Alaska Peninsula and Bristol Bay Basin

ECOREGIONAL ASSESSMENT

DECEMBER 2003

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Alaska Peninsula and Bristol Bay Basin Ecoregional Assessment

The Nature Conservancy in Alaska

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Reading this Assessment

Data sources for all figures may be found in Appendix 11. A number of agencies and organizations are referred to in the text by their acronym. The following is a list of frequently used acronyms in this assessment.

ADOT	Alaska Department of Transportation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AKNHP	Alaska Natural Heritage Program
ASWG	Alaska Shorebird Working Group
EPA	Environmental Protection Agency
ISER	Institute for Social Research, University of Alaska Anchorage
NMML	National Marine Mammal Laboratory
NOAA	National Oceanographic and Atmospheric Administration
NPS	National Park Service
PIF	Partners in Flight
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
USFWS	United State Fish and Wildlife Service
USGS	United States Geological Survey
WWF	World Wildlife Fund

A. EXECUTIVE SUMMARY

In 2000, The Nature Conservancy in Alaska and its partners assembled a team, working with over 70 scientists noted for their expertise in southwest Alaska, to assess the biodiversity of the Alaska Peninsula and Bristol Bay Basin ecoregions and to identify areas of biological significance. The team carried out the assessment guided by the methodology outlined in *Designing a Geography of Hope: A Practitioner's Handbook to Ecoregional Conservation Planning*, although certain modifications were required to adapt the framework to the unique characteristics of Alaskan ecoregions.

The primary product of this ecoregional assessment is termed a *portfolio* of areas of biological significance. This portfolio may be considered a conservation blueprint—a vision for conservation success—to guide public land managers, land and water conservation organizations, private landowners, and others in conserving natural diversity within this ecoregion. The ultimate goal is to conserve the plants, animals and natural communities of the Alaska Peninsula and Bristol Bay Basin over the long term. The portfolio serves as a blueprint for strategic investment and action.

It is certain that this initial identification of areas of biological significance will require further qualitative assessment as new information becomes available. This assessment is designed to focus conservation work in the immediate future, allowing conservation practitioners to quickly put emerging opportunities into the appropriate ecological context and to take actions that are scientifically defensible and result in highly effective and focused biodiversity conservation.

The Alaska Peninsula and Bristol Bay Basin Ecoregions

The Alaska Peninsula and Bristol Bay Basin ecoregions, totaling over 7,064,200 ha, are located in southwest Alaska (see Figure 1). The Alaska Peninsula and Bristol Bay Basin ecoregions are considered to be intact ecoregions with unimpeded natural ecological processes shaping the landscape. The ecoregions are notable for healthy populations of top level predators, such as brown bear, and globally important habitats for shorebirds, waterfowl, marine mammals, and 5 species of Pacific salmon, including the greatest runs of sockeye salmon on earth.

FIGURE 1. Location of the Alaska Peninsula and [illegible] Ecoregions

Conservation Targets

As a first step in the assessment, the team identified 227 conservation "targets" to represent the ecoregions' biodiversity, including both coarse filter targets (ecological systems) and fine filter targets (species and species aggregations). Fine filter targets were selected based on their imperilment, vulnerability, endemism, declining status, and the inability of coarse scale targets alone to represent them. Aquatic, terrestrial and coastal ecological systems were used to represent a broader level of biological diversity across the ecoregion. The team assumed that a combination of fine filter and coarse filter target selection would be a robust way to capture the broadest array of biodiversity. Significant gaps in information on species populations and occurrences, however, limited analysis of some fine filter targets. In addition, lack of information on the location and extent of fine scale habitats necessitated crosswalking several of these targets to associated systems, which were represented with coarse scale data.

Portfolio Design

Identifying areas of biological significance involved several steps. Once conservation targets were selected and conservation goals were set for these targets, identification began. The portfolio of areas was designed using manual delineation based on expert opinion, other conservation plans, and existing spatial data for fine filter targets. Area selection started with delineation of the most restricted habitat needs of fine filter targets (e.g. limited nesting habitat of Beringian marbled godwits). These areas were augmented with coarse-scale targets (e.g. spawning streams for pink salmon) and then regional-scale targets (e.g. caribou calving concentrations). The initial selections were then reviewed by local biologists and evaluated for how well it captured the coarse filter systems. The final portfolio incorporates review comments and achieves the conservation goals set for a majority (>81%) of the conservation targets.

Portfolio of Areas of Biological Significance

The 38 areas of biological significance in the Alaska Peninsula and Bristol Bay Basin ecoregions are not and need not be wilderness reserves; rather they should constitute a well-managed blend of protected areas and working landscapes. (see Figure 2). If managed with an emphasis on biodiversity, this portfolio of areas will likely conserve the fish and wildlife of the two ecoregions over the long term.

The portfolio reflects the character of northern landscapes and the migratory or wide-ranging nature of many of the species. Such species use a number of habitats at different seasons and life stages, including feeding areas, resting and staging areas, and areas for breeding and the care of young. For the Alaska Peninsula and Bristol Bay Basin ecoregions, the total portfolio, including marine environments and places adjacent to the ecoregions, comprises 12.4 million ha (30.6 million acres). The terrestrial portion alone is 9.2 million ha. The terrestrial areas within the ecoregion boundaries, 8.3 million ha, contain nearly 62% of the ecoregions.

An efficient portfolio makes use of land already in public ownership and avoids, when possible, private land and areas of development. Public lands make up the majority (85%) of the portfolio, and of public managers, the federal government is the lead with nearly 52% of the portfolio in its ownership. The state of Alaska manages 33% of the land.

Not all public lands are managed for conservation. The assessment team therefore assigned a relative conservation "status" to public lands, based on an area's legally designated purpose. A federal wildlife refuge, for example, would rank high; whereas a state recreation area would rank lower. The portfolio was then built around areas of high or medium status. Within the portfolio, 48% of the land ranks high or medium and less than 1% ranks low. The remaining 52% includes private land as well as public land.

Noteworthy are the areas on the Bristol Bay side of the peninsula that are critical for migrating waterfowl and shorebirds and calving caribou; many of these areas lack conservation status.

To further prioritize conservation efforts within the portfolio, the assessment team defined cores of biological significance, buffer areas, and corridors. Cores encompass critical life stage habitat for target species or habitat for endemic, endangered and vulnerable species, including rare plants. Corridors provide the necessary connective routes between cores, and buffer areas constitute additional important areas for wide-ranging species and provide extra habitat protections in the event of large-scale disturbances such as volcanic eruptions.

Assessment of Human Impact

The objective of this aspect of the assessment was to identify the potential impacts of various human activities on targets across the ecoregion. Currently, human activities, including non-native species introduction, incompatible recreational use, incompatible residential development and incompatible resource development have the greatest impact on the long-term survival of fish and wildlife in the ecoregion.

Conclusions and Recommendations

Ideally this assessment will be a resource and tool not just for the Conservancy, but also for land managers and other stakeholders in southwest Alaska. For example, the portfolio might be used to guide management decisions for public lands. The State of Alaska and the Bureau of Land Management own more than a third of the portfolio and manage those lands in undesignated status. This assessment provides biological information that these agencies could apply to their planning and land disposal processes. For example, ADNR's Bristol Bay Area Plan, currently being revised, may explore reclassifying state lands in the Nushagak area of biological significance in order to protect critical habitats for nesting waterfowl or spawning fish. The state can also use the portfolio to consider higher levels of protection for the habitat needs of declining and vulnerable species, including classifying additional state lands as Critical Habitat Areas, Special Use Areas, or Game Sanctuaries. As BLM completes its Ring of Fire plan and adjudicates land selections, the ecoregional assessment can identify lands that should be given a higher priority for conservation.

The assessment may also be used to enhance the work of local conservation partners, such as the Nushagak Mulchatna Wood-Tikchik Land Trust, the Nushagak Mulchatna Watershed Council, and the Southwest Alaska Conservation Council, through technical support and training, collaboration on grant proposals, sharing of data, assistance with conservation or land use management plans, and assistance on land acquisition projects (i.e. fee simple or conservation easements).

A number of data gaps and research needs were identified as part of the assessment. Opportunities to better the ecological understanding of these ecoregions and their species are many. A critical data gap for this assessment was the lack of a consistent, detailed, high-quality vegetation map for the ecoregions and the lack of digital data for many wide-ranging and migratory species. A complete land cover map could be produced either through the completion of the Bristol Bay Landcover Mapping Project or a statewide project. The Alaska Department of Fish and Game has information on salmon in its *Anadromous Waters C*atalog and many other species in *its Alaska Habitat Management Guide*s, but both datasets could use updating, expansion and refinement, and conversion to digital format.

In the conclusion to the assessment, the Conservancy makes a number of recommendations such as these, ranging from land management to future research. Turning those recommendations and the assessment as a whole into conservation action will require the work of many: private landowners, government agencies, land use planners, civic leaders, concerned citizens and non-governmental organizations. The Conservancy looks forward to working cooperatively with these and other stakeholders to translate this assessment and future iterations into long-lasting conservation success on the ground.

FIGURE 2. Portfolio of areas of biological significance

B. OVERVIEW OF THE ALASKA PENINSULA AND BRISTOL BAY BASIN ECOREGIONS

1. Landscape and Species

The Alaska Peninsula and Bristol Bay Basin ecoregions lie adjacent to each other in southwest Alaska (Figure 3). The Bristol Bay Basin is composed of the low-lying basin surrounding Bristol Bay. It stretches from Goodnews and Chagvan Bays on the west side around to the Cinder River on the southeast. It is bound on the west by the Ahklun and Kilbuck Mountains, on the north by the Kuskokwim River drainage, and on the east by the Aleutian Range. The Bristol Bay Basin ecoregion includes the Bristol Bay lowlands, the Wood-Tikchik Lake systems, and the lowlands draining into the east side of Bristol Bay. The terrestrial and freshwater portions of the ecoregion comprise over 7,064,200 ha. This assessment also includes marine waters within 10 km of the shoreline of both ecoregions.

The Alaska Peninsula and Unimak Island, the northernmost island of the Aleutian archipelago, comprise the Alaska Peninsula ecoregion. The ecoregion is bound on the north by the southern end of the Alaska Range, and tapers to the southwest to the Aleutian chain, separating the Gulf of Alaska from the Bering Sea. The dominant feature of the ecoregion is the Aleutian Range, the volcanic spine of the peninsula that reaches elevations of 2,600m. The terrestrial and freshwater portions of the ecoregion comprise over 6,369,600 ha.

The Nature Conservancy has prepared one biological assessment for the Alaska Peninsula and Bristol Bay Basin ecoregions because they share many characteristics of vegetation, climate, species composition, land status, and socio-economics. On some levels, the distinction between the two ecoregions is artificial, given that the Bristol Bay Basin ecoregion contains the upper portion of the geographic Alaska Peninsula, and the Alaska Peninsula ecoregion is the southern shore of Bristol Bay. There are important differences, nonetheless, and this joint assessment attempts to point out both these differences and the similarities.

Southwest Alaska sits at the transition between maritime and continental climate influences (Figure 4). The maritime climate affects the south slope of the Aleutian Range along the Alaska Peninsula, which is often buffeted by major ocean storms with high winds and heavy rains from the Gulf of Alaska. In this part of the ecoregion, average annual precipitation ranges from 610 to 1,650mm, and average annual temperature ranges from 1 to 4° C (McNab and Avers 1994). Sea ice does not form along this coast, except in a few protected bays and inlets (ADEC 1976). On the other side of the Aleutian Range, the transitional climate creates a slightly cooler yet drier climate around Bristol Bay. Average annual precipitation ranges from 460 to 810 mm, and average annual temperature ranges from (-1 to 3° C) (McNab and Avers 1994). Sea ice does form in Bristol Bay during the winter. The interior portions of both ecoregions have a continental climate, characterized by short warm summers, long cold winters, and less precipitation than the transitional and maritime zones (Ricketts and others 1999).

Pleistocene glaciation was extensive in both ecoregions, carving U-shaped valleys into the mountains. Glaciers remain in the high peaks of the Aleutian Range (Ricketts and others 1999), therefore many valley soils are formed in glacial till and lakes and rivers have suspended glacial flour. Deep to discontinuous permafrost occurs in the Bristol Bay Basin ecoregion (Gallant and others 1996, Ricketts and others 1999), but the Alaska Peninsula is largely free of permafrost. Volcanic activity also has shaped the topography and soils of the

Alaska Peninsula ecoregion. Soils there have formed from volanic ash and cinders (Ricketts and others 1999).

Due to topography, past glaciation, and climate, these ecoregions are dominated by tundra vegetation. The Aleutian Range, and Ahklun and Kilbuck mountains are characterized by alpine tundra – a semi-arid habitat that supports low shrubs like shrubby cinquefoil (*Potentilla fruticosa*), Arctic willow (*Salix arctica*), and alpine azalea (*Loiseleuria procumbens*), and various lichens, mosses, grasses, and flowers. Moist tussock tundra occurs on the undulating terrain of mountain valleys and along plateaus and has a complex plant association growing from a mat of mosses, lichens, and tufted hair grass (*Deschampsia caespitosa*) (Selkregg 1976). Wet tundra is confined to low-lying coastal areas around Bristol Bay. Ponds, lakes, and wetlands cover most of these areas (Ricketts and others 1999). Floodplains are dominated by high brush communities with alder and willows (*Alnus* and *Salix* spp.). Forest types include coniferous and mixed forest types. White spruce (*Picea glauca*) and black spruce (*P. mariana*) dominate coniferous forested areas, with black spruce primarily in interior lowland, on north-facing slopes, and on poorly-drained flats (Selkregg 1976). Balsam poplar (*Populus balsamifera*), black cottonwood (*Populus balsamifera ssp. trichocarpa),* paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*) occur within mixed forests.

Much of the shoreline of Bristol Bay is characterized by mixed sand and gravel beaches and exposed tidal mudflats. The protected bays and lagoons often have eelgrass beds (*Zostera* spp.), which form the food base for many fish and waterfowl. Izembek Lagoon at the south tip of the Alaska Peninsula contains one of the largest eelgrass beds in the world (USFWS 1985b). The rugged Gulf coast has intertidal and subtidal algal forest, characterized by kelp attached to rocky substrates.

The lowlands of the ecoregions contain numerous lakes, estuaries, and large river basins, including the drainages of the Nushagak, Kvichak, Egegik, and Ugashik rivers. These large rivers terminate in broad estuarine areas around Bristol Bay. These rivers support some of the largest salmon runs and fisheries in the world.

Five species of Pacific salmon (*Oncorhynchus* spp.*)* are present in the waters of the ecoregion, as are other anadromous species such as steelhead (*O. mykiss*), rainbow smelt (*Osmerus mordax*) and dolly varden (*Salvelinus malma*). The Kvichak River has been the most productive sockeye system in the world (Woody 2003), and the Nushagak River supports the third largest king salmon run in the world. Arctic grayling (*Thymallus arcticus*) remain in freshwater in these ecoregions. Over 70 percent of the trophy grayling registered by the Alaska Department of Fish and Game come from the Ugashik lake and river system, which straddles the two ecoregions (ADFG 1994).

Healthy populations of many top-level predators exist in the Alaska Peninsula and Bristol Bay Basin, including brown bear (*Ursus arctos*), black bear (*U. americanus*), wolf (*Canis lupus*), wolverine (*Gulo gulo*), and lynx (*Lynx canadensis*) (Ricketts and others 1999). Five distinct herds of caribou (*Rangifer tarandus*) range across the ecoregions, using all land but the small and remote islands. Moose (A*lces alces*) inhabit the uplands and riparian corridors, preferring willow, alder, and cottonwood habitats (Aderman and others 2000). Beaver (*Castor canadensis*) are abundant.

Coastal wetlands, lagoons, and bays along the shores of Bristol Bay and the Alaska Peninsula provide staging areas for large seasonal aggregations of waterfowl and shorebirds. Izembek Lagoon hosts the majority of the eastern Pacific population of black brant (*Branta nigricans*) before they depart for wintering areas to the south. The endemic Beringian marbled godwit (*Limosa fedoa beringiae*) breeds only in the wetlands along the

north side of the Alaska Peninsula (Gibson and Kessel 1989). Several other birds that breed only in Alaska on the east side of the Pacific nest here—Aleutian tern (*Sterna aleutica*), Arctic warbler (*Phylloscopus borealis*), red-faced cormorant (*Phalacrocorax urile*), and Kittlitz's murrelet (*Brachyramphus brevirostris*). The ecoregions provide prime wintering habitat for several birds—Emperor goose (*Chen canagica*), King eider (*Somateria spectabilis*), Steller's eider (*Polysticta stelleri*), and McKay's bunting (*Plectrophenax hyperboreus*). Lagoons and bays around Bristol Bay also provide major spring stopover sites for migrating shorebirds. Thirteen of these bays have been identified as hosting concentrations of tens of thousands of shorebirds and a number have concentrations of over 100,000. Egegik Bay, Nelson Lagoon/Mud Bay, and Izembek-Moffet Lagoons in particular host concentrations of more than 500,000 shorebirds annually (ASWG 2000). Shorebirds depending on these locations include dunlin (*Calidris alpina pacifica*), black-bellied plover (*Pluvialis squatarola),* Beringian marbled godwit, bar-tailed godwit (*Limosa lapponica baueri*), rock sandpiper (*Calidris p. ptilocnemis*), western sandpiper (*Calidris mauri*), and least sandpiper (*Calidris minutilla*).

Bristol Bay and the Gulf of Alaska support a diverse assemblage of marine species. The Bristol Bay population of the beluga whale (*Delphinapterus leucas*), a separate stock from the eastern Bering Sea stock, resides in the northeast bays in summer, especially Nushagak and Kvichak Bay, following returning salmon and smelt. Rookeries and haul-outs for Steller sea lions (*Eumetopias jubatus*) are distributed primarily along the Gulf coast of the Alaska Peninsula, while adult male walruses (*Odobenus rosmarus divergens*) use four haulouts in the summer around Bristol Bay. Harbor seals (*Phoca vitulina*) haul out on beaches along the coastlines of both ecoregions. Sea otters (*Enhydra lutris*) have re-colonized the lower half of the peninsula as their population has increased since the days they were hunted almost to extinction for their fur. Pacific herring (*Clupea pallasi*) and Pacific halibut (*Hippoglossus stenolepis*) also occur in the marine portions of the ecoregion, as do several shellfish species, such as scallops, crab, shrimp and many species of groundfish.

Several mammal species are endemic to the islands of the Alaska Peninsula and Bristol Bay Basin ecoregions, including tundra voles on Amak and Shumagin islands (*Microtus oeconomus amakensis* and *Microtus oeconomus popofensis*). Several birds are also endemic to the ecoregion for all or parts of their life cycles, including the Amak Island Song Sparrow (*Melopiza melodia amaka*), the Semidi Islands Winter Wren (*Troglodytes troglodytes semidiensis*), McKay's Bunting (*Plectrophenax hyperboreus*), and the Beringian Marbled Godwit (*Limosa fedoa beringiae*). There are five globally rare species in the ecoregion with Natural Heritage Program ranks of G1 or G2, four of which are plants; the other is the Bristle - thighed curlew (*Numenius tahitiensis*) (Appendix 4).

2. Ecological Processes

Ecological processes are natural events that shape a landscape and its constituent biodiversity. Although ecological processes occur at many scales, natural disturbances such as flooding and fire are often most noticeable for their quick and significant impacts. Natural disturbance regimes affect biodiversity by maintaining heterogeneity of habitat patches (Pickett and Thompson 1978). The primary ecological processes driving the natural ecological systems of the Alaska Peninsula and Bristol Bay Basin ecoregions are climate, flooding, fire, vulcanism, tectonic activity, tidal activity, ocean currents, and ocean storms. The interaction of these natural ecological processes at varying intensities, frequencies, and spatial scales is fundamental to maintaining landscape heterogeneity and biotic diversity of ecological systems in this ecoregion.

A primary ecological driver across this ecoregion is climate, and climate change may become the dominant disturbance regime in these ecoregions. Climate shapes the land and influences the type of vegetation that occurs on the landscape. Alaska is thought to have experienced the greatest regional warming of all states in the U.S., with an average temperature increase of 3°C and rise in average winter temperature of 4.5°C in winter months since the 1960s (ARAG 1999). It is estimated that in the coming years precipitation will increase, with larger increases in northern and western Alaska (ARAG 1999).

The Alaska Peninsula, which lies along the "Ring of Fire," is an area with considerable volcanic and tectonic activity. Eruptions from the volcanoes along the peninsula's spine can play a significant disturbance role due to ash deposition. The 1912 eruption of Mt Katmai was the largest eruption on earth in the 20th century. Since that time, 8 other volcanoes in the ecoregion have had major eruptions, most recently in 1994 and 1995 (AVO 2003). Regular earthquakes also occur in the ecoregions. The Alaska Peninsula runs north and parallel to the boundary between the North American plate and the Pacific plate. Most earthquakes are produced when these two plates come into contact and slide past each other. The Shumagin seismic gap is considered to have a very high probability of a major earthquake in the next few decades because there has not been a recent large earthquake at that place on the fault (UAFSGCP 2002). Some of the largest earthquakes in the world have affected the Alaska Peninsula and Bristol Bay Basin, and coastal lands have been known to rise or fall several feet. In 1964 the largest earthquake recorded in North America permanently changed the elevations of many coastal areas. Subsidence and uplift at this scale can dramatically change the landscape and character of associated surface waters.

Fires are sporadic occurrences in these ecoregions, but can play an important ecological role due to limited suppression. Fire can rejuvenate forest and other ecosystems by removing some of the insulating organic matter and thus warming the soil and allowing increased growth. Nutrients are added both by ash from the fire and increased decomposition rates. In 2002, Southwest Alaska experienced 64 fires, totalling over 312,000 ha affected, yet one year earlier 17 fires burned just over 405 ha (ADNR 2003).

Ocean currents, tidal activity, and ocean storms play an important role in the ecology of the Bristol Bay and Gulf of Alaska coastlines. The Alaska stream flows around the Gulf of Alaska, passing southwest along the Alaska Peninsula, and enters into Bristol Bay between islands. The current in Bristol Bay primarily moves counter-clockwise (Selkregg 1976). Bristol Bay and the bays, estuaries, lagoons, and tidelands ringing it are among the most productive waters in the world. Tides in the shallow bay are influenced by the strong Bering Sea currents, and a significant portion of the bay's water is exchanged daily (USFWS 1985a). The Bristol Bay tidal range is large and fast, exceeding 4.5 m at times with a 6 knot current (Selkregg 1976). Rivers draining west and north from the Alaska Peninsula deposit glacial sediment into Bristol Bay and much of this is redistributed and deposited in extensive tidal flats. The freshwater systems discharging into the bay bring a rich nutrient load with them (USFWS 1985a). Mixing of freshwater and saltwater influences the high productivity within the bay. Along the south side of the Alaska Peninsula, lack of sea ice and offshore upwelling create conditions for one of the most productive marine environments in the North Pacific (ADEC 1976). This part of the ecoregion is also buffeted by frequent and violent winter storms. The combination of ash-deposited slopes and heavy storms creates an easily eroded landscape and vegetation is often disturbed (Ricketts and others 1999).

Flooding is another significant ecological process in the Alaska Peninsula and Bristol Bay Basin ecoregions. Snowfall and corresponding melt in mountains surrounding the ecoregions send large quantities of water into the rivers and lakes. Floods occur annually

due to heavy precipitation in August and September. When flooding occurs within the Alaska Peninsula and Bristol Bay Basin ecoregions, it can greatly affect deposition and sedimentation processes as well as erosion. Irregular flooding may occur coincident with events such as volcanic eruptions.

3. Trends in Biodiversity

The Alaska Peninsula and Bristol Bay Basin ecoregions are considered to be unfragmented landscapes, shaped by unimpeded natural ecological processes; however, there are several notable negative trends in biodiversity, such as non-cyclical population declines and decline of anadromous fish populations.

Some evidence suggests that the carrying capacity of the Bering Sea has decreased, possibly due to increased temperatures in the past 25 years (Schell 2000). With this regime shift, marine productivity has decreased. The resulting change in the composition of species at the bottom of the food chain may be the cause of documented declines in marine species. The National Marine Fisheries Service listed the western Alaska Steller sea lion population as endangered in 1997 following population declines by over 70% since the 1960s (Loughlin and others 1992), with a 40% drop between 1990 and 2000 (NMFS 2002). Numbers of two distinct stocks of harbor seals, one in Bristol Bay and one in Gulf of Alaska, are also believed to be down since the 1970s (NMFS 1998a, NMFS 1998, Boveng and others 2003). Populations of the southwest stock of the Northern sea otter have also decreased, declining 27-49% on the north side of the Alaska Peninsula and 93-94% along the south side since 1986 (Doroff and others 2004). Seaduck and seabird populations have declined throughout the Bering Sea, including the common murre (*Uria aalge*) and Kittlitz's murrelet. The abrupt collapse of the Bristol Bay red king crab population in the early 1980s may be due to natural causes or shifts in the management of crab and other bottom trawling fisheries (Dew and McConnaughey 2004).

Scientists speculate that this temperature increase has also affected some anadromous species due to changes in their nursery waters. Sockeye salmon runs up the Kvichak River, which once peaked at 25 million fish, are down since the 1980s (Woody 2003). Warmer lake temperatures may increase growth rates of sockeye fry, which may then leave their nursery water system for Bristol Bay a year earlier. Despite the increased growth rate, these fry are still too small for survival in the ocean (Woody 2003).

Many landbirds are considered declining on a global scale, including the olive-sided flycatcher (*Contupus cooperi*), an "Alaska Species of Special Concern" according to the Alaska Department of Fish and Game. Sources of decline may be within or outside these ecoregions. The flycatcher's decline, for example, may be due to alterations of its wintering habitats in South America (BPFWG 1999).

There are currently no known declines of terrestrial mammal populations in the ecoregion; however, little is known about population sizes of many species.

Only two of the ecoregion's species are listed by the Endangered Species Act: Steller's sea lion (endangered) and the breeding population of Steller's eider (*Polysticta stelleri*) (threatened). The Alaska Peninsula and Bristol Bay Basin ecoregions provide primary wintering, molting, and stopover habitat for the Steller's eider. The endangered short-tailed albatross (*Phoebastia albatrus*) has been observed in the coastal waters of the ecoregions, but too little is known about the species distribution and habitat needs at this time to include it in this assessment.

4. Socioeconomic Trends

The 2000 census found roughly 10,000 people in the Alaska Peninsula and Bristol Bay Basin ecoregions. The population of Bristol Bay Basin is slightly larger than the Alaska Peninsula, and almost a quarter of the total population lives in Dillingham in the Bristol Bay Basin (SWAMC 2003). In the region as a whole, the population has been increasing for the past 40 years, but some towns have seen reductions due to closure or staffing reductions at military installations or Coast Guard stations (SWAMC 2003). The Alaska Department of Labor projects that all boroughs and census areas within the ecoregions, except the Aleutians East Borough, will experience population increases from 28 to 50% in the next 20 years (SWAMC 2003). Population in the Aleutians East Borough is projected to decrease by almost a third in that same time period. Population tends to increase seasonally to support the fishing industry.

The people are a diverse ethnic composition of Caucasian (44%), Alaska Native or American Indian (32%), Asian (14%), and other races (SWAMC 2003). These proportions vary from borough to borough within the ecoregions, with the Lake and Peninsula Borough and Dillingham census area populations having over 70% Alaska Native (SWAMC 2003).

The major components of the economy of the region are commercial fishing, transportation services, government jobs, Native corporations, subsistence, and tourism. Oil and gas development has been proposed for the area, and this development and its attendant infrastructure may become a reality with current trends in energy policy.

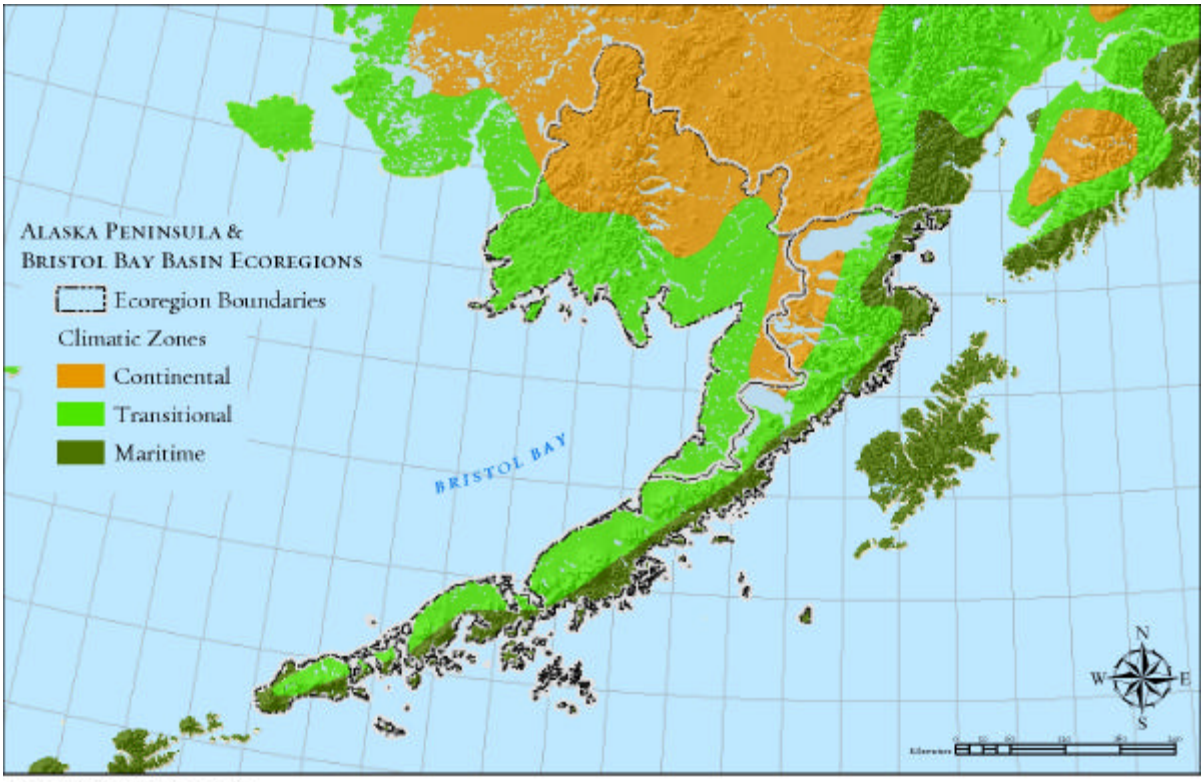
5. Land Management

The ecoregions fall in the jurisdictions of the Lake and Peninsula Borough, Bristol Bay Borough and the Aleutians East Borough (Figure 5). Most of the Bristol Bay Basin ecoregion remains unincorporated outside of a few towns. The majority of land in both ecoregions is publicly managed (Figure 6). In the Alaska Peninsula, state-managed lands constitute only 18% of the ecoregion, while federally-managed lands constitute 69%. Katmai National Park and Alaska Peninsula National Wildlife Refuge account for most of the federally-owned lands. In the Bristol Bay Basin, the federal government manages 35% of the land and the state owns 38%. The largest federal unit is Togiak National Wildlife Refuge, and the largest state park in the country, Wood-Tikchik State Park, comprises 23% of the state lands. In both ecoregions, only a fraction of state-managed lands are managed for conservation values. These include game refuges, critical habitat areas, state parks, and state recreation rivers. Much of the state-managed lands contained in the two ecoregions (77%) are as yet undesignated, and thus not necessarily managed for conservation, though the Bristol Bay Area Plan (ADNR 1984) classified many state lands for wildlife and recreation.

