft plan reads more like a draft program of work for hired consultants than a plan for Humboldt Bay. There are numerous plans, inventories, strategies, etc... proposed, with no timeline for completion, no discussion of how public input will be included, how and when these documents will be reviewed for compliance with CEQA and other applicable laws, and no discussion as to the scope and nature of these plans. The following plans and projects are proposed within the draft plan:

Site specific management plans and other work products on Harbor District property which are still subject to Coastal Act and CEQA review:

1. Woodley Island
2. The Buhne Point/King Salmon restoration area
3. The Fields Landing boat repair facility/Kramer dock
4. The Park Street Mitigation Site
5. Samoa Redwood Dock facility

Inventories:
1. Inventory of shipping terminal facilities

Standards:

1. standards and guidelines for shoreline development and maintenance structures ; Humboldt Bay Blue Book.

Long Term Maintenance Strategy
1. Long Term Maintenance Strategy For Dredge Spoil Disposal (Vol.III, pg.3-12).

Sediment Management Program or Approach (Vol. III, pg.3-12).

Public Interpretive Center (Vol.III, pg.4-13)
Bay View Plan or Map (Vol.III, pg.4-15)
Enhancement Plan (Vol.III, pg.5-5, Policy CAE-3)
Restoration and enhancement plan for Humboldt Bay's aquatic ecosystems (Policy CAE-3, Vol.III, pg.5-5)
Water quality maintenance plan (Policy CAE-4, Vol.III, pg.5-6)
Native biological diversity plan (Policy CAS-1 (Vol.III, pg.5-7), for incorporation-fish, invertebrate, and plants

1. Water Use Designations

The Harbor District proposes four water use designations: harbor, conservation, recreation, and a mariculture combining zone. We provide additional comments on the Harbor designation in subsequent sections.

The conservation designation proposes authorizing educational and scientific studies that include manipulating the environment. We have serious concerns about this provision, given the Harbor District track record of facilitating development in Humboldt Bay and using scientific studies as a cover for continued destruction of Public Trust resources, such has been the case in mariculture. We believe that manipulating the environment of Humboldt Bay should not be an authorized use and should be subject to discretionary permits depending upon the size, location, intensity, and duration of the project.

Fields Landing Channel Harbor Water Use Designation: During the initial public meetings held by the Draft Plan Task Force, there were numerous concerns expressed by both regulatory agencies and the public over the proposed water use designation of "Harbor" for the Fields Landing Channel. Many reasons were given why the Fields Landing Channel water use designation from "Harbor" to bay conservation is more appropriate. These include: a major faultline runs parallel to the shoreline, representing a significant siting hazard for any industrial facility; the Fields Landing Channel is located in South Bay, which is primarily lands of the Humboldt Bay Wildlife Refuge, which has significant environmentally sensitive resource values that would be at risk from potential industrial Port related activities; the channel is inefficiently located away from other Harbor water use designations, which makes it expensive and the least cost effective channel to maintain. Tax dollars would be better spent on efforts to reduce sediment in the upper portions of the watershed, rather than in maintaining the Fields Landing Channel. Many of the docks are in extremely poor condition, and would have to be replaced to function properly. The community is much better served in the maintenance of this area for recreational boating use, which would not require constant dredging to maintain adequate depths. The King Salmon area also represents a significant source of water pollution in Humboldt Bay due to numerous failed septic systems. Rather than develop a plan for buying out theses residents and eliminating a public nuisance, the Harbor District proposes to enhance development in this area by proposing to assist residents in dredging the channels. We are disappointed that the Harbor District is not considering other options that would eliminate this public nuisance and water pollution hazard to Humboldt Bay.

Mariculture Combining Zone: We object to the size and configuration of this water use designation in Arcata Bay, given the sensitive resource values that are at risk and the conservation designation. While only approximately 300 acres of mariculture are currently taking place, approximately 3,950 acres of Arcata Bay would be encompassed under this water use designation (Vol.III, pg.3-16). Much of that 3,950 acre area contains *Zostera marina* (eelgrass), an environmentally sensitive habitat adversely impacted by mariculture activities. Longlines used in mariculture shade the eelgrass, and increase sedimentation, altering bay mud elevations and the optimal elevations in which eelgrass thrives. However, some of the approximately 4,000 acres does not contain eelgrass. There is no evidence to date that mariculture activities must take place in eelgrass beds, particularly now that most of the aquaculture is taking place on longlines and rack and bags rather than directly on the bay muds as ground culture. We believe that aquaculture activities should be confined to areas outside of environmentally sensitive habitat areas such as eelgrass beds and native oyster and clam bed reserves located in the southernmost portion of the mariculture combining zone and in the Mad River Slough. In particular, aquaculture should not be allowed between -1.5' and +1.5' elevations in eelgrass beds, the optimal elevation for eelgrass. The Mad River Slough should also be closed to mariculture activities due to the sensitive environmental resources present - the marsh islands contain some of the best salt marsh habitat left in Humboldt Bay - and one of two significant native oyster populations in Humboldt Bay are found there (Milton Boyd, personal communication, 2005).

We are concerned about public health and safety being protected from exposure to consumption of toxic oysters loaded with pentachlorophenol in this area. The Sierra Pacific Industries Mill on the Mad River Slough has polluted the waters of the state with pentachlorophenol and dioxins, which are known carcinogens. The Harbor District has a responsibility to protect the public health and safety from known threats. Contamination in Mad River Slough is a known threat to public health and safety. The Harbor District could also be considered liable for allowing continued mariculture activities in areas commonly known to contain toxic levels of carcinogens.

HARBOR ELEMENT PLANNING POLICIES

The California Coastal Act is clear that while commerce and port development are important to the state of California, protection of the environment is also of paramount importance as well, as stated in Coastal Act section 30230.

"Marine resources shall be maintained, enhanced, and, where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

The Harbor District does not recognize this important section of the California Coastal Act in the Draft Plan policies and direction contained within the Harbor water Use designation and other sections of the draft plan, in violation of the California Coastal Act. We believe that the draft plan should be rewritten to reflect the direction of the California Coastal Act, so that uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes, including within the Harbor water use designation.

Much of the bayshore area along the Fields Landing channel has also been illegally filled, and should therefore still be considered Public Trust property not subject to industrial Port development but rather should be subject to reparation in any future proposed activities. We request that HLU-3 and HLU-4 (Vol.III, Section 3-4.5) delete the Fields Landing Channel from this section. Potential constraints for marine dependent or coastal dependent land uses that are in place for this area are reasonable and economically prudent, and it would be fiscally and environmentally irresponsible of the Harbor District to pursue any additional plans for port development in this area in the future. The Harbor District essentially proposes to reward and sanction this illegal filling activity by creating additional incentives for development and immunity from the law in the Fields Landing Area. We believe this is in direct violation of the Coastal Act, section 404 of the Clean Water Act, and violates the public trust.

Dredging and Waterway Maintenance

The harbor designation seeks to significantly expand the Harbor District's authorities in terms of dredging, by changing policies from maintenance dredging, to the dredging of new and deepened channels ((Voll. III, 2-5, no. 3). We believe that combined with past and current dredging activities that are already impacting Humboldt Bay, that this activity would result in significant adverse impacts on the Humboldt Bay estuarine system, an an overall adverse cumulative effect, in violation of the Coastal Act section 30233(c), which states that, "diking, filling, or dredging in existing estuaries and wetlands shall maintain or enhance the functional capacity of the wetland or estuary." We believe that the Harbor District has not adequately considered the adverse impacts of dredging on the Humboldt Bay environment through resuspension of toxic wastes, increased turbidity, smothering of eelgrass beds, and disturbance and smothering of benthic fauna.

The Harbor District has spent thousands of dollars commissioning studies as to the potential siting and location of future dredging proposals, and knows where either new proposed channels or deeper channels would be located. The Harbor District also knows exactly how deep they would ideally like to dredge the entrance channel and other channels within the bay. According to some reports, cargo ships are getting substantially larger, and now require a draft of 50' rather than 45'. There has been some concern that the integrity of the jetties would be compromised if the entrance channel was dredged to any greater depth, particularly in the event of an earthquake, and there have also been questioned raised as to whether it is economically feasible or even physically possible to maintain the channel at such a depth given the significant amounts of sediment transport that take place in this area that require constant dredging. Yet the goal of the Harbor District is to assure that the harbor "be maintained at depths suitable for commercial vessels in use in the world today"(Vol.III, section 3.4.1, pg.3-9). We believe that if the Harbor District is proposing either new or deepened channels, those proposals should be included within this draft plan. Otherwise the Draft Plan lacks sufficient detail for us to determine what the impacts would be from the proposed action. We would also like to take this opportunity to remind the Harbor District that while the Harbor District does have a clear direction to for "the promotion of commerce, navigation, fisheries and recreation thereon," the Harbor District also has a clear direction "for the development and protection of the natural resources of the area" as stated in the Harbor District's implementing ordinances.

Note: There have also been discussions taking place about the Harbor District potentially purchasing the property known as the "dogranch" owned by Simpson in order to facilitate dredge spoils disposal of toxic dredge spoils from the Woodley Island Marina. We are very concerned about this proposal, and object to the Harbor District attempts to thwart conservation efforts by Friends of The Dunes to purchase this parcel for conservation and recreation purposes. The Harbor District should restrict its activities to parcels below the navigable water line and should not be attempting to purchase pristine dune ecosystems with rare and endangered plants and animals present, given the Districts poor track record of land stewardship on other sites around Humboldt Bay.

COMMERCIAL FISHING AND AQUACULTURE

Once again, we would like to remind the Harbor District that Coast Act policies supporting aquaculture do not exist in a vacuum; aquaculture must be balanced with other Coastal Act provisions that require protection and maintenance of resource values. Mariculture poses the potential threat of additional ANS introduction in Humboldt Bay. It is widely recognized that ballast water is not the only significant source of ANS introduction, yet the Harbor District does not address this issue in any of the policies related to mariculture activities for Humboldt Bay. There is no mention in the draft plan of this potential ecological and economic threat to the resources of Humboldt Bay, other than in the objectives on pg. 3-14,(Vol.III). This objective does not explicitly address the importance of controlling and preventing ANS introductions from occurring in the bay. The Harbor District should be taking a more active role in preventing further ANS introductions into Humboldt Bay from all sources, including mariculture. It is in the best interests of mariculture and the other fishing industries of Humboldt Bay to prevent further introductions of ANS, particularly if these introductions are by aggressive species that foul motors and boats, and out compete native species. We believe the Draft Plan should include additional policies and discussion to address this pressing and important issue to Humboldt Bay.

We are concerned that mariculture operations are becoming increasingly intrusive to the Humboldt Bay system, particularly now that floating nurseries, FLUPSYs, and other off-bottom culturing techniques are now being used. We believe the visual impacts, the increased hard substrate for ANS, potential impacts on essential fish habitat and critical habitat and the navigational hazards presented by these structures are a significant concern and should not be an authorized use in such a large area, which would be in direct violation of the California Coastal Act. The mariculture combining designation should be significantly reduced in size in order to prevent the mariculture industry from overly polluting the bay with structures, other navigational hazards and to protect the eelgrass beds from unnecessary impacts. We also believe that the current configuration of mariculture permits constitutes unfair business practices, since it gives Coast Seafoods virtually a monopoly over the entire bay except for fringe areas and the Mad River Slough. We believe that the permit system should be modified to allow others to cultivate in Arcata Bay, which would eliminate the need for mariculture activities in Mad River Slough, which should be closed to mariculture activities. If Coast is only cultivating 300 acres in Arcata Bay, surely they can let some of the smaller cultivators to operate in the bay as well.

We are concerned that aquaculture activities will have an adverse impact on Essential Fish Habitat (EFH) and federally listed species in Humboldt Bay, in violation of the MSFCMA and the ESA. The fish species in Humboldt Bay affected by EFH include the following:

Engraulis mordax, Sardinops sagax caeruleus, Triakis semifasciata, Galeorrhinus zyopterus, Squalis acanthias, Raja binoculata, Ophidon elongates, Scorpaenichthys marmoratus, Hexagrammos decegrammus, Sebastes melanops, Sebastes mystinus, Sebastes paucispinis, Sebastes auriculatus, Sebastes caurinus, Sebastes rastrelliger, Sebastes miniatus, Sebastes flavidus, Isopsetta isolepis, Microstomus pacificus, Citharichthys sordidus, Psettichthys melanostictus, Platichthys stellatus, Oncorhyncus kisutch, and *Oncorhyncus tshawytscha.* The last two species *Oncorhyncus kisutch,* and *Oncorhyncus tshawytscha* are also federally listed under the Federal Endangered Species Act.

We are also concerned about the combined cumulative effects of mariculture and port development on EFH and Federally listed fish species in Humboldt Bay, and believe that the draft plan does not provide policies or direction that will adequately address these concerns. According to joint U.S. Fish and Wildlife Service (USFWS) - National Marine Fisheries Service (NMFS) regulations, the environmental effects of a proposed action refers to "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 CFR § 402.02) (USFWS and NMFS 1998).

We believe that the policies in the draft plan that disproportionately support port development will also compromise the significant fisheries and listed fish species of Humboldt Bay, would could potentially adversely impact the fishing industry and the local economy as well.

TOXIC MATERIALS

The stated goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (33 USC § 1251(a)). To achieve this goal, the CWA establishes several objectives related to the discharge of pollutants into waters of the nation, and requires the development of comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters (33 USC §§ 1251-1252).

We are concerned that the toxic materials section lacks any mention of the ongoing water pollution sources in Humboldt Bay, some of which are extremely toxic, and a threat to public health and safety, such as sites of pentachloraphenol contamination (Attachment 1-map of pentachloraphenol sites by EPIC and CATS, 2002). Many of these sites should be a priority for cleanup efforts around the bay since they threaten water quality and have caused elevated levels of dioxins in commercial oysters, shellfish, and other bottom feeders, and could potentially bioaccumulate higher in the food chain among other fish species. We request that the Harbor District add policies and provisions to address the sites of ongoing contamination around the bay, especially around areas that are proposed for dredging. We also believe that the Harbor District should add additional provisions to ensure that public health and safety as well as water and air quality are adequately protected in the event of port development, since those sections are currently missing from the draft plan. We are also concerned that the draft plan does not include any policies that would address the potential for increased risk of spills from port development and increased shipping in Humboldt Bay. We are also concerned that the Harbor District does not include any mandatory provisions for ballast water treatment, or inspections of ships coming from San Francisco and other polluted Harbors to ensure that they have been adequately cleaned of potential ANS prior to entering the bay. There is no consideration of a ballast water treatment facility to ensure that toxic organisms do not enter Humboldt Bay via ballast, a request that was repeatedly voiced in meetings with the Harbor District in the development of the strategic plan, the Harbor revitalization plan, and the Humboldt Bay Management Plan. There is no reason why the Harbor District, in its pursuit of port development, should not be seeking to minimize the environmental impacts to the maximum extent practicable, which would include a ballast water treatment facility.

There is also no mention of developing contingency plans for anything other than oil spills in Humboldt Bay. While oil spills are undoubtedly a significant threat, there are other hazards as well that may warrant contingency plans in the future, and the policies and draft plan should reflect this concern.

REGULATORY STREAMLINING

We object to any reduced regulatory review by the local, state, and federal agencies, as proposed in Policy HSM-3, Vol.III, pg.3-8, and policy HRS-1, pgs. 3-19 & 3-20. We do not believe that the Harbor District has the expertise or the regulatory authority to streamline permit review. While these reviews may be cumbersome at times, they are important for ensuring that the public health and safety is maintained and balanced with the needs of the environment. We believe that any changes to the regulations as currently implemented would result in a significant impact on the environment and jeopardize public health and safety. Perhaps most importantly, the Harbor District lacks the jurisdiction in these areas, and is overstepping their police power authorities by proposing to streamline regulations. The proposed permit streamlining is also so vague that is it impossible to know what the actual proposed impacts may be, and how they will impact the environment and our public health and safety in Humboldt Bay.

RECREATION

While the overview section recognizes the importance of the Public Trust doctrine and that the Harbor District is responsible for maintaining the public's right of access to the bay, the policies do not reflect this legal obligation on the part of the Harbor District to maintain public access for all Californians to the bay. We do not believe that coastal dependent industrial or commercial uses should take priority over recreational access and use anywhere in Humboldt Bay as proposed in Policy RFA-4, (Vol.III, pg.407), and believe that this may constitute a violation of the Coastal Act and the Public Trust doctrine. We believe that maintaining the public's right of access to the bay is a basic tenet of the California Coastal Act that may arguably supercede over all other coastal dependent uses. The draft plan is significantly biased towards port development, at the expense of public access and all other resource values. We believe this emphasis is inappropriately placed and violates the Public Trust doctrine. The draft plan should be revised to reflect the importance of maintaining coastal access, and include additional policies beyond RFA-1 (Vol.III, pg.4-6) to ensure that safe and appropriate public access to Humboldt Bay and to use Humboldt Bay are given greater weight in plan policies and implementing ordinances.Policy RFA-4, (Vol.III, pg.407) should be deleted in its entirety.

The recreational water use designation in the draft plan dedicates an alarmingly small area for recreation. Given that the Arcata Marsh within Arcata Bay is a popular launching spot for windsurfers, we believe that the overlay zone for Arcata Bay should be recreation, not aquaculture. Windsurfing is a compatible use with eelgrass beds, and is a more appropriate use of the area than aquaculture. This change in designation would make the draft plan more consistent with the Public Trust doctrine.

We do not believe that limited amounts of fill for recreational purposes should be authorized by the draft plan due to the potential significant environmental impacts, and request that RFA-8 should be struck in its entirety. There are already enough illegally filled locations in Humboldt Bay that as part of reparation could be converted to coastal access points.

Policies related to improvement and provision of boat launch sites should take into consideration their location relative to environmentally sensitive resource areas. If these boat launch sites are located close to environmentally sensitive resource areas, they should either be relocated or appropriately scaled to the site.

INTERPRETATION AND PUBLIC OUTREACH

We are concerned that the District is proposing to develop a public interpretive center at the Woodley Island Marina, which could have a significant adverse impact on marine and estuarine resources. While we support the concept of an interpretive center, there are many filled sites around Humboldt Bay that could provide the ideal location for such a facility without further impacting bay resources. For example, Parcel 4 in the City of Eureka would be an ideal site to locate a public interpretive Center, rather than at the Woodley Island Marina. We are disappointed that the draft plan has so little detail that we can only speculate on what the Habor District proposes to do in the future in terms of siting such a facility. Here is a project that could garner significant public support, yet the Harbor District is so used to being secretive and working without public input that we can often only conclude the worst.

We are also concerned that the Harbor District is not considering developing Fields landing as a potential recreational site. We think this site would provide ideal recreational opportunities; unfortunately the Harbor District has made it clear that they intend instead to make this a coastal industrial dependent site, with expected high levels of contaminants and other hazards that would make public use incompatible in this area. Once again, we encourage the Harbor District to reassess their proposed uses for this site, given the significant resource values present in South Bay, and the policies that *are currently in place* that support recreational use in South Bay.

CONSERVATION POLICIES

There are no policies related to ensuring that air and water quality are maintained in the Humboldt Bay air basin and the Humboldt Bay region.

We are concerned that the Harbor District is already in violation of one its essential stewardship tasks outlined in the draft plan conservation section, which is the following,

"*Clearly indicating to applicants, decision-makers, agency staff, and citizens the direction of management, the acceptability of potential uses, and the requirements for the District's programs.*" (Vol.III,pg.5-3).

We are still unclear as to when and how the Harbor District will be complying with applicable laws and regulations related to protection of the natural environment. We believe that the Harbor District on a regular basis demonstrates their contempt for meeting its obligations related to managing the trust resources placed in its charge. We are concerned that the Harbor District does not take this direction to heart, and instead continually allows the Public Trust to be eroded through the diking and filling of wetlands, through illegal expansion of port facilities such as at Fields landing into public trust waters of Humboldt Bay, and through ignoring the pollution sources that are degrading water quality and public trust values while threatening public health and safety in Humboldt Bay.

Policy CAE-2 states that the draft plan will protect and maintain environmentally sensitive habitat areas, yet in many portions of the draft plan, it is clear that port development, mariculture, and even recreation supercede any protection provided to the environment from these uses, even if there is an obvious conflict. For example, mariculture is proposed as a combining zone in eelgrass beds. Based on this policy, there is no justifiable reason why any mariculture should be allowed within areas of eelgrass in Humboldt Bay between -1.5 elevation and +1.5 elevation in Humboldt Bay.

We are concerned that the Harbor District does not have the expertise, jurisdiction, or authority to develop a restoration and enhancement plan for Humboldt Bay's aquatic ecosystems. While the Harbor District may have the authority to work on a portion of these lands, much of the wetland and aquatic systems in question are not within the jurisdiction of the Harbor District. We are also concerned that the Harbor District does not have the authority or jurisdiction to develop and implement a water quality maintenance plan for Humboldt Bay, although we do think the development of both a restoration and enhancement plan for Humboldt Bay's aquatic ecosystems and a water quality maintenance plan for Humboldt Bay would be useful and the bay would greatly benefit from their development and implementation.

Aquatic Species Management

It appears that it was the intent of the writer that policy CAS-3 should have been policy CAS-4, and CAS-4 should have been CAS-3 in the draft plan in order for the policy described under "Maintain and enhance habitat for sensitive species to encompass three previous policies, as stated in what is currently CAS-3 , Vol.III, pg. 5-9. We bring this to your attention so that this error can either be corrected or clarified in the next release of the draft plan that authorizes the Harbor District to prepare a plan that encompasses the three previous policies and the policy in which the respective statement currently resides, policy CAS-3. We also suggest that CAS-5 be incorporated into the proposed plan that will be developed, given the controversial and environmentally sensitive nature of placing fill anywhere in the bay below MHHW.

We are concerned that the Harbor District has essentially proposed authorizing that any activity can take place in streams, wetlands, estuaries, and coastal waters for the purposes of port facilities, energy facilities, coastal dependent industrial facilities, dredging, public service purposes, flood control projects, habitat restoration and enhancement projects, nature study, aquaculture, boating facilities, and structural piling for public recreational piers. We believe that this in violation of the CWA, NEPA, CEQA, FESA, CESA, the Coastal Act, and all other applicable rules and regulations. Furthermore, we do not believe that the Harbor District has the jurisdiction and the authority to authorize uses in these areas.

Dredging

According to Policy CEP-2, the Harbor District should seriously be considering eliminating dredging to Fields Landing. By dredging this channel the Harbor District has not limited itself to dredging the smallest area feasible in Humboldt Bay.

Functional Capacity of Aquatic Ecosystems

We request that the Harbor District explain in detail what is meant exactly by Policy CEP-4, "Functional capacity of aquatic ecosystems must be maintained or enhanced." (CEP-4, Vol.II, pg.5-12). While functional capacity is defined as self sustaining and maintaining species diversity, we are not clear on what the Harbor District seeks to maintain or enhance through this policy. If this policy is meant to maintain agricultural farmed wetlands, than it should clearly state it. However, these lands are outside of the jurisdiction of the Harbor District, and this policy would be in violation of the law. If that is not the intent of this provision, we encourage you to more clearly state this policy, and to explain what you intend by establishing a tripartite functional test that the Harbor District will use for verifying the functional capacity. We request that the tripartite functional test be included so that we can provide public input as to whether or not this test is an adequate measure of functional capacity of aquatic systems.

Water Quality

We are concerned that CEP-5 requiring water quality protection does not provide adequate provisions for ensuring that water quality is maintained in Humboldt Bay. While controlling pollution sources at the site, and using non-polluting construction materials is helpful, it does not address the root problem of the types of industries that have unavoidable adverse and extremely toxic effects on the aquatic, terrestrial, air, and human and physical environment. This provision does not provide any direction as to what types of chemicals are acceptable as part of industrial activities, and the types of industrial products that could potentially be manufactured on Humboldt Bay. We are greatly concerned that the draft plan lacks this provision and strongly encourage the Harbor District to correct this deficiency.

Buffer Requirements

We are concerned that the draft plan does not provide sufficient buffer requirements for streams, wetlands, estuaries, open coastal waters, and environmentally sensitive habitat areas within Humboldt Bay such as eelgrass. We believe the Harbor District lacks the jurisdiction to reduce buffer widths below those required by the Coastal Act in Humboldt Bay, and that the plan should be rewritten to reflect this suggested change.

Native American Policies

We are disappointed that the Harbor District so rudely and insensitively chose to ignore the fact that there are numerous cultural sites around the bay, including potentially ones in navigable waters, there are still numerous cultural uses by the Wiyot tribe which give them rights to the fishery and rights to protection of that fishery which have yet to be challenged and recognized. We request that the Harbor District add additional provisions and policies regarding Native American use by a federally recognized tribe in Humboldt Bay.

Implementation

There is simply very little worthy of note in the implementation section of the draft plan, because no information is provided about what types of implementing actions will be proposed, who will be on the advisory committee that is to be formed, and what will be produced. The implementation section simply states that the management plan will be implemented through a general process. It does not discuss what actions will be taken, when the plans outlined in the policy document will be completed, who will complete them, and the timetable for completion. It does not discuss the importance of using this plan to prioritize plans and activities and policies that will be implemented immediately or at some as yet undetermined and future date. This is in spite of the fact that the draft plan states the following, "Many plan elements and policies require the development of supplementary information, and these information elements must be carried out before the specific policies can be fully implemented." If the public does not know which order and when policies will be implemented there is no way for the public and decisionmakers to gage the impacts or the desirable effects, or to be able to see that development will proceed (or not proceed) in an orderly fashion.

We look forward to seeing the revised plan pursuant to all applicable rules and regulations in the near future.

Thank you for your consideration of these comments. We request written response to all concerns. Please provide responses to EPIC at P.O. Box 397, Garberville, CA 95542, and to Christine Ambrose, 611 Richmond Street, El Cerrito CA 94530. Please make sure that EPIC and Christine Ambrose are included on the Harbor District's email and direct mail list and that EPIC and Christine Ambrose are sent to the addresses provided in this paragraph notices of all public meetings and activities. The email address for epic is epic@wildcalifornia.org and the email address for Christine Ambrose is ghizopiaca@yahoo.com.

Thank you in advance for your anticipated cooperation.

Sincerely,

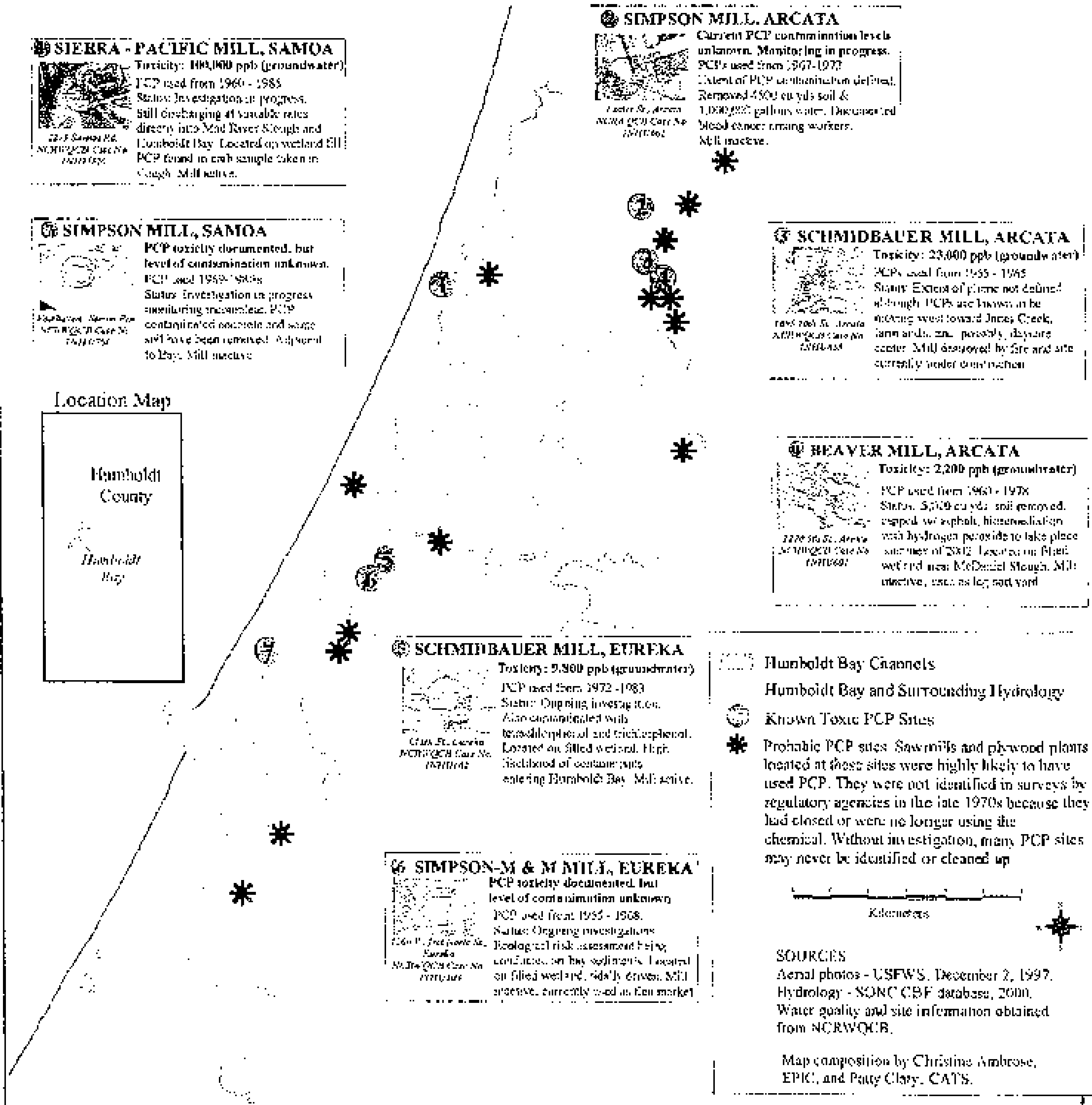
s/sChristine Ambrose
Coastal Advocate, EPIC

Pentachlorphenol (PCP) Sites On Humboldt Bay: Forgotten But Not Gone

TOXIC WASTE

PCP (C_6HCL_5O) is a pesticide used by sawmills from the early 1950s until the mid-1980s to protect wood products from damage by fungi and insects. It is heavily contaminated with dioxins. This chemical compound harms the liver, kidneys, blood, lungs, nervous, reproductive, digestive, and immune systems, causes birth defects and cancer. Careless and unregulated PCP application methods resulted in soil, surface, and ground water contamination at sawmills. The health of Humboldt Bay and surrounding areas are impacted by the extreme toxicity and persistence of PCP.

The main sites known to be contaminated with PCP are identified. These sites are either under investigation and/or cleanup overseen by the North Coast Regional Water Quality Control Board.



The Environmental Protection Information Center & Californians For Alternatives To Toxics   February 7, 2002

Sea Grant California

UNIVERSITY of CALIFORNIA COOPERATIVE EXTENSION

Susan Schlosser, Marine Advisor
Sea Grant Extension Program
2 Commercial Street, Suite 4
Eureka, CA 95501

Humboldt/Mendocino Counties
Email: seschlosser@ucdavis.edu
Phone: (707) 443-8369
Fax: (707) 445-3901

Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502

31 March 2005

Dear Harbor District Commissioners,

Following are my general and editorial comments on the DRAFT Humboldt Bay Management Plan (March 2005 version).

General Comments

This plan is very well written, contains important information, and reflects the time and effort of the Harbor District Commissioners, staff, and consultants. I appreciate the clarity on such things as the time frame (10 years), the geographical descriptions (three bays, etc.) and addressing the sphere of interest and the watershed. Identification of the changes in the community and attitudes towards natural resource and use of new information generated from ongoing studies are other important factors well described in the Management Plan. The plan is very positive and gives the Harbor District excellent direction for future activities.

The Harbor District's role in the community will expand as a result of this plan. The elected Commissioners and their staff will become leaders in Humboldt Bay activities. This will undoubtedly increase the workload of the elected commissioners and their staff. To accomplish this, you might consider expanding the collaborations mentioned throughout the plan. I would encourage including collaborators in other general categories such as non-profit organizations, academic institutions, community groups and the tribes. These are essentially non-regulatory collaborators but I feel they are as important as state and federal regulatory agencies and many are conducting activities that may contribute to the Management Plan objectives.

It will be important for the Harbor District to take lead roles in some cases and to get involved with the appropriated group(s) for other activities. I feel this is very important as you do not want to waste precious human capital and time on something others are already doing. Nor do any of us want to "reinvent the wheel."

Regarding all the questions and comments about "ownership" of Humboldt Bay, I suggest using the word "trustee" when describing your role regarding tidelands and submerged lands.

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APR 0 5 2005
H.B.H.R.& C.D.

Editorial Comments

Page Number	Comment
1-4	Figure 1-1, add watershed boundary
1-6	Figure 1-2: I think the Jacoby Creek watershed boundary is incorrect as it extends into the dunes.
1-8	Fig 1-3: map would be improved by inserting lines to delineate the "three bays"
1-12	Second paragraph, change sentence wording to "Typically approximately .....is **removed by maintenance dredging."**
1-13	Does Ted Kuiper still lease from the Harbor District at Field's Landing?
1-15	It would be helpful to add a figure showing the City of Eureka, City of Arcata and Harbor District tidelands (like the old one you used to have in red, blue and gray).
1-19	Sentence "Like other such .." is unclear.
1-19 to 1-20	Section 7.1.4. Would it be useful to mention the Resources Conservation District in this section? They are an important agency in the agricultural wetlands and also work with the Regional Water Quality Control Board.
3-1	Section 3.0 seems weak
4-21	State the reference and date of the NWI data
4-23	Change "mysterious food chain" to "unknown food chain"
4-24	Bay waters do have a defined structure. See Costa, S.L., 1982. The Physical Oceanography of Humboldt Bay. In Humboldt Bay Symposium Proceedings (eds: C. Toole and C. Deibel), pp 2-31 And Barnhart et al. 1992. The Ecology of Humboldt Bay: An Estuarine Profile, Figure 2.10.
4-25	Given all the community concern, research and interest in eelgrass, I strongly suggest adding eelgrass as a separate habitat description as has been done with salt marsh and bay waters. Including it in "Tidal Channels and Tidal Flats" is not sufficient recognition of this important habitat.
4-30	The rows in the table are not correctly aligned.
4-38 to 4-39	Using the Humboldt Bay Symposium Proceedings of 2003 and the poster session of HBS 2005, I have compiled a complete (I think) list of estuarine restoration projects. It is attached to this letter and I emailed it to J. Robinson. You are welcome to add this list to your plan if you like.
Appendix E	Wetland Gain/Loss Map is very unclear. It needs some dates.

Thank you for considering these comments.
Sincerely

Susan C Schlosser

Susan C. Schlosser
Marine Advisor, Humboldt and Mendocino Counties

Cc: R. Blyther, P. Golightly, S. Kramer, M. Herbelin, J. Neander, V. Frey, J. Mello, P. Nicols, C. Vandermeer, D. Ashton, G. Dale, G. Markegard, P. Olin, M. Wheetley, R. Moll, P. Nelson, V. Metz, M. McKinney

Current Humboldt Bay Restoration Projects

Title	Participants	Objective
Freshwater Creek Site Rehabilitation	Northcoast Regional Land Trust, McBain &Trush , Redwood Community Action Agency, Freshwater Farms Nursery	Reclaim former tidelands
Salmon Creek Estuary Enhancement Project	Michael Love and Associates, Humboldt Bay National Wildlife Refuge, and others	Restore salmonid habitat
Rocky Gulch	McBain & Trush, and others	Restore marsh and salmonid habitats
Martin Slough	Redwood Community Action Agency and others	Restore marsh and salmonid habitat
McDaniel's Slough	City of Arcata and others	Restore fresh, brackish and salt marsh habitats
Beith Creek	City of Arcata and others	Restore slough habitats
Indian Island Cultural and Environmental Restoration	Wiyot Tribe and others	Construct cultural center, restore salt marsh ecosystem
Palco March Enhancement Project	City of Eureka and others	Restore salt marsh ecosystem
Butchers Slough Salt Marsh Enhancement	City of Arcata and others	Restore salt marsh ecosystem
Eureka Slough Mitigation Based Restoration	City of Eureka and others	Restore salt marsh ecosystem
Humboldt Bay Cooperative Eelgrass Project	California Sea Grant, California Department of Fish and Game, Humboldt Bay Harbor, Recreation and Conservation District, and others	Restore mudflat ecosystem

Table Bluff Reservation
Wiyot Tribe

April 5, 2005

David Hull, Chief Executive Officer
Board of Commissioners
Humboldt Bay Harbor, Recreation and Conservation District
601 Startare Drive
P.O. Box 1030
Eureka, CA 95502-1030

Re: Submission of comments pertaining to the *DRAFT* Humboldt Bay Management Plan

Dear Mr. Hull and Harbor District Commissioners,

The Wiyot Tribe would like to take this opportunity to submit comments to you regarding the recently released draft Humboldt Bay Management Plan. Below please find six specific comments to the draft plan. Overall, the tribe takes exception to the lack of provisions for the cultural resources and values of Humboldt Bay. Given that the tribe is one of the largest landowners on Humboldt Bay, we expect the concerns noted below will be resolved and incorporated into the final Humboldt Bay Management Plan.

Humboldt Bay is within the ancestral territory of the Wiyot Tribe. The activities of the Humboldt Bay Harbor, Recreation and Conservation District, as outlined in the draft Humboldt Bay Management Plan, have a significant impact on the cultural and environmental resources and legacy of the Wiyot Tribe. Although we are disappointed that the Harbor District neglected key issues central to the legacy and future of the Wiyot Tribe as part of the initial draft Humboldt Bay Management Plan, we are optimistic that we can advance in a positive manner from this point forward.

1. **The draft Humboldt Bay Management Plan lacks provisions for cultural resources and values along and within Humboldt Bay.**

Throughout the entire draft Humboldt Bay Management Plan, the word "cultural" is found only once, on page 1-1. The Wiyot Tribe, Table Bluff Reservation, and/or Native American interests are not mentioned even once. We believe the final Humboldt Bay Management Plan should further incorporate the aforementioned "cultural assets" noted on page 1-1 throughout the entire plan. The tribe requests that the Harbor District define "cultural assets" and specify how Native American cultural assets relate to the Harbor District's definition of the term. Additionally, the final Humboldt Bay Management Plan will benefit from including the Wiyot Tribe as a noteworthy entity and constituency interacting with policies and projects on Humboldt Bay.

1000 Wiyot Drive · Loleta, California 95551 · (707) 733-5055 · (800) 388-7633 · FAX (707) 733-5601

2. **Responsibilities to uphold environmental justice conditions must be applied to the entire plan and not limited to recreational opportunities.**

In section 3.2.5, the draft Humboldt Bay Management Plan describes provisions for environmental justice in regards to providing equitable, inclusionary, and universal recreational opportunities. We believe this acknowledgement of the Humboldt Bay Harbor District's obligations to uphold environmental justice should be upheld throughout the entire plan and not just applied to recreational opportunities.

3. **Provisions for shoreline management lack provisions regarding cultural values and resources.**

While Section 3.3 clearly outlines policies for harbor-related shoreline policies that protect the environment, it altogether lacks policies that address protections for cultural resources already in existence or those which may be uncovered given future development, recreational expansion, and/or erosion. We believe the final Humboldt Bay Management Plan will benefit from provisions that clearly outline protections for cultural assets as they pertain to shoreline management.

4. **We are concerned that policies relating to regulatory streamlining for future bay development are a direct impact to the Wiyot Tribe.**

Section 3.7 outlines regulatory streamlining for development projects on Humboldt Bay. We are concerned that such regulatory streamlining will be a direct impact to the Wiyot Tribe given the potential damage, which may occur to cultural deposits as a result of development. Given this concern, we are hopeful the final plan will clearly address how cultural assets will be protected despite "regulatory streamlining."

5. **CEP-12 requires revision to better address the interests of the Wiyot Tribe.**

The current draft policy reads, "Indian Island shall be managed pursuant to adopted City of Eureka plans as a site for habitat, scientific research, and education. Existing uses may be maintained but shall not be expanded, except the reburial of Native Americans may be authorized by the District." The tribe requests that the Harbor District work with the City of Eureka to update the City's plans to include the tribe's cultural uses of Indian Island. The City's General Plan is currently outdated and does not take into account cultural goals of the tribe, as detailed in *Indian Island Cultural and Environmental Restoration Proejct Feasibility Study* (Humboldt Water Resources July 2003). Furthermore, it should be documented that a portion of Indian Island is located above Mean High High Water and thus not within the jurisdiction of this plan.

6. **The map found in the Appendices entitled, *"Humboldt Bay Public Land Owners and Managers"* is inaccurate.**

The aforementioned map indicates that nearly all of Indian Island is owned by the City of Eureka. We believe the map should be revised to indicate that the 61.5 acres on the northern portion of Indian Island are no longer in City of Eureka ownership.

Thank you very much for taking the time to review these comments. We look forward to maintaining a positive working relationship with the Humboldt Bay Harbor, Recreation and Conservation District as you finalize and begin to implement the policies contained within the final Humboldt Bay Management Plan.

Cawoks,

Andrea Z. Davis
Environmental Director

MEMORANDUM
To: Dave Hull, Humboldt Bay Harbor, Recreation and Conservation District and Maggie Herbelin, Humboldt Bay Stewards
From: David Ammerman, Eureka Field Office, USACE
File No.: Humboldt Bay Management Plan and Harbor Revitalization Plan
Date: April 1, 2005
Subject: Response to 17 March 2005 letter from Environmental Protection Information Center (EPIC)
Project : Varous projects
Applicant: N/A
Consultants: PB Ports and Marine
Site Location: Within navigable waters of Humboldt Bay to MHHW

The following are NOT official comments from the U.S. Army Corps of Engineers. They are my personal views only, although I may attempt to clarify some issues pertaining to environmental regulation.

I have read most sections of both plans. Under the Harbor Revitalization Plan by PB Ports & Marine, Inc., the recommended site utilization seems reasonable, but that is just my personal view. EPIC takes issue with the recommendations and elements of both plans, but it appears they have ignored the market analysis. EPIC seems to be of the mind frame that if heavy industry and dredging would just disappear, Humboldt Bay's economic returns would be dependent on a "restoration-based economy, or capitalizing on the recreation and science potential of the bay". The latter is certainly important and there should be increasing emphasis on those activities, but very few people in this region make a living staring through a spotting scope and/or camera attachment watching birds, mammals and flowers reproduce. People must have food, clothing, employment, housing, medicine, education, security, and a variety of services we take for granted. There is still a need for raw materials to supply the construction industry to build infrastructure ranging from low-income housing to repair or improvement of highways and local roads.

EPIC and its affiliated organizations like North Coast Environmental Center make misleading statements saying the Management Plan has more emphasis on growth in heavy industry, as in an Oakland-style container port or refinery. I believe that the Humboldt Bay Region's residents have made it loud and clear with the now withdrawn LNG proposals by Cal-Pine, that heavy industry of that type is extreme and unwanted for a variety of reasons. Among the reasons is that people here in general value the natural resource attributes of Humboldt Bay and would like to see our wetlands and other bay natural resources preserved. I agree that a large portion of Humboldt Bay needs wetland and estuary restoration to repair damage done in long-abandoned industries that have left contamination of our shoreline and bay waters.

The reality of it is that there is very little room for growth in heavy industry here except possibly aggregates and other raw materials. There could be growth for light industry, retail and other commercial ventures including power/water distribution. I like PB Port and Marine's recommendations for the long neglected Balloon Tract where it recommends a "tourism/marine science cluster, possibly including a public aquarium, marine lab, cruise dock naval vessel museum and related activities". They also have some ideas for a rail trolley, water taxi and terminus of a short-line excursion railroad. I agree that these are great ideas, just thinking about it make me want to change jobs. The Harbor District should spend some time in coordination with the City of Eureka, the landowner of the Balloon Tract, and the Humboldt Bay community overall to acquire the property, clean it up and develop it for the above described uses (provided there is ample public review of the proposals and subsequent support). In my personal view, I would like to see a combination of Humboldt Transit-City Transit bus hub at the Balloon Tract as well as the above proposals to replace the 3rd and H hub, which should still stay in place along the route (I'm a regular bus rider). The bus hub would complement the railroad and water taxi proposals.

The Balloon Tract is just one of many long-neglected sites that need attention. The problem comes with public funding. Almost all levels of government (city, county, state and Federal) are facing service and funding cutbacks, including the Corps of Engineers. Our Regulatory program is in a budget black hole, that puts restrictions on travel and operations. Just about everything we do and are responsible for is driven by politics. Some great ideas can't be realized without adequate capital. Telling certain industries to go away deprives local governments of support, directly and indirectly. All industries have to conform to environmental regulations now in place. That's life and politics, but I think we need to be careful about choosing our industries.

My mention of environmental regulations leads to EPIC's comments on proposals in the plans to streamline regulatory permit processes by the Corps, Coastal Commission and other agencies. There's no question that there seems to be a puzzling array of overlapping jurisdictions and regulatory requirements at all levels of government. There have been some efforts to streamline permitting with some kind of joint regulatory application authority in the S.F. Bay Area and other places with mixed results. An attempt by Sustainable Conservation (Seth Lancaster and others) was made to bring all the regulatory agencies together in Humboldt County to hash out a permit streamlining effort, which has become a kind of mantra by those who have been subject to permit regulation in the past.

EPIC states that, "We object to any reduced regulatory review by the local, state, and federal agencies…We do not believe that the Harbor District has the expertise or the regulatory authority to streamline permit review" The last sentence might have an element of truth to it, especially with regards to NEPA permitting, but which agency would have the expertise or authority as an umbrella permit agency? As for the first sentence, that comment won't sit well with non-profit organizations and other entities that are on pins and needles waiting anxiously for permits from the Corps or Coastal

Commission to implement projects (a majority of these are fish passage restoration, stream or wetland restoration projects) funded by state or Federal grants that are more valuable than gold. If a permit process is not timely enough, these entities can lose funding and have to start all over again (sometimes the applicants create problems because of not enough lead time for regulatory review or inadequate or incomplete permit applications). EPIC's statements lead me to believe that EPIC deliberately would like to see complex regulatory processes as a permanent buffer to economic development from an industrial or non-recreational or environmental standpoint.

The Corps is trying to streamline its own processes through nationwide permits, regional general permits and other means. We try to tailor a certain project to the appropriate permit process. Despite our efforts, coordination with the National Marine Fisheries Service and U.S. Fish and Wildlife Service for compliance with the Endangered Species Act has sometimes made a simple permit process into a major undertaking. Headquarters, Washington, D.C. generated policies, rules and regulations and other programs are, as we speak, may soon change the way we do business in either obvious or subtle ways. Things like Project Management Business Processes (PMBP's), National Security Personnel Systems (NSPS), other Homeland Security directives, General Accounting Office (GAO) review of regulatory permitting procedures, changes to jurisdictional determination and wetland delineation procedures and reporting are some of the thing in the coming fiscal years that will affect regulatory operations and personnel. Add to this the difficulty in retaining skilled and qualified people in the Corps regulatory program. We've already lost several people to the private sector or other levels of government that appear to offer better incentives.

The Corps San Francisco Office is in a state of transition. One Regulatory Branch Chief has retired and we are trying to hire a new Chief while an Acting Chief is in place. Other branches of the Corps have lost long time experienced career professionals in public affairs, navigation, hydrographic surveys, planning and engineering, construction civil or military, contracting, legal affairs and others due to retirement, early retirement, phase out of positions or even medical disabilities. Dredging of Federal Navigation channels in our harbors including Humboldt Bay can face funding restrictions from Congress including reducing episodes of dredging in any given fiscal year, with efforts being explored to contract out services.

This leads to EPIC's comments about dredging in general and Fields Landing in particular. EPIC proposes that Federal dredging of Fields Landing be eliminated and redesignate Fields Landing to bay conservation instead of harbor facilities. In a way, this is not a bad idea. The dredging of Fields Landing seems to serve primarily one business (Woody Murphy's Humboldt Bay Forest Products) although the Harbor District's boat haul-out facilities also benefit to a certain extent along with a fish processing place. With dredging funds that might be cut, Fields Landing probably should be the first to go and the business owner probably should fund dredging at his own facilities. However, since there is still an active business there, EPIC's comments probably won't sit well with Mr. Murphy. EPIC is a long time antagonist of the timber industry, so EPIC's comments on

Fields Landing might be construed as a veiled arrow against an element of the timber industry.
EPIC also mentions “illegal fills” at Fields Landing, but doesn’t elaborate to these allegations unless it refers to pre-regulatory era fills (i.e., before the Clean Water Act). The Corps would like to know where these “illegal fills” are if they are post Clean Water Act.

Mariculture: Regarding EPIC’s comments on mariculture, their comments should be balanced with a response by the aquaculture industry, I think there will be vigorous response to EPIC’s comments. In one paragraph EPIC states they are concerned that mariculture operations are becoming increasingly intrusive to Humboldt Bay, while in the same paragraph they acknowledge that Coast Seafoods has reduced their operations to 300 acres. Coast Seafoods has taken some business sacrifices by reducing their footprint of operations, changing from bottom culture to long-line culture, eliminating bat ray depredation and other activities in order to comply with a variety of regulatory requirements and Coast believes they are being penalized for their actions instead. I personally do not know why EPIC is making such a negative crusade towards aquaculture, except to bring up perceived adverse impacts that really haven’t been quantified thoroughly, yet. It would take long-time monitoring along with vigil and review by the existing aquaculture monitoring committee to make meaningful statements about eelgrass or other aquatic life impacts in Humboldt Bay.

The literally poor folks at King Salmon are being targeted by EPIC for water pollution (they are labeled a “public nuisance”) and EPIC suggests they be bought out and moved to dry land or someplace else. I suppose some residents may be receptive to such a suggestion but I’m not so sure about the reaction of other residents. King Salmon residents would probably suggest that EPIC stay in Berkeley or move to China where pollution is a much more real problem. I think the focus should be on spending money on the water pollution problem. I do, however, agree with EPIC that using public funds to dredge what is essentially a water-filled back yard for private residents is not wise use of funds. The dredging funding should come from the homeowner’s association. King Salmon community does look a little like Hong Kong’s Kowloon.

I will give credit to EPIC for recognizing that regulatory authority, especially with the Corps permit program, is well beyond MHHW with most regulatory agencies. Corps Clean Water Act Section 404 permits are required for discharge of solid fill at or below the High Tide Line or on wetlands adjacent to and above the High Tide Line. Installation of facilities or structure and dredging are regulated in navigable waters at or below Mean High Water line and require Corps permits under Section 10 of the Rivers and Harbors Act, that includes placement of structures on lands that were historically Section 10 behind earthen dikes around the bay.

FINAL COMMENTS: I refer you to Page 8 of EPIC’s letter under “Toxic materials”, near the bottom of the second paragraph. It mentions the issue of ballast water treatment of ship coming into the harbor from other ports of origin. I’ve attached some pertinent articles regarding higher authorities responsible for addressing this very important issue.

One is an article which appeared in the Eureka Times Standard on Friday, April 1, 2005 regarding court ruling and EPA responsibilities with ship ballast and a good article from the February-March 2005 issue of the "Professional Mariner" magazine on ship ballast issues. I also an article from the "Professional Mariner" on oil spill investigations. I presume EPIC is familiar with oil spill interagency organization here on Humboldt Bay?