As elsewhere in the state, Native groups and individuals are among the most significant private landowners (Figure 5). Several regional for-profit Native corporations are located within the ecoregions—Bristol Bay Native Corporation, Calista Corporation, Koniag Native Corporation, Cook Inlet Region Incorporated, and Aleut Corporation. There are 33 Native village corporations, each a federally-recognized tribe. Almost 12% of the Alaska Peninsula and Bristol Bay Basin ecoregions is composed of Alaska Native Claims Settlement Act (ANCSA) lands. Of the ANCSA lands, the regional corporations own subsurface rights while the village corporations own the surface rights. Village land statistics are unavailable. There are a total of 3228 Native allotments in the ecoregion, with a total area of 66,930 ha.

FIGURE 3. Alaska Peninsula and Bristol Bay Basin ecoregions

FIGURE 4. Climatic Zones



Albers Equal Area Projection

Source: Zenone et al. 1978

FIGURE 5. Native corporations and boroughs

FIGURE 6. Generalized land management

C. METHODS

The Nature Conservancy carried out this ecoregional assessment guided by the methodology outlined in *Designing a Geography of Hope: A Practitioner's Handbook to Ecoregional Conservation Planning* (Groves and others 2000). Modifications required to adapt the framework to the unique characteristics of the Alaska Peninsula and Bristol Bay Basin ecoregions are documented in this report.

Geography of Hope describes the five key steps that constitute an ecoregional assessment:

1. **Select conservation targets** *(e.g., species, communities, and ecological systems) to represent the ecoregion's biodiversity and to be the focus of conservation efforts within the ecoregion.*
2. **Set conservation goals** *in terms of number and distribution of the targets to be represented in the portfolio. These goals serve as initial hypotheses about the level of effort required to conserve biodiversity.*
3. **Assess viability** *of individual target occurrences to determine the likelihood of long-term persistence.*
4. **Identify and design a portfolio** *of areas of biological significance that meets conservation goals.*
5. **Identify preliminary threats** *to targets at conservation areas and identify action steps to conserve the portfolio.*

This type of rigorous analysis employs thousands of pieces of detailed information. It requires location-specific information about conservation targets as well as the past, current, and potential future status of lands where they occur. The assessment team used the most up-to-date biological and physical data available for this assessment. However, given the quantity and quality of information involved—and the reality of ecological change—our knowledge will remain incomplete. We therefore approach this assessment with the intention of clarifying and filling information gaps over time, and to periodically revisit our analysis.

This chapter summarizes the ecoregional assessment process for the Alaska Peninsula and Bristol Bay Basin ecoregions. The following chapters provide more in-depth information about each stage of the process.

1. Selecting Conservation Targets

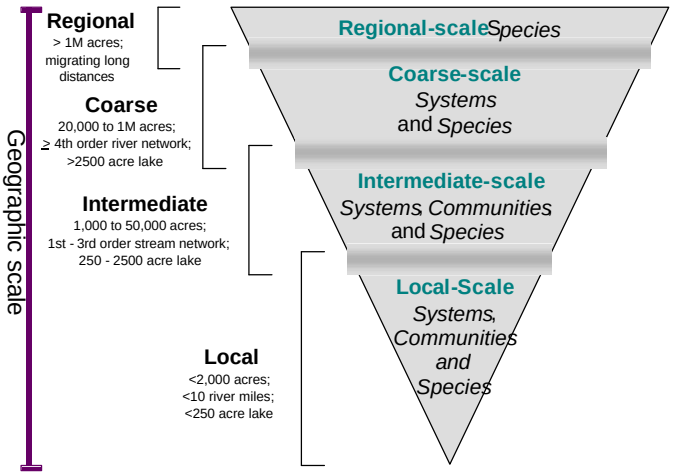
The vast number of species comprising an ecoregion's biological diversity makes it impractical to assess and plan for each individual element of that diversity. The first step in an ecoregional assessment, therefore, is to identify a subset of species and communities that represent major components of diversity of an area. To complement this subset, all coarse-scale ecological systems representative of the region are also selected as targets. This "coarse filter/fine filter" approach to biodiversity conservation, developed by The Nature Conservancy (Groves and others 2000), is designed to strike a balance between manageability of information about biodiversity and insurance that all major habitat types (i.e. ecological systems) are considered in the analysis.

In order to use the coarse filter, it is necessary first to name and describe (classify) the constituent terrestrial, aquatic, and coastal systems in an ecoregion. In the Alaska Peninsula and Bristol Bay Basin ecoregions, broad classification units were preferred over more detailed classifications, in order to match the level of detail available in most spatial data

sets. By describing major habitat types, the coarse filter is assumed to represent many species and ecological processes, without having to inventory and manage each species individually. Given the limited status of our biological knowledge, however, this coarse filter approach cannot be counted on to represent all biodiversity. Some species, especially the rarest, will fall through the screen of the coarse filter. Therefore, a fine filter is needed as a complement to the coarse filter.

FIGURE 7. Spatial scale of target species

Categories representing geographic scale of conservation targets. Areal ranges are approximate and overlapping (Poiani et al. 2000).



Fine filter targets include species—particularly those that are rare, endemic and/or in decline—and certain rare, small patch plant and animal community types. Some fine filter species may be addressed as members of recurrent communities (or species assemblages, such as migratory bird stopovers, bear feeding areas, etc.), while others require attention as individual species (such as species that are globally rare and imperiled, or narrowly endemic). Fine filter targets may also include focal species. Focal species have spatial, compositional and functional requirements that encompass those of other species in the region and may help address the functionality of ecological systems (Groves and others 2000). Focal species can provide information on the necessary size and arrangement of reserves, as well as quality of habitat. This assessment considered two types of focal species—keystone and wide-ranging species (See Table 5 in Chapter D for the primary categories used to choose targets).

Once lists of conservation targets are developed and reviewed by experts, additional descriptive information is gathered for each target. Particularly important is the target's characteristic spatial pattern, which represents the typical range of a species, extent of a system type, or length of a stream (stream order can substitute as a preliminary estimate). Four spatial scales are used: *local, intermediate, coarse* and *regional*. Spatial scale is attributed to each target not necessarily as it occurs today, but as it has occurred in recent centuries without significant human alteration (*sensu* Poiani and others 2000) (See Figure 7). To ensure that conservation is focused on all scales of biodiversity in the ecoregion, it is important that the final list of conservation targets include representatives from all four spatial scales.

2. Setting Conservation Goals

Goals provide the quantitative basis for identifying areas of biological significance and for evaluating the effectiveness of conservation action. Conservation goals are measureable both quantitatively and spatially. The quantitatitve component defines the number of

occurrences of each target necessary to adequately conserve the target in the ecoregion. The spatial component describes how target occurrences should be distributed across the landscape. For example, a conservation goal of five occurrences in the ecoregion may be further refined to require that at least one occurrence be located in each subregion of the ecoregion. As a general rule, multiple examples of each target, stratified across the target's geographic range, are necessary to represent the variability of the target and its environment, and to provide some level of replication to ensure persistence in the face of environmental stochasticity.

It is important to set conservation goals based on *viable* species or populations that have a high probability of continued existence in a state that maintains vigor and potential for evolutionary adaptation over a specified period of time. Conservation goals should support the evolutionary pathway of target species in continually changing systems; in the case of this assessment, goals were therefore set based on a time horizon of 100 years or 10 generations of a species (Groves and others 2000).

The science involved in setting conservation goals is still young, and appropriate guidelines for answering the inherent question "How much is enough?" are sparse, particularly in largely intact systems such as occur in these ecoregions. The assessment team relied upon a variety of resources to set conservation goals, from existing species management studies to existing conservation plans to expert opinion to default measures that must be refined in time through monitoring and observation.

A number of factors, including life history, key ecological processes and genetic or environmental variability of a target, contribute to the goal-setting process for each target. Ideally, conservation goals should be based on minimum population viability theory and a thorough and modern understanding of the population biology of targeted species. Unfortunately, current, complete and specific data were not available for most of the targets within the Alaska Peninsula and Bristol Bay Basin ecoregions. Due to this lack of information, several modifications were made during the goal-setting process. One modification linked species to habitat types in cases where information did not exist to set species goals independently. Unfortunately, the terrestrial habitat information available for these ecoregions could not reliably represent fine-scale habitats. Thus, an assumption had to be made—that coarse filter systems could represent finer-scale habitats. The goals for representation of each system (typically 30% of historic extent) were then assumed to protect a sufficient amount of the fine scale habitat requirements. These assumptions magnify the possibility of error in targeting specific areas of biological significance, but they constitute a best attempt at using available information. Though they have no explicit goals, fine filter targets lacking sufficient data for species goal-setting remain on the target list as a reminder to update their conservation goals and re-analyze their protection when better information becomes available.

Establishing conservation goals is a process rooted in the most difficult—and most important—scientific questions in biodiversity conservation (e.g. How much is enough?). As some have pointed out (e.g. Noss 1996, Soule and Sanjayan 1998), these questions cannot be answered by theory alone, but require an empirical approach, target-by-target, and a commitment to monitoring and continual re-evaluation over the long-term. Goals for the Alaska Peninsula and Bristol Bay Basin ecoregions, therefore, should ideally be tested, refined and monitored over time in order to incorporate new information and to measure the success of the assessment and its resulting conservation efforts. For now, conservation goals must be considered working hypotheses regarding what, how much, and where

conservation actions should be focused to ensure the persistence of native species within the ecoregion.

3. Viability Assessment

The term 'viability' refers to the ability of a species to persist for many generations, or an ecological system to persist over a specified time period. In a conservation assessment context, viability of a species or system may be determined for any of several scales: the individual example, a group or population, or the entire species or system. In ecoregions where sufficient detail is available, the emphasis is on viability of populations of species, and occurrences (or examples) of ecological communities and systems. The purpose of conducting viability assessments in those ecoregions is to ensure that the portfolio of areas of biological significance is composed of targets of the highest viability and that the areas are of sufficient dimension to endure natural processes that maintain the viability of the conservation targets therein. In essence, viability assessment represents a risk analysis for making an investment decision (Groves and others 2000).

Information about viability of populations and occurrences in the Alaska Peninsula and Bristol Bay Basin ecoregions is lacking, so the assessment team had to make assumptions about target viability based on the apparent health of the ecoregions and species. These ecoregions have little fragmentation from infrastructure and relatively few, small footprints from development. In other ecoregions, degree of fragmentation and viability of conservation targets have been shown to be inversely related. Also, most species and systems in these ecoregions are assumed to have stable, if not increasing, populations; those with declining populations are typically vulnerable to stresses outside the ecoregions. For these reasons, all current populations and occurrences of species and systems included in this assessment were assumed to be 'viable.' Areas in the ecoregion that have a higher level of development, fragmentation, or other human pressure, were avoided in the final portfolio, unless the conservation targets in such areas did not occur anywhere else in the ecoregions.

4. Designing the Portfolio

The primary goal of this assessment is to identify a portfolio of areas of biological significance. These areas, if managed properly, represent one way to ensure the long-term survival of the species, plant communities, and ecological systems of the Alaska Peninsula and Bristol Bay Basin ecoregions.

The assessment team used the following principles, based on guidelines outlined in *Designing a Geography of Hope*, to assemble the portfolio:

1. **Representativeness*:*** *Capture multiple examples of all conservation targets across the diversity of environmental gradients appropriate to the ecoregion (e.g., subregion, ecological land unit).*
2. **Efficiency:** *Give priority in the portfolio selection process to areas where multiple targets occur in order to meet conservation goals for targets in the least amount of area.*
3. **Integration:** *Give priority to areas that contain multiple types of coarse-scale systems (e.g., terrestrial, aquatic and coastal) or areas that have targets at multiple spatial scales and levels of biological organization.*
4. **Functionality:** *"Functional" refers to the ability of a conservation area to maintain healthy, viable targets over the long term (100+ years), including the ability to respond to natural or*

human-caused environmental change (Poiani and others 2000). Areas should be functional or readily restorable to a functional condition.

5. **Irreplaceability:** *Areas with irreplaceable occurrences, or those that have no substitutes, should be included in the portfolio. Irreplaceable occurrences include those where targets are endemic to a single area, an only-known area for a target, one of the best-known areas for any target, concentrations of targets, or areas of high ecological integrity.*

6. **Complementarity:** *Favor areas that complement existing conservation areas, assuming that management plans on these lands are adequate for conserving the species and systems present.*

Areas of biological significance were delineated manually based on expert opinion, established conservation plans, and existing spatial data for fine filter targets. The process deviated from *Designing a Geography of Hope* by placing more emphasis on targets with habitat requirements at finer spatial scales than on coarse-scale targets in the ecoregions. Portfolio selection began with delineation of the most restricted habitat needs of fine filter targets (e.g. limited nesting habitat of Beringian marbled godwits). These areas were augmented with coarse-scale targets (e.g. spawning streams for pink salmon) and then regional-scale targets (e.g. caribou calving concentrations). The initial portfolio was then evaluated for how well it captured the coarse filter systems.

The Alaska Peninsula and Bristol Bay Basin ecoregions are ecologically intact, and characterized by functional ecological systems and wide-ranging species. In ecoregions such as these, there may be several viable portfolio "solutions" that meet conservation goals. The assessment team judged the portfolio in this report to be the best first iteration based on existing data and the knowledge and decisions of the experts involved in the process.

5. Data Sources, Management and Limitations

5a. Data Sources

Information about conservation targets and the ecology of the ecoregion was assembled from existing data sources (maps, literature, data sets) and supplemented with expert opinion. Expert opinion was sought throughout the assessment process through individual interviews, group meetings, and expert workshops. The assessment team attempted to compile all pertinent available data sets regarding targets in the Alaska Peninsula and Bristol Bay Basin ecoregions.

A variety of GIS layers for assessment, analysis, and the production of maps were compiled for these ecoregions. Base data layers included transportation, hydrography, ecoregional boundaries, element occurrences, land status, surficial geology, digital elevation models and species data from many sources. Biological information on habitats, ranges and aggregations of targeted species were also compiled using published and unpublished literature, and information from scientific experts. Expert-generated spatial data and habitat descriptions were also used to augment datasets that did not cover the ecoregions. Due to time constraints, the objective during data assembly was to compile comprehensive ecoregional data sets from existing sources, rather than to assemble data sets from small areas in the ecoregion or to collect primary information.

5b. Data Management

In addition to assembling a GIS database, the assessment team compiled tabular information in an Access-based database created by The Nature Conservancy for ecoregional planning, called the Conservation Planning Tool (CPT). This relational database allows information related to the ecoregion to be stored in a central location. The CPT and data layers that are not restricted under data sharing agreements are available upon request. For a complete list of data sources as they relate to targets, see Appendix 11.

A comprehensive land cover map was not available for either ecoregion, therefore a statewide, coarse-scale data set based on ten major ecological systems throughout the state was used as a surrogate for the terrestrial ecological systems. Aquatic systems were modeled using existing hydrography data, elevation and surficial geology. For coastal systems, existing information from the Environmental Sensitivity Index consisting of shoreline classes was used in lieu of modeling systems. A CD compilation of modeled information is available upon request.

5c. Data Limitations

The assessment and portfolio design were based on the most current and comprehensive data readily available; however, comprehensive field inventories and basic data on species distribution and habitat in these ecoregions are limited. These data gaps necessitated a number of working assumptions. First, because published data are limited for many targets, the assessment team assumed expert information to be a workable substitute. Second, the assessment teams assumed that models were accurate enough to provide sufficient information at the ecoregional scale, although they were not ground-truthed. Third, data from a wide variety of sources were compiled and used in the assessment; the team merged the data regardless of collection time and scale. Finally, data for many targets are incomplete and thus assumptions were made based on modeled information.

The Alaska Peninsula and Bristol Bay Basin ecoregions have many species that commonly range throughout the ecoregions and beyond. Mapping habitats for these wide-ranging species presents a number of challenges. Wide-ranging species require large areas to meet habitat requirements and many habitats are not well known; thus habitat prioritization is difficult. For example, brown bears may have a home range of between tens and hundreds of square miles (ADFG 2000). Because population-level information and specific habitat area needs for many species that use large areas is not available, conservation goals for these species will need refinement over time and should be updated once area requirements and population dynamics are better understood.

A summary of the most significant data gaps and consequent methodological challenges is in itself an important product of the assessment process. Identification of data gaps provides salient research topics for biologists and conservation scientists. These gaps are documented in more detail in Appendix 13 of this report.

6. Ecoregional Assessment Team

The Alaska Peninsula and Bristol Bay Basin ecoregional assessment team consisted of representatives from The Nature Conservancy in Alaska, the Alaska Natural Heritage Program, the Conservancy's Freshwater Initiative, and the Conservancy's Wings of the Americas program. Staff from the Conservancy's Alaska office led taxonomic teams, information management and data compilation. The Freshwater Initiative performed the aquatic classification work.

A number of experts helped obtain information and provided input to the assessment. Scientists and land managers knowledgeable about the ecoregions reviewed assessment materials and attended the expert workshops (Appendix 1). Several meetings were held with individuals with taxonomic expertise. Experts assisted with selecting appropriate conservation targets, setting conservation goals, and mapping habitats and occurrences of targeted species. Experts also assisted in the delineation of areas of biological significance.

Participants in this assessment included representatives from Alaska Department of Fish and Game, US Geological Survey Biological Resources Division, US Fish and Wildlife Service, National Park Service, National Marine Fisheries Service, Alaska Natural Heritage Program, Bristol Bay Native Association, and Bristol Bay Native Corporation (see Appendix 1 for a full listing of participants and agencies involved). We are endebted to all of these experts for their time, commitment and excellent advice.

D. IDENTIFYING CONSERVATION TARGETS

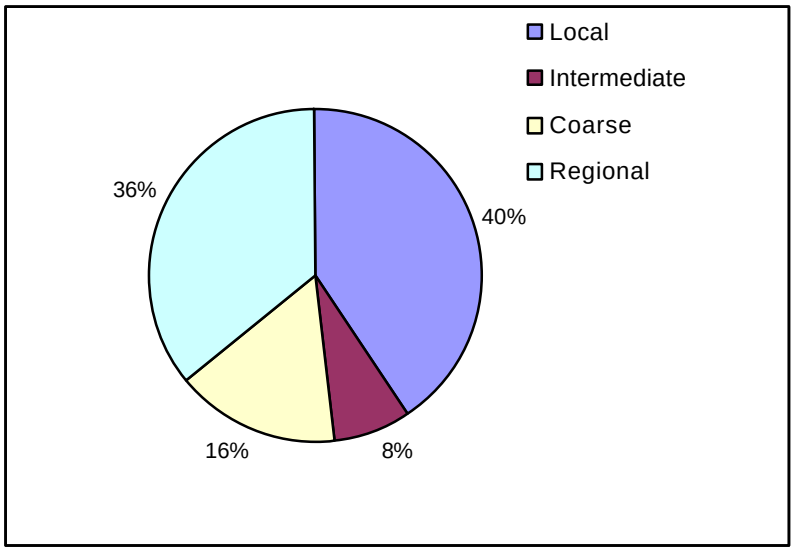
The ecoregional assessment began with the identification of conservation targets, using the coarse filter/fine filter approach. Between the two ecoregions, 227 conservation targets were selected; most of those targets occurred in both ecoregions. All mappable terrestrial, aquatic, and coastal systems were selected as conservation targets; whereas only select species—particularly those species endemic to the ecoregion, vulnerable or in decline—were selected. Certain important species aggregation areas were also chosen as species targets, even if they were not in decline. Plant communities were assumed to be represented by system targets; too little is currently known about their distribution in the ecoregions to make them meaningful targets.

The following table identifies the type and number of targets in the Alaska Peninsula (AP) and Bristol Bay Basin (BB) ecoregions. Many targets occur in both ecoregions; the final column tallies the total number of targets of the ecoregions as a whole. Species targets from all spatial scales were selected (Figure 8).

TABLE 1. Conservation targets

TYPE OF CONSERVATION TARGET	NUMBER OF TARGETS		
	AP	BB	TOTAL OF BOTH ECO-REGIONS
Ecological systems	**79**	**57**	**86**
Aquatic systems	59	37	65
Coastal systems	12	12	12
Terrestrial systems	8	8	9
Species	**129**	**122**	**134**
Birds	47	42	48
Crustaceans	1	1	1
Fish	16	15	16
Marine mammals	7	8	9
Plants	45	45	45
Terrestrial mammals	13	11	15
Species aggregations	**7**	**7**	**7**
TOTAL	**215**	**186**	**227**

FIGURE 8. Characteristic spatial patterns of conservation targets



1. Coarse Filter Targets

1a Aquatic Ecological Systems

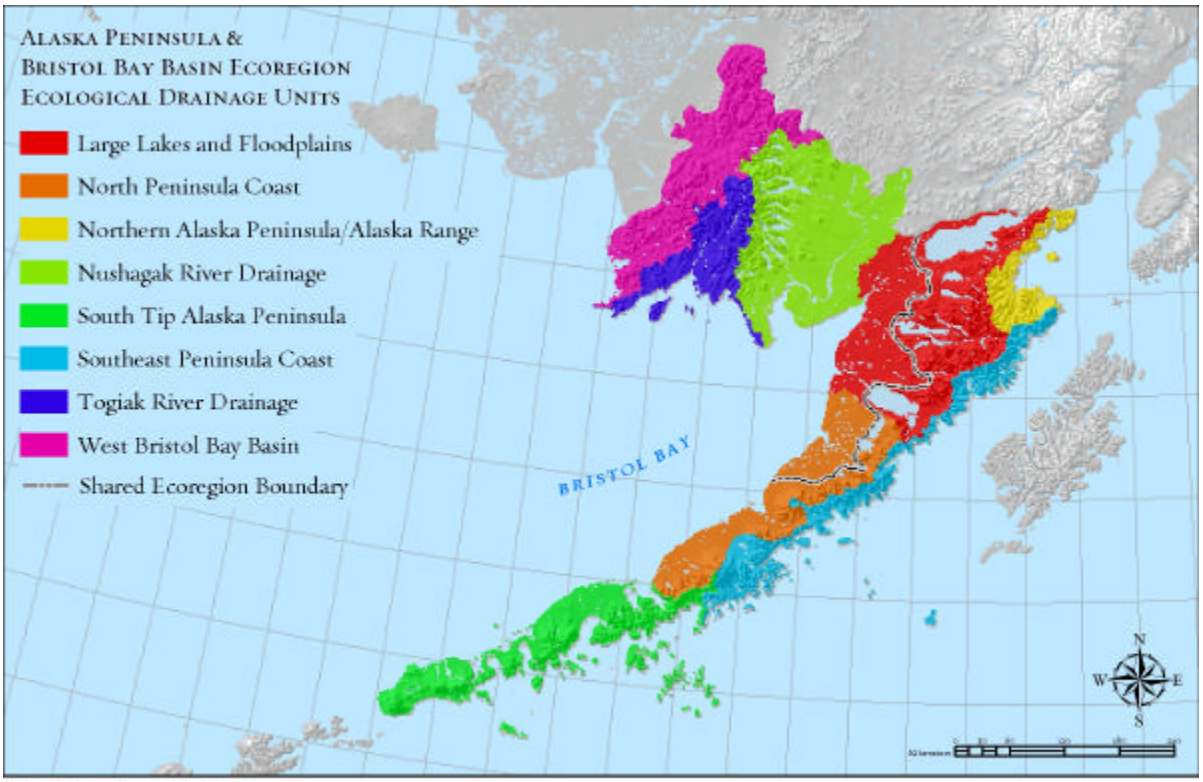
Aquatic systems are defined by distinct geomorphological patterns of stream and lake networks. Streams and lakes in a system must share similar environmental processes (e.g., hydrologic and nutrient regimes) and gradients (e.g. temperature), occur in the same part of a drainage network, and form distinguishable spatial units (Higgins 2003). These spatial units have characteristics potentially important for biotic assemblages, as well as for genetic and ecotype characteristics of species.

The aquatic systems analysis was designed to highlight factors that are likely driving variables in distinguishing aquatic environmental patterns and processes, which in turn determine the types and distributions of natural communities. Rather than define the fine-scale differences within and between riverine and lacustrine systems, the analysis seeks to characterize the potential for these differences. For example, rivers with well-developed floodplains have main channels, lateral channels, riparian floodplains, oxbow lakes, and intermittently connected lakes; the classification used in this assessment will merely distinguish a floodplain river from other river types, but not the components within them. This analysis assumes that modeled aquatic systems are adequate targets at the ecoregional scale and provide meaningful distinctions among classes that are likely important to freshwater biodiversity.

To account for the different freshwater environmental contexts within the ecoregions, the landscape was divided into eight ecological drainage units (EDUs): the Large Lakes and Floodplains EDU, the North Peninsula Coast EDU, the Northern Alaska Peninsula/Alaska Range EDU, the Nushagak River Drainage EDU, the South Tip Alaska Peninsula EDU, the Southeast Peninsula Coast EDU, the Togiak River Drainage EDU, and the West Bristol Bay Basin EDU (see Figure 9). EDUs are areas delineated by watershed boundaries that contain sets of aquatic ecological system types with similar patterns of climate, physiography, drainage density, hydrologic characteristics, connectivity and zoogeographic source, and occur within a zoogeographic region. Identifying and describing ecological drainage units

allows stratification of the ecoregion into smaller units to better evaluate patterns of aquatic diversity. Two EDUs (Large Lakes and Floodplains, and North Peninsula Coast) straddle the boundary between the ecoregions. The aquatic systems described in the Alaska Peninsula and Bristol Bay Basin ecoregions are nested within these EDUs.

FIGURE 9. Ecological drainage units



Albers Equal Area Projection

Source: TNC Freshwater Initiative

The classification of the ecoregions' aquatic systems, based on available data for hydrography, elevation, geology and glaciers, yielded 65 types. There were two main divisions among the river systems: those that had a glacial origin and those that had a non-glacial origin. The hydrologic patterns of glacial and non-glacial rivers are distinct. Glacial-fed rivers have very high peak flows and sediment loads during glacial melt-off; whereas the peak flows and sediment loads of non-glacial rivers are much lower.

Following the initial division of systems into glacial and non-glacial, subsequent classification was based on patterns of stream gradient, surficial geology, and connectivity to lakes, other rivers, or the ocean. If lakes were small and a component of a riverine network, they were not classified separately as lakes. Only lakes unconnected to riverine environments, or those over a given size class were classified as lakes. Lakes were classified using size, number of surface connections, surficial geology, elevation and glacial influence. The classification of aquatic systems for the Alaska Peninsula and Bristol Bay Basin ecoregions appears in Table 2 below. For further discussion of the aquatic classification process and maps of the each drainage unit, see Appendix 6.

TABLE 2. Aquatic ecological systems targets

GENERAL TYPE	AQUATIC SYSTEM CLASSIFICATION	AP	BB
GLACIAL	Alluvial streams that enter caldera lake not connected to river	X	
	Bedrock mainstems that enter glacial dam lake, not connected to river	X	X
	Braided rivers on old glacial outwash and moraine	X	
	Braided rivers on old glacial outwash and moraine with lake complex	X	
	Braided rivers on outwash or moraine, enter glacial headwater lakes	X	
	Braided rivers on volcanic alluvium and bedrock	X	
	Glacial streams on volcanic alluvium, bedrock, and coarse rubble	X	
	Glacial streams over volcanic alluvium or bedrock	X	
	Glacial streams transitioning into alluvial terrace	X	
	Moraine mainstems that enter glacial dam lake not connected to river	X	X
	Small glacial streams on bedrock or coarse rubble	X	
	Small glacial streams on volcanic mountain alluvium	X	
NON-GLACIAL	Alluvial streams that enter caldera lake	X	
	Bedrock mainstems that enter glacial dam lake	X	X
	Braided rivers on alluvial terrace on moraine	X	X
	Braided rivers on alluvial terrace on moraine connected to lakes	X	X
	Braided rivers on alluvial terrace on moraine with headwater lake	X	
	Braided rivers on moraine valley with tributaries on coarse rubble and bedrock	X	
	Braided rivers on moraine valley with tributaries on coarse rubble and bedrock connected to lakes	X	
	Braided rivers with tributaries on matrix of moraine, coarse rubble, and bedrock		X
	Floodplain rivers on moraine and old glacial outwash with headwater lakes	X	X
	Highly deranged drainages on moraine connected to lakes and to ocean		X
	Highly deranged stream network among lakes on old marine deposits	X	
	Highly deranged tributaries on moraine connected to lakes		X
	Large braided rivers in floodplain on old glacial outwash or moraine	X	X
	Large braided rivers in floodplain on old glacial outwash or moraine with headwater lake	X	X
	Large braided rivers on old glacial outwash channels or alluvial terraces	X	X
	Low gradient floodplain river on alluvial terrace.	X	X
	Low gradient large river with large morainal debris dam in headwaters		X
	Low gradient riverine delta on outwash and alluvial fan		X
	Low gradient rivers on a matrix of old glacial outwash	X	X
	Low gradient rivers on a matrix of old glacial outwash, connected to lakes	X	
	Low gradient rivers on moraine	X	X
	Low gradient rivers on moraine connected to lakes	X	X
	Low gradient streams on old glacial outwash	X	X
	Low gradient streams on old glacial outwash connected to lakes	X	X
	Low gradient streams on old glacial outwash with headwater lake	X	
	Low gradient streams on old marine and alluvial coast	X	X
	Low gradient streams on old marine and alluvial coast connected to lakes	X	X
	Low gradient, braided tributaries to riverine delta		X
	Mainstem in bedrock valleys	X	X
	Mainstem in bedrock valleys, connected to lakes	X	
	Moraine mainstems that enter large glacial dam lake	X	X
	Small streams on volcanic mountain alluvium	X	
	Small streams on volcanic mountain alluvium connected to lakes	X	
	Small streams on volcanic mountain alluvium with headwater lake	X	
	Streams on volcanic materials that enter caldera-type lake	X	
LAKE	Caldera, maar, or lava flow dam lakes	X	
	Glacial valley lakes, glacial influenced	X	

	Glacial valley lakes, non-glacial influenced	X	X
	High elevation bedrock mountain lake	X	
	Morainal depression lakes	X	
	Small and moderate sized lakes on lightly modified moraine	X	X
	Small and moderate sized lakes on marine sediments and alluvial outwash	X	X
	Small and moderate sized lakes on moderately and highly modified moraine	X	X
	Small lakes in old glacial outwash and floodplains	X	X
	Small lakes on bedrock	X	X
	Unconnected caldera, maar, or lava flow dam lakes	X	
	Unconnected glacial valley lakes, non-glacial influenced	X	
	Unconnected small and moderate sized lakes in lightly modified moraine	X	X
	Unconnected small and moderate sized lakes on marine sediments and alluvial outwash	X	X
	Unconnected small and moderate sized lakes on moderately and highly modified moraine	X	X
	Unconnected small lakes on bedrock	X	X
	TOTAL 65	**57**	**35**

1b. Coastal Ecological Systems

Coastal system targets are generally areas of high productivity that provide critical habitats for a range of species. In the Alaska Peninsula and Bristol Bay Basin ecoregions, coastal system targets include both ecological systems and vegetative communities. Vegetative communities are based on dominant plant type, such as eelgrass. Ecological systems are defined based on substrate and structural characteristics of the coastline. These systems often occur in discrete patches, share ecological processes, and can be delineated from maps of substrate and aquatic vegetation. A typical substrate feature identified on a map might be a rocky intertidal zone. In this assessment, 'coastal systems' will refer to both the 10 ecological systems and 2 vegetative communities used as targets.

A mixed classification system—one based on biotic and abiotic features—results in some overlap between targets. For example, eelgrass (*Zostera marina*) usually grows on intertidal and subtidal soft substrates (McRoy 1968) in protected bays and lagoons; therefore, protecting tidal flats, lagoon, or estuary systems may protect eelgrass beds. Eelgrass beds were considered as a separate target, however, from these systems in order to ensure that their more limited distribution was captured in the portfolio.

The identification and mapping of coastal system targets was dependent on available spatial data. For the coastal systems in these ecoregions, the primary source of spatial data used was the Environmental Sensitivity Index (ESI) (RPI 1982, NOAA 2001, NOAA 2002b). This classification and associated map was developed by the U.S. Minerals Management Service and National Oceanic Atmospheric Administration (NOAA 2002b). The ESI is a classification of shoretype (coastal morphology), and it was produced for use in analyzing vulnerability of the coastal environment to oil spills. In this assessment, ESI shoreline types were used as surrogates for coastal system targets. Appendix 7 contains a fuller description of ESI shoreline types and development of the data, as well as maps of the ESI in these ecoregions.

Table 3 lists the 12 coastal systems that were used as conservation targets in this ecoregional assessment. In addition to the ESI system types, 2 community level targets in the ecoregion could be mapped from existing data or expert workshops. The Alaska Intertidal Survey Atlas (Sears and Zimmerman 1977) locates eelgrass beds and kelp stands

(the main vegetation in the intertidal and subtidal algal forest system). Experts also mapped locations of eelgrass beds and kelp.

TABLE 3. Coastal ecological system targets

COASTAL SYSTEM TARGET	AP	BB
Coarse-grained sand beaches	X	X
Eelgrass beds	X	X
Exposed rocky shores	X	X
Exposed tidal flats (moderate biomass)	X	X
Exposed wavecut platforms	X	X
Fine to medium-grained sand beaches	X	X
Gravel beaches	X	X
Intertidal and subtidal algal forests	X	X
Mixed sand and gravel beaches	X	X
Sheltered rocky shores	X	X
Sheltered tidal flats	X	X
Tidal marshes and wetlands	X	X
TOTAL 12	**12**	**12**

1c. Terrestrial Ecological Systems

The Alaska Natural Heritage Program (AKNHP) describes 17 ecological systems that are known to occur within the Alaska Peninsula and Bristol Bay Basin ecoregions (Appendix 5). Ideally, a detailed and ground-truthed vegetation map would be used to model these systems; however, no complete map exists for either ecoregion. The Bristol Bay Mapping Project data sets have adequate spatial resolution and appropriate thematic classification, but are only available for *parts* of the ecoregions. Due to budget constraints, the assessment team chose to use the coarse-scale (1:2,500,000) Major Ecosystems of Alaska (MEA) data set to represent terrestrial systems for this iteration of the assessment (JFSLUPC 1973).

Of the 17 systems described by AKNHP, 4 systems were not modeled. “Bluejoint meadow” could not be modeled using any of the available data sets, and “marine aquatic and eelgrass beds,” “tidal marshes,” and “freshwater aquatic and lakes” were modeled with coastal or aquatic data. The thematic classification and scale of the MEA data was also not sufficient to depict the spatial distribution of all of the 13 remaining terrestrial systems; therefore, the MEA was used as a surrogate for the distribution of 12 terrestrial systems.

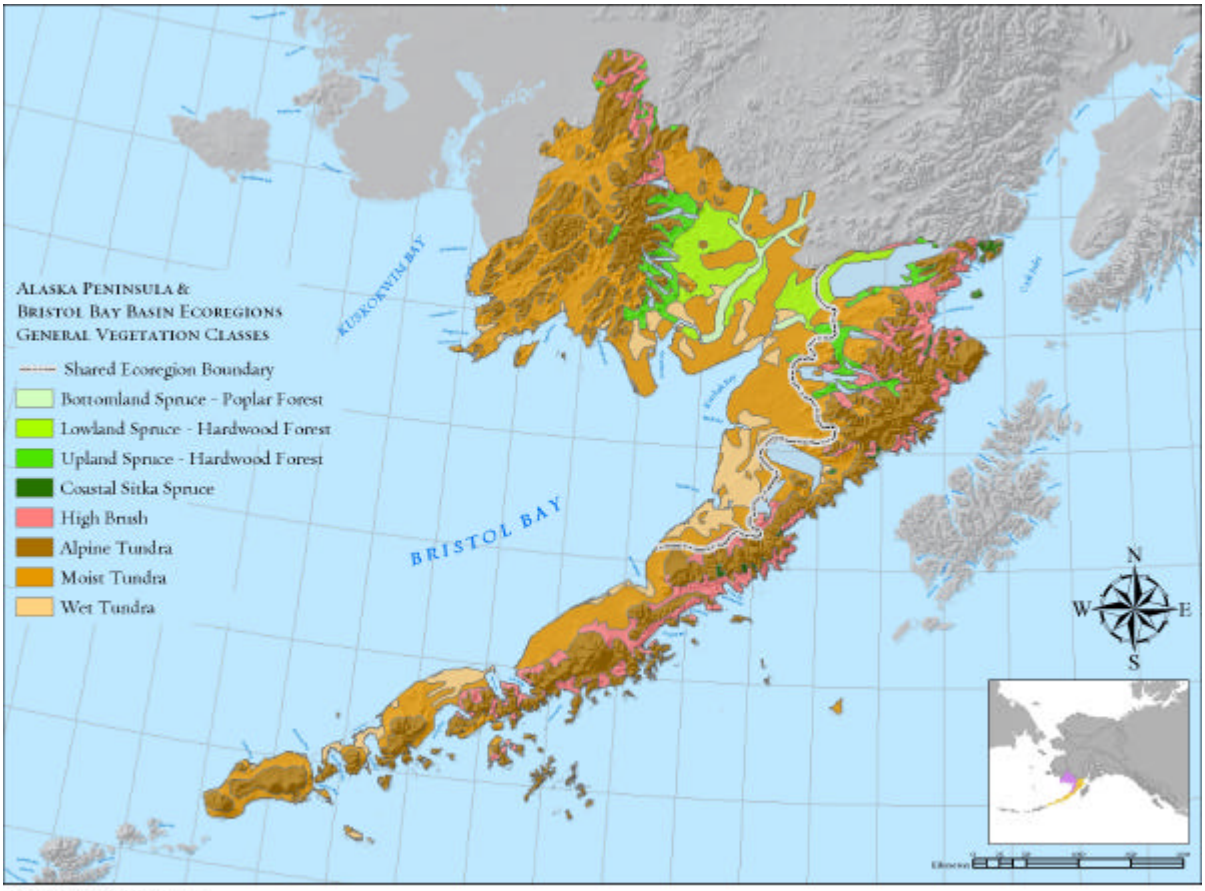
The 13th terrestrial system identified by AKNHP—floodplain/outwash plain—is described primarily by the geological substrate and not the vegetation. The fluvial classes of a surficial geology dataset (State Surficial Geology Map of Alaska (1964, 1:1,584,000), digitized by the National Park Service (2000)) were used as a surrogate for this system. The fluvial subclasses include floodplains, alluvial terraces, and the alluvial fans associated with the floodplains.

Table 4 lists the resulting 9 modeled terrestrial systems used as conservation targets in this assessment, along with the 13 AKNHP-defined systems from which the models were derived. See also Figure 10.

TABLE 4. Modeled terrestrial ecological systems targets

TERRESTRIAL SYSTEMS DEFINED BY AKNHP	MODELED TERRESTRIAL SYSTEMS USED AS TARGETS	AP	BB
Low shrub Alpine ericaceous dwarf shrubland Exposed bedrock/sparse vegetation	Alpine tundra and barren ground	X	X
White spruce forest and woodland	Bottomland spruce– poplar forest		X
Identified through the MEA data	Coastal forest	X	
Floodplain / outwash plain	Floodplain /outwash plain	X	X
Subalpine tall shrubland and avalanche chutes	High brush	X	X
Black spruce forest and woodland	Lowland spruce – hardwood forest	X	X
Tussock tundra Mesic herbaceous Wet sedge	Moist tundra	X	X
Birch forest and woodland White spruce forest and woodland	Upland spruce – hardwood forest	X	X
Wet herbaceous	Wet tundra	X	X
TOTAL 13	**TOTAL 9**	**8**	**8**

FIGURE 10. Modeled terrestrial ecological system targets



Albers Equal Area Projection

Source: Major ecosystems of Alaska by joint federal and state planning commission 1973

2. Fine Filter Targets

Species that are rare, have extremely restricted habitat requirements, are wide-ranging or migratory, or show high fidelity to a specific area year after year may not be adequately represented by the coarse filter. Such species may be included in the ecoregional assessment as fine filter targets. Fine filter targets were selected in consultation with biologists familiar with the ecology and species in these ecoregions.

Species under the following categories were included as fine filter targets:

- all species with Natural Heritage Program ranks of G1 to G3, T1 to T3, or S1 to S3 (see Appendix 3 for definitions of these ranks);
- all species listed as Threatened or Endangered under the Endangered Species Act; and
- species thought to be endemic to the ecoregion or state, or disjunct from the species' main population base.

In addition, several species considered to be declining, vulnerable, keystone, or wide-ranging were selected as targets. Definitions of these categories, however, are not agreed upon universally and so selection was subjective. The team relied on expert opinion and conservation plans by other organizations to determine which species would be considered declining or vulnerable. Table 5 outlines the definitions used in this assessment. The seasonal needs of some species groups (e.g waterfowl staging areas) were considered as a single target and are listed in Section 2f Species Aggregations.

The availability of spatial data determines the ability to use a particular species as a fine filter target. If specific information about the species' range, use of particular places, or preferred habitats was lacking, the assessment team could not consider the species' needs when designing the portfolio. Species that met one of the criteria in Table 5, but lacked spatial data or a habitat surrogate, were included in the target list but were not part of the portfolio selection process. Future research on these species may allow their inclusion in a subsequent iteration of the ecoregional assessment. See Appendix 8 for a list of these species.

TABLE 5. Criteria Used for Species Target Selection

CRITERIA	DESCRIPTION
G1-G3 / T1-T3 / S1-S3	Natural Heritage Program Global (G), Subspecies (T), and State (S) rarity rank
Federally-listed Threatened or Endangered	U.S. Endangered Species Act
Endemic to the ecoregion	Species with >75% of total geographic distribution, populations, or individuals that fall within the ecoregion
Endemic to the state	Species with >75% of total geographic distribution, populations, or individuals that fall within the state, and rely upon these ecoregions for part of their life cycle
Disjunct	Species does not occur in adjacent ecoregions
Documented declining	Species that exhibit significant declines in part of their range, are subject to a high degree of threat in multiple seasons, or have unique habitat or behavioral requirements that expose them to great risk
Keystone	Species whose impact on a community or ecosystem is disproportionately large for their abundance
Wide-ranging	Species whose seasonal habitat use and life history require vast areas
Vulnerable	Species with an aspect of life history that makes them susceptible to species-level declines
Species aggregation	Species concentration areas that are unique, irreplaceable, or critical to the conservation of a certain species or suite of species

2a. Bird Species

Bird targets were chosen based on several criteria: AKNHP global and state rank; federal and IUCN status; listing as species of concern by Audubon (NAS 2003), US Fish and Wildlife Service (Gotthardt and others 2002), Partners in Flight (BPFWG 1999, Pashley and others 2000), and/or the Alaska Shorebird Working Group (ASWG 2000); and vulnerability according to experts. In consultation with experts, 48 targets were selected from landbirds, seabirds, shorebirds, waterbirds, and waterfowl groups that spend some portion of their life cycle in the ecoregions. Bird species targets are listed below in Table 6. Aggregations of birds also warranted consideration as targets, and are noted in Section 2f below.

Landbirds

Several landbirds were identified as targets from the Landbird Conservation Plan for Biogeographic Regions (BPFWG 1999) and the Audubon Watchlist (NAS 2003). Several endemic birds reside in the ecoregions during part or all of their life cycle. McKay's bunting breeds on only two islands in the Bering Sea (outside the ecoregions) and winters only on the Alaska Peninsula. The range and distribution of most landbirds in the ecoregion is little known or studied at this time. Eleven landbirds were selected as targets.

Raptors

Four raptors were selected as targets due to their state rank and vulnerable populations in the rest of the United States. One of these 4 species, the gyrfalcon (*Falco rusticolus*), is identified as a priority species by Boreal Partners in Flight (1999).

Seabirds

Seabirds are attracted to the unique environments that these ecoregions provide, such as the shallow waters of Bristol Bay for feeding and the rocky Gulf coast of the Alaska Peninsula for nesting. Many seabird species that use these ecoregions are considered vulnerable in some or all of their ranges in Alaska and were therefore selected as fine filter targets. These include Kittlitz's murrelet, Aleutian tern, 2 species of cormorants, and pigeon guillemot (*Cephus columba*). Aleutian terns, which breed only in Alaska (USFWS 1979), nest in flat wet meadows or sand or gravel flats (USFWS 1992); both places are very susceptible to human and natural disturbances. Some seabirds congregate during the breeding season, thus seabird colonies were also included as species aggregation targets (see Section 2f below). Other seabirds, such as murrelets, remain dispersed throughout their life cycle, so less is known about nesting locations. The USFWS divides seabirds into 4 guilds based on feeding behavior (USFWS 2000); 2 of these guilds—surface and diving fish-feeders—are represented in the 8 seabirds on the target list.

Shorebirds

Most of the shorebirds identified as high priority in the Alaska Shorebird Conservation Plan (ASWG 2000) occur in western Alaska, which includes these two ecoregions and the Yukon and Kuskokwim deltas further north. The intertidal habitats and wetlands of the Alaska Peninsula and Bristol Bay Basin ecoregions provide important feeding stopovers for several species of migrating shorebirds, especially sandpipers (Wightman and others 2002). For example, great numbers of western sandpipers, rock sandpipers, dunlins, bar-tailed godwits, and short-billed dowitchers (*Limnodromus griseus*) stop at Port Heiden and Nelson Lagoon

in the Alaska Peninsula during the fall migration. Several shorebird species rely on various habitats in the ecoregions for breeding and wintering as well. The Beringian marbled godwit has a small, highly disjunct breeding population on the Bering Sea coastal plain of the Alaska Peninsula (Gotthardt 2002, ASWG 2000). The assessment team organized the shorebird targets into 3 broad guilds, according to each species' dominant habitat and seasonal use of the ecoregion.

Waterfowl and Waterbirds

The lowlands, lagoons, and estuaries surrounding Bristol Bay provide prime migrating, wintering, and/or breeding habitat for many species of waterfowl (ducks and geese) (USFWS 1999) and waterbirds (loons and cranes). The 1998 update to the North American Waterfowl Management Plan (NAWMPC 1998) identifies Izembek Lagoon and the upper interior coast of the Alaska Peninsula as important waterfowl habitat area for North American birds. Nearly the entire black brant population spends as long as nine weeks at Izembek Lagoon before departing for wintering areas to the south (Derksen and Ward 1993). In the Bristol Bay Basin lowlands, as much as 25% of the North American population of greater scaup nests (Larned 2003). Coastal salt marshes in particular are important for waterfowl. Waterfowl concentration areas for different life cycle stages were identified as Species Aggregation targets (see Section 2f) to capture the broad habitat needs of this group of birds.

Several waterfowl species were also identified as fine filter targets because their exact habitats may not be sufficiently captured by the aggregation target. Audubon and USFWS have placed 4 seaducks and 2 geese that occupy these ecoregions on their Watchlist and Species of Concern Lists, respectively (NAS 2003, ASDWG 1999). The Aleutian Canada goose breeds primarily in the Aleutian Islands, but a small group nest in the Semidi Islands. Four other seaducks have state ranks that indicate vulnerability. The emperor goose, which migrates through and winters in the ecoregions, has been identified as an *extremely high priority* by the National Partners in Flight program (Pashley and others 2000). The only waterbird selected as a target—the red-throated loon—has shown significant population declines in western Alaska. Ten percent of the Pacific population of the red-throated loon breeds in the Bristol Bay lowlands.

TABLE 6. Bird targets

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	WHY CHOSEN	AP	BB
LANDBIRD						
Carduelis homemanni	Hoary redpoll ++	G5	S5B,S5N	PIF	X	X
Catharus minimus	Gray-cheeked thrush ++	G5	S3B	PIF, state rank	X	X
Contopus borealis / cooperi	Olive-sided flycatcher ++	G5	S3B	Audubon, state rank	X	X
Dendroica striata	Blackpoll warbler ++	G5	S3B	PIF, state rank	X	X
Euphagus carolinus	Rusty blackbird ++	G5	S4B	PIF	X	X
Lxoreus naevius	Varied thrush ++	G5	S5	PIF	X	X
Melopiza melodia amaka	Amak Island song sparrow ++	G5T2	S2	Endemic, state rank	X	
Phylloscopus borealis	Arctic warbler ++	G5	S5B	Endemic	X	X
Plectrophenax hyperboreus	McKay's bunting ++	G3	S3	Endemic, PIF, Audubon	X	
Troglodytes troglodytes semidiensis	Semidi Islands winter wren ++	G5T3	S3	Endemic, state rank	X	
Zonotrichia atricapilla	Golden-crowned sparrow ++	G5	S3N,S5B	PIF	X	X

RAPTOR						
Falco peregrinus anatum	American peregrine falcon ++	G4T3	S3B	State rank	X	X
Falco peregrinus pealei	Peale's peregrine falcon ++	G4T3	S3B	State rank	X	X
Falco rusticolus	Gyrfalcon ++	G5	S3	State rank , PIF	X	X
Haliaeetus leucocephalus alascanus	Bald eagle ++	G4T3	S3N,S3B	State rank	X	X
SEABIRD - DIVING FISH-FEEDER						
Cepphus columba	Pigeon guillemot	G5	S3B	State rank	X	X
Phalacrocorax pelagicus	Pelagic cormorant	G5	S5	Vulnerable	X	X
Phalacrocorax urile	Red-faced cormorant	G5	S5	Vulnerable	X	X
Uria aalge	Common murre	G5	S5	Declining	X	X
SEABIRD - SURFACE FISH-FEEDER						
Brachyramphus brevirostris	Kittlitz's murrelet	G3G4	S2?S3?	Global and state ranks, Audubon	X	
Brachyrampus marmoratus	Marbled murrelet ++	G3G4	S2S3	Global and state ranks	X	
Rissa tridactyla	Black-legged kittiwake	G5	S3N,S5B	State rank	X	X
Sterna aleutica	Aleutian tern	G4	S4B	Vulnerable	X	X
SHOREBIRD - ROCKY COASTLINE (RESIDENT OR WINTER)						
Aphriza virgata	Surfbird ++	G5	S3?N,S5?B	State rank, ASWG, Audubon	X	X
Calidris ptilocnemis	Rock sandpiper ++	G5	S5?	ASWG, Audubon	X	X
Haematopus bachmani	Black oystercatcher ++	G5	S5	ASWG, PIF	X	X
Heteroscelus incanus	Wandering tattler ++	G5	S4B	ASWG	X	X
SHOREBIRD - TIDAL FLATS (MIGRATE)						
Limosa haemastica	Hudsonian godwit ++	G4	S3B	State rank, ASWG, PIF	X	X
Limosa lapponica	Bar-tailed godwit ++	G5	S3B	State rank, ASWG	X	X
SHOREBIRD - TUNDRA MEADOWS (BREED AND/OR MIGRATE)						
Arenaria melanocephala	Black turnstone ++	G5	S3N,S5B	State rank, ASWG, PIF	X	X
Calidris alpina	Dunlin ++	G5	S3N,S5B	State rank, ASWG	X	X
Limnodromus griseus	Short-billed dowitcher ++	G5	S5B	ASWG, Audubon	X	X
Limosa fedoa beringiae	Beringian marbled godwit	G5T3	S3?B	State rank, ASWG, PIF, Audubon	X	X
Numenius phaeopus	Whimbrel ++	G5	S5B	ASWG	X	X
Numenius tahitiensis	Bristle - thighed curlew ++	G2	S2B	Global and state ranks, ASWG	X	X
Pluvialis fulva	Pacific golden plover ++	G5	S5B,SAN	ASWG	X	X
WATERBIRDS – LOON						
Gavia stellata	Red throated loon	G5	S3B,S3?N	State rank, declining	X	X
WATERFOWL – GOOSE						
Branta canadensis leucopareia	Aleutian Canada goose	G5T3	S3B	State rank, USFWS	X	
Branta nigricans	Black brant	G5T	S3N,S5B	State rank, Audubon	X	X
Chen canagica	Emperor goose	G3G4	S3S4B,S3S 4N	Global and state ranks, PIF	X	X
WATERFOWL – SEADUCK						
Aythya marila	Greater scaup ++	G5	S5B	Vulnerable	X	X
Clangula hyemalis	Long - tailed duck	G5	S2B, S3N	State rank, Audubon, USFWS	X	X
Histrionicus histrionicus	Harlequin duck ++	G4	S3S4B,S3S	State rank	X	X

			4N			
Melanitta fusca	White - winged scoter ++	G5	S2S3B,S2S3N	State rank		X
Melanitta nigra	Black scoter	G5	S2S3B,S2S3N	State rank, Audubon, USFWS	X	X
Melanitta perspicillata	Surf scoter ++	G5	S2S3B,S2S3N	State rank	X	X
Polysticta stelleri	Steller's eider	G3	S2B,S3?N	State rank, Threatened, USFWS	X	X
Somateria spectabilis	King eider	G5	S2S3B,S2S3N	State rank, Audubon, USFWS	X	X
TOTAL 48					**47**	**42**

PIF: Partners in Flight priority species (BPFWG 1999); Audubon: Audubon Watchlist (NAS 2003); ASWG: Alaska Shorebird Working Group (ASWG 2000); USFWS: Species of Concern (Gotthardt and others 2002). See Appendix 4 for a complete list of bird species and selection criteria.
++ Spatial data lacking for this species so target not included in analysis of portfolio.

2b. Fish and Crustacean Species

Although the coarse filter dominated the analysis of aquatic and coastal biodiversity in the ecoregion, fine filter targets were also used to provide conservation focus to certain fish and crustacean species. Sixteen fish species were chosen as conservation targets (Table 7). The 5 Pacific salmon species were selected because there is some concern that their populations are declining or vulnerable, and in other parts of the western United States some of these species are listed as Endangered Species. In addition, salmon and the other anadromous species are considered keystone species by some biologists. As transporters of important nutrients from marine to freshwater systems, these species are ecological drivers of freshwater systems. They are also an important prey species to a wide variety of terrestrial and marine species. Their reliance on a wide variety of habitats throughout their life cycle also means that protection of their habitat results in the protection of other, less-studied aquatic species as well.

The freshwater fish species were chosen primarily based on expert opinion; generally the distribution and habitat use of these species are better understood. Northern pike (*Esox lucius*) are native to these ecoregions (Dye and others 2002). Experts nominated 3 species of whitefish (*Coregonianae* subfamily) as sensitive and keystone species. Spatial data on the distribution and habitat use of whitefish does not exist, but these species remain as a target for future iterations of the assessment.

Pacific herring were selected as the only marine fish species target due to their importance as a prey species for marine mammals and the availability of spatial data on their spawning grounds. The largest herring spawning concentration in the state, and possibly the world, occurs at the mouth of the Togiak River in the Bristol Bay Basin ecoregion. Experts emphasized the ecological importance of forage fish in these ecoregions, but thought that other targets, such as sea ducks and eelgrass beds, capture the needs of forage fish.

The only crustacean chosen as a target is the red king crab, due to its reliance on the nearshore and coastal environments. Red king crabs spawn along the Bristol Bay side of the Alaska Peninsula, and juveniles rear in the nearshore areas around Bristol Bay, including inside the lagoons and estuaries along the Alaska Peninsula.

TABLE 7. Fish and crustacean targets

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	WHY CHOSEN	AP	BB
FISH - ANADROMOUS						
Oncorhynchus gorbuscha	Pink salmon	G5		Endangered, keystone	X	X
Oncorhynchus keta	Chum salmon	G5		Endangered, keystone	X	X
Oncorhynchus kisutch	Coho salmon	G5		Keystone	X	X
Oncorhynchus nerka	Sockeye salmon	G5		Declining, keystone	X	X
Oncorhynchus tshawytscha	Chinook salmon	G5		Vulnerable, keystone	X	X
Osmerus mordax	Rainbow smelt	G5		Keystone	X	X
Salmo gairdneri	Steelhead	G5	S?	Disjunct	X	
Salvelinus malma	Dolly varden	G5	S5	Endangered	X	X
FISH – RESIDENT FRESHWATER						
Coregoninae subfamily of Salmonidae	Whitefish species ++	G4-G5		Keystone, vulnerable	X	X
Esox lucius	Northern pike	G5	SE4?	Keystone	X	X
Lota lota	Burbot	G5		Declining	X	X
Oncorhynchus mykiss	Rainbow Trout	G5	S?	Vulnerable	X	X
Salvelinus alpinus	Arctic Char	G5	S5	Keystone	X	X
Salvelinus namaycush	Lake Trout	G5	S5	Vulnerable	X	X
Thymallus arcticus	Arctic Grayling	G5	S5	Vulnerable	X	X
FISH - MARINE						
Clupea pallasi	Pacific Herring	G?	S?	Endangered	X	X
TOTAL 16					**16**	**15**

CRUSTACEAN						
Paralithodes camschatica	Red king crab			Vulnerable	X	X
TOTAL 1					**1**	**1**

++ Spatial data lacking for this species so target not included in analysis of portfolio.

2c. Marine Mammal Species

Nine marine mammal species were selected as targets based on notable declines and vulnerability or listing as an endangered species. Many marine species in the Bering Sea have experienced significant population declines in the last 50 years. The western population of the Steller sea lion, listed as endangered by the US Fish and Wildlife Service, resides throughout the Aleutians and the western Gulf of Alaska, including these two ecoregions. The sea lion currently uses 7 rookeries and 61 haulouts in the ecoregions, primarily located along the Gulf of Alaska coastline (NMFS 1993). The Northern sea otter population of the Aleutians, including the Alaska Peninsula, may soon be listed as threatened or endangered due to population declines (USFWS 2003). Harbor seal populations appear to be stable in Bristol Bay, but may be declining in the Gulf of Alaska (Small and others 2003, Boveng and others 2003). Beluga whales (*Delphinapterus leucas)* in Bristol Bay are a separate population from other stocks in the Bering and Chukchi Seas

(Frost and others 2002). Populations of most whales, porpoises, and walruses are difficult to assess due to their large movements and dispersed life style; these species are considered vulnerable and some have been listed as endangered. Porpoises and whales with low global or state ranks that use nearshore and coastal areas were included as conservation targets.

TABLE 8. Marine mammal targets

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	WHY CHOSEN	AP	BB
Delphinapterus leucas	Beluga whale	G4	S?	Vulnerable		X
Enhydra lutris kenyoni	Northern sea otter ++	G4T2T3	S2S3	Declining	X	
Eschrichtius robustus	Gray whale	G3G4		Endangered	X	X
Eumetopias jubatus	Steller sea lion	G3	S2	Endangered	X	X
Megaptera novaeangliae	Humpback whale ++	G3	S2B	Endangered	X	X
Odobenus rosmarus divergens	Walrus	G4	S2	State rank	X	X
Phocoena phocoena	Harbor porpoise ++	G4G5	S2S3	Vulnerable	X	X
Phoca vitulina	Harbor seal	G5	S3	Declining	X	X
Phoca vitulina - freshwater	Freshwater harbor seal			Vulnerable	X	
TOTAL 9					**8**	**7**

++ Spatial data lacking for this species so target not included in analysis of portfolio.