Well, that's it. Reminder: these are my personal comments, not the Corps, and I take sole responsibility for the statements in this memorandum. Refutations are welcome.

David Ammerman
Regulatory Project Manager

Date

ATTN — Management Plan Comments

Aqua-Rodeo Farms
P.O. Box 371
Eureka, CA 95502
(707)444-3854

RECEIVED
APR 15 2005
H.B.H.R. & C.D.

4/13/2005

Subject:Humboldt Bay Management Plan Section 2.2.3 Mariculture Draft

To Whom It May Concern,

In reviewing this section I felt it necessary to submit my comments on the matter. First paragraph sentence #4 might also include the City of Arcata, City of Eureka, North Coast Water Quality District, U.S. Fish and Wildlife Service, NOAH Fisheries, and the State Lands Commission. Paragraph #2 sentence #4 might read "oyster longlines" rather than "Pacific longlines". Paragraph #2 sentence #7 might read " hydraulic dredging operations have been discontinued." rather than" ground culture has been permanently discontinued." Paragraph #4 might read

"Other mariculture companies operating in Humboldt Bay include North Bay Shellfish, Emerald Pacific Seafoods, Aqua-Rodeo Farms, Humboldt Bay Oyster Company, and Kuiper Mariculture. These companies have holdings and interests from Mad River Slough to Fields Landing. Activities include shore based tanks, rack and bag, longlines, FLUPSY, and floating work platforms. Various scientific studies related to mariculture and the environment have been conducted in recent years thru cooperation and volunteer efforts by mariculture companies, including studies related to eelgrass, salmonids, and water quality."

Please contact me if you have any questions regarding my comment or reasoning. I would be glad to discuss this issue with you further.

Sincerely, Sebastian T. Elrite

Sebastian T. Elrite
Aqua-Rodeo Farms

The Humboldt Bay Stewards
2619 Ridgeway Lane Eureka, CA 95501 herbelin@tidepool.com

April 14, 2005

The Humboldt Bay Harbor, Recreation & Conservation District
PO Box 1030
Eureka, CA 95502-1030

Attn: Jeff Robinson, Resource Specialist

RE: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners:

At the request of several community members, The Humboldt Bay Stewards held a workshop on April 5, 2005 to discuss the draft Management Plan and create comments for submittal to the District. Approximately thirty community members attended the four- hour meeting.

We are submitting the summary of comments and recommendations for inclusion in the draft revision. Thank you for your consideration of these comments. We request written response to all concerns. Please provide response to The Humboldt Bay Stewards at 2619 Ridgeway Lane, Eureka, CA 95501. We request to be included on the District's email and direct mail list of all public meetings and activities. The email address for The Humboldt Bay Stewards is: herbelin@tidepool.com

We look forward to seeing the revised plan and participating in the CEQA process.

RECEIVED
APR 14 2005
H.B.H.R.& C.D.

Sincerely,

Margaret Herbelin

Margaret Herbelin, The Humboldt Bay Stewards

R A Rasmussen

Robert A. Rasmussen, The Humboldt Bay Stewards

The Humboldt Bay Stewards
Bay Management Plan Workshop Summary
April 5, 2005

GENERAL COMMENTS

Planning policy and concepts

A clear statement of the district's role as the manager of public trust resources should preface the plan. A distinction between ownership and public trusteeship should be made clear.

A protocol for cooperation with other governments, agencies, non-governmental organizations, and the public should be written and published. This protocol should include provisions for notification of meetings and pending actions, consultation on policy changes and enforcement, and providing representation on committees and in public forums. The language of the Management Plan should also reflect this breadth of cooperation and be uniform throughout the document.

The plan needs to look beyond historical uses; like the Revitalization Plan, it uses them as a foundation. Just because a use is historic does not make it valid. Language that allows flexibility and changes of direction and of uses is needed.

The neglect of the Wiyot Tribe, historic owners of the bay, present owners of Indian Island, and a major source of cultural capital is a major *faux pas*. NHPA Section 106 (NEPA) requires consideration of impacts of projects on pre-historic or historic archaeological sites or other cultural features and Native American interests.

Dividing the bay into distinct regions as a planning technique has value, but it is also necessary to view the bay as a whole. As the bay is an integral, tide-dominated system, it is impossible to isolate environmental impacts. Cumulative impacts must be considered. This is a CEQA requirement.

Adaptive management needs data and information and monitoring. The District needs a policy to establish a data management system that will allow trend analysis. Management must be science based; it must be measurable, so we know the policy is working. The system should be accessible to the public. Reference KRIS as an example.

Many conservation and recreation policy areas are missing or minimally recognized, probably for lack of information. Each of these areas requires baseline information that is not presently available. The plan should include provisions for studies to provide baseline information. This information can then be used to set benchmarks for development, recreational activity, conservation, and restoration.

COMMENTS SPECIFIC TO EACH SECTION

Additions or expansions

Water Use Designations

Dividing the bay into regions, each with a preferred use, while allowing consideration of other uses, creates three multiple-use regions. Yield to reality and designate the whole bay as multiple-use, then develop protocols for determining appropriate uses. Present policy appears to give precedence to harbor use. A policy for resolving conflict between uses should be created. Critical habitats should be identified and set aside, regardless of their location in the bay.

Over 4,000 acres are designated for mariculture in North Bay. It is evident that all that acreage cannot be used. The plan should provide for a study to define the physical and ecological limits for future mariculture, to define a carrying capacity, and to define the mechanisms appropriate to setting limits for production.

As the bay is dynamic, a better understanding of inner bay erosion and the physical impacts of hardening require more study.

Harbor/Port Element

The community has recently addressed issues of developing heavy industry in the port. The plan needs to reflect the community's skepticism of continuing in this direction. The designation of specific industrial sites limits future economic opportunities. All zoning designations should be revisited during the update of the Local Coastal Plan, with a view towards 'vitalizing' the harbor, rather than 'revitalizing' it.

A spill prevention program is needed, as the present policy addresses only cleanup.

The control of invasive species needs to be prominent. A program for offshore discharge or sterilization of ballast water is needed. (Recognition of the new court ruling that directs EPA to deal with ballast should be added) Monitoring and enforcement should be addressed. Similar guidelines for hull fouling are needed. Contracts with other ports should be explored in the antifouling section. Co-ordination with the mandatory ballast restrictions, both those in place and being developed, by the U.S. Coast Guard should be included in the Management Plan.

Because dredging impacts other areas of the bay (public trust resources) a monitoring program needs to be in place.

The clean up of brown field sites and of toxic deposits in shallow water sediments should be an extensive part of the management plan. Inventories and action plans should be considered.

The concept of the mid-bay as a deep-water port is questionable and has not proven profitable. Does it make sense to protect this use, in light of dredging impacts and the loss of deep draft commerce? An inventory of conservation and recreation resources leading to a balanced-use policy for the mid-bay should be considered.

A permit policy is needed for the proposed Mariculture Park, as permits are likely to be needed from various entities.

Recreation element

The element needs more specific goals and objectives, which could be accomplished by use of a multiple-use recreation overlay for the entire bay.

Recreation on the bay requires access: access from landside as well as waterside. Integration of the Bay Trail Plan into the Management Plan requires a policy of collaboration with governmental entities and private landowners to ensure access points.

Appropriate access, by water, to public trust resources should be included in the plan. Anchorage buoys, courtesy docks, fishing piers, non-motorized boating areas, suitable destinations, launching sites, and parking areas should all be addressed in the plan.

Conservation element

In general, the plan needs more specific goals and objectives. The plan should provide guidance as to the preferred future condition of bay habitats. We need to know what we are managing for. We need to know our restoration goals. Conservation should be the underlying tenet of all the plan elements. A tiered approach that involves quantitatively measurable goals and timelines should be developed.

The protection of native species is a paramount goal. To achieve that goal, population inventories, inventories of currently available and potentially available habitat, and carrying capacity studies are needed. A strategy for contracting and funding such studies should be developed. The eel grass beds are a particularly noteworthy example.

The economic impact of the fish nursery in the bay is not appreciated.

There are several issues of water quality that involve other governmental agencies, beyond the jurisdiction of the Bay District, that should be addressed in terms of interagency agreements, joint policies, or memoranda of understanding. These include: sedimentation from drainages entering the bay, toxics from point-source discharges into the bay, storm water run-off, agricultural and septic non-point discharges.

The issue of filled inter-tidal lands needs more attention. Development is not the highest and best use for re-claimed (filled) land around the bay. Areas suitable for marsh and mudflat restoration should be identified and a policy for re-establishing their public trust status developed.

The Elk River parcel is not included in the plan. Ordinances are needed to protect it.

Implementation

Successful implementation of the plan's elements will require citizen input, citizen education, and citizen participation. The citizen advisory group contemplated is critical to the success of the plan and should be structured to promote citizen interaction with the district. As written, the structure is too vague and does not reflect the public interest in the bay management plan.

A policy of using local expertise before outsourcing studies and assistance should be established.

Volunteers, as a resource, should also be explored in these tight economic times.

A determination of the district's responsibility to public input, for inclusion in the district's charter, should be made and promulgated.

Information projects that utilize the local media should be planned for.

Priority lists or timelines should be included for each action item.

Under components for management approach, add a precautionary element; we don't know, so let's err on the side of caution.

As a 'living document' the plan needs a detailed and dynamic process for amendment before it can function.

Recommendations

Before the document is completed and submitted, it should be given to a professional editor for rewrite, to ensure readability. Scrap the present Executive Summary and have it rewritten professionally.

A comprehensive Executive Summary should be made freely available during any public comment period. Perhaps parts of the plan can be published, sequentially, in the local media, during the CEQA process.

Provide for a simple public access to district ordinances.

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Changes in the content, construction or language of the document

Some portions, notably in the Harbor/Port Element, overstep the HBHR&CD jurisdiction in addressing upland uses and in the designation for port development.

Embedding the Revitalization Plan in the HB Management Plan, without its own CEQA review, loses the public commentary required by CEQA. How can we rectify this omission?

Vet the document for consistency in language with the Coastal Act and other plans. Other plans such as those of the Humboldt Bay Watershed Action Council, the Bay Trails Plan, and the views of community groups interested in the bay should be included in the appendices.

RA-1 should be in implementation and more inclusive in the committee make-up.

RFA-1 should be worded like HFA-2 and should be much stronger.

Recreation should be included in the mission statement.

Paragraph #2 in introduction should be in harbor introduction - Show how these policies interrelate.

RFA-2 – remove "if feasible".

RIO-1 & 2 – use same wording as RA-2.

All policies in the management plan require implementation steps and imperative language, e.g., 'shall', rather than 'should'.

North Coast Chapter
P.O. Box 1067
Arcata, CA 95518
April 15, 2005

Mr. Jeff Robinson
and
Board of Commissioners
Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

Re: March 2005 Draft Humboldt Bay Management Plan

Dear Mr. Robinson and Commissioners,

I am writing this letter on behalf of the North Coast Chapter of the California Native Plant Society (CNPS). CNPS is a statewide nonprofit organization of nearly 10,000 amateurs and professionals dedicated to the preservation of California's diverse native flora. CNPS conducts a variety of conservation efforts focused on long-term protection and preservation of native flora in its natural habitat, and is the foremost non-governmental organization working to protect rare, threatened, and endangered plants in California. The North Coast Chapter is based in Arcata and represents approximately 330 members in Humboldt, Trinity, Del Norte, and western Siskiyou Counties. The majority of our members reside in the Humboldt Bay area.

We appreciate the opportunity to review and comment on the Draft Humboldt Bay Management Plan (hereafter called "the Plan"). Major issues of concern to the North Coast Chapter are as follows:

Wetlands Conservation

EPA funding granted in 1998 to the District to develop a wetlands management plan (Grant # CD 999967-01-0) required consistency with the California Wetlands Conservation Policy of 1993. How does the Plan fulfill the requirements of the wetlands management plan grant? And how does the Plan ensure consistency with the California Wetlands Conservation Policy as required by the EPA grant?

CNPS believes that a wetlands management plan should be a top priority for the District, and should be conducted in collaboration with the Scientific Advisory Committee on Estuarine Restoration, local and state trustee agencies, and other local wetlands ecologists and restoration practitioners. CNPS also believes that a no-net-loss policy for wetlands in inadequate, since mitigation has failed more often than succeeded in replacing intact wetlands.[1] Destruction, development, or disturbance of intact wetland habitats should be limited to the absolute minimum. All mitigation and restoration plans involving public lands, public funding, and/or public permits should require long-term monitoring to examine the success of restoration methods.

Since the use of federal funding triggers compliance with the policies and processes required by the National Environmental Policy Act (NEPA), we trust that the District will be complying with the requirements of NEPA as well as the California Environmental Quality Act (CEQA).

Lack of a Policy on Billboards

CNPS is concerned about the Plan's lack of a policy on billboards within the District's jurisdiction. There are numerous billboards located on sensitive salt marsh habitat within the District's jurisdiction. Salt marshes of Humboldt Bay are home to two protected plant species protected under Cal. Code Regs. 14 §15380(d) and 15065. Northern coastal salt marsh is a rare plant community,[2] and therefore is protected under Section IV(b) of the CEQA Environmental Checklist (Appendix G of the CEQA Guidelines).

Construction of new billboards and maintenance of existing billboards clearly has the potential to cause significant negative impacts to protected species and habitats. As the Lead Agency regulating activities within the intertidal zone, the District should include a clear policy in the Plan that limits future siting of billboards in habitats that are protected under CEQA. A similar policy should be developed regarding existing billboards: they should be eliminated wherever possible, and contracts for existing billboards should not be renewed upon expiration.

Locally Rare Species

Locally rare species should be protected pursuant to Cal. Code Regs. 14 §15125(c). Small, isolated peripheral plant populations are more likely than large

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[1] R.H. Chamberlain and R.A. Barnhart. 1993. Early use by fish of a mitigation salt marsh, Humboldt Bay, California. Estuaries 16: 769-783.
[2] List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Database, Sept. 2003. California Department of Fish and Game, Sacramento, CA.

central populations to be influenced by impacts related to development, changes in microclimate and hydrologic regimes, and other disturbance factors. Although it is a tenet of conservation biology to prioritize protection of larger, core populations, smaller isolated populations are worthy of protection as well due to the increased risk of extirpation. Studies have found that when a species undergoes a catastrophic range contraction, populations on the edge of their range have a significantly greater survivorship than core populations.[3] Therefore, locally rare species should be protected to ensure the stability of these native plant species throughout their range. This principle is particularly important in the management and protection of species with restricted ranges, and for those species that are at the edge of their range in the Humboldt Bay area.

Eelgrass

Eelgrass (*Zostera marina*) is a keystone species in Humboldt Bay, providing food and cover for numerous fish, birds, and invertebrate species, including black brant, Pacific herring, English sole, and coho salmon. Recent studies have found that oyster farming on longlines spaced closer than 5 feet apart has significant negative impacts on eelgrass.[4] Oyster farming should be required to space lines 5 to10 feet apart to minimize impacts to eelgrass, and the footprint of mariculture in the Conservation-designated portion of the Bay should be restricted to the amount currently under cultivation until impacts to other protected species can be examined.

Conservation Policies

In general, CNPS is concerned that many of the conservation policies are not policies at all, but rather vague intentions to develop a plan at some unspecified later date. While we understand that not enough information is known at this time to develop each policy in specific, we believe that timelines should be included wherever possible. It is important to include language that would clarify the District's position on allowing other entities to develop such policies as appropriate, rather than to effectively block other organizations from making progress wherever possible and desirable. We mention this due to the specific problem of the failure of the City of Eureka to develop a management plan for the Elk River Wildlife Area, while blocking other organizations that have proposed to work on such a plan in conjunction with City staff. The result is that the City has no means to develop a plan, nor will they allow non-City entities to develop the plan, so the plan doesn't get done. Examples of these non-specific plans are:

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[3] Channell, R, and M. V. Lomolino. 2000. Dynamic biogeography and conservation of endangered species. Nature 403:84-86.

[4] S.S. Rumrill, unpublished research presented at the Humboldt Bay Interagency Task Force meeting, Dec. 14, 2004, Eureka, CA.

- CAE-3, the plan to develop and implement a restoration and enhancement plan for the Bay's aquatic ecosystems, including wetlands;
- CAE-4, the plan to develop and implement a water quality maintenance plan for the Bay;
- CAS-1, the plan to develop a plan to maintain native biological diversity and important habitats;
- CAS-2, the plan to develop a plan to maintain diversity of native and desired commercial species;
- CAS-3, the plan to develop a plan to manage or protect state-listed or federally-listed species and critical habitats.

In some instances, there is no need to develop a plan to enable the District to carry out its public trust responsibilities. In the case of CAS-3, there is no need for the development of a District-specific plan, since there are established state and federal regulations that require protection of these species and habitats.

At the very least, these plans to develop plans should be prioritized, if not given specific timelines for development and implementation.

An important question we would like to see addressed is the level of public input that will be involved in the development of these future plans. Will there be separate CEQA and NEPA processes for these proposed plans when they are developed? Or does public review and comment period for the Plan represent the public comment period for these undeveloped plans?

Policy CEP-1 (5.4.2) lists the specific exceptions to rules preventing impacts to streams, wetlands, estuaries, and coastal waters. This section should be revised to be consistent with Section 30233 of the California Coastal Act, which states that such exemptions are only allowed "where there is no feasible less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects."

Nature Study and Exploration as Recreation

CNPS believes that nature study and exploration are important aspects of recreation on and around Humboldt Bay, and should be recognized as such in the Plan. Botanizing, birdwatching, research, and other natural history nature-related activities are important to the recreational, educational, and scientific values of Humboldt Bay.

Advisory Committee Membership

The Advisory Committee should be comprised of specified representatives of various community elements, including fishing, recreation, and conservation advocacy organizations such as CNPS. We also suggest expanding the list of stakeholders to include the many non-profit organizations with interests in the

Bay, including CNPS. The current list appears to be inappropriately limited to the organizations that were represented at stakeholder meetings related to the Bay Management Plan.

Encourage Native Landscaping

CNPS urges the District to consider adding a policy to the Plan to encourage native landscaping wherever possible on the District's property and within the District's jurisdiction. The Bay's sensitive ecosystems are susceptible to invasion by non-native plants, and native landscaping can protect wetlands and other habitats from impacts related to fertilizers and pesticides often used on horticultural landscaping plants. The use of local natives is recommended wherever possible. The area between the Bay and the trail behind the new Target store in Eureka is a good example of native landscaping that will help buffer the impact of the development while providing wildlife habitat and scenic continuity with the natural landscape.

Conclusion

Thank you for the opportunity to comment on the Plan. We look forward to incorporation of our comments into the Plan, and would appreciate written responses to these comments. Please keep CNPS informed about hearings, workshops, and other future opportunities to comment on the Humboldt Bay Management Plan, as well as any other plans or proposals that have potential impacts to native plants and/ore vegetation.

Please send correspondence to the address above.

Respectfully,

Jennifer Kalt

Jennifer Kalt
Conservation Chair
North Coast Chapter

City of ARCATA

City Manager
(707) 822-5953

Environmental Services
822-8184

Police
822-2428

Recreation
822-7091

Community Development
822-5955

Finance
822-5951

Public Works
822-5957

Transportation
822-3775

736 F Street
Arcata, CA 95521
April 15, 2005

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H.B.H.R. & C.D.

David M. Hull
Port Director
Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502

VIA FACSIMILE 443.0800
4 PAGES

RE: Humboldt Bay Management Plan

Dear Mr. Hull:

Thank you for the opportunity to comment on the draft *Humboldt Bay Management Plan* (Plan). This document contains policies under which the Humboldt Bay Harbor, Recreation and Conservation District (HBHRD) will manage Humboldt Bay. City of Arcata staff has reviewed the March 2005 draft. The City offers the following comments and recommendations regarding the draft document.

General Comments

The Plan is well organized and represents an impressive amount of work by the District. As the City of Arcata city limits includes several hundred acres of the HBHRD jurisdiction, the City is interested in making sure that policies contained in the plan do not conflict with the City's *General Plan 2020*.

Focused Comments

Plan Element: **Executive Summary; Mission Statement**
Comment: Please include recreation in the Mission Statement. This is consistent with the enabling legislation that states in Section 19 – Master Plan: "The District shall plan, designate and protect wildlife habitats, establish open space areas, and areas provided for recreational use with open access for the public , protect, conserve, supervise and improve the wildlife and fish resources of and control and enhance the aesthetic appearance of the area…"

Plan Element: **Section 2 Humboldt Bay Water Use Designations Figure 2-1 – Humboldt Bay Use Designations -**
Comment: The City has a concern that the mariculture preference designation is much larger than the current land area committed to aquaculture in the bay. This conflicts with the *City's General Plan Policy , RC-4e Aquaculture use of coastal wetlands/tidelands*, while committed to protecting aquaculture also states that *"Aquaculture shall not adversely impact natural ecological processes nor native wildlife or fisheries or their habitat in the Bay. No new aquaculture uses shall be permitted unless it can be*

demonstrated that adequate precautions will be taken to prevent new adverse impacts to natural ecological processes".

Plan Element: **Section 3 – Harbor Planning Policies HLU 6 - - Harbor District shall develop "specific plans" for District-owned parcels**
Comment: Please include reference in the discussion section to "any additional parcels acquired in the future…"

Plan Element: **Section 3.4 Dredging and Waterways Maintenance - Goals**
Comment: Please add a goal that supports the policy for ongoing monitoring activities to assess and address potential negative impacts associated with dredging activities on Humboldt Bay's physical and biological resources.

Plan Element: **Aquaculture Use Area in Arcata Bay**
Comment: With respect to the reference to: "An area will be designated in Arcata Bay in which Aquaculture is to be considered a preferred use of Humboldt Bay tidelands"… please include language that states that no expansion of existing uses are permitted unless scientific information shows that an expansion will not cause adverse environmental or other negative impacts to public trust resources.

> This provides consistency with the City of Arcata's *General Plan, POLICY RC-4* ***OPEN WATERS OF ARCATA BAY & TIDELANDS*** – Objective - Maintain existing Bay wetlands and tidelands, protect them from urban and agricultural encroachments, or degradation, and manage the open waters of Arcata Bay for their wildlife, fisheries, navigation and ecological values and recreation and tourism uses. *Arcata's Policy C-4a* ***Protection of open waters /tideland areas of Arcata Bay.*** *states that: The tidal and water areas of Arcata Bay constitute a fragile Public Trust resource and access shall be controlled to avoid resource degradation, while maintaining the public's right to navigation. Tidal marshes shall be enhanced and maintained, especially in the areas of McDaniel, Gannon, and Butcher's Sloughs, to protect wetland values.*
>
> And *RC-4e* ***Aquaculture use of coastal wetlands/tidelands.*** *To protect aquaculture activities in Arcata Bay,…Aquaculture shall not adversely impact natural ecological processes nor native wildlife or fisheries or their habitat in the Bay. No new aquaculture uses shall be permitted unless it can be demonstrated that adequate precautions will be taken to prevent new adverse impacts to natural ecological processes. The City shall continue its management of: 1. Integrated wetland enhancement*

Plan Element: **Section 3.6 Toxic Materials Management**
Comment: Please consider expanding the Goals section to include preventing the use of biocides.

Plan Element: **An additional element that should be considered in the Harbor Element Planning Policies is Shoreline hazards (tsunami, tidal flooding).**
Comment: A State of California study (*Planning Scenario in Humboldt and Del Norte Counties, California, for a Great Earthquake on the Cascadia Subduction Zone, Special Publication 115, California Department of Conservation, Division of Mines & Geology, 1995*) indicates that the Arcata Bay shoreline and adjacent areas between McDaniel Slough and Mad River Slough could be inundated by tsunami run-up. The City's *General Plan* prohibits the location of critical facilities in the tsunami run-up area, and advocates the use of available emergency broadcasting systems to communicate tsunami warnings. Should coastal access within the tsunami run-up zone be provided in the future, appropriate evacuation route signage shall be posted. The City recommends that the Harbor District look at similar hazards and adopt policies similar to Arcata's to that protect both resources and lives.

Plan Element: **Section 4 - Recreation Element, Planning Policies**
Comment: Please include policies and language that reflects the *City of Arcata General Plan 2020* policies for recreation on Arcata Bay. The City's recreation policies include designating public access corridors, establishing a system of foot trails and interpretive sites along the Arcata Bay shore westward to the city limit, that development of areas adjacent to state and federal lands be done in conjunction with those agencies, restricting motorized vehicles to paved roads and parking lots, and encouraging valid scientific and educational srudies of wetlands and tidelands.

> Of particular note is ***Policy RC-4c Coastal-dependent and public trust uses of Arcata's tidelands.*** *This states: Tidelands of Arcata Bay support a variety of wildlife as well as human activities. The following provisions shall be made for managing tidelands. New development shall not restrict access to the shoreline. Access to coastal areas shall be required for new development.*
>
> ***Tidelands and water areas of Arcata Bay shall be designated Natural Resource-Public Trust Lands [NR-PTL], and identified as passive use recreational areas.***
> *The Arcata Marsh and Wildlife Sanctuary shall be designated as Natural Resource [NR] and the recreational component of the project identified as a passive use recreational area.*
> ***The continued use of the tideland for scientific and educational studies is encouraged.***
> *The Arcata Marsh and Wildlife Sanctuary (AMWS) shall be maintained and new facilities shall be consistent with the AMWS plan adopted by the City Council.*
> ***The South "I" Street boat launch shall be enhanced and maintained to accommodate small watercraft and windsurfing.***
> *The placement of interpretative sites along the Arcata Bay shore, including nature and wildlife centers, shall be coordinated with other agencies, and serve as an educational focal point for Arcata's natural resource areas.*
> ***Access on the levee from the AMWS westward to the city limit will be provided for passive recreation and nature observation.***
> Please also note that the City also prohibits hunting within 1,000 yards of the lands and waters of the Arcata Marsh and Wildlife Sanctuary.

Plan Element: **4.7 – Visual Resources and Scenic Views**
Comment: Please include policies that will more actively protect the Bay's scenic resources. *The City of Arcata General Plan* Scenic Resource Policies include the following features that can be incorporated into the *Humboldt Bay Management Plan*: Identify and protect scenic routes, resources, and landscape features, Retain natural features, coastal scenic resources, and scenic vistas as important aesthetic components of the built environment and visual and associative links to nature on HBHRD owned lands; Minimize impairment and obstructions of scenic views to the minimum necessary to allow reasonable development; Develop design standards that include the following: Billboards or other off-premises signs are prohibited on land under HBHRD jurisdiction; For HBHRD owned lands landscape planting shall be native species and shall not interrupt scenic views to the bay.

Plan Element: **CAE4 – Work cooperatively to implement a water quality maintenance plan for Humboldt Bay**
Comment: While plans are good, the City requests that this policy also include requiring Best Management Practices of all contractors and HBHRD staff for all lands under HBHRD jurisdiction. This is an activity that can be implemented now rather than waiting until another plan is completed.

Plan Element: **<u>5.3 Aquatic Species Management CAS1 – Maintain biological diversity through out Humboldt Bay</u>**
Comment: The City requests that this policy also include actively working to prevent introduction of non-native species to Humboldt Bay. Strategies include continuing to implement and to actively monitor and enforce ballast water exchange requirements, to actively inspect other boating traffic at marinas and to implement an educational program.

Plan Element: **<u>Section 5 – Conservation Element Planning Polices CEP-1 Determination about boundaries, buffers, and other environmentally sensitive areas require specific information</u>**
Comment: Please note that the City has designated all of Arcata Bay as an environmentally sensitive area. Therefore the requirements outlined in this policy would be necessary for any project in Arcata Bay.

<u>Additional considerations</u>
Comment: There are a number of other policies that the City of Arcata has developed in the *Arcata General Plan 2020* that are consistent with HBHRD Goals for Humboldt Bay that could be incorporated into the *Humboldt Bay Management Plan*. These include the following:

Rc-3 Energy Efficiency and Conservation Program

Conduct a continuous program to identify and purchase appropriate energy supplies, implement and evaluate energy conservation measures, provide energy education and pubic information, and promote energy efficiency in transportation. Establish a funding mechanism to assure that a significant portion of the savings are used to fund energy programs and as a reward for savings.

D-1e Promote energy efficiency and solar access.

Site and building design shall emphasize energy efficiency and solar orientation.

D-1i Renewable green building

Site and building design shall incorporate green building concepts including maximizing use of recycled materials and recycling, energy efficiency, solar access, insulation, energy efficiency, use of toxic-free materials, natural lighting, native landscaping, permeable surfaces around structures, and minimizing construction waste generation.

Sincerely,

Dan Hauser
City Manager
City of Arcata

cc: Tom Conlon, Director, Community Development Department, City of Arcata
Stephen C. Tyler, Director, Environmental Services Department, City of Arcata

THE HUMBOLDT SURFRIDERS

A CHAPTER OF THE SURFRIDER FOUNDATION
P.O. BOX 4805 • ARCATA, CA 95521
TAX ID# 95-3841923

April 15,2005

Dear Harbor Commission,

The local chapter of the Humboldt Surfriders is aware of your Humboldt Bay Draft Plan.

We observed that very little or no input has been made concerning recreational use of the bay. As a year round user group, we would like to notify you of the areas frequented by surfers. These areas, and access to them, are very important to us. They include the North and South Jetty shorelines, as well as in between the jetties northwest of buoy #5. Occasionally, surfers also use the area across from the Coast Guard Station (to the east of Humboldt Station).

We appreciate your good work in improving the bay, and hope we can work together in this effort.

Humboldt Surfriders

Gordon Leppig
1812 Fischer Avenue
McKinleyville, CA 95519

Humboldt Bay Harbor, Recreation
and Conservation District
601 Startare Drive
P.O. Box 1030
Eureka, CA 95502

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April 5, 2005

RE: Comments on the Draft Humboldt Bay Harbor District Management Plan

Dear Harbor District:

Below, please find my comments and suggestions on the Draft Humboldt Bay Harbor District Management Plan (Plan). I have not had the opportunity to thoroughly review the entire Plan, therefore my comments are specific to certain sections. My general comments are that major sections of the Plan are vague, ambiguous and awkwerdly worded. It is sometimes difficult to know what the Plan truly intends. Professional editing may improve this.

Cultural resources

Humboldt Bay has a rich and valued cultural and historical significance. The Plan therefore, should have an explicit policy on cultural resources. The Plan does not adequately address cultural resources. Indeed, cultural resources do not appear to be given any special status or priority. I can find little in the Plan thet calls for the protection, mitigation or enhancement of sites with historical or cultural value. It is unclear if the Plan was developed with any input or coordination with local Tribes, such as the Wiyot or the Humboldt Bay Historical Society.

Locally significant populations and habitats

The Plan should include a policy on the protection of locally rare or significant species or habitats of non-listed species. General plans are important tools to conserve locally significant species and habitats, see for example the Ventura County, California General Plan. In addition to endangered, threatened or rare species and their habitats, and other sensitive habitats such as wetlands and wildlife corridors, the Ventura County Plan also includes "locally important species/communities" as a significant biological resource to preserve and protect. The Humboldt Bay Plan should do the same.

Elimination of Billboards

The Plan should include specific language to eliminate billboards from jurisdictional lands. Billboards along Humboldt Bay are widely unpopular and their presence has resulted in numerous efforts and lawsuits to have them removed.

Billboards in and along Humboldt Bay tidal lands and other wetlands are and aesthetic blight. Billboards significantly diminish the viewshed, impact plant habitat and hydrology patterns, and present a blowdown hazard during extreme storm events. There is no reason the Harbor District cannot develop a policy that results in the prohibition of future billboards and the removal of current billboards in jurisdictional lands.

Recreational development and access

Humboldt Bay is a major recreation focus of the region, yet the Plan's coverage of the development, enhancement and evaluation of recreational opportunities and infrastructure is vague and done almost as an afterthought. The Plan should include specific goals and objectives to enhance all the principle recreational opportunities that the bay provides. Clearly this Plan could greatly improve is promotion of recreational opportunities around the bay, and in doing so, enhance tourism and local enjoyment of the bay. For instance, the Plan should development a robust and explicit access-enhancement plan for Humboldt Bay.

Clarity on how future plans are developed

The Conservation Section tends to rely on developing future plans as a standard methodology for implementing it's goals and objectives, e.g. CAE-3 "Restoration and Enhancement Plan;" CAE-4 "Water Quality Maintenance Plan;" CAS-1 "Biological Diversity Plan." The development of these plans are vital to the implementation of the Management Plan, yet details on their development is vague and ambiguous. Perhaps this was this intentional?

Development of future plans must include a schedule and deadline for development and implementation. Otherwise, their development is theoretical and the public will have no idea if, or when they these plans will be realized. For instance, as the Plan is presently written, 15 years could transpire without a single plan being implemented. I recommend that all proposed plans be developed and implemented within three years of the final approval of the Management Plan.

What is the California Environmental Quality Act (CEQA) or National Environmental Policy Act (NEPA) nexus for future plans? Will they fall under the Management Plans' Environmental Impact Report (EIR)? The Plan should specify if these future plans are anticipated to have an EIR or will receive negative declarations. If negative declarations are what the Harbor District intend, then public input on these important and sweeping future plans could be greatly diminished. I recommend the Plan include details on how the public will actively participate in future plan development.

Ballast Water exchange

The Plan is unclear how the Harbor District will enforce and implement its ballast water exchange policy. The Plan should include specific language to this effect.

Harbor District Commission attendance at public comment meeting

This Plan if of vital importance for Humboldt Bay and the region. It is therefore unfortunate that the Harbor Commission did not find it necessary to convene a special meeting for the entire Humboldt Bay Harbor Commission to hear public comments. As the elected officials that determine the Districts' policies, the entire Commission should have been present at the March meeting to hear public comments on the Plan. Meetings such as these provide value opportunities for the Commission to fully understand the publics' issues and concerns regarding Humboldt Bay. Future meetings such as this, should be publicly noticed so that the entire Commission can be present.

I appreciate the Harbor District's careful consideration to these comments and I would like to see their written response to each of the points made in this letter.

Thank you,

Gordon Leppig

April 8, 2005

Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030 Eureka, CA 95502

Dear Commisioners:

Please accept the following written comments for your consideration when revising the Draft Humboldt Bay Management Plan.

#1 I am concerned that the Revitalization Plan, which was never publicly vetted through the CEQA process, has become the guiding policy document for the new Management Plan. Chad Roberts commented at the Management Plan Meeting at the end of March, that the Revitalization Plan was shelved due to environmental concerns, but parts of it are now included in the Management Plan. Since the public has not been made privy to which parts have been retained and which discarded, I believe you have limited the public's ability to comment on issues related to the future uses of the port by industrial tenants. With a heavy focus on historical, industrial uses of the port, the new Management Plan seems to solidify those uses of the port into perpetuity. I believe this is starkly at odds with the desire of the community for appropriate bay and port development.

#2 I am concerned that the Management Plan does not give any indication of how conflicts between the three types of use (Industrial, Recreation and Conservation) will be adjudicated. Will you provide for a flow chart of decision-making, so that the public can see how conflicting uses within your three areas of the bay will be remedied? Please clarify.

#3 I am unsatisfied with the discussion of toxics in the Management Plan. This is a significant limiting factor for the future of commercial development of the Port, as well as a serious constraint on environmental quality. Please indicate what will be done specifically, to address contamination identification and remediation on both the Bay and on District owned properties.

#4 What specific steps will the Harbor District take to prevent the continuous influx of anthropogenic sources of sediment coming into the bay from tributary streams? With so much expense coming from the annual dredging and the original deep dredge in 1999, it would be advantageous to take a more active stance in preventing incoming sediment.

Thank you for your consideration of these comments, I look forward to reading your responses.

Sincerely,

Kirk Cohune

Kirk Cohune

Arcata

RECEIVED
APR 11 2005
H.B.H.R.C.D.

SACER

Humboldt Bay Scientific Advisory Committee for Estuarine Restoration

April 13, 2005

Humboldt Bay Harbor District
P.O. Box 1030
Eureka, California
95502-1030

RECEIVED
APR 1 ? 2005
H.B.H.R.& C.D.

Dear Humboldt Bay Harbor District Commissioners,

The Scientific Advisory Committee for Estuary Restoration (SACER) has prepared this letter to provide comments on the March 2005 draft Humboldt Bay Management Plan (HBMP). SACER is comprised of federal, state and local agencies and municipalities, Humboldt State University, local non-profit organizations, the UC Sea Grant Extension Program, and other community members. The mission of SACER is to contribute to an interdisciplinary science-driven, ecosystem-based approach for guiding restoration efforts in Humboldt Bay through a better understanding of the functions, processes, and resilience of the Bay ecosystem to invasive species and other human-induced alterations.

SACER is interested in developing a plan for Humboldt Bay that identifies and prioritizes research needs for guiding restoration in Humboldt Bay. To date, most of the restoration efforts have been "piece meal" and are not guided by a general plan with definite goals. There has been little coordination or follow-up monitoring to determine if restoration efforts have been effective or if goals have been achieved. SACER proposes to develop a long-range planning document that identifies gaps in knowledge and prioritizes research needs as well as addressing restoration priorities for Humboldt Bay.

To date, this effort has included organizing 2 symposia with science panels to address specific issues relevant to the long-term planning effort. The first symposium, held in October 2003, identified research priorities, addressed gaps in knowledge and identified future directions for restoration in Humboldt Bay. A second March 2005 symposium, "A Regional Perspective to Restoring Physical and Ecological Processes in Humboldt Bay", applied the expertise gained throughout the region (San Francisco Bay in particular) to restoring physical and ecological processes in Humboldt Bay.

SACER could provide a scientific advisory role to the District and already has a track record for bringing together local and regional scientists to address Humboldt Bay-specific issues. The HBMP identifies several areas where SACER can work with the District. These are described in greater detail below. SACER could be involved in implementation of the HBMP in a scientific advisory role. In that role, SACER could be involved in 1) developing long range planning, 2) reviewing and advising the District on scientific studies and providing scientific guidance, and 3) working with the district to develop sources of funding and identifying appropriate applicants.

The HBMP has identified three areas in particular that SACER could serve in a scientific advisory capacity: 1) develop and implement a restoration and enhancement plan for Humboldt Bay aquatic ecosystems, 2) identify sediment dynamics in Humboldt Bay and develop an approach for sediment management, and 3) develop an aquatic species management plan focused on maintaining the native biological diversity and important habitats that are present in Humboldt Bay and its watershed. SACER's possible involvement with the District in each of these areas is described in more detail below.

The mission of the Humboldt Bay Scientific Advisory Committee on Estuarine Restoration is to contribute to an interdisciplinary science-driven, ecosystem-based approach for guiding restoration efforts in Humboldt Bay through a better understanding of the functions, processes, and resilience of the Bay ecosystem to invasive species and other human-induced alterations.

SACER

Humboldt Bay Scientific Advisory Committee for Estuarine Restoration

Restoration and enhancement plan for Humboldt Bay aquatic ecosystems
SACER has already initiated this process through the two symposia in October 2003 and March 2005. SACER should take a major role in development of this planning effort, and is seeking to find funds at this time to take the first step in this planning process and collate all existing information as a basis for a restoration plan. SACER is working with the San Francisco Estuary Institute's (SFEI) Josh Collins and Robin Grossinger to identify the process for plan development. SACER believes that it will be necessary to use a tiered approach for developing a restoration and enhancement plan because of difficulty in obtaining the large amounts of funding necessary. Identification of these steps, with the assistance of SFEI, will allow SACER to pursue smaller amounts of funding that would be more readily obtainable. SACER and the District could work collaboratively on efforts to develop the plan and to obtain funding for its development and implementation.

Sediment dynamics in Humboldt Bay and an approach for sediment management
The issue facing the District is that information on is lacking on the sediment dynamics in Humboldt Bay. Dredging must occur regularly to maintain appropriate depths for shipping and safety within the Bay's channels. SACER could assist the District with identification of these gaps in knowledge by coordinating scientists involved in watershed/hillslope sediment source studies and with scientists working on estuary/marine sediment dynamics. Scientists in these disciplines appear to rarely interact, and SACER would provide a means for working with both groups. SACER and the District could host one or a series of workshops to identify gaps in knowledge and appropriate studies, the use of dredge spoils in restoration efforts, and develop communication and collaboration between academics, industry, and consultants working in hillslope and marine/estuarine dynamics.

Plan for maintaining the native biological diversity and important habitats present in Humboldt Bay and its watershed
The District could work with SACER in the planning process. SACER, as a multi-disciplinary group, would be able to provide scientific guidance to the District with identification of the key questions facing the Bay's native biological diversity and important habitats, and in identifying and prioritizing research needs.

We look forward to discussing these ideas with you throughout the CEQA process and working with you in the future.

Sincerely,

Sharon Kramer

Sharon Kramer, Ph.D.
Aquatic Ecologist-Principal, Stillwater Sciences

Susan Schlosser

Susan Schlosser
Marine Advisor, UC Sea Grant Extension

The mission of the Humboldt Bay Scientific Advisory Committee on Estuarine Restoration is to contribute to an interdisciplinary science-driven, ecosystem-based approach for guiding restoration efforts in Humboldt Bay through a better understanding of the functions, processes, and resilience of the Bay ecosystem to invasive species and other human induced alterations.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802 4213

Jeff Robinson
Conservation Specialist
Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, California 95502-1030

Dear Mr. Robinson:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Draft Humboldt Bay Management Plan (Draft Plan) dated March, 2005. NMFS appreciates the opportunity provided by the Humboldt Bay Harbor, Recreation, and Conservation District (District) to comment on the Draft Plan. Furthermore, NMFS applauds the District for developing this important long-term strategy for resource management in Humboldt Bay. In order to assist the District with their efforts, NMFS offers the following comments to further clarify NMFS' role and our interest in partnering with the District and other Humboldt Bay stakeholders.

Clarification of NMFS Responsibilities

The Draft Humboldt Bay Management Plan provides a description of the jurisdictional responsibilities of the various Federal and state agencies within Humboldt Bay. NMFS would like to clarify our role in Humboldt Bay. NMFS' primary responsibility is the stewardship of the nation's living marine resources and their habitats. Within Humboldt Bay, this is primarily achieved via our authority under the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Marine Mammal Protection Act, and the Fish and Wildlife Coordination Act.

Endangered Species Act (ESA)

The ESA provides for the conservation of species that are endangered or threatened with extinction throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhyncus kisutsch*), California Coastal (CC) Chinook salmon (*Oncorhyncus tshawytcha*), and Northern California (NC) steelhead (*Oncorhyncus mykiss*), are Federally threatened species that are known to occur within Humboldt Bay. Humboldt Bay is also designated critical habitat for SONCC coho salmon and is proposed critical habitat for CC Chinook and NC steelhead.

Federal agencies are obligated to consult with NMFS on any activities, which they authorize, fund, or carry out, that may affect a listed species via an interagency Section 7 consultation. If "take" is anticipated or likely to occur in the course of research or enhancement activities, or if "take" is likely to occur incidentally to an otherwise lawful activity, non-Federal organizations and individuals must obtain a Section 10 permit, which exempts them from the take prohibitions of Section 9 of the ESA.

Magnuson-Stevens Act Essential Fish Habitat Provisions

The Draft Humboldt Bay Management Plan includes a detailed section on Essential Fish Habitat (EFH). NMFS appreciates the District's efforts to include EFH issues within the context of the Draft Plan. In order to assist the District, NMFS would like to provide further clarification on EFH designation and the regulatory context. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. EFH is described by the Regional Fishery Management Councils in amendments to Fishery Management Plans, and is approved by the Secretary of Commerce acting through NMFS.

The Pacific Fishery Management Council, which oversees fisheries for California, Oregon, and Washington, has defined EFH for various Federally managed species within the Pacific Salmon, Pacific Groundfish, and Coastal Pelagics Fishery Management Plans. In the estuarine and marine areas, Pacific Salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (EEZ). The Pacific Groundfish EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the EEZ. The east-west geographic boundary of Coastal Pelagics EFH is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10°C to 26°C. Thus, all waters within Humboldt Bay are considered EFH for various Federally managed fish species within the Pacific Salmon, Pacific Groundfish, and Coastal Pelagics Fishery Management Plans.

More detailed descriptions and identifications of EFH for the groundfish species are found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to the Pacific Coast Groundfish Management Plan and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix. Detailed descriptions and identifications of EFH for the coastal pelagic species are found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan. Links to this information can be found at http://swr.nmfs.noaa.gov/efh.htm.

In the regulatory context, the consultation requirements in the Magnuson-Stevens Act direct Federal agencies to consult with NMFS when any of their activities may have an adverse effect on EFH within Humboldt Bay. The EFH regulations define an adverse effect as "any impact which reduces quality and/or quantity of EFH [and] may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions." Once NMFS learns of a Federal or state project that may have an adverse effect on EFH within Humboldt Bay, NMFS is required to develop EFH Conservation Recommendations for the project. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH. Federal agencies are required to respond to EFH Conservation Recommendations in writing within 30 days. The Act also authorizes the Pacific Fishery Management Council to comment on Federal and state projects, and directs the Council to comment on any project that may substantially impact anadromous fish habitat.

Fish and Wildlife Coordination Act (FWCA)

The Fish and Wildlife Coordination Act requires that wildlife, including fish, invertebrates, and marine vegetation, receive equal consideration and be coordinated with other aspects of water resource development. This is accomplished via consultation with NMFS, the U.S. Fish and Wildlife Service, and appropriate state agencies, whenever any body of water is proposed to be modified in any way and a Federal permit or license is required. These agencies determine: (1) the possible harm to fish and wildlife resources; (2) the measures needed to both prevent the damage to and loss of these resources; and (3) the measures needed to develop and improve the resources, in connection with water resource development.

Marine Mammal Protection Act (MMPA)

The MMPA establishes a moratorium on the "taking" of marine mammals in U.S. waters by any person and by U.S. citizens in international waters, as well as a moratorium on the importing of marine mammals and marine mammal products into the United States. As defined in the MMPA, "take" is defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal."

Although "take" is generally prohibited, certain activities are exempted from this moratorium. NOAA may issue two types of "take" authorizations pursuant to section 101 of the MMPA. Incidental Harassment Authorizations (IHA) are for activities with no potential for mortality or serious injury while utilizing required mitigation measures. Letters of Authorization (LOA) are for activities that may result in injury or mortality despite utilizing required mitigation measures.

Coordination and Streamlining

NMFS supports the District's efforts to expand harbor, recreational, and conservation opportunities. Given that many of the policies and development proposals identified in the Draft Plan have the potential to affect NMFS trust resources, NMFS encourages the District to solicit our input on the implementation of the management plan. Specifically, NMFS would like the opportunity to comment on projects that may affect listed species, marine mammals, EFH, and/or other marine resources. Therefore, NMFS encourages the District to contact NMFS at the earliest opportunity to discuss coastal development projects that have the potential to impact NMFS trust resources. This coordination should help facilitate the District's regulatory streamlining goal and ensure environmentally sound management decisions and development proposals in Humboldt Bay.

Clarification of NMFS Agency Name

The Draft Plan identifies our agency as NOAA Fisheries (formerly the National Marine Fisheries Service). The official name of the agency actually is NOAA's National Marine Fisheries Service (NMFS), which we use in official correspondence. We recommend that the District use our official name, NMFS, in the final management plan.

Appropriate Contacts

Irma Lagomarsino is the Supervisor of the Arcata Field Office and can be reached at (707) 825-5160. Chuck Glasgow is the Federal Permits Coordinator for the Arcata Field Office and can be reached at (707) 825-5170. For specific questions related to marine mammals, contact Monica DeAngelis at (562) 980-3232. For specific questions related to EFH, contact Korie Schaeffer at (707) 575-6087 or Bryant Chesney at (562) 980-4037.

Again, NMFS thanks you for the opportunity to comment on the Draft Plan and looks forward to future collaboration on the implementation of the Humboldt Bay Management Plan.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Californians for Alternatives to Toxics

315 P Street • Eureka, CA • 95501
707-445-5100 • Fax:707-445-5151
cats@alternatives2toxics.org
www.alternatives2toxics.org

April 15, 2005

Harbor District Board of Commissioners
Humboldt Bay Harbor Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

Attn: Jeff Robinson, Resource Specialist

Re: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners,

Californians for Alternatives to Toxics (CATs) submits the following comments on the 2005 Draft Humboldt Bay Management Plan. CATs is a public interest organization, concerned about the use of pesticides and alternatives to pesticides in California. Many of CATs' members live in the vicinity of or otherwise use, enjoy and depend on the Humboldt Bay for recreation, study, and livelihood. Our comments address the following aspects of the plan:

1. Industrial focus of the plan
2. Eradication of non-native species
3. Mariculture
4. Control of point source and watershed pollution
5. Treatment of ballast water
6. Rare, Threatened, and Endangered Species
7. CEQA and NEPA compliance

Industrial focus of the plan

While the plan seeks to promote economic growth in the area through increased industrialization and port traffic, the community has continually proven more supportive of efforts to preserve the recreational and natural qualities of the Bay, which would be greatly diminished with increased commercialization. The focus of the plan should shift from industrial expansion to the preservation of the area's unique natural resources and recreational opportunities if it is to fit with the view of a majority of the community.

Eradication of non-native species

The invasion of exotic species is currently one of the most pressing environmental problems facing bays along the West Coast. While we applaud the District for addressing non-native species in the Management Plan, CATs is concerned that the strategy suggested does not adequately detail measures to effectively combat these species. The District should establish a Technical Options Committee to develop a long-term, comprehensive, Integrated Pest Management (IPM) strategy that focuses on education, prevention, quick response, and control of exotic species and their vectors through measures that will not cause secondary impacts or degrade the Bay. Because pesticide-dependent control efforts create an inhospitable environment for sensitive natives and threaten other native plant and animal species, as well as providing disturbance factors that favor aggressive invasives, the plan should require that only non-chemical means of eradication and control may be utilized. Evergreen State College has conducted extensive research on nontoxic and non-chemical *spartina* controls (http://192.211.16.13/curricular/MES/spartina.htm), and many other information sources exist for non-toxic strategies.

Mariculture

The draft plan calls for the expansion of mariculture activities, particularly for shellfish. CATs is concerned with several aspects of this mariculture expansion. As stated by the Convention on Biological Diversity: "mariculture on an industrial scale may pose several threats to marine and coastal biological diversity due to, for example, wide-scale destruction and degradation of natural habitats, nutrients and antibiotics in mariculture wastes, accidental releases of alien or living modified organisms resulting from modern biotechnology, transmission of diseases to wild stocks, and displacement of local and indigenous communities" (http://www.biodiv.org/programmes/areas/marine/mariculture.asp).

Increasing mariculture may lead to further introduction of non-native species, including both the culture species themselves and any pathogens they may carry. While identifying their Best Management Practices for mariculture, the District should include a protocol for monitoring and addressing this threat that avoids toxic chemicals in treatments regimens that may be developed.

No mention has been given to the hazardous inputs used in large-scale mariculture, such as pesticides and antibiotics, and the cumulative effects these substances could have on water quality and environmental health of the Bay. Mariculture operations in Willapa Bay in Washington have resorted to using large quantities of the toxic organophosphate carbaryl to control the native ghost shrimp that complicate oyster culture. The plan should be written to prevent the use of pesticides and other toxic chemicals for mariculture operations. Also, the detrimental effects of waste products should be evaluated. Finally, toxicological studies of dioxin and pentachloraphenol levels (and other possible carcinogens existing in Humboldt Bay) should be conducted in the area designated for mariculture expansion, as these pollutants could lead to serious public health consequences (see below).

Control of point source pollution

The section of the plan entitled "Toxic Materials Management" focuses primarily on toxic spills and illegal dumping, but makes no mention of continued point source pollution by Bay industries and former industrial sites. While the plan currently emphasizes industrial expansion, emphasis should be placed instead on the cleanup and reuse of existing industrial sites, many of which are sites of substantial toxic pollution, including pentachlorphenol.

Pentachlorophenol (PCP) was used at many mill sites in the Humboldt Bay area in the years 1952 until the mid-1980s. The toxicity and long persistence of PCP is well established and its use was both widespread and careless at sawmills, resulting in contamination that continues today at significant levels and results in on-going discharge of PCP to water, including tributaries to the Bay and directly to the Bay itself.

During surveys by the Regional Water Quality Control Board in the 1970s, it was assumed that PCP use was restricted to softwood mills. Evidence later surfaced that it was also used at redwood mills. Many larger mills in the Humboldt Bay area sawed both softwoods and redwood, depending on economic and other conditions, and, by the volume of board feet they produced, were likely to have used significant quantities of PCP if it was used at all. Many mills were no longer operating during the 1970s when inventories of mills using PCP were made by NCRWQCB, therefore many mills that had used PCP were not identified. Thus, CATs believes that the weight of evidence indicates that former mill sites of significant size that were operating at any time in the 1950s through the 1980s should be considered as potentially contaminated with PCP.

To protect Bay resources from ongoing PCP discharge, the plan should include a protocol for identifying sites that may be contaminated and affecting the Bay and addressing how the District will ensure that these sites will by characterized and remediated.

CATs is submitting with these comments a map prepared from our records in 2002 that depicts the remediation status of sites polluted with pentachlorphenol, based on information from the North Coast Regional Water Quality Control Board and the Agency for Toxic Substances and Disease Registry. In addition to these known sites, numerous others of former sawmills and plywood plants have never been identified in surveys.

CATs has developed the following list of sites of larger sawmills from around the Humboldt Bay that should be evaluated as to whether PCP discharges to the Bay are ongoing. A more detailed inventory is needed.

Arcata Plywood Corporation	Arcata
Arcata Redwood Co.	1925 G St, Arcata
Coast Pacific Lumber Co.	ft. of Washington St. Eureka
Diebold Lumber Co.	928 H St., Arcata
Emmerson R.H. Lumber Co.	Somoa Rd, Arcata
Eureka Redwood Lumber Co.	M St. Eureka
Hammond Lumber Co.	Ft. of Whipple, Eureka
Holmes Eureka Lumber Co.	2006 4th St, Eureka (Bucksport)
Orleans Veneer and Lumber	Arcata
Pacific Lumber Co.	3300 Broadway, Eureka
Precision Lumber Co.	Old Arcata Road
Rockey Valley (Mecca) Lumber Co.	ft. of Washington St., Eureka
Washington Lumber	Somoa Rd, Arcata
Wes-Cal Lumber Co.	south Arcata
Weyerhaeuser Lumber Co.	Arcata

(Sources: Regional Water Quality Control Board, North Coast Region, September 28, 1988; Department of Toxic Substances Control, 1997; numerous NCRWQCB site remediation documents for mills described on CATs' map, available from the agency and CATs' library; and personal interviews with NCRWQCB staff and former mill workers by Patty Clary)

In addition, the District should address and monitor the cumulative effects of pesticide and sediment runoff from logging operations that are eventually discharged into Humboldt Bay. According to the California Department of Pesticide Regulation's Pesticide Use Report database, Pacific Lumber Company sprayed 3,095 lbs of toxic pesticides in the Freshwater and Elk River Watersheds in 2002-3. These chemicals have the potential to either leach readily to water or adsorb to soil particles that discharge to water and ultimately impact the Bay. While the District may not have jurisdiction over the entire watershed, including logging lands, it does have influence with the Regional Water Board over the decision making processes that result in timberland pesticide use. The plan should spell out how the District plans to use this influence to prevent pesticide runoff.

Treatment of ballast water

The District should include obligatory provisions for ballast water treatment to avoid introduction of non-native species, and ensure proper regulation of treatment. The plan should address recent rulings concerning EPA responsibilities in monitoring ballast water. On March 31st, 2005, a federal court ordered the EPA to repeal regulations exempting ship operators from having to obtain permits under the Clean Water Act to dump ballast water (case no. C03-05760 SI), overruling a decision made by the Bush Administration in 2003. (*Fed. Regist.* 2003, *68*, 53,165–53,166). The new regulatory responsibilities are to be further defined in an all-party conference set for April 15th 2005. The plan needs a built-in protocol for addressing these rapidly evolving issues.

As open water ballast exchange can lead to a wider dispersal of invasive species (http://globallast.imo.org/index.asp?page=mepc.htm), other methods have been considered for ballast water treatment programs, including mechanical (filtration and separation), sterilization (ultraviolet light, electric currents, or other means), and chemical (biocides). As stated in a 2004 summary from the International Convention for the Control and Management of Ships Ballast Water and Sediments: "Parties should ensure that ballast water management practices do not cause greater harm than they prevent to their environment, human health, property or resources, or those of other States." (http://globallast.imo.org/index.asp?page=mepc.htm). The NISA requirements state treatment methods must be "environmentally sound," which as defined "minimizes adverse impacts to the structure and function of an ecosystem and adverse effects on non-target organisms and ecosystems and emphasizes integrated pest management techniques and non-chemical measures." (http://www.nemw.org/Ballast_Residuals.pdf) CATs recommends the District should prioritize nontoxic treatment methods and establish strict standards of allowable ballast residuals, including strong provisions disallowing biocide use.

Rare, Threatened, and Endangered Species

As the Bay serves as the home of numerous rare, threatened, or endangered aquatic and avian species, the plan needs to make special mention of a commitment to not only minimize potential threats to these species, but to actually promote them through habitat preservation and improvement. Any discussion of mariculture and industrial expansion needs to address this concern, as do efforts to address toxic pollution.

Compliance with California Enviornmental Quality Act (CEQA) and National Environmental Policy Act (NEPA)

The draft plan has been developed prior to the initiation of CEQA and NEPA. Though the draft plan mentions the District's intention to comply with CEQA and NEPA in conducting an analysis and evaluation of the environmental impacts of the plan, it is unclear when the process will be initiated. This raises the question of whether the District intends to finalize the plan before the CEQA and NEPA processes are initiated. Doing so would be contrary to the spirit of CEQA and NEPA. The intent is that analysis and evaluation of potential environmental impacts of a plan occurs concurrent to plan development so that significant impacts are identified and mitigations incorporated into the plan. If the plan is finalized in advance of environmental review which finds significant impacts and that mitigations must be crafted, the Harbor District risks having to scrap and rewrite all or substantial portions of the plan at significant cost. Having the plan completed before initiating its environmental review also creates a situation in which a pro forma review is more likely, as review done after a plan is " finalized" can tend to be oriented to ephold its conclusions. We urge the District to begin CEQA analysis now while the plan is in the draft phase.

CATs requests the District to consider the issues discussed above prudently. Additional supporting documents will be included with a hard copy being sent through conventional mail. We look forward to your responses to the public comment period.

Sincerely,

Patricia Clary

Patty Clary
Executive Director
Californians for Alternatives to Toxics

Noelle Johnson

Noelle Johnson
Program Associate
Californians for Alternatives to Toxics

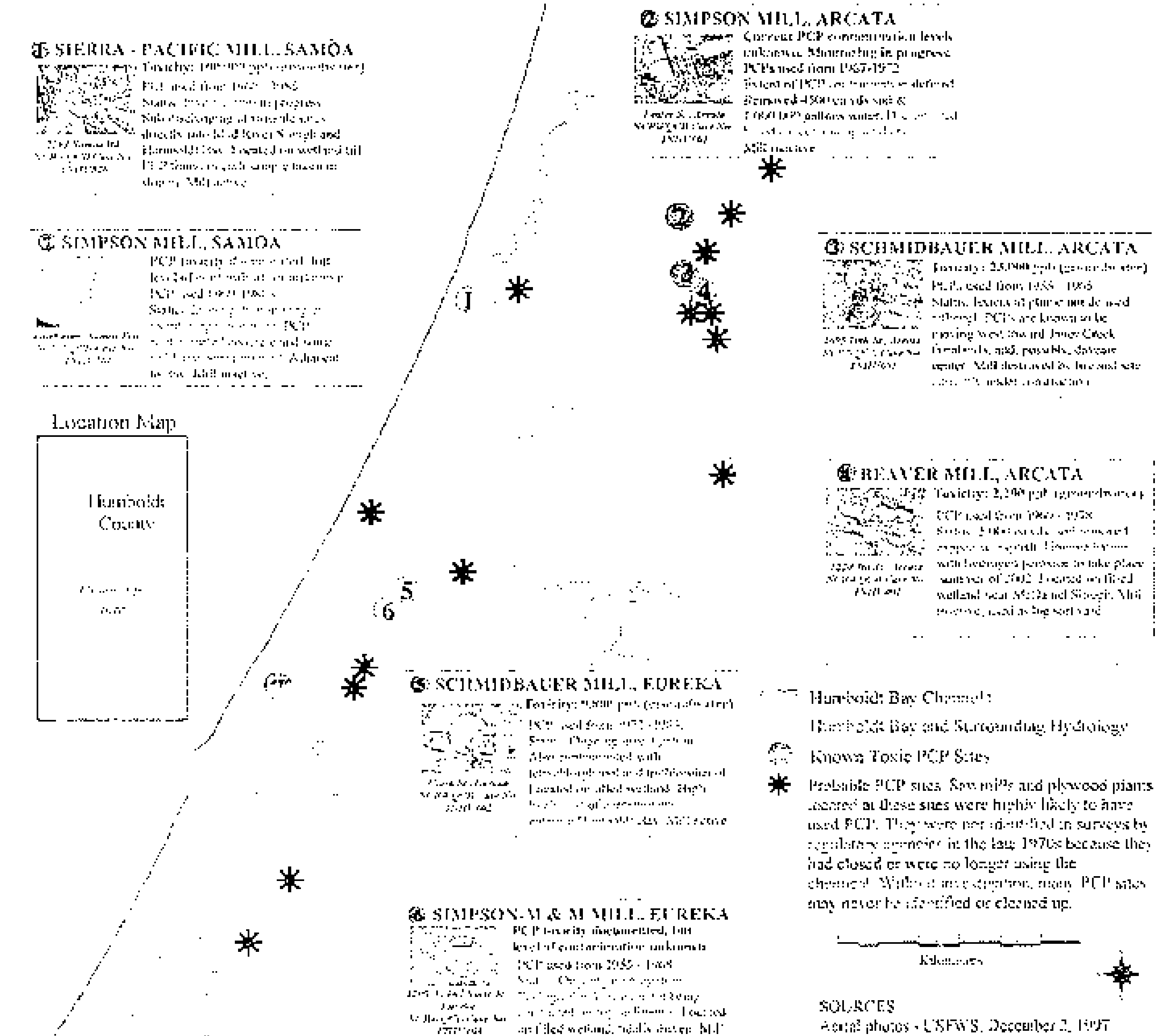
TOXIC WASTE

Pentachlorphenol (PCP) Sites On Humboldt Bay: Forgotten But Not Gone

TOXIC WASTE

PCP (C_6HCl_5O) is a pesticide used by sawmills from the early 1950s until the mid-1980s to protect wood products from damage by fungi and insects. It is heavily contaminated with dioxins. This chemical compound harms the liver, kidneys, blood, lungs, nervous, reproductive, digestive, and immune systems, causes birth defects and cancer. Careless and unregulated PCP application methods resulted in soil, surface, and ground water contamination at sawmills. The health of Humboldt Bay and surrounding areas are impacted by the extreme toxicity and persistence of PCP.

The main sites known to be contaminated with PCP are identified. These sites are either under investigation and/or cleanup overseen by the North Coast Regional Water Quality Control Board.



SOURCES
Aerial photos - USFWS, December 2, 1997
Hydrology - SONC CBF database, 2000.
Waste geology and site information obtained from NCRWQCB.

Map composition by Christine Ambrose, EPIC, and Patty Clary, CATS.

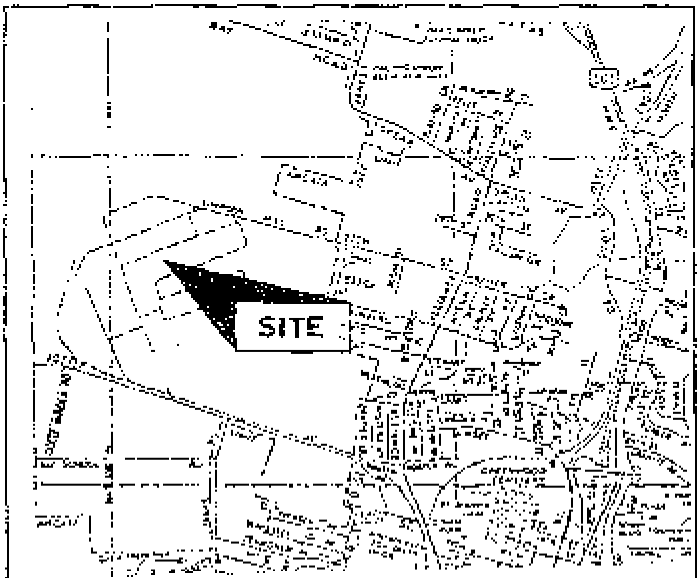
The Environmental Protection Information Center & Californians For Alternatives To Toxics February 7, 2002

California Environmental Protection Agency
Department of Toxic Substances Control

Former Simpson Timber Company Remanufacturing Plant Site

Arcata, California

Fact Sheet No. 1 **September 1997**



Site Location Map (also see insert)

Public Comment Period and Meeting

The public is invited to comment on the Draft Removal Action Workplan and proposed Negative Declaration for the Simpson Timber Company Remanufacturing Plant Site during a 30-day comment period from:

September 15, 1997
to
October 15, 1997

DTSC will hold a public meeting on Tuesday, September 23, 1997, at 7:00 p.m. at the Arcata Community Center located at 14th and "D" Streets, Arcata, CA

INTRODUCTION

This fact sheet provides information on the planned environmental cleanup at the former Simpson Timber Company Remanufacturing Plant on Foster Avenue in Arcata, California. Specifically it describes the Draft Removal Action Workplan (RAW), dated September 12, 1997. The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) will accept public comments on this plan from September 15, to October 15, 1997.

In addition, DTSC will accept comments on a proposed Negative Declaration prepared in accordance with the California Environmental Quality Act (CEQA). The proposed Negative Declaration finds that approving the Draft RAW would not result in significant adverse environmental impacts.

DTSC will hold a public meeting on September 23, 1997, to provide information about the proposed cleanup activities and to facilitate public input. DTSC representatives will be available to respond to questions and comments after the meeting presentations.

Words in boldface are defined in the glossary section of this fact sheet

SITE HISTORY AND DESCRIPTION

The site was acquired in 1951 and developed as a remanufacturing plant by the Simpson Timber Company to process old growth lumber. The plant operated until 1989 when it was closed. The equipment was sold and removed between 1990 and 1991. Of the 209 acres, 95 acres were developed for industrial use. The remaining 114 acres has remained undeveloped or periodically used for grazing or other agricultural uses (i.e. flower bulbs and cattle feed). Processing operations were centered around a 10 acre building located on the southwest corner of the site close to Foster Avenue and the main entrance to the site. Of the 95 developed acres, 46 acres were graded, covered in asphalt and used for seasoning the lumber. One evaporation pond with an overflow holding pond was also developed.

An Environmental Site Assessment (ESA) was performed on behalf of the City of Arcata in 1995 when the City considered acquiring the site. The purpose of this assessment was to identify past and present land uses that may have generated or caused the release of hazardous materials. The ESA was primarily based on visual inspections of the

SITE HISTORY & DESCRIPTION
(Continued from page 1)

site and review of public records. The ESA summarized limited investigation and cleanup activities previously performed at the site. The cleanup activities included the removal of soil contaminated with **polychlorinated biphenyls (PCBs)** from areas where transformers had been located and the removal of asbestos from dry kiln buildings. The ESA recommended areas of the site where further investigation was required.

In preparation for the sale of the property to a private party, Simpson initiated an investigation of the site in December 1996 to determine if soil and **groundwater** had been contaminated by former operations. This investigation was conducted with DTSC oversight under a Voluntary Cleanup Agreement. The areas investigated included areas of concern identified by the ESA. Contamination was found in six of the twenty-two areas of the site that were investigated. The areas where contamination was found are: the steam cleaning area; beneath a teepee burner; beneath two above-ground storage tanks; in the dip tank area; in a debris disposal area; and in an area south of the main building, the southern lunch room area. The locations of these areas are shown on the site map (Page 4). The contaminants include pentachlorophenol (PCP), petroleum hydrocarbons (diesel, motor oil, and Bunker C fuel oil), hydrocarbon and **chlorinated solvents**.

Most of the contaminated soil was excavated from the impacted areas during the site investigation. Excavated soil from the contaminated areas is currently stockpiled in the main building on the site. Lead, zinc, and motor oil were detected in several soil samples collected from the debris disposal area. However, further investigation of the debris disposal area is required to determine the extent of contamination.

The southern lunch room area was the most significant area of contamination identified during the investigation. Former Simpson employees indicated that paint residue and solvents had been placed in this area. Approximately 3,000 cubic yards of soil was excavated from this area to locate where paint residue and solvents had been placed. While excavation was occurring, the area where paint residue and solvents were placed was evident because of soil discoloration and the strong odor that was observed. Soil excavated from this location has been segregated in a separate stockpile in the main building. Low or non-detectable concentrations of contaminants were detected in soil in this area. Limited areas of groundwater were found to be contaminated with concentrations of contaminants exceeding **Maximum Contaminant Levels.** The contaminants detected at or above Maximum Contaminant Levels in the water samples that were collected were PCP, **xylenes, toluene, benzene, ethylbenzene,** and **1,2-dichloroethene (cis/trans).**

Because groundwater at the site occurs close to the ground surface, dewatering was required to prevent excavations from filling with water and to prevent excavation sidewalls from collapsing. Additionally, dewatering of the excavations minimized the contact of inflowing water with contaminated soil. Most of the contaminated groundwater occurring in the southern lunch room area was pumped from the excavation and treated on-site using a mobile treatment unit with **granular activated carbon** filters. Removal of contaminants was necessary before it could be sent to the Sewage Treatment Plant. Treated water was placed in tanks and was transported by truck to the Eureka Sewage Treatment Plant where it was discharged. A total of over one million gallons of water was pumped from excavations, treated, and discharged.

The report of Investigation, July 31, 1997 and revision dated September 12, 1997 discussed the results of the investigation in detail. A copy of these materials are **available in the Arcata public library** (see page 6 for address and hours).

ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The purpose of the RAW is to evaluate removal action alternatives that will minimize or eliminate the threat to public health and the environment, and to select a preferred alternative.

The Draft RAW identifies four removal action alternatives for the site. The four alternatives are:

- Alternative A - No Action
- Alternative B- French Drain Groundwater Extraction
- Alternative C - Soil Excavation and Groundwater Extraction
- Alternative D - Cap and Barrier Wall

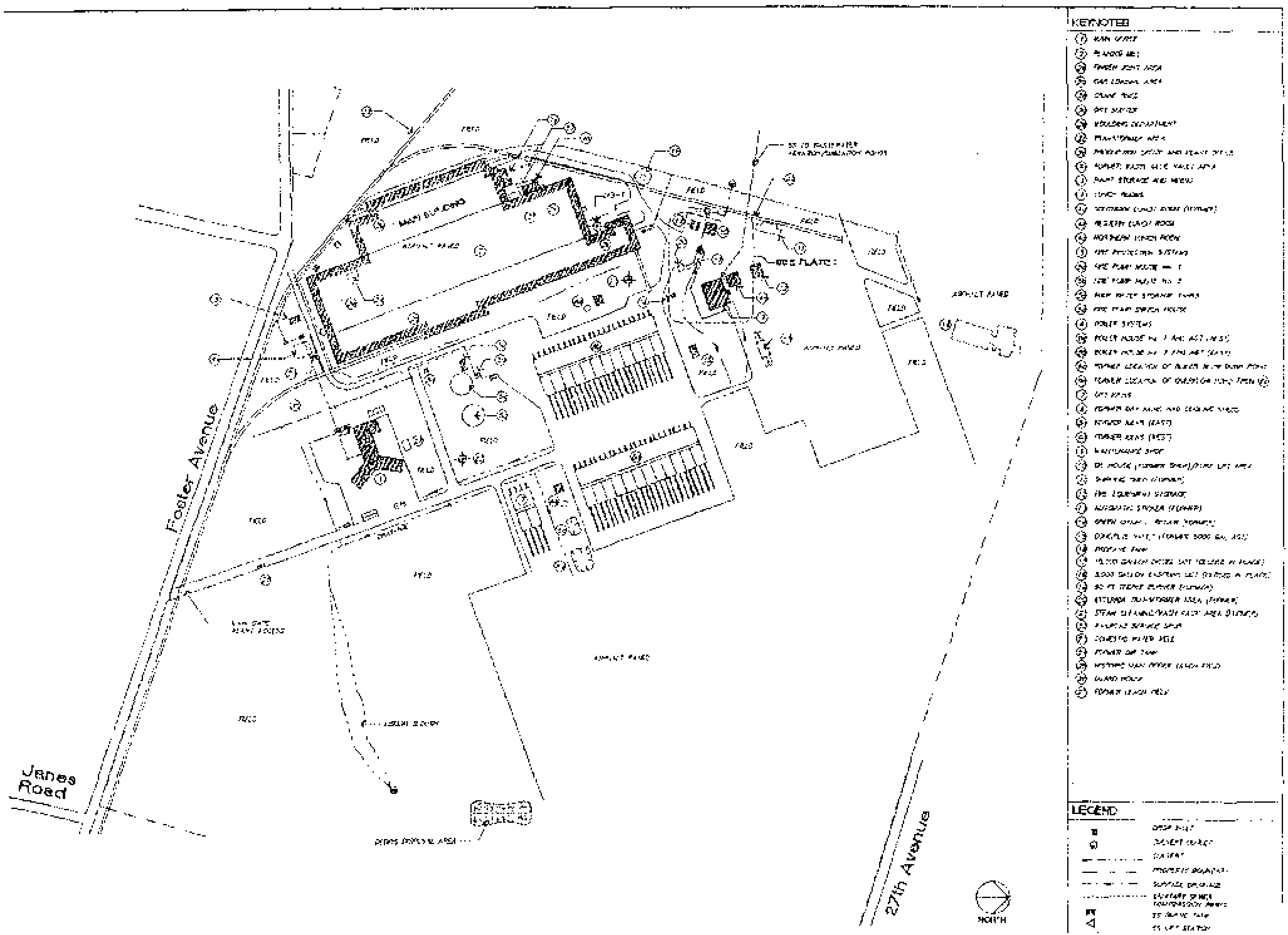
All of the alternatives include as a component the classification of soil excavated during the site investigation which is currently stockpiled in the main building. Stockpiled soil with contaminant levels exceeding cleanup levels (see discussion in next section) would be disposed at a permitted off-site disposal facility. Additionally, all alternatives include the backfilling of open excavation from the site investigation. Clean fill will be used to backfill the excavations.

Alternatives B, C, and D all include as components the excavation of debris and contaminated soil, if present, from the debris disposal area. The four alternatives primarily differ in the actions that would be taken to address the former southern lunch area. The actions under each alternative for addressing the southern lunch room area are described below.

Alternative A: "No Action"

Alternative B: French Drain Groundwater Extraction

A French Drain would be installed down gradient of contaminated soil and groundwater. Groundwater would be pumped from the French drain and treated on-site. The likely method by which treated


KEYNOTES
LEGEND
Foster Avenue
27th Avenue
Janes Road
NORTH

groundwater would be disposed is by discharge to the Eureka Sewage Treatment Plant. Monitoring wells would be installed and sampled to verify that the French drain is effectively capturing contaminated groundwater.

Alternative C: Soil Excavation and Groundwater Extraction

Remaining contaminated soil above cleanup levels (see discussion in next section) would be excavated and disposed at a permitted off-site disposal facility. Groundwater exceeding Maximum Contaminant Levels would be pumped from the excavation and treated on-site. Treated water would be disposed by discharge to the Eureka Sewage Treatment Plant. Monitoring wells would be installed and sampled to verify that the soil removal is effective in preventing further impacts to groundwater. Quarterly sampling of the monitoring wells for a period of one year would be the expected duration of monitoring under this alternative.

Alternative D: Cap and Barrier Wall

An impermeable cap would be constructed over and a subsurface barrier would be constructed to contain contaminated soil and groundwater. Monitoring wells would be installed and sampled to verify that contaminants are effectively contained.

Glossary

benzene - produced from petroleum and very widely used in the chemical industry for the production of resins and plastics and as a gasoline additive. A component of cigarette smoke. A known cancer causing agent.

chlorinated solvents - solvents are substances which readily dissolve other substances. Chlorinated solvents contain chlorine atoms in their chemical structure.

1,2 dichloroethene (cis/trans) chemicals formed as intermediates in the production or degradation of commercial chlorinated solvents.

ethylbenzene - a chemical substance which occurs naturally in coal tar and petroleum. It is used in making paints, inks, and insecticides.

granular activated carbon - a form of crushed and hardened charcoal which has a strong ability to attract and absorb a number of contaminants from extracted groundwater.

Maximum Contaminant Levels - a contaminant level for drinking water which is based on health risk (primary standard) and non health concerns such as odor or taste (secondary standards). These levels are established and legally enforced by the California Department of Health Services and U.S. Environmental Protection Agency.

pentachlorophenol (PCP) - a chemical that is used as a wood preservative because it kills fungus and termites. PCP is listed as a cancer-causing chemical under Proposition 65.

Preliminary Remediation Goals (PRGs) - PRGs are contaminant concentrations that are protective of humans, including sensitive groups, over a lifetime. PRGs are specific to the environmental media in which a contaminant might occur (i.e., soil, air, water). PRGs for soil take into account potential exposure by ingestion, inhalation of particulates, inhalation of volatiles, and dermal absorption.

polychlorinated biphenyl (PCBs) - a group of chemicals used for a variety of purposes including electrical applications, carbonless copy paper, adhesives, hydraulic fluids, and caulking compounds. PCBs do not breakdown easily and are listed as cancer-causing chemicals under Proposition 65.

toluene - a chemical substance which occurs naturally in crude oil and which is produced in the process of making gasoline and other fuels from crude oil, in making coke from coal, and as a by-product in the manufacture of styrene. Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber.

xylene - a chemical substance used as a solvent in the printing, rubber and leather industries. Along with other solvents, xylene is also used as a cleaning agent, a thinner for paint, and in varnishes.

RECOMMENDED REMOVAL ACTION ALTERNATIVE

The removal action alternatives were evaluated based on effectiveness, implementability, and cost. Based on the results of the evaluation, Alternative C is the most effective at protecting human health and the environment, and therefore is recommended. Alternative C is the recommended alternative.

The soil and groundwater cleanup levels that would be applied under Alternative C are: 1) **Preliminary Remediation Goals** established by the U.S. Environmental Protection Agency, Region IX, for soil on residential land and 2) Maximum Contaminant Levels.

The activities to complete the work at the site would involve the use of heavy equipment which would be operated by licensed California contractors.

Work would be performed in accordance with a site-specific health and safety plan. This plan would comply with both State and federal regulations and be designed to protect the health and safety of on-site workers and the public during implementation.

After public comments have been considered (see box on page 1 regarding public comment period and meeting) and final RAW is approved, a Removal Design and Implementation Plan will be prepared within 30 days. After approval of this Plan by DTSC, field work can begin immediately.

An implementation report would be submitted within three months following the implementation of the Workplan and would document work performed at the site.

TO SUBMIT COMMENTS

DTSC welcomes community input as an important part of the cleanup process. The Draft RAW and proposed Negative Declaration are available at the public repositories identified on the next page. If you wish to make comments on the Draft RAW or proposed Negative Declaration, please send those comments to Derek Whitworth at DTSC at the address shown below by October 15, 1997:

California Environmental
Protection Agency
Department of Toxic
Substances Control
Derek Whitworth
700 Heinz Avenue, Suite 200
Berkeley, California 94710-2737
(510) 540-3838

PLEASE KEEP ME INFORMED

If you didn't receive this fact sheet in the mail and would like to be included on the mailing list for future information updates regarding the former Simpson Timber Company Remanufacturing Plant Site, please complete and return the coupon to: **Rachelle Maricq, California Environmental Protection Agency, Department of Toxic Substances Control, 700 Heinz Avenue, Suite 200, Berkeley, CA 94710-2737**

Name: ______________________________

Address: ______________________________

City,State,Zip: ______________________________

Telephone Number: ______________________________

Comments: ______________________________

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State of California
Regional Water Quality Control Board
North Coast Region

Frank Reichmuth
Albert L. Wellman

To: Patty Clary
822-7136
7 pages

EXECUTIVE OFFICER'S SUMMARY REPORT
9:00 a.m., September 28, 1988
Del Norte County Board of
Supervisors Chambers
450 H Street
Crescent City, California

ITEM: 1.a

SUBJECT: Status Report on Problems of Disposal of Pentachlorophenol Wastes from the Timber Industry

DISCUSSION: From the mid 1950's to the early 1980's, it was common practice for whitewood sawmills to apply fungicides to newly sawn lumber to prevent growth of mildew, mold, and comparable organisms which might discolor the lumber and lower its value. It was also a common practice to apply fungicides on export lumber which would be subjected to moisture in a ship's hold. The usual method of application was by means of temporary immersion in a shallow "dip tank" at the head of the "green chain" from which the lumber was sorted into various sizes and grades. Although the effect of this treatment was limited to cosmetic, rather than structural protection of the wood, consumers often preferred the whiter lumber for both exposed and concealed applications. It was not uncommon to treat even the poorer grades of lumber once the fungicide application system was installed.

The most common lumber fungicide formulations used in these dip tanks were water soluble concentrates with pentachlorophenol, or "penta" as the primary active ingredient. Penta's resistance to biodegradation was initially regarded as an asset, and its biocidal efficiency encouraged widespread use for numerous other applications including protection of leather, rope, textiles, and paper. Additional uses by the timber industry included stain prevention on plywood and kiln dried specialty millwork by the application of pentachlorophenol in light mineral spirits. Structural lumber products such as fence posts, railroad ties, power poles, and subgrade structural timbers were treated by pressure tank applications which commonly included tetrachlorophenol and lesser chlorophenols.

The toxicity of penta has been well known. Pentachlorophenol has been found to have detrimental affects to aquatic organisms at chronic exposures as low as 3.2 parts per billion (ppb). The Department of Health Services has established an Action Level for drinking water supplies of 30 ppb. As laboratory analytical techniques improved, it was realized that the manufacturing of chlorophenol also produced byproducts which included chlorinated dioxins and furans.

Before the industry was aware of the potential problems of careless pesticide use, it was standard practice to simply drain a dip tank's contents onto the ground to clean out accumulated sawdust or to replace a solution diluted by rainwater. Although sawmill runoff was identified as a cause of fish kills in the 1960's, effluent limitations developed by the

Environmental Protection Agency a decade later focused exclusively on conventional pollutant parameters such as pH, biochemical oxygen demand, settleable solids, and bark fragments. As increasing numbers of biological studies revealed the hazards of pentachlorophenol, the timber industry reacted by replacing the sloppy individual board dip tanks with vacuum spray booths and then with unit dip systems which dip only the grades requiring protection and provide positive containment for drippage. Chemical manufacturers offered lumber fungicide formulations with new active ingredients. The first try was tetrachlorophenol, the technical grades of which still contained pentachlorophenol and the same list of byproduct impurities. Present offering include benzothiazoles, iodocarbamates, and copper quinolinol chelates.

Within the North Coast Region today chlorophenol use is a thing of the past. Staff is aware of about 55 sites where PCP had been used historically. Seven sawmills continue to use wood treatment chemicals and only two mills continue to use the old style dip tank. The legacy of past practices continues to haunt us, however. Many whitewood sawmills, including some which are no longer in operation, are underlain by pockets of contaminated soils. Chlorophenol residues leaching from these soils have contaminated groundwater and stormwater runoff. Most cleanup efforts begin with the sawmill establishing the history, type of application and specific location of fungicide use. The site is then sampled to determine the areal extent of soil and groundwater contamination by construction of soil test pits or borings and monitoring wells. Soils which are contaminated with hazardous concentrations of PCP are often excavated and hauled by truck to appropriate hazardous waste disposal sites. In our Region most contaminated soils are hauled to disposal sites in located in either Oregon or Idaho. Estimated costs for excavation, hauling and disposal of contaminated soil range from \$200 to \$400 per ton. the estimated volumes of contaminated soil at the mills range upwards to 1000 yd^3. The costs for disposal of hazardous waste soils can range up to \$300,000 dollars.

Another complicating factor at some cleanup sites is the presence of contaminated soils beneath existing sawmill structures which makes complete excavation infeasible without demolition of the sawmill. At least one facility is attempting to install a soil wash system which will inject a detergent with an affinity for PCP into soils beneath the mill. The PCP and detergent would be extracted and treated for disposal. This attempt would be a pilot project which , if successful, may be used at other sites.

The North Coast Region has high rainfall and rapid groundwater movement particularly in areas where many sawmills were built adjacent to streams. In a few cases, we have found groundwater contamination to attenuate after the contaminated soils have been removed. However, we have found high PCP concentrations to persist for years particularly in the northeastern section of the Region where rainfall is comparatively sparse. Staff believes that long term groundwater extraction and treatment will be necessary particularly in this area.

At the present time there are 11 sites where soil and groundwater investigations are being conducted. We have been working with these facilities to establish cleanup levels for groundwater and storm water runoff at each site. We have been successful in working with most active sawmills in developing mutually acceptable cleanup plans. However, in some controversial cases these plans will be presented to the Board for approval.

Following is a brief summary of circumstances at the various sawmill sites in the Region:

Alderpoint, Louisiana-Pacific	Mill dismantled; History of PCP use; No site investigation to date.
Alton, Eel River Sawmills	Mill active; No history of fungicide use.
Annapolis, Annapolis Milling	Mill active; No history of fungicide use.
Arcata, Beaver Lumber Company	Mill active; Fungicide use discontinued ten years ago; Confirmed soil and groundwater contamination; Low level runoff contamination; Site investigation in progress under cleanup and abatement order.
Arcata, Blue Chip Milling	Mill active; No site investigation to date.
Arcata, Blue Lake Forest Prod	Mill active; Improved fungicide application system in use; Confirmed soil contamination; Low level groundwater and runoff contamination; Site investigation in progress by DHS pursuant to State Superfund.
Arcata, Bob Britt	Mill active; No history of fungicide use.
Arcata, Schmidbauer	Mill dismantled; No site investigation to date.
Arcata, Sierra-Pacific	Mill active; Improved fungicide application system in use; No site investigation to date.
Arcata, Simpson Timber Co.	Mill active; No site investigation to date.
Big Lagoon, Louisiana-Pacific	Mill active; History of PCP use; No site investigation to date.

Bodega, Chenoweth	Mill inactive; No history of fungicide use.
Brainerd, Arcata Redwood	Mill active; No site investigation to date.
Branscomb, Harwood Products	Mill active; Fungicide use discontinued; Cleanup complete.
Burnt Ranch, Stone Forest Ind.	Mill active; Improved fungicide application system in use; Soil cleanup completed; Low level runoff contamination persists.
Callahan, Hjertager Lumber Co.	Mill dismantled; No site investigation to date.
Calpella, Louisiana-Pacific	Mill dismantled; Site investigation produced negative results.
Carlotta, Carlotta Lumber Co.	Mill active; Fungicide use discontinued;Domestic groundwater supply contaminated; Site investigation in progress under cleanup and abatement order.
Carlotta, Pacific Lumber Co.	Mill active; Fungicide use discontinued; No site investigation to date.
Cazadero, Berry's Sawmill	Mill dismantled; No history of fungicide use.
Cloverdale, Louisiana-Pacific	Mill active; Fungicide use discontinued; Site investigation in progress under DHS.
Cloverdale, Richardson Lumber	Mill active; History of PCP use; No site investigation to date.
Covelo, Louisiana-Pacific	Mill active; Fungicide use discontinued; No site investigation to date.
Crescent City, McNamara & Peepe	Mill dismantled; Confirmed history of pentachlorophenol use; No site investigation to date.
Crescent City, Miller Redwood	Mill active; No history of fungicide use.
Crescent City, Northcrest	Mill active; Fungicide use discontinued; No site investigation to date.
Crescent City, Standard Plywood	Mill dismantled; No site investigation to date.
Crescent City, Westbrook Wood	Mill dismantled; No site investigation to date.

Dinsmore, Louisiana-Pacific	Mill dismantled; No site investigation to date.
Dorris, Dorris Lumber Company	Mill active; No site investigation to date.
Dorris, Mountain Valley Molding	Mill active; No site investigation to date.
Duncans Mills, Berry's Sawmill	Mill active; No history of fungicide use.
Eureka, Schmidbauer	Mill active; History of PCP use; No site investigation to date.
Fort Bragg, Georgia-Pacific	Mill active; History of PCP use; No site investigation to date.
Fort Bragg, Louisiana-Pacific	Mill active; Fungicide use discontinued; Low level groundwater and runoff contamination; Site investigation in progress under cleanup and abatement order.
Fairhaven, Simpson Timber Co.	Mill dismantled; History of PCP use; no site investigation to date.
Fortuna, Pacific Lumber Co.	Mill active; Limited history of fungicide use; No site investigation to date.
Happy Camp, Stone Forest Ind.	Mill Active; Improved fungicide application system in use; low level groundwater and runoff contamination; Site investigation failed to discover source.
Hayfork, Sierra-Pacific	Mill active; Fungicide use discontinued; low level groundwater contamination; Cleanup in progress under waste discharge requirements.
Hilt, Fruit Growers Supply	Mill dismantled; No site investigation to date.
Hyampom, Jensen Lumber Co.	Mill dismantled; DHS site investigation in progress.
Hoopa, Two Sites	Mills dismantled; Low level soil contamination persists; DHS site investigation in progress.
Klamath, Simpson Timber Co.	Mill active; No history of fungicide use.
Korbel, Simpson Timber Co.	Mill active; Fungicide use discontinued; Site investigation produces negative results.

Laytonville, Philo Lumber	Mill dismantled; No site investigation to date.
Myers Flat, Georgia-Pacific	Mill dismantled; No site investigation to date.
Orick, Arcata Redwood Co.	Mill active; No history of fungicide use.
Philo, Philo Lumber Co.	Mill active; No history of fungicide use.
Potter Valley Louisiana-Pacific	Mill active; Pentachlorophenol use discontinued; Fungicide application continues; Low level groundwater and runoff contamination; Site cleanup in progress under cleanup and abatement order.
Redcrest, Eel River Sawmills	Mill active; No history of fungicide use.
Rio Dell, Eel River Sawmills	Mill active; Improved fungicide application system in use; Groundwater and runoff contamination; Site investigation in progress.
Salyer, Southwest Forest Ind.	Mill dismantled; No site investigation to date.
Samoa, Louisiana-Pacific	Mill dismantled; History of PCP use; No site investigation to date.
Scotia, Pacific Lumber Co.	Mill active, No site investigation to date.
Smith River, Arcata Redwood Co.	Mill dismantled; Cleanup complete.
Ukiah, Louisiana-Pacific	Mill active; Fungicide use discontinued; Site investigation in progress.
Weaverville, Trinity River Lumber Company	Mill active; Fungicide use3 discontinued; No site investigation to date.
Weed, Baxter/Roseburg	Mill active; Pentachlorophenol use discontinued; Site investigation in progress under federal superfund.
Wildwood, Kimberly-Clark	Mill dismantled; No site investigation to date.
Willits, Harwood Products	Mill active; History of PCP use; No site investigation to date.

Willits, Louisiana-Pacific	Mill active; Fungicide use discontinued; No site investigation to date.
Willits, R&J Lumber Co.	Mill active; No history of fungicide use.
Willow Creek, Pilot Lumber Co.	Mill dismantled; No site investigation to date.
Yreka, Georgia-Pacific	Mill active; No site investigation to date.
Yreka, Hi-Ridge Lumber Co.	Mill active; Pentachlorophenol use discontinued; Fungicide application continues; Groundwater and runoff contamination; Site investigation in progress.
Yreka, Pine Mountain Lumber	Mill dismantled; Groundwater and runoff contamination; Cleanup in progress under cleanup and abatement order.
Yreka, Timber Products	Mill active; No history of fungicide use.

PRELIMINARY STAFF
RECOMMENDATIONS: Information item only. No action required.

Name: Robert Frye, PhD
Affiliation: Retired HSU faculty
Mailing Address: 4161 Patricks Point Drive/Trinidad/95570
Phone:: 677.0483
Email address: fryebob@myway.com
Comments:
Judging from the parts I read carefully and the parts I skimmed--very professional, good job.

Fisheries are declining, shipping raw logs from here reduces us to third world status and can't continue indefinitely. As you point out, trying to compete for general cargo is unwise.

One industry is unique, renewable, and viable--oyster cultivation. Therefore, facilities, technical expertise, and even, perhaps, financing to encourage entrepreneurs should be a high priority.

However, fish farming would seem to be totally uncalled for because of its polluting nature.

Thanks for the opportunity to express my view.

Reid, Kelley E SPN [Kelley.E.Reid@spd02.usace.army.mil]

Thanks for the "workshop" last night. I went ahead and told Mr. Russel (VP for the commision, I think) and Mr. Dave Hull that I'd be interested in joining the advisory group and Dave said he'd keep me in mind.

The Draft Plan Vol 3, Sec 3.7 says the District seeks to coordinate and simplify the regulatory processes and consolidate permit forms, requirements, and review processes... while maintaining full environmental protection. The first step, I think, is to develop a list of the permits and applications required. I think we'd make a flyer with different lists for different projects. And phone numbers and addresses for the local agency offices. This is something I could also use in other parts of the Corps' district.

Until we can develop a consolidated application, Does the Harbor District want to distribute a stack of applications to interested people? Probably be best to start with or adopt the application that JARPA developed for the San Fran Bay area.

Does the Harbor want to contribute to developing a SAMP (Special Area Management Plan) because we already have Nationwide permits for boat ramps, boat docks, bank stabilization, stream and wetland restoration, etc. There's 43 of those and then about 4 RGP's that are particular to San Francisco District.

Name:: Scott Sterner
Affiliation:: North Bay Shellfish
Mailing Address:: 2550 Daffodil Ave. , McKInleyville, CA 95519
Phone:: 707 839-4723
Email address:: shellfish95519@juno.com
Comments::
I would like to commend the Harbor District on their comprehensive Humboldt Bay Management Plan (HBMP). It addresses the multi uses and the future goals for one of the North Coast"s valuable resource – Humboldt Bay. It seems to be well balanced, with great concern for the protection of this diverse eco-system.
I have only a few comments / suggestions on the HBMP :
1.) On the map showing Shellfish Resouces...it should be noted that these are natural or native shellfish beds/ reserves...not commercial.
2.) On the map of Humboldt Bay Aquaculture: refer to the ground culture sites as "historic ground culture sites" since ground culture is no longer used as a growing method.
3.) In section 3/HFA-5 Designate a Preffered...under discussion. In the last sentence, the part that states, "and it is likely that the actual areas used in the future will not be significantly greater percentage of the designated aquaculture (mariculture) combing designation (approx. 3950 acres)."....should be omitted, since it may imply that growth or expansion in the designated Mariculture area would not be allowed if we are limited to the 300 acres that are now in use. This would not permit for any growth of present businesses or new participants.
4.) In section 4/4.5.3.2 Aquaculture. In the sentence, "it is possible that oyster mariculture may be unable...." , it should be understood that oyster culture also provides for the ecological needs of many other species. Oyster culture sites are not absent of other organisms.
5.) In section 2.3.3 Mariculture, paragraph 4. The mariculture rafts in Mad River Slough that belong to North Bay Shellfish are used as a "certified wet storage". This area is used to hold oysters for a short time before taking them to market. This has been an approved wet storage area for over 12 years by the Califoria State Health. These waters have met CA shellfish growing water standards for over 25 years.

If you have further questions about these comments or need any further information, please feel free to contact me.

Sincerely,
Scott Sterner
North Bay Shellfish, owner

Aldaron Laird

Environmental Planner

www.riverplanner.com

Specializing in Regulatory Compliance and Historical Research in Riverine Environments

Dave Hull,
General Manager
Humboldt Bay District
601 Startare Drive
P.O.B. 1030
Eureka, CA 95501

RECEIVED
APR 27 2005
H.B.H.R.& C.D.

April 25th 2005

Dave,

I am very happy that the Humboldt Bay District has undertaken the arduous task of preparing a planning document for the management of Humboldt Bay so that the public may use and enjoy its public trust resources. The Humboldt Bay Commission, Staff, Humboldt Bay Management Plan Task Force and your consultants Chad Roberts and Bruce Kemp, should be commended for producing the Draft Humboldt Bay Management Plan (DHBMP). I am pleased to have an opportunity to provide you my comments and I look forward to reviewing the Final Plan.

Sincerely,

Aldaron Laird
Environmental Planner

Enc.
comments pages 2 through 8
2 attachments

980 7th Street, Suite K, Arcata, CA 95518 • (707) 825-8770 • Fax (707) 825-6737
riverplanner@sbcglobal.net

Comments
On The
March 2005
Draft Humboldt Bay Management Plan

RECEIVED
APR 27 2005
H.B.H.R.& C.D.

By

Aldaron Laird
April 25th 2005

1. It is time for a paradigm shift. We need to change how we think of Humboldt Bay. In 1970, the legislature created the Humboldt Bay Harbor, Recreation, and Conservation District, but in our local vernacular it has come to be called the Harbor District because that is how we and the District have come to think of its purpose. In economic terms, the Bay's function as a harbor is certainly significant. But if we stop to think, what is the economic value of the Bay as a beautiful and dynamic landscape? What is the economic value of the Bay for supporting several populations of migratory birds on the Pacific flyway, or in the production of commercially valuable seafood products? What value can we place on the Bay for providing those who live here and visit here opportunities to recreate whether by boating, fishing, hunting, hiking, or birding? Today, thinking of the Bay as just a Harbor is too limiting, so when we or the HBMP speak of the Bay's management authority we need to start referring to it as the Bay District, not the Harbor District. <u>Please change all references to the Harbor District to the Bay District.</u>

2. On September 9, 1850, upon California's entry into the Union, the State acquired ownership of all seashores, submerged lands, and tide lands up to mean higher high tide, as well as beds of non-tidal waterways that were susceptible to navigation up to the ordinary high water mark. These lands that were acquired in 1850 are referred to as sovereign lands or public trust lands. Essentially, public trust lands are all those lands that were "waterward" of the "U.S. Meander Line" as surveyed and recorded on the official 1854 and 1855 Township Plat maps of the United States Surveyor General Office. The U.S. Meander line around the perimeter of Humboldt Bay delineates the original extent of the Bay's salt marsh or tidelands subject to the ebb and flow of tides (see Figure 1). In 1855, Humboldt Bay and its associated tidelands occupied approximately 25,800 acres (see Figure 2). Today, almost ninety percent of the Bay's tidelands are diked and no longer experience the ebb and flow of the tides. These former tidelands are still sovereign lands or public trust lands. <u>Please identify on HBMP maps and Bay District's GIS database all lands in and around Humboldt Bay where the PTD applies.</u>

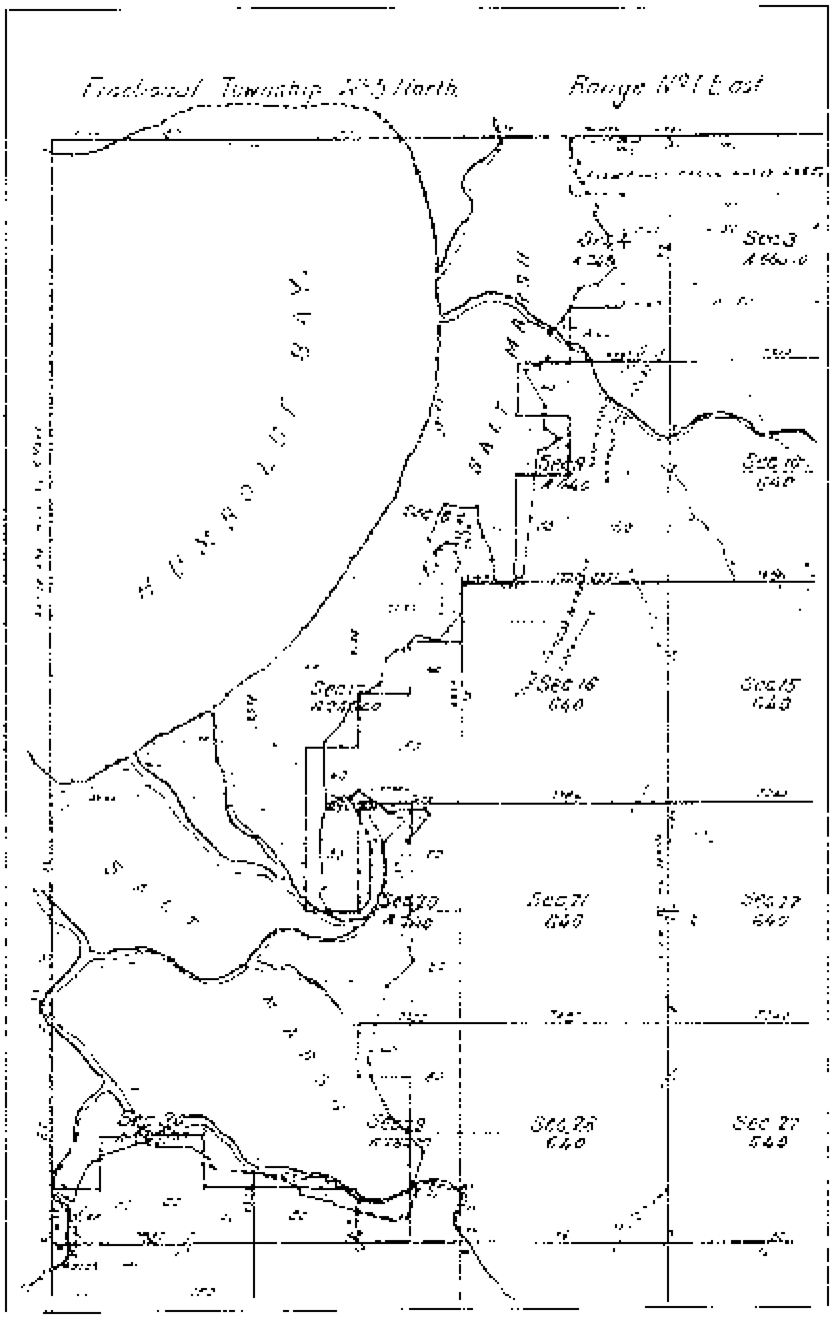

Figure 1. An 1855 fractional survey of Township 5 North Range 1 East segregates Humboldt Bay's tide lands from surrounding uplands (near Jacoby and Freshwater Creeks).