2d. Plant Species

Botanists from the Alaska Natural Heritage Program developed the target list for plant species (Table 9). Most were chosen because they are globally rare species or subspecies with low global and/or state ranks. Distribution of these vascular plants is known primarily through surveys conducted on federal lands, and the use of a particular plant as a target in one ecoregion does not suggest that the plant does not exist in the other ecoregion.

TABLE 9. Plant targets

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	WHY CHOSEN	AP	BB
Anemone multiceps		G3G4	S3S4	Global and state rank		X
Antennaria rosea s pulv		G5T?	S3S4	State rank		X
Aphragmus eschscholtzia		G3	S3	Global and state rank		X
Arnica amplexicaulis		G4	S3	State rank		X
Artemisia tilesii ssp u		G5T3	S3	State rank		X
Astragalus harringtonii		G5T3	S3	State rank		X
Atriplex alaskensis		G3G4Q	S3S4	State rank	X	
Botrychium ascendens		G2G3	S2	Global and state rank	X	
Cakile edentula ssp. Ed		G5T3T4	S3S4	State rank	X	
Carex eleusinoides		G4G5	S3S4	Rarity		X
Catabrosa aquatica	Brook grass	G5	S1	State rank	X	X
Cerastium regelii		G4Q	S2S3	State rank		X
Claytonia scammaniana		G3G4	S3S4	State rank		X
Cryptogramma stelleri		G5	S2S3	State rank		X

Douglasia alaskana	Alaska rock jasmine	G2G3	S2S3	Global and state rank	X	X
Draba corymbosa		G4G5	S4	Rarity		X
Draba fladnizensis		G4	S3S4	State rank		X
Draba lactea		G4	S3S4	State rank		X
Eleocharis nitida		G3G4	S1	State rank	X	
Eriophorum gracile		G5	S2S3	State rank	X	
Eritrichium aretioides		G4G5T5	S3S4	State rank		X
Festuca brevissima		G4	S3S4	State rank	X	X
Festuca vivipara		G4G5Q	S3S4	State rank		X
Minuartia elegans		G4G5	S4	Rarity		X
Novosieversia glacialis		G5	S4	Rarity		X
Oxytropis mertensiana		G4	S3S4	State rank		X
Papaver alboroseum	Pale poppy	G3G4	S3	State rank	X	
Papaver macounii		G4G5	S4	Rarity		X
Papaver walpolei		G3	S3	Global and state rank		X
Phyllospadix serrulatus		G3?	S2	Global and state rank	X	
Potamogeton subsibiricu		G3	S3	Global and state rank		X
Primula tschuktschorum		G2G3	S2S3	Global and state rank		X
Ranunculus kamchaticus		G4G5	S2S3	State rank		X
Romanzoffia unalaschens		G3	S3	Global and state rank	X	
Rumex beringensis	Rumex beringensis	G3	S3	Global and state rank	X	
Saxifraga eschscholtzii		G4	S3S4	State rank	X	X
Smelowskia pyriformis	Smelowskia pyriformis	G2	S2	Global and state rank		X
Stellaria dicranoides		G3	S3	Global and state rank	X	
Taraxacum carneocoloratum	Pink-flower dandelion	G3Q	S3	Global and state rank		X
Thalictrum minus		G5	S2	State rank		X
Thlaspi arcticum	Arctic pennycress	G3	S3	Global and state rank		X
Viola selkirkii		G5?	S3	State rank		X
Woodsia glabella		G5	S4	Rarity		X
Zannichellia palustris		G5	S3	State rank	X	X
TOTAL 44					**15**	**34**

2e. Terrestrial Mammal Species

The Wildlife Conservation Society (WCS) is developing a novel method for documenting and selecting focal species for conservation planning (Sanderson and others 2001; Coppolillo and others 2003). The Landscape Species Method focuses on those species that use large, ecologically diverse areas, have impacts on the structure and function of natural

ecosystems, and are susceptible to human alteration of wild landscapes. The assessment team used this approach in selecting terrestrial mammal targets, including a subset of wide-ranging and keystone species. Initially all terrestrial mammals were considered as candidates in order to 1) include species at all scales; 2) include species that perform important ecosystem functions that might be excluded otherwise; and 3) include species that rely upon one habitat type. Four criteria were used (area required, landscape heterogeneity, ecological functionality, and socio-economic significance) to rank candidates for landscape species. Candidate species were chosen based on their rank and a comparison of complementary and specialized habitat use. Using the Landscape Species Method and including all species endemic to the ecoregions or the state resulted in 15 terrestrial mammals as targets.

TABLE 10. Terrestrial mammal targets

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK	STATE RANK	WHY CHOSEN	AP	BB
Alces alces	Moose	G5	S?	Keystone	X	X
Castor canadensis	American beaver	G5	S?	Keystone	X	X
Gulo gulo	Wolverine	G4	S?	Vulnerable, wide-ranging	X	X
Lantra canadensis	River otter ++	G5	S4	Specialized habitat use	X	X
Lepus othus	Alaskan hare	G4?	S4?	Endemic to Alaska	X	X
Lynx canadensis	Canada lynx	G5	S4?	Wide-ranging	X	X
Marmota caligata	Hoary marmot	G5	S?	Specialized habitat use	X	X
Microtus pennsylvanicus	Meadow vole	G5	S?	Specialized habitat use	X	X
Microtus oeconomus amakensis	Amak Island tundra vole	G5T2Q	S2	Endemic to ecoregion	X	
Microtus oeconomus popofensis	Shumagin Island tundra vole	G5T3	S3	Endemic to ecoregion	X	
Rangifer tarandus	Caribou	G5	S?	Keystone, wide-ranging	X	X
Sorex vagrans shumaginensis	Popof Island dusky shrew	G?	S?	Endemic to ecoregion	X	
Sorex yukonicus	Alaska tiny shrew	GU	S?	Endemic to Alaska		X
Spermophilus parryii nebulicola	Shumagin Islands Arctic ground squirrel	G5T3	S3	Endemic to ecoregion	X	
Ursus arctos	Brown bear	G4	S?	Keystone, wide-ranging	X	X
TOTAL 15					**14**	**11**

++ Spatial data lacking for this species so target not included in analysis of portfolio.

2f. Species Aggregations

Species aggregation targets often represent critical life stages, such as staging and nesting, or important feeding areas. In the Alaska Peninsula and Bristol Bay Basin ecoregions, 7 bird species aggregation types were selected as targets (Table 11). Some shorebirds and waterbirds congregate in the same food-rich lagoons during their spring and fall migration or in protected, ice-free estuaries as wintering areas. One expert identified molting as the most critical stage of waterfowl life due to the vulnerability to predators and disturbance (Larned 2003). Seabirds nest along the coastline in single and multi-species colonies.

TABLE 11. Species aggregation targets

BIRD AGGREGATIONS	AP	BB
Seabird colonies	X	X
Shorebird nesting and breeding areas ++	X	X
Shorebird fall staging/stopover areas ++	X	X
Waterfowl molting areas	X	X
Waterfowl nesting areas	X	X
Waterfowl spring and fall staging/stopovers	X	X
Waterfowl wintering areas	X	
TOTAL 7	**7**	**6**

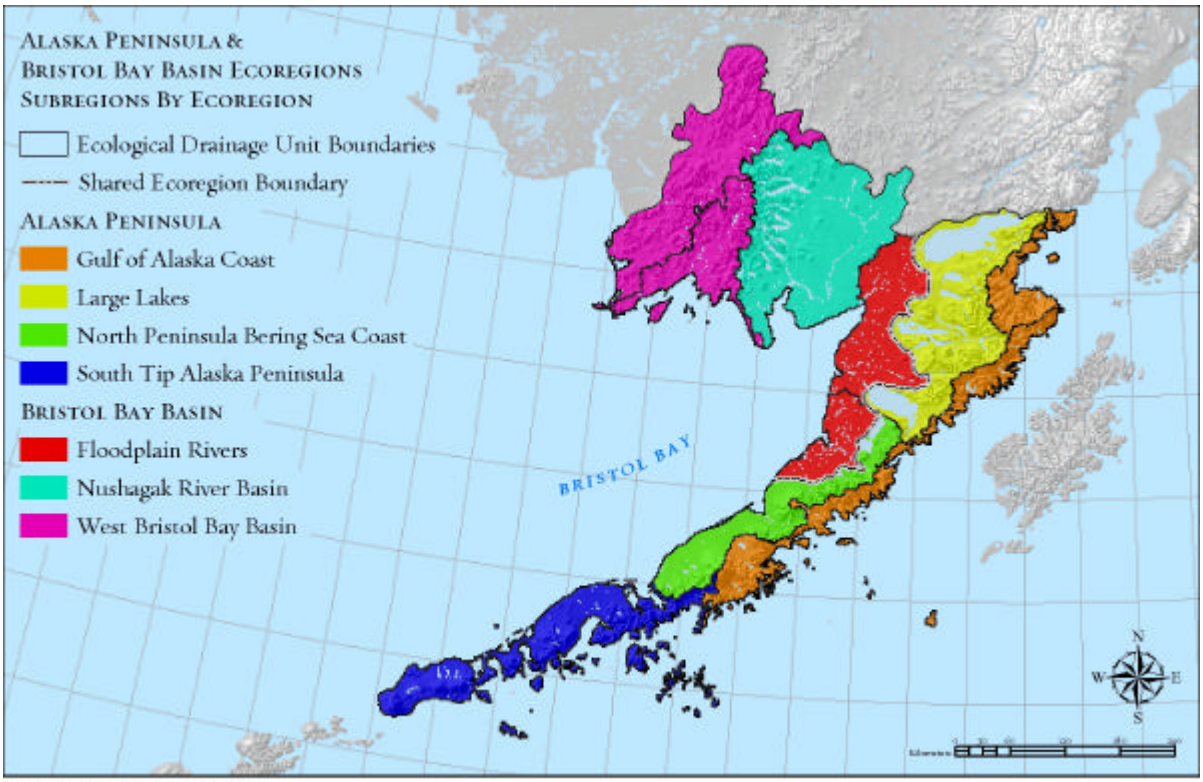
++ Spatial data lacking for this target.

E. SETTING CONSERVATION GOALS

As part of the assessment, taxonomic teams set conservation goals for all species, systems and species aggregations identified as conservation targets (for a complete listing, see Appendix 8). In setting goals, teams relied on existing literature, expert knowledge and existing spatial data pertaining to population size, life stages and habitat needs. The quality and availability of such information, however, varied greatly for many species. As a result, some goals were set using systems as surrogates for more specific habitats; others were set using mapped distribution data and numerical goals. If data did not exist for the target's full range within the ecoregions, goals were set only for the extent of the available data.

To account for adequate representation of heterogeneity across the ecoregions and to maintain adequate separation distances between occurrences in case of stochastic events such as disease or catastrophic disturbance, the ecoregions were stratified into subregions. Subregions were formed based on the 8 ecological drainage units (EDUs) (see Figure 10). Two EDUs straddled the ecoregional boundary; these two were split and the components combined with other EDUs wholly contained in the respective ecoregion (see Figure 11). Some EDUs within each ecoregion were also combined. Goals were set for targets in each of the 4 subregions in the Alaska Peninsula ecoregion and the 3 subregions in the Bristol Bay Basin ecoregion.

FIGURE 11. Subregions of the Alaska Peninsula and Bristol Bay Basin ecoregions



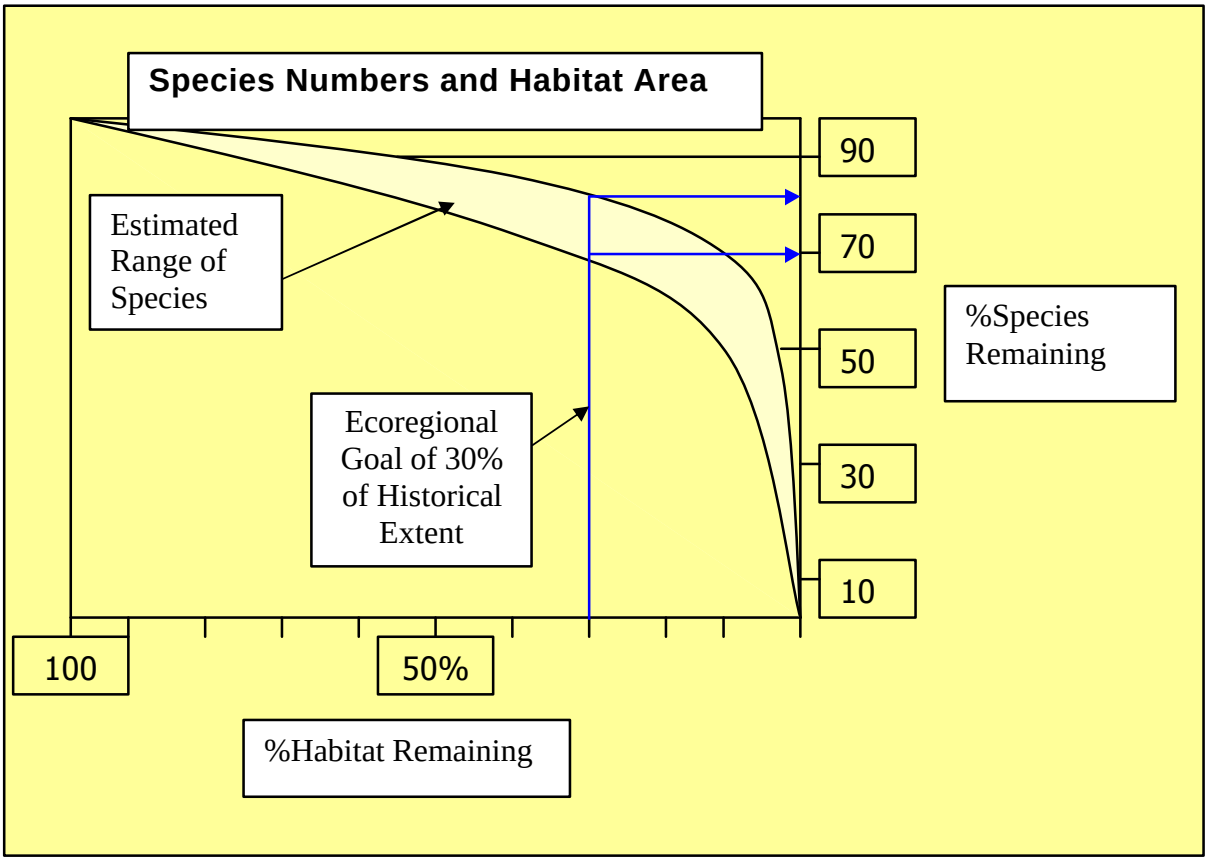
Albers Equal Area Projection

Sources: U.S. Geologic Survey and TNC in Alaska

1. Conservation Goals for Coarse Filter Targets

In this assessment, all conservation goals for ecological systems are based on the general correlation between the size of a sample area (island, lake, or other habitat patch) and the number of native species supported (Dobson 1996, MacArthur and Wilson 1967). This relationship is expressed mathematically as a species-area curve, and it describes the expected rate of change in number of native species with a corresponding change in available habitat area (Figure 12). Dobson (1996) suggests that by preserving 30% of the historical area of a particular system, one might expect to preserve 65% to 85% of the remaining native species. Which species are lost cannot be predetermined, but species requiring large areas or specialized habitats will be the most vulnerable to a 70% loss of habitat. The assessment team decided to use 30% of the current extent of all ecological systems as a conservation goal; however, this decision does not indicate approval of extensive habitat loss or extirpation of any species. Goal-setting for fine filter targets should ensure survival of vulnerable species and may indicate the need for more than 30% preservation of any given system.

FIGURE 12. Estimated species loss with % area of habitat loss over time (curve taken from Dobson 1996).



1a. Aquatic Ecological Systems

Conservation goals for aquatic systems were set at 30% of the current extent of each aquatic system in each subregion (Appendix 8). The aquatics team assumed this would adequately represent the diversity of freshwater habitats, environmental gradients, and common and understudied elements of biodiversity present within the ecoregion.

1b. Coastal Ecological Systems

Another interpretation of the species-area curve is that species richness declines are greater when reserves fall below 20% of a particular region; this number is often used in marine reserve design (Beck and Odaya 2001). Because the size of marine reserves necessary for conservation is currently under debate (Ward and others 1999; Roberts and Hawkins 2000), the assessment team set a more conservative goal (30%) for coastal systems (Appendix 8). This goal remains consistent with an overall objective of conserving 30% of all systems in the ecoregions.

1c. Terrestrial Ecological Systems

Many terrestrial communities and systems maintain a characteristic landscape pattern as a result of disturbance regimes. It is assumed that for a system occurrence, or patch, to persist on the landscape, it must be large enough to contain by several-fold the spatial extent of typical disturbance events. In its classification of the 17 ecological systems in these ecoregions, the Alaska Natural Heritage Program recommended minimum dynamic areas or *mininum patch size* goals for each system. The coarse-scale of the vegetation data precluded the use of minimum patch sizes as part of the conservation goals for terrestrial systems. Each matrix-forming, large-patch system, and all small-patch systems were assigned a goal of 30% of the existing extent in each subregion where it occurred (Appendix 8). Application of the 30% area goal to small patch is not based on the species-area relationship, as teams interpreted this to apply to only matrix-forming systems. Instead, the 30% figure was chosen as an arbitrary but consistent means to compare representation of the varied array of targets.

2. Conservation Goals for Fine Filter Targets

As discussed in Section C “Methods,” current complete and specific data was unavailable for many fine filter targets in the Alaska Peninsula and Bristol Bay Basin ecoregions. In lieu of specific numbers of populations or known habitat locations by which to set a goal, the taxonomic teams attempted to set conservation goals for some species using specific habitat preferences. Unfortunately, these fine-scale habitats were also not mappable and so many fine filter target goals had to be based on modeled ecological systems. For these targets, primarily terrestrial mammals, this assessment provides a coarse-scale analysis. Many bird species, especially passerines, require fine-scale habitats that could not be linked to modeled ecological systems, therefore no explicit goals were set. Appendix 8 contains a complete list of conservation goals.

2a. Bird Species

Existing bird conservation plans, relevant literature, expert knowledge, and recommendations from the Conservancy's Wings of the Americas program were used as the basis for setting goals for birds (Mehlman and Hanners 1999). Conservation goals for bird species in the Alaska Peninsula and Bristol Bay Basin ecoregions fell into 4 categories, depending upon the availability and quality of spatial data.

Species for which spatial data could not be obtained were nested under a goal for species aggregation areas. For example, surf scoters (*Melanitta perspicillata)* and white-winged scoters (*M. fusca*) are known to congregate with other waterfowl at certain times of the year. Therefore, no explicit goal was set for these species, but protection of their habitats is assumed to occur if the waterfowl concentration area target goals are met. See Section 2f below for a description of conservation goals for species aggregation fine filter targets.

For species for which spatial data could not be obtained for the species or a group of similar species, no explicit goals were set. The assessment team noted the habitat utilized by these species to aid in including them in future iterations of the assessment, but for the current assessment, these species were not used in selecting areas of biological significance. All of the landbird and raptor species, as well as the marbled murrelet (*Brachyrampus marmoratus*) and most shorebird species, had no explicit conservation goal in this assessment.

For species for which no spatial data could be obtained but for which specific types of habitat could be identified and mapped with available data, the conservation goal equals the number of such places required to sustain a viable population equal to 100 individuals per subregion (Groves and others 2000). For example, red-throated loons (*Gavia stellata*) nest at lakes of an average size of 1.0 ha. Knowing that loons nest in pairs, the goal was set at 50 lakes of that size per subregion.

For species for which spatial data was available, the conservation goal was based on a specific number of known occurrences. For most species, these occurrences were concentration areas, such as colonies or staging areas. For seabird species, colonies must have a significant number, as determined by expert knowledge, of that species. For endemic species and those with G1-G3 or S1-S3 ranks, the goal was all known concentration areas. For all other species, Wings of the Americas recommended 2 concentration areas per subregion (Mehlman and Hanners 1999). This goal should preserve a network of areas for migration, nesting, and molting, which are important for conservation of many migratory species. For non-colonial birds, like the Kittlitz's murrelet, the goal was based on known nesting sites.

2b. Fish and Crustacean Species

Many of the fish target species are anadromous; they are wide-ranging species that use freshwater and marine habitats throughout their life histories. Successful conservation depends on consideration of their entire ranges of habitats. Due to the lack of information about important offshore marine habitats, this assessment considers only freshwater and estuarine habitats. The conservation goal was set at 2 river systems per subregion for each anadromous species. A river system was defined as the entire length of the river, from ocean or confluence to its headwaters. Headwater lakes were included for some species. The Anadromous Waters Catalog (ADFG 2002) documents presence of anadromous fish in river systems. The exception to this goal was steelhead, for which *all* known steelhead-

supporting river systems were chosen due to steelhead's limited distribution in the Alaska Peninsula ecoregion.

For resident freshwater fish species, the conservation goal was also 2 river systems or 2 lakes of specified size per subregion. River systems and lakes were prioritized based on various Alaska Department of Fish and Game fisheries management plans, the Southwest Alaska Rainbow Trout Management Plan (ADFG 1990), and expert opinion.

For marine species—Pacific herring and red king crab—the goal was based on an interpretation of the species-area curve developed for marine reserve design. Marine studies have shown species richness declines are greater when reserves fall below 20% of a particular region (Beck 2003). The assessment team set a goal of 20% of known nearshore (within 10 km) and coastal areas of use by these two marine species.

2c. Marine Mammal Species

In this assessment, consideration of marine mammal species was limited to the coastal components of species' life histories. Conservation goals for some marine mammal species were based on known coastal locations for certain life history stages. For example, the beluga whale was a target in the assessment, but conservation goals and portfolio design only considered those nearshore areas known to be important feeding areas. No explicit goals were set for 3 coastal species due to lack of data, but protection of habitat affinities is assumed to protect habitat for these species.

Explicit goals fell into two categories: *all* known haulouts over a certain size for pinnipeds, and 20% of known coastal use areas for whales. The latter goal is based on current work on marine reserve designs by Conservancy scientists, as noted earlier (Beck 2003).

2d. Plant Species

Conservation goals for individual plant species were set using the available location data. The goal was to capture all known occurrences in the ecoregions. Information on locations of plant species, their viability, and rangewide information was very limited and rare plant information should be considered a significant data gap in this assessment.

2e. Terrestrial Mammal Species

Setting conservation goals for terrestrial mammals, many of which are wide-ranging, proved to be a challenge. Information about home-range size of area-sensitive species, however, was useful in setting area goals for system targets associated with these mammal targets. Most of these targets have conservation goals of intact blocks of terrestrial systems, with the area based on the needs of a population (Appendix 8). This approach provides a coarse-scale analysis of a species' habitat needs, but may not address critical seasonal needs. For example, the conservation goal for brown bears (4,000 km^2 of intact systems) was successfully met, but brown bears may actually need additional acreage in more specific places to ensure viability over time. Bears are known to occur throughout the ecoregion, and they concentrate at different times at different locations (e.g. anadromous streams in summer and fall, sedge meadows in spring). As the population declines or as the suitable area declines, identifying specific locations becomes even more important.

Where data existed, conservation goals were based on known use areas. For American beaver, known high-density use areas in both ecoregions were used as the basis for area requirements. For the 2 ungulate species, area goals were based on capturing intact blocks

of terrestrial system targets and capturing 50% of known concentration areas. Caribou cows gather to calve in the tundra systems along the Bristol Bay side of the Alaska Peninsula each spring. The goal for caribou was 4,000 km^2 of unfragmented mixed tundra systems and 50% of the calving concentration areas included in the portfolio. For moose, wintering areas are especially vital to their survival; therefore, the conservation goal included 50% of known wintering areas and blocks of mixed forest and high brush systems (Aderman and others 2000).

2f. Species Aggregations

The aggregation targets represent critical life stages, such as staging, nesting and/or feeding for groups of bird species. Based on recommendations by the Wings of the Americas program (Mehlman and Hanners 1999), the assessment team set the conservation goal for all species aggregations at 2 known concentration areas per subregion for each particular phase of the species group's life cycle. The delineation of these concentration areas was based on expert information, US Fish and Wildlife Service seabird colony surveys, and Most Environmentally Sensitive Areas, adapted by the State of Alaska from the Alaska Habitat Management Guides. No comprehensive data, however, was available to analyze the specific seasonal use of shorebird concentration areas, thus no explicit goals were set for this group of birds.

F. PORTFOLIO DESIGN

The principal product of an ecoregional assessment is a map indicating areas of biological significance for the ecoregion. Referred to as a portfolio, this map is the outcome of an analysis of the distribution, goals, and viability of selected conservation targets, and it represents the areas that, if managed for biodiversity, will likely conserve the native species and ecological communities of the ecoregion.

The process of selecting sites can be a complex one. Computer algorithms are available, but the assessment team opted to delineate the portfolio manually for several reasons. First, terrestrial data at an appropriate scale for computer analysis was lacking. Second, the number of targets with data was limited. Third, the team anticipated that the large amount of land already in medium or high conservation status and the identification of important biological areas by others would be an adequate foundation for the portfolio. For these reasons, the benefits of using a computer-based tool did not outweigh the costs of training staff and preparing data for such a tool.

The assessment team assembled the portfolio for the Alaska Peninsula and Bristol Bay Basin ecoregions based on:

- areas identified by experts in workshops and reviews
- review of other published information on important areas within the ecoregion
- emphasis on fine filter targets

For a discussion of general criteria used in portfolio selection, please see Section C: "Methods."

1. Portfolio Selection Process

1a. Expert Workshops and Review

The assessment team relied on experts at several junctures to inform decisions about target lists, conservation goals, and portfolio selection. The team conducted two sets of expert workshops at King Salmon in the Alaska Peninsula ecoregion and Dillingham in the Bristol Bay Basin ecoregion. In total, approximately 30 scientists, noted for their expertise in the ecoregions, provided constructive feedback and supplemented the existing biological data on targets for the ecoregion (see Appendix 1 for list of participants).

In the first set of workshops in the summer of 2000, the experts focused primarily on conservation targets. They reviewed draft target lists, identified occurrences for targets and species aggregations, drafted conservation goals, and commented on long-term viability needs and threats to targets. They also delineated areas that are important for individual species, species groups, and multiple species in the ecoregions. The team recorded information about targets, threats, ownership, and additional experts.

The second set of workshops, held in April 2001, had multiple goals: refine targets and goals; develop aquatic targets and goals; analyze and rank viability of targets; develop a generalized list of threats and abatement strategies; identify data gaps and research needs; delineate areas of biological significance; and determine how the assessment could best

serve partners. At these workshops, experts were presented with draft target lists and goals and a draft portfolio of areas of biological significance based on the first workshops and other research by the assessment team. Experts identified key species within each draft area and delineated additional areas. Fisheries biologists located aquatic systems that should be included in the portfolio, identified fish targets within them, and prioritized drainages. The assessment team also presented the aquatics classification developed by the Freshwater Initiative for feedback from the experts.

At both sets of workshops, experts identified areas important to particular species or species groups or preliminary areas of biological significance. This information was delineated on base maps at a scale of 1:950,000 showing elevation and hydrography. Descriptive information such as target viability and status, important ecological processes, and threats were entered onto forms that corresponded with the mapped locations. The spatial information was digitized into a GIS and the tabular data entered into an Access database.

The assessment team continued gathering information on targets, goals, and occurrences in 2002. Spatial data from state and federal agencies was located for many targets. In December 2002, the team sent target lists, goals, and maps of available spatial data to 18 experts divided into 5 taxonomic groups: birds, anadromous and freshwater fish, marine fish and shellfish, terrestrial mammals, and marine mammals. Roughly half of these experts had participated in the earlier workshops and could assess how well the team had incorporated the information gathered at the workshops. The rest of the experts had not participated in the assessment previously and were able to provide additional knowledge about species and places in the ecoregions. These taxonomic groups met via teleconference to comment on the targets, goals, and spatial data. Groups added and deleted species from the target lists, refined conservation goals, provided status information, and located especially important places for targets. The fish group prioritized river systems for anadromous species as well as overall biodiversity. The bird group revised information on the 1:5,000,000 maps they had received and marked additional habitat usage. The assessment team entered the descriptive information into the Access database and digitized the additional spatial data into a GIS. This review led to the final target list and conservation goals.

1b. Conservation Lands Assessment

An efficient portfolio makes use of land already in conservation status and avoids, when possible, areas of development associated with private lands. In the Alaska Peninsula and Bristol Bay Basin ecoregions, conservation status of lands was assigned based on general land management status, a task regularly done by GAP programs across the country. Conservation status refers to the degree to which an area is managed to maintain biodiversity (Scott 1993). All lands were assigned to one of four categories, modified from national GAP categories (Caicco and others 1995).

Lands range from those that are managed as preserves and wilderness areas to those privately held and not explicitly managed for conservation. The categories used to assess conservation status were high, medium, low and none (Table 12). High conservation status lands include those lands that have an active management plan in place and allow for natural disturbance events to occur, including Nature Conservancy preserves, national parks and preserves and federally designated wilderness areas. Many state specially-designated lands (e.g. state park, state critical habitat areas, etc.) as well as national forests and USFWS refuges garnered a medium rank. Such lands are generally managed for natural values, but activities are allowed that may degrade the natural quality of the habitat (ADFG

1991). Low conservation status lands include other state-designated lands (e.g. state public use and recreation areas). All other public or private lands were assigned no conservation status. While these ranks differ from GAP categories and from a recent landscape assessment for Alaska (Duffy and others 1999), there was agreement by experts that they accurately portrayed the management of the land units in parts of Alaska.

Land status information (generalized to a minimum mapping unit of 640 acres) and state administrative boundaries data for the ecoregion were compiled from the Alaska Department of Natural Resources and Bureau of Land Management.

TABLE 12. Conservation status ranking based on land management

I. HIGH	II. MEDIUM	III. LOW	IV. NONE
The Nature Conservancy Preserves National Park and Preserve Federal Wilderness Area	National Wildlife Refuge National Wild and Scenic Rivers State Park State Critical Habitat Area State Preserve State Wildlife Refuge or Sanctuary State Game Sanctuary	State Moose Range State Public Use and Recreation Areas State Special Management Area State Game Refuge State Fisheries Reserve	Private Undesignated State University of Alaska BLM Military Native Lands Municipal Miscellaneous

The results of the conservation lands assessment indicate that 55% of terrestrial lands in the combined ecoregions have high and medium conservation status; while 45% have low or no conservation status (Table 13). In the Alaska Peninsula, the amount of land managed for conservation is 67%; the Bristol Bay Basin, on the other hand, only has 44% of lands in high or medium status. Over half the lands in Bristol Bay Basin have no conservation status; the vast majority of these lands are owned by the state.

This conservation lands assessment was completed only for the terrestrial lands within the ecoregions. Some federally-designated and state-designated areas reach into the marine waters of both ecoregions; however, marine waters were not included in the conservation lands assessment. See Figure 13 for a map of conservation status.

TABLE 13. Conservation status as percentage of total area

CONSERVATION STATUS	ALASKA PENINSULA	BRISTOL BAY BASIN	COMBINED ECOREGIONS
High	40	14	26
Medium	27	30	29
Low	<1	<<1	<1
None	32	56	44

1c. Building A Portfolio Based Upon Existing Conservation Lands

In *Designing a Geography of Hope*, Groves and others (2000) emphasize portfolio design based on existing conservation lands (high and medium conservation status). Because a majority of land in the ecoregions has high or medium conservation status, the assessment team planned to build a portfolio by simply augmenting existing conservation units with areas having high biodiversity value and/or high importance for certain species assemblages (e.g. salmon and migratory birds). The team found, however, that a high conservation status in a region does not necessarily equal high conservation of biodiversity.

Following Groves' recommendations, the assessment team analyzed the existing conservation lands for the amount of coarse filter system targets contained. Overall, the existing conservation lands achieve the conservation goals for the terrestrial, aquatic, and coastal systems, except in subregions with little or no federally or state-designated lands.

Then the assessment team added aquatic and coastal areas identified by experts and other conservation plans as having high biodiversity value and/or high importance for certain species assemblages (e.g. salmon and migratory birds). In order to take advantage of analyses by conservation organizations specializing in birds, the assessment team relied upon Audubon's Important Bird Areas (IBA) (NAS 2003) and information from the Alaska Shorebird Working Group (ASWG 2000) to identify places important for the conservation of seabirds, shorebirds, and waterfowl around Bristol Bay.

An overlay of the priority aquatic and coastal places reveals that the existing conservation lands exclude many of the important river systems and lagoons, bays, and estuaries necessary for the conservation of fish and bird species in these ecoregions (see Figure 14). Adding these places to the existing conservation lands results in an inefficient portfolio. Conservation goals for the majority of coarse and regional scale fine filter targets and system targets are met or overmet. A portfolio developed by augmenting existing conservation lands with habitat needs of species contains 81% of the terrestrial portion of the ecoregions. The assessment team decided that this approach to portfolio design does not adequately prioritize areas of biological significance in large intact landscapes with a large percentage of existing conservation lands. The national parks and wildlife refuges of Alaska are scenic and the epitomy of wilderness, but conservation of biodiversity was not the impetus for the creation of many of these conservation units.

1d. Building a Portfolio Based Upon Fine Filter Targets

The assessment team next approached portfolio design using an opposite approach: ignore land management and build the portfolio on the needs of the fine filter. Species with restricted ranges, specialized habitat requirements, or vulnerable populations would be given priority in portfolio selection. The assessment team assumed that the areal needs of coarse and regional scale species (e.g. brown bears, caribou, and salmon) and the inclusion of expert-identified priority areas would meet the conservation goals for coarse filter targets.

In this approach, portfolio selection began with mapping of the most restricted habitat needs of fine filter targets (e.g. limited nesting habitat of Beringian marbled godwits and islands with mammal and bird endemics). Then species targets with conservation goals of *all known occurrences* were considered. The majority of these places were coastal (e.g. pinniped haulouts, seabird colonies, and waterfowl concentration areas). Next, river systems identified as priorities for freshwater and anadromous fish were added. Lastly, known concentration areas to be used as seeds for areal needs of coarse and regional scale targets (e.g. caribou and moose) and known concentration areas for marine species (e.g. red king crab, gray whale) were drawn.

The assessment team's objective was to capture a majority of these mapped habitats and places in the portfolio, thus ensuring that conservation goals for the fine filter would be achieved. Audubon IBAs and Western Hemisphere Shorebird Reserve Network sites were used to delineate coastal areas for birds; some adjacent IBAs were combined and augmented for other species' needs and some IBAs were excluded due to redundancy. Existing land management plans were consulted to assist in prioritizing and selecting lands within existing conservation units (Appendix 14). The assessment team used watersheds (i.e. hydrological unit code boundaries) to define areas based on river systems. Areas

chosen primarily for the marine environments included an approximately 5 km wide strip of shoreline.

The assessment team evaluated this initial portfolio for how well it captured the coarse filter targets and found that most ecological systems were represented at the 30% level or greater. Additional areas were added to the Large Lakes subregion to increase terrestrial and aquatic system targets and lynx and caribou habitat.

This portfolio design process produced a draft portfolio similar to the one built upon the coarse filter and existing conservation lands because priority aquatic systems and important bird areas were included. This second process, however, provided a better framework for selecting portions of existing conservation lands. The assessment team chose this draft portfolio to submit to experts for review.

1e. Final Portfolio Design

The final portfolio was based on expert review. Four biologists, employed in the ecoregions by Alaska Department of Fish and Game and U.S. Fish and Wildlife Service, reviewed the draft portfolio. Their comments included deletion of 2 areas, addition of 2 areas, and boundary changes to several others to increase good habitat for some species and exclude less-than-prime habitat. The assessment team used the expert suggestions to produce the final portfolio of areas of biological significance.

To further prioritize conservation efforts within the portfolio, the assessment team defined cores of biological significance, buffer areas, and corridors. Cores encompass critical life stage habitat for target species or habitat for endemic, endangered and vulnerable species, including rare plants. Corridors provide the necessary connective routes between cores, and buffer areas constitute additional important areas for wide-ranging species and ecological systems and provide extra habitat protections in the event of large-scale disturbances such as volcanic eruptions.

The core focuses attention on critical elements of biodiversity. The shape and size of the cores are based on the fine filter target data that led to the area's selection. In areas chosen primarily for aquatic targets, rivers and lakes form the core. Likewise, areas with a marine emphasis have a core based on the marine portion of the area.

2. Portfolio Assembly Results

The total portfolio for the Alaska Peninsula and Bristol Bay Basin ecoregion comprises 12.4 million ha and it includes 38 areas of biological significance (Table 14, Figure 15). The terrestrial and freshwater portion of the portfolio is 9.2 million ha, with 8.3 million ha within the ecoregions. These terrestrial areas contain 62% of the ecoregions. Thirty-one areas of biological significance have a marine and terrestrial component. If managed with an eye toward conservation, these areas of biological significance should greatly contribute to the maintenance of biological diversity in the ecoregion.

The assessment resulted in a large portfolio for several reasons. First, many species targeted in the ecoregions, such as caribou, brown bear, lynx, and wolverine, have large home-range sizes. Home range refers to that area traversed by an individual in its normal activities of food-gathering, mating and caring for young. Other species in the ecoregions are migratory and require a network of areas for various life stages (e.g., migratory shorebirds). These large area requirements are reflected in the conservation goals that were set for each target (Appendix 8).

Second, larger areas have several advantages. Large areas are likely to contain a greater number of species than small areas, as well as larger populations of the species present (Meffe and Carroll 1997). Larger areas are more likely than small areas both to maintain genetic diversity through disturbance events and environmental stochasticities and to minimize edge effects (Primack 2000). Large areas also are more likely to contain heterogenous habitat patches.

Third, connectivity among isolated patches is important for the interchange of individuals among populations and may increase local and regional persistence of populations (Fahrig and Merriam 1994, Sjogren 1991 in Rosenberg et al. 1997). In the portfolio, the large areas of biological significance offer some connectivity among terrestrial areas. Further study may reveal that other areas are used as corridors.

Fourth, salmon play a crucial role in transferring nutrients from the marine environments to the freshwater systems. Effectively utilizing salmon as targets entails protection of entire river systems through which they pass in their lifetimes, from spawning grounds at headwaters to juvenile rearing in estuaries. Many of the priority salmon river systems identified by experts encompass vast areas.

Finally, it is important to note that several of the areas of biological significance identified in this ecoregional assessment lie partially in adjacent ecoregions, such as the Beringian Tundra and the Alaska Range ecoregions. These areas will be incorporated into adjacent ecoregional assessment efforts in the future. In the following analyses, results are reported only for elements *within* the Alaska Peninsula and Bristol Bay Basin ecoregions.

TABLE 14. Areas of biological significance

AREA	TOTAL AREA (HA)	AREA	TOTAL AREA (HA)
Amak Island	14,279	Nushagak	1,819,181
Aniak River	509,343	Nushagak Peninsula	130,667
Bechevin Bay and False Pass	95,800	Pavlof Bay	245,113
Belkofski	127,358	Port Heiden	284,465
Cape Seniavan	62,232	Port Moller	246,004
Caribou River	173,286	Puale Bay	65,768
Chignik	398,359	Sanak Islands	98,756
Chirikof Island	45,969	Sandy and Bear Rivers	139,772
Cinder River Flats	232,496	Sapsuk	42,143
Egegik-Becharof	561,277	Seal Islands	103,982
Goodnews Coast	387,733	Semidi Islands	66,959
Goodnews River	288,813	Shumagin Islands	600,669
Izembek-Morzhovoi-Cold Bay	359,372	Togiak Islands	230,169
Kamishak	791,013	Togiak River	356,169
Katmai Coast	512,864	Ugashik	276,883
Kvichak and Alagnak	683,936	Urilia Bay	83,717
Lake Iliamna	783,883	Wide Bay	143,665
Mother Goose Lake	53,514	Wood-Tikchiks	778,159
Naknek Lake Drainage	509,465	Yantarni	96,960
		TOTAL	12,400,193

FIGURE 13. Conservation status of lands

FIGURE 14. Existing conservation areas, important bird areas, and priority aquatic systems

FIGURE 15. Portfolio of areas of biological significance

G. ASSESSING THE PORTFOLIO

Once the portfolio of areas of biological significance was assembled, the team analyzed the portfolio to assess how well conservation goals were met for each target and to identify information gaps and future inventory and research needs. Multiple goals were set for some species based on seasonal needs, such as nesting, molting, and wintering. When summarizing results of targets based on multiple goals, each goal was considered separately and marked as met or unmet. Thus Tables 15-17 tally more goals than targets.

In the Bristol Bay Basin ecoregion, the conservation goals for 87% of species and system targets were met within the portfolio. The results by major target group show that 100% of goals were met for terrestrial systems, crustaceans, terrestrial mammals and species aggregations. Over 90% of aquatic and coastal systems goals and over 80% of birds, fish, and marine mammal targets goals were met. (See Appendices 9 and 10 for conservation goal achievement for each target.)

Results in the Alaska Peninsula ecoregion were similar, with 81% of species and systems goals met within the portfolio. Goals were met for 100% of coastal and terrestrial systems, crustaceans, terrestrial mammals, and species aggregations. For other target groups, results show that 85% of goals for fish targets were met, 70% for bird targets, and 50% for marine mammals.

Despite best attempts, some goals were not met. This may be the result of inappropriately set goals or lack of data to describe the locations of targets. More than 25% of the targeted species—mostly birds— were entirely unrepresented in the portfolio due to a lack of information about their location and distribution. Insufficient data for other species, like plants and some aquatic fish, prevented analysis throughout the ecoregions. The portfolio may capture the habitat needs of these targets, but the assessment team did not have the data to make that evaluation.

On the other hand, some goals were overmet by a large margin, signaling inefficiencies in the portfolio (Appendix 9). Large area requirements for wide-ranging species and entire anadromous rivers tended to sweep in many targets, especially ecological systems, far beyond their minimum goals. Overrepresentation of certain targets is the by-product of conserving species with large area requirements (e.g., brown bear, caribou). Planners must allow portfolio design to be driven by these requirements. Efficiency of the portfolio will be affected by the large area needs of these wide-ranging species.

Although some goals were undermet or overmet—most often due to gaps in information on species population numbers and the location of fine scale habitats—the portfolio identifies likely areas of biological significance in the Alaska Peninsula and Bristol Bay Basin ecoregions

TABLE 15. Summary of goals met

TYPE OF CONSERVATION TARGET	TOTAL NUMBER OF TARGETS	NUMBER OF TARGETS IN ANALYSIS**	ALASKA PENINSULA			BRISTOL BAY BASIN		
			# GOALS MET	# GOALS NOT MET	% OF GOALS MET	# GOALS MET	# GOALS NOT MET	% OF GOALS MET
ECOLOGICAL SYSTEMS	86	86	67	12	85	55	3	95
Aquatic systems	65	65	47	12	80	35	2	95
Coastal systems	12	12	12	0	100	11	1	92
Terrestrial systems	9	9	8	0	100	8	0	100
SPECIES	134	99	51	17	75	63	16	80
Birds*	48	16	16	7	70	15	2	88
Crustaceans	1	1	1	0	100	1	0	100
Fish	16	13	11	2	85	10	2	83
Marine mammals	9	6	2	2	50	4	1	80
Plants	44	44	8	6	57	23	11	68
Terrestrial mammals *	15	14	13	0	100	10	0	100
SPECIES AGGREGATIONS	7	5	5	0	100	4	0	100
TOTAL	**227**	**190**	**123**	**29**	**81**	**122**	**19**	**87**

** Multiple goals were set for some species based on seasonal needs, such as nesting, molting, and wintering, so the number of goals may exceed the number of targets.*

***The assessment team lacked data for all targets. This column represents the number of targets with conservation goals that were used in the portfolio design.*

1. Goal Assessment for Coarse Filter Targets

1a. Aquatic Systems

Of the 67 aquatic systems in the two ecoregions, 59 occur in Alaska Peninsula and 37 in Bristol Bay Basin. The conservation goals were met in the portfolio for 47 systems in Alaska Peninsula (80%) and 35 in Bristol Bay Basin (95%). All but one of these systems exceeded the 30% goal by a significant margin. This is likely a result of the large areal requirements for terrestrial species such as brown bear and the inclusion of entire river systems for salmon. Of the 14 systems not met, only 4 were missed by less than half of the 30% representation goal. These systems, all in the Alaska Peninsula, include three streams in the South Tip Alaska Peninsula subregion (which has the same boundaries as the EDU of the same name) and one lake system in the Large Lakes subregion. The majority of that lake system type occurs in two subregions in Bristol Bay Basin, where its conservation goals are substantially overmet.

1b. Coastal Systems

All coastal system goals were fully met in the portfolio for the Alaska Peninsula ecoregion, and all but 1 was met in Bristol Bay Basin. These overall results are likely due to the fact that the needs of fine filter targets that depend upon the coastline—seabird colonies, migratory bird stopovers, and pinniped haulouts—drove portfolio selection. The assessment lacked ecoregion-wide data for the one unmet system—Intertidal and Subtidal Algal Forest. The limited extent and coarse scale of the expert-identified locations of kelp beds that were

used to analyze that system may overestimate the extent of particular kelp beds while excluding other beds that may exist in the portfolio.

1c. Terrestrial Systems

All 9 terrestrial systems met the 30% conservation goal and exceeded it by a significant margin. These systems appear to be overmet for two reasons. First, the large areal needs of wide-ranging species like caribou and brown bear required large areas to be selected for the portfolio in each subregion. Second, the low number of classes in the data set, combined with its coarse scale, result in large areas for many of the data set classes. Future iterations of this assessment should employ more refined landcover data.

2. Goal Assessment for Fine Filter Targets

2a. Birds

Conservation goals were set for only 16 bird species, one-third of the total number of bird targets, because locational data was not available for all species. Multiple goals were set for most waterfowl, because they use different habitat for nesting, molting, migrating, and wintering. Thus Table 15 lists more goals than targets. Long-tailed duck, for example, use both ecoregions for wintering and nesting/breeding. All of the wintering and nesting/breeding areas within the Alaska Peninsula ecoregion were captured in the portfolio, but in Bristol Bay Basin, one nesting/breeding concentration area was not captured. The goal summary table records that these 2 goals for long-tailed duck were met in Alaska Peninsula, and only 1 of 2 was met in Bristol Bay Basin. The majority of conservation goals were met for waterfowl. Goals marked as unmet result from not capturing 1 or 2 seasonal concentration areas when all known concentration areas was the goal.

In general, for bird species targets unmet goals were primarily those requiring the capture of *all known* concentration areas. For example, the Beringian Seabird Colony Catalog records 65 significant colonies for pigeon guillemot (each with more than 90 pigeon guillemots) in the Alaska Peninsula ecoregion, but only 50 of these colonies are within the portfolio. Likewise, only 30 of the 37 black-legged kittiwake colonies in that same ecoregion are captured. Many of the unmet subregion goals occur in the South Tip Alaska Peninsula and Gulf of Alaska subregions, where seabird colonies are numerous. To include all of these colonies would have meant including most of the coastline. The goal of all known concentration areas may have been too ambitious in ecoregions that are largely intact.

2b. Fish and Crustacean Species

At the ecoregion level, goals of 2 river systems per subregion were met for all anadromous fish species, except dolly varden and rainbow smelt. For these 2 species, the portfolio probably contains sufficient river systems to conserve their populations, but the data to accurately determine this is lacking. All known occurrences of streams supporting steelhead are included in the portfolio. For the Pacific salmon species, anadromous streams were overrepresented as much as 4 to 6 times in the Alaska Peninsula ecoregion. Future iterations of this assessment would be improved by focusing on spawning and rearing areas, rather than entire anadromous streams.

Ecoregion goals were met for all resident freshwater fish species and for Pacific herring, the only marine fish species.

The known concentration areas of the only crustacean species considered in this assessment—red king crab—were well captured within the 10 km nearshore boundary of the assessment area. Over 60% of spawning, larvae, and early juvenile concentration areas occur in the portfolio.

2c. Marine Mammal Species

In the Bristol Bay Basin ecoregion, conservation goals were set for 5 pinnipeds and whales, and goals were met for 4 of these. In Alaska Peninsula, goals were only set for 4 pinniped groups and only 50% were met. Unmet goals in each ecoregion were for pinnipeds and may not have been achieved due to the ambitious nature of the goal – *all known* haulouts and rookeries in the ecoregions. Harbor seals use more than 220 locations to haulout in the ecoregions, with 179 occurrences in Alaska Peninsula alone. Over 77% of the Alaska Peninsula haulouts and 97% of the Bristol Bay haulouts fall within the portfolio. Steller sea lions use 32 haulouts and rookeries in the Alaska Peninsula, and 62% of these are within the portfolio. Goals for gray and beluga whales were significantly overmet in Bristol Bay Basin.

2d. Plants

Most of the goals for plants were met. For most plants, only 1 or 2 occurrences were known within the ecoregions. For those plants whose goals were considered unmet, they may be captured through the coarse filter. The lack of data does not allow us to draw any conclusions about whether or not conservation of this portfolio protects rare plants within these ecoregions.

2e. Terrestrial Mammals

As discussed in Chapters C and E, conservation goals were set for the entire ecoregion and then by subregion to ensure a distribution of habitat. At the ecoregion level, all goals were met for terrestrial mammals. The large areal needs of the regional-scale species (brown bear, caribou, wolverine, and Canada lynx) were exceeded by a substantial margin in most subregions. At the subregion level, however, goals for concentration areas for caribou and moose in the South Tip Alaska Peninsula and Gulf of Alaska subregions were unmet. Known concentration areas in these subregions were small in comparison to other subregions. At the ecoregion level, the portfolio included more than 50% of known caribou calving concentration areas and moose wintering areas.

2f. Species Aggregations

Of the 7 species aggregations identified as targets, conservation goals could be set and analyzed for only 5. Even though data did not exist to set and analyze conservation goals for shorebird concentration areas, the 2 bays that are part of the Western Hemisphere Shorebird Reserve Network in these ecoregions, plus 11 other bays and lagoons identified as important by the Alaska Shorebird Working Group, are included in the portfolio. The goals for waterfowl concentration areas and seabird colonies were met in all subregions and ecoregions in which they occurred. Goals were substantially overmet for seabird colonies and waterfowl spring and fall staging/stopover areas and wintering areas. This is due to the goals of *all colonies* for some individual seabird species and *all concentration areas* for some individual waterfowl species.

3. Goal Assessment by Subregion

General patterns emerged when assessing goals met by subregion (Tables 16 and 17, see Figure 11 for subregions). The Nushagak subregion has the greatest percentage of land included in the portfolio; therefore, all system goals were met, and overall goals were reached for most fine filter targets. Conversely, West Bristol Bay Basin subregion has the least percentage of land in the portfolio. That subregion is one of only 2 that is lacking 30% representation of one terrestrial system and the only subregion that is lacking 30% representation of any coastal systems.

The Gulf of Alaska subregion has the poorest results for several reasons. First, the subregion's configuration is composed of 2 EDUs and encompasses many small river systems. Due to the classification's bias toward watersheds, capturing 30% of each aquatic system would require the portfolio to include parts of most watersheds. In addition, this subregion is less diverse in terrestrial systems, so the failure to meet goals for one system lowers its overall results. For fine filter targets, this subregion has the lowest results for 3 species groups. These low results are due to the conservation goals of *all known colonies* for some seabirds, *all known haulouts* for pinnipeds, *and all known occurrences* of rare plants. What these results do not consider is how the existing conservation lands outside the portfolio protect these systems and species habitats.

Unmet goals may reflect the manual method used to design the portfolio design or ambitious goal setting or a combination of both. Certainly the manual method of selecting areas lacks the rigorous analysis that a computer algorithm could apply to goals for 190 targets. In addition, trying to capture all known occurrences for species that inhabit many places in the ecoregions may not be feasible and could result in an inefficient portfolio.

TABLE 16. Summary of goals met, by percentage per target type, in each subregion

TYPE OF CONSERVATION TARGET	ALASKA PENINSULA				BRISTOL BAY BASIN		
	SOUTH TIP ALASKA PENINSULA	GULF OF ALASKA COAST	NORTH PENINSULA BERING SEA COAST	LARGE LAKES	WEST BRISTOL BAY BASIN	NUSHAGAK RIVER BASIN	FLOOD-PLAIN RIVER
ECOLOGICAL SYSTEMS	76	88	89	77	84	100	93
Aquatic systems	67	85	83	70	85	100	88
Coastal systems	100	100	100	100	82	100	100
Terrestrial systems	100	80	100	100	86	100	100
SPECIES	78	62	90	83	73	88	94
Birds	70	67	100	67	92	80	100
Crustaceans	100	100	100	100	100	100	100
Fish	78	78	75	82	70	73	89
Marine mammals	0	0	100	100	80	100	100
Plants	100	20	100	50	62	92	0
Terrestrial mammals	100	75	86	100	78	100	100
SPECIES AGGREGATIONS	100	100	100	100	100	100	100
TOTAL	**78**	**77**	**90**	**80**	**79**	**94**	**94**

TABLE 17. Summary of goals met, by total number per target type, in each subregion

TYPE OF CONSERVATION TARGET	ALASKA PENINSULA				BRISTOL BAY BASIN		
	SOUTH TIP ALASKA PENINSULA	GULF OF ALASKA COAST	NORTH PENINSULA BERING SEA COAST	LARGE LAKES	WEST BRISTOL BAY BASIN	NUSHAGAK RIVER BASIN	FLOOD-PLAIN RIVER
ECOLOGICAL SYSTEMS	42	37	39	24	38	44	38
Aquatic systems	26	22	25	16	23	27	21
Coastal systems	11	11	8	1	9	9	9
Terrestrial systems	5	4	6	7	6	8	8
SPECIES	35	23	35	24	47	37	31
Birds	14	8	13	2	12	4	12
Crustaceans	1	1	1	1	1	1	1
Fish	7	7	9	9	7	8	8
Marine mammals	0	0	2	1	4	2	2
Plants	4	1	4	2	16	12	0
Terrestrial mammals	9	6	6	9	7	10	8
SPECIES AGGREGATIONS	5	3	4	1	4	3	3
TOTAL	**82**	**63**	**78**	**49**	**89**	**84**	**72**

4. Land Management and Conservation Status of Portfolio

The analysis of conservation status within the portfolio was limited to the terrestrial portions of the areas of biological significance inside the ecoregional boundaries. Public lands make up 85% of the portfolio (Figure 16, Table 18). Lands managed by the federal government constitute approximately 52% of the portfolio. The State of Alaska manages approximately 33% of the portfolio, with 23% of those lands having no designated use. Native organizations are the largest private landowners, with 14% ownership. Boroughs and private individuals (Native and non-Native) each own less than 1% of the lands in the portfolio.

The conservation status of the portfolio is shown in Figure 17. Forty-eight percent of lands in the portfolio are currently managed as high or medium conservation status; less than 1% are managed with a lower conservation status. Fifty-two percent of lands within the portfolio currently have no conservation status.

TABLE 18. Land management of the portfolio

LAND MANAGEMENT	PERCENTAGE OF ECOREGIONS	TOTAL AREA IN PORTFOLIO (HA.)	PERCENTAGE OF PORTFOLIO
State Lands (undesignated)	22%	1,957,415	23%
National Wildlife Refuge (non Wilderness)	24%	1,590,579	19%
Native Lands	12%	1,179,102	14%
National Park, Monument, & Preserve	14%	1,161,320	14%
Bureau of Land Management	10%	1,068,620	13%

State Park	5%	603,386	7%
National Wildlife Refuge (Wilderness)	12%	506,610	6%
Private	<1%	51,783	<1%
State Game Refuge	<1%	51,177	<1%
State Game Sanctuary	<1%	49,586	<1%
Native Allotment	<1%	46,719	<1%
State Critical Habitat Area	<1%	43,380	<1%
National Wild and Scenic River	<1%	16,664	<1%
State and Native Lands within Section	<1%	5,822	<1%
Bristol Bay Fisheries Reserve	<1%	4,086	<1%
Borough	<1%	2,262	<1%
Major Military	<1%	1,689	<1%
TOTAL	**100%**	**8,340,250**	**100%**

TABLE 19. Conservation status of the portfolio

CONSERVATION STATUS	PERCENTAGE OF ECOREGIONS	TOTAL IN PORTFOLIO (HA.)	% OF PORTFOLIO
High	26%	1,910,848	23%
Medium	29%	2,060,725	25%
Low	<1%	55,263	<1%
None	44%	4,313,412	52%
TOTAL	**100%**	**8,340,250**	**100%**

FIGURE 16. Generalized Land Status in the portfolio

FIGURE 17. Conservation Land status in the portfolio

H. HUMAN USE OF RESOURCES

For thousands of years, the native people of Alaska have relied upon the living and non-living resources of the Alaska Peninsula and Bristol Bay Basin ecoregions to meet their daily needs for food and shelter and their social and economic needs. That tradition continues today. Subsistence is an important aspect of the economy and the culture of the region. In comparison to state per capita averages, southwest Alaska residents harvest 2.5 times as much wild food (SWAMC 2003). Time spent in subsistence activities on the national wildlife refuges in these two ecoregions is equivalent to 750 jobs (Goldsmith 1998).

These subsistence activities in turn also contribute to the Alaskan economy through the purchase of fishing nets, rifles, snowmachines, and other supplies. Throughout Alaska, annual income from subsistence amounts to $60 million (Colt 2001). A healthy environment with a rich diversity of fish and wildlife is at the foundation of that subsistence.

A healthy environment is also at the foundation of many other aspects of the economy. Salmon spawning habitat, for example, supports the commercial and sport fishing industries. Wildlife and vast wild landscapes draw tourists and recreationists. Large populations of caribou and bear provide excellent hunting for residents and non-residents alike, and land and resource management jobs employ local people. In 1997 the national wildlife refuges in these ecoregions alone generated, both directly and indirectly, approximately 3200 jobs and $127 million in personal income, with 92% of those jobs and income related to the commercial fishing industry (all refuge numbers from Goldsmith and others 1998). Excluding commercial fishing, over one-third of jobs were generated by sport fishing, and refuge management generated almost another third. Approximately 80% of the $5.2 million in annual payroll generated by recreational activities on the refuges came from non-resident sport hunters and anglers.

Survival of people in any place depends upon their ability to use natural resources, both living and non-living, in a way that provides for immediate human needs while conserving resources for future generations. “Sustainable development” of any resource or man-made asset therefore means that the needs of the current generation are met without diminishing the ability of future generations to meet their needs (Larsen 1998). To use living resources sustainably, harvest levels must not harm total population survival. Scientists are continually refining their estimates of thresholds of resource use, beyond which species or systems will be irreversibly imperiled.

The use of any one natural resource will have consequences for other natural resources. For example, commercial and sport salmon fisheries reduce the number of spawning fish, remove a rich part of the food supply for bears, eagles, and other predators, and diminish the transport of nutrients to freshwater systems. ADFG biologists and managers set escapement goals (i.e. thresholds) to ensure that sufficient numbers of salmon are allowed upstream to accomplish these other roles. If scientists have set the thresholds correctly and escapement goals are met, salmon fisheries are a compatible use of salmon and do not adversely impact other resources. Human resource use becomes incompatible when the use of one resource results in unsustainable loss to another resource, either through over-harvest of the desired resource or negative impacts to the other resource. Such incomptible use ultimately has serious consequences for humans as well as fish and wildlife. Appendix 12 presents information on a number of human activities in the Alaska Peninsula and Bristol Bay ecoregion and the ways they may become incompatible and have negative impacts on the diversity of fish and wildlife in these ecoregions.

I. CONCLUSIONS AND RECOMMENDATIONS

Ecoregional assessment is the first step in the Conservancy's four-step conservation process. The assessment identifies conservation priorities at a coarse scale; subsequent steps focus on cooperative conservation action at areas of biological significance. The assessment's identification of key systems and species, spatial requirements for their survival, and potential stresses is intended to be a guide for interested stakeholders, as well as the Conservancy, in setting priorities and developing their own strategies for conservation.

The following are conclusions and recommendations that various stakeholders, as well as Conservancy staff, may find useful in both developing conservation action and studies and planning for conservation in intact landscapes. Turning these recommendations and the assessment as a whole into conservation action will require the work of many: private landowners, government agencies, land use planners, civic leaders, concerned citizens and non-governmental organizations. The Conservancy looks forward to working cooperatively with these and other stakeholders to translate this assessment and future iterations into long-lasting conservation success on the ground.