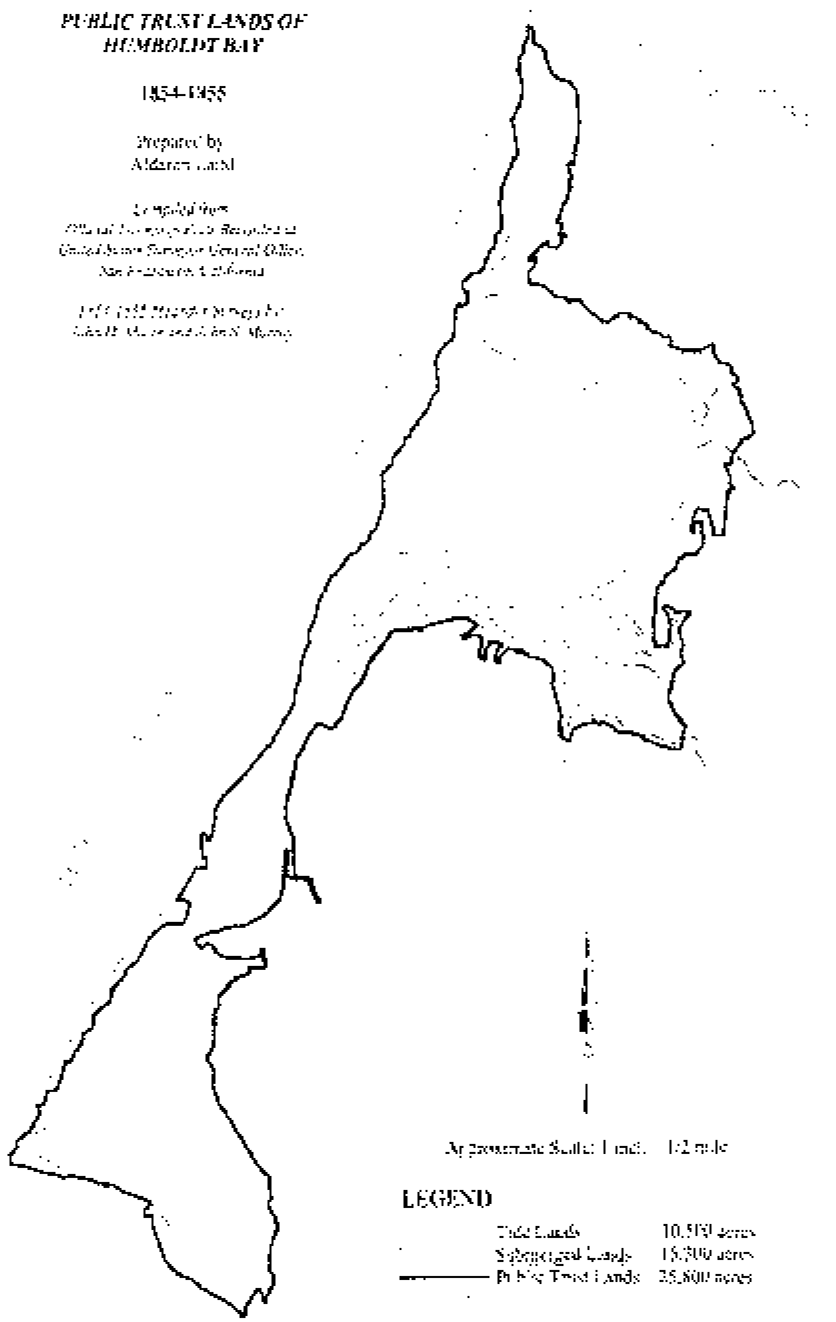

Figure 2. Public Trust Lands of Humboldt Bay 1854-1855, compiled from Official Township Plats recorded at United States Surveyor General Office, San Francisco, California.

3. The HBMP, as does the California Coastal Act (CCA) (Public Resource Code (PRC) Sections 30230 and 30231), should build upon the 1971 Supreme Court decision (Marks v. Whitney, 6 Cal. 3d 251 1971) by requiring that marine resources such as submerged and tide lands be maintained, enhanced, and restored, where feasible. The HBMW, should establish as a high priority, reconnecting and restoring former tide lands that have been diked and reclaimed. The HBMP needs to establish the Bay District as the primary agency to coordinate and lead efforts to re-connect and restore as much as is feasible of Humboldt Bay's former tidelands. Please adopt a primary coordinating agency function as policy and elevate its implementation to one of the primary purposes of the Humboldt Bay District and HBMP. Have the HBMP develop policies to establish memorandum of agreements with other land use or regulatory agencies in the Humboldt Bay planning area to streamline regulatory compliance for projects that hydraulically reconnect, restore, and enhance, former tide lands that have been diked and reclaimed.

4. In 1970, at the time of its enabling legislation the legislature transferred management of Humboldt Bay's sovereign lands (submerged and tide lands) from the State Lands Commission (SLC) to the Bay District, up to the limits of mean higher high tide(except for Indian, Woodley, and Daby Islands). The SLC exercises oversight over all granted lands. In 2001, the SLC adopted a public trust policy to guide public trust lands grantees (which includes the Bay District), lease applicants, and the public, in understanding how the Public Trust Doctrine (PTD) applies to granted and state-owned public trust lands, refer to http://www.slc.ca.gov/Policy%20Statements/Public_Trust/Public_Trust_Policy.pdf (see attachment). Therefore, the Bay District's management responsibility is similar to the SLC's in that the legislature has made the Bay District a "trustee" who "*must manage trust lands consistent with its own granting statute and the Public Trust Doctrine*" (SLC 2001). Therefore, the Bay District has a duty which should guide the formation of all of its policies and actions, to apply the PTD in the protection of the public's rights to use and enjoy its trust resources in Humboldt Bay. Please change the purpose and mission statement of Bay District and HBMP to clearly state its continuing responsibility to protect and enhance the public's use and enjoyment of trust lands and waters of Humboldt Bay.

5. When the State legislature "granted" its sovereign lands to the Humboldt Bay District, it did so with a caveat that Humboldt Bay be managed to assure the use and enjoyment of its trust resource for all people of California. The primary public uses of sovereign-public trust lands are: commerce, recreation and conservation. Neither, the legislature nor the PTD, place a priority on managing or furthering trust uses that generate revenue (commerce) over those that do not (recreation or conservation). The legislature did not create just a Harbor District unencumbered of trust responsibility. However, the DHBMP and its Revitalization Plan do place an emphasis on revenue generating trust uses associated with harbor related commerce (industrial and commercial) over those uses that do not (recreational uses such as fishing, hunting, boating, birding etc. or conservation) or in the restoration of public trust lands to tidal action and public use that were cut-off from the bay during the era of reclamation in the late 1800s and early 1900s. The SLC provides three land use-development guidelines for achieving compliance with the PTD: 1) any use or structure must directly promote uses authorized by the trust, 2) structures must be incidental to the promotion of trust uses, 3) uses or structures must accommodate or enhance the public's enjoyment of trust lands. Therefore, uses that do not accommodate, promote, foster, or

enhance the statewide public's need for the enjoyment of tide lands, are not appropriate uses of public trust lands. Please, develop policies and implementation measures in the HBMP for each public trust use. Balance trust uses in the HBMP independent of their ability to generate revenue. Include in the HBMP a policy to aggressively pursue grant funding to manage those trust uses without associated revenues.

6. The basis of the Bay District's legislative authority is the PTD, and the scope of its jurisdiction is that portion of Humboldt Bay that experiences the ebb and flow of tides. Because the PTD forms the foundation of the Bay District's management authority, the HBMP's "sphere of interest" (SOI) should be the original limit of Humboldt Bay's sovereign lands, not the 1976 CCA's Coastal Zone boundary. In 1981, the Supreme Court ruled that even if tide lands have been conveyed earlier to private persons, the public's trust interests are retained in these lands (State of California v. Superior Court (Lyon), 29 Cal.3d 210, 1981). Please adjust the HBMP's SOI boundary to coincide with Humboldt Bay's public trust lands as delineated by the U.S. Meander Line described by metes and bounds on the 1854 and 1855 Township Plats.

7. The DHBMP is an excellent opportunity for the Bay District to provide guidance on balancing land uses which may affect public trust lands, both those that are currently tidal and former tidelands. In 2001, the SLC adopted a paper prepared by the Attorney General's Office discussing Public Trust Law with particular emphasis on what the courts have found to be proper trust uses in the past, and what can be gleaned from case law regarding proposals for new and different uses of Public Trust lands http://www.slc.ca.gov/Policy%20Statements/Policy_Statements_Home.htm (see attachment). The HBMD should describe the state of the Bay (physical and biological processes affecting its waters, lands, and biota), and identify all of Humboldt Bay's trust resources and protected trust uses, similar to what the SLC's did when it prepared two Public Trust Reports on the Delta Estuary; California's Inland Coast (1991) and California's Rivers (1993). Today, typical trust uses of the Bay and its associated natural resources may include: navigation (recreational and for commerce), commerce (transportation, industrial, commercial, and aquaculture), fishing (commercial and recreational), hunting, recreation (boating, swimming, wind surfing, hiking, and birding), scientific study, and enjoyment of open spaces. All uses of Humboldt Bay's public trust lands, waters, and resources, must take into account the overarching principle of the PTD which is that trust lands and their resources belong to the public and are to be used to promote public rather than exclusively private purposes (CSLC, 2001). Commercial uses of trust lands and waters must benefit the people of the State and ensure their ability to enjoy its trust lands and waters. Essential trust purposes have always been, and remain, water related, and the essential obligation of the State is to manage tide lands in order to implement and facilitate those trust purposes for all people of the State (CSLC, 2001). Please amend the HBMP so that it serves as a public trust report by clearly describing historic, existing, and potential public trust resources of Humboldt Bay, and associated public trust uses.

8. The HBMP should review current land uses in its sphere of influence (as amended by comment number 5) to assess their affect on the feasibility of restoration of Humboldt Bay's former tidelands, and the quality of the Bay currently. The HBMP should also review current land uses in its larger watershed planning area. In 1983, the Supreme Court in the

Mono Lake case, expounded on the PTD and held that the State (read Bay District and local land use authorities) has an affirmative duty to take the public trust into account when making decisions affecting public trust lands, waters, and resources, and that the State must protect public trust uses whenever feasible (National Audubon Society v Superior Court, 33 Cal. 3d 419, 1983). That 1983 case also expanded the scope of the PTD to affect previously authorized diversions of non-navigable waters upstream when there is an adverse impact on the navigable waters and public trust resources downstream. These two rulings by the Supreme Court on the PTD have particular relevance to management and protection of Humboldt Bay, which is a public trust resource of state-wide significance. Please include policies in the HBMP to direct the Bay District to avail itself of every opportunity to comment on amendments to Local Coastal Programs (City of Arcata, City of Eureka and County of Humboldt) that control land uses that potentially could adversely affect, the feasibility of restoring Humboldt Bay's former tidelands and the quality of the Bay currently. Include policies in the HBMP to direct the Bay District to avail itself of every opportunity to comment on amendments to local General Plans with jurisdiction within the watershed planning area to protect public trust resources downstream in Humboldt Bay.

9. The 1976 CCA requires all public agencies to comply with its provisions (PRC Section 30003). In 1970, the Legislature granted to the Bay District authority over Humboldt Bay tidal waters and lands, but in 1976, it granted to the California Coastal Commission (CCC), authority over coastal development on any tide and submerged lands which are public trust lands, whether filled or unfilled, lying within the coastal zone (PRC Section 30519). Humboldt Bay contains tide and submerged lands which are public trust lands and resides in the Coastal Zone. Coastal development is defined as a development which requires a site on, or adjacent to, the sea, in order to operate (PRC Section 30101.3). Local land use authorities must now submit that portion of their General Plan and Zoning Ordinances in the California Coastal Zone, as a Local Coastal Program to the CCC for certification that the Program complies with the CCA. Please discuss in the HBMP whether the Bay District will be submitting its HBMP to the CCC for certification that it is consistent with the CCA. Provide a discussion in the HBMP as to whether the Bay District will be submitting it to the CCC for certification, and cite appropriate statute(s) if it finds that it is not subject to PRC Section 30003.

10. The HBMP should incorporate the State Lands Commission's 2001 guidelines for approval of development on existing or former tide lands and submerged lands. All uses must: 1) need to be located on the water front, or be water dependent or related, 2) be a trust related use which includes commerce, fisheries, navigation, environmental preservation, and recreation, 3) serve a public purpose, and 4) serve statewide as opposed to purely local public purposes. Public Trust lands may also be kept in their natural state for habitat, wildlife refuges, scientific study, or open space. Please include in the HBMP a set of findings incorporating the above trust use guidelines which the Bay District would make before rendering any discretionary decision that affect trust uses.

11. The Bay District, in exercising its ongoing responsibilities pursuant to its enabling legislation and PTD, may require a review of rights heretofore considered vested, when changing circumstances or new knowledge warrant such review to protect the public's right to use and enjoy its trust resources (Big Bear Municipal Water Dist. V. Bear Valley Mutual

Water Co. (1989) 207 Cal.App.3d 363.). Earlier decisions to allocate water and land use rights cannot preclude future Bay District decision-makers from considering and protecting the public's use and enjoyment of its trust lands and resources when exercising their discretionary powers. <u>Please include a policy in the HBMP that directs the Bay District, when exercising their discretionary powers, that it review the effect of previous water and land use decisions on the public's ability to use and enjoy Humboldt Bay's trust resources. Have the HBMP develop policies that foster the public's use and enjoyment of trust lands and waters by providing access to dikes that surround Humboldt Bay.</u>

ATTACHMENTS

California State Lands Commission

Public Trust Statement

At its meeting on April 24, 2001, the California State Lands Commission requested information on the Public Trust Doctrine and the role the Commission plays in administering the Public Trust. The Commission also directed staff to prepare an informative statement that it could adopt that would guide Public Trust lands grantees, lease applicants and the public in understanding how the Public Trust Doctrine applies to granted and state-owned Public Trust lands.

At the September 17, 2001 meeting of the Commission, staff presented a policy statement setting forth a statement for administration of Public Trust lands and a paper prepared by the Attorney General's Office discussing Public Trust Law with particular emphasis on what the courts have found to be proper trust uses in the past and what can be gleaned from case law regarding proposals for new and different uses of Public Trust lands. The policy statement was adopted by a 3-0 vote.

The materials presented here are intended to assist in the understanding of the Commission's role in exercising its discretion as each factual situation arises and to provide assistance to potential Public Trust land users and grantees. In determining whether a proposed use is consistent with the Public Trust Doctrine and in the best interests of the state, the Commission will consider other legal requirements such as the Coastal Act and the California Environmental Quality Act as well as the views of various public groups, businesses or other relevant sectors of California society.
http://www.slc.ca.gov/Policy%20Statements/Policy_Statements_Home.htm

PUBLIC TRUST POLICY

For

The California State Lands Commission

The Legislature has given the California State Lands Commission authority over California's sovereign lands – lands under navigable waters. These are lands to which California received title upon its admission to the Union and that are held by virtue of its sovereignty. These lands are also known as public trust lands. The Commission administers public trust lands pursuant to statute and the Public Trust Doctrine – the common law principles that govern use of these lands.

Public Trust Doctrine

The Public Trust Doctrine is set forth in common law. Several of its guiding principles are that:

I. Lands under the ocean and under navigable streams are owned by the public and held in trust for the people by government. These are referred to as public trust lands, and include filled lands formerly under water. Public trust lands cannot be bought and sold like other state-owned lands. Only in rare cases may the public trust be terminated, and only where consistent with the purposes and needs of the trust.

II. Uses of trust lands, whether granted to a local agency or administered by the State directly, are generally limited to those that are water dependent or related, and include commerce, fisheries, and navigation, environmental preservation and recreation. Public trust uses include, among others, ports, marinas, docks and wharves, buoys, hunting, commercial and sport fishing, bathing, swimming, and boating. Public trust lands may also be kept in their natural state for habitat, wildlife refuges, scientific study, or open space. Ancillary or incidental uses, that is, uses that directly promote trust uses, are directly supportive and necessary for trust uses, or that accommodate the public's enjoyment of trust lands, are also permitted. Examples include facilities to serve visitors, such as hotels and restaurants, shops, parking lots, and restrooms. Other examples are commercial facilities that must be located on or directly adjacent to the water, such as warehouses, container cargo storage, and facilities for the development and production of oil and gas. Uses that are generally not permitted on public trust lands are those that are not trust use related, do not serve a public purpose, and can be located on non-waterfront property, such as residential and non-maritime related commercial and office uses. While trust lands cannot generally be alienated from public ownership, uses of trust lands can be carried out by public or private entities by lease from this Commission or a local agency grantee. In some cases, such as some industrial leases, the public may be excluded from public trust lands in order to accomplish a proper trust use.

III. Because public trust lands are held in trust for all citizens of California, they must be used to serve statewide, as opposed to purely local, public purposes.

Commission Authority

The Legislature has granted general authority to the Commission to manage trust lands. Unless otherwise expressly stated in the State Constitution or statutes, the public trust doctrine mandates the criteria for Commission management of trust lands. In carrying out its management responsibilities, the Commission commonly leases trust lands to private and public entities for uses consistent with the doctrine. Subject to the criteria in statutes and case law, the Commission may also exchange public trust lands for non-trust lands, lift the trust from public trust lands, enter into boundary line agreements, and otherwise generally manage trust lands. While most of the authority over public trust lands possessed by the Legislature is vested in the Commission, the Legislature, as the people's elected representatives, has not delegated the authority to modify uses permitted on public trust lands by the Public Trust Doctrine. There are times when the Legislature, exercising its retained powers, enacts laws dealing with public trust lands and uses for specified properties. This may include, in limited circumstances, allowing some non-trust uses when not in conflict with trust needs, in order to serve broader public trust purposes.

Implementation by the Commission of the Public Trust Doctrine.

The Commission implements the Public Trust Doctrine through careful consideration of its principles and the exercise of discretion within the specific context of proposed uses. Factors such as location, existing and planned surrounding facilities, and public needs may militate in favor of a particular use in one area and against the same use in another. The Commission applies the doctrine's tenets to proposed projects with consideration given to the context of the project and the needs of a healthy California society, to meet the needs of the public, business and the environment. The Commission may also choose among competing valid trust uses. The Commission must also comply with the requirements of other applicable law, such as the California Environmental Quality Act. In administering its trust responsibilities, the Commission exercises its discretionary authority in a reasoned manner, accommodating the changing needs of the public while preserving the public's right to use public trust lands for the purposes to which they are uniquely suited.

Relationship of the Commission to Granted Lands

The Legislature has granted certain public trust lands to local governments for management. A grantee must manage trust lands consistent with its own granting statutes and the Public Trust Doctrine. The Legislature has retained for the state, by delegating to the Commission, the power to approve land exchanges, boundary line agreements, etc.

The State Lands Commission exercises oversight over all granted lands. Generally, this means the Commission carries out this responsibility by working cooperatively with grantees to assure that requirements of the legislative grants and the Public Trust Doctrine are carried out and to achieve trust uses. The Commission monitors and audits the activities of the grantees to insure that they are complying with the terms of their statutory grants and with the public trust. With a few exceptions, grantees are not required to secure approval from the Commission before embarking on development projects on their trust lands nor before expending revenues generated from activities on these lands. However, where an abuse of the Public Trust Doctrine or violation of a legislative grant occurs, the Commission can advise the grantee of the abuse or violation; if necessary, report to the Legislature, which may revoke or modify the grant; or file a lawsuit against the grantee to halt the project or expenditure.

The Public Trust Doctrine

California State Lands Commission

I. Origins of the Public Trust

The origins of the public trust doctrine are traceable to Roman law concepts of common property. Under Roman law, the air, the rivers, the sea and the seashore were incapable of private ownership; they were dedicated to the use of the public.[1] This concept that tide and submerged lands are unique and that the state holds them in trust for the people has endured throughout the ages. In 13th century Spain, for example, public rights in navigable waterways were recognized in *Las Siete Partidas*, the laws of Spain set forth by Alfonso the Wise.[2] Under English common law, this principle evolved into the public trust doctrine pursuant to which the sovereign held the navigable waterways and submerged lands, not in a proprietary capacity, but rather "as trustee of a public trust for the benefit of the people" for uses such as commerce, navigation and fishing.[3]

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[1] Institutes of Justinian 2.1.1.

[2] Las Siete Partidas 3.28.6 (S. Scott trans. & ed. 1932).

[3] *Colberg, Inc. v. State of California ex rel. Dept. Pub. Works* (1967) 67 Cal.2d 408, 416.

After the American Revolution, each of the original states succeeded to this sovereign right and duty. Each became trustee of the tide and submerged lands within its boundaries for the common use of the people.[4] Subsequently admitted states, like California, possess the same sovereign rights over their tide and submerged lands as the original thirteen states under the equal-footing doctrine.[5] That is, title to lands under navigable waters up to the high water mark is held by the state in trust for the people. These lands are not alienable in that all of the public's interest in them cannot be extinguished.[6]

II. Purpose of the Public Trust

The United States Supreme Court issued its landmark opinion on the nature of a state's title to its tide and submerged lands nearly 110 years ago, and although courts have reviewed tidelands trust issues many times since then, the basic premise of the trust remains fundamentally unchanged. The Court said then that a state's title to its tide and submerged lands is different from that to the lands it holds for sale. "It is a title held in trust for the people of the State that they may enjoy the navigation of the waters, carry on commerce over them, and have liberty of fishing" free from obstruction or interference

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[4] *Martin v. Waddell* (1842) 41 U.S. (16 Pet.) 367, 410.

[5] *Pollard=s Lessee v. Hagen* (1845) 44 U.S. (3 How.) 212, 228-29.

[6] *People v. California Fish* Co. (1913) 166 Cal. 576, 597-99; *City of Berkeley v. Superior Court* (1980) 26 Cal.3d 515, 524-25.

from private parties.[7] In other words, the public trust is an affirmation of the duty of the state to protect the people's common heritage of tide and submerged lands for their common use.[8]

But to what common uses may tide and submerged lands be put? Traditionally, public trust uses were limited to water-related commerce, navigation, and fishing. In more recent years, however, the California Supreme Court has said that the public trust embraces the right of the public to use the navigable waters of the state for bathing, swimming, boating, and general recreational purposes. It is sufficiently flexible to encompass changing public needs, such as the preservation of the lands in their natural state for scientific study, as open space and as wildlife habitat. The administrator of the public trust "is not burdened with an outmoded classification favoring one mode of utilization over another."[9]

The Legislature, acting within the confines of the common law public trust doctrine, is the ultimate administrator of the tidelands trust and often may be the ultimate arbiter of permissible uses of trust lands. All uses, including those specifically authorized by the Legislature, must take into account the overarching principle of the public trust doctrine that trust lands belong to the public and are to be used to promote public rather

[7] *Illinois Central R.R. Co. v Illinois* (1892) 146 U.S. 387, 452.

[8] *National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419, 441.

[9] *Marks v. Whitney* (1971) 6 Cal.3d 251, 259-260.

than exclusively private purposes. The Legislature cannot commit trust lands irretrievably to private development because it would be abdicating the public trust.[10] Within these confines, however, the Legislature has considerable discretion.

The Legislature already may have spoken to the issue of the uses to which particular tide and submerged lands may be put when making grants of these lands in trust to local government entities. Statutory trust grants are not all the same--some authorize the construction of ports and airports, others allow only recreational uses and still others allow a broad range of uses.

A further and often complicating factor is that granted and ungranted lands already may have been developed for particular trust uses that are incompatible with other trust uses or may have become antiquated. Some tidelands have been dedicated exclusively to industrial port uses, for example, and in these areas, recreational uses, even if also authorized by the trust grant, may be incompatible. Similarly, tidelands set aside for public beaches may not be suitable for construction of a cannery, even though a cannery may be an acceptable trust use. Piers, wharves and warehouses that once served commercial navigation but no longer can serve modern container shipping may have to be removed or converted to a more productive trust use. Historic public trust uses may have been replaced by new technologies. Antiquated structures on the waterfront may be an

[10] *Illinois Central Railroad v. Illinois, supra,* at 452-53.

impediment rather than a magnet for public access and use of the waters. Public trust uses may and often do conflict with one another. The state and local tidelands grantees, as administrators of their respective public trust lands, are charged with choosing among these conflicting uses, with the Legislature as the ultimate arbiter of their choices.

For all these reasons, a list of uses or a list of cases without more may not be as useful as an analysis of public trust law applied to a specific factual situation.

III. <u>The Leasing of Tidelands</u>

A few principles established by the courts are instructive in analyzing under the public trust doctrine the leasing of public trust lands for particular uses. For example, it was settled long ago that tidelands granted in trust to local entities may be leased and improved if the leases and improvements promote uses authorized by the statutory trust grant and the public trust. Leases for the construction of wharves and warehouses and for railroad uses, i.e., structures that directly promote port development, were approved early in the 20th century.[11] Later, leases for structures incidental to the promotion of port commerce, such as the Port of Oakland's convention center, were held to be valid because although they did not directly support port business, they encouraged trade, shipping, and commercial associations to become familiar with the port and its assets.[12] Visitor-serving

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[11] *San Pedro etc. R.R. Co. v. Hamilton* (1911) 161 Cal. 610; *Koyner v. Miner* (1916) 172 Cal. 448; *Oakland v. Larue Wharf & Warehouse Co.* (1918) 179 Cal. 207; *City of Oakland v. Williams* (1929) 206 Cal. 315.

[12] *Haggerty v. City of Oakland* (1958) 161 Cal.App.2d 407, 413-414.

facilities, such as restaurants, hotels, shops, and parking areas, were also approved as appropriate uses because as places of public accommodation, they allow broad public access to the tidelands and, therefore, enhance the public's enjoyment of these lands historically set apart for their benefit.[13]

These cases provide three guidelines for achieving compliance with the public trust when leasing tidelands for construction of permanent structures to serve a lessee's development project: (1) the structure must directly promote uses authorized by the statutory trust grant and trust law generally, (2) the structure must be incidental to the promotion of such uses, or (3) the structure must accommodate or enhance the public's enjoyment of the trust lands. Nonetheless, when considering what constitutes a trust use, it is critical to keep in mind the following counsel from the California Supreme Court: The objective of the public trust is always evolving so that a trustee is not burdened with outmoded classifications favoring the original and traditional triad of commerce, navigation and fisheries over those uses encompassing changing public needs.[14]

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[13] *Id.* at p. 414; *Martin v. Smith* (1960) 184 Cal.App.2d 571, 577-78.

[14] *National Audubon Society v. Superior Court, supra,* at p. 434.

IV. Promotion of Trust Uses and Public Enjoyment of Trust Lands

Installations not directly connected with water-related commerce are appropriate trust uses when they must be located on, over or adjacent to water to accommodate or foster commercial enterprises. Examples include oil production facilities, freeway bridges and nuclear power plants.[15] Hotels, restaurants, shops and parking areas are appropriate because they accommodate or enhance the public's ability to enjoy tide and submerged lands and navigable waterways. The tidelands trust is intended to promote rather than serve as an impediment to essential commercial services benefiting the people and the ability of the people to enjoy trust lands.[16]

Nevertheless, the essential trust purposes have always been, and remain, water related, and the essential obligation of the state is to manage the tidelands in order to implement and facilitate those trust purposes for all of the people of the state.[17] Therefore, uses that do not accommodate, promote, foster or enhance the statewide public's need for essential commercial services or their enjoyment tidelands are not appropriate uses for public trust lands. These would include commercial installations that could as easily be sited on uplands and strictly local or "neighborhood-serving" uses that

[15]See *Boone v. Kingsbury* (1928) 206 Cal.148, 183; *Colberg, Inc. v. State of California ex rel. Dept. Pub. Work, supra,* at pp. 421-22; and *Carstens v. California Coastal Com.* (1986) 182 Cal.App.3d 277, 289.

[16]*Carstens v. California Coastal Com., supra,* at p. 289.

[17]Joseph L. Sax, AThe Public Trust in Stormy Western Waters,@ October 1997.

confer no significant benefit to Californians statewide. Examples may include hospitals, supermarkets, department stores, and local government buildings and private office buildings that serve general rather than specifically trust-related functions.

V. Mixed-Use Developments

Mixed-use development proposals for filled and unfilled tide and submerged lands have generally consisted of several structures, including non-trust use structures or structures where only the ground floor contains a trust use. While mixed-use developments on tidelands may provide a stable population base for the development, may draw the public to the development, or may yield the financing to pay for the trust uses to be included in the development, they ought not be approved as consistent with statutory trust grants and the public trust for these reasons. These reasons simply make the development financially attractive to a developer. Projects must have a connection to water-related activities that provide benefits to the public statewide, which is the hallmark of the public trust doctrine. Failure to achieve this goal, simply to make a development financially attractive, sacrifices public benefit for private or purely local advantage. A mixed-use development may not be compatible with the public trust, not because it may contain some non-trust elements, but because it promotes a "commercial enterprise unaffected by a public use"[18] rather than promoting, fostering, accommodating or

[18] *City of Long Beach v. Morse* (1947) 31 Cal.2d 254, 261.

enhancing a public trust use.[19] That use, however, need not be restricted to the traditional triad of commerce, navigation and fishing. It is an evolving use that is responsive to changing public needs for trust lands and for the benefits these lands provide.[20]

Moreover, commercial enterprises without a statewide public trust use may violate the terms of statutory trust grants. Typically, grants allow tidelands to be leased, but only for purposes "consistent with the trust upon which said lands are held." This term is not equivalent to "not required for trust uses" or "not interfering with trust uses." Since leases of tidelands must be consistent with statutory trust grant purposes, leases which expressly contemplate the promotion of non-trust uses rather than trust uses would not comply with the terms of the trust grants.

[19] *Haggerty v. City of Oakland, supra,* at pp. 413-14.

[20] *National Audubon Society v. Superior Court, supra,* at p. 434.

For these reasons, non-trust uses on tidelands, whether considered separately or part of a mixed-use development, are not mitigable. That is, unlike some environmental contexts where developments with harmful impacts may be approved so long as the impacts are appropriately mitigated by the developer, in the tidelands trust context, mitigation of a non-trust use has never been recognized by the courts. To the contrary, the California Supreme Court has said that just as the state is prohibited from selling its tidelands, it is similarly prohibited from freeing tidelands from the trust and dedicating them to other uses while they remain useable for or susceptible of being used for water-related activities.[21]

VI. Incidental Non-Trust Use

All structures built on tide and submerged lands should have as their main purpose the furtherance of a public trust use. Any structure designed or used primarily for a non-trust purpose would be suspect. Mixed-use development proposals, however, frequently justify non-trust uses as "incidental" to the entire project. The only published case in California in which a non-trust use of tidelands has been allowed focused on the fact that the real or main purpose of the *structure* was a public trust use and that the non-trust use would be incidental to the main purpose of the structure.[22] In this context, the court noted that because the real or main purpose of the structure was to promote public trust uses,

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[21] *Atwood v. Hammond* (1935) 4 Cal.2d 31, 42-43.

[22] *Haggerty v. City of Oakland, supra,* at p. 413.

non-trust groups could also use the facility, but the non-trust uses must remain *incidental* to the main purpose of the structure.[23] This is the state of the law, and it is supported by good policy reasons as well. If the test for whether a non-trust use is incidental to the main purpose of a development were not applied on a structure-by-structure basis, pressure for more dense coastal development may increase as developers seek to maximize the square feet of allowable non-trust uses. Disputes may arise as to how to calculate the square footage attributable to the proper trust uses versus non-trust uses, with open waterways and parking garages likely being the dominant trust uses and structures being devoted to non-trust uses.

It is beyond contention that the state cannot grant tidelands free of the trust merely because the grant serves some public purpose, such as increasing tax revenues or because the grantee might put the property to a commercial use.[24] The same reasoning applies to putting tidelands to enduring non-trust uses by building structures on them. Accordingly, the only enduring non-trust uses that may be made of tidelands without specific legislative authorization are those incidental to the main trust purpose applied on a structure-by-structure basis. Each structure in a mixed-use development on tidelands must have as its primary purpose an appropriate public trust use. If its real or main purpose is a trust use, portions of the structure not needed for trust purposes may be

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[23] *Ibid.*

[24] *National Audubon Society v. Superior Court, supra,* at p. 440.

leased temporarily to non-trust tenants, provided that the non-trust use is incidental to the main purpose of the structure.

VII. <u>The Role of the Legislature</u>

The Legislature is the representative of all the people and, subject to judicial review, is the ultimate arbiter of uses to which public trust lands may be put. The Legislature may create, alter, amend, modify, or revoke a trust grant so that the tidelands are administered in a manner most suitable to the needs of the people of the state.[25] The Legislature has the power to authorize the non-trust use of tidelands. It has done so rarely, and then on a case-specific basis.[26] Many of its actions have been a recognition of incidental non-trust uses or of a use that must be located on the tidelands. When these legislative actions have been challenged in court, the courts, understandably, have been very deferential, upholding the actions and the findings supporting them.[27]

The Legislature has provided a statutory framework for the leasing of tidelands for non-trust uses by the cities of Long Beach and San Francisco grounded on findings that the tidelands are *not required for* (San Francisco) or *not required for* and *will not*

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[25] *City of Coronado v. San Diego Unified Port District* (1964) 227 Cal.App.2d 455, 474.

[26] For example, in Chapter 728, Statutes of 1994, the Legislature authorized tidelands in Newport Beach to continue to be put to non-trust uses for a limited term after it was determined that the tidelands had been erroneously characterized and treated as uplands by the city due to incorrect placement of the tidelands boundary.

[27] See, e.g., *Boone v. Kingsbury, supra,* at p. 183 and *City of Coronado v. San Diego Unified Port District, supra,* at pp. 474-75; but see *Mallon v. City of Long Beach* (1955) 44 Cal.2d 199, 206-07, 212.

interfere with (Long Beach) the uses and purposes of the granting statute.[28] Where, as in these two statutes, the Legislature has authorized in general terms the use of tidelands for non-trust purposes, the statutes' provisions must be interpreted so as to be consistent with the paramount rights of commerce, navigation, fishery, recreation and environmental protection. This means that the tidelands may be devoted to purposes unrelated to the common law public trust to the extent that these purposes are incidental to and accommodate projects that must be located on, over or adjacent to the tidelands. These non-trust uses are not unlimited, for there are limits on the Legislature's authority to free tidelands from trust use restrictions.[29]

To ensure that the exercise of the Long Beach and San Francisco statutes is consistent with the common law public trust, the tidelands to be leased for non-trust uses must have been filled and reclaimed and no longer be tidelands or submerged lands and must be leased for a limited term. The space occupied by the non-trust use, whether measured by the percentage of the land area or the percentage of the structure, should be relatively small. Finally, any structure with a non-trust use should be compatible with the overall project. Findings such as these are necessary because legislative authorizations to devote substantial portions of tidelands to long-term non-trust uses have generally been

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[28]Ch. 1560, Stats. 1959; Ch. 422, Stats. 1975. These statutes also provide for, *inter alia*, the lease revenues to be used to further trust uses and purposes.

[29]*Illinois Central R.R. Co. v. Illinois, supra,* at pp. 452-54.

considered by the courts as tantamount to alienation.[30]

In several out-of-state cases, specific, express legislative authorizations of incidental leasing of publicly-financed office building space to private tenants solely for the purpose of producing revenue have been subject to close judicial scrutiny, although they did not involve tidelands trust use restrictions.[31] One case involved construction of an international trade center at Baltimore's Inner Harbor with public financing where legislation expressly permitted *portions* of the structure to be leased to private tenants for the production of income. Another was a condemnation case where the statute authorizing the New York Port Authority to acquire a site on which to build the World Trade Center was challenged on the basis that it allowed *portions* of the new structure to be used for no other purpose than the raising of revenue. In both cases, opponents of the projects argued that a publicly financed office building should not be permitted to have *any* private commercial tenants even though the respective legislatures had expressly allowed incidental private use of each building. The state courts in both Maryland and New York held that so long as the primary purpose of the office building was for maritime purposes connected with the port, legislation authorizing the leasing to private

[30] *Atwood v. Hammond, supra,* at p. 42; see also *Illinois Central R.R. Co. v. Illinois, supra,* at pp. 454-53.

[31] *Lerch v. Maryland Port Authority* (1965) 240 Md. 438; *Courtesy Sandwich Shop, Inc. v. Port of New York Authority* (1963) 12 N.Y.2d 379.

tenants was valid.[32] Although both cases involve challenges to financing and condemnation statutes and do not involve the public trust, they are instructive because they demonstrate the importance to the courts, even in the context of public financing and condemnation, that when a portion of a structure is to be leased for the purpose of raising revenues to offset expenses, this incidental non-public leasing must have been legislatively authorized.

VIII. Exchanges of Lands

Situations where a local government or a private party acquires a right to use former trust property free of trust restrictions are rare.[33] In order for such a right to be valid, the Legislature must have intended to grant the right free of the trust and the grant must serve the purpose of the trust. Public Resources Code section 6307 is an example of the rare situation where abandonment of the public trust is consistent with the purposes of the trust. Section 6307 authorizes the Commission to exchange lands of equal value, whether filled or unfilled, whenever it finds that it is "in the best interests of the state, for the improvement of navigation, aid in reclamation, for flood control protection, or to enhance the configuration of the shoreline for the improvement of the water and upland, on navigable rivers, sloughs, streams, lakes, bays, estuaries, inlets, or straits, and that it will not substantially interfere with the right of navigation and fishing in the waters

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[32] *Ibid.*

[33] *National Audubon Society v. Superior Court, supra,* at p. 440.

involved." The lands exchanged may be improved, filled and reclaimed by the grantee, and upon adoption by the Commission of a resolution finding that such lands (1) have been improved, filled, and reclaimed, and (2) have thereby been excluded from the public channels and are no longer available or useful or susceptible of being used for navigation and fishing, and (3) are no longer in fact tidelands and submerged lands, the lands are thereupon free from the public trust. The grantee may thereafter make any use of the lands, free of trust restrictions.

In order for such an exchange of lands to take place, the Commission must find that the lands to be exchanged are no longer available or useful or susceptible of being used for navigation and fishing, taking into consideration whether adjacent lands remaining subject to the trust are sufficient for public access and future trust needs; that non-trust use of the lands to be freed of the public trust will not interfere with the public's use of adjacent trust lands; and that the lands that will be received by the state in the exchange not only are of equal, or greater, monetary value but also have value to the tidelands trust, since they will take on the status of public trust lands after the exchange. Only then can the Commission find that the transaction is in the best interests of the state, that the exchange of lands will promote the public trust and that it will not result in any substantial interference with the public interest in the lands and waters remaining.

April 27, 2005

RECEIVED
APR 27 2005
H.B.H.R.& C.D.

Craig Spjut
2631 Lincoln Ave.
Fairhaven, CA 95564

Humboldt Bay Harbor Recreation and Conservation District
601 Startare Drive
Eureka, CA 95501

Re: Comments on Recreation Plan

Dear District,

I wanted to inform the District of my recreation and of some possible improvements to the upcoming plan.

I have surfed the Humboldt Bay area the last 35 plus years. One improvement could be access to help surfers getting in and out of the water on the jetties. This could also aid anyone who could be trying to get out of the water in an emergency. Please contact me on suggested locations.

Another sport that I have enjoyed in the area has been boating. I first started boating in the bay over 40 plus years ago. I really enjoy riding my personal watercraft in the bay and ocean. I hope to continue to ride in the bay and ocean for years to come.

As other riding areas decrease (Banning of pwc's in the Pacific Northwest) for the personal watercraft, the out of town pwc riders increase in the Humboldt Bay area. This could pose a problem with the latest trend of kayaking in the bay. I hope that this does not become an issue.

Thank you for allowing me to comment on the recreation management plan.

Sincerely,

Craig Spjut

Craig Spjut

HUMBOLDT BAYKEEPER

RECEIVED
APR 27 2005
H.B.H.R.&C.D.

April 27, 2005

Board of Commissioners
Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502

Commissioners,

On behalf of the board, staff, and supporting members of Humboldt Baykeeper, I would like to thank you for the opportunity to comment on the *Draft Humboldt Bay Management Plan* (from here on the "Plan"). We appreciate the effort put forth by the District and its consultants to produce this document and we look forward to working collaboratively with the District in preparation and implementation of the final plan.

Below are some of the general concerns Humboldt Baykeeper has regarding the Plan followed by specific comments on the policies outlined within the Plan.

- **Public Trust Doctrine Issues**

  To address comments made by the District's consultant at the recent Humboldt Bay Symposium regarding the District's outright "ownership" of the tidelands and other lands under its jurisdiction, it should be noted that the Public Trust Doctrine in California went into effect upon the establishment of statehood 1850. This act states that all non-federal and privately-owned lands at that time were to be granted to the residents of California as part of the public trust. We appreciate the Harbor District's capacity in managing these lands for the public and look forward to assisting in creating a vision for future use of these lands.

- **Humboldt Bay Wetlands Management Plan**

  In 1998, the Humboldt Bay Harbor, Recreation, and Conservation District received a $200,000 grant from the Environmental Protection Agency (EPA) to "*develop a comprehensive management and* *conservation plan for the Humboldt Bay ecosystem and its associated wetlands. The objectives include: meeting the California Wetlands Conservation Policy; identifying and inviting all stakeholders to participate in the development of this plan; facilitating the development of a comprehensive plan to conserve, manage, and protect Humboldt Bay's ecosystems; developing agreements that will allow for impacts and mitigation for wetlands in certain areas while providing permanent protection of wetlands in other areas; and developing a plan that will be implemented by local lead agencies".*

In recent communication with District staff, it was mentioned that this Humboldt Bay Management Plan is the result of that planning process, and the use of the EPA granted funds. Since the Harbor District received federal funding for this wetlands plan it requires the District to engage in environmental review of the policies outlined in this Plan as mandated under the National Environmental Protection Act (NEPA) of 1969.

- **Humboldt Bay Water Use Designations**

The Plan designates four water-use designations for Humboldt Bay (harbor, marine recreation, mariculture, and Bay conservation). The Plan also states that there will "preferred activities" for each of these areas. This portion of the policy section heavily favors harbor or port-related activities over recreation and conservation.

The segregation of Humboldt Bay into three separate bays for management purposes precludes the analysis and management of the Bay as a complete ecological unit. It ignores the reality that activities that occur in one section of the Bay result in impacts to the entire Bay and do not stop at the constructed "boundaries" between each of the designated bay areas. This interrelationship between these zones needs to be addressed throughout the management plan. Humboldt Bay is a dynamic tidally-influenced marine system, and negative impacts from one area can easily manifest in another.

- **Humboldt Bay Management Plan Advisory Committee (HBMPAC)**

It is unclear from this Plan what exactly the structure and purpose of this Advisory Committee is proposed to be. This committee should be defined as to numbers of members, terms and composition. As a committee designed to represent the community's interest in the implementation of this Plan, the committee should be comprised of members representing various segments of the community.

The committee should be comprised of 8 members, with representatives from the fishing industry, port development, conservation, recreation, development, and 3 at large seats for interested community members. The District should conduct a search and application process for qualified individuals, and the process of forming this committee should be conducted in a public forum.

- **Exotic Marine Species Control**

  Invasion of Humboldt Bay from exotic marine species is scantly mentioned in this Plan. Proposed container ship activity from the Port of Oakland would inundate Humboldt Bay with some of the 250+ exotic species in SF Bay. Any proposals to bring ships in from this or any other heavily infested port needs to consider these impacts. At very least, these projects need to include a mandatory ballast-exchange program that is enforced and monitored.

- **Dredging**

  This section of the Plan states that the shipping channels within the Humboldt Bay be maintained at depths suitable for commercial vessels in use in the world today. The maintenance of Humboldt Bay through dredging is a necessary action. However, these channels should be maintained at depths suitable for commercial vessels that currently use Humboldt Bay, not a depth that would accommodate deep sea vessels that are inappropriate to our location, such as large oil tankers. This plan should not suggest a "dredge it and they will come policy".

Again, we appreciate the opportunity to comment of the Draft Humboldt Bay Management Plan, and feel free to contact me directly if you have any questions or comments. Also, please include me on any future correspondence regarding this Plan or meetings referring to this Plan.

Sincerely,

Pete Nichols, Director

Volume I, Introduction

"The central part of Humboldt Bay that was associated with the Bay's entrance, channels, and wharfage was identified as the part of the Bay of greatest significance for commercial and coastal-dependent industrial uses (the "Development - Water"), while the northern and southern parts of the Bay and large areas in the central part of the Bay were identified as having greater importance as habitat or natural areas (the "Conservation - Water")." **Vol. I, Introduction, at 1-5.**

"This plan also addresses Humboldt Bay management in terms of these three subareas, shown in Figure 1-3. The general kinds of activities that the District anticipates will occur in each of these primary sectors of Humboldt Bay represent a broad policy framework with respect to uses in the Bay. That is, the segregation of Humboldt Bay into three geographically distinct areas represents the first "layer" of the District's management approach." **Vol. I, Introduction, at 1-6.**

- ► The segregation of Humboldt Bay into three separate bays for management purposes precludes the analysis and management of the Bay as a complete ecological unit. It ignores the reality that activities that occur in one section of the Bay result in impacts to the entire Bay and are not limited to the constructed "boundaries" between each of the bay areas. This interrelationship needs to be addressed throughout the management plan.

Volume III, Section 2

"Water Use designations identify geographical areas of the Bay where certain uses will generally be treated preferentially by the District. They are meant to assist in guiding the discretionary use of Humboldt Bay.... Consistency with the water use designations will be considered by the District as a positive indication of general consistency with the requirements of the Management Plan." **Vol. III, Section 2, at 2-1.**
"A use that is found to be consistent, or compatible, with an identified use designation will still be required to meet or comply with all of the policy directions identified in the plan." **Vol. III, Section 2 at 2-2.**

- ► Defining certain areas as preferred for certain activities potentially precludes their use for other types of activities that may be better suited to their specific site conditions. As an example, the designations outlined in this plan categorize the entire Samoa Peninsula is designated as "Harbor," with a presumption towards development for industrial uses. This does not consider that specific areas may be better suited to conservation or recreation.

- ► Additionally, by restricting such areas to preferential treatment for coastal dependent development there is the possibility that proposals that have greater economic benefit for the community would be precluded, i.e. should there be concurrent applications for potential use of a parcel where one is a coastal dependent industrial use and the other is not (such as residential development) the industrial use would be selected even if the other potential use would be more beneficial for the community as a whole.

"The Harbor District has identified two additional water use designations that will be assigned within geographically restricted subsets of the primary use (or "base") designations (the Bay Conservation and Harbor designations). These use designations will be considered to represent "overlay" or "combining" designations that will apply within the designated locations. The combining designations will not remove or change the underlying base designations. However, the Harbor District will exercise a preference for uses that are consistent with the requirements of the combining designations where these districts are assigned, subject to balancing the requirements of the base designation with the uses authorized by the combining designations." **Vol. III, Sec. 2 at 2-6.**

- The division of the Bay into two water use designations with two additional potential combining use designations, with a preference for uses that are consistent with the combining use designations in the narrow part of the Bay to which they are restricted, severely limits the potential use of the Bay by a large section of the community. The <u>entirety</u> of the Bay should have an underlying multi-use designation, with preferences then expressed for certain types of use in specific areas (as the draft plan currently proposes).

- In addition, there needs to be a provision included in the Plan for the continuation of existing uses. As mentioned above almost the entirety of the Samoa Peninsula is designated "Harbor." There is no discussion in the Plan of the fact that the Samoa Peninsula contains the only actual beach area on the Bay, and that such areas should be protected and enhanced for recreational uses.

<u>**Volume III, Section 3.0**</u>

"Working with local governments, protect designated water dependent or coastal dependent industrial sites near Humboldt Bay and maintain opportunities for designating additional water-dependent or coastal dependent industrial sites and uses near Humboldt Bay." **Vol. III, Section 3, at 3-3.**

- This statement presents a preference for the expansion of industrial uses of the Bay at the cost of other potentially productive uses of areas of Humboldt Bay. It would be more appropriate, considering the Harbor District's other mandates of conservation and recreation, to state that the Harbor district will work to protect currently designated water dependent or coastal dependent industrial sites near Humboldt Bay.

HLU-1: "Policy: Within the portion of Humboldt Bay identified in this Plan as having a priority for harbor-related uses (see Figure 5-1 in Section 5.0), the District shall adopt, for elements that are subject to the District's jurisdiction, and identify a preference for, proposals and uses that are related to the existence of Humboldt Bay as a port or harbor." **Vol. III, Section 3, at 3-3.**

- The use of the phrase "shall adopt" in this section limits the Districts discretion regarding proposals, and uses, related to the existence of Humboldt Bay as a port or harbor. When read in its entirety, this section states that any use that is related to the existence of the Bay as a port or a harbor *shall be adopted* by the Harbor District. Though there are limitations throughout the rest of the plan that would ordinarily limit what uses would be accepted by the District, this phrase alone implies a mandatory action on the part of the District.

HLU-2: "The District shall assign a policy priority to harbor-related elements or actions that are associated with such uses, including shoreline protection, wharfage or terminal development, dredging, and other development or maintenance actions." **Vol. III, Section 3, at 3-4**

- The inclusion of this sentence in this section gives the impression that harbor related elements or actions associated with upland areas that are reserved for water dependent uses or activities will receive priority in decisions made by the Harbor Districts. This policy would be contrary to the mixed mandate that includes recreation and conservation found within the Harbor District's enabling legislation.

HLU-3 and HLU-4: "Policy: The District shall work collaboratively with the County of Humboldt and the California Coastal Commission to assure a "pre-designation" and "pre-zoning" of industrial sites in the South Bay (King Salmon and Fields Landing) (and the Samoa Peninsula) to remove potential obstacles for coastal-dependent or marine-dependent industrial uses." **Vol. III, Section 3, at 3-4 to 3-5.**

- There needs to be policy included within this plan that expresses a preference for the re-use and cleanup of existing industrial sites around the Bay. Project proponents should need to demonstrate that there is a compelling and overriding justification for the use of new industrial areas instead of existing industrial sites.

HSM-2: "Policy: The District shall develop a consistent set of standards with respect to shoreline improvements (levee protection, levee maintenance programs, culvert replacement policies, etc.), which shall apply for all shorelines of Humboldt Bay." **Vol. III, Section 3, at 3-7.**

- Public participation and environmental review needs to be included within this policy. The Discussion additionally states that the standards developed "…will also identify adequate payments to local agencies to assure the level of review necessary to assure the safety of the proposed projects will be provided." It is unclear from the discussion what the need and/or purpose of such payments would be. This needs to be clarified.

HSM-6: "Policy: Shoreline protective projects shall include provisions for nonstructural methods (such as marsh vegetation) where feasible. Along shorelines that support marsh vegetation or where marsh establishment has a reasonable chance of success, the District may require that the design of authorized protective projects include provisions for establishing marsh and transitional upland vegetation as part of the protective structure." **Vol. III, Section 3, at 3-9.**

► This policy statement should be changed from "may" to "shall" or "will." If the shoreline where protective measures are proposed is one which supports marsh vegetation, or if marsh vegetation has a reasonable chance of success, such non-structural means should be required. This would be consistent with the legislative mandate imposed upon the Harbor District related to conservation.

3.4.1 Goals and Objectives: "Assuring that Humboldt Bay's harbor functions continue to be available in the future requires that the shipping channels within the bay, as well as the bay's entrance, be maintained at depths suitable for commercial vessels in use in the world today." **Vol. III, Section 3, at 3-9.**

► This section states that the shipping channels within the bay be maintained at depths suitable for commercial vessels in use in the world today. The maintenance of Humboldt Bay through dredging is a necessary action; however, these channels should be maintained at depths suitable for commercial vessels that currently use Humboldt Bay, not a depth that would accommodate deep sea vessels that are inappropriate to our location, such as large oil tankers. These depths would not be sustainable and could have severe environmental impacts.