Recommendations for Conservation of Biodiversity in the Alaska Peninsula and Bristol Bay Ecoregions

1. The ecological requirements of many species and ecological systems in these ecoregions (e.g., wide ranging species) result in a portfolio that captures a great deal of land and water. To prioritize conservation efforts, the assessment team defined *cores* within larger areas of biological significance (see Chapter F). The cores are places consistently used by species for particular purposes, such as spawning or calving. These places are less interchangeable than the buffer lands that compose the remainder of each area of biological significance.

> **Recommendation:** Use the cores of the portfolio to prioritize which lands and waters within an area of biological significance should be protected or managed for conservation values. Ensure public and private land owners manage the identified core areas primarily to conserve their natural values. Direct land protection efforts (e.g., acquisition of land or conservation easements, conservation designation of public lands) to lands within the core areas identified in the portfolio.

2. An analysis examining how well the existing protected areas (e.g. state parks, federal wildlife refuges, etc) in the region capture habitat needs of the target species and ecological systems showed that the existing protected areas do not adequately represent the biodiversity of these ecoregions (see chapter F). Some priority rivers, bays and lagoons essential for migrating waterfowl and shorebirds (e.g. Kvichak and Nushagak Rivers, Ilnik Lagoon) lay outside the existing protected areas. These key areas may benefit from outright protection, adding to the size of the protected area network in the region. Alternatively, there may be areas where land exchanges between state and federal agencies or between federal and private entities makes the most sense for comprehensive yet efficient conservation.

Recommendation: Use the portfolio of areas of biological significance to identify candidate areas for land exchanges. For example, in some important areas, land owned by the federal government may be more suitable for development than tracts owned by private or state interests that are biologically important. We recommend a systematic analysis to identify potential exchange tracts and proposals to advance those exchanges.

3. Several declining and vulnerable species aggregate during phases of their life cycles. Survival of these species depends upon the quality of the habitats to which they return each year. For example, Beringian marbled godwits breed and nest on the coastal plain between Ugashik Bay and Port Heiden on the east side of the Alaska Peninsula. Male walruses haulout in the summer at Cape Seniavin, and harbor seals use numerous haulouts around Bristol Bay. USFWS identified Seal Islands and the lagoon as critical habitat for Steller's eider. Many of these areas are currently undesignated state lands (see Figure 6)

Recommendation: Focus attention on the habitat needs of declining and vulnerable species on undesignated state lands that intersect the portfolio. These areas are excellent candidates for Critical Habitat Areas, Special Use Areas, or Game Sanctuaries. Pursue administrative and legislative designations to conserve these habitats.

4. The State of Alaska and the Bureau of Land Management own more than a third of the portfolio and manage those lands in undesignated status (see Chapter F). Currently, both agencies are planning for the long-term management of their lands. BLM continues to adjudicate land selections by the state and Native corporations. This assessment provides biological information that these agencies may wish to apply to their planning and land conveyance processes.

Recommendation: Use the portfolio of areas of biological significance to help guide management decisions for public lands. For example, ADNR's Bristol Bay Area Plan, currently being revised, may provide an opportunity to reclassify state lands in the Nushagak area of biological significance in order to protect critical habitats for nesting waterfowl or spawning fish. As BLM completes its Ring of Fire plan and adjudicates land selections, the ecoregional assessment can help identify lands that should be given priority for conservation.

5. Within these ecoregions, local conservation organizations are protecting natural resources. These groups include watershed councils, land trusts, and tribal associations. There are many opportunities to collaborate with these organizations and bring regional and national resources to these local efforts.

Recommendation: Enhance work of local conservation partners such as the Nushagak Mulchatna Wood-Tikchik Land Trust, the Nushagak Mulchatna Watershed Council, and the Southwest Alaska Conservation Coalition, through technical support and training, collaboration on grant proposals, data sharing, and assistance with conservation or land use management plans, and assistance on land acquisition projects (i.e. fee simple or conservation easements).

6. A number of areas of biological significance in the Alaska Peninsula and Bristol Bay Basin ecoregions harbor significant conservation targets that depend upon natural hydrologic conditions. Riparian forest communities, wetlands, and aquatic communities in particular depend upon a supporting hydrologic regime. Research is needed to create baseline data and to help land managers understand these systems in order to effectively address the impacts of hydrologic alterations. Ecologically sustainable water management and instream flow reservations are two tools available for protecting freshwater biodiversity. Alaska is one of a few states in the nation in which private individuals and groups can file applications for reserving water for fish and wildlife habitat.

Recommendation: Collect the baseline data necessary to implement ecologically sustainable water management. Secure instream flow reservations in streams and rivers that are priorities for conservation of aquatic biodiversity.

7. A critical data gap for this assessment was the lack of a consistent, detailed, high-quality vegetation map. This would have been useful for delineating natural community types and key habitats for a number of species, which we were unable to represent accurately using existing data (see Chapter D for more information about the Major Ecosystems of Alaska data). Although the Bristol Bay Land Cover Mapping Project (USGS EROS 1999) provides land cover classification for most of the Alaska Peninsula and Bristol Bay Basin ecoregions, gaps in the coverage of the BBLCMP data precluded the team from using it to analyze terrestrial ecological systems for this assessment.

Recommendation: Produce a complete land cover map for southwest Alaska, either through the completion of the BBLCMP or a more comprehensive statewide project.

8. The assessment team used the Anadromous Waters Catalog, created and maintained by ADFG, to identify anadromous streams in these ecoregions (see section on fish targets in Chapter E). The electronic form of the catalog is not complete for the state because paper maps must be converted to digital format, resolution of stream delineation must be increased, and many additional streams and lakes need to be identified. Future iterations of this assessment and salmon conservation efforts in southwest Alaska will benefit from a more complete Anadromous Waters Catalog.

Recommendation: Continue digital conversion, improvement, expansion, and stewardship of ADFG's Anadromous Waters Catalog and improve biological management data, including escapement numbers and identification of spawning and critical rearing areas.

9. The availability of spatial data determines the ability to map a particular species. The assessment team identified non-game species as targets, but lack of locational information for most of these species precluded their use in portfolio selection. Currently, ADFG is focusing on non-game species in their Comprehensive Wildlife Conservation Plan. Federal funding available upon completion of that plan could address distribution and habitat use of non-game species. The National Park Service is conducting a limited inventory of primarily non-game freshwater fish and small mammals in southwest Alaska parks through the Inventory and Monitoring Program. Together, the ADFG and NPS projects could provide a more complete picture of non-game species in these ecoregions.

Recommendation: Use federal and state funds available to agencies to inventory non-game species in southwest Alaska and model habitat preferences.

10. The assessment team digitized several of the color maps in the Alaska Habitat Management Guides, which were produced by the State of Alaska in the early 1980s (ADFG 1985, ADFG 1986) to provide a source of information about species' life histories, habitat requirements, distribution, abundance, and human uses of fish and wildlife. The Alaska Habitat Management Guides are excellent sources of species information; unfortunately, most of the maps have not been digitized. Once digitized, the Guides could be easily updated by biologists and experts. Over time, the Guides could provide an historical record of changes in species distribution in these ecoregions and across the state.

Recommendation: Digitize and attribute all the maps in the Alaska Habitat Management Guides and update information through expert review. Provide on-going stewardship of this information.

11. The threats assessment in Appendix 12 describes current and potential stresses to targets and areas of biological significance. To better understand the impacts of individual factors and the cumulative effect of multiple factors, stresses should be mapped. A spatial stress analysis could facilitate creative solutions to conflicts between conservation and development needs

Recommendation: Map current and potential infrastructure and resource development in these ecoregions in relation to the portfolio and species' habitat data to identify current and potential projects that are incompatible with conservation of biodiversity and to inform land use decisions.

12. This assessment focused on the terrestrial, coastal, and aquatic elements of biodiversity in these ecoregions. Due to constraints of available data, expertise, and financial resources, the Conservancy could not address the marine portion of these ecoregions. Future assessments of these ecoregions should address the marine ecological systems and fish species.

Recommendation: Seek funding, possibly from the North Pacific Research Board, for marine habitat characterization and identification of important marine habitats in these ecoregions.

Recommendations for adapting planning methods to functional landscapes

The standards and methods for ecoregional assessment as outlined in the document *Designing a Geography of Hope* have been widely applicable and met the Conservancy's large-scale planning needs within the continental United States. In Alaska, however, and likely in other places characterized by intact, functional landscapes with wide-ranging species, applying the current ecoregional standards and methods has presented special challenges. Below are described several of the methods outlined in *Designing a Geography of Hope* that have been difficult to apply in functional, intact ecoregions. Obvious

methodological weaknesses discussed below represent major issues; other shortcomings may be present but not explicitly identified. Future assessments will need to address both as additional knowledge is gained and methods further refined.

Selecting Conservation Targets:

The outcome of a conservation assessment is highly dependent on the selection of target species and systems. The Conservancy's guidelines recommend selecting *all* terrestrial, freshwater and coastal systems, as well as a limited set of species, including among others rare, endemic, keystone and wide-ranging species. In southwest Alaska, few species are rare or endemic. There are, however, many species that may be considered keystone, wide-ranging or both. Unfortunately, these terms have no established and consistent definitions in scientific literature, and the assessment team could not find consistent criteria by which to assign species to these categories. Thus, determining a conservation target list for this ecoregion—according to the guidelines in *Designing a Geography of Hope*—was challenging. To overcome this challenge, the team used the Landscape Species Method, developed by the Wildlife Conservation Society, to select terrestrial mammal species. Use of this method in these ecoregions resulted in the inclusion of species that do not meet the criteria outlined in *Designing a Geography of Hope*, yet require unique habitat. Benefits of the Landscape Species Method included recognition of species which perform important functions in their ecosystems; inclusion of habitat specialists to prioritize where certain habitats are conserved; and use of ecologically meaningful and replicable criteria based on scientific or expert data.

To further complicate the matter of target selection, there was little documented locational information on many species targets, and experts were largely unable to compensate for these omissions. The availability of spatial data determines the ability to use a particular species as a fine filter target. Species that met one of the target criteria, but lacked spatial data or a habitat surrogate, were included in the target list but were not part of the portfolio selection process. The assessment team included these species on the target list to provide a more complete picture of the fine filter component of the ecoregions and to highlight these species for future assessment iterations.

Reliance on Surrogate and Modeled Information:

The lack of data on species and community locations forced the assessment team to rely on surrogate models. This reliance represents the most significant methodological shortcoming of the assessment. The aquatic coarse filter systems modeled by the Conservancy have not been ground-truthed or assessed for accuracy. The modeled terrestrial system relied upon coarse scale data which had known inaccuracies that the team could not correct for this iteration. Thus, the overall quality of the models is unknown, as is any information based on the models, such as some species information and goals. In subsequent iterations, the planning team recommends ground-truthing of the models or the use of fine-scale vegetation coverages as training sets.

Setting and Assessing Conservation Goals:

Although it is challenging in any ecoregion to set quantitative conservation goals for species, goal-setting for species in these ecoregions was particularly challenging. Current guidelines suggest that conservation goals be set as a number of occurrences, or populations, of a species. In the Alaska Peninsula and Bristol Bay Basin, unfragmented ecoregions characterized by wide-ranging species, occurrences or populations of many species are not clearly delineated. Moreover, because little information exists on what

constitutes *an occurrence* of a wide-ranging species, goals were generally linked to habitat as portrayed by predictive system models. Unfortunately, the scale of the system models could not indicate fine scale habitats, and so goals were generalized to broad system types.

For systems, guidelines suggest a default goal of 30% of the historical area occupied by that system. This default is widely applied by the Conservancy in ecoregions in the western U.S. and although its basis is tenuous even there, it is all the more questionable in a landscape that is relatively intact and unfragmented. In future iterations, it may be worth experimenting with alternate goals and/or trying to quantify and qualify what might be lost from intact landscapes if only 30% of each habitat type were to remain.

Most improvements in goal-setting will require general advances in our understanding of the ecology of these ecoregions and their species and systems. On the other hand, two improvements can be made to the process without this information. First, species that migrate or disperse beyond one ecoregion should be assigned rangewide goals rather than goals by ecoregion. Second, fine scale habitats should not be used to set conservation goals, unless the fine scale habitats are reliably mappable. Otherwise, information becomes generalized to the point of relative meaninglessness and the potential to replicate error is magnified.

Assessing Viability:

There is little data on the viability of species in these ecoregions. A limited number of population viability studies exist, but most were done elsewhere and may not be applicable to the conditions characteristic of southwest Alaska. Based on the stable, if not increasing, populations of most species and systems in the ecoregion and the intactness of the landscape, the assessment team assumed that all current populations and occurrences of species included in this assessment were assumed to be 'viable,' or able to persist. This blanket assumption, however, may not be appropriate for endangered or threatened species like Steller sea lions, or species like gray whales and walruses where little information exists about their populations.

Portfolio Assembly:

In assembling a portfolio, an assessment team attempts to identify the "best" set of areas that meet conservation goals for target species and systems. The most efficient assembly achieves these goals in the least amount of area and within areas already managed for conservation. In fragmented landscapes where *Designing a Geography of Hope* methods are applied, the best portfolio design is often quite clear—the portfolio is comprised of the remaining blocks of habitat nestled among developed areas.

The best portfolio design is not quite as obvious in intact, unfragmented landscapes. Here, many species range widely across the landscape. Others seem to exist everywhere at once in low densities. Still others use different habitats in the ecoregion at different times of the year, and in some years, they use none of the habitats. Furthermore, the Alaska Peninsula and Bristol Bay Basin have a large share of land in medium and high conservation status. An assessment of how well these existing conservation units capture conservation goals for targets indicated that systems are well represented overall, but many species' needs are not included these units. In this situation, where any spot may be inhabited by a target species at some point in its life cycle and where protected areas may not afford protection of the "right" places, there is not a clear solution to the task of assembling the "best" set of areas to achieve conservation goals.

More so than in fragmented landscapes, setting goals in intact landscapes is a decision about how much can be lost rather than how much should be "saved." Although it is a subtle shift in perspective, the ramifications of choosing how much can be lost are considerable. While there is no one "answer" for identifying areas of biological significance in intact ecoregions, the recommendation of the assessment team is to build outward from the following seeds: locations known for consistent use by species targets and areas of species aggregations. Choose areas of highest conservation status when possible.

Aquatic System Models:

Although the aquatic systems model received high marks from reviewers for its accuracy, methods for using the model to identify important aquatic areas in intact landscapes need improvement. Further work is also needed to correlate specific salmon habitat with aquatic systems by developing finer-scale information.

J. DESCRIPTION OF AREAS OF BIOLOGICAL SIGNIFICANCE

The following section provides a brief introduction to each area of biological significance in the Alaska Peninsula and Bristol Bay Basin ecoregions. In the descriptions for each area, 'total area' records terrestrial, freshwater, and marine areas within each area inside the ecoregion boundaries. Some areas of biological significance extend beyond the ecoregion boundaries; in these cases, the land and water outside the ecoregion is not included in the description of size. Table 20 lists the ecoregion and subregion which contain most of the area, the total size of the area, and the conservation status. The target lists for each area list the primary targets, or the dominant ecological systems and the species targets that led to the inclusion of the area in the portfolio. Other targets may occur within the area, and prime habitat may exist for those species, but lack of data precludes their listing in this section. Most passerines, non-game fish, and shorebirds fall into this category of target.

TABLE 20. Summary of areas of biological significance

CONSERVATION AREA	ECO-REGION	PRIMARY SUBREGION	TOTAL AREA (HA)	CONSERVATION STATUS			
				HIGH	MEDIUM	LOW	NONE
Amak Island	AKP	South Tip Alaska Peninsula	14,279	0.0%	100.0%	0.0%	0.0%
Aniak River	BB	West Bristol Bay Basin	509,343	0.0%	2.6%	0.0%	97.4%
Bechevin Bay and False Pass	AKP	South Tip Alaska Peninsula	95,800	15.3%	39.9%	0.0%	44.8%
Belkofski	AKP	South Tip Alaska Peninsula	127,358	1.3%	20.7%	0.0%	78.0%
Cape Seniavan	AKP	North Peninsula Bering Sea Coast	62,232	0.0%	0.0%	0.0%	100.0%
Caribou River	AKP	South Tip Alaska Peninsula	173,286	0.4%	22.6%	0.0%	77.0%
Chignik	AKP	Gulf of Alaska coast	398,359	0.0%	50.0%	0.0%	50.0%
Chirikof Island	AKP	Gulf of Alaska coast	45,969	0.0%	100.0%	0.0%	0.0%
Cinder River Flats	BB	Floodplain Rivers	232,496	18.0%	4.0%	0.0%	78.0%
Egegik-Becharof	BB	Floodplain Rivers	561,277	10.6%	54.1%	0.0%	35.3%
Goodnews Coast	BB	West Bristol Bay Basin	387,733	0.0%	53.5%	0.0%	46.6%
Goodnews River	BB	West Bristol Bay Basin	288,813	58.0%	13.0%	0.0%	29.0%
Izembek-Morzhovoi-Cold Bay	AKP	South Tip Alaska Peninsula	359,372	57.4%	14.8%	0.0%	27.8%
Kamishak	AKP	Gulf of Alaska coast	791,013	45.0%	10.0%	11.5%	33.5%
Katmai Coast	AKP	Gulf of Alaska coast	512,864	99.2%	0.2%	0.0%	0.6%
Kvichak and Alagnak	BB	Floodplain Rivers	683,936	5.5%	3.3%	0.5%	90.7%
Lake Iliamna	AKP	Large Lakes	783,883	0.6%	0.0%	0.0%	99.4%
Mother Goose Lake	AKP	North Peninsula Bering Sea Coast	53,514	0.0%	90.3%	0.0%	9.7%
Naknek Lake Drainage	AKP	Large Lakes	509,465	97.6%	1.0%	0.0%	1.4%
Nushagak	BB	Nushagak River Basin	1,819,181	0.0%	2.9%	0.1%	97.0%
Nushagak Peninsula	BB	Nushagak River Basin	130,667	0.0%	97.2%	0.2%	2.6%
Pavlof Bay	AKP	South Tip Alaska Peninsula	245,113	0.0%	72.6%	0.0%	26.6%
Port Heiden	AKP	North Peninsula Bering Sea Coast	284,465	20.8%	48.9%	0.0%	30.3%
Port Moller	AKP	South Tip Alaska Peninsula	246,004	0.0%	41.7%	0.0%	57.3%
Puale Bay	AKP	Gulf of Alaska coast	65,768	92.0%	8.0%	0.0%	0.0%
Sanak Islands	AKP	South Tip Alaska Peninsula	98,756	17.8%	0.3%	0.0%	81.9%
Sandy and Bear Rivers	AKP	North Peninsula Bering Sea Coast	139,772	0.0%	35.7%	0.0%	64.3%
Sapsuk	AKP	South Tip Alaska Peninsula	42,143	0.0%	16.0%	0.0%	84.0%
Seal Islands	AKP	North Peninsula Bering Sea Coast	103,982	0.0%	8.1%	0.0%	90.9%

Semidi Islands	AKP	Gulf of Alaska coast	66,959	92.8%	7.2%	0.0%	0.0%
Shumagin Islands	AKP	South Tip Alaska Peninsula	600,669	4.0%	58.0%	0.0%	38.0%
Togiak Islands	BB	West Bristol Bay Basin	230,169	0.0%	99.2%	0.0%	0.8%
Togiak River	BB	West Bristol Bay Basin	356,169	86.0%	4.0%	0.0%	10.0%
Ugashik	BB	Floodplain Rivers	276,883	0.0%	40.1%	0.0%	59.9%
Urilia Bay	AKP	South Tip Alaska Peninsula	83,717	100.0%	0.0%	0.0%	0.0%
Wide Bay	AKP	Gulf of Alaska coast	143,665	0.0%	98.2%	0.0%	1.8%
Wood-Tikchiks	BB	Nushagak River Basin	778,159	4.3%	74.2%	0.0%	21.5%
Yantarni	AKP	Gulf of Alaska coast	96,960	0.0%	54.0%	0.0%	46.0%

1. Amak Island

TOTAL AREA : 14,279 HA
LAND AREA : 1,226 HA
MARINE AREA: 13,053 HA

CONSERVATION STATUS:
HIGH 0.0 %
MEDIUM 100.0 %
LOW 0.0 **%**
NONE 0.0 **%**

Amak Island is a small island in the Bering Sea, located off the coast of the Alaska Peninsula and near Izembek Lagoon (Figure 18) The entire island is included in the Alaska Maritime National Wildlife Refuge. Much of the island's shoreline is characterized by stretches of beach boulders, intermixed with steep to vertical cliffs of bedrock (O'Clair and others 1979). Audubon lists it as one of the *Important Bird Areas in the Bering Sea* for seabirds, including cormorants and black-legged kittiwakes (Audubon Alaska 2002). The island also provides wintering habitat for king eider. The endemic Amak Island song sparrow winters on the coast and nests a short distance inland on the tundra.

The only Steller sea lion rookery in Bristol Bay is on Amak Island. An endemic subspecies of tundra vole also inhabits the island. Red king crab spawn around Amak Island and juveniles rear here.

TABLE 21. Primary targets in Amak Island area of biological significance

COASTAL SYSTEMS			
Exposed rocky shores		Gravel beaches	
Exposed wavecut platforms			
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground			
BIRDS			
Melopiza melodia amaka	Amak Island song sparrow	*Rissa tridactyla*	Black-legged kittiwake
Phalacrocorax pelagicus	Pelagic cormorant	*Somateria spectabilis*	King eider
Phalacrocorax urile	Red-faced cormorant	*Uria aalge*	Common murre
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
MARINE MAMMALS			
Eumetopias jubatus	Steller sea lion		

TERRESTRIAL MAMMALS			
Microtus oeconomus amakensis	Amak Island tundra vole		
SPECIES AGGREGATIONS			
Seabird colonies			

2. Aniak River

TOTAL AREA: 509,343 HA
LAND AREA: 229,379 HA
MARINE AREA: 0 HA
AREA OUTSIDE ECOREGIONS: 279,964 HA

CONSERVATION STATUS:
HIGH 0.0 %
MEDIUM 2.6 %
LOW 0.0 %
NONE 97.4%

This area encompasses the entire drainage of the Aniak River (Figure 19). The Aniak River flows north from the Kilbuck Mountains and empties into the Kuskokwim River. The Aniak supports a wide variety of freshwater and anadromous fish species. Spruce-dominated forests along the river provide prime habitat for Canada lynx; the tundra of the mountains is habitat for wolverine. The Kilbuck caribou herd migrates through the upper drainage.

Most of this area is owned by the State of Alaska and is not necessarily managed for conservation. Other landholders are the Bureau of Land Management and private parties. A small portion of this area is in Wood-Tikchik State Park, which is managed for conservation. The Aniak River area of biological significance straddles the boundary between the Bristol Bay Basin, Beringian Tundra, and Interior Alaska Taiga ecoregions.

TABLE 22. Primary targets in Aniak River area of biological significance

AQUATIC SYSTEMS			
Small and moderate sized lakes on lightly modified moraine		Unconnected small and moderate sized lakes in lightly modified moraine	
Small lakes in old glacial outwash and		Unconnected small lakes on bedrock	
Small lakes on bedrock			
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		High brush	
Floodplain / outwash plain		Upland spruce-hardwood forest	
FISH			
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Lota lota	Burbot	*Osmerus mordax*	Rainbow smelt
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus nerka	Sockeye salmon	*Thymallus arcticus*	Arctic grayling
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
Lynx canadensis	Canada lynx		

3. Bechevin Bay and False Pass

TOTAL AREA: 95,800 HA
LAND AREA: 42,977 HA
MARINE AREA: 52,823 HA

CONSERVATION STATUS:
HIGH 15.3 %
MEDIUM 39.9 %
LOW 0.0 %
NONE 44.8 %

This area consists of Bechevin Bay, False Pass, Ikatan Bay, and the shoreline along each (Figure 20). Bechevin Bay separates the southern tip of the Alaska Peninsula from Unimak Island, the first island in the Aleutian Chain. The bay opens onto the Bering Sea, and False Pass connects the Bechevin Bay to Ikatan Bay on the Gulf of Alaska. Marine mammals and migrating birds use Bechevin Bay and False Pass as a passage between the Bering Sea and the Gulf. Audubon named this one of the *Important Bird Areas of the Bering Sea* for its role in migration of waterfowl and shorebirds (Audubon Alaska 2002). The US Fish and Wildlife Service designated Bechevin Bay as critical habitat for Steller's eider during the autumn molt and spring migration.

Most of the land on the east side of the bay is included in the Izembek National Wildlife Refuge, while the western shores are managed by the Alaska Maritime National Wildlife Refuge or owned by private parties. A regional Native corporation owns the majority of the private land, with local government and private individuals owning a small percentage. The Aleutians East Borough (AECRSAB 1985) identified Bechevin Bay as a Special Use Area in its Coastal Management Program (see Appendix 14).

TABLE 23. Primary targets in Bechevin Bay and False Pass area of biological significance

COASTAL SYSTEMS			
Coarse-grained sand beaches		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Sheltered tidal flats	
Gravel beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Wet tundra	
Moist tundra			
BIRDS			
Cepphus columba	Pigeon guillemot	*Phalacrocorax urile*	Red-faced cormorant
Phalacrocorax pelagicus	Pelagic cormorant	*Polysticta stelleri*	Steller 's eider
FISH			
Oncorhynchus gorbuscha	Pink salmon		
MARINE MAMMALS			
Phoca vitulina	Harbor seal		
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl spring and fall	
Shorebird fall staging/stopover areas			

4. Belkofski

TOTAL AREA : 127,358 HA
LAND AREA : 48,392 HA
MARINE AREA: 78,966 HA

CONSERVATION STATUS:

HIGH 1.3%
MEDIUM 20.7%
LOW 0.0 %
NONE 78.0 %

The Belkofski area is composed of a small peninsula off the southeast coast of the Alaska Peninsula, the bay it forms, Dolgoi Island, and the group of islands surrounding it (Figure 21). Several large colonies of pigeon guillemot are on the mainland and Dolgoi Island. King eiders and Steller's eiders winter in the bay, and Emperor geese stage there in the spring and fall. Harbor seals haul out in significant numbers on Bear Bay Reef.

The islands are managed as part of the Alaska Maritime National Wildlife Refuge, but most of the land is owned by a regional Native corporation. Portions of the mainland are included in the Izembek and Alaska Peninsula National Wildlife Refuges.

TABLE 24. Primary targets in Belkofski area of biological significance

COASTAL SYSTEMS			
Exposed rocky shores		Mixed sand and gravel beaches	
Exposed wavecut platforms		Sheltered tidal flats	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Floodplain / outwash plain	
BIRDS			
Cepphus columba	Pigeon guillemot	*Rissa tridactyla*	Black-legged kittiwake
Chen canagica	Emperor goose	*Somateria spectabilis*	King eider
Polysticta stelleri	Steller's eider		
FISH			
Oncorhynchus gorbuscha	Pink salmon		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal

5. Cape Seniavan

TOTAL AREA: 62,232 HA
LAND AREA: 32,046 HA
MARINE AREA: 30,186 HA

CONSERVATION STATUS:

HIGH 0.0 %
MEDIUM 0.0 **%**
LOW 0.0 **%**
NONE 100.0 **%**

The area consists of Cape Seniavan, which is located near the mouth of the Muddy River on the western shore of the Alaska Peninsula, and the coastline on either side of the cape (Figure 22). One of the four haulouts in Southwest Alaska used by bachelor walruses is here, as well as seabird colonies for black-legged kittiwakes, common murres, and cormorants. Audubon named Cape Seniavan one of the *Important Bird Areas of the Bering Sea* due to these colonies and use by waterfowl for spring staging and wintering (Audubon Alaska 2002). The US Fish and Wildlife Service designated Cape Seniavan as critical

habitat for Steller's eiders during the spring migration. Caribou also calve on the tundra along the coastal plain around the cape.

The State of Alaska owns all the land within this area of biological significance. State biologists have proposed designating Cape Seniavan a *Special Use Area* (see Appendix 14) to protect the birds and marine mammals that use it.

TABLE 25. Primary targets in Cape Seniavan area of biological significance

COASTAL SYSTEMS			
Coarse-grained sand beaches		Mixed sand and gravel beaches	
Exposed wavecut platforms			
TERRESTRIAL SYSTEMS			
Floodplain / outwash plain		Moist tundra	
BIRDS			
Phalacrocorax pelagicus	Pelagic cormorant	*Rissa tridactyla*	Black-legged kittiwake
Phalacrocorax urile	Red-faced cormorant	*Somateria spectabilis*	King eider
Polysticta stelleri	Steller's eider	*Uria aalge*	Common murre
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
MARINE MAMMALS			
Odobenus rosmarus divergens	Walrus		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl spring and fall staging/stopover areas	

6. Caribou River

TOTAL AREA: 173,286 HA
LAND AREA: 163,405 HA
MARINE AREA: 9,881 HA

CONSERVATION STATUS:
HIGH 0.4 %
MEDIUM 22.6 %
LOW 0.0 **%**
NONE 77.0 %

The Caribou River area is composed of the pond-rich lowlands west of Herendeen Bay, the Black Hills on the north slopes of Pavlof Volcano, and the drainage of the Cathedral River (Figure 23). Less than a quarter of the area, primarily the hills, is owned and managed by the US Fish and Wildlife Service as part of the Alaska Peninsula National Wildlife Refuge. The State of Alaska owns a majority of the area, but does not manage it for conservation. The Bureau of Land Management and Native corporations each own a small percentage of this area, and the corporations have selected most of the BLM lands.

The rolling tundra of the lowlands is the calving grounds of the Southern Alaska Peninsula caribou herd. The tundra of the uplands provides good habitat for brown bear and wolverine, and moose can be found along riparian corridors. Waterfowl nest and breed around the many small lakes and ponds. The Caribou River has a significant run of chum salmon.