HWM-2: "Dredging is authorized under the Management Plan to meet Plan purposes.... (D)redging will be carried out in the least-environmentally damaging feasible method available." **Vol. III, Section 3, at 3-10.**

► Again, the dredging of Humboldt Bay is necessary in order to maintain current uses. This section needs to include a provision that mandates the sampling and analysis of dredge spoils in order to determine the potential contaminants found with in the Bay prior to spoil disposal so that appropriate disposal locations can be used

► Additionally, "feasible" should be removed from this section. The least environmentally damaging method available should be the option chosen for future dredging within Humboldt Bay in order to meet the conservation mandate of the Harbor District.

HWM-4: Policy: "The placement of fill into areas subject to the District's jurisdiction may be approved if the District finds that the fill and the uses proposed for the fill are consistent with the Public Trust Doctrine, that the fill placement constitutes the least environmentally damaging alternative method for achieving the desired uses, and that any adverse effects resulting from the fill placement are mitigated to the greatest practicable extent." **Vol. III, Section 3, at 3-10.**

- The District should only allow the placement of fill if such action would not result in environmental damage or adverse effects are mitigated to the greatest extent possible, not merely to the "greatest practicable extent."

HFA-5: "The District shall require the implementation of a suite of industry-adopted and agency-approved Best Management Practices as the regulatory basis for aquacultural operations within the designated area."
"Discussion: The District expects to identify, in a time frame that includes the life of this Management Plan, a combination of specific use areas and agency-adopted Best Management Practices (BMPs) addressing the environmental effects of aquaculture." **Vol. III, Section 3, at 3-16.**

- The agency should not approve BMPs that have not been subject to environmental review, review by other relevant agencies, and public comment. Additionally, as the life of the Management Plan has not been defined, the District needs to define the time frame in which the adoption of such BMPs will occur. As the District is planning on allowing additional freedom to aquaculture operators a time frame needs to be defined in which review of the BMPs will occur.

Volume III, Section 4.0

RA-1: "Policy: The District shall establish a standing committee, called Humboldt Bay Management Plan Advisory Committee (HBMPAC). The HBMPAC will be overseen by two members of the Board of Commissioners of the District. The HBMPAC will be staffed by the District's Conservation Specialist. The HBMPAC will meet at intervals to consider the implementation of the Humboldt Bay Management Plan, and to recommend appropriate additional policies or alterations in existing policies with respect to the recreational opportunities, areas, and facilities of Humboldt Bay. The HBMPAC will be strictly volunteer and advisory in nature. HBMPAC members will be appointed by the Board of Commissioners and the HBMPAC members will serve at the pleasure of the District's Board of Commissioners." **Vol. III, Section 4, at 4-2.**

- It is unclear in this Management Plan what exactly the structure and purpose of the Advisory Committee is proposed to be. The Advisory Committee should be defined as to numbers, terms, and composition. As a committee designed to presumably represent the additional interests of the community at large it would be appropriate that this committee contain representatives from the different segments of our local community. This committee should contain a representatives from the following interest groups: the fishing industry, harbor, conservation, recreation, development, and two additional members selected from the community at large.

This diverse committee would allow for full community representation. The individuals selected for this committee should be selected from applications submitted to the Board of commissioners.

In addition, it needs to be made clear precisely what the role of the Advisory Committee will be. Do they function as a filter between the community and the Board of Commissioners? Are they a prioritizing group for projects of the Harbor District? Do they determine what projects and policies will be receiving the most immediate implementation and focus? These questions need to be addressed in this plan.

***RA-3: "Policy: In the review of all proposals before the District, opportunities for enhancing public outdoor recreation and access shall be considered." "Discussion: In reviews of proposals and projects where the primary objectives pertain to harbor or conservation actions, the District should seek to integrate access and public recreation components where possible, feasible, acceptable for public safety, and protective of the primary uses."* Vol. III, Section 4, at 4-3.**

- The "Discussion" should be changed to read that the "District shall seek to integrate access." Public access is mandated by the provisions of the California Coastal Act. Additionally, recreation, and therefore public access, is one of the mandates of the Harbor District. Instead of simply considering the opportunities for enhancing public recreation and access "where possible, feasible, acceptable for public safety, and protective of the primary uses," the District should include a statement of its mandate to increase public recreational opportunities on Humboldt Bay.

***RFA-1: "The District shall endeavor to retain existing public access points, and support the development of new access points, that promote safe and appropriate public recreational access to the Bay."* Vol. III, Section 4, at 4-6.**

- As mentioned in the Discussion section for this policy statement, the retention of existing public access points is required under the Coastal Act. The district has a responsibility to do more than simply "endeavor" to retain these existing access points. The policy statement should therefore be changed to state that the District will retain existing public access points.

RFA-2: "Policy: Projects approved by the District shall require the provision of appropriate public access and related services and amenities, if feasible, including

viewing areas, restrooms, public parking, visual access, and access facility maintenance, to the extent that such access and amenities..." **Vol. III, Section 4, at 4-6.**

- The phrase "if feasible" should be removed from this policy statement. The policy statement would then read that projects approved by the District would require the provision of appropriate public access. It would be inappropriate to require public access through a hazardous area, thus provisions for public safety would be incorporated. Again, the District has a mandate to provide public recreational opportunities on Humboldt Bay and to manage the Bay for the benefit of all users.

RFA-3: "Policy: The District shall provide, cause to be provided, or support the provision by others of improved and new water-oriented recreation facilities, including but not limited to marinas, launch ramps, pumpout stations, fish-cleaning stations, beaches, artificial reefs, native clam stocking programs, and fishing piers, to the extent possible and feasible to meet current and projected recreational needs. The District shall provide adequate access and facilities for recreational fishing and shellfish harvesting, which should include shoreline access, fishing vessel amenities, and pier fishing in Humboldt Bay, where appropriate. The District should encourage and allow such additional recreational facilities and access improvements on the Bay, provided that such uses:

> ***a. do not preempt land or water areas needed for other priority uses,***
> ***b. are feasible from engineering and financing viewpoints, and***
> ***c. do not have significant adverse effects on water quality, environmentally sensitive resources, or other aspects of the environment."***

Vol. III, Section 4, at 4-7.

- The clause included on the end of this policy stating that such uses should be encouraged provided that they "do not preempt land or water areas needed for other priority uses" implies that the provision of improved and new recreational facilities is a secondary interest to others contained within the Management Plan. Again, it is necessary to note that the provision of recreational access is mandated to the District by the enabling legislation as well as other provisions of California law, including the Coastal Act.

Volume III, Section 5

CAE-4: "Policy: The District shall consult with the North Coast Regional Water Quality Control Board, Humboldt County, the City of Arcata, the City of Eureka, and other appropriate agencies, to develop and implement a plan improving and maintaining water quality in Humboldt Bay..." **Vol. III, Section 5, at 5-6.**

- The District's plan regarding the improvement and maintenance of water quality of Humboldt Bay should include the participation of the public in addition to relevant government agencies. The policy statement states that they will consult with, but does not require the incorporation of suggestions from, the Regional Board or other relevant agencies whose individual mandates and relevant experience provide them with a substantial basis by which to develop a management plan for the water quality of Humboldt Bay. Such a requirement should be included within any water quality plan developed for Humboldt Bay.

***CAS-1: "Policy: The District shall, to the extent possible, maintain viable populations of native species in Humboldt Bay, distributed in appropriate habitats within the Bay, in a state that will maintain the ecological functions of the Humboldt Bay ecosystem." "The District shall develop a plan, in consultation with local, state, and federal agencies, non-profit conservation organizations, and other interested parties, which is focused on maintaining the native biological diversity and important habitats that are present in Humboldt Bay and its watershed."* Vol. III, Section 5, at 5-7.**

- No standards or requirements have been included in this policy statement as to how "appropriate" habitats and distributions of native species will be determined by the District

- Although the District is developing a plan, and is required to adopt findings for decisions that impact the resources covered by the plan, there is nothing specifically included that requires actual Plan implementation. The Management Plan should contain a schedule of implementation.

***CAS-2: "Policy: The District shall, to the extent possible, maintain viable populations of commercially important fish species and invertebrate species, and the habitats for these species." "The plan shall identify strategies for District adoption that will assist the District in managing or protecting native and desirable non-native fish, invertebrate, and plant species while carrying out District operations."* Vol. III, Section 5, at 5-8.**

- As with native species found within Humboldt Bay, the requirement to develop a plan regarding commercial species within Humboldt Bay does not include a requirement that the District actually implement any plan that it might develop.

***CAS-3: "Policy: The District shall, to the extent possible, maintain habitat for sensitive species identified under auspices of California or federal law."
"Discussion: This policy extends the District's planning requirements to include species and habitats that are considered sensitive pursuant to one or more state or federal laws. The development of the plan specified in this policy would functionally meet a portion of the habitat-based plan development requirements that the federal Endangered Species Act and the California Endangered Species Act require as an element of a program allowing the "incidental take" of listed species for otherwise lawful activities."* Vol. III, Section 5, at 5-8 to 5-9.**

- The District's policy of maintaining habitat for sensitive species "to the extent possible" is an inadequate statement as to the actions that would be taken under this plan by the Harbor District. The policy should be changed to eliminate the "to the extent possible" language such that the District would be required to maintain habitat for sensitive species.

- The discussion portion of this policy statement appears to be focused on developing provisions such that Incidental Take Permits can be issued for activities carried out by the District.

CAS-4: "The plan shall identify a strategy for District actions that will be focused on preventing the introduction of additional non-native species as a result of port-related activities in Humboldt Bay. If appropriate, the plan may endorse active programs to eradicate selected non-native species." **Vol. III, Section 5, at 5-9.**

- This policy statement refers to a plan that is not otherwise identified within the rest of the policy section. If the District is planning on developing a plan with regards to non-native species, such a plan needs to actually be identified and explained before the main plan of which it is part of (this Management Plan) can be adopted.

CAS-5: "Policy: Based on appropriate ecological analysis and the resulting findings, and upon consultation with the relevant federal, state, and local agencies and other interested parties, the District may authorize the placement of minor amounts of fill in order to enhance or restore habitats for fish, other aquatic organisms, or wildlife." **Vol. III, Section 5, at 5-10.**

- As with other sections of the Plan that allow for the use of fill within the Bay, there should be a statement included as to the quality of the fill that would be allowed and the circumstances where such filling would be permitted. Such approval should additionally be granted only upon condition that such other approvals as required by law are obtained.

CEP-2: "Policy: Dredging, when otherwise consistent with the provisions of this Management Plan or other adopted District regulations, shall be subject to the following conditions:

> ***a. Dredging shall be prohibited in identified key breeding and nursery areas during periods of fish migration and spawning.***
> ***b. Dredging, including maintenance dredging, shall be limited to the smallest area feasible to accomplish the purposes for which the dredging is proposed.***
> ***c. Designs for dredging projects shall incorporate protective measures to protect water quality in adjacent areas during construction, by limiting the discharge of refuse, petroleum spills, and the unnecessary dispersal of mobilized silt and other materials.***

Generally, the District shall require that dredging and spoils disposal avoid significant disruption to aquatic ecosystems and water circulation." **Vol. III, Section 5, at 5-11 to 5-12.**

- Certain portions of Humboldt Bay should be identified as entirely off limits to dredging due to their importance for other values such as habitat protection or conservation.

- Any dredging project should be required to incorporate sampling, analysis and monitoring into their plan that is adequate to evaluate their impacts on other Bay values

- The District should adopt findings as to the results of such monitoring and analysis prior to any dredge approval.

CEP-4: ***" Policy: The District shall permit the diking, filling, or dredging of streams, wetlands, estuaries, and open coastal waters under the District's jurisdiction only under the following conditions:***

a. The diking, filling or dredging is for a permitted use in that resource area;

b. There is no feasible, less environmentally damaging alternative;

c. Feasible mitigation measures have been provided to minimize adverse environmental effects;

d. The functional capacity of the resource area is maintained or enhanced. Functional capacity means the ability of the streams, wetlands, estuary, or coastal waters to be self-sustaining and to maintain natural species diversity. In order to establish that the functional capacity is being maintained or enhanced, all of the following must be demonstrated:

(1) Presently-occurring indigenous plant and animal populations in the ecosystem will not be altered in a manner that would impair the long-term stability of the ecosystem, i.e., natural species diversity, abundance and composition are essentially unchanged as the result of the project;

(2) A species that is rare or endangered will not be significantly adversely affected; and

(3) Consumptive (e.g., fishing, aquaculture and hunting) or nonconsumptive (e.g., water quality and research opportunity) values of the streams, wetlands, estuary, or open coastal waters will not be significantly reduced.

Vol. III., Section 5, at 5-12 to 5-13.

- For each project that is proposed, the District should adopt findings with regards to the elements that are required to be met in order to permit the diking, filling, or dredging of the various proposed areas covered by this policy.

CEP-6: ***"Policy: The District shall require that proposed actions that create impacts to streams, wetlands, estuaries, and open coastal or marine waters under the District's***

jurisdiction, which are otherwise in accordance with the policies of this management plan, shall, at a minimum, incorporate the following mitigation elements:

a. A mitigation program that incorporates feasible mitigation measures for all impacts .A detailed mitigation plan shall be required as part of the project application, including a plan for each specific site where mitigation is proposed. The mitigation plan shall include provisions for purchase, if required, and restoration or enhancement that results in equal or greater functional capacity when compared to the impact of the proposal, and the dedication of the mitigation site(s) to a public agency or other method which permanently restricts the use of the site(s) to habitat and open space purposes. The restoration site(s) normally shall be purchased or otherwise made available prior to any permitted diking or filling;

b. Mitigation shall, to the maximum extent feasible, result in the same ecosystem type(s) as the area(s) affected by the proposal (i.e., freshwater marsh for freshwater marsh, saltwater marsh for saltwater marsh, etc.).

c. Where no suitable private or public restoration or enhancement sites are available, an in-lieu fee may be required to be paid to an appropriate public agency for use in the restoration or enhancement of an area of equivalent functional capacity, productive value, or surface area."

Vol. III., Section 5, at 5-14.

- Any mitigation plan that is adopted should be subject to public review prior to its adoption.

- With the acceptance of any mitigation plan, the District should adopt findings as to the sufficiency of the mitigation measures adopted and a statement of reasons as to why mitigation measures that are more protective of the environmental resources affected are not being required.

CPE-3: "Policy: the District shall establish a standing committee, called the Humboldt Bay Management Plan Advisory Committee (HBMPAC). **Vol. III, Section 5, at 5-19.**

- As discussed in comments above, the Advisory Committee needs to be defined as to purpose, number, and composition. The Committee should be a representative group from the Humboldt Bay community. There should be representatives from the conservation community, fisheries, recreation, development, industry, and two members form the community at large.

Volume III, Section 6

6.1 Plan Adoption and Implementation Generally
"The Humboldt Bay Management Plan will be adopted by the Harbor District following an appropriate public review and a programmatic environmental review pursuant to the California Environmental Quality Act (CEQA), as required by the District's ordinances and by state law." **Volume III, Section 6, at 6-1.**

- The type of environmental review that is proposed by the Harbor Commission needs to be defined and begin at the soonest possible time in order to ensure a thorough and complete review of the proposed project and in order to enable sufficient public review. The Harbor District needs to define the intent and purpose of the proposed environmental review.

"Advisory Committee. The implementation program contemplated by the District at the present time includes the appointment of a Humboldt Bay Management Plan Advisory Committee to assist the District in implementing this Plan. The composition of this committee has not been established at the present time. " **Volume III, Section 6, at 6-2.**

- The advisory committee needs to be defined as to membership prior to the adoption of the Plan. The committee needs to be representative of the Humboldt Bay community at large, with representatives from industry, fisheries, conservation, development, recreation, and two members of the community at large

"Public. The implementation elements will also receive public reviews in at least two contexts in most cases...Second, the District's decision makers will consider the implementation program elements before adopting them formally, and this step is expected to provide an opportunity for public review and comment prior to Board action." **Volume III, Section 6, at 6-3.**

- The public should be involved in each stage of program implementation. This involvement should be formally included in the policy requirements defined throughout the Management Plan

6.4.2 District Procedural Requirements for Bay Related Activities
The Management Plan includes a number of subject areas in which the Harbor District is committed to developing "procedural manuals" or "Blue Books."
"In essence these adopted procedural guidelines would function as Best Management Practices (BMPs), which would be applied as design standards for the physical elements involved, and which would act to mitigate the environmental effects of the proposed actions." **Volume III, Section 6, at 6-5.**

- The development of the procedural manuals needs to occur along a defined time frame. As they are intended to act as BMPs they should include a period of public review as well as consultation with other agencies that have special knowledge or jurisdiction over the respective subject areas.

6.5 Future Amendments and Plan Revisions.
"The Harbor District contemplates that this Management Plan should be considered as a "preliminary" approach to Bay management, and that within a period of three to five years the District may find that some hopeful approaches described in this Volume need adjustment, revision, or even recission. Additional policies that are not currently contemplated may appear in time to be essential. Consequently the District fully expects that this Plan will be amended or revised."
"The Districts anticipates that the actual revision of or amendment to this Plan will be undertaken in a semi-formal sense after enough time (presumed to be three to five years noted above) has passed to gauge the Plan's success and the need for modifications. **Volume III, Section 6, at 6-7.**

- There needs to be clearly defined periods for review and amendment of the proposed Management Plan. The Plan should be scheduled for review after three years.

- There needs to be a set of formal methods defined for revision of the Management Plan. These methods need to be included within the Plan itself. Any revision of the Plan should include full public participation.

REDWOOD REGION AUDUBON SOCIETY

P.O. BOX 1054, EUREKA, CALIFORNIA 95502

Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502

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APR 27 2005

27 April 2005

Dear Harbor District Commissioners:

Overall we think an excellent job has been done preparing this document. It reflects the time, patience, and care that has been taken to reflect the attitudes and concerns of our diverse community.

Dredging and spoils:

Dredging is addressed in several places including Volume I p 1-10 and Volume III Section 5.2. In Vol. I p 1-10 Trust and Public Stewardship Responsibilities the document states the Harbor Commission shall control impacts from "pollution" and "dredging and filling" and Volume III Section 5.4 Humboldt Bay Ecosystem Management Program Elements. Policy CEP-2: states "Dredging may be approved under specific conditions."

We understand that areas within the industrial channel area likely to be dredged for shipping may contain PCB contamination or PCB leachates from old fill.

Add a section to CEP-2.c. indicating that samples of dredging spoils should be tested for harmful chemicals and residues.

Volume III Section 4.0 Recreation Area Planning Policies

Our region, which includes Humboldt Bay, is considered a destination for birders from around the world. Humboldt Bay has been designated as an Important Bird Area (reference: page 118 in Daniel S. Cooper. 2004. **Important Bird Areas in California**. Published Audubon California. Pasadena), **and** has been recognized by American Birding Association as an IBA. In addition Humboldt Bay has been recognized as **a Western Hemisphere Shorebird Reserve Network** site of International importance since 1998. Neither of these designations is mentioned within this document.

In this case birding is a recreation activity that involves an element of conservation to preserve the proper environment for the wildlife. It is a crossover between elements in Volume III sections 4.0 and 5.0.

Volume III Section 3.0 Harbor Element Planning Policies
Volume III Section 5.0 Conservation Element Planning Policies

The following is a crossover between elements in Volume III, Sections 3.0 and 5.0.

Realize that within the planning boundaries of the Harbor Commission and within the "central bay" industrial channel area that there are environmentally sensitive areas including rare plant community types. Such plant community types occur within Parcels APN 40114104 and APN 40114105 owned by the City of Eureka (refer to the parcel maps prepared by Winzler and Kelly used in the Port of Humboldt Bay Harbor Revitalization Plan). These parcels contain a **palustrine persistent emergent** wetland type and a **palustrine forested deciduous/conifer** wetland type (reference: Cowardin et al. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Department of the Interior). In this particular area the relationship between the two palustrine areas either has remained relatively undisturbed by man, or has reverted, by lack of continuous use, perhaps grazing, to a condition where the soil and water relationships between the areas are interdependent. The palustrine persistent emergent wetland here is unique for our region. It occurs nowhere else around Humboldt Bay according to Andrea Pickart. This wetland is similar to, but on a much smaller scale, the Everglades of Florida. These particular parcels contain a forested palustrine wetland immediately east and west of the highway with alders and willows; immediately east of these forested wetlands are the palustrine persistent emergent "everglade" wetlands. The laminar water flow of these two areas is interconnected. Any type of development within these parcels must not impinge on underground laminar water flow or affect water quality.

These areas within the industrial use area of the central bay should be classified as conservation areas, not classified as industrial.

This willow patch **palustrine forested deciduous/conifer** in 40114105, the mixed willow and cypress patch immediately south of the airport runway in 40114104, and the willow patch directly south of the access to the airport immediately opposite Lincoln Avenue, also in 40114105 are extremely important stopover areas for migrating birds and are subject to protection under the Migratory Bird Act and North American Wetlands Conservation Act. Birds not mentioned in the species list in Appendix F-2 that have occurred in these willow patches and wetlands include but are not limited to yellow rail, long-eared owl, black-billed cuckoo, tropical kingbird, black-capped chickadee, Blackburnian warbler, black-throated blue warbler, palm warbler, blackpoll warbler, chestnut-sided warbler, and Baltimore oriole, to name a few. Reports in *North American Birds, American Birds,* and *Audubon Field Notes* need to be looked at carefully

These areas should be protected wetlands. Since they are unique in Humboldt County and cannot be mitigated for, no development of any kind should occur on them.

These areas may not be properly colored on the maps in the Appendices. In particular I refer to the maps called **Habitat Types of Humboldt Bay and Surrounding Vicinity** and **Wetland Habitat of Humboldt Bay** created by Ken Morefield, GIS Technician, CDFG, Region 1, August

2001. The differences may lie in interpretations of definitions or in my ability to interpret the colors on the large-scale maps. Webster defines a swamp as a tract of wet, spongy land, usually with abundant vegetation. Webster defines a marsh as a tract of waterlogged soil, typically treeless and covered with emergent rushes, cattails, and other tall grasses. I suggest that the labels on **Habitat Types of Humboldt Bay and Surrounding Vicinity** should correspond at least with the terms as used in Table 4-5 in Volume II- page 4-20, which seems to be consistent with Cowardin et al., 1979.

Eelgrass:
We are glad that eelgrass has been addressed and recognized as important in this document. According to a paper in preparation by Susan Schlosser et al., the major eelgrass beds in Humboldt Bay occur between 0.5 meters above and 0.5 meters below 0 elevation mean sea level as defined in the tide charts.. This zone should be delineated on the maps in the appendices as the best potential area for eelgrass beds.

Appendix F-2 Bird Species Identified in the Humboldt Bay Region
This list is antiquated and inaccurate. Either more species need to be listed such as those mentioned several paragraphs above, or some species which occur very infrequently, such as Cape May warbler, need to be taken off. Species that occur every year along Humboldt Bay not included in this list are tropical kingbird and palm warbler. Black-capped chickadees have replaced chestnut-backed chickadees as the most common chickadee in thickets adjacent to the bay. The list does not include Aleutian cackling goose, a newly designated species. Pomarine jaegers fly over the waters of Humboldt Bay infrequently but regularly.

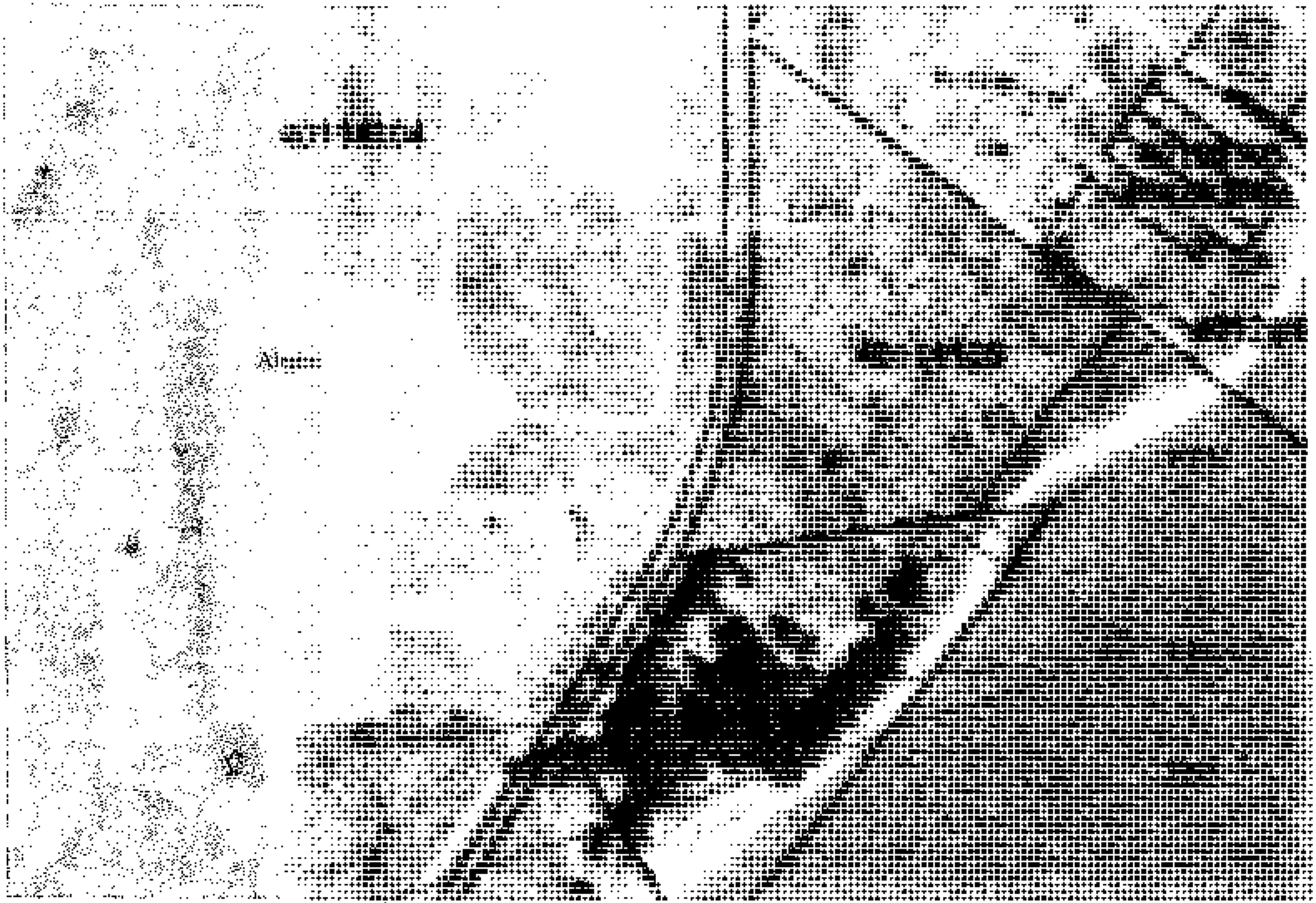
Thank you for considering these comments.

Respectfully,

Chet Ogan

Chet Ogan

Conservation Chair,
Redwood Region Audubon Society



PEM- Palustrine persistent emergent
PPO 1/4- Palustrine forested deciduous >6 m tall
PSS- Palustrine scrub-shrub <6 m tall

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H.B.H.R.& C.D.

April 27, 2005

Harbor Bay Harbor, Recreation and Conservation District

RE: Humboldt Bay Management Plan

I offer my support for the attached comments prepared by the Humboldt Bay Stewards. I believe the Stewards' comments offer a very desirable balance to the Bay Management Plan and must be respected as the result of input from many astute people. A "plan" is only as good as its implementation and there needs to be better balance of the use of resources of the Humboldt Bay District, which has spent hundreds of thousands of dollars on studies promoting commercial and industrial development, and hardly any funds have been used to develop recreation and conservation matters. I suggest that most of the tax revenues the HBHRD receive should be devoted to recreation and conservation efforts and harbor enterprises should be self-supporting; if they are not, some properties or facilities should be liquidated.

David Elsebusch

DAVID ELSEBUSCH
P. O. Box 2035
McKinleyville, CA 95519
(707) 839-8383

The Humboldt Bay Stewards
Bay Management Plan Workshop Summary
April 5, 2005

GENERAL COMMENTS
Planning policy and concepts

A clear statement of the district's role as the manager of public trust resources should preface the plan. A distinction between ownership and public trusteeship should be made clear.

A protocol for cooperation with other governments, agencies, non-governmental organizations, and the public should be written and published. This protocol should include provisions for notification of meetings and pending actions, consultation on policy changes and enforcement, and providing representation on committees and in public forums. The language of the Management Plan should also reflect this breadth of cooperation and be uniform throughout the document.

The plan needs to look beyond historical uses; like the Revitalization Plan, it uses them as a foundation. Just because a use is historic does not make it valid. Language that allows flexibility and changes of direction and of uses is needed.

The neglect of the Wiyot Tribe, historic owners of the bay, present owners of Indian Island, and a major source of cultural capital is a major *faux pas*. NHPA Section 106 (NEPA) requires consideration of impacts of projects on pre-historic or historic archaeological sites or other cultural features and Native American interests

Dividing the bay into distinct regions as a planning technique has value, but it is also necessary to view the bay as a whole. As the bay is an integral, tide-dominated system, it is impossible to isolate environmental impacts. Cumulative impacts must be considered. This is a CEQA requirement.

Adaptive management needs data and information and monitoring. The District needs a policy to establish a data management system that will allow trend analysis. Management must be science based; it must be measurable, so we know the policy is working. The system should be accessible to the public. Reference KRIS as an example

Many conservation and recreation policy areas are missing or minimally recognized, probably for lack of information. Each of these areas requires baseline information that is not presently available. The plan should include provisions for studies to provide baseline information. This information can then be used to set benchmarks for development, recreational activity, conservation, and restoration.

COMMENTS SPECIFIC TO EACH SECTION

Additions or expansions

Water Use Designations

Dividing the bay into regions, each with a preferred use, while allowing consideration of other uses, creates three multiple-use regions. Yield to reality and designate the whole bay as multiple-use, then develop protocols for determining appropriate uses. Present policy appears to give precedence to harbor use. A policy for resolving conflict between uses should be created. Critical habitats should be identified and set aside, regardless of their location in the bay

Over 4,000 acres are designated for mariculture in North Bay. It is evident that all that acreage cannot be used. The plan should provide for a study to define the physical and ecological limits for future mariculture, to define a carrying capacity, and to define the mechanisms appropriate to setting limits for production.

As the bay is dynamic, a better understanding of inner bay erosion and the physical impacts of hardening require more study.

Harbor/Port Element

The community has recently addressed issues of developing heavy industry in the port The plan needs to reflect the community's skepticism of continuing in this direction. The designation of specific industrial sites limits future economic opportunities. All zoning designations should be revisited during the update of the Local Coastal Plan, with a view towards 'vitalizing' the harbor, rather than 'revitalizing' it.

A spill prevention program is needed, as the present policy addresses only cleanup.

The control of invasive species needs to be prominent. A program for offshore discharge or sterilization of ballast water is needed. (Recognition of the new court ruling that directs EPA to deal with ballast should be added) Monitoring and enforcement should be addressed. Similar guidelines for hull fouling are needed. Contracts with other ports should be explored in the antifouling section Co-ordination with the mandatory ballast restrictions, both those in place and being developed, by the U.S. Coast Guard should be included in the Management Plan.

Because dredging impacts other areas of the bay (public trust resources) a monitoring program needs to be in place.

The clean up of brown field sites and of toxic deposits in shallow water sediments should be an extensive part of the management plan. Inventories and action plans should be considered.

The concept of the mid-bay as a deep-water port is questionable and has not proven profitable. Does it make sense to protect this use, in light of dredging impacts and the loss of deep draft commerce? An inventory of conservation and recreation resources leading to a balanced-use policy for the mid-bay should be considered.

A permit policy is needed for the proposed Mariculture Park, as permits are likely to be needed from various entities.

Recreation element

The element needs more specific goals and objectives, which could be accomplished by use of a multiple-use recreation overlay for the entire bay.

Recreation on the bay requires access: access from landside as well as waterside. Integration of the Bay Trail Plan into the Management Plan requires a policy of collaboration with governmental entities and private landowners to ensure access points.

Appropriate access, by water, to public trust resources should be included in the plan. Anchorage buoys, courtesy docks, fishing piers, non-motorized boating areas, suitable destinations, launching sites, and parking areas should all be addressed in the plan.

Conservation element

In general, the plan needs more specific goals and objectives. The plan should provide guidance as to the preferred future condition of bay habitats. We need to know what we are managing for. We need to know our restoration goals. Conservation should be the underlying tenet of all the plan elements. A tiered approach that involves quantitatively measurable goals and timelines should be developed.

The protection of native species is a paramount goal. To achieve that goal, population inventories, inventories of currently available and potentially available habitat, and carrying capacity studies are needed. A strategy for contracting and funding such studies should be developed. The eel grass beds are a particularly noteworthy example.

The economic impact of the fish nursery in the bay is not appreciated.

There are several issues of water quality that involve other governmental agencies, beyond the jurisdiction of the Bay District, that should be addressed in terms of interagency agreements, joint policies, or memoranda of understanding. These include: sedimentation from drainages entering the bay, toxics from point-source discharges into the bay, storm water run-off, agricultural and septic non-point discharges.

The issue of filled inter-tidal lands needs more attention. Development is not the highest and best use for re-claimed (filled) land around the bay. Areas suitable for marsh and mudflat restoration should be identified and a policy for re-establishing their public trust status developed.

The Elk River parcel is not included in the plan. Ordinances are needed to protect it.

Implementation

Successful implementation of the plan's elements will require citizen input, citizen education, and citizen participation. The citizen advisory group contemplated is critical to the success of the plan and should be structured to promote citizen interaction with the district. As written, the structure is too vague and does not reflect the public interest in the bay management plan.

A policy of using local expertise before outsourcing studies and assistance should be established.

Volunteers, as a resource, should also be explored in these tight economic times

A determination of the district's responsibility to public input, for inclusion in the district's charter, should be made and promulgated.

Information projects that utilize the local media should be planned for.

Priority lists or timelines should be included for each action item.

Under components for management approach, add a precautionary element; we don't know, so let's err on the side of caution.

As a 'living document' the plan needs a detailed and dynamic process for amendment before it can function.

Recommendations

Before the document is completed and submitted, it should be given to a professional editor for rewrite, to ensure readability Scrap the present Executive Summary and have it rewritten professionally.

A comprehensive Executive Summary should be made freely available during any public comment period. Perhaps parts of the plan can be published, sequentially, in the local media, during the CEQA process

Provide for a simple public access to district ordinances

Changes in the content, construction or language of the document

Some portions, notably in the Harbor/Port Element, overstep the HBHR&CD jurisdiction in addressing upland uses and in the designation for port development.

Embedding the Revitalization Plan in the HB Management Plan, without its own CEQA review, loses the public commentary required by CEQA. How can we rectify this omission?

Vet the document for consistency in language with the Coastal Act and other plans. Other plans such as those of the Humboldt Bay Watershed Action Council, the Bay Trails Plan, and the views of community groups interested in the bay should be included in the appendices.

RA-1 should be in implementation and more inclusive in the committee make-up.

RFA-1 should be worded like HFA-2 and should be much stronger.

Recreation should be included in the mission statement.

Paragraph #2 in introduction should be in harbor introduction - Show how these policies interrelate.

RFA-2 remove "if feasible".

RIO-1 & 2 use same wording as RA-2

All policies in the management plan require implementation steps and imperative language, e.g., 'shall', rather than 'should'.

Center for Natural Lands Management

A non-profit organization for the protection & management of natural resources

www.cnlm.org

April 27, 2005

Jeff Robinson and Board of Commissioners
Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

Re: March 2005 Draft Humboldt Bay Management Plan

Dear Mr. Robinson and Commissioners,

I am writing this letter on behalf of the Center for Natural Lands Management (CNLM). CNLM is a non-profit organization dedicated to the preservation of natural habitat and native species. CNLM currently manages over 46,000 acres of land throughout California.

In 1991, the City of Eureka granted The Nature Conservancy a conservation easement over 80 acres of City of Eureka property south of the Eureka Airport. The site is now called the Eureka Dunes Protected Area (EDPA). In 1996, this easement was transferred to CNLM. The purpose of the easement was to establish the EDPA as a location for dune restoration projects to mitigate for future impacts to endangered plant populations and wetlands on the adjacent City property, which is zoned for coastal-dependent industrial development. Under the terms of the conservation easement no development may occur on the EDPA.

The EDPA is not distinguishable from rest of the Eureka Airport property in several figures in the Draft Humboldt Bay Management Plan including Figure 2-1 and the Zoning and Public Land Owners and Managers maps provided in Appendix G. In should be clear in Figure 2-1 that EDPA is not a key coastal-dependent industrial site. The Zoning map indicates that the EDPA is zoned Industrial. The map should show the EDPA zoning as Natural Resources. The Public Land Owners and Managers map should show that although the EDPA is owned by the City of Eureka, it is managed by CNLM. In addition, Section 2.2.3 should clearly state that the EDPA is separate from the rest of the Eureka Airport property and is not a site for future development.

If you have any questions or need additional information please contact us.

Sincerely,

Kyle Wear

Kyle Wear
Humboldt Preserve Manager

RECEIVED
APR 28 2005
H.B.H.R.& C.D.

Chet Ogan
811 'O' Street
Eureka, Ca 95501

Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502

27 April 2005

Dear Harbor District Commissioners:

I submitted comments for Redwood Region Audubon Society, but these are some items I missed but think should be included. Again let me state that this Plan looks very good, and obviously took a lot of planning and hard work. I commend all those involved for a job well done.

In Volume I section 10.3 Plan Development (page 1-30) you state:

> While it is the intent of this Plan to identify and coordinate efforts and resources to close data gaps in a timely manner, resource managers, policy makers, and local governments in Humboldt County must effectively manage the local environment based on the **best science available** [my emphasis] while providing ample public participation.

This implies adaptive management without actually stating it.

In Volume II, Section 5.1 Section Overview you mention **adaptive management**, **sustainability**, and **stewardship** in relationship to the Conservation element. I suggest that these principles and Best Management Practices (BMPs) should be included much further forward in this document perhaps in Volume I Section 5.2 Trust and stewardship Responsibilities.

One great shortcoming I see missing in this document is a way of amending it. This plan, once approved, will be in effect for quite a number of years before it is re written or updated. A section needs to be included that suggests ways of amending this document, adding sections not yet even considered, or correcting errors and shortcomings that may show up after it is approved.

Thank you for considering my suggestions. This has been quite an accomplishment.

Sincerely,
Chet Ogan
Chet Ogan

HUMBOLDT BAY OYSTER CO.

P.O. Box 2237 McKinleyville CA 95519

Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

RECEIVED
APR 28 2005
H.B.H.R.& C.D.

9 April 2005

Re: Humboldt Bay Management Plan

Dear Commissioners;

Thank you for the opportunity to comment on the Humboldt Bay Management Plan draft document. I commend the work you've performed as lead agency for the Plan. My comments specifically address shellfish mariculture on Humboldt Bay and its representation in the Plan. They are perhaps less comment than illumination of what my company does on Humboldt Bay.

My wife and I operate Humboldt Bay Oyster Company. We produce oyster seed and market oysters for customers from San Diego to Seattle. I've worked in the local shellfish industry for 10 years among its diverse, hard-working, innovative people. We are all proud of the product we produce and the way in which we produce it and are ever-vigilante for ways to improve our methods both for quality of product and minimizing/eliminating negative impacts.

We produce "single oysters" which are oysters not attached to a substrate nor one another. This is a highly desired specialty product specifically targeting the live "half-shell" market; restaurants, oyster bars and fresh seafood markets. We utilize rafts in Mad River Slough for our nursery stage of production. Seed oysters the size of sesame seeds are suspended in the water column in mesh-lined stackable trays where they filter feed the abundant microalgae in the slough and enjoy rapid growth and protection from wave action found in the more exposed areas of the main bay. Mad River Slough is unique on Humboldt Bay in its attributes and suitability to a shellfish nursery. Mad River Slough is an integral part of the shellfish industry locally and along the west coast.

Seed oysters graduate from the raft nursery and are moved to the North Bay (Arcata Bay) to be grown in mesh bags strapped to rebar racks in the intertidal zone. This "off-bottom" method of culture is performed outside of areas that contain eelgrass. Exposure to the air at low tides during this stage is crucial to conditioning the oyster and promotes the shell shape desired by the market. Most of our oysters are sold as seed shortly after being moved to the "rack and bag" stage. Our seed customers grow them the remainder of the way to market size. We have begun this year selling market-sized oysters locally and to the San Francisco market.

Humboldt Bay has a long tradition of oyster farming. It is a locally important, coastal dependant use of the bay. Employees and local vendors and local markets all contribute to the general economy of the area. The California Department of Fish and Game and California Coastal Commission are both tasked with the promotion of aquaculture as a sustainable, coastal-dependant prioritized land use. In other words, the California Legislature and resource agencies recognize aquaculture as a perfect fit for small, coastal communities.

The Arcata Bay Oyster Festival grows greatly every year exhibiting the popularity, pride and importance of oysters to local residents and tourists. In it's seventeen years it has become a community celebration of Humboldt Bay's oyster tradition. Up to 15,000 people are expected at this year's festival. The event is Arcata Mainstreet's largest fundraiser, hence contributing more funding to the city's community events than any other and fulfilling their mission to "enhance and promote Arcata's identity, economy and cultural spirit."

The Monterey Bay Aquarium Seafood Watch program has featured farm-raised oysters as a sustainable, ecologically responsible "Best Choice" seafood product and concurs, "Shellfish farms cause little impact on the environment." This coupled with the superb inherent healthfulness of oysters make it an excellent addition to a healthy diet. The high-rate filtering ability of oysters aids clarification of bay water helping to fight eutrophication, a major threat to the health of all estuarine environments. Clearer water also improves the transmission of light to submerged aquatic vegetation, most notably eelgrass.

Oyster farmers are stewards of Humboldt Bay. We are the front line of water quality monitoring. We take numerous water samples from an array of sampling locations in the North Bay at least monthly. These samples are delivered to the Humboldt County Public Health Lab for analysis and the results reported to the California Department of Public Health. Each sample adds to the vast historical data record compiled on Humboldt Bay. If anything is amiss in the Bay's water quality, we are the first to see it.

Our farm has complete health certification on all of our oysters. We regularly send samples of our oysters to a registered pathology lab for analysis. Humboldt Bay can boast of a long, responsible record of no certifiable disease in our oysters.

The unique stewardship role of oyster farmers, long-time champions for water quality, is beneficial to every water user. We recognize that long-term sustainability depends on the broader overall environmental health of the estuary in which we work and a recognition and respect for other bay users. Continued high water quality and ecological health are of paramount importance to us. Without both, our families and the greater community couldn't continue to do what we do and enjoy the lifestyle and quality of life that we cherish so much here on Humboldt Bay.

Respectfully,

Todd Van Herpe
Humboldt Bay Oyster Co.

RECEIVED

APR 28 2005

H.B.H.R. & C.D.

Aqua-Rodeo Farms
P.O. Box 371
Eureka, CA 95502
(707)444-3854

4/13/2005

Subject: Humboldt Bay Management Plan

To Whom It May Concern.

In reviewing this plan further I felt it necessary to submit some additional comments on the matter. Section 4.5.3.2. paragraph 1 sentence 2 at the end add "and the spirit of cooperation shown by the growers." Paragraph 2 sentence 3 cut word oyster keep effects. My reasoning is that varying situations may benefit eelgrass in mariculture areas. Additionally at the end "while recognizing the benefits of shellfish as biofilters.

Section 3.5.1

Objectives:

Bullet 1 I am for increased knowledge and understanding but at some feasible point inspiration must be put to action. So as the industry of mariculture in Humboldt Bay can move forward.

Bullet 2 These are good but may go further by referencing other points made in the Coastal Act that aren't previously listed.

Bullet 3 Seems right on track.

Bullet 4,5,6, and 7 The Pacific Coast Shellfish Growers Association has a good base for the these points in their Environmental Codes of Practice Program For all members coast wide. Their Pacific Coast Shellfish institute is also working with varying agencies to come up with acceptable industry best practices.

Section 3.5.2

HFA 3 The emphasis on agency approval strategies, is this for permit process? If so elaborate in policy explanation.

HFA 5 The District might recognize the Current preferred area and elaborate on other potential areas to be designated.

Section 1.7 My observation on this is that it might reflect all uses in the bay and all regulating agencies and private parties.

Section2.2.1

B.14 Could be worded as commercially landed fishery and aquacultured products processing facility to be more inclusive

Section2.3.2 Mariculture

B.1 Replace"off-bottom" with "permitted"

Please contact me if you have any questions regarding my comment or reasoning. I would be glad to discuss this issue with you further.

Sincerely,

Sebastian T. Elrite

Sebastian T. Elrite
Aqua-Rodeo Farms

CITY OF EUREKA
COMMUNITY DEVELOPMENT DEPARTMENT
531 K Street • Eureka, California 95501-1146
(707) 441-4160 • Fax (707) 441-4202

April 27, 2005

Jeff Robinson
Humboldt Bay Harbor Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

RE: March 2005 Draft Humboldt Bay Management Plan - Comments

Dear Mr. Robinson,

The City of Eureka congratulates the District on the completion of the Draft Humboldt Bay Management Plan, and thanks you for the opportunity to provide the District with comments, which are as follows:

1. Volume II, Section 2.2.2, first paragraph. The paragraph refers to the City of Eureka "City Plan" website, and specifically notes that per the "City Plan" more storage is being planned to support existing uses. According to the City's Redevelopment Agency, the "City Plan" is a tool the Agency uses to provide general information to businesses considering relocation within the City. The document was not intended for planning purposes, and is not current. Further, the information regarding the provision of additional storage was likely provided to the Agency as something the District, and not the City, was planning to do at the time the information was provided. We would therefore recommend this reference to the "City Plan" be removed from the Management Plan

2. We would suggest the Eureka Public Marina be consistently referred to by that name throughout the document. In Volume II, Sections 2.3.1 and 2.3.2 it is referred to as the Eureka Boat Basin, Small Craft Harbor and City Marina, which can be confusing for those that don't know these names all refer to the same marina.

3. Volume II, top of page 3-12, City of Eureka: The 2005 Economic and Demographic Profile published by the Chico based Center for Economic Development notes the 2004 population for the City as being 26,250 per the California Department of Finance Demographic Research Unit. We include this information because we assume you would like to have your population information be as current as possible

4. Also on page 3-12, the Management Plan states that the City's General Plan identifies, and generally prescribes improvements for a number of coastal access locations, with the list of locations included in the plan. The list appears to have been taken from Table 5-2 of the

City's General Plan Policy document; citing this table may be useful. However, the sixth bulleted item, "On an expanded west-side shoulder of State Highway 255 on Indian Island", is not included in that table, and I could found no reference to this access location in the policy document. Thus, we would recommend that it be removed from the list, unless a specific citation can be provided.

5. Volume II, Table 3-1 on page 3-22: Please correct the name for PALCO Marsh. The table incorrectly refers to it as Eureka (PALCO) Marsh.

6. Figure 2-1 in Volume III on page 2-2 shows Water Use Designations. However, it is very difficult to relate these designations to adjoining land uses since there are no landmarks included on the figure. This same concern regarding a lack of landmarks is true for other similar figures showing the bay such a Figure 4-2 in Volume II.

7. In regard to the Water Use Designations, the City would like to stress the importance of having those designations consistent with the adjoining designated land uses within the City. We note that adjoining Parcel 4 and the industrially-developed Chevron facility, both of which have a City of Eureka land use and zoning designation of Coastal Dependent Industrial, the Management Plan proposes a Marine Recreation combining water use designation. We understand that the underlying Harbor water use designation is still applicable which supports industrial uses, but we also understand that the District will "exercise a preference for uses that are consistent with the requirements of the combining designations where these districts are assigned, subject to balancing the requirements of the base designation with the uses authorized by the combining designations."

   The preference for activities authorized pursuant to the Marine Recreation combining zone is a concern, since the intent of the City's Coastal Dependent Industrial land use designation is to encourage industrial uses related to shipping or the fishing industry. Further, the recreational uses "preferred" by the Marine Recreation overlay zone are not necessarily compatible with principally permitted industrial uses allowed under the City's Coastal Dependent Industrial land use designation. It appears there could be other areas where this conflict may exist, but this example is brought to your attention to illustrate our general concern. We do not want to have the District's water use designations inhibit or prevent the City from implementing our zoning ordinance and general plan where such implementation requires development within the District's jurisdiction.

8. Policy HLU-3 is a bit confusing. It is introduced with a description of the City, County and other agencies working together to remove potential constraints for marine-dependent or coastal-dependent land uses along the Samoa Peninsula, Fields Landing Channel, Eureka Shorelines and other harbor-related areas. The Policy itself makes mention of only the Samoa Peninsula.

9. Policy HSM-2 should include working with City as well as other affected agencies when developing standards for new and existing shoreline protection. A comprehensive guide for standards for development such as road crossing installation, levee repair, culvert

installation, etc. is a good idea only so long as all regulating agencies recognize the "Blue Book" as the standard. Otherwise, the book will become just another layer of regulation or guidelines project proponents must deal with, and could even introduce standards that conflict with existing agency guidelines, further complicating matters. Good coordination between, and buy-in from, state, federal and local agencies is essential for the success of the "Humboldt Bay Blue Book".

10. The document was generally confusing to navigate. I personally associate "Volumes" with separate documents (i.e. the Parts should be Volumes), with "Part", "Section" or "Chapter" being internal dividers. Also confusing is the fact that, for example, there are two Figures 2-1, one in Volume II and one in Volume III, and three pages 1-1, one in each of three volumes, which further contributes to confusion.

11. In reading through the Plan, I encountered a few typographical errors which certainly are not substantive issues, but may prove helpful to you in producing your final plan:

   - Page ES-5 of the Executive Summary - change semi-colon to a colon after City of Eureka under Current Task Force Representatives
   - Policy HFA-5, third sentence under Discussion "addressing the environmen*tal* effects of aquaculture."
   - Policy RSA-9, last sentence under policy: "The program shall incorporate~~d~~ necessary signage and safety provisions."
   - Volume III, page 6-2, Advisory Committee, 6th line: "assisting staff and decision-makers ~~is~~ *in* ranking implementation alternatives"

We hope you find our comments helpful. Please do not hesitate to contact the City if you have questions regarding issues that were raised. The City thanks you for the opportunity to have had representation on the Management Plan Task Force. In recognition of the coordinated effort required for the successful management of Humboldt Bay, we look forward to continuing to work with the District on the implementation of the Humboldt Bay Management Plan.

Sincerely,

Becky Colburn for

Lisa D. Shikany
Environmental Planner
(707) 268-5265
lshikany@ci.eureka.ca.gov

LS:bc

cc: Director of Community Development
Special Projects Manager
City Manager

Name: Leslie Heald
Affiliation: Humboldt Heritage Professionals Network Mailing Address::
2301 C Street, Eureka, CA 95501
Phone: 707.444.9494
Email address: lheald@tidepool.com
Comments:
April 27, 2005

To: Humboldt Bay Harbor, Recreation and Conservation District

Re: Humboldt Bay Management Plan

Dear Harbor District,

I am a local historic resource consultant and member of an informal group, the "Humboldt Heritage Professionals Network" (HHPN). HHPN is dedicated to promoting the appreciation and preservation of significant cultural resources on the North Coast such as prehistoric and historic archaeological sites, historic buildings and structures, traditional cultural properties and cultural landscapes. Our group includes local cultural resource managers, Tribal representatives, archaeologists, historians, archivists and educators. I have been asked by the group to review local planning documents and environmental reports for their attention to cultural resource issues. As part of this mission, I have recently reviewed the Humboldt Bay Management Plan.

I understand that the objectives of the Humboldt Bay Management Plan are to provide a management and planning tool for the Harbor District and other organizations interested in the future of Humboldt Bay. While I am impressed with the comprehensiveness of the draft Humboldt Bay Management Plan, I would like to provide you with comments in my area of expertise.

- Humboldt Bay, and the area immediately surrounding the Bay, is home to a wealth of significant cultural resources, including both archaeological sites and historic resources. In fact, the Bay itself has been designated as State Historical Landmark #882 (Humboldt Harbor Historical District) and is listed in the California Register of Historical Resources. Because of human use of Humboldt Bay over time, the area immediately surrounding the Bay has a high potential for previously undiscovered cultural resources. This highly sensitive area includes the tidelands (potential cultural resources may include dikes, weirs, docks, bridges, submerged or partially submerged archaeological sites, and other resource types) and upland parcels defined as the Primary Area by the Humboldt Bay Management Plan.

- At the present time, the Humboldt Bay Management Plan includes no reference to cultural resources. Clearly, the main focus of the plan is on port activities and environmental and recreational resources of the Bay. However, I would recommend including a at least a brief description of known and potential cultural resources in the vicinity of Humboldt Bay within the inventory of existing conditions presented in Volume II. Such a description would make it clear that these types of resources are present on the Bay and that potential impacts to these resources must be evaluated under relevant environmental laws. This would set the stage for the cultural resources review that will occur as part of the upcoming CEQA process.

The members of HHPN have a wealth of expertise in the field of cultural resources management. We are willing to lend our skills to the Harbor District to help draft these important changes to the Humboldt Bay Management Plan and develop relevant sections of the Environmental Impact Statement (EIS). If we can be of assistance, please contact me, and I would be happy to pass on the request to our group.

Sincerely,
Leslie Heald, M.S.
2301 C Street
Eureka, CA 95501
lheald@tidepool.com
707.444.9494

April 28, 2005

Humboldt Bay Harbor District
P.O. Box 1030
Eureka, California 95502-1030
Fax: 707.443.0800

ATT: Jeff Robinson, Resource Specialist

RE: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners:

Thank you for taking comments regarding the Draft Humboldt Bay Management Plan (HBMP). I have limited my comments to my main concern, which centers on the strong incorporation of the Port of Humboldt Bay Harbor Revitalization Plan (the Revitalization Plan) into the Draft HBMP and the absence of other local planning documents such as RCAA's Bay Trails Feasibility Study, the Interpretive Signing Program and the Humboldt Bay Salmon and Steelhead Conservation Plan.

The Revitalization Plan is among the most frequently referenced document in the entire HBMP and seems to be used in a variety of ways ranging from a source of information and policy to being an actual part of the HBMP itself. The following is a summary of how the Revitalization Plan is referenced throughout the document.

In the Executive Summary of the HBMP the Revitalization Plan is referred to as a "commercial/industrial siting study" (Page ES-2)

In, Volume 1, Section 8.3 Strategic Direction it was referenced as if it were a to guide policy.

8.3.1 Harbor (Page 1-24)

- Identify the need for permit process streamlining of historic uses of the bay and its margins with the overall goal of maintaining historic uses that are compatible with the findings of the Humboldt Bay Management Plan and Harbor Revitalization Plan.
- Identify and implement those elements of the Harbor Revitalization Plan, which would be needed to build the foundation for a real increase in the cargo handling capacity of the bay.

In Volume 2 there are other references to the Revitalization Plan where one could also reasonably construe that it is being used directly or indirectly as a policy and/or planning document. Examples are:

- "An important part of the overall planning context for the harbor is the Port of Humboldt Bay Harbor Revitalization Plan…Some of the major recommendations from this plan pertaining to harbor use and future scenarios are discussed further in this section..." (Page 2-2)

- "This Harbor portion of the Humboldt Bay Management Plan is based in part upon and incorporates recommendations from the Port of Humboldt Bay Harbor Revitalization Plan .. This section of the Plan highlights some of the main findings and recommendations of the Revitalization Plan..." (Page 2-15)

There is also one direct reference to the Revitalization Plan being an actual part of the HBMP:

"The Harbor Revitalization Plan, which is incorporated by reference into this Management Plan..." (Page 2-2)

In Volume 3 there are some policies that appear to have been directly taken from the Revitalization Plan such as:

- HLU-3: Working cooperatively with the City of Eureka, and the County of Humboldt, and other agencies, assist in removing potential constraints for marine-dependent or coastal-dependent land uses along the Samoa Peninsula, Fields Landing Channel, Eureka shorelines, and other harbor related areas (from Harbor Revitalization Plan) and,

- HLU-4: Working cooperatively with the County of Humboldt and other agencies, assist in removing potential constraints for marine-dependent or coastal-dependent land uses on harbor-related parcels in the South Bay (from Harbor Revitalization Plan)

In addition the HBMP states "The Harbor Planning section of this Management Plan therefore includes goals and policies that will assist in achieving the goals established in the Harbor Revitalization Plan." (Page 3-2)

Of particular concern is the phrase "incorporated by reference," mentioned above. This could be understood to mean that the contents of the Revitalization Plan will be adopted in its entirety when the Management Plan is adopted. I believe that there could be some unintended consequences if this occurs.

I think it is important that the Management Plan should clearly state what is the intended use of the Revitalization Plan is in this process. Use of the Revitalization Plan in all these different ways is confusing. There is no direct explanation of why some portions recommendations and even policies of the Revitalization Plan were used and why some were not. There are some significant recommendations and findings in the Revitalization Plan that I believe are unsupported by the community and some regulatory agencies, as was demonstrated in the recent water bagging and LNG controversies. Furthermore, the Revitalization Plan does not adequately take into account the environmental or social impact of its stated goals or recommendations. If the Revitalization Plan is to be adopted in its current state the Commission should allow for a separate CEQA review process. If the Revitalization Plan cannot be adopted in its current state then it should be removed from the HBMP as an "incorporated" document or modified so that it can serve a purpose for which it is may be useful in this process.

While there are ample references to the Revitalization Plan I could find only one indirect reference to the Bay Trails Feasibility Study and no reference to the Interpretive Signing Program in the HBMP. These efforts were developed using a significant amount of public input and it is my understanding that, like the Revitalization Plan, they were developed with the goal of serving the District's planning and coordination efforts and were shaped by Harbor District involvement. The Recreation Sections of the HBMP, especially where trails and interruptive signage is specifically discussed omit specific reference to these local planning efforts. In addition, the Humboldt Bay Salmon and Steelhead Conservation Plan which is a comprehensive document that included input from virtually all the stakeholders in the bay over a seven year period was not even mentioned in the Conservation Sections. I would like to see that the final draft of the HBMP directly address the adopted trails and conservations plans and studies so that we can more easily move toward implementation of policies and projects that can enhance the use and protection of Humboldt Bay.

Thank you for considering my comments.

Sincerely,

Mike Wilson, P.E.
1071 13th St.
Arcata, CA 95521

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APR 2 8 2005
H.B.H.R.&C.D.

KUIPER MARICULTURE, INC.
Ted Kuiper, President
P.O. Box 507
Bayside, Ca. 95524
Tel 707- 822- 9057
Fax 707- 822-3652
email- tedkuiper@cox.net

27 April 2005

Mr. Jeff Robinson
Humboldt Bay Harbor, Recreation and
Conservation District
P.O. Box 507
Bayside, Ca. 95524

Dear Mr. Robinson:

Thank you for the opportunity to comment on the draft Humboldt Bay Management Plan. The draft that resulted from numerous committee and stakeholder meetings is impressive. I believe that the plan is successful in balancing the diverse responsibilities the district has in managing both commercial, recreational and habitat conservation within your plan boundary.

Specific comments:

Volume II Section 4.4.3.2 , page 4-42 first sentence:
Suggest removing word "apparent" regarding additional aquaculture development.

Aquaculture is growing worldwide at the rate of about 10% annually, and specifically mollusc culture, especially intensive - raft based culture systems that have a small foot print and have negligible environmental impact offer business expansion opportunities for small business development. Technology is rapidly developing for shore based systems that can take advantage of coastal dependent industrial property to produce specialty products for coastal communities.

Para 2. Last sentence on page 4-42: "It is possible the oyster culture may be unable to avoid...." Suggest change wording to. " One existing oyster farm may be unable to avoid. ..."
Suggest you may add the following sentence where appropriate:
" Several small oyster farms have no impact on eel grass because they culture their oysters on racks off-bottom at the intertidal zone where the mud flat is too high to sustain eel grass beds(approximately higher than +0.0 ft)". Farms established after the Coastal Act are specifically forbidden from culturing their product in eel grass beds."

Volume III Section 2.2.1, page 2-5 Uses:
Suggest under item "(14)" Please add the words Aquaculture under Seafood processing facilities.

At this time, it is understood that processing includes oysters, clams and other bivalves, however, in the future algae processing for pharmaceutical, cosmetic or as a food supplement may not be considered a bonafide "seafood".

Volume III, Section 2.3.2, page 2-7

The combining use designation I believe clearly allows mariculture growing activities outside Arcata Bay and Mad River Slough. However, in paragraph two the words "only" is used which may result in agency denial of an operating permit in the future for culture activities outside of those primary areas. Recommend that you consider adding a sentence which reflects a broader understanding that aquaculture is a principally permitted coastal dependent industrial activity that may be sited where it does not conflict with other preferred harbor activities such as, navigation. Aquaculture can coexist with many Industrial activities in the Harbor area due to the exceptional water quality in most areas. This issue is covered very well in the Section 3.5 (Vol III page 3-13), so a sentence in 2.3.2 referring to Section 3.5 may be appropriate.

Volume III, HFA-4.

Thank you for mentioning the availability of freshwater for aquaculture.

Volume III, HFA-5
Regarding the general area under consideration, suggest you include the reference to the "conditionally approved growing areas" map developed by the State Department of Health which shows the zones of Arcata Bay and Mad River Slough which are now certified as growing areas and the water quality monitoring stations designated. Sentence at the end of para 2, regarding the number of acres which may be cultured in the future should be clarified. Something like:"Future expansion of mariculture within the presently leased area of 3950 acres and the acreage within the designated "conditionally approved" culture area by State Health will depend upon use of culture technologies that have no impact on eel grass and negligible impact on the aquatic habitat after full evaluation under CEQA. "

Volume II, Section 2.3.3, page 2-14, para 2
... Manila clam (add word "seed") mariculture ...

Para 4 ; True that North Bay Shellfish sells locally. Kuiper Mariculture is a seed supplier both domestically and internationally and is a member of the USDA endorsed Shellfish High Health Plan for international sales.

Maps in the appendix.

Shellfish Resources-

I believe that the "shellfish reserves" are now outdated and no longer apply since these were established during the period of over exploitation of native oysters in the early 1900's and well before Pacific oysters have become the dominant commercial species. Also, native oyster beds are not impacted by commercial culture since to my knowledge the only significant populations are epifaunal beds located in Mad River Slough well outside any culture area. The shellfish beds should be noted as either wild, natural or "not cultured".

The aquaculture map is out of date and should more accurately reflect the current culture areas. The "round circles" were representative when Coast Seafoods practiced ground culture.

Thanks for the opportunity to comment.

Sincerely,

Imelda Kuiper for

Ted Kuiper,
by President

CTA 4-14-05

RESOLUTION NO. 05 - 16 .

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF EUREKA
SUPPORTING THE HUMBOLDT BAY HARBOR, RECREATION AND CONSERVATION DISTRICT'S
ONGOING PLANNING PROCESS TOWARD COMPLETION OF THE
HUMBOLDT BAY MANAGEMENT PLAN

WHEREAS, in March 2005, the Humboldt Bay Harbor, Recreation and Conservation District (District) completed and distributed a Draft Humboldt Bay Management Plan for public review; and,

WHEREAS, the District spent approximately 8 years formulating the Draft Plan, and willingly incorporated public participation early in the planning process, wanting the public to have a voice in the decision making process; and,

WHEREAS, the District invited Humboldt Bay stakeholders from diverse backgrounds to participate in the planning process, including representatives from the business community, agriculture, mariculture, recreational and commercial fisherman, the educational community, cultural and environmental organizations, citizens and others; and,

WHEREAS, in 1999 the District formed a 16 member Task Force made up of city and county government representatives, agency land managers, and representatives of various stakeholder groups within the sphere of interest; and,

WHEREAS, the Task Force was generally charged with seeking citizen participation in the planning process, collecting and analyzing public input, integrating this input with existing scientific data and agency mandates, and putting it all together into a comprehensive Management Plan document; and,

WHEREAS, in 2001 and 2002, the Task Force held numerous stakeholder workshops and received over 350 valuable ideas and concerns from stakeholders offering a wide perspective of opinions, knowledge and vision which have been mostly incorporated into the Draft Plan; and,

WHEREAS, the purpose of the Management Plan is to serve as a management guide, planning tool, policy strategy, and reference document for the District and other resource management agencies and organizations interested in Humboldt Bay, and is intended to guide new projects and to be a long term strategy for resource management around Humboldt Bay; and,

WHEREAS, the District is currently accepting public comment on the Draft Plan prior to initiating a lengthy environmental review process which will involve further citizen participation.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Eureka as follows:

SECTION 1

The City of Eureka hereby commends the District on their completion of the Draft Humboldt Bay Management Plan and supports the District's lengthy and on-going planning efforts to formulate a Humboldt Bay Management Plan for our community.

SECTION 2

The City of Eureka hereby recognizes the District's acknowledgement of the importance of early and on-going public participation in the formulation of the Humboldt Bay Management Plan, and hereby commends the District's extensive and open public participation process which continues to directly contribute to an improved planning document.

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H.B.H.R.& C.D.

SECTION 3

The City of Eureka hereby acknowledges that the process of developing a Management Plan for Humboldt Bay is an incredibly complex and courageous endeavor, and hereby commends the District for taking on this important effort.

THIS RESOLUTION IS HEREBY PASSED, APPROVED AND ADOPTED by the City Council of the City of Eureka in the County of Humboldt, State of California, on the 5th day of April 2005, by the following vote:

AYES: COUNCILMEMBERS: Wolford, Bass-Jackson, Leonard, Kerrigan

NOES: COUNCILMEMBERS: None

ABSENT: COUNCILMEMBERS: Jones

ABSTAIN: COUNCILMEMBERS: None

PETER LAVALLEE
Mayor

Attest:

KATHLEEN FRANCO SIMMONS
City Clerk

Approved as to Form:

DAVID TRANBERG
City Attorney

Approved for Administration:

DAVID W. TYSON
City Manager

Tera Prucha
Environmental Chemist
P. O. Box 476
Eureka, CA 95502

April 27, 2005

Board of Commissioners
Humboldt Bay Harbor, Recreation and Conservation District
P. O. Box 1030
Eureka, CA 95502-1030

RE: Humboldt Bay Management Plan – March 2005 Draft

Thank you for the opportunity to comment on the March 2005 Draft Humboldt Bay Management Plan. I only recently found out about this deadline; the documents were hard to get, lengthy, and ordered in a manner that I found difficult to follow. I shall appreciate more opportunities to further review a Bay Management Plan.

First and foremost, this draft does not include any policies or plans to cope with the recent listing by the EPA (Environmental Protection Agency) of Humboldt Bay as an "impaired water body" due to PCBs (polychlorinated biphenyls). As mariculture is a priority for the Humboldt Bay District, addressing the realities of toxic chemicals bioaccumulating in oysters is essential for a Humboldt Bay Management Plan.

In fact, this draft plan encourages the dredging of new channels and the deepening of existing channels. Dredging has many severe negative impacts on the Bay, including the resuspension of toxic chemicals and the harming of eelgrass beds. Details of proposed dredging are missing from this draft plan. Limitation of dredging is vital if we sincerely want to encourage mariculture.

My second observation of this draft plan was the lack of attention devoted to stormwater runoff into Humboldt Bay. The small section titled "Toxic Materials Management" only addresses oil spills, yet this proposal encourages development of industrial sites. Currently, all stormwater runoff goes directly into Humboldt Bay. No treatment facilities exist and, according to this draft plan, there are no plans to construct a treatment facility.

As the attached graph shows, 30 percent of shellfish harvesting restrictions are due to stormwater runoff. There are many "First Flush" studies that have been done on stormwater runoff, and I shall be happy to provide you with more date on Humboldt Bay.

As David Ammerman of the Eureka Field Office, USACE writes in his 04/01/05 memo, "a large portion of Humboldt Bay needs wetland and estuary restoration to repair damage done in long-abandoned industries that have left contamination of our shoreline and bay waters." This March 2005 Draft Plan proposes future industrial development as a priority, yet the plan does not address any mitigation of the negative effects of past, present, or future development.

Humboldt Bay is currently unhealthy according to the USACE, EPA, and NCRWQB. This draft plan does not address the issues of toxic chemicals in the Bay, yet encourages the development of industrial sites which will increase runoff and emphasizes increased dredging which resuspends existing toxic chemicals back into the water column.

Thank you for the opportunity to comment on this draft which I understand is only for scoping purposes. I shall appreciate the opportunity to comment further. Please include me on the email and direct mail list so that I may be informed of public meetings, deadlines, and activities to *"provide a comprehensive framework for balancing and integrating conservation goals and economic opportunities in a cooperative manner for the management of Humboldt Bay's resources."*

Sincerely,

Tera Prucha

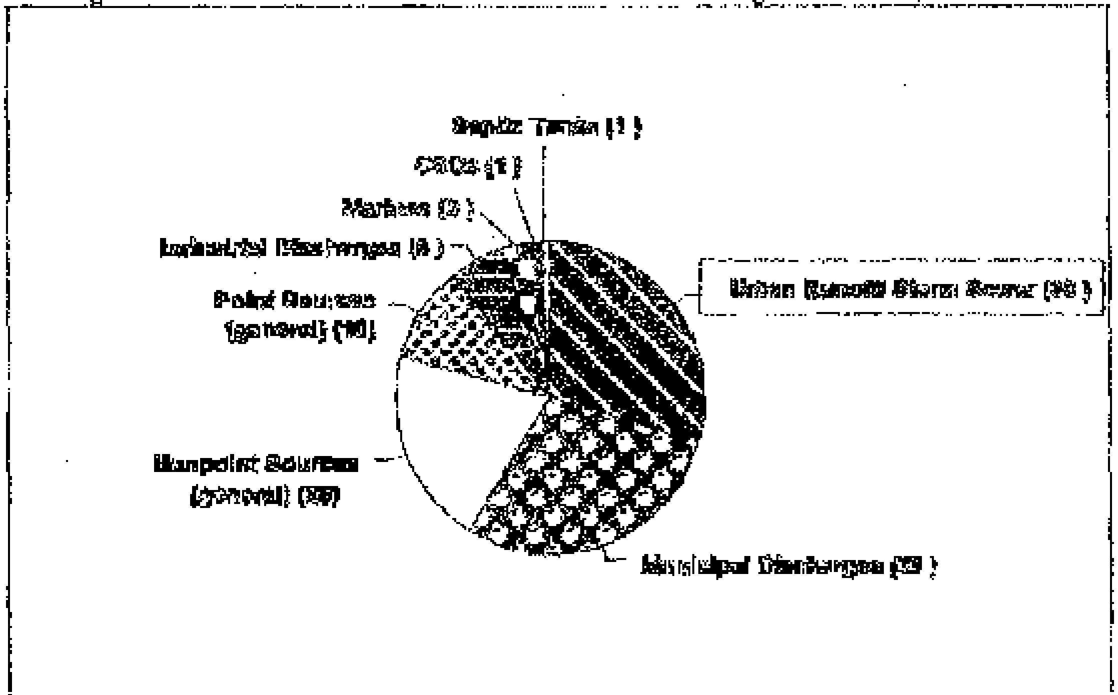
Tera Prucha
Environmental Chemist
P. O. Box 476
Eureka, CA 95502
trinitytigerlily@hotmail.com

Attachment (1)

http://www.epa.gov/oat/stormwater/usw_b.pdf

US EPA. 1995a. *National Water Quality Inventory: 1994 Report to Congress.* EPA 841-R-95-005. Washington, DC.

Figure 4-17. Sources Associated with Shellfish Harvesting Restrictions, in Percent



Source: US EPA, 1995a

PLANNING DIVISION OF THE
COMMUNITY DEVELOPMENT SERVICES DEPARTMENT

COUNTY OF HUMBOLDT

3015 H STREET
EUREKA, CALIF. 95501-4484 PHONE (707) 445-7541

April 28, 2005

Jeff Robinson
Harbor District Board of Commissioners
Humboldt Bay Harbor, Recreation and Conservation District
601 Startare Drive
PO Box 1030
Eureka, CA 95521

Att: Jeff Robinson, Resource Specialist

RE: Draft Humboldt Bay Management Plan, March, 2005

Dear Commissioners

The Humboldt County Community Development Services would like to thank you for the opportunity to comment on the 2005 Draft Humboldt Bay Management Plan (herein referred to as the Draft Plan). The Harbor District should be commended on the distillation of a large quantity of information into a very "readable" plan. It is our understanding that the Draft Plan contains three volumes which includes the history and setting of Humboldt Bay, the state of the Bay and the Plan Policy document. Also included for review as separate documents are the Executive Summary and Appendices.

We would like to offer the following comments on the Draft Plan.

MAP/TEXT CORRECTIONS:

1. Text Correction – Humboldt County General Plan, 2002 (Volume I, Page 1-25)

The second paragraph on page 1-25 of Volume I references the 2002 Humboldt County General Plan. This document does not exist. The Framework Plan was adopted in 1984. The Humboldt Bay Area Plan (which provides land use regulations for those areas within the Coastal Zone around Humboldt Bay) was adopted in 1982. Humboldt County is currently in the process of updating both the Local Coastal Plans and the Humboldt County General Plan; however, to date, no action has been taken on these planning documents.

2. Map Correction – Humboldt Bay Primary and Secondary Boundaries (Volume I, Figure 1-1)

Figure 1-1 is not clear enough to illustrate where the District has direct jurisdiction and where the authority is advisory only. The Draft Plan does not clearly delineate the proposed uses in an accurate manner on both the lands that the District has primary jurisdiction and those that are advisory only. It would be beneficial for the reader to accurately understand where these boundaries are, and how they interrelate with land use

3. Map Correction – Key Marine Sites (Volume II, Page 2-4)

A few of the ownerships referenced on Figure 2-1 (Key Marine Sites) are incorrect. Please contact Chinmaya Lewis of the Community Development Services at 268-3737 for the correct information. Also, the Map should include label names as the colors are difficult to distinguish between one another and the differences are completely lost when photocopied.

4. Map Correction – Access Inventory Map (Volume II, Page 3-18)

The Humboldt Bay Coastal Access Inventory May shown on page 3-18 has been updated to include Ma-le'l Dunes Unit recently acquired by BLM and USFWS (see attached). Please note that this map is included in the draft Local Coastal Plan Access Inventory which has not yet been reviewed or approved by either the County Board of Supervisors or the California Coastal Commission. Also, it is inappropriate to add the Harbor District's label to this map as it was generated by the County.

5. Text Correction – Bracut Wetland Restoration site (Volume II, Table 3-1)

The Bracut Wetland Restoration site owned by the California Coastal Conservancy is not listed on the table citing major access points around Humboldt Bay. This access point is identified in the Humboldt Bay Area Plan (see attached) and should be included as an access point in the District's Plan.

6. Map Correction – Zoning Classification Map (Part II – Appendix G)

The map title indicates that this is a Zoning Classification Map; however, the disclaimer below the title indicates that the map represents land use designations based upon the County's classification system. Please note that land use designations are different than zoning and the title needs to accurately portray the information presented. Also, the land use designations indicated on the map are not an accurate representation of the approved designations found in the adopted Humboldt Bay Area Plan, and may be misleading to the reader. For instance, the Eureka Airport site has a "split" designation of PR, NR and MC but the map indicates that the entire site is planned for industrial use. The map should be revised to accurately illustrate these areas that have "split" designations and be descriptive enough for the reader to understand.

GENERAL COMMENTS:

1. Humboldt Bay Interpretive Signing Manual

Although the Humboldt Bay Interpretive Signing Manual is referenced in the Supplemental Information in Appendix H, it would be beneficial to reference this program in the Discussion section for Policy RIO-1, Interpretive Program.

2. Historical Mariculture Use Comparison (Volume II, Page 2-14; Volume III Figure 2-1)

The 1975 Humboldt Bay Master Plan identified a much smaller footprint for mariculture uses than what was illustrated on Figure 2-1. The Draft Plan is lacking a discussion of historical harvest rates and current conditions. A map overlaying these differences would be helpful to identify possible impacts to Bay resources. Also, although the Plan indicates that the operational area has varied from 300 to 600 acres under production at any one time, the total area under lease is slightly less than 4,000 acres. What measures are currently in place to limit areas under production to these historic levels?

3. Description of Goals, Policies and Objectives (Volume III, Page 1-1)

Volume III, Section 1.0 titled "Introduction" gives a brief section overview on the policy framework for the Draft Plan. It would be helpful to include an explanation of what the District means by Goals, Policies and Objectives, and what type of "weight" they carry as far as the regulatory framework is proposed. Also, following each policy is a "discussion" section. It would be helpful to understand the significance this section holds for the implementation or interpretation of the proposed policy.

4. Consistency of Heading Format for Policies (Volume III)

The style of headings for the policies under Section 3 (Harbor Element Planning Policies) is different than those found in Sections 4 and 5. The headings listed in Section 3 are somewhat confusing in that they seem more like a policy directive than a heading. It would be clearer to the reader if these heading formats were consistent. County staff recommends using the style of headings found in Sections 4 and 5.

5. "Pre-zoning" of industrial sites – (Volume III, Page 3-4, 5 Policy HLU-3 and HLU-4)

County staff recommends that these two policies be amended to recognize the District's advisory role only when it comes to land use designations in the County. The County currently does not engage in the "pre-zoning" or "pre-designations" of land uses within the county. In order to approve a request to change the zoning or plan designation, the Board of Supervisors must determine that the applicant has submitted evidence to support making the required findings. State law also requires amendments to the Local Coastal Plan be consistent with California Government Code Section 13551 and Public Resources Code §30200. The County notifies all interested parties of proposed land use actions. The Harbor District would certainly be notified early on in the amendment process for all projects within your jurisdictions in order to be actively involved in this process. County staff would ensure that all comments received on an amendment request were forwarded to the decision-makers and the Harbor District would be notified of the public hearing dates.

6. Dredging Policies (Volume III, Page 3-10, Policies HWM-1 and HWM-2)

The 1975 Master Plan included an Economic Analysis of the Deepwater Port Potential for Humboldt Bay. The Plan concluded that "based upon a preliminary analysis of the engineering, economic and environmental factors, the Corps of Engineers found that Humboldt Bay was among several sites for which deepwater port development would be especially more costly than all others considered. Humboldt Bay is not likely to receive further consideration as a deepwater port for deep draft tankers in the foreseeable future, unless basic conditions at other ports change radically" (Page III-8). A similar discussion is needed in the Draft Plan that addresses the economic benefits received from dredging the channel while comparing the costs of maintaining the deepwater port functions. Also, the policies on dredging do not include a maximum depth threshold. In order to adequately review the impacts of dredging, a maximum depth should be given for each channel along with a proposed maintenance program.

7. Specific Plan for Kramer Dock (Volume III, Page 3-6, HLU -6)

Policy HLU-6 discusses the need to develop a Specific Plan for the use and management of the Kramer Dock. It is our understanding that this site is proposed for future development as deep water port which would require continued dredging maintenance of the channel. However, Figure 2-1 (Volume III, Section 2.0) illustrates a Water Use Designation of "Bay Conservation" for this site. Is it the intention of this Plan to restore the Kramer Dock to a functional deep water port facility, and if so, this information should be provided now in order that the necessary environmental review for this change of use can be conducted.

8. "Sovereign Immunity" for District-owned sites (Volume III, Page 3-6, HLU -6)

In the Discussion section for Policy HLU-6, the Draft Plan asserts that the District has "sovereign immunity" over land use for District-owned sites. Please provide the legal documentation for this assertion. Also, if this is the case, does the District recognize the land use designation and zoning currently adopted in the Humboldt Bay Management Plan? Would the District prefer that no designation be given for all District- owned sites?

9. Implementation Program

The Implementation Program is lacking detailed information on the process of implementing the Draft Plan. Each policy directive should have an implementation discussion that would outline the work that would need to be completed to implement the policy (if any), the budget implications, estimated timeline for completion and required staffing. This would provide the Commissioners and the public the "complete picture" when proposing new policies. Each policy could then be adequately reviewed during the CEQA process for anticipated environmental impacts to the Bay resources.

Again, thank you for the opportunity to comment on the Draft Plan. If you have questions regarding these comments, please contact Tom Hofweber at 268-3738 or Martha Spencer at 268-3704. We look forward to hearing from you

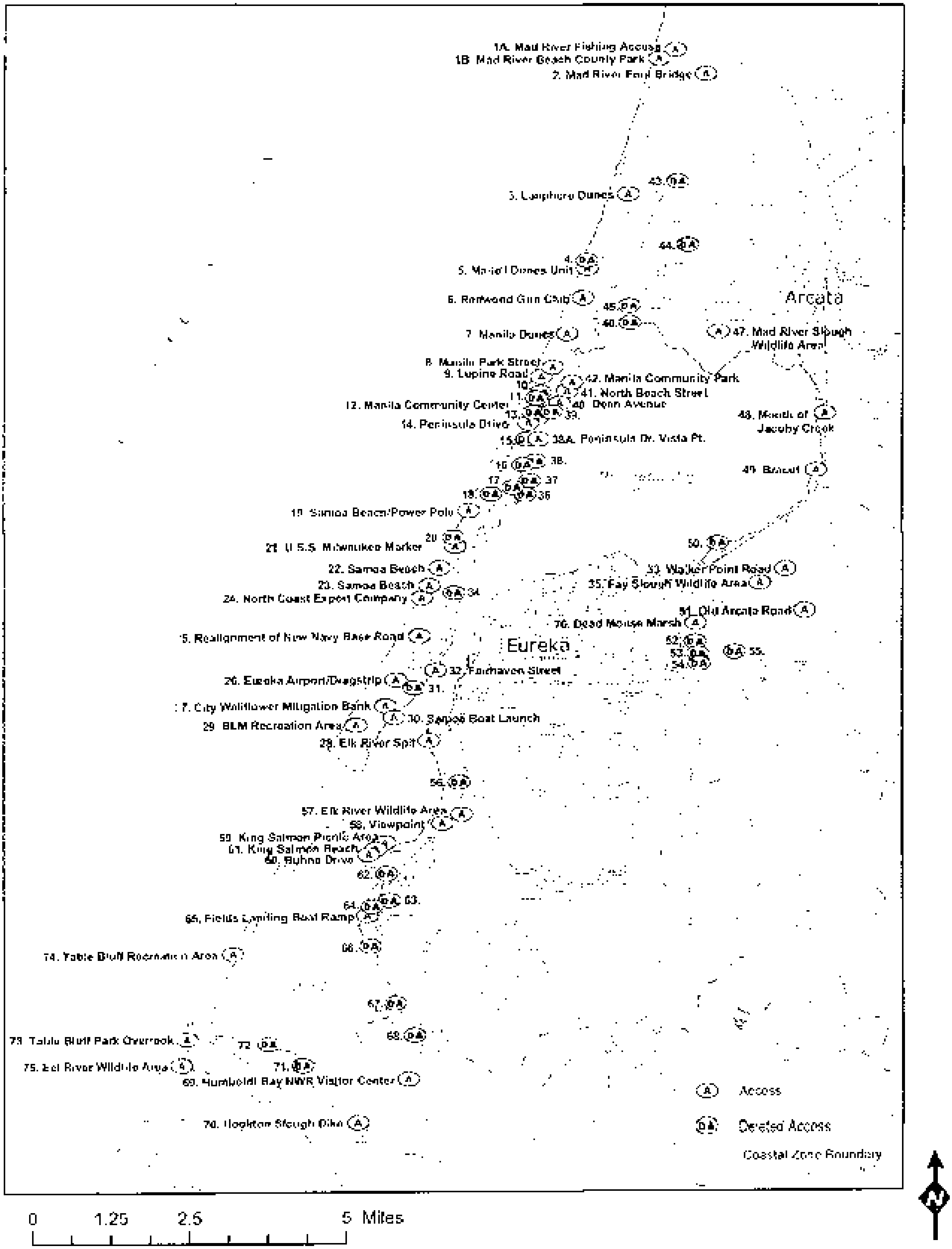
Sincerely,

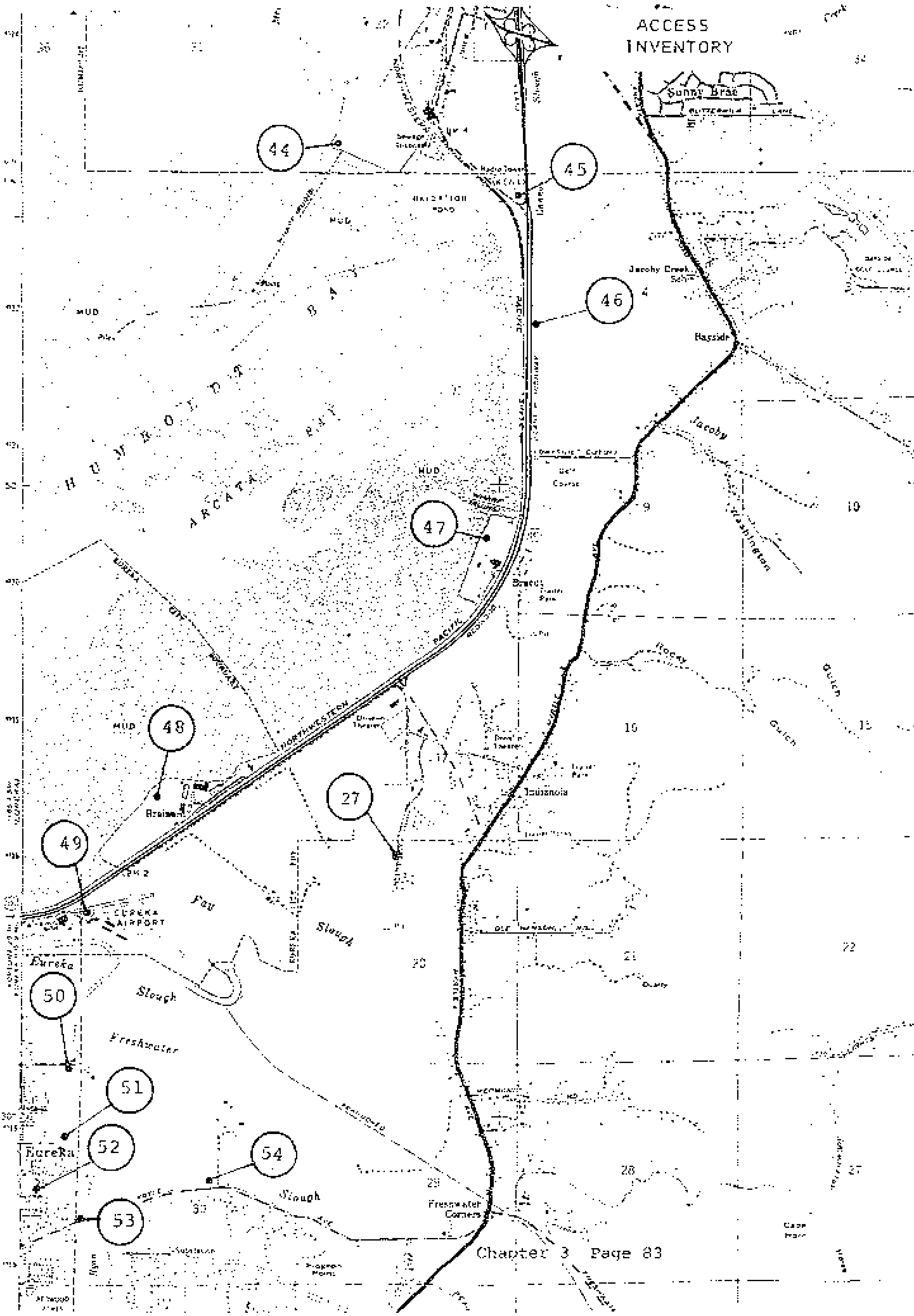
Martha Sp

Martha Spencer
Senior Planner
Humboldt County Community Development Services

Attachment: Revised Draft Humboldt Bay Access Inventory;
Adopted Humboldt Bay Area Plan Access Inventory (Bracut site)

Humboldt Bay Access Inventory
Sheet Index




ACCESS INVENTORY
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Jacoby
Golf Course
Rocky
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PACIFIC
EUREKA AIRPORT
Fay
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Eureka
Slough
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Freshwater Corners
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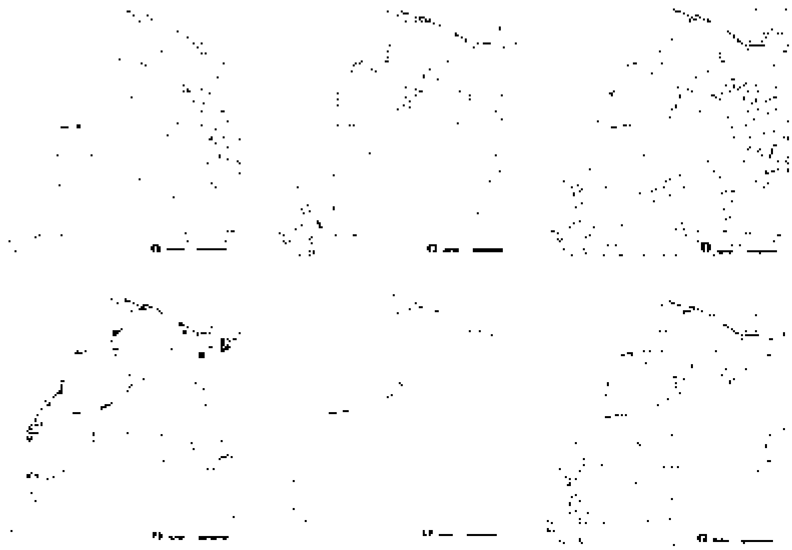
HUMBOLDT 2025
GENERAL PLAN UPDATE



Urban Study Areas Report

April 2005 Draft

A Discussion Paper for Community Workshops

Prepared by

Humboldt County Department of Community Development Services

April 28, 2005

Jeff Robinson
HarborDistrict Board of Commissioners
Humboldt Bay Harbor Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

ATT: Jeff Robinson, Resource Specialist

RE: Supplemental Comments to March 17, 2005 comments on March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners:

The Environmental Protection Information Center (EPIC) offers the following additional supplemental comments on the Draft Humboldt Bay Management Plan for your consideration. The March 2005 Draft Humboldt Bay Management Plan (hereafter referred to as the "Draft Plan") contains three volumes outlining the background and history, the setting, and the proposed policies by the Humboldt Bay Harbor Recreation and Conservation District (hereafter referred to as the Harbor District) for Humboldt Bay, along with supporting appendices.

Lack of Lawful Process

EPIC continues to be concerned about the lack of clear and lawful process and meaningful opportunity to comment on planning by the Harbor District. In addition to the initial comments it submitted on March 17, 2005 for the Draft Plan, EPIC has previously provided comments on the following documents:

Humboldt Bay Revitalization Plan – April 28, 2004
Harbor Revitalization Plan - June 23, 2003
Humboldt Bay Management Plan Task Force - January 22, 2002
Strategic Planning - August 24, 2001.

However, as far as EPIC is aware, the Harbor District has yet to proceed with any formal review of these planning proposals to comply with the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), and other governing laws. Nor has the Harbor District provided any formal notice of such review for the Draft Plan. The lack of a coordinated and transparent process for planning by the Harbor District undermines not only the public's confidence that its comments are actually considered, but also the legal adequacy of any actions to be taken.

Before the Harbor District proceeds it must clarify the relationship of these various planning mechanisms. Environmental review required by CEQA, NEPA and other laws for the Draft Plan in conjunction with these other planning documents must be commenced before any further action or review is undertaken.   An environmental impact report/statement (EIR/EIS) must be prepared pursuant to CEQA/NEPA, given the level of potential impacts that will occur to Humboldt Bay from the proposed policies and to ensure compliance.

EPIC incorporates all of our previous comments on the above listed documents as comment on the Draft Plan, and requests that all of these comments be considered in the development of any subsequent draft of the Humboldt Bay Management Plan prepared and circulated for public review pursuant to CEQA/NEPA and other laws.

Please provide EPIC and the undersigned with any and all notices related to these planning processes, and place us on all "interested persons" lists intended to provide notice of Harbor District proceedings.

The Need for A Sustainable Vision for Humboldt Bay

There is overwhelming public input supporting a sustainable vision for Humboldt Bay. Despite this, the overriding focus in the Draft Plan for the future of Humboldt Bay is still an industrial port.   Thus, valuable time and resources are being expended to try and develop Humboldt Bay into an industrial port, while neglecting other potentially more sustainable and appropriate collective visions.

Our previous comments proposing a more sustainable "vision" are not reflected in the Draft Plan. Our comments dated April 28, 2004, jointly submitted by the Environmental Protection Information Center, Humboldt Watershed Council, Humboldt Watch, Salmon Forever, Northcoast Environmental Center, Eureka Homeowners Committee, and the Redwood Alliance, outlined problems with the Harbor Revitalization Plan, and presented an alternative vision for consideration. This collective vision included the following:

(1) The Board of Supervisors, Harbor District, and City of Eureka should utilize its vested power and authority to foster a local, sustainable economy. This includes pursuing zoning changes for large industrial sites and other areas where needed and reserving tax benefits, loan guarantees, granting programs, and other types of support for local businesses and enterprises described above.

(2) The restoration economy is of growing importance to Humboldt County, and should be encouraged to facilitate sustainability and provide local jobs. Restoration jobs should pay living wages and be awarded to local firms, individuals, and entities. Top priorities should include: reclaiming salt marshes and sensitive dune habitat; restoring rare and endemic plant species; removing introduced, invasive species; restoring habitat for salmon, sturgeon, rockfish, and other native fish; and restoring habitat for the Olympic oyster and native clams.

(3) All claims and requirements of the traditional Native American community of Humboldt Bay should receive resolution before any development projects are considered.

Additionally, returning Indian Island to the Wiyot people and assisting in restoring this land is a highest priority.

(4) Finished, "value added" products that are substantially produced, marketed, distributed, and utilized within the local resource base are desirable economic endeavors. The Board of Supervisors, Harbor District, City of Eureka, and City of Arcata should facilitate the development of these types of enterprises, supporting and fostering *within* the local community the production of the goods, products, and services *needed* by the local community. Whether local wood products become fine furniture or a handcrafted boat, or locally caught fish and shellfish are processed in local facilities into canned or smoked goods, the completion of the production cycle at the local level maximizes the economic potential available to the local populace. Marketing and distributing these local goods, services, and products within the local region adds further economic benefits, increasing employment opportunities and the value of every dollar by keeping it within the local community for a longer period of time.

(5) Any extractive, resource based industry should be of a renewable nature and must be practiced within natural rates of replenishment. Specifically, commercial and recreational fishing, mariculture, and agriculture have very high potential as an economic base that is ecological at its core. Any such enterprise should be locally-owned and focused on providing for the local community, providing goods that are sold and distributed at local markets, restaurants, and other establishments.

(6) It should be a primary goal to find and implement long-term, sustainable solutions to meet energy supply problems, promoting and establishing local companies and non-profits that will ultimately make the Humboldt Bay region self-sufficient in providing for its energy needs. Studies indicate that using renewable sources of energy creates many more jobs than those based on fossil fuels. Producing and distributing this energy within the area in which it is utilized would expand employment opportunities further still, and ways to provide an infrastructure for this should be explored. The North Coast could not be better situated to accomplish these goals, with numerous entities and individuals working to develop and use alternative sources of energy and together, providing a deep pool of resources upon which to draw. Schatz Energy Research Center at Humboldt State University, Alternative Energy Engineering, Redwood Alliance, and other forward-thinking organizations and individuals should be brought together and consulted to form and implement this plan.

(7) All costs related to economic activity affecting Humboldt Bay should be borne by the economic entity involved. In economic terms, all externalities must be internalized by the business entity. This includes clean air, water, and soil, as well as all human social costs (industrial disease-both physical and mental, etc.). If these costs are too great for the economic concerns to bear and still operate, then the market rejects the business entity.

(8) Local control through economic democracy within private economic concerns ties the local residents/owners to their ecological fates as well as to their economic fates. In other

words, local control by the employees of an economic firm are less likely to result in decisions with the worst ecological consequences because the decision makers may be affected by the results of their decisions. While local owners can make very bad decisions, nevertheless, the decisions of many local owners of a firm might also be affected by the opinions of their neighbors. Private economic ownership models such as Employee Owned Stock Programs (ESOP), employee-owned and other types of cooperative businesses all have aspects of economic democracy.

(9) Tourism, light manufacturing, the arts and events, eco-tourism and adventure travel, the hospitality industry, and other possible economic endeavors must ALL operate within the bounds of the natural viability of the Bay ecosystem.

(10) All critical habitat areas on the Bay should be identified and permanently protected. Critical habitat areas are those necessary for maintaining viable populations of all native species, including existing natural areas as well as areas of potential restoration. All agencies that serve on the Advisory Committee should be working with the U.S. Fish and Wildlife Service to expand the Humboldt Bay National Wildlife Refuge to its planned level. A comprehensive study of the biological systems of Humboldt Bay should be conducted to identify other critical habitat areas in need of protection and restoration, and options such as conservation easements and acquisition should be fully explored.

This alternative and sustainable vision for Humboldt Bay is not served by:

(1) Use and dispersal of, or contamination with, toxic substances;

(2) Further deepening of the shipping channels;

(3) Additional development of the shoreline;

(4) Destruction of existing or potential critical habitat elements;

(5) Destruction of sacred sites or other Native American cultural areas;

(6) Development related activities that lead to loss of native species or other elements of biological diversity;

(7) Development related activities that lead to introduction of invasive exotic species; or

(8) General development activity of municipalities, unincorporated areas, or upper watershed areas leading to adverse impacts to the Bay from contaminated runoff, sedimentation, herbicide/pesticide residues, human sewage, or other damaging inputs.

Any subsequent planning documents should incorporate a broader and more sustainable vision for the future of Humboldt Bay, and eliminate those activities which can only serve to further deteriorate the quality and resources of the Bay.

Content of the Plan

The Draft Plan should contain enough specificity to be useful to decision makers and the public, and provide adequate disclosure of impacts. If the purpose of the Plan is to serve as a management guide, planning tool, and policy strategy, as well as a reference document, then the Draft Plan must contain substantially more information than currently provided. The Draft Plan is little more than a rehash of the 1980 Shapiro and Associates report on Humboldt Bay, which is over twenty years old and out-of-date. As a result, many of the base maps, such as parcel maps, currently being used by the Harbor District are also out-of-date. This is just one example of how the Draft Plan does not provide the best available information, and errors should be corrected.

While the Draft Plan does include policies that provide for protection of resource and recreational values, in almost all cases those policies contain provisions that can be superceded by the harbor water use designation, or at the discretion of the Harbor District. Thus, the Harbor District has removed any accountability to the Draft Plan, and retains discretion to exploit rather than protect resource values within Humboldt Bay. The Draft Plan policies support Harbor development, not protection of recreation and resource values. This outcome must be fully evaluated within an EIR pursuant to CEQA.

The Draft Plan should eliminate the three-bay approach and instead utilize a one-bay approach for Humboldt Bay. The artificial division of the bay into three separate sections is arbitrary, not supported by science, and obsolete. The bay is one ecosystem. The three bays comprise the Humboldt Bay ecosystem, rather than any one particular bay, and the Draft Plan should be rewritten to reflect the bay system as one whole ecosystem rather than three disjunctive sections.

The physical size, configuration, and channel of Humboldt Bay may not realistically accommodate port development as envisioned by the Harbor District without substantial environmental impacts and lost economic opportunity for the community. In order to be economically viable, port development is subject to economies of scale. To be economically viable the development must be large, because costs are reduced per unit shipment. While the Harbor Revitalization Plan examined the potential for port development within Humboldt Bay by evaluating existing port properties, including eighty key parcels, there was no economic analysis of the impacts from port development on other industries within Humboldt Bay from this type and scale of development. For example, no analysis was provided of impacts to tourism, recreation, resource values, air quality, ambient noise levels, scenic resources, visual character, fishing, mariculture, impacts on public services, etc. Nor did the Harbor Revitalization Plan provide analysis of requirements for a minimum and viable port related industry, such as (1) imports/export traffic, (2) bay property acreage necessary to support industrial use, (3) trip volume by cargo/vessels into Humboldt Bay, and (4) business precluded as a result of industrial uses. We request that the Harbor District analyze the full costs and environmental impacts to Humboldt Bay if large scale port development were to occur (including the potential impacts from hazardous materials) as proposed in the Harbor Revitalization Plan and carried forward in the policies proposed in the Draft Plan.

Suggested Language

"The Harbor District shall maintain and where feasible, restore biological productivity and the quality of coastal waters, streams, wetlands, and estuaries appropriate to maintain optimum populations of aquatic organisms and for the protection of human health through, among other means, minimizing adverse effects of wastewater and stormwater discharges and entrainment, controlling the quantity and quality of runoff, preventing depletion of groundwater supplies and substantial interference with surface water flow, encouraging wastewater reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams."

declares the following to be environmentally sensitive habitat areas within the Coastal Zone:

a. Rivers, creeks, sloughs, gulches, associated riparian habitats, including but not limited to Eureka Slough, Fay Slough, Cut-off Slough, Freshwater Slough, Cooper Slough, Second Slough, Third Slough, Martin Slough, Ryan Slough, Swain Slough, and Elk River (Emphasis added).

b. Wetlands and estuaries, including that portion of Humboldt Bay within the City's jurisdiction, riparian areas, and vegetated dunes.

d. Other unique habitat areas, such as waterbird rookeries, and habitat for all rare or endangered species on state or federal lists.

e. Grazed or farmed wetlands (i.e., diked former tidelands).