TABLE 26. Primary targets in Caribou River area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on a matrix of old glacial outwash		Low gradient streams on old glacial outwash	
Low gradient rivers on moraine		Small and moderate sized lakes on lightly modified moraine	
COASTAL SYSTEMS			
Tidal marshes and wetlands		Coarse-grained sand beaches	
TERRESTRIAL SYSTEMS			
Moist tundra		Wet tundra	
BIRDS			
Polysticta stelleri	Steller's eider	*Somateria spectabilis*	King eider
FISH			
Oncorhynchus keta	Chum salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear

7. Chignik

TOTAL AREA: 398,359 HA
LAND AREA: 232,345 HA
MARINE AREA: 166,015HA

CONSERVATION STATUS: **HIGH** 0.0%
MEDIUM 50.0%
LOW 0.0%
NONE 50.0%

The Chignik area includes the marine environments of Chignik Bay as well as the freshwater drainages of Black Lake and Chignik Lake (Figure 24). These aquatic environments support the only significant chinook salmon run on the Gulf side of the Alaska Peninsula and 1 of 4 known populations of steelhead in Southwest Alaska. The area is important for brown bears, which occur at a high density here, at all life stages. A fall salmon run can attract 500 to 600 bears to Black Lake. Viereck and Zasada (1972) recommended setting aside part of the land around Black and Chignik Lakes as an ecological reserve due to its coastal marsh and tundra, willow, alder, and birch shrub thickets. These systems provide some of the best moose habitat on the lower peninsula and are important for calving.

Chignik Bay has eelgrass beds, which provide critical food sources to waterfowl. Emperor geese, king eiders, Steller's eiders, and harlequin ducks winter in the bay. The US Fish and Wildlife Service designated Chignik Bay as critical habitat for Steller's eider for wintering.

Harlequin ducks breed in the interior portions of the area. Chignik Bay also supports marine mammals. Harbor seals haul out on its shores, and sea otters feed in its waters.

Half of this area -- the upper elevations, lands north of the bay, and Black Lake -- are managed by the US Fish and Wildlife Service as part of the Alaska Peninsula National Wildlife Refuge. The refuge's Comprehensive Conservation Plan (USFWS 1985c) identifies Black Lake and Chignik Lake as a *Special Value Area* (see Appendix 14). Native village and regional corporations own almost half of the area, with a small percentage of land owned by the State of Alaska, private parties, and Native allottees.

TABLE 27. Primary targets in Chignik area of biological significance

AQUATIC SYSTEMS			
Bedrock mainstems that enter glacial dam lake		Mainstem in bedrock valleys	
Braided rivers on volcanic alluvium and bedrock		Small lakes on bedrock	
COASTAL SYSTEMS			
Exposed rocky shores		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Sheltered rocky shores	
Exposed wavecut platforms		Sheltered tidal flats	
Gravel beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		High brush	
Floodplain / outwash plain		Moist tundra	
BIRDS			
Cepphus columba	Pigeon guillemot	*Phalacrocorax urile*	Red-faced cormorant
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Histrionicus histrionicus	Harlequin duck	*Rissa tridactyla*	Black-legged kittiwake
Phalacrocorax pelagicus	Pelagic cormorant	*Somateria spectabilis*	King eider
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus keta	Chum salmon	*Salmo gairdneri*	Steelhead
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus nerka	Sockeye salmon		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			

Seabird colonies	Waterfowl spring and fall staging / stopover areas
Waterfowl wintering areas	

8. Chirikof Island

TOTAL AREA: 45,969 HA
LAND AREA: 10,562 HA
MARINE AREA: 35,406 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 100.0%
LOW 0.0 **%**
NONE 0.0%

Chirikof Island, a small island in the Gulf of Alaska, is entirely managed as part of the Alaska Maritime National Wildlife Refuge (Figure 25). The island has a large colony of black-legged kittiwakes. One of only 6 Steller sea lion rookeries in this portion of the Gulf of Alaska occurs on the island, and harbor seals haul out on its shores.

TABLE 28. Primary targets in Chirikof Island area of biological significance

TERRESTRIAL SYSTEMS			
Moist tundra			
BIRDS			
Rissa tridactyla	Black-legged kittiwake		
MARINE MAMMALS			
Eumetopias jubatus	Steller sea lion	*Phoca vitulina*	Harbor seal

9. Cinder River Flats

TOTAL AREA: 232,496HA
LAND AREA: 208,947HA
MARINE AREA: 23,548HA

CONSERVATION STATUS:
HIGH 18.0%
MEDIUM 4.0%
LOW 0.0%
NONE 78.0%

The Cinder River Flats area includes 3 rivers (Mud Creek, Cinder River, and the lower King Salmon), 2 coastal lagoons (Cinder and Hook), and numerous small lakes and ponds (Figure 26). The Southwest Alaska Conservation Council has identified the King Salmon River as a *Priority Salmon Conservation Watershed* for 5 Pacific species (SWACC 2002). Harbor seals haul out in great numbers along the coastline of this area. The tundra matrix of the coastal plain has historically been a critical calving area for the Northern Alaska Peninsula caribou herd.

The area is widely recognized for its importance to birds, including dunlin, western sandpiper, bar-tailed godwit and marbled godwits, which gather to feed at the tidal flats at the mouth of the Cinder River and in the lagoons, in concentrations in the tens of thousands (ASWG 2000). This is the only known staging area for Beringian marbled godwits. Audubon identifies these lagoons as important for shorebirds and waterfowl. Emperor geese and king eiders stage here in the spring and fall, and black scoters breed here. The US Fish

and Wildlife Service designated the Cinder River estuary as critical wintering habitat for Steller's eider.

The State of Alaska owns most of this area, with some places set aside to protect important wildlife habitat. Cinder and Hook Lagoons are included in the Cinder River State Critical Habitat Area, and this area also includes part of the Pilot Point State Critical Habitat Area. The headwaters of the Cinder River start in Aniakchak National Monument. The Bureau of Land Management and Native corporations also own land in this area.

TABLE 29. Primary targets in Cinder River Flats area of biological significance

AQUATIC SYSTEMS			
Braided rivers on alluvial terrace on moraine		Low gradient streams on old marine and alluvial coast connected to lakes	
Low gradient floodplain river on alluvial terrace.		Small and moderate sized lakes on marine sediments and alluvial outwash	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
Floodplain / outwash plain		Wet tundra	
BIRDS			
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Limosa fedoa beringiae	Beringian marbled godwit	*Somateria spectabilis*	King eider
Melanitta nigra	Black scoter		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus nerka*	Sockeye salmon
Oncorhynchus keta	Chum salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus kisutch	Coho salmon	*Thymallus arcticus*	Arctic grayling
MARINE MAMMALS			
Phoca vitulina	Harbor seal		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
Lynx canadensis	Canada lynx		
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl spring and fall areas	

10. Egegik-Becharof

TOTAL AREA: 561,277HA
LAND AREA: 523,654HA
MARINE AREA: 37,623HA

CONSERVATION STATUS:

HIGH 10.6%
MEDIUM 54.1%
LOW 0.0%
NONE 35.3%

The Egegik-Becharof area is composed of Egegik Bay, the drainages of the Egegik and King Salmon Rivers, and Becharof Lake (Figure 27). Almost two-thirds of this area, including the upper half of the King Salmon River and Becharof Lake, are within the boundaries of Becharof National Wildlife Refuge. The refuge's Comprehensive Conservation Plan (USFWS 1985d) identifies these places as *Special Value Areas* (see Appendix 14). As navigable waterbodies, the river and lakes are owned and managed by the State of Alaska. The moist tundra lowlands, dotted with small lakes and ponds, are owned by the State of Alaska and Native corporations. The state has designated Egegik Bay and the surrounding land as the Egegik Critical Habitat Area.

Audubon has identified Egegik Bay as an *Important Bird Area in the Bering Sea* for migrating and breeding waterfowl and shorebirds (Audubon Alaska 2002). Eelgrass beds in the bay provide important food for these birds. Dunlin, western sandpiper, and bar-tailed godwit concentrate here in numbers greater than 100,000 (ASWG 2000). The Southwest Alaska Conservation Council named the Egegik and King Salmon Rivers as *Priority Salmon Conservation Watersheds* for 5 Pacific species, including 9.6 million sockeye salmon. The Egegik-Becharof area also provides prime wintering habitat for caribou.

TABLE 30. Primary targets in the Egegik-Becharof area of biological significance

AQUATIC SYSTEMS			
Highly deranged drainages on moraine connected to lakes and to ocean		Small lakes in old glacial outwash and floodplains	
Large braided rivers in floodplain on old glacial outwash or moraine		Small lakes on bedrock	
Morainal depression lakes		Unconnected small and moderate sized lakes in lightly modified moraine	
Moraine mainstems that enter large glacial dam lake		Unconnected small and moderate sized lakes on marine sediments and alluvial outwash	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Sheltered tidal flats	
Gravel beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
Floodplain / outwash plain		Wet tundra	
BIRDS			
Chen canagica	Emperor goose	*Melanitta nigra*	Black scoter
Clangula hyemalis	Long - tailed duck	*Somateria spectabilis*	King eider
Histrionicus histrionicus	Harlequin duck		
FISH			
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		
MARINE MAMMALS			

Eschrichtius robustus	Gray whale	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Ursus arctos*	Brown bear
Rangifer tarandus	Caribou		
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl spring and fall staging/stopover areas	
Shorebird nesting and breeding areas		Waterfowl wintering areas	
Waterfowl nesting and breeding areas			

11. Goodnews Coast

TOTAL AREA: 387,733 HA
LAND AREA: 145,880 HA
MARINE AREA: 241,853 HA

CONSERVATION STATUS: **HIGH** 0.0%
MEDIUM 53.5%
LOW 0.0%
NONE 46.5%

The Goodnews Coast area reaches from Cape Peirce at the western edge of Bristol Bay, north to the south side of Jacksmith Bay, and encompasses several biologically-important marine areas—Nanvak Bay, Chagvan Bay, Goodnews Bay, and Carter Bay (Figure 28). Several of these areas were identified by Audubon as *Important Bird Areas* for waterfowl, shorebirds, and seabirds (Audubon Alaska 2002). Steller's eiders, king eiders, black brant, and most of the North American west coast population of emperor geese stop at these bays to feed on eelgrass beds during the spring migration. More than 20,000 dunlin and western sandpiper may use these bays (ASWG 2000). Two of the largest seabird colonies in the eastern Bering Sea exist at Cape Peirce and Cape Newenham, and Aleutian terns nest on the spit of Goodnews Bay.

Goodnews Coast also has important habitat for marine species. The only major harbor seal haulout in the northern Bristol Bay occurs in Nanvak Bay. Steller sea lions and walruses have few haulouts in Bristol Bay but both species rest at these capes. Gray whales migrate along the coast, passing close to Cape Newenham, to the upper parts of the Bering Sea.

Various rivers supporting salmon and freshwater fish empty into the bays, and Pacific herring spawn in the nearshore waters. Brown bears occur in high concentrations along the Slug River, which drains into Nanvak Bay.

Over half of the Goodnews Coast area is in the Togiak National Wildlife Refuge. The refuge's Comprehensive Conservation Plan (USFWS 1986) identifies Cape Peirce and Cape Newenham as *Special Value Areas* (see Appendix 14). The State of Alaska has also designated some of this area, including tide and submerged lands in Chagvan Bay, as part of a state game refuge (Cape Newenham National Wildlife Range). The remainder of the Goodnews Coast area is owned and managed by the Bureau of Land Management and Native corporations.

TABLE 31. Primary targets in the Goodnews Coast area of biological significance

AQUATIC SYSTEMS	
Low gradient rivers on a matrix of old glacial outwash	Low gradient streams on old marine and alluvial coast

Low gradient rivers on moraine	Small and moderate sized lakes on moderately and highly modified moraine
Low gradient streams on old glacial outwash	Unconnected small and moderate sized lakes on marine sediments and alluvial outwash

COASTAL SYSTEMS			
Coarse-grained sand beaches		Gravel beaches	
Exposed rocky shores		Tidal marshes and wetlands	
Exposed tidal flats (moderate biomass)		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
Floodplain / outwash plain		Wet tundra	
BIRDS			
Branta nigricans	Black brant	*Rissa tridactyla*	Black-legged kittiwake
Chen canagica	Emperor goose	*Somateria spectabilis*	King eider
Gavia stellata	Red-throated loon	*Sterna aleutica*	Aleutian tern
Polysticta stelleri	Steller's eider		
FISH			
Clupea pallasi	Pacific herring	*Oncorhynchus nerka*	Sockeye salmon
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Thymallus arcticus*	Arctic grayling
MARINE MAMMALS			
Eschrichtius robustus	Gray whale	*Phoca vitulina*	Harbor seal
Odobenus rosmarus divergens	Walrus		
TERRESTRIAL MAMMALS			
Ursus arctos	Brown bear		
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl spring and fall staging/stopover areas	
Shorebird fall staging/stopover areas			

12. Goodnews River

TOTAL AREA: 288,813 HA
LAND AREA: 288,211 HA
MARINE AREA: 602HA

CONSERVATION STATUS: **HIGH** 58.0 %
MEDIUM 13.0%
LOW 0.0 %
NONE 29.0%

This area encompasses the entire drainage of the Goodnews River, which drains the Ahklun Mountains southwest to Goodnews Bay (Figure 29). The Southwest Alaska Conservation Council identified the Goodnews River as a *Priority Salmon Conservation Watershed* for 5 Pacific salmon species (SWACC 2002). Thirty-nine thousand sockeye salmon and 20,000

coho salmon travel up the Goodnews River each summer to spawn in the tributaries and headwater lakes. The river also supports healthy populations of rainbow trout, lake trout, and Arctic grayling.

The upper part of the drainage is in the Wilderness Area of the Togiak National Wildlife Refuge. The refuge's Comprehensive Conservation Plan (USFWS 1986) identifies the Goodnews River drainage as a *Special Value Area* (see Appendix 14). The lower river passes through Native corporation and BLM lands, which have mineral mining potential.

TABLE 32. Primary targets in the Goodnews River Area of biological significance

AQUATIC SYSTEMS			
Braided rivers with tributaries on matrix of moraine, coarse rubble, and bedrock		Small lakes on bedrock	
Low gradient rivers on moraine		Small and moderate sized lakes on lightly modified moraine	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Cepphus columba	Pigeon guillemot		
FISH			
Clupea pallasi	Pacific herring	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Osmerus mordax*	Rainbow smelt
Oncorhynchus keta	Chum salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		

13. Izembek-Morzhovoi-Cold Bay

TOTAL AREA: 359,372 HA
LAND AREA: 161,253HA
MARINE AREA: 198,119 HA

CONSERVATION STATUS: **HIGH** 57.4%
MEDIUM 14.8 %
LOW 0.0 %
NONE 27.8 %

The Izembek-Morzhovoi-Cold Bay area encompasses the southern end of the Alaska Peninsula. Morzhovoi Bay and Cold Bay open onto the Gulf of Alaska (Figure 30). These bays provide wintering habitat for waterfowl, as well as access during migration to the Bering Sea, which lies just beyond narrow strips of low land at the back of these bays. Izembek Lagoon, separated from the Bering Sea by a long line of barrier islands, is widely considered to be important bird habitat, primarily due to its eelgrass beds, which are the largest in the world at 34,000 ha. Audubon has identified the lagoon as an *Important Bird Area in the Bering Sea* for waterfowl and shorebirds (Audubon Alaska 2002). The US Fish and Wildlife Service designated these bays and lagoons as critical habitat for molting, wintering, and spring staging of Steller's eiders. The lagoon is a critically important stop for black brant in spring and late summer, hosting the majority of the eastern Pacific population, as well as being one of 2 wintering locations for the species in the ecoregions. The lagoon also supports more than half of the world population of emperor geese. Roughly

5000 greater scaup winter in the estuarine areas of Izembek Refuge. Izembek Lagoon and Moffett Lagoon at its north end host tens and even hundreds of thousands of shorebirds, including rock sandpiper, bar-tailed godwit, and dunlin (ASWG 2000). McKay's bunting, the only passerine endemic to Alaska, winters at Cold Bay.

These bays and lagoons are key habitat for a wide variety of marine species. Red king crab spawn outside the barrier islands that form Izembek Lagoon, but juveniles rear offshore and in the lagoon. Northern sea otters feed and rest in the waters, and some of the world's largest harbor seal haulouts occur in this area.

Almost three-quarters of this area is contained in Izembek National Wildlife Refuge, part of which is Wilderness Area. The refuge's Comprehensive Conservation Plan (USFWS 1985b) identifies the wilderness area and Izembek, Kinsarof, Big, Middle, and Little Lagoons as *Special Value Areas* (see Appendix 14). The State of Alaska has also designated some of this area, including tide and submerged lands, as part of a state game refuge, Izembek Refuge.

Aleutians East Borough owns the rest of the land, most of which is on the shores of Cold and Morzhovoi Bays. The borough identified Izembek Lagoon as a *Special Use Area* in its Coastal Management Plan.

TABLE 33. Primary targets in Izembek-Morzhovoi-Cold Bay Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on moraine connected to lakes		Mainstem in bedrock valleys	
Low gradient streams on old glacial outwash		Small and moderate sized lakes on marine sediments and alluvial outwash	
Low gradient streams on old marine and alluvial coast		Unconnected small and moderate sized lakes in lightly modified moraine	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Tidal marshes and wetlands	
Fine to medium-grained sand beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
Floodplain / outwash plain		Wet tundra	
BIRDS			
Aythya marila	Greater scaup	*Clangula hyemalis*	Long - tailed duck
Brachyramphus brevirostris	Kittlitz's murrelet	*Plectrophenax hyperboreus*	McKay's bunting
Branta nigricans	Black brant	*Polysticta stelleri*	Steller s eider
Chen canagica	Emperor goose	*Sterna aleutica*	Aleutian tern
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus kisutch*	Coho salmon
Oncorhynchus keta	Chum salmon	*Salmo gairdneri*	Steelhead
MARINE MAMMALS			

Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Ursus arctos	Brown bear		
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl molting areas	
Waterfowl spring and fall staging/stopover areas		Waterfowl wintering areas	

14. Kamishak

TOTAL AREA: 791,013 HA
LAND AREA: 456,665 HA
MARINE AREA: 334,348 HA

CONSERVATION STATUS: **HIGH** 45.0%
MEDIUM 10.0 %
LOW 11.5%
NONE 33.5%

The Kamishak area includes all of Kamishak Bay and its shoreline, Augustine Island, and the entire watersheds of the Kamishak and McNeil Rivers (Figure 31). Kamishak Bay is situated at the southwest end of Cook Inlet, where the inlet opens into the Gulf of Alaska and where the Alaska Peninsula begins. The rivers flowing into Cook Inlet carry high loads of suspended sediments, mainly loess-derived. Strong tidal currents and turbulent mixing keep the sediments suspended in the upper Inlet and flush them south where they are deposited in shallow coastal areas, including Kamishak Bay, or carried out to the Gulf of Alaska. Protected bays with extensive, broad flats of mixed sand/mud substrate and unprotected rocky shore and reefs dominate the intertidal zone in the Kamishak area.

The result is that this stretch of southwestern Cook Inlet, including Kamishak Bay, contains some of the most important and biologically productive ecological systems in the Gulf of Alaska (Hood and Zimmerman 1986). The marine environment supports a diverse group of species. The coastal waters and streams provide spawning and rearing habitat for 5 species of Pacific salmon. Salmon and seabirds prey on both the Pacific herring that spawn on the area's rocky reefs, and several other forage fish species inhabiting the nearshore waters. Seabird colonies include a high density of cormorants. Sea otters are common and occur in moderate densities at Cape Douglas, and harbor seals congregate on Shaw Island in large numbers. This area is also critical for all life stages of brown bear. In the spring, brown bears graze in intertidal sedge meadows, and then feed on summer salmon runs in the creeks and rivers draining into Kamishak Bay.

In a 1980 study of special areas in the Alaska Coastal Zone, the Alaska Department of Fish and Game proposed a coastal marine refuge in Kamishak Bay, a coastal marine sanctuary at the mouth of McNeil River, and a critical habitat area at Akumwarvik Bay and Douglas River flats (AOCM 1980). The state did not create those conservation units, but 10% of the area is the McNeil River State Game Sanctuary, largely set aside for brown bears, and 11.5% is in the McNeil River State Game Preserve. The headwaters of the Kamishak River start in the Wilderness Area of Katmai National Park, which makes up 45% of the area. One-third of the area, including most of the coastline, is owned by the State of Alaska, Native corporations, the Bureau of Land Management, and private parties.

TABLE 34. Primary targets in Kamishak Area of biological significance

AQUATIC SYSTEMS			
Braided rivers on alluvial terrace on moraine		Low gradient streams on old glacial outwash	
Braided rivers on moraine valley with tributaries on coarse rubble and bedrock		Mainstem in bedrock valleys	
Braided rivers on volcanic alluvium and bedrock		Small lakes on bedrock	
Low gradient rivers on moraine		Unconnected small and moderate sized lakes in lightly modified moraine	
COASTAL SYSTEMS			
Exposed wavecut platforms		Sheltered rocky shores	
Gravel beaches		Sheltered tidal flats	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Floodplain / outwash plain	
Coastal forest		High brush	
BIRDS			
Cepphus columba	Pigeon guillemot	*Polysticta stelleri*	Steller's eider
Phalacrocorax pelagicus	Pelagic cormorant	*Uria aalge*	Common murre
Phalacrocorax urile	Red-faced cormorant		
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Clupea pallasi	Pacific herring	*Oncorhynchus kisutch*	Coho salmon
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus nerka*	Sockeye salmon
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			
Seabird colonies			

15. Katmai Coast

TOTAL AREA: 512,864 HA
LAND AREA: 328,887 HA
MARINE AREA: 183,977 HA

CONSERVATION STATUS:
HIGH 99.2%
MEDIUM 0.2%
LOW 0.0%
NONE 0.6%

The Katmai Coast area encompasses the steep southeast draining slopes of the Aleutian Range along the Gulf of Alaska coast (Figure 32). The federal government manages most of this area as wilderness in Katmai National Park and a smaller portion as Becharof National Wildlife Refuge. The roughly 900 ha of lands within this area that are not managed for conservation are privately owned.

This coastline is a mixture of rocky cliffs interspersed with sand and gravel beaches and protected embayments with muddy tidal flats. These habitats support several large seabird colonies, and several significant harbor seal and Steller sea lion haulouts. Sea otters feed at kelp beds at the more-exposed parts of the coast. In the spring, brown bears graze in sedge meadows on tidal flats in sheltered bays. The mountains have habitat for wolverine, brown bears, and nesting Kittlitz's murrelets, and marbled murrelets nest in old growth forests along the coast.

TABLE 35. Primary targets in Katmai Coast Area of biological significance

COASTAL SYSTEMS			
Exposed rocky shores		Intertidal and subtidal algal forests	
Exposed tidal flats (moderate biomass)		Sheltered rocky shores	
Exposed wavecut platforms		Sheltered tidal flats	
Gravel beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Floodplain / outwash plain	
Coastal forest		High brush	
BIRDS			
Brachyramphus brevirostris	Kittlitz's murrelet	*Haliaeetus leucocephalus*	Bald eagle
Brachyrampus marmoratus	Marbled murrelet	*Phalacrocorax pelagicus*	Pelagic cormorant
Cepphus columba	Pigeon guillemot	*Phalacrocorax urile*	Red-faced cormorant
Haematopus bachmani	Black oystercatcher		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus kisutch*	Coho salmon
Oncorhynchus keta	Chum salmon		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
Eumetopias jubatus	Steller sea lion		
TERRESTRIAL MAMMALS			
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			
Seabird colonies			

16. Kvichak and Alagnak

TOTAL AREA: 683,936 HA
LAND AREA: 507,860 HA
MARINE AREA: 176,076 HA

CONSERVATION STATUS:
HIGH 5.5%
MEDIUM 3.3%
LOW 0.5%
NONE 90.7%

The Kvichak and Alagnak Area comprises all of Kvichak Bay, the Alagnak River drainage, and Kvichak River to its start at Iliamna Lake (Figure 33). This area supports healthy populations of terrestrial, freshwater, and marine species. Kvichak Bay is characterized by tidal flats of dark gray silt, with some gravel beaches (Berryhill 1963). Some of the world's largest harbor seal haulouts are in the bay, and the Bristol Bay population of beluga whales congregates here (Quakenbush 2002). The bay is an Audubon *Important Bird Area in the Bering Se*a for waterfowl and shorebirds (Audubon Alaska 2002). Seaducks molt on shoals in the bay and use the bay for a stopover during their spring migration. The Western Hemisphere Shorebird Reserve Network includes Kvichak Bay because over 45,000 shorebirds, including Beringian marbled godwit, bar-tailed godwit, dunlin, and golden plover, feed on its intertidal habitat during the fall migration (ASWG 2000). Aleutian terns nest in a colony on the coastal plain near Naknek on the east side of the bay.

Both the Alagnak and Kvichak Rivers support healthy populations of freshwater and anadromous fish species. The Bristol Bay Plan for State Lands (ADNR 1984) identified the Kvichak River as a priority for conservation. The Kvichak River, which drains Lake Iliamna, is the most productive sockeye salmon fishery in the world, and in the past has supported sockeye in the tens of millions. These salmon rely upon Iliamna and the smaller lakes above it for spawning. Kaskanak Flats, several miles below Lake Iliamna, is a critical rainbow trout spawning area. The Southwest Alaska Conservation Council calls the Alagnak River a *Priority Salmon Conservation Watershed* for 5 Pacific species, which include 259,000 sockeye salmon and 137,000 pink and coho salmon (SWACC 2002). Regional biologists note the Alagnak for its large range of diversity of freshwater and anadromous fish species.

These biologically-rich rivers feed many terrestrial predators, such as brown bear, bald eagles, osprey, and goshawks, and support a high density of beavers. Terrestrial species utilizing the spruce forests and tundra habitats of the river watersheds include lynx, wolves, and moose. The Mulchatna and North Peninsula caribou herds winter in the area.

The majority of the area is owned by the Bureau of Land Management and is not managed for conservation. The Alagnak River originates in the Wilderness Area of Katmai National Park, and the upper 67km of its length is designated as a Wild and Scenic River. A small portion of Kvichak Bay is included in the Bristol Bay Fisheries Reserve, which prohibits surface entry permits to develop oil or gas leases on submerged or shore lands on state-owned or controlled land until the legislature specifically finds that the entry will not constitute danger to the fishery.

TABLE 36. Primary targets in Kvichak and Alagnak Area of biological significance

AQUATIC SYSTEMS	
Floodplain rivers on moraine and old glacial outwash with headwater lakes	Small and moderate sized lakes on marine sediments and alluvial outwash
Highly deranged drainages on moraine connected to lakes and to ocean	Small and moderate sized lakes on moderately and highly modified moraine
Highly deranged tributaries on moraine connected to lakes	Small lakes in old glacial outwash and floodplains
Large braided rivers on old glacial outwash channels or alluvial terraces	
COASTAL SYSTEMS	
Gravel beaches	Sheltered rocky shores
TERRESTRIAL SYSTEMS	

Floodplain / outwash plain	Upland spruce-hardwood forest
Lowland spruce-hardwood forest	Wet tundra
Moist tundra	Bottomland spruce – poplar forest

BIRDS			
Arenaria melanocephala	Black turnstone	*Limosa lapponica*	Bar-tailed godwit
Calidris alpina	Dunlin	*Melanitta nigra*	Black scoter
Chen canagica	Emperor goose	*Pluvialis fulva*	Pacific golden plover
Clangula hyemalis	Long - tailed duck	*Polysticta stelleri*	Steller's eider
Histrionicus histrionicus	Harlequin duck	*Somateria spectabilis*	King eider
Limosa haemastica	Hudsonian godwit	*Sterna aleutica*	Aleutian tern
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Coregoninae subfamily	Whitefish species	*Oncorhynchus nerka*	Sockeye salmon
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Osmerus mordax*	Rainbow smelt
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
MARINE MAMMALS			
Delphinapterus leucas	Beluga whale	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Castor canadensis	American beaver	*Ursus arctos*	Brown bear
Lynx canadensis	Canada lynx		

SPECIES AGGREGATIONS	
Shorebird fall staging/stopover areas	Waterfowl nesting and breeding areas
Shorebird nesting and breeding areas	Waterfowl spring and fall staging/stopover areas
Waterfowl molting areas	

17. Lake Iliamna

TOTAL AREA: 783,883 HA
LAND AREA: 594,254 HA
MARINE AREA: 0 HA
OUTSIDE ECOREGIONS: 189,629 HA

CONSERVATION STATUS: **HIGH** 0.6%
MEDIUM 0.0%
LOW 0.0%
NONE 99.4%

The Lake Iliamna area includes Lake Iliamna, the largest lake in Alaska, its shoreline, and several small drainages feeding into it (Figure 34). This area extends beyond the Alaska Peninsula ecoregion to include the entire watershed for several small rivers that begin in the Interior Alaska Taiga ecoregion. This area has a great diversity of habitat and species. Wetlands and small ponds attract various waterfowl for breeding, including black scoters and long-tailed ducks. Coniferous forests are prime habitat for lynx and passerines like gray-cheeked thrush, blackpoll warbler, and varied thrush. Alder and willow thickets support moose and golden-crowned sparrow.

The sheer size of Lake Iliamna allows a great diversity of fish species, including sockeye salmon, Arctic grayling, rainbow trout, whitefish, Arctic char, northern pike, lake trout, and dolly varden. The Kvichak River, which drains Lake Iliamna, is the most productive sockeye salmon fishery in the world, and these salmon rely upon Iliamna and the smaller lakes above it for spawning. A small population of harbor seals has adjusted to a freshwater habitat and hauls out on rocks and beaches in the lake.

The Bureau of Land Management owns more than half of the uplands within this area. The State of Alaska and Native corporations are the other major landholders. A small portion of the Wilderness Area of Katmai National Park is contained in this area, but no other portion of this area is specifically managed for conservation of biodiversity. As a navigable waterbody, Lake Iliamna is owned and managed by the State of Alaska.

TABLE 37. Primary targets in Lake Iliamna Area of biological significance

AQUATIC SYSTEMS			
Large braided rivers in floodplain on old glacial outwash or moraine		Small lakes on bedrock	
Moraine mainstems that enter large glacial dam lake		Unconnected small and moderate sized lakes in lightly modified moraine	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Lowland spruce-hardwood forest	
High brush		Upland spruce-hardwood forest	
BIRDS			
Catharus minimus	Gray-cheeked thrush	*Lxoreus naevius*	Varied thrush
Clangula hyemalis	Long - tailed duck	*Melanitta nigra*	Black scoter
Dendroica striata	Blackpoll Warbler	*Zonotrichia atricapilla*	Golden-crowned sparrow
FISH			
Coregoninae subfamily	Whitefish species (3)	*Oncorhynchus nerka*	Sockeye salmon
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
MARINE MAMMALS			
Phoca vitulina - freshwater	Harbor Seal - freshwater		
TERRESTRIAL MAMMALS			

Alces alces	Moose	*Ursus arctos*	Brown bear
Lynx canadensis	Canada lynx		
SPECIES AGGREGATIONS			
Waterfowl nesting and breeding areas		Waterfowl spring and fall areas	

18. Mother Goose Lake

TOTAL AREA: 53,514 HA
LAND AREA: 53,514 HA
MARINE AREA: 0 HA

CONSERVATION STATUS: **HIGH** 0.0%
MEDIUM 90.3 %
LOW 0.0%
NONE 9.7%

The Mother Goose Lake area includes Mother Goose Lake, its shorelines, and the drainages of Painter, Volcano, and Indecision Creeks (Figure 35). The Final Comprehensive Conservation Plan for Alaska Peninsula National Wildlife Refuge (USFWS 1985c) identifies Mother Goose Lake as a *Special Value Area* (see Appendix 14). The balsam poplar/cottonwood community in the area, unique due to its distance from any similar plant communities, provides important breeding and nesting habitat for passerines, including gray-cheeked thrush, northern shrike, and golden-crowned sparrow (Egan and Adler 2001). Tundra-nesting shorebirds like Beringian marbled godwit and short-billed dowitcher breed in meadows here. This area provides important wintering and calving habitat for moose, which are at a higher density here relative to other areas on the Alaska Peninsula. The area also receives high use by brown bears.

The federal government is the primary landowner in this area. State lands make up less than 8% of this area, and private parties own roughly 2%.

TABLE 38. Primary targets in Mother Goose Lake Area of biological significance

AQUATIC SYSTEMS			
Braided rivers on alluvial terrace on moraine connected to lakes		Small lakes on bedrock	
Morainal depression lakes		Unconnected small and moderate sized lakes in lightly modified moraine	
Small and moderate sized lakes on lightly modified moraine			
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		High brush	
Floodplain / outwash plain		Moist tundra	
BIRDS			
Catharus minimus	Gray-cheeked thrush	*Limosa fedoa beringiae*	Beringian marbled godwit
Histrionicus histrionicus	Harlequin duck	*Zonotrichia atricapilla*	Golden-crowned sparrow
Limnodromus griseus	Short-billed dowitcher		
FISH			
Esox lucius	Northern pike	*Oncorhynchus mykiss*	Rainbow trout
Oncorhynchus	Pink salmon	*Oncorhynchus nerka*	Sockeye salmon

gorbuscha			
Oncorhynchus keta	Chum salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus kisutch	Coho salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Ursus arctos*	Brown bear
Gulo gulo	Wolverine		

19. Naknek Lake Drainage

TOTAL AREA: 509,465 HA
LAND AREA: 509,465 HA
MARINE AREA: 0 HA

CONSERVATION STATUS:
HIGH 97.6%
MEDIUM 1.0%
LOW 0.0%
NONE 1.4%

The Naknek Lake Drainage area encompasses several large lakes that drain into the Naknek River, including Naknek, Brooks, and Grosvernor Lakes (Figure 36). These freshwater bodies fill glacially-scoured valleys and serve as headwaters to rivers in alluvial terraces. The glaciers and volcanoes in the Aleutian Range heavily influence these lakes. The large size of the lakes allows a great diversity of fish species, including sockeye salmon, Arctic grayling, rainbow trout, whitefish, Arctic char, burbot, lake trout, Northern pike, and dolly varden. The Southwest Alaska Conservation Council named the Naknek River drainage as a *Priority Salmon Conservation Watershed* for 5 Pacific salmon species, including 4.4 million sockeye salmon (SWACC 2002).

These biologically rich rivers feed many terrestrial predators, such as brown bear, bald eagle, boreal owl, and goshawk, and support a high density of beaver. Wetlands and small ponds attract various waterfowl, such as long-tailed ducks, for breeding. Coniferous forests are prime habitat for lynx, as well as passerines like gray-cheeked thrush, blackpoll warbler, olive-sided flycatcher and varied thrush. Alder and willow thickets support moose and golden-crowned sparrow.

Most of this area resides within Katmai National Park's Wilderness boundary. The State of Alaska owns a small amount of land near the top of the Naknek River, and Native allottees and corporations and private parties own some land within the park.

TABLE 39. Primary targets in Naknek Lake Drainage Area of biological significance

AQUATIC SYSTEMS	
Bedrock mainstems that enter glacial dam lake	Small and moderate sized lakes on lightly modified moraine
Braided rivers on outwash or moraine, enter glacial headwater lakes	Small lakes in old glacial outwash and floodplains
Large braided rivers in floodplain on old glacial outwash or moraine	Small lakes on bedrock
Moraine mainstems that enter glacial dam lake not connected to river	Unconnected glacial valley lakes, non-glacial influenced
TERRESTRIAL SYSTEMS	
Alpine tundra and barren ground	Moist tundra

High brush		Upland spruce-hardwood forest	
BIRDS			
Catharus minimus	Gray-cheeked thrush	*Dendroica striata*	Blackpoll warbler
Clangula hyemalis	Long - tailed duck	*Lxoreus naevius*	Varied thrush
Contopus borealis / cooperi	Olive-sided flycatcher	*Zonotrichia atricapilla*	Golden-crowned sparrow
FISH			
Coregoninae subfamily	Whitefish species	*Oncorhynchus mykiss*	Rainbow trout
Esox lucius	Northern pike	*Oncorhynchus nerka*	Sockeye salmon
Lota lota	Burbot	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus kisutch	Coho salmon	*Thymallus arcticus*	Arctic grayling
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Lynx canadensis*	Canada lynx
Castor canadensis	American beaver	*Ursus arctos*	Brown bear
Gulo gulo	Wolverine		
SPECIES AGGREGATIONS			
Waterfowl nesting and breeding areas			

20. Nushagak

TOTAL AREA: 1,819,181 HA
LAND AREA: 1,292,523 HA
MARINE AREA: 116,228 HA
AREA OUTSIDE ECOREGIONS: 410,430 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 2.9%
LOW 0.1%
NONE 97.0%

This area encompasses the entire Nushagak River drainage, the lower reaches of the Mulchatna River, and all of Nushagak Bay (Figure 37). The Nushagak River watershed is composed of mountains, mixed forests, tundra, lakes and rivers. The dominant terrestrial vegetation is tundra, mixed coniferous/birch forest, and willow/cottonwood/alder riparian corridors. In general, white spruce and mixed spruce-birch forests as well as muskeg and willow-alder thickets exist up to 900-ft elevation. Above this are bare rock, heath tundra, and alpine meadow. At the lowest elevations, wet tundra or marsh is common, and a large tidal marsh exists at the mouth of the Nushagak River. Tidal mudflats, sandy and/or gravelly shorelines, and bluffs of glaciofluvial material up to 200 feet high characterize the bay (Berryhill 1963). The Nushagak area is considered one of the richest areas in the state for its abundance of natural resources.

The Nushagak River watershed, an area of about 1,800,000 ha, provides important habitat to moose, especially in lowland forests near lakes and rivers. Caribou from the Mulchatna Herd migrate and calve through the area where tundra and open boreal forest is found. Caribou breed in the upper Nushagak Basin along the King Salmon River; past post-calving congregations numbered 80,000 to 100,000 animals. The area also provides habitat for

brown and black bears, wolverine, wolves, and fox. Lynx and marten tend to be found in the woodlands in the area. Beaver are abundant throughout most streams and large lakes. Also common are muskrats, weasels, mink, ground squirrels and microtenes.

The Nushagak area provides staging, nesting, molting or year round habitat for some 150 species of birds. These include 32 species of waterfowl, 22 species of shore birds, 55 species of passerine, 17 species of raptors, 5 species of upland birds and 10 species of sea birds. Audubon considers Nushagak Bay an *Important Bird Area in the Bering Sea* for waterfowl and shorebirds (Audubon Alaska 2002), and the Western Hemisphere Shorebird Reserve Network has identified the bay for its importance to migrating godwits, dunlins, golden plover, western sandpiper, and black turnstone (ASWG 2000). The Bristol Bay lowlands, of which this area makes up a significant portion, may host up to 25% of the North American population of greater scaup and roughly 10% of the breeding population of red-throated loons. The Nushagak area also has prime breeding habitat for black scoters and long-tailed ducks, and eiders molt in shoals near the mouth of the bay.

The Nushagak River system, the fifth largest volume river in Alaska, is rich in biological resources and supports a great diversity of freshwater and anadromous fish species. The Nushagak River and its tributaries host 5 specis of Pacific salmon and provide significant habitat for the Bristol Bay sockeye salmon run—the largest in the world. The Nushagak River hosts the largest sport fishery for chinook salmon in the United States, with the third largest chinook run in the country. In addition, there are significant numbers of rainbow trout, grayling, Arctic char, dolly varden and non-game species. Northern pike are native to some of the lakes, and the Nushagak River has a significant population. Beluga whales calve in and around the mouth of the Igushik River on the west side of Nushagak Bay.

The rich biological resources of this area have been recognized by the State of Alaska, the principal land owner. The state has identified the Nushagak Mulchatna Rivers Recreation Area as an *Area which Merits Special Attention* (BBCRSAB 1990), and the Bristol Bay Plan for State Lands (ADNR 1984) identified the Nushagak and Mulchatna River drainages as priorities for conservation. The Bureau of Land Management and village and regional Native corporations also own land along the Nushagak River. Lands managed for conservation include a small portion of Togiak National Wildlife Refuge and Wood-Tikchik State Park. Part of the bay is in the Bristol Bay Fisheries Reserve, which prohibits surface entry permits to develop oil or gas leases on submerged or shorelands on state-owned or controlled land until the legislature specifically finds that the entry will not constitute danger to the fishery.

TABLE 40. Primary targets in Nushagak Area of biological significance

AQUATIC SYSTEMS	
Floodplain rivers on moraine and old glacial outwash with headwater lakes	Large braided rivers on old glacial outwash channels or alluvial terraces
Highly deranged drainages on moraine connected to lakes and to ocean	Low gradient large river with large morainal debris dam in headwaters
Highly deranged tributaries on moraine connected to lakes	Small and moderate sized lakes on moderately and highly modified moraine
Large braided rivers in floodplain on old glacial outwash or moraine	Small lakes in old glacial outwash and floodplains
COASTAL SYSTEMS	
Exposed tidal flats (moderate biomass)	Intertidal and subtidal algal forests
Fine to medium-grained sand beaches	Sheltered rocky shores

Gravel beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Lowland spruce-hardwood forest	
Bottomland spruce-poplar forest		Moist tundra	
Floodplain / outwash plain		Wet tundra	
BIRDS			
Arenaria melanocephala	Black turnstone	*Limosa lapponica*	Bar-tailed godwit
Aythya marila	Greater scaup	*Melanitta nigra*	Black scoter
Calidris alpina	Dunlin	*Pluvialis fulva*	Pacific golden plover
Clangula hyemalis	Long - tailed duck	*Somateria spectabilis*	King eider
Gavia stellata	Red-throated loon	*Sterna aleutica*	Aleutian tern
Limosa haemastica	Hudsonian godwit		
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Osmerus mordax*	Rainbow smelt
Oncorhynchus keta	Chum salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		
MARINE MAMMALS			
Delphinapterus leucas	Beluga whale		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Lynx canadensis*	Canada lynx
Castor canadensis	American beaver	*Rangifer tarandus*	Caribou
Lantra canadensis	River otter	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl molting areas	
Shorebird nesting and breeding areas		Waterfowl nesting and breeding areas	

21. Nushagak Peninsula

TOTAL AREA: 130,667HA
LAND AREA: 117,702HA
MARINE AREA: 12,965HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 97.2%
LOW 0.2%
NONE 2.6%

The Nushagak Peninsula area includes most of the Nushagak Peninsula, except for the eastern shoreline, which is included in the Nushagak area of biological significance (Figure

38). The many wetlands and ponds on the peninsula provide prime breeding and nesting habitat for waterfowl, such as long-tailed duck and black scoter. Four estuaries on the southern tip of the peninsula have a high density of shorebirds during spring and fall migration and the breeding season. The Nushagak caribou herd, which was introduced, has a high fidelity to the peninsula. Southwest Alaska Conservation Council calls Igushik River, on the east side of the peninsula, a *Priority Salmon Conservation Watershed* for sockeye salmon, which can number 1.25 million each year (SWACC 2002).

Most of this area is inside the Togiak National Wildlife Refuge. Other landholders include Native corporations, Native allottees, the State of Alaska, and private parties. A fraction of the marine portion of the area receives a low level of conservation through the Bristol Bay Fisheries Reserve, which prohibits surface entry permits to develop oil or gas leases on submerged or shorelands on state-owned or controlled land until the legislature specifically finds that the entry will not constitute danger to the fishery.

TABLE 41. Primary targets in Nushagak Peninsula Area of biological significance

AQUATIC SYSTEMS			
Low gradient large river with large morainal debris dam in headwaters		Small lakes in old glacial outwash and floodplains	
Low gradient streams on old marine and alluvial coast		Small and moderate sized lakes on marine sediments and alluvial outwash	
COASTAL SYSTEMS			
Fine to medium-grained sand beaches		Sheltered rocky shores	
Gravel beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Moist tundra		Wet tundra	
BIRDS			
Clangula hyemalis	Long - tailed duck	*Melanitta nigra*	Black scoter
FISH			
Clupea pallasi	Pacific herring	*Oncorhynchus nerka*	Sockeye salmon
MARINE MAMMALS			
Delphinapterus leucas	Beluga whale		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
Lantra canadensis	River otter		
SPECIES AGGREGATIONS			
Seabird colonies		Shorebird fall staging/stopover areas	
Shorebird nesting and breeding areas			

22. Pavlof Bay

TOTAL AREA: 245,113 HA **CONSERVATION STATUS:** **HIGH** 0.0%

LAND AREA: 128,367 HA
MARINE AREA: 116,746 HA

MEDIUM 73.0%
LOW 0.0 %
NONE 27.0%

This area consists of Pavlof Bay, Ukolnoi Island, and Wosnesenski Island, and the Gulf of Alaska waters between the bay and the islands (Figure 39). These marine waters support a diverse group of species. Pavlof Bay hosts a high concentration of wintering emperor geese and is a stopover during spring and fall migrations for waterfowl, including emperor geese, king eider, and Steller's eider. Pigeon guillemot and black-legged kittiwakes have colonies around Pavlof Bay and on the islands. Harbor seals haul out at eight locations within this area, and sea otter numbers are high in Pavlof Bay.

The high brush and tundra systems in the uplands of this area provide important habitat for moose on the lower end of the peninsula.

Over 70% of this area is in the Alaska Peninsula National Wildlife Refuge, and another 3%— offshore islands—is part of the Alaska Maritime National Wildlife Refuge. The State of Alaska and Native corporations own more than a quarter of the area.

TABLE 42. Primary targets in Pavlof Bay Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on a matrix of old glacial outwash, connected to lakes		Mainstem in bedrock valleys	
Low gradient rivers on moraine		Small streams on volcanic mountain alluvium	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Sheltered rocky shores	
Exposed wavecut platforms		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Brachyramphus brevirostris	Kittlitz's murrelet	*Polysticta stelleri*	Steller's eider
Cepphus columba	Pigeon guillemot	*Rissa tridactyla*	Black-legged kittiwake
Chen canagica	Emperor goose	*Somateria spectabilis*	King eider
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus kisutch*	Coho salmon
Oncorhynchus keta	Chum salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
SPECIES AGGREGATIONS			

Seabird colonies	Waterfowl wintering areas
Waterfowl spring and fall staging/stopover areas	

23. Port Heiden

TOTAL AREA: 284,465 HA
LAND AREA: 227,545 HA
MARINE AREA: 56,920 HA

CONSERVATION STATUS: **HIGH** 20.8%
MEDIUM 48.9 %
LOW 0.0%
NONE 30.3%

This area comprises Port Heiden and the drainage of the Meshik River on the north side of the Alaska Peninsula (Figure 40). Mudflats with sedge meadows and beach rye characterize Port Heiden; this highly productive food base supports waterfowl and shorebirds. The US Fish and Wildlife Service designated Port Heiden as critical habitat for Steller's eider for wintering and during the autumn molt. King eider also molt here, and both eiders as well as long-tailed duck stop here during the spring migration. Tens of thousands of dunlin, western sandpiper, bar-tailed godwit, and rock sandpiper use this area (ASWG 2000). Audubon has identified Port Heiden as an *Important Bird Area in the Bering Sea* for waterfowl and shorebirds (Audubon Alaska 2002). The marine portion of the area also supports large numbers of harbor seals and northern sea otters.

The Final Comprehensive Conservation Plan for Alaska Peninsula National Wildlife Refuge (USFWS 1985c) identifies the Meshik River as a *Special Value Area* (see Appendix 14). The river supports chum, coho, and chinook salmon, Arctic char, and dolly varden. High brush in the upper parts of the watershed provides good habitat for moose.

The federal government owns the majority of this area and manages it as the Alaska Peninsula National Wildlife Refuge. The State of Alaska has designated most of their lands around the port as the Port Heiden State Critical Habitat Area. The remaining lands are owned primarily by Native corporations and the State of Alaska as undesignated lands.

TABLE 43. Primary targets in Port Heiden Area of biological significance

AQUATIC SYSTEMS		
Highly deranged stream network among lakes on old marine deposits	Low gradient streams on old marine and alluvial coast connected to lakes	
Low gradient rivers on moraine connected to lakes	Small and moderate sized lakes on marine sediments and alluvial outwash	
Low gradient streams on old marine and alluvial coast		
COASTAL SYSTEMS		
Coarse-grained sand beaches	Tidal marshes and wetlands	
Gravel beaches	*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS		
Alpine tundra and barren ground	Moist tundra	
Floodplain / outwash plain	Wet tundra	
High brush		
BIRDS		

Calidris alpina	Dunlin	*Limosa fedoa beringiae*	Beringian marbled godwit
Calidris ptilocnemis	Rock sandpiper	*Limosa lapponica*	Bar-tailed godwit
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Clangula hyemalis	Long - tailed duck	*Somateria spectabilis*	King eider
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Oncorhynchus keta	Chum salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus tshawytscha	Chinook salmon		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Ursus arctos*	Brown bear
Rangifer tarandus	Caribou		
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl spring and fall staging/stopover areas	
Shorebird nesting and breeding areas		Waterfowl wintering areas	

24. Port Moller

TOTAL AREA: 246,004 HA
LAND AREA: 95,221 HA
MARINE AREA: 150,783 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 41.7%
LOW 0.0%
NONE 57.3%

This area comprises three large bays and lagoons on the north side of the Alaska Peninsula—Port Moller, Herendeen Bay, and Nelson Lagoon—and the uplands around them (Figure 41). These marine waters support a diverse group of species. Eelgrass beds and tidal flats provide important feeding grounds for migrating birds. Audubon identified Port Moller and Herendeen Bay as *Important Bird Areas in the Bering Sea* for waterfowl and shorebirds, and Nelson Lagoon was identified for waterfowl, shorebirds, and seabirds (Audubon Alaska 2002). Nelson Lagoon hosts dunlin, western sandpiper, bar-tailed godwit, short-billed dowitcher, and rock sandpiper in the hundreds of thousands (ASWG 2000). The Bering Sea Ecoregional Plan (Banks and others 1999), prepared by The Nature Conservancy and World Wildlife Fund, labeled Nelson Lagoon a *Global Priority Bird Area in the Bering Sea* because it has the highest number and diversity of migrating waterfowl and shorebirds in the Bering Sea. Waterfowl utilizing this area include molting Steller's eider, migrating king eider, long-tailed duck, black scoter, emperor goose, and Steller's eiders, and wintering black scoter. The US Fish and Wildlife Service designated Port Moller and Herendeen Bay as critical habitat for Steller's eider for wintering and during the autumn molt.

This area also has a high concentration of many marine fish, shellfish and mammal species. Red king crab spawn in the waters outside the barrier islands, and juveniles rear offshore and within the lagoons of this area. Overall, herring stocks in the Bering Sea are declining, but spawning has remained stable at Port Moller (USFWS 1993). Harbor seals haul out at many places in this area in large numbers.

The State of Alaska owns more than half of this area. A fraction of that land is managed as the Port Moller Critical Habitat Area. Other lands managed for conservation belong to the Alaska Peninsula National Wildlife Refuge. There are also private, Native corporation, and local government lands in this area. The Aleutians East Borough identified Port Moller, Herendeen Bay, and Nelson Lagoon as *Special Use Areas* in its Coastal Management Program (see Appendix 14).

TABLE 44. Primary targets in Port Moller Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on a matrix of old glacial outwash		Low gradient streams on old marine and alluvial coast	
Low gradient rivers on a matrix of old glacial outwash, connected to lakes		Mainstem in bedrock valleys	
Low gradient rivers on moraine		Small and moderate sized lakes on lightly modified moraine	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Sheltered tidal flats	
Exposed tidal flats (moderate biomass)		Tidal marshes and wetlands	
Mixed sand and gravel beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
High brush		Wet tundra	
BIRDS			
Calidris alpina	Dunlin	*Limosa lapponica*	Bar-tailed godwit
Calidris ptilocnemis	Rock Sandpiper	*Polysticta stelleri*	Steller's eider
Chen canagica	Emperor goose	*Somateria spectabilis*	King eider
Limnodromus griseus	Short-billed dowitcher	*Sterna aleutica*	Aleutian tern
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Clupea pallasi	Pacific Herring	*Oncorhynchus nerka*	Sockeye salmon
Oncorhynchus keta	Chum salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern Sea otter	*Phoca vitulina*	Harbor Seal
TERRESTRIAL MAMMALS			
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			

Seabird Colonies	Waterfowl spring and fall staging/stopover areas
Shorebird nesting and breeding areas	Waterfowl molting areas
Shorebird fall staging/stopover areas	Waterfowl wintering areas

25. Puale Bay

TOTAL AREA: 65,768 HA
LAND AREA: 29,492 HA
MARINE AREA: 36,276 HA

CONSERVATION STATUS:
HIGH 92.0%
MEDIUM 8.0%
LOW 0.0%
NONE 0.0%

The Puale Bay area is a long, narrow bay along the coast of the Alaska Peninsula, near the southern end of Shelikof Straits (Figure 42). The rocky coast here is home to the largest seabird colonies along the upper Alaska Peninsula, hosting tens of thousands of cormorants and black-legged kittiwakes. Harlequin ducks use this stretch of coastline in high densities year round. Harbor seals and Steller sea lions haul out on the shoreline and on reefs offshore. On the tundra surrounding the bay, brown bear densities are high, with roughly one bear per 260 ha (approximately 1 bear per square mile).

All of Puale Bay falls within Becharof National Wildlife Refuge, with 92% of the area within the refuge Wilderness Area.

TABLE 45. Primary targets in Puale Bay Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on moraine		Moraine mainstems that enter large glacial dam lake	
Mainstem in bedrock valleys		Small and moderate sized lakes on lightly modified moraine	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Gravel beaches	
Exposed rocky shores		Sheltered tidal flats	
Exposed wavecut platforms			
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Cepphus columba	Pigeon guillemot	*Phalacrocorax urile*	Red-faced cormorant
Histrionicus histrionicus	Harlequin duck	*Rissa tridactyla*	Black-legged kittiwake
Phalacrocorax pelagicus	Pelagic cormorant	*Uria aalge*	Common murre
MARINE MAMMALS			
Eumetopias jubatus	Steller sea lion	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Ursus arctos	Brown bear		
SPECIES AGGREGATIONS			

Seabird colonies	

26. Sanak Islands

TOTAL AREA: 98,756 HA
LAND AREA: 15,343 HA
MARINE AREA: 83,413 HA

CONSERVATION STATUS: **HIGH** 17.8%
MEDIUM 0.3%
LOW 0.0%
NONE 81.9%

The Sanak Islands and the marine environment around them compose this area (Figure 43). The diverse shoreline of the islands plus productive eelgrass and kelp beds offer important habitat for many marine-based species. Harbor seals use numerous haulouts in the area, and Steller sea lions use 2 haulouts. Black-legged kittiwakes and pigeon guillemots congregate in colonies among the islands. This area is 1 of only 2 wintering locations for black brant in the ecoregions. Steller's eider and king eider also winter here.

Native corporations own the majority of this area. Caton Island and some of the smaller islands belong to the Alaska Maritime National Wildlife Refuge. The State of Alaska has also designated these islands as part of a state game refuge, Aleutian Islands Refuge.

TABLE 46. Primary targets in Sanak Islands Area of biological significance

COASTAL SYSTEMS			
Coarse-grained sand beaches		Intertidal and subtidal algal forests	
Exposed rocky shores		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Sheltered tidal flats	
Exposed wavecut platforms		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Moist tundra		Wet tundra	
BIRDS			
Branta nigricans	Black brant	*Polysticta stelleri*	Steller's eider
Cepphus columba	Pigeon guillemot	*Rissa tridactyla*	Black-legged kittiwake
Haliaeetus leucocephalus	Bald eagle	*Somateria spectabilis*	King eider
MARINE MAMMALS			
Eumetopias jubatus	Steller sea lion	*Phoca vitulina*	Harbor seal
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl wintering areas	

27. Sandy and Bear Rivers

TOTAL AREA: 139,772 HA
LAND AREA: 139,772 HA
MARINE AREA: 0 HA

CONSERVATION STATUS: **HIGH** 0.0%
MEDIUM 35.7%
LOW 0.0%
NONE 64.3%

This area encompasses the drainages of the Sandy and Bear Rivers, including their headwaters and lakes of the same names, on the north side of the Alaska Peninsula (Figure 44). The Sandy River has the most significant steelhead fishery in southwest Alaska; steelhead are only found in 4 drainages on the Alaska Peninsula. The rivers in this area also

have 5 Pacific salmon species, plus rainbow trout, dolly varden, and Arctic grayling. Migrating marine mammals use this section of coastline, sometimes stopping to feed in the tidal marshes and wetlands, as they move to the upper regions of the Bering Sea. Male walruses also use this area during the summer. The tundra of this area attracts caribou in large concentrations for calving each spring. The riparian and high brush areas provide good habitat for moose, and Bear Lake has high concentrations of calving moose and brown bear.

The State of Alaska is the primary landholder in this area. The headwaters and higher elevations are within the Alaska Peninsula National Wildlife Refuge. Private parties and the Bureau of Land Management own a small percentage of the land. The Aleutians East Borough identified Bear River as a *Special Use Area* (see Appendix 14) in its Coastal Management Program (AECRSAB 1985).

TABLE 47. Primary targets in Sandy and Bear River Area of biological significance

AQUATIC SYSTEMS			
Braided rivers on old glacial outwash and moraine		Morainal depression lakes	
Braided rivers on old glacial outwash and moraine with lake complex			
COASTAL SYSTEMS			
Coarse-grained sand beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		High brush	
Floodplain / outwash plain		Moist tundra	
BIRDS			
Phalacrocorax pelagicus	Pelagic cormorant	*Somateria spectabilis*	King eider
Phalacrocorax urile	Red-faced cormorant		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus keta	Chum salmon	*Salmo gairdneri*	Steelhead
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		
MARINE MAMMALS			
Odobenus rosmarus divergens	Walrus		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Ursus arctos*	Brown bear
Rangifer tarandus	Caribou		
SPECIES AGGREGATIONS			
Waterfowl spring and fall staging / stopover areas			

28. Sapsuk

TOTAL AREA: 42,143 HA
LAND AREA: 42,143 HA
MARINE AREA: 0 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 16.0%
LOW 0.0%
NONE 84.0%

This area encompasses most of the Sapsuk River drainage to its headwaters at Sapsuk Lake on the north side of the Alaska Peninsula (Figure 45). This river supports an important sockeye salmon run and has a higher biomass of salmon than other streams on the lower peninsula. The presence of salmon attracts brown bears. The high brush around Sapsuk Lake provides good habitat for brown bear, wolverine, and moose. Caribou calve on the tundra along the lower river.

The State of Alaska owns the majority of this area. A small portion of the state's Port Moller Critical Habitat Area is included on the east side of the area, and the higher elevations are in the Alaska Peninsula National Wildlife Refuge. Native corporations, Native allottees, private parties, and the Bureau of Land Management also own land within this area.

TABLE 48. Primary targets in the Sapsuk Area of biological significance

AQUATIC SYSTEMS			
Caldera, maar, or lava flow dam lakes		Low gradient rivers on moraine connected to lakes	
Low gradient rivers on a matrix of old glacial outwash, connected to lakes		Small and moderate sized lakes on lightly modified moraine	
TERRESTRIAL SYSTEMS			
High brush		Wet tundra	
FISH			
Oncorhynchus nerka	Sockeye salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear

29. Seal Islands

TOTAL AREA: 103,982 HA
LAND AREA: 46,058 HA
MARINE AREA: 57,924 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 8.1%
LOW 0.0%
NONE 90.9%

The Seal Islands area comprises the Seal islands, Ilnik Lagoon, which the islands create, the lower portion of the Ilnik River, and a coastal plain of tundra dotted with small and moderate-sized lakes (Figure 46). Sandy beaches and tidal mudflats with sedge meadows and beach rye characterize the lagoon. This estuarine environment is an important staging area for waterfowl and shorebirds, and Audubon has identified it as an *Important Bird Area in the Bering Sea*. Emperor geese, Steller's eiders, and king eiders stop here during spring migration (Audubon Alaska 2002). The US Fish and Wildlife Service designated this area

as critical habitat for Steller's eider for wintering and during the autumn molt. Long-tailed ducks also stop here during migration and some winter here. Harbor seals and male walruses use this section of coastline. The Ilnik River has a strong sockeye run, and also dolly varden and supports 4 other Pacific salmon species.

The State of Alaska owns roughly 99% of this area. Only 7% at the far east end of the area is managed for conservation as the Port Heiden Critical Habitat Area. The Alaska Peninsula National Wildlife Refuge manages a small percentage of the area.

TABLE 49. Primary targets in the Seal Islands Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on a matrix of old glacial outwash		Low gradient streams on old glacial outwash connected to lakes	
COASTAL SYSTEMS			
Coarse