> *Within the Coastal Zone, the Harbor District shall ensure that environmentally sensitive habitat areas are protected against significant disruption of habitat values, and that only uses dependent on such resources shall be allowed within such areas. The Harbor District shall require that development in areas adjacent to environmentally sensitive habitat areas be sited and designed to prevent impacts which could significantly degrade such areas, and be compatible with the continuance of such habitat areas."*
>
> *"Within the Coastal Zone, prior to approval of a development, the Harbor District shall require that all development on lots or parcels designated Conservation or within 250 feet of such designation, or development potentially affecting an environmentally sensitive habitat area, shall be found to be in conformity with the applicable habitat protection policies of this Plan. All development plans, drainage plans, and grading plans submitted as part of an application shall show the precise location of the habitat (s) potentially affected by the proposed project and the manner in which they will be protected, enhanced, or restored."*

“Within the Coastal Zone, the Harbor District will promote the development of sound science and support funding of studies geared towards our increased understanding and appreciation for the natural resources and ways to maintain those values in Humboldt Bay”

“The Harbor District shall require establishment of a buffer for permitted development adjacent to all environmentally sensitive habitat areas. The minimum width of a buffer shall be 100 feet, unless the applicant for the development demonstrates on the basis of site specific information, the type and size of the development, and/or proposed mitigation (such as planting of vegetation) that will achieve the purposes(s) of the buffer, that a smaller buffer will protect the resources of the habitat area. As necessary to protect the environmentally sensitive area, the Harbor District may require a buffer greater than 100 feet. The buffer shall be measured horizontally from the edge of the environmental sensitive area nearest the proposed development to the edge of the development nearest the environmentally sensitive area. Maps and supplemental information submitted as part of the application shall be used to specifically define these boundaries."

“The Harbor District, in consultation with the Department of Fish and Game Coastal Conservancy Coastal Commission, Humboldt County, City of Eureka, affected landowners, and other interested parties shall prepare a detailed, implementable wetlands management, restoration, and enhancement program consistent with the provisions of this General Plan. The objectives of the program shall be to enhance the biological productivity of wetlands; to minimize or eliminate conflicts between wetlands and adjacent urban uses; to provide stable boundaries and buffers between urban and habitat areas; to provide restoration areas, including the Harbor District-owned lands on the Elk River Spit that may benefit from restoration and enhancement.”

The Humboldt Bay Management Plan would be greatly improved if the above sections were included in the next reiteration and within the Draft Environmental Impact Report.

Toxics

The stated goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (33 USC § 1251(a)). To achieve this goal, the CWA establishes several objectives related to the discharge of pollutants into waters of the nation, and requires the development of comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary condition of surface and underground waters (33 USC §§ 1251-1252).

The toxic materials section lacks any mention of the ongoing water pollution sources in Humboldt Bay. Some of these are extremely toxic and constitute a threat to public health and safety, such as sites of pentachloraphenol contamination. These must be addressed. Dr. Marc Lappé, consulting toxicologist, reviewed the potential and likely environmental and human health risks from movement of chemicals off-site from Sierra Pacific Industries (SPI) millsite located at 2293 Samoa Road in Arcata, California. Some of the findings of his report illustrate the need for a thorough toxics analysis.

> "The sedimentary testing reveals a substantial amount of dioxin at the two outfalls entering Humboldt Bay from the SPI property."
>
> "The source of the dioxins is clearly from the SPI mill site."
>
> "This last finding is of substantial concern because of the presence of a significant oyster fishery in the Mad River Slough. It appears that the contamination from the SPI mill or some other proximal source have contaminated the sediments in the area in which oysters are presently grown."
>
> "Sediment at the SPI site continues to be a source of dioxin or dioxin-like compounds in the aquatic ecosystem in the immediate and near vicinity of the site. This contamination poses a significant and substantial risk to any humans who might obtain food from the immediate area. Since the railroad trestle near the SPI site is frequently used crabbing and fishing point, this risk is more than theoretical."
>
> " The apparent distant movement of sedimentary contaminants to the Mad River Slough is of particular concern because of the presence of a significant mariculture program in that area. Special concern exists for persons who routinely eat oysters from that area, should they prove to have the same level of contamination levels as do mussels from the SPI slough. The latter class of shellfish foodstuffs contain sufficient dioxin to warrant a Proposition 65 alert, as do the edible crabs taken from the same vicinity."

This expert opinion about the risks of consuming foodstuffs from the Mad River Slough in the vicinity of the SPI mill site underscores the imperative for the Harbor District and Humboldt County to protect public health and safety as related to potential contamination of foodstuffs collected from the Mad River Slough. As stated in our previous comments, there are other sites around Humboldt Bay that were known to use pentachloraphenol in the past. Many of these sites should be a priority for cleanup efforts around the Bay since they potentially threaten water quality and may have caused elevated levels of dioxins in commercial oysters, shellfish, and other bottom feeders. Dioxins can bioaccumulate higher up the food chain to other fish species. The impacts from toxics to the federally listed tidewater goby, which lives in the Mad River Slough., also must be evaluated. There are limited populations of tidewater goby in Humboldt Bay, which makes the Mad River slough particularly important to its continued survival.

Any management directive much include evaluation of impacts from release of ballast water, and provide mandatory provisions for its treatment. Measures must be required of ships coming from San Francisco and other polluted harbors to ensure that potential Aquatic Nuisance Species have been removed prior to entering the Bay. A recent court decision (*Northwest Environmental Advocates et al. vs. USEPA*) has reaffirmed that the Clean Water Act applies to the discharge of ballast water, that ballast water constitutes a "pollutant", and that NPDES permits should be required for all vessels discharging ballast. The Harbor District needs to be proactive and include a ballast water treatment facility in the Draft Plan to ensure that water quality is protected and maintained in Humboldt Bay.

Regulatory Streamlining

While EPIC supports efforts to reduce paperwork and eliminate confusion over permit processing so that restoration projects can proceed in a timely manner, we do not support reduced regulatory oversight and accountability by agencies with a duty to protect resource values in Humboldt Bay. The Harbor District needs to explore options to eliminate unnecessary paperwork and delays in permit processing while retaining regulatory authority and oversight over activities that may affect Humboldt Bay to ensure protection of resource values.

Mariculture

The Draft Plan also must address the full impact of operations by Coast Seafoods and other aquaculture operations in the Bay. Coast Seafoods leases approximately 300 tideland acres, and owns an additional 560 acres. The Draft Plan only mentions the 300 leased tideland acres, with no clear discussion of the full scope of cultivation operations by Coast Seafoods. The Draft Plan needs to identify and evaluate all acreage currently being used, as well as what is available for use for oyster operations.

Coast Seafoods appears to have a monopoly over leased tidelands in North Bay. Through the Draft Plan, the Harbor District seems willing to guarantee Coast Seafoods the right to cultivate. We consider this to be a breach of authority under the public trust doctrine, as the resources of the Bay cannot be relegated to such private dominion. The impacts from the use of longlines must also be evaluated. Longlines can shade out eelgrass, an environmentally sensitive habitat area, potentially increase sedimentation rates, change the composition of fish species, provide hard substrate areas for establishment of Aquatic Nuisance Species, and alter bird use. Longline spacing may overly impact other resource values, particularly at spacing less than 10’ intervals.

The Draft Plan should also disclose in what manner Harbor District policies may distinguish lands leased from the Harbor District from privately owned tidelands. The evaluation of operations also must evaluate the cumulative effects from operations on all cultivated acres. This discussion should include consideration of the extent to which some operations may be relocated from the Mad River Slough to potentially less toxic areas.

Water Quality In Humboldt Bay

Many of the septic systems at King Salmon are “failing,” and are impacting Humboldt Bay water quality. Previously, EPIC suggested that proactive steps be taken by the Harbor District and other entities to buy out the parcels in Kings Salmon to eliminate these water quality issues. If this cannot be done, then the Harbor District should investigate the feasibility of annexing King Salmon so as to extend sewer lines to the area to remedy this significant water quality issue, or explore an alternative wetlands treatment pond for water treatment.

Coordination of Review

As mentioned above, there are numerous proposed plans, inventories, and strategies under review by the Harbor District for which formal processes are lacking. These various documents have been promulgated in the absence of adequate disclosure of their scope and nature, respect for meaningful consideration of public input, and in the absence of compliance with CEQA and other applicable laws. We request that the Harbor District disclose how public input and CEQA/NEPA review will take place for all of the plans proposed in the Draft Plan listed below. We include the Elk River Wildlife Refuge, which should have been referenced in the Draft Plan.

> **<u>Site specific management plans still subject to Coastal Act and CEQA review</u>:**
> Harbor District Properties

I. Woodley Island
2. The Buhne Point/King Salmon restoration area
3. The Fields Landing boat repair facility/Kramer dock
4. The Park Street Mitigation Site
5. Samoa Redwood Dock facility
6. Elk River Wildlife Refuge

<u>Inventories, standards, etc. subject to Coastal Act and CEQA review</u>:

1. Inventory of shipping terminal facilities
2. Standards and guidelines for shoreline development & maintenance structures
3. Humboldt Bay Blue Book
4. Long Term Maintenance Strategy For Dredge Spoil Disposal (Vol.III, pg.3-12)
5. Sediment Management Program or Approach (Vol. III, pg.3-12)
6. Public Interpretive Center (Vol.III, pg.4-13)
7. Bay View Plan or Map (Vol.III, pg.4-15)
8. Enhancement Plan (Vol.III, pg.5-5, Policy CAE-3)
9. Restoration and enhancement plan for Humboldt Bay's aquatic ecosystems (Policy CAE-3, Vol.III, pg.5-5)
10. Water quality maintenance plan (Policy CAE-4, Vol.III, pg.5-6)
11. Native biological diversity plan (Policy CAS-1 (Vol.III, pg.5-7), for incorporation-fish, invertebrate, and plants.

Thank you for your consideration of these comments. We request written response to all concerns. Please provide responses to EPIC at P.O. Box 397, Garberville, CA 95542, and to Christine Ambrose, 611 Richmond Street, El Cerrito CA 94530. Please make sure that EPIC and Christine Ambrose are included on the Harbor District's email and direct mail list and that EPIC and Christine Ambrose are sent to the addresses provided in this paragraph notices of all public meetings and activities. The email address for epic is epic@wildcalifornia.org and the email address for Christine Ambrose is usnea@sbcglobal.net.

Sincerely,

Christine Ambrose, Coastal Advocate, EPIC

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Arcata Fish and Wildlife Office
1655 Heindon Road, Arcata, CA 95521-5582
Phone: (707) 822-7201 FAX: (707) 822-8411

Humboldt Bay National Wildlife Refuge Complex
1020 Ranch Road, Loleta, CA 95551
Phone: (707) 733-5406 FAX: (707) 733-1946

APR 2 8 2005

Mr. Jeff Robinson
Conservation Specialist
Humboldt Bay Harbor, Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502

Subject: Comments on the Draft Humboldt Bay Management Plan.

Dear Mr. Robinson:

This responds to a request by the Humboldt Bay Harbor, Recreation and Conservation District (District) for comments on the Draft Humboldt Bay Management Plan (Plan). We appreciate the amount of time and effort required to develop a document that encompasses many complex issues across such a diverse landscape as Humboldt Bay. Once the document is finalized, we look forward to partnering with the District to address conservation issues in keeping with the Fish and Wildlife Service's (Service), mission of "working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people." Consistent with our mission, we have conservation responsibility for a number of issues that are particularly relevant to Humboldt Bay including migratory birds, endangered species, anadromous fisheries, and national wildlife refuge lands.

The comments that follow have been coordinated between the two local offices that generally represent the interests of the Service in the Humboldt Bay region. These comments are primarily focused on the content of subject matter as opposed to editorial comments, although some broad editorial suggestions are included. Specific comments are entitled, and presented, in the same order, as the structure of the Plan.

General Comments

- References to the Humboldt Bay Harbor, Recreation and Conservation District changes throughout the document. We suggest referring to the agency as "The Bay District". The term is more inclusive of all actions involved within the Plan Boundary and the Sphere of Interest and it seems to be a better reference than identified specifically as "The Harbor District".

- All references to black brant should be changed to Pacific brant.

- The spelling of water-**dependant** should be changed throughout to water-**dependent.**

- Where applicable, identify that the Lanphere and Ma-le'l Dunes Units protect sensitive dune and estuarine plant communities and endangered species.

- When listing units of the Humboldt Bay National Wildlife Refuge include the Table Bluff, South Bay, Indian Island, and Ma-le'l Dunes Units. The latter will become a part of the refuge within the next 6 months; the former all include current holdings.

Specific Comments

Part I-The Plan, Volume I. Introduction
Section 2.0 Purpose of the Humboldt Bay Management Plan

Page 1-3, Paragraph 1:
Consider changing first sentence to the following: The biological, chemical and physical complexity contained in Humboldt Bay is more than any individual.....

Paragraph 2:
Consider adding "and sustainability" to the end of the last sentence.

Section 6.0 Relationships with Other Local Planning Actions...., 6.1, Areas of Primary Interest.
Page 1-15, Paragraph 1:
The Humboldt Bay National Wildlife Refuge also owns some tidelands, including saltmarsh and mudflat, in fee in both North and South Bays. Use of these tidelands is guided by the Refuge's management plan.

Section 7.0, Relationships with State and Federal Requirements.
Page 1-17, Paragraph 1:
The second sentence of this paragraph says "These State and Federal agencies enjoy little or no direct control over potential land uses such as the authority exercised by the District, the County,

and cities" This sentence is somewhat confusing. Is the Plan referring to land within the District's Plan Boundary, Sphere of Interest or both? The State and Federal land management agencies along with the public have control over potential land uses on State and Federal lands around the Bay. In addition, the Army Corps of Engineers (Corps) and the Coastal Commission, although not land management agencies, have control over land use as regulatory agencies.

Section 7.2, Federal Agencies, 7.2.2 The U. S. Fish and Wildlife Service,
Page1-21
We suggest this entire section be re-written to include the information described below.

Paragraph 1:
Change the first sentence to reflect the following: The U.S. Fish and Wildlife Service (FWS), an agency of the Department of Interior, is a Federal......

This section should identify that the Service's role in providing advisory recommendations to the Corps and other Federal agencies regarding proposed actions where Federally funded or permitted water resource development activities are planned, are a part of our responsibilities under the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e, et sec).

Note that in carrying out requirements of the Endangered Species Act, the Service works with the public on recovery of Federally listed species. The Plan should also emphasize that the plant species and the non-commercial fish referred to are Federally listed as well as include their common and scientific names.

The Plan should also describe the Service's non-regulatory role as a funding and technical assistance partner for habitat restoration in and around the Bay. The Service has several programs to cost share and partner with local communities, landowners, tribes, counties, agencies, non-governmental organizations, and others. Examples of these voluntary programs are the Partners for Fish and Wildlife Program, a recently funded Humboldt Bay/North Coast Region Coastal Program, Private Stewardship Grants, and National Coastal Wetland Grants Program. See our website at http://arcata.fws.gov/restoration for more information about these and other applicable programs.

Paragraph 2:
We recommend that the second sentence be changed to read as follows: In the Humboldt Bay area, the FWS manages the Humboldt Bay National Wildlife Refuge (NWR), which consists of several non-contiguous units adjacent to Humboldt Bay and its tributaries.

Also, please change the remainder of the paragraph to read as follows: From north to south, the refuge units are: Lanphere Dunes, Ma-le'l Dunes, Jacoby Eureka Slough, Indian Island, South Bay, White Slough, Salmon Creek, Hookton Slough and Table Bluff. Humboldt Bay NWR conserves and enhances wetland and upland habitats in and around the bay for a diversity of fish, wildlife and plants. The refuge office and visitor center are located at the Salmon Creek Unit. Public uses managed by the refuge include wildlife viewing and photography, environmental education and interpretation, hunting and fishing. There are walking trails at several refuge units and a public dock for launching non-motorized boats and/or fishing at the Hookton Slough Unit.

At the end of this paragraph we suggest changing the statement: "The Lanphere Dunes Unit protects sensitive dune plant communities to": "The Lanphere and Ma-le'l Units protect sensitive dune and estuarine plant communities and endangered species".

Section 10.3, Plan Development
Page 1-29, Paragraph 3:
This paragraph is very helpful in understanding the context of the Plan. Consider moving it or repeating it at the beginning of the document.

Volume II. State of the Bay
Section 3.5, Major Public Recreation Areas , Facilities and Access.
Page 3-16 to 3-18
Since this Plan will be used as a major reference document in the future, we believe that it is important in this section and elsewhere to have the most recent and updated information included. The maps on page 3-17 and 3-18 both contain outdated information, such as boundaries of Federal lands (p. 3-17) and the names of access sites (p. 3-18). "Cooperative Management Area" should be changed to Ma-le'l Dunes Cooperative Management Area (CMA). Remove Redwood Gun Club, which is not a public access point, and Humboldt Buggy Club, which is now part of the newly formed Ma-le'l Dunes CMA.

3.5.2. Recreation Resources and Opportunities by Sub-Areas, South Bay.
Page 3-20
Please change bullet number 5 as follows: The FWS small, non-motorized boat launch facility on Hookton Slough.

The last sentence on the page should read as follows: Recreational opportunities in and around South Bay include: recreational boating, waterfowl hunting, birdwatching, wildlife observation and photography, environmental education and interpretation, beachcombing….

Section 4.0, Conservation Setting, 4.1 Introduction and General Setting.
Page 4-1 to 4-2
We recommend that you reconsider the language in paragraphs 2 through 4. Updated scientific data describing Humboldt Bay has become available since the documents cited were published, and the Bay itself has undergone changes. The Plan makes this point later on in pages 4-4 and 4-37. Prior descriptions of the Bay were adequate for their time, and were the best available

information on which to base management decisions, but our knowledge base has since expanded, and will continue to in the future. We understand that the purpose of this Plan is not to exhaustively compile this information. However, it is also important to acknowledge that new information is accruing and should be considered when making management decisions.

4.1.1., Summary of General Physical and Ecological Setting.
Page 4-3, Paragraph 2:
Consider identifying major tributaries of Humboldt Bay starting from the north and moving south.

Page 4-4, Paragraph 2:
We suggest changing the last sentence to the following: The complex issue of maintaining these culturally modified areas and the existing values or restoring some, or all, of them to tidal influence has been and likely will continue to be much debated. Key concepts of this are: (1) what values would we be trying to restore, and (2) could we get them back given the changes that have occurred, to and within, the whole bay system.

Paragraph 3:
In the second sentence the Plan describes uplands and refers to "periodic land surface modifications that are accompanied by increased sediment production". Is the Plan referring to timber harvest operations? Please clarify this sentence.

4.1.2. General Consideration of Ecological Conditions.....
Page 4-4 to 4-5, Paragraph 1
We suggest this paragraph discuss the Wiyot Tribe.

Page 4-5, Humboldt Bay in 1850......
Paragraph 3:
This paragraph seems unnecessary, since we have historical records of the Bay's conditions at the time of settlement. The lagoons are a very different system.

Page 4-6, The Pre-settlement Humboldt Bay watershed was........
Consider including Sitka spruce as a conifer species that historically covered significant areas of bottomland along Humboldt Bay.

4.2 Geophysical Setting, 4.2.2 Regional Geology, Seismic Events, and Tsunamis.
Page 4-8 to 4-10
Consider mentioning potential effects of sea-level rise. It may be just as likely to happen within the next 20-30 years as any major seismic event and it's impacts could be just as significant.

4.4 Ecosystem and Environmental Resource Patterns
Page 4-18
Consider titling this section "Environmental Resource Patterns and Ecosystem Restoration". Then move 4.5.1, Basin-wide Wetland Restoration or Enhancement on page 4-38 to this section. The subject of restoration seems to fit better separated from Section 4.5 Management-Related Issues and Concerns.

4.4.1.1. Intertidal and Subtidal Habitats in Humboldt Bay.
Table 4-5 Summary of Common Wetland Types, page 4-20.
The National Wetland Inventory (NWI) classifies agricultural wetlands as PEM1C as opposed to PEM2 shown in the table. The NWI code of PEM2 is used for in areas where cold weather causes complete dieback of vegetation.

Figure 4-2 Humboldt Bay Wetlands, page 4-22
Please re-title the figure "Humboldt Bay Subtidal and Intertidal wetlands," or consider adding the palustrine wetlands and have the map depict all wetlands. Then it can be referred to here in this section as well as in 4.4.1.2, Diked Former Tidelands and Seasonal Wetlands.

Page 4-24, Saltmarshes.
It would be informative to list some key processes that are not understood, in addition to what is known, about our salt marshes. Specifically, the role salt marshes play in nutrient cycling and productivity in the bay, including how the diking of salt marshes and the invasion of *Spartina densiflora* has altered this dynamic.

4.4.1.2. Diked Former Tidelands and Seasonal Wetlands
Page 4-25 to 4-26
Please expand this section to include all palustrine wetlands in the sphere of interest, including semi-permanent wetlands such as some marshes and swamps. In the previous section on Intertidal and Subtidal habitats the Plan has headings of Tidal Channels and Tidal Flats, Salt marsh, etc. It would be helpful if general headings for habitats within this section are created that include all palustrine wetland types. In addition, a table like Table 4-6 for this section would be helpful, even if limited to the somewhat outdated statistics available through the NWI, noting the source and date of that mapping.

Page 4-25, Paragraph 2:
Phalaris arundinacea grows primarily in areas that are more flooded than the seasonal agricultural wetlands, such as in ditches and along streams. It is becoming more prevalent primarily in Arcata Bay.

Page 4-26, Paragraph 2:
Carex obnupta is not very common in pastures. Please refer to the habitat types in the attached Vascular Plants of Humboldt Bay Dunes and Wetlands species list compiled by Leppig and Pickart 2005. It would be helpful to clarify that the sedge and bulrush species mentioned are found primarily in old sloughs or depressions that receive more flooding than much of the pasture area, or in areas of the Humboldt Bay National Wildlife Refuge that are being managed as seasonal wetlands rather than pasture.

Paragraph 5:
In the last paragraph please add that these lands are also the primary habitat for the increasing population of Aleutian geese each spring from February to April.

4.4.1.3, Rivers, Streams, and Riparian Areas
Page 4-26 to 4-28
It would be helpful if general headings for habitats within this section are created that include all palustrine wetland types. In addition, a table like Table 4-6 for this section would be helpful, even if limited to the somewhat outdated statistics available through the NWI (noting the source, and date of that mapping

Page 4-27, Paragraph 3:
The last sentence in this paragraph mentions willow species in dune and riparian areas around Humboldt Bay. Please correct the information to reflect that *Salix hookeriana* is the most abundant willow in the dunes but also occurs in riparian areas while *Salix lucida* and *Salix sitchensis* are quite common in riparian areas.

Paragraph 4:
Other shrub species often present in riparian areas along streams are *Sambucus callicarpa*, *Vaccinium parvifolium*, and *Rubus parviflorus*. *Cornus* and *Carex obnupta* are not typical of the riparian areas that are in the area covered by the management plan. Please refer to the attached Vascular Plant species list.

4.4.2, Sensitive Species in the Humboldt Bay Region
Page 4-28 to 4-31
It is unclear how the species included were determined to be of concern for the Plan area. Sensitive species are somewhat defined in the beginning of this section and then also in the Appendix but the omission of several species in the list is inconsistent with these definitions. Clearly define what is meant by sensitive species in the body of the text.

The organization of Table 4-7 is difficult to follow. In two places habitat types are under the heading of Common Name. Were species in the list intended to be categorized by habitat type? If so, the first several species listed do not have a habitat type defined for them. We suggest listing the species by categories of plants, birds, amphibians, mammals etc. Consider changing the title of the table to identify that the list includes species above and beyond those listed in California Natural Diversity Data Base (CNDDB). Results of the CNDDB search did not include two Federally listed species that exist around the Bay. Please include the following list of bird and mammal species in this section of the Plan:

- Brown pelican (*Pelecanus occidentalis*)-Endangered-Federal List
- Marbled murrelet (*Brachyramphus marmoratus*) -Threatened-Federal List, Endangered-State List: In the fall as many as 200 individual birds have been documented in the bay during their molt.
- Pacific Fisher (*Martes pennanti pacifica*) -Candidate for Listing-Federal List: Humboldt Marten is identified in Table 4-7 but they have not been seen since the mid 1920's or 1930's. Pacific Fisher currently exist in the coast ranges here.
- Foothill-yellow legged frog (Rana boylii)-Special Concern-State List
- Aleutian Goose (Delisted-Federal List)
- Peregrine Falcon (Delisted-Federal List)

The 1988 amendment to the Fish and Wildlife Conservation Act (16 U.S.C. 2901-2911 et sec) mandates the Service to identify species, subspecies and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544 et sec). The document titled Birds of Conservation Concern 2002 (BCC 2002) is the Service's most recent effort to carry out this mandate. The following is a list of Birds of Conservation Concern within the Humboldt Bay Region. Please include within this section of the Plan.

- Black Oystercatcher (*Haematopus bachmani)*
- Black Turnstone (Arenaria melanocephala)
- Caspian Tern (*Sterna caspia*)
- Long-billed Curlew (*Nemenius americana)*
- Marbled Godwit *(Limosa fedoa)*
- Red Knot *(Calidris canutus)*
- Rock sandpiper *(Calidrus ptilocnemis)*
- Short billed Dowitcher *(Limnodromus griseus)*
- Surfbird *(Aphriza virgata)*
- Whimbrel (*Numenius phaeopus)*

Please include the following list of plant species. They are Plant Species of Concern as designated by the California Native Plant Society.

Angelica lucida
Glehnia littoralis ssp. *leiocarpa*
Hesperevax sparsiflora var. *brevifolia*
Eleocharis parvula

In addition, there are two non vascular plant species listed, which is not exhaustive for this area (and no source is cited or discussed in the text for ranking non-vascular plant species).

Page 4-31, Paragraph 1:
This paragraph states that the majority of elements in Table 4-7 do not occur in habitats that would be affected by the Plan. However, the Plan makes recommendations that would have direct effects on the Sphere of Interest as most of the species listed occur in this area. An example of this is mentioned later in the Plan under Humboldt Bay Water Use Designations, Volume III. Section 1.0. On page 1-1, the Plan states "the designations identify large regions in the Bay in which certain categories of uses (described in Section 2.0) will generally be considered by the Harbor District to be compatible with the management directions presented in this Plan." Large areas of shoreline designated for Harbor use contain sensitive elements and could be affected by the adoption of this Plan.

4.4.4. An Ecosystem Perspective-Streams, Wetlands…….
Page 4-35, Paragraph 3:
We understand the Plan was not intended to go into great detail on individual species but we believe Pacific brant deserve more comment given their dependence on the Bay in relation to eelgrass. We suggest the following sentence be inserted after sentence 3: Pacific brant are primary feeders and are dependent on healthy eelgrass beds. Humboldt Bay is a critical migration area for the continental Pacific brant population. Over 40% of this population stops on South Bay during their spring migration. Please change sentence 4 to say the following: Some other waterfowl, including pintail, wigeon, and teal are also primary consumers; many other waterfowl species….

4.5 Management Related Issues and Concerns, page 4-37 to 4-47
We suggest separating the subject of habitat restoration out of this section and placing it into it's own main heading titled "Section 4.X, Basin Wide Wetland Restoration and Enhancement" with equal weight as Section 4.5. It is now a subsection under 4.5 and it's significance is lost among other management issues identified here.

The body of the Plan in this section and in others communicates uncertainty about the meaning of habitat restoration. Even though the term is defined in Appendix A, it is not immediately clear what the Plan definition is and the reader is left with uncertainty throughout the document. Because the term restoration can have many different interpretations, we suggest a definition be clearly identified within the body of the proposed new section requested previously. Please use a definition that can be referenced. For example, consider using the definition provided by the Society for Ecological Restoration, International Science and Policy Working Group. 2004. The

SER, International Primer on Ecological Restoration. *"the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."*

4.5.1.1 Intertidal Restoration
Page 4-38, Paragraph 3:
In the second sentence please identify that there are at least **four** major projects instead of the three listed. Please include the Lower Salmon Creek Delta Restoration project on the Salmon Creek Unit of Humboldt Bay NWR.

4.5.2 Exotic Species, page 4-40 to 4-41
In this section, we suggest the Plan state that activities within the Plan Boundary and Sphere of Interest have the potential to affect physical features which may promote the spread of *Spartina densiflora* to the detriment of native salt marsh plants and associated habitats. This will fit in with the first sentence at the top of page 4-41 that says the District will work collaboratively with agencies to control or reduce exotic species.

4.5.4. Sensitive Species and Sensitive Habitats
Page 4-43, Paragraph 1:
Please identify the characteristics of coho salmon that cause them to be considered the most significant listed species for the Plan area. There are other listed species in the Plan area including marbled murrelet, steelhead, Chinook salmon, and tidewater goby that also have complex habitat requirements. Define sensitive habitats either here or as requested earlier in Section 4.0. Then clearly state which habitats in the Plan area fit the definition. Please show eelgrass habitat as a distinct heading under this secifon and describe why this is an important and unique habitat from a regional and local perspective. Also, identify in general what aquatic organisms and waterbirds, such as Pacific brant, depend on eelgrass habitat.

Paragraph 2:
Please add Salmon Creek after Elk River in the last sentence.

Part I-The Plan, Volume III. Policy Document
Section 5.0 Conservation Planning Policies, 5.1 Section Overview
Page 5-2, Paragraph 4:
In the first sentence please add U.S. Fish and Wildlife Service after U. S. Army Corps of Engineers.

5.2.2 Policies, CAE-3, page 5-5
In the first sentence add U.S. Fish and Wildlife Service.

Part II Appendices

Appendix A: Glossary of Selected Terms. Habitat Restoration.

Please use a definition that is a nationally and regionally accepted by restoration practitioners and land managers as mentioned previously in this correspondence. Please add a definition for invasive species that differentiates them from merely exotic species.

Appendix C: State and Federal Implementing Entities, U. S. Fish and Wildlife Service, Mission Statement

Page C-15, Paragraph 1:

Please change the second sentence to read as follows: Among its key functions, the Service enforces Federal wildlife laws, protects endangered species, manages migratory birds, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, manages the 93 million acre National Wildlife Refuge System, and oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to State fish and wildlife agencies.

Page C-15 to C-16, Major Roles and Responsibilities in Wetlands Management, Paragraph 3:

Much of this section is not accurate for the Plan area. The Service's local contact for Ecological Services, Endangered Species, Joint Venture activities, Habitat Restoration Programs, Fisheries and other programs is the Arcata Fish and Wildlife Office.

The Central Valley Habitat Joint Venture is mentioned several times. We are not located within this joint venture. We are located within the Pacific Coast Habitat Joint Venture (PCJV). Please see the website for PCJV at http://www.madriverbio.com/ca-pcjv.html for the applicable information.

Page C-16, Legal Mandate

The contact information is not correct for the Plan area. The following is the correct information:

U.S. Fish and Wildlife Service
Arcata Fish and Wildlife Office
1655 Heindon Rd.
Arcata, CA 95521

Humboldt Bay National Wildlife Refuge
U. S. Fish and Wildlife Service
1020 Ranch Rd.
Loleta, CA 95551

Appendix F. Partial Humboldt Bay Species Listing.
Because this Plan will be widely used as a reference document, it is important for the species list to be as accurate as possible. For plant species, please refer to the attached Vascular Plants species list, which also provides habitat listings for each species. This list is comprehensive and could be incorporated into the Plan with attribution, to replace the existing list of salt marsh species in F.4, and to provide plant species lists for other Humboldt Bay wetlands.

F.2 Bird Species Identified In the Humboldt Bay Vicinity, page F-19
Please add bald eagle.

Appendix G. Maps.
Zoning Classification For Area Surrounding Humboldt Bay:
There are several errors on this map. A Natural Resource-zoned area in the vicinity of Lanphere Dunes is incorrectly identified as zoned for Agriculture. The inclusion of Natural Resource-zoned area at the Eureka Dunes Protected Area is incorrectly shown as zoned for Industrial.

Humboldt Bay Public Land Owners and Mangers:
Please update the boundaries of the refuge to include our current holdings in the South Bay, Jacoby Creek, Table Bluff and Ma-le'l Units. In addition, correct the boundary on the Lanphere Unit (see attached Approved Boundary and Acquired Parcels map), and correct the acreage in the legend.

Habitat Types of Humboldt Bay and Surrounding Vicinity:
Please add the date in larger font so that the viewer knows the map represents information historical data published 25 years ago. We suggest updating parts of the map with more recent information, including the NWI wetland types, which are also outdated, but more recent than shown, and the dune mapping document conducted by Travis Aria in 1999 which is available electronically.

Wetland Habitat Types of Humboldt Bay and National Wetland Inventory of Humboldt Bay:
Please add the dates in larger font so that the viewer knows these maps represent historical data tied to the year of mapping. In the NWI map, please add the palustrine wetlands in the sphere of interest.

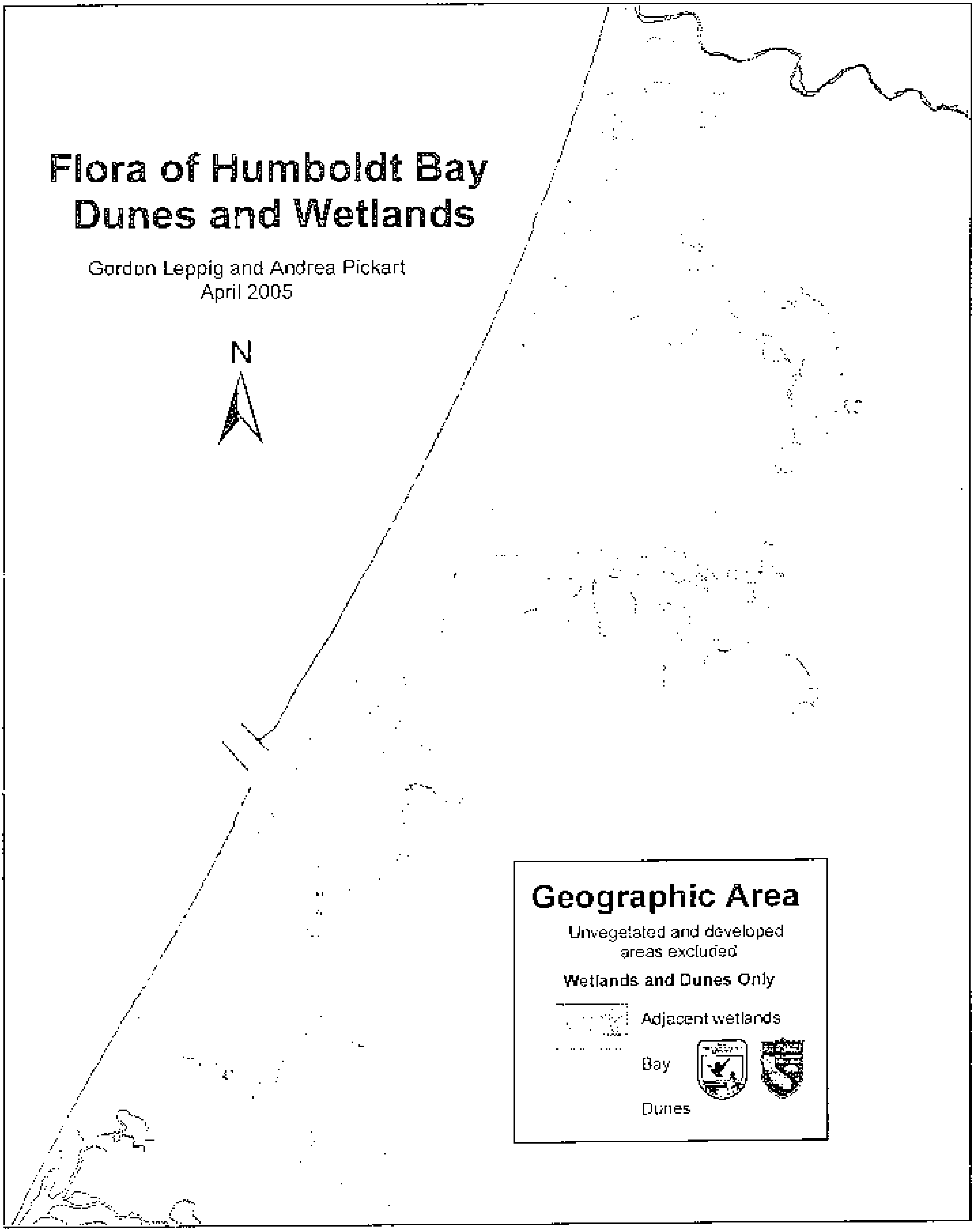
In conclusion, we trust that the District will find these comments to be helpful in completion of the Plan. As noted in the introduction to this correspondence, we look forward to working with the District on conservation issues around Humboldt Bay, and the many partnering opportunities we believe are available. If you have any questions regarding these comments, please contact either Paula Golightly, with the Arcata Fish and Wildlife Office at 822-7201 or Andrea Pickart, for the Humboldt Bay National Wildlife Refuge, at 822-6378.

Sincerely,

Acting for
Michael M. Long
Field Supervisor
Arcata Fish and Wildlife Office

Andrea J Pickart
for
Eric T. Nelson
Refuge Manager
Humboldt Bay National Wildlife Refuge

Enclosures(3)

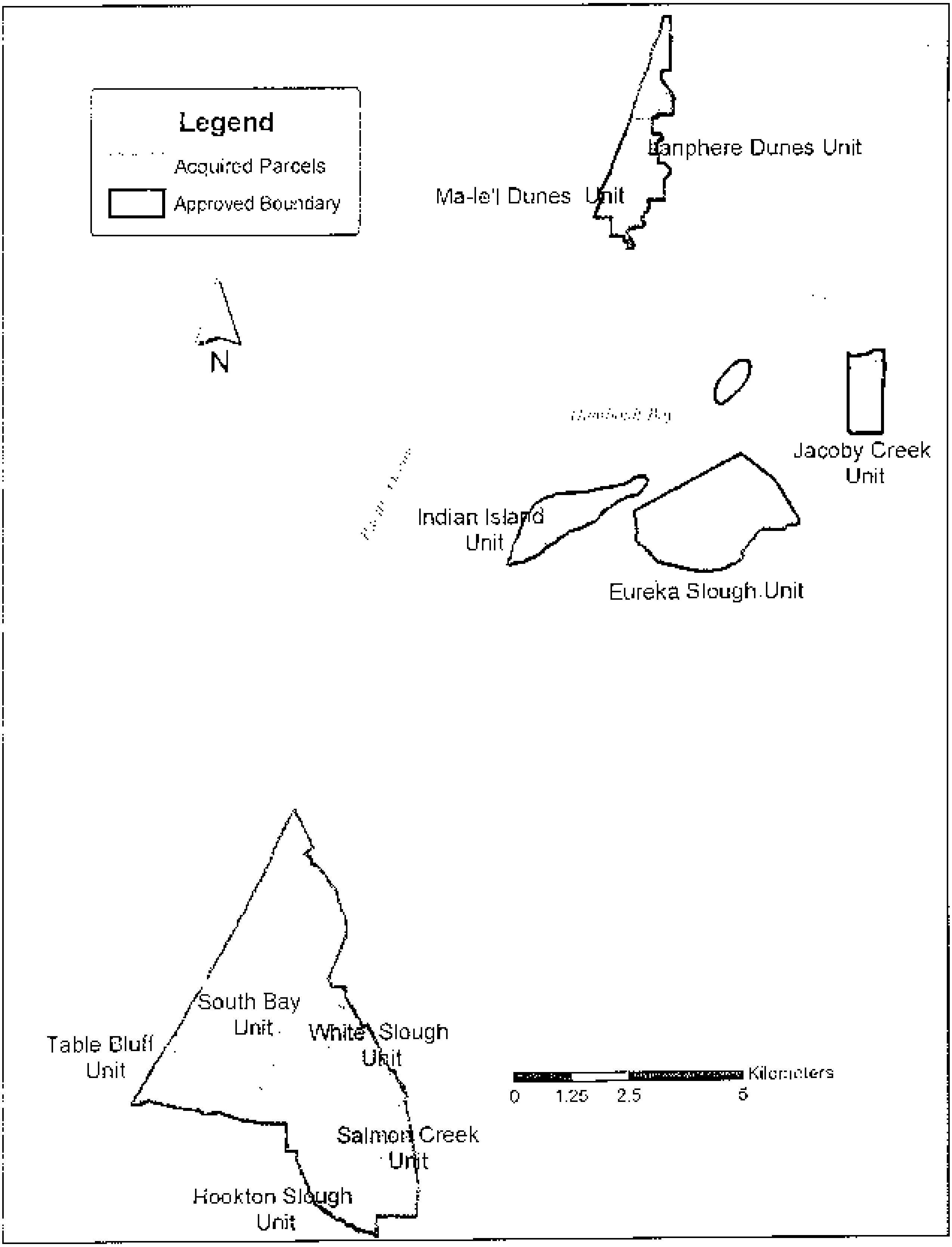


3,000 1,500 0 3,000 Meters

Produced at the Lanphere Dunes Unit, Humboldt Bay National Wildlife Refuge
Land Status Current to 1986, Map date 4/25/05
Data sources: Wetland boundary: U.S. Fish and Wildlife Service National Wetland Inventory;
Dune boundary: US Fish and Wildlife Service, Humboldt Bay NWR 2003.

Approved Boundary and Acquired Parcels

Humboldt Bay National Wildlife Refuge 2005



Vascular Plants of Humboldt Bay Dunes and Wetlands

Compiled by Gordon Leppig and Andrea Pickart

Published by: U.S. Fish and Wildlife Service and California Department of Fish and Game
April 2005 Release 1.1

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Aceraceae					
Acer macrophyllum Pursh	FS		X		N
Agavaceae					
Cordyline australis Hook. F.	FM, BM				E
Aizoaceae					
Carpobrotus chilensis Molina	DM	X			E
Carpobrotus edulis L.	DM	X			E, I
Alismataceae					
Alisma lanceolatum With.	FM		X		E
Alisma plantago-aquatica L.	FM		X		N
Anacardiaceae					
Toxicodendron diversilobum Torrey & A. Gray	CDF	X	X		N
Apiaceae					
Angelica lucida L.	BM, SM		X	X	N, C
Anthriscus caucalis M. Bieb	DM	X			E
Cicuta douglasii (DC.) J. Coulter & Rose	FM		X		N
Conium maculatum L.	RF, AW		X		I
Daucus carota L.	AW	X	X		I
Daucus pusillus Michaux	DM	X	X		N
Foeniculum vulgare Miller	AW, FM, SW	X	X		I
Glehnia littoralis (A. Gray) Miq. ssp. *leiocarpa* (Mathias) Hultén	DM	X			N, C
Heracleum lanatum Michaux	FM, AW		X		N
Hydrocotyle ranunculoides L.f.	FM		X		N
Lilaeopsis occidentalis J. Coulter & Rose	BM, SW		X	X	N
Oenanthe sarmentosa J.S. Presl	FM, BM, FS, RF		X		N
Sanicula arctopoides Hook. & Arn.	DM	X	X		N
Sanicula crassicaulis DC.	CDF	X	X		N
Torilis arvensis (Hudson) Link	CDF	X	X		E
Apocynaceae					
Vinca major L.	DM, FM, CDF, DS	X	X		E, I
Aquifoliaceae					
Ilex aquifolium L.	CDF	X	X		E, I
Araceae					
Dracunculus vulgaris Schott	BM, FM		X		E, I
Lysichiton americanum Hultén & St. John	RF, FS		X		N
Zantedeschia aethiopica (L.) Sprengel	FM, DM, DS	X	X		E
Araliaceae					
Hedera helix L.	CDF, RF	X	X		E, I
Asteraceae					
Achillea millefolium L.	DM, CDF	X	X		N
Ambrosia chamissonis (Less.)	DM, DS	X			N

Species	Habitat (specific) (see codes)	Habitat (broad) ED	PW	EW	Status
Anaphalis margaritacea (L.) Benth. & Hook.	CDF, DM	X	X		N
Anthemis arvensis L.	DM				E
Anthemis cotula L.	AW, FM		X		E, I
Arctotheca calendula (L.) Levyns	CDF,FS	X	X		E,I
Artemisia pycnocephala DC.	DM	X			N
Aster chilensis Nees	SW, BM, FM		X		N
Baccharis douglasii DC.	BM, FM		X	X	N
Baccharis pilularis DC.	DM, AW, BM, FM/S R	X	X	X	N
Bellis perennis L.	AW		X		E
Bidens cernua L. var. *cernua*	FM, BM		X		N
Chamomilla suaveolens (Pursh) Rydb.	AW, CDF, R	X	X		E
Chrysanthemum segetum L.	DM	X			E, I
Cichorium intybus	AW		X		E
Cirsium arvense (L.) Scop.	AW		X		E, I
Cirsium vulgare (Savi) Ten.	SW, DM, AW, FM		X		E
Conyza canadensis (L.) Cronq.	DM, CDF, AW	X	X		E, I
Conyza bilbaoana E.J. Remy	CDF, DM, AW	X	X		E
Cotula australis (Sieber) Hook. f.	DM, DS	X			
Cotula coronopifolia L.	BM, SM		X	X	E
Crepis capillaris (L.) Wallr.	AW		X		E,I
Erechtites glomerata (Poiret) DC.	DM, SW, FM	X	X		E
Erechtites minima (Poiret) DC.	CDF, DM, BM, FM	X	X		E, I
Erigeron glaucus Ker-Gawler	DM, DS	X			N
Gnaphalium purpureum L.	DM	X			N
Gnaphalium palustre Nutt.	SW, DM, AW	X	X		N
Gnaphalium stramineum Kunth.	DM, SW, AW	X	X		N
Grindelia stricta DC. var. *stricta*	SM, BM			X	N
Hesperevax sparsiflora (A. Gray) E. Greene var. *brevifolia*	DM	X			N, C
Hieracium albiflorum Hook.	CDF	X			N
Hypochaeris glabra L.	FM, DM, SW	X	X		E
Hypochaeris radicata L.	DM, CDF, AW	X	X		E
Jaumea carnosa (Less.) A. Gray	SM			X	N
Lapsana communis L.	RF		X		E
Layia carnosa (Nutt.) Torrey & A. Gray	DM	X			C
Leontodon taraxacoides (Villars) Mérat ssp. *taraxacoides*	SW, DM, BM, FM, DS	X	X		E
Lessingia filaginifolia (Hook & Arn.)	DM	X			N
Leucanthemum vulgare Lam.	FM, DM	X	X		E, I
Madia sativa Molina	SW, BM, DM	X	X		N
Petasites frigidus (L.) Fries var. *palmatus* (Aiton) Cronq.	RF		X		N
Picris echioides L.	FM, CDF	X	X		E, I
Senecio vulgaris L.	DM, DS	X			E
Senecio elegans L.	DM, DS	X			E, I
Senecio hydrophilus Nutt.	SW		X		N
Senecio jacobaea L.	BM	X	X		E,I
Senecio mikanioides Walp. (Delairea odorata)	DM, FS	X	X		E
Senecio sylvaticus L.	CDF	X			E
Silybum marianum (L.) Gaertner	AW		X		E, I
Solidago canadensis L. ssp. *elongata* (Nutt.) Keck	BM		X		N

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Solidago spathulata DC. ssp. *spathulata*	DM, CDF	X			N
Soliva sessilis Ruiz & Pavon	DM, CDF	X			E, I
Sonchus oleraceus L.	DM, AW	X	X		E, I
Tanacetum camphoratum Less.	DM	X			N
Taraxacum officinale Wigg.	AW		X		E
Azollaceae					
Azolla filiculoides Lam.	FM, SW, OW		X		N
Azolla mexicana C. Presl	OW, FM		X		N
Betulaceae					
Alnus rubra Bong.	RF, FS, SW		X		N
Blechnaceae					
Boraginaceae					
Amsinckia spectabilis Fischer & C. Meyer var. *spectabilis*	DM	X		X	
Borago officinalis L.	AW		X		E
Cryptantha leiocarpa (Fischer & C. Meyer) E. Greene	DM	X			N
Myosotis discolor Pers.	AW		X		E
Symphytum asperum Lepechin	AW		X		E
Brassicaceae					
Barbarea vulgaris R. Br.	AW		X		E
Brassica rapa L.	AW, FM		X		E
Cakile edentula (Bigelow) Hook.	DM	X			E
Cakile maritima Scop.	DM	X			E
Capsella bursa pastoris (L.) Medikus	DM, DS, AW	X	X		E
Cardamine oligosperma Torrey & Gray	DM, AW, DS, SW	X	X		N
Coincya monensis (L.) Greuter &Burdet	DM	X			E,I
Coronopus didymus	SW		X		
Draba verna L.	DM, SW	X	X		N
Erysimum menziesii (Hook) ssp. *eurekense* R.A. Price	DM	X			N, C
Hirschfeldia incana (L.) Lagr.-Fossat	DM, AW	X	X		E,I
Lepidium nitidum Torrey & A. Gray var. *nitidum*	DM	X			N
Lobularia maritima (L.) Desv.	DS	X			E
Raphanus raphanistrum L.	DM, AW, RF	X	X		E
Rorippa nasturtium-aquaticum (L.) Hayek	FM, RF		X		N
Sisymbrium officinale L.	AW, CDF	X	X		E, I
Callitrichaceae					
Callitriche stagnalis Scop.	OW, FM		X		E
Caprifoliaceae					
Linnaea borealis L. var. *longiflora* Torrey	CDF	X			E
Lonicera hispidula Douglas var. *vacillans* A. Gray	CDF	X			N
Lonicera involucrata (Richardson) Banks var. *ledebourii* (Eschsch.) Jepson	CDF, FS, RF	X	X		N
Sambucus racemosa L.	RF, CDF, FS	X	X		N
Caryophyllaceae					
Cardionema ramosissimum (J. A. Weinm.) Nelson & J.F. Macbr.	DM, DS	X			N
Cerastium glomeratum Thuill	DM, DS, SW, AW, FM	X	X		E
Polycarpon tetraphyllum (L.)L.	DM	X			E
Sagina procumbens L.	AW		X		E
Silene gallica L.	DM	X			E
Spergula arvensis L. ssp. *arvensis*	DM, DS, FM	X	X		N

Species	Habitat (specific) (see codes)	Habitat (broad) CD	PW	EW	Status
Spergularia canadensis (Pers.) G. Don var. *occidentalis* R. Rossbach	BM, SM		X	X	N, C
Spergularia marina (L.) Griseb.	SM, BM, AW		X	X	N
Spergularia macrotheca (Hornem.) Heynh. var. *macrotheca*	SM, SW		X	X	N
Spergularia rubra (L.)J.S. Presl. & C. Presl.	BM, AW		X		E
Stellaria calycantha (Ledeb.) Bong.	BM, SW		X		N
Stellaria longipes Goldie. var. *longipes*	FM		X		
Stellaria media L. Villars	AW, DM, FM, DS, SW	X	X		E
Chenopodiaceae					
Atriplex leucophylla (Moq.) D. Dietr.	DM, SM	X		X	N
Atriplex patula L.	BM, SM			X	N
Atriplex triangularis Willd.	BM, SM, AW		X	X	E, I
Chenopodium album L.	DM, CDF, BM	X	X		E, I
Chenopodium ambrosioides L.	R, CDF	X	X		E
Chenopodium foliosum (Moench) Asch.	BM, AW		X	X	E, I
Chenopodium rubrum L.	BM/MF		X	X	N?
Salicornia bigelovii Torrey	SM			X	N, I
Salicornia virginica L.	SM, BM, AW		X	X	N
Convolvulaceae					
Calystegia soldanella (L.) R. Br.	DM	X			N
Calystegia silvatica (Kit.) griseb. ssp. *Disjuncta* Brummitt	RF, FS, AW		X		E, I
Convolvulus arvensis L.	AW, FM		X		E
Crassulaceae					
Crassula connata (Ruiz Lopez & Pavon)	DM				N
Cucurbitaceae					
Marah oreganus (Torrey & A. Gray) Howell	CDF, RF	X	X		N
Cupressaceae					
Cupressus macrocarpa Gordon	CDF, AW, DM	X	X		E
Thuja plicata D. Don	RF		X		N
Cuscutaceae					
Cuscuta salina Engelm. var. *major* Yuncker	SM, BM		X	X	N
Cyperaceae					
Carex cusickii Mackenzie	FS		X		N
Carex deweyana Schwein. ssp. *leptopoda* (Mackenzie) Calder & R. Taylor	CDF				N
Carex lyngbyei Hornem	BM, SM		X	X	N, C
Carex obnupta L. Bailey	SW, FM		X		N
Carex pansa L. Bailey	SW, DM	X	X		N
Cyperus eragrostis Lam.	FM, SW, BM, DM, R	X	X	X	N
Eleocharis macrostachya Britton	SW, FM		X		N
Eleocharis pachycarpa Desv.	FM		X		E
Eleocharis parvula (Roemer & Schultes) Link	FM		X		N C
Scirpus acutus Bigelow var. *occidentalis* (S. Watson) Beetle	FM, BM		X		N
Scirpus americanus Pers.	FM, BM		X	X	N
Scirpus cernuus (Roemer & Schultes) Vahl.	SW, FM, BM, SM		X	X	N
Scirpus microcarpus C. Presl	FM, RF		X		N
Scirpus maritimus L.	BM		X	X	N
Scirpus pungens Vahl	FM, BM		X	X	N
Scirpus robustus Pursh	BM		X	X	N
Scirpus setaceus L.	FS, FM		X		N

Species	Habitat (specific) (see codes)	Habitat (broad) CD	PW	EW	Status
Dennstaedtiaceae					
Pteridium aquilinum (L.) Kuhn var. *pubescens* L.	CDF, DM, DS	X			N
Dipsicaceae					
Dipsacus fullonum L.	AW, FM		X		E, I
Dryopteridaceae					
Dryopteris arguta (Kaulf.) Maxon	RF, FM		X		
Polystichum munitum (Kaulf.) C. Presl	CDF, RF	X	X		N
Equisetaceae					
Equisetum arvense L.	FM, RF		X		N
Equisetum laevigatum A. Braun					N
Equisetum telmateia Ehrh. ssp. *Braunii* (Milde) R.L.Hauke	FM, RF, AW, CDF	X	X		N
Ericaceae					
Allotropa virgata A. Gray	CDF	X			N
Arbutus menziesii Pursh	CDF	X			N
Arctostaphylos columbiana Piper	CDF	X			N
Arctostaphylos uva-ursi (L.) Sprengel	CDF, DM	X			N
Arctostaphylos nissenana E. Greene	CDF	X			N
Chimaphila umbellata (L.) Bartram	CDF	X			N
Erica lusitanica Rudolphi	FM/FS		X		E, I
Gaultheria shallon Pursh	CDF	X			N
Vaccinium ovatum Pursh	CDF, FS	X	X		N
Fabaceae					
Acacia dealbata Link	FS, CDF	X	X		E, I
Astragalus pycnostachyus A. Gray var. *pycnostachyus*	SM				N, C, PX
Cytisus scoparius (L.) Link	CDF, RF, FS, DS, SW	X	X		E, I
Genista monspessulana (L.) L. Johnson	FS		X		E, I
Lathyrus latifolius (L.)	BM, DM	X	X	X	E
Lathyrus littoralis (Nutt.) Endl.	DM	X			N
Lathyrus palustris L.	FS		X		N, C
Lotus corniculatus L.	FM, SW, AW		X		E, I
Lotus formosissimus E. Greene	FM, FS		X		N
Lotus micranthus Benth.	DM, SW	X	X		E
Lotus purshianus (Benth.) Clements & E.G. Clements var. *purshianus*	SW, DM	X	X		N
Lotus uliginosus Schk.?	AW		X		E
Lupinus arboreus Sims	DM, DS	X			N, I
Lupinus bicolor Lindley	DM	X			N
Lupinus littoralis Douglas	DM	X			N
Lupinus polyphyllus Lindley	AW		X		N
Lupinus rivularis Lindley	AW, DM, DS	X	X		N
Medicago polymorpha L.	DS, BM, DM	X	X		E
Melilotus alba Medikus	DM, DS	X			E
Melilotus officinalis (L.) Pall.	DM, DS	X			E
Trifolium arvense L.	DM, DS	X			E
Trifolium campestre Schreber	DM, DS	X			E
Trifolium dubium Sibth.	DM, DS, CDF, AW	X	X		E, I
Trifolium fragiferum L.	AW		X		E, I
Trifolium hirtum All.	DM, DS	X			E
Trifolium macraei Hook. & Arn.	DM	X			N
Trifolium microcephalum Pursh	DM	X			N

Species	Habitat (specific) (see codes)	Habitat (broad) CD	PW	EW	Status
Trifolium microdon Hook. & Arn.	DM	X			N
Trifolium repens L.	AW, SW		X		E, I
Trifolium subterraneum L.	SW, AW		X		E, I
Trifolium variegatum Nutt.	AW		X		N
Trifolium wormskioldii Lehm.	SW, AW, FM		X		N
Vicia benghalensis L.	DM, DS, BM	X	X	X	E, I
Vicia gigantea Hook.	FS, RF		X		N
Vicia hirsuta (L.) S.F. Gray	CDF, DM, DS	X			E
Vicia sativa L. ssp. *sativa*	FM, RF		X		E
Vicia sativa L. ssp. *nigra* (L.)	AW, DM		X		E, I
Vicia villosa Roth ssp. *villosa*	CDF	X			E, I
Garryaceae					
Garrya elliptica Lindley	CDF	X			N
Gentianaceae					
Centaurium davyi (Jepson) Abrams	BM			X	N
Centaurium muehlenbergii (Griseb.)	FM, SW		X		N
Geraniaceae					
Erodium botrys (Cav.) Bertol.	DS, DM	X			E
Erodium cicutarium (L.) L'Hér.	AW, DM	X	X		E
Geranium dissectum L.	AW		X		E
Geranium molle L.	AW, DM, DS	X	X		E
Geranium robertianum L.	RF, FS		X		E, I
Grossulariaceae					
Ribes divaricatum Douglas var. *pubiflorum* Koehne	CDF	X			N
Ribes laxiflorum Pursh	CDF	X			N
Ribes sanguineum Pursh var. *glutinosum* (Benth)	CDF, FS, RF	X	X		N
Guttiferae					
Hypericum anagalloides Cham. & Schdl.	AW, FM		X		N
Hypericum perforatum L.	DM, DS, BM	X	X	X	E, I
Hippuridaceae					
Hippuris vulgaris L.	FM		X		N
Hydrocharitaceae					
Egeria densa Planchon	OW		X		E, I
Iridaceae					
Crocosmia xcrocosmiiflora (Burb. & Dean) N.E. Br.	DM, DS, FM	X	X		E, I
Iris douglasiana Herbert	CDF, FM	X	X		N
Iris germanica L. var. *florentina* (L.) Dykes	DS	X			E
Iris pseudacorus L.	FM		X		E
Sisyrinchium bellum S. Watson	FM		X		
Sisyrinchium californicum (Ker Gawler) Dryander	SW, FM		X		N
Juncaceae					
Juncus ambiguus Guss.	BM, SM		X	X	N
Juncus balticus Willd.	SM, BM		X	X	N
Juncus bolanderi Engelm.	AW, FM		X		N
Juncus breweri Engelm.	SW, DM	X	X		N
Juncus bufonius L. var. *bufonius*	SW, AW, FM		X		N
Juncus bufonius L. var. *occidentalis* F.J. Herm	DM, SW	X	X		N
Juncus effusus L. var. *brunneus* Engelm.	AW, FM		X		N
Juncus effusus L. var. *pacificus* Fern. & Wieg.	AW		X		

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Juncus ensifolius Wikstrom	AW, FM		X		N
Juncus falcatus E. Meyer var. *falcatus*	SW	X			N
Juncus lesueurii Bolander	BM, SM		X	X	N
Luzula comosa E. Meyer	CDF, DM, DS	X			N
Luzula subcongesta (S. Watson) Jepson					N
Juncaginaceae					
Lilaea scilloides (Poiret) Hauman	SM, BM			X	N
Triglochin concinna var. *concinna* Burtt Davy	SM			X	N
Triglochin maritima L.	BM, SM		X	X	N
Triglochin striata Ruiz Lopez & Pavon	BM		X		N
Lamiaceae					
Lamium amplexicaule L.	AW		X		E
Lamium purpureum L.	FM, DM, DS	X	X		E
Mentha pulegium L.	SW, AW, FM		X		E, I
Prunella vulgaris L. ssp. *vulgaris*	AW		X		E
Satureja douglasii (Benth.) Briq.	CDF	X			N
Stachys chamissonis Benth.	RF, FS		X		N
Stachys ajugoides Benth. var. *rigida* Jepson & Hoover	FM, BM, RF, SW, AW		X		N
Lemnaceae					
Lemna minuscula Herter	OW, FM		X		N
Liliaceae					
Allium triquetrum L.	FS, FM		X		E
Amaryllis belladonna L.	DS, AW	X	X		E
Brodiaea coronaria (Salisb.) Engl.	DM, CDF	X			N
Dichelostemma capitatum (Benth.)A.W. Wood	DM , CDF	X			N
Fritillaria affinis (Schultes) Sealy var. *affinis*	CDF	X			N
Lilium occidentale Purdy	FM				N, C, PX
Maianthemum dilatatum (Alph. Wood) Nelson & J.F. Macbr.	CDF, RF	X	X		N
Muscari botryoides (L.) Miller	CDF	X			E
Narcissus pseudonarcissus	AW, DS, SW	X	X		E
Triteleia hyacinthina (Lindley) E. Greene	DM, CDF	X			N
Linaceae					
Linum bienne Miller	DM, FM, BM	X	X		E
Lythraceae					
Lythrum hyssopifolium L.	SW, AW, FM		X		E, I
Malvaceae					
Malva neglecta Wallr.	AW		X		E
Myrtaceae					
Eucalyptus globulus Labill.	RF, AW, CDF		X		E
Myricaceae					
Myrica californica Cham.	CDF, RF, FS, SW	X	X		N
Nyctaginaceae					
Abronia latifolia Eschsch	DM	X			N
Abronia umbellata Lam.ssp. *breviflora* (Standley) Munz	DM	X			N, C
Nymphaeaceae					
Nuphar lutea (L.) Sibth. & Sm. ssp. *polysepala* (Engelm.) E. Beal	FM		X		N
Onagraceae					
Camissonia cheiranthifolia (Sprengel) Raim ssp. *cheiranthifolia*	DM	X			N

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Camissonia strigulosa (Fischer & C. Meyer) Raven	CDF, DM	X			N
Clarkia davyi (Jepson) Harlan Lewis & M. Lewis	DM, DS	X			N
Clarkia purpurea (Curtis) Nelson & J.F. Macbr ssp. *quadrivulnera* (Douglas) Harlan Lewis & M. Lewis.	SW		X		N
Epilobium angustifolium L. ssp. *circumvagum* Mosq.	FM, RF		X		N
Epilobium ciliatum Raf. ssp. *watsonii* (Barbey) P. Hoch & Raven	SW, FM, BM, AW		X	X	N
Fuchsia magellanica Lam.	FS		X		E
Oenothera glazioviana Micheli	DM, DS, FM	X	X		E, I
Ophioglossaceae					
Botrychium multifidum (S. Gmelin) Rupr.	FM, FS		X		N
Orchidaceae					
Calypso bulbosa (L.) Oakes	CDF	X			N
Corallorhiza maculata Raf.	CDF	X			N
Goodyera oblongifolia Raf.	CDF	X			N
Listera cordata (L.)	CDF	X			N
Piperia elegans (Lindley) Rydb.	SW, CDF	X	X		N
Piperia transversa Suksd.	CDF	X			N
Spiranthes romanzoffiana Cham.	SW, CDF	X	X		N
Oxalidaceae					
Oxalis corniculata L.	FS, DS	X	X		E
Oxalis pes-caprae L.	DM, DS	X			E, I
Oxalis rubra A. St. Hil.	DM, DS	X			E, I
Papaveraceae					
Eschscholzia californica Cham.	AW, DM	X	X		N
Fumaria officinalis (L.)	AW		X		E
Platystemon californicus Benth.	DM, DS	X			N
Pinaceae					
Abies grandis (Douglas) Lindley	CDF, RF	X	X		N
Picea sitchensis (Bong.) Carriere	CDF, FS, SW	X	X		N
Pinus contorta ssp. *contorta* Loudon	CDF, SW	X	X		N
Pinus radiata D. Don	AW, CDF	X	X		E
Pseudotsuga menziesii (Mirbel) Franco var. *menziesii*	CDF				N
Pittosporaceae					
Pittosporum tenuifolium Gaertner	CDF	X			E, I
Plantaginaceae					
Plantago coronopus L.	DM, SW	X	X		E
Plantago erecta E. Morris	DM, SW, DS	X	X		N
Plantago lanceolata L.	CDF, DM, AW	X	X		E
Plantago major L.	SW, AW, FM		X		E
Plantago maritima L.	SM			X	N
Plantago truncata Cham. ssp. *firma* (Kunze) Pilger	AW		X		E
Plumbaginaceae					
Armeria maritima (Miller) Willd. ssp. *californica* (Boiss.)	DM, DS	X			N
Limonium californicum (Boiss.) A.A. Heller	SM			X	N
Poaceae					
Agropyron cf. repens					
Agrostis exarata Trin.	AW, BM		X		N
Agrostis hallii Vasey	CDF	X			N
Agrostis microphylla Steudel	SW	X			N

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Agrostis stolonifera L.	BM, AW		X		E, I
Agrostis viridis Gouan	AW, BM	X	X		E
Aira praecox L.	DM, DS, SW	X	X		E
Aira caryophyllea L.	DM, DS, SW	X	X		E
Alopecurus aequalis Sobol.	FM		X		N
Alopecurus geniculatus L.	FM, AW		X		N
Alopecurus pratensis L.	AW		X		E
Ammophila arenaria (L.) Link	DM, DS	X			E, I
Ammophila breviligulata Fern.	DM				E, I,PX
Anthoxanthum odoratum L.	DM, DS, SW, AW, FS	X	X		E
Avena fatua L.	AW, DM		X		E
Avena sativa L.	AW		X		E
Briza maxima L.	DM, DS, SW	X	X		E
Briza minor L.	SW, FM		X		E
Bromus carinatus Hook & Arn.	DM, DS	X			N
Bromus diandrus Roth	DM, DS	X			E, I
Bromus hordeaceus L.	DM, BM	X	X	X	E, I
Calamagrostis nutkaensis (C. Presl) Steudel	CDF, BM	X	X		N
Cortaderia jubata (Lemoine) Stapf	DM, SW, CDF, RF	X	X		E, I
Cortaderia selloana (Schultes) Asch. & Graebner	DM	X			E, I
Cynodon dactylon (L.) Pers.	DM, DS, AW	X	X		E
Cynosurus echinatus L.	DM, DS	X			E
Dactylis glomerata L.	CDF, AW	X	X		E
Deschampsia cespitosa (L.) Beauv. var. *holciformis* (C. Presl) W.E. Lawr.	BM,SM		X	X	N
Distichlis spicata (L.) E. Greene	SM, BM, SW, AW		X	X	N
Echinochloa crus-galli (L.) P. Beauv.	FM		X		E
Elymus glaucus Buckley ssp. *jepsonii* (Burtt Davy) Gould	CDF	X			N
Festuca arundinacea Schreber	FM, BM, AW		X		E
Festuca occidentalis	CDF	X			N
Festuca rubra L.	DM	X			N
Glyceria occidentalis (Piper) J.C. Nelson	FM, RF		X		N
Hierochloe occidentalis Buckley	CDF	X			N
Holcus lanatus L.	AW, SW, FM, CDF	X	X		E
Hordeum brachyantherum Nevski ssp. *brachyantherum*	BM			X	N
Hordeum jubatum L.	BM, SM		X	X	N
Hordeum marinum Hudson ssp. *gussoneanum* (Parl.) Thell.	AW, SM		X	X	E
Hordeum murinum L. ssp. *glaucum* (Steudel) Tzvelev	DM				E
Hordeum murinum L. ssp. *murinum* ?	DM, DS	X			E
Leymus mollis (Trin.) Pilger ssp. *mollis*	DM	X			N
Leymus xvancouverensis (Vasey) Pilger	AW, DM, BM	X	X	X	N
Lolium multiflorum Lam.	AW, RF		X		E
Lolium perenne L.	AW, CDF	X	X		E
Parapholis incurva (L.) C.E. Hubb.	SM			X	E
Parapholis strigosa (Dumort) C.E. Hubb.	SM			X	E
Phalaris arundinacea L.	FM, AW		X		E, I
Phragmites australis (Cav.) Steudel	BM, SM		X	X	E, I
Pleuropogon californicus (Nees) Vasey	AW		X		N
Poa annua L.	CDF, DM, DS, AW	X	X		E

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Poa confinis Vasey	DM	X			N
Poa macrantha Vasey	DM	X			N
Poa pratensis L. ssp. *pratensis*	CDF	X			E
Polypogon maritimus Willd.	SW, FM		X		E, I
Polypogon monspeliensis (L.) Desf.	SW, FM		X		E, I
Puccinellia pumila (Vasey) A. Hitchc. ?	SM			X	N, C
Spartina alterniflora Lois.	SM				E, I, PX
Spartina densiflora Brongn.	SM, BM		X	X	E, I
Trisetum canescens Buckley	CDF	X			N
Vulpia bromoides (L.) S.F. Gray	DM, DS	X			E
Vulpia myuros (L.) C. Gmelin	CDF, R	X			E
Zea mays L.	AW		X		E
Polemoniaceae					
Gilia millefoliata Fischer & C. Meyer	DM	X			N, C
Navarretia squarrosa (Eschsch.) Hook. & Arn.	DM, AW	X	X		N
Polygonaceae					
Eriogonum latifolium Smith	DM	X			N
Polygonum arenastrum Boreau	AW		X		E
Polygonum hydropiperoides Michaux	FM		X		N
Polygonum lapathifolium L.	FM, AW		X		N
Polygonum paronychia Cham. & Schldl.	DM, DS	X			N
Polygonum persicaria L.	AW, FM, BM, RF		X		E
Rumex acetosella L.	DM, DS, SW, CDF, RF	X	X		E
Rumex crispus L.	FM, SW, AW, BM		X	X	E
Rumex occidentalis S. Watson	FM, BM		X		N
Rumex salicifolius J.A. Weinm. var. *crassus* (Rech.f.) J. Howell	SW, BM		X	X	N
Rumex salicifolius J.A. Weinm. var. *transitorius* (Rech.f.) J. Hickman	FM, BM		X		N
Polypodiaceae					
Athyrium filix-femina (L.) Roth var. *cyclosorum* Rupr.	CDF, FS	X	X		N
Polypodium calirrhiza S. Whitmore & A. R. Smith	CDF, DS	X			N
Polypodium scouleri Hook. & Grev.	CDF	X			N
Portulacaceae					
Calandrinia ciliata (Ruiz Lopez & Pavón) DC.	DM, DS, SW	X	X		N
Claytonia exigua Torrey & A. Gray ssp. *exigua*	DM, DS	X			N
Claytonia perfoliata Willd. ssp. *perfoliata*	DM, DS, RF	X	X		N
Claytonia rubra (Howell) Tidestrom ssp. *depressa* (A. Gray) John M. Miller & Chambers	DM				N
Potamogetonaceae					
Potamogeton nodosus Poiret (*x natans*)	OW		X		N
Potamogeton pectinatus L.	OW		X		N
Ruppia maritima L.	SP			X	N
Primulaceae					
Anagallis arvensis L.	FM, DM, BM, SW	X	X	X	E
Glaux maritima L.	BM, SM		X	X	N
Pteridaceae					
Pentagramma triangularis (Kaulf.) G. Yatskievych, M.D. Windham & E. Wollenweber ssp. *triangularis*	CDF, DM	X			N
Ranunculaceae					

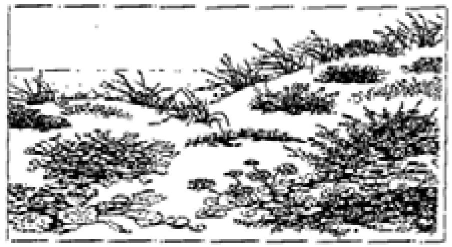
Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Myosurus minimus L.	AW		X		E
Ranunculus muricatus L.					
Ranunculus repens L.	FM, RF, AW		X		E
Rhamnaceae					
Rhamnus purshiana DC.	CDF	X			N
Rosaceae					
Aphanes occidentalis (Nutt.) Rydb.	DM, SW	X	X		N
Crataegus monogyna Jacq.	AW		X		E, I
Cotoneaster franchetii Boiss.	CDF	X			E, I
Fragaria chiloensis (L.) Duchesne	DM, CDF	X			N
Holodiscus discolor (Pursh.) Maxim.	FS		X		N
Malus fusca (Raf.) C. Schneider	RF, CDF	X	X		N
Malus sylvestris Miller	CDF, FS	X	X		
Oemleria cerasiformis (Hook. & Arn.) J.W. Landon	RF		X		N
Potentilla anserina L. ssp. *pacifica* (Howell) Rousi	SW, BM, FM		X	X	N
Rubus discolor Weihe & Nees	FS, SW, R, AW,		X		E, I
Rubus parviflorus Nutt.	FS		X		N
Rubus spectabilis Pursh	RF, FS		X		N
Rubus ursinus Cham. & Schdl.	CDF, RF, FS, DM, DS, SW	X	X		N
Spiraea douglasii Hook.	FM, FS, AW		X		N
Rubiaceae					
Galium aparine L.	CDF, RF, BM, FM, AW	X	X		N
Galium divaricatum Lam.	FM		X		E
Galium trifidum L. var. *pacificum* Wieg.	BM		X	X	N
Galium triflorum Michaux	CDF	X			N
Salicaceae					
Populus balsamifera L. ssp. *trichocarpa* (Torry & A. Gray) Brayshaw	FS, RF		X		N
Salix alba L.	FS		X		E
Salix hookeriana Hook.	SW, FS, DS	X	X		N
Salix lasiolepis Benth.	FS, RF		X		N
Salix lucida Muhlenb. ssp. *lasiandra* (Benth.) E. Murray	FS, RF		X		N
Salix sitchensis Bong.	FS		X		N
Saxifragaceae					
Tellima grandiflora (Pursh) Lindley	RF		X		N
Tolmiea menziesii (Pursh) Torrey & A. Gray	RF		X		N
Scrophulariaceae					
Bellardia trixago (L.) All.	FM, DM	X	X		E, I
Castilleja ambigua Hook & Arn.ssp. *humboldtiensis* (Keck) Chuang & Heckard	SM, AW		X	X	N, C
Castilleja exserta (A.A. Heller) Chuang & Heckard ssp. *latifolia* (S. Watson)	DM	X			N
Cordylanthus maritimus Benth. ssp. *palustris* (Behr) Chuang & Heckard	SM			X	N, C
Digitalis purpurea L.	FM		X		E, I
Linaria canadensis (L.) Dum.-Cours.	DM	X			E
Mimulus guttatus DC.	FM, AW, RF		X		N
Parentucellia viscosa (L.) Caruel	SW, FM, AW		X		E, I
Scrophularia californica Cham. & Schldl.	DS, SW, CDF	X	X		N

Species	Habitat (specific) (see codes)	Habitat (broad) UD	PW	EW	Status
Triphysaria eriantha (Benth.) Chuang & Heckard ssp. *eriantha*	DM	X			N
Triphysaria versicolor Fischer & C. Meyer ssp. *versicolor*	AW		X		N
Triphysaria pusilla (Benth.) Chuang & Heckard	DS, DM, CDF	X			N
Veronica americana (Raf.) Schein.	FM		X		N
Veronica persica Poiret	AW		X		E
Solanaceae					
Solanum americanum Miller	FM, CDF	X	X		N
Solanum aviculare Forst. F.	CDF	X			E, I
Solanum douglasii Dunal	FS		X		N
Solanum nigrum L.	CDF, AW, FM	X	X		E, I
Taxodiaceae					
Sequoia sempervirens (D. Don) Endl.	AW, RF		X		N
Typhaceae					
Sparganium eurycarpum Engelm. ssp. *eurycarpum*	BM		X	X	N
Typha latifolia L.	SW, BM, FM		X	X	N
Urticaceae					
Urtica dioica L. ssp. *gracilis* (Aiton) Selander	RF, AW, FM		X		N
Valerianaceae					
Plectritis congesta (Lindley) A. DC.	DM, SW, DS	X	X		N
Plectritis brachystemon Fischer & C. Meyer	AW		X		N
Zosteraceae					
Zostera japonica Aschers. & Graebn.	MF			X	E, I
Zostera marina L.	MF			X	N

Status: Conservation concern (C); Exotic (E); Invasive (I); California Native (N); Presumed extirpated (PX).
Broad Habitat: Upland dune (UD), Palustrine wetland (PW), Estuarine wetland (EW).
Specific Habitat: Dune mat (DM), Dune scrub (DS), Dune swale (SW), Coniferous dune forest (CDF), Riparian forest (RF), Freshwater swamp (FS), Freshwater marsh (FM), Open water (OW), Brackish marsh (BM), Salt marsh (SM), Salt panne (SP), Mudflat (MF) Agricultural wetland (AW).

* This vascular plant list for Humboldt Bay dunes and wetlands is still in progress. It is based on collections made by the authors primarily between 2001 and 2005. Dissemination of the list prior to completion is being undertaken in part to make the information accessible earlier, but also to motivate feedback from interested amateur and professional botanists who can contribute to its accuracy and completeness. A major goal of this interim release is to assist agencies and other land managers tasked with the monitoring and management of wetland and dune vegetation. We encourage feedback on the list's content. Please email comments to andrea_pickart@fws.gov or gleppig@dfg.ca.gov. Nomenclature follows the Jepson Manual, Higher Plants of California (U.C. Press 1993).

AmeriCorps Watershed Stewards Project • California State Coastal Conservancy • California Conservation Corps • California Department of Fish and Game • California Department of Parks and Recreation • California Native Plant Society, Northcoast Chapter • Table Bluff Reservation •



THE DUNES FORUM

Center for Natural Lands Management • Friends of the Dunes • Humboldt Bay Harbor, Recreation, and Conservation District • Humboldt Coastal Coalition • Manila Community Services District • National Park Service • Surfriders Foundation • U.S. Bureau of Land Management • U.S. Fish and Wildlife Service • Beach and Dune Stewards

April 27, 2005

Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka CA 95502-1030

Dear Humboldt Bay Harbor District Commissioners:

This letter has been prepared by the Dunes Forum to provide input on the March 2005 draft Humboldt Bay Management Plan. As you are a member of the Dunes Forum, you are aware that the forum is a consortium of federal, state, tribal, and local agencies, private landowners, and community members who share a common concern for the protection and restoration of dune environments in Humboldt County. Active Harbor District attendance has been missed at the Dunes Forum meetings for some time; therefore, the forum felt a letter to communicate our concerns was in order.

The Forum suggests that the Harbor District do more than the legal minimum required by the Brown Act to promote participation by the public and other interested parties in formulating plans for the future management of Humboldt Bay. As the Harbor District is comprised of officials elected to manage this valuable public trust resource, these officials should better determine public needs and seek public visions for incorporation into the planning process. We firmly believe that early and continuing public involvement is likely to result in better planning for our valuable bay. The forum was disappointed with the speed and lack of public input sought regarding your recent effort to purchase property from Simpson; which has already created a perception that public comments are unwelcome, at least in the scoping or preliminary planning stages.

The forum also suggests that you demonstrate to the public that your intent is to promote needed bay developments without damage to the bay's crucial functions as a nursery for fish and shellfish, as well as a food source for migrating birds and other wildlife. It is our hope that the Harbor District will maintain their stated commitment to achieve this objective. Humboldt Bay provides great opportunities for future research, recreation, tourism, and aquaculture, all with associated economic gains, and we would like to see it continue to be the most pristine bay on the California coast, with the fewest possible unintended introductions of invasive species.

Finally, the District needs to continue to promote basic research that provides an accurate socio-economic and ecological baseline against which the effects of Humboldt Bay development can be measured. These measures will benefit the District in the long run, as well as the citizens that benefit directly or indirectly from the bay.

The Dunes Forum thanks you for providing this opportunity for public input during this important planning process.

Sincerely,

Tamara Gedik
Facilitator

The Dunes Forum is a coalition of landowners, community members, private organizations, and public agencies who share a concern for the coastal dunes of Humboldt and Del Norte Counties. Our mission is to promote a coordinated, regional, ecosystem management to conserve and restore these systems. Statements appearing under the letterhead of the forum generally reflect the consensus of participating individuals but do not necessarily represent the official positions of agencies on the masthead unless signed individually by an authorized representative of that agency.

April 28, 2005

Humboldt Bay Harbor District
P.O. Box 1030
Eureka, California 95502-1030
Fax: 707.443.0800

ATT: Jeff Robinson, Resource Specialist

RE: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners:

Thank you for the opportunity to comment on the March 2005 Draft Humboldt Bay Management Plan. We look forward to being involved in the public process and additional CEQA Review that will occur over the next few months, and feel confident that the final result will be a plan that will *"provide a comprehensive framework for balancing and integrating conservation goals and economic opportunities in a cooperative manner for the management of Humboldt Bay's resources."*

The Natural Resources Services Division of Redwood Community Action Agency (NRS) has the following comments:

Consistency and Clarity:
There needs to be a clear introduction to the policy section and how it is to be utilized. The reason for the bolded statements above the policy statements is unclear. Some are complete sentences, some are not, some are policy language, some are not. What exactly are these bolded statements and how do they relate to the goals and to the policy below them?

It is unclear why California Coastal Act is quoted under some Goals and Objectives in the Plan and not in others. For example, under 3.5.1 sections of the Act are quoted, yet in section 4 there are no such direct quotes. It would be good to stay consistent or to explain why there is not a consistent use of quoting the Coastal Act language.

The Plan states that the elements are equal in weight and there are no priorities (Section 1.1), yet in HWM-1 states 'Safe navigation in Humboldt Bay is a priority under this Plan'. In addition the second paragraph in the introduction to Recreation Section 4.0 specifically spells out that the "…policies under this section are meant to be applied as an overall set of guidelines…" This paragraph should also appear in the introduction to the Harbor and the Conservation policy sections to be consistent.

The wording in the Harbor-Related Land Use and Development section shows a greater level of detail than those in the Recreation and Conservation sections, and we hope that in subsequent drafts more specific language for these sections can be crafted.

Comments regarding Volume II - Section 3.0

II-3

- Public access sites map is missing public access sites in Eureka and Arcata, though such sites are shown for county, state and federally managed public access sites.
- Page 3-23: The existing Elk River Wildlife Sanctuary Trail is over a decade old. The City is pursuing a proposal for more extensive trail and public access amenity development north and southeast of the existing trail.

Comments regarding Volume III - Section 3.0

- HLU-1 change the wording to read '.. portions of Humboldt Bay that are designated for use as port-related or harbor related.'
- HLU-2 Why are federal agencies left out of the bolded statement? Also the wording of this policy could also be used for recreation facilities if the District is truly interested in maintaining public access to the Bay.
- HLU-4 South Bay should be removed and only King Salmon and Fields Landing used in the policy. The cost effectiveness of this policy is questionable.
- HLU-5 Why is this only a policy for Harbor Related land use. There should be a similar policy for both conservation and recreation.
- HFA-6 The discussion of the policy specifically identifies the institutions that are doing research and education regarding fish populations. We would like to see the same detail in other sections of the plan. There are many valid efforts going on in the bay regarding education, outreach, monitoring, recreation, planning, and the plan should be more specific and less vague about coordinating with these efforts.
- 3.6 Is there Coastal Act Language that could be used in this section? This section is inadequate as it does not discuss existing point source toxic sites and brownfields that have been identified in the bay. It also does not address urban runoff. There needs to be inclusion of working with entities that do public education on toxic pollution and coastal clean ups. HTM-1 could use similar language to HFA-3
- HTM-3 Need to include taking an active role in monitoring the progress involving spills to ensure that compensation is forthcoming, and that the public is kept informed of process. We still don't have compensation from the last oil spill!
- HRS-1 typo in the policy section ..simply should be simplify. The first sentence should not include the word watershed.

Comments regarding Volume III - Sections 4.0 and 5.0

NRS has completed on three fairly extensive Humboldt Bay planning projects for the State Coastal Conservancy that should be referenced in this plan more significantly (in Appendix H and additionally in policies, where appropriate). Two of these projects (the *Humboldt Bay Trails Feasibility Study* and the *Humboldt Bay Interpretive Signing Program*) were crafted and funded with the goal of serving the District's planning and coordination efforts and were shaped by Harbor District involvement. Though the District declined to participate in the *Humboldt Bay Watershed Salmon and Steelhead Conservation Plan* effort, document development was guided and final document approved by a multi-stakeholder group including interests such as agriculture, environment, landowners, timber industry, fishing, restoration and local, state and federal government representatives – it makes sense that the District Plan reference the effort as the primary guide for watershed restoration actions outside of and affecting District jurisdiction. This document should be included in the appendices.

We understand the District cannot permit every potential public access project addressed in the *Humboldt Bay Trails Feasibility Study*, however it is a much more comprehensive public access planning document that deserves reference as a tool for planning and prioritizing projects. For example, nothing in the District Plan would facilitate prioritization of public access projects around the bay, however a process like the Stuyvesant oil spill mitigation funds for public access improvements would be best served if it utilized a tool like the *Bay Trails Feasibility Study* to prioritize funding for public access projects.

The lack of functional reference to the *Interpretive Signing Program* in the District Plan is even more puzzling, since it would be so easy to reference and since the Harbor District Interagency forum was the one used to take direction from managing agencies and achieve consensus on this tool that all bay land managers could use. All bay land managers and interest groups have a copy of the Manual and it is easily accessible online at www.rcaa.org/baysigns. Not one of the District Plan signage or interpretation policies reference it as the programmatic and project-based tool it is for cost savings and regional consistency within a flexible framework. Encouraging bay managers and interest groups to use this tool will make interpretation and signage easy and coordinated with little effort on the District's part.

Section 4.0

- Page 4-1: The second paragraph seems to imply that the following policies are [merely] a set of guidelines within the [more important] context of policies promoting conservation and harbor industry development. This paragraph intimates that this somewhat 'fudging' language is used elsewhere in the document, but we cannot find similar introduction to conservation or harbor development policies. This language implies that there is reduced importance of and dedication to promotion and provision of public access facilities. If there is any District effort that will be supported by the public at large, it is improvement of appropriate public access opportunities. We as well as anyone understand the need to balance those efforts with other uses, particularly conservation needs, however we feel that equal emphasis and weight need be given to all areas of District responsibility in this Plan.
- RA-1: This policy is an implementation policy that should be in Section 6.0 and should apply to all of the policy sections not just recreation. It would help any future members of the HBMPAC and of the Board of Commissioners to understand the relationship of the two bodies to be more clear about how the PAC will communicate with and be heard by the Board of Commissioners. It seems to be assumed that the PAC will make recommendations for Board consideration, however this is not made clear and could result in confusion and frustration.
- RA-2 Add 'planning' in the first line of the first paragraph. The language used in this policy is clear and also identifies different ways that the District may work with other

entities. This language should be used in other policies in the plan such as R10-1, 2, CAE-4, and under section 5.5.

- RFA-1 Should be worded like HFA-2
- RFA-3. Use same language as in discussion under RA-2 which says partnerships are essential rather than likely be needed.
- RFA-4 The bolded statement should say …uses may take priority in designated Harbor area.
- RFA-8: 'Minor fill' might need a little more definition or should state as defined by COE.
- RFA-9,11, RSA-9, R10-1: Policies should reference the Humboldt Bay Interpretive Signing Program as a tool for agencies to save money and maintain consistency within an interpretive signing framework that is flexible and expandable.
- RVR-4: This policy should include not only removal but prevention of trash in the first place. Work with other entities to prevent trash from entering the bay.

Section 5.0

In the third paragraph the first bullet (1) should include protection of ecological systems not just stewarding. Because there is much we do not know about the Bay ecosystem and how best to protect and restore it , there should be a precautionary element included here. The statement should include some language like " .. in which the District will adopt a precautionary standard and err on the side of caution when information/knowledge is not available to determine effects of specific actions."

The overview needs to discuss the connection between the three Bays and how they are all one interconnected ecological system.

Since many of the policies in this section include areas that are outside of the Districts jurisdiction we encourage you to utilize language in policies that includes the other players in the watershed. The policy language that is similar to that in HLU-2, 5, RA-2. The policies regarding watershed related issues, public outreach and education, water quality protection and thelike should include non-profit conservation organizations as does CAS-1.

We would like to continue with review and comment of the document, but have run out of time. We encourage the District to redouble its efforts to reach the public and provide opportunities for review of subsequent drafts and the PEIR. Thank you for this effort, which we know has been long and arduous. We appreciate all the time and energy that your staff has put into this plan and believe it is a good start to protecting our most valuable resource.

Sincerely

Ruth Blyther, Co-Director
Natural Resources Services
Redwood Community Action Agency

Sierra Club
North Group, Redwood Chapter
P.O. Box 238
Arcata CA 95518

28 April 2005

Board of Commissioners
Humboldt Bay Harbor, Recreation, and Conservation District
P.O. Box 1030
Eureka, CA 95502

Attention: Jeff Robinson

Re. Draft Humboldt Bay Management Plan, March 2005

The following comments are on behalf of the North Group, Redwood Chapter, Sierra Club and the Northcoast Environmental Center.

The Draft Humboldt Bay Management Plan (HBMP) is complex, lengthy, and difficult to comprehend in its ramifications, so it is good to hear that the Humboldt Bay Harbor, Recreation, and Conservation District (Bay District) will welcome continuing comments. We think certain that all concerned would like to feel able to have a more extensive period of time in which to offer comments.

Bay District vs Harbor District.--The shortened form of the Humboldt Bay Harbor, Recreation, and Conservation Distrist is presently "Harbor District." Given the fact that the District's regulatory authority and responsibilities derive from the State of California and are based on the Public Trust Doctrine, we think it wise and just to replace "Harbor District" with "Bay District," the more meaningful designation that reflects the far broader responsibility and mission of the District. Words do matter and are important to conceptualization, and "harbor" is a far too limiting a term when one is dealing with the entire bay and public trust lands.

Public Trust Doctrine.--While the Bay District clearly recognizes its Trust and Stewardship Responsibilities under state law and the Public Trust Doctrine in the Draft HBMP, its primary emphasis and expenditure has been in developing commerce. The lengthy quotation from the State Lands Commission on a policy regarding the Public Trust applies primarily to development within Entrance Bay (or Middle Bay). But. "Neither the legislature nor the PTD place a priority on managing or furthering trust uses that generate revenue (commerce) over those that do not (recreation or conservation)" (according to Aldaron Laird). The HBMP should include a policy to pursue aggressively grant funding to manage those trust uses.

The Harbor (Port).--The Harbor Revitalization Plan of 2003 was incorporated into the HBMP "by reference." But the Revitalization Plan was a self-limited document, in that it prioritized large marine-based industrial development--in this 10-year plan--even with the understanding that "there is no certainty that rail service will be funded and restored in the foreseeable future" and highway conditions to the east and the south are not suitable for contemporary large trucks and will not be so in the foreseeable (even with improvements at Buckhorn Summit and Confusion Hill).

The Revitalization Plan itself makes no bones about the appropriateness of bulk cargo (excluding dry and liquid bulk cargo, or rock, water, and LNG): "Humboldt's basic weaknesses are in the areas of **local** market size, lack of proxmitity to a large metropolitan market and limited inland truck and rail access. These are major competitive diadvantages for cargo handling activities including containers, automobiles, breakbulk steel, fruit, and project cargoes. . . . These markets should be given the lowest priority." (And of course, water export and LNG have been given extremely negative responses from the community.) Nevertheless, the Management Plan maintains that a major goal is to "Assure the availability and readiness of large coastal dependent industrial sites adjacent to Humboldt Bay."

Given such essential drawbacks, we would like to see greater commitment on the part of the District to seeking appropriately scaled development, and development that is less likely to have the capability to override other public trust values and conservation, restoration, and recreational goals. Both the agencies and the public are far more likely to support appropriately scaled development.

Dredging.--The deepening of the bay completed in 2000 has made the entrance safer for all users, which is to be applauded. It is unclear, however, whether this major deepening project of channels as well as entrance was either financially or environmentally sound. This major project seems to have been an if-you-build-it-they-will-come affair. Unfortunately, the only ones who came were undesirable neighbors. Meanwhile, the impacts to other public trust values besides commerce have been given little attention to our knowledge. Studies are surely required of the consequences of that major project, especially the impact on fisheries--a major benefit to the industry and the citizens of Humboldt County--and eelgrass beds and erosion impacts.

In the Management Plan the lead-off goal under dredging is: "Assuring that Humboldt Bay's harbor functions continue to be available in the future requires that the shipping channels withing the bay . . . be maintained *at depths suitable for commercial vessels in use in the world today*" (emphasis added). Some commercial vessels are ca. 1,000 feet long now and are getting ever larger, requiring ever deeper channels. However, no proposals should be entertained by the Bay District for ships larger than the Panamax class (or 750 feet in length, ca. 110 feet wide, and ca. 50,000 deadweight tons) until studies and monitoring have been done to understand the environmental consequences of the five-year-old deepening project. Such studies and monitoring will give the experts and the community an idea of the true possibilities of the port and the actual environmental consequences of channel deepening, might redirect financial resources to more appropriate endeavors, and might save everyone a great deal of time and grief.

The **Wiyot Tribe** ought not have been so fundamentally neglected in the Draft Plan. The relationship between the Wiyots and the Bay District ought to be discussed in the Final Plan.

Elk River Spit.--"Parcel 38" (APN No. 302-181-38) was not listed as District property under HLU-6 ("The Harbor District shall develop 'specific plans' for District-owned parcels") or elsewhere. This piece of land is contiguous to the City of Eureka Elk River Wildlife Sanctuary and should probably be managed along with it. Yet the District has stalled for years over making any decisions toward managing or providing ordinances and signs or having the City provide the management.

Eelgrass.--CEP-11, "Determination about boundaries, buffers, or other environmentally sensitive areas require specific information," requires that mariculture applicants provide the District with maps of all eelgrass beds near and in their growing areas. Mariculture should not be allowed between -1.5 and +1.5 feet elevation, the optimal elevation for eelgrass. The ecosystem needs eelgrass but oysters do not.

Saltmarsh.--Around 90 percent of the saltmarshes in the Bay have been filled or diked "and they continue to be lost" (4.4.1.1). Parcel 4 behind the Bayshore Mall contains around 10 acres of saltmarsh and 5 of high ground. At least some of the marshland was used for mitigation and has been restored. The configuration of the high ground makes much of it is difficult to develop. None of those 10 acres should be lost to development.

Spills.--The MP should address spill prevention, rather than merely cleanup.

Toxic Sites.--The MP should include inventories of the numerous historic toxic sites and brown-field sites around the Bay, and plans should be put forward for cleaning them up.

We appreciate the time-consuming difficulty and complexity of drawing up a Management Plan for this complex Bay. All who have contributed are to be commended. We have deep regard for this tremendous resource and do not take it for granted, and we are pleased to have the opportunity to comment.

Yours sincerely,

Diane Fairchild Beck
North Group, Redwood Chapter, Sierra Club

Melvin McKinney
North Group, Redwood Chapter, Sierra Club

Tim McKay
Northcoast Environmental Center

MEMORANDUM

RE: MARCH 05 DRAFT HUMBOLDT BAY MGT PLAN

to MR. JEFF ROBINSON AND OTHERS WHOM IT MAY CONCERN
C/O HUMBOLDT BAY HARBOR RECREATION & CONSERVATION DISTRICT
P.O. BOX 1030, EUREKA, CA. 95502-1030

DATE APRIL 28, 2005, TIME 4:02 PM
FROM ANDY COLONNA PO BOX 4814, ARCATA, CA. 95518

DEAR JEFF AND OTHER COMMISSION MEMBERS,

THANK YOU FOR EXTENDING THE COMMENT DEADLINE ON YOUR DRAFT MGT PLAN UNTIL APRIL 28, WHICH GAVE ME (AND SEVERAL OTHERS) SOME MORE TIME TO REVIEW YOUR "EXECUTIVE SUMMARY" AND "DRAFT PLAN".

I ALSO APPRECIATE YOUR INCLUSION OF THE "ENABLING LEGISLATION" IN PART II APPENDIX B WHICH HELPED ME TO EVALUATE YOUR "E.S." AND "PART I, THE PLAN", WHICH LED ME IN TURN, TO RELY ON: THE CALIFORNIA GOVT. CODE, TITLE 7, "PLANNING AND LAND USE", ESPECIALLY CHAPTER 1 "GENERAL PROVISIONS", CHAPTER 2., REGIONAL PLANNING DISTRICTS AND CHAPTER 3, "LOCAL PLANNING", AS WELL AS THE RULES STANDARDS PROCEDURES AND THE FEDERAL AND STATE LAWS CITED AND/OR INCORPORATED BY REFERENCE THEREIN, WHICH I HOPE YOU WILL RELY ON AS WELL IN ORDER TO

PREPARE YOUR FINAL DRAFT PLAN AND DRAFT EIR

to THE BEST OF MY KNOWLEDGE THESE DOCUMENTS PROVIDE THE BEST INFORMATION AVAILABLE REGARDING THE FORMULATION, ADOPTION, AND IMPLEMENTATION OF THE FINAL BAY DISTRICT MGT PLAN AND FINAL EIR.

IN ADDITION RE. THE PUBLIC TRUST DOCTRINE MENTIONED IN YOUR DRAFT, THE BEST INFO. I CAN FIND (AS OF THIS DATE) ON THIS IS CONTAINED IN THE "MONO LAKE DECISION" AKA "NATIONAL AUDOBON SOCIETY V. SUPERIOR COURT [redacted] (1983) 33 CAL. 3d 419, 189 CAL. Rptr. 346; 658 P.2d 709 [SF NO. 24368. SUPREM COURT OF CALIFORNIA, FEB. 17, 1983] ESPECIALLY, PART 2 "THE PUBLIC TRUST DOCTRINE IN CALIFORNIA (All); AS WELL AS THE VARIOUS CASE LAW CITED AND/OR INCORPORATED BY REFERENCE THERE IN.

SINCE I DO APPRECIATE THE CONSIDERABLE TIME AND EFFORT YOU ALL HAVE MADE TO PREPARE AND PRESENT YOUR DRAFT PLAN AS WELL AS THE HIGH STAKES, AND POLITICALLY CHARGED ATMOSPHERE IN WHICH YOU HAVE TO OPERATE

I HOPE YOU'LL FIND THESE DOCUMENTS TO BE OF USE AS YOU TAKE THIS PROCESS FORWARD

SINCERELY, Andy Coloma

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ARCATA CA 95518

Pietro Parravano
President
David Bitts
Vice-President
Barbara Stickel
Secretary
Robert Miller
Treasurer
In Memoriam:
Nathaniel S. Bingham
Harold C. Christensen

PACIFIC COAST FEDERATION of FISHERMEN'S ASSOCIATIONS

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April. 27, 2005

Jeff Robinson
Harbor District Board of Commissioners
Humboldt Bay Harbor Recreation and Conservation District
P.O. Box 1030
Eureka, CA 95502-1030

ATT: Jeff Robinson, Resource Specialist

RE: March 2005 Draft Humboldt Bay Management Plan

Dear Commissioners,

The Pacific Coast Federation of Fishermen's Associations (PCFFA) offers the following comments on the Draft Humboldt Bay management Plan for your consideration. PCFFA is an organization of commercial fishing port associations representing about 1,500 West Coast fishing businesses.

The March 2005 Draft Humboldt Bay Management Plan ("Draft Plan") by the Humboldt Bay Harbor Recreation and Conservation District (Harbor District) has three volumes relating to

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history, setting, and proposed policies for Humboldt Bay. Volume III, the Policy Document, references the Harbor Revitalization Plan and the Strategic Plan.

PCFFA is concerned with the viability of fisheries from an economic as well as ecological viewpoint. We are concerned that the Draft Plan does not specify adequate protections for fish habitat. Humboldt Bay provides a nursery for numerous marine species that support the aquatic species important to economic fisheries, especially Dungeness crab, salmon, and herring.

The eelgrass beds are essential for tidal nursery habitat, and should not be compromised for aquaculture. Deep-channel dredging may cause erosion and alter the bay in unforeseen ways, as by altering the depths of habitats with movement of sediment. Additional fill along the shore also intrudes into sensitive habitats. The introduction of invasive species from ship bottoms, even if bilge water is treated, is a serious threat to established fish regimes and needs to be addressed. Policy CAE-2 states that the Draft Plan will protect and maintain environmentally sensitive areas, yet it is not clear how this can be accomplished within the proposed activities.

We would like the Harbor District to show how it plans to comply with the laws designed to protect our living marine resources: the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), the California Coastal Act, the Federal Clean Water Act of 1977 (CWA. The Federal Endangered Species Act (FESA), The California Endangered Species Act (CESA), and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as amended by the Sustainable Fisheries Act of 1996. We believe that an EIR/EIS is required for the Draft Plan, the Strategic Plan, and the Harbor Revitalization Plan due to possible environmental impacts on marine resources. We are not clear on how compliance with these laws will be met.

The Harbor District must provide an analysis of the potential effects on the estuarine ecology of the port developments being considered so that the public can realistically evaluate the costs and benefits. Alternative scenarios with more emphasis on recreation and scientific economy than the proposed shipping, industry, and aquaculture would also better support the fishing economy that brings employment, fresh seafood, and a romantic aspect of being a living fishing port that tourists love to see. About 16 million pound of Dungeness crab were landed between Fort Bragg and Crescent City in each year of 2004 and 2005, according to California Department of Fish and Game landing figures. Fields Landing, for example, would make a better recreational site than an industrial site.

The Harbor District must comply with buffer requirements in the Coastal Act for streams, wetlands, estuaries, open coastal waters, and environmentally sensitive habitat areas such as eelgrass within Humboldt Bay. We are concerned that proposed increase in aquaculture activities will have an adverse impact on eelgrass and estuarine nurseries that are Essential Fish Habitat for numerous sensitive fish species, and are also essential habitat for two species of salmon listed as Threatened under the Federal Endangered Species Act: Oncorhyncus kisutch (coho), and Oncorhyncus tshawytscha (chinook).

PCFFA would like clarification of how the Harbor District plans to measure whether Policy CEP-4, "Functional capacity of aquatic ecosystems must by maintained or enhanced," is met (CEP-4, Vol. III, pg 5-12). How will the proposed actions fulfill this policy?

PCFFA does not believe that the Harbor District has legal authority to streamline permit review as proposed in Policy HSM-3, Vol. III, pg.3-8, and Policy HRS-1, pgs. 3-19 and 3-20. The required review of permits is designed to balance development with the care needed to maintain natural resources and environmental functioning. The Draft Plan should reflect the direction of the California Coastal Act, section 30230:

"Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall re given to area and species for special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Many of the proposals in the Draft Plan do not give enough detail for adequate evaluation. PCFFA would like to have further opportunity for input on the Humboldt Bay Management Plan after clarification of issues mentioned above. Please put us on your notification list for the process.

Sincerely.

Vivian Helliwell
Watershed Conservation Director. PCFFA
850 Greenwood Heights Drive
Kneeland, CA 95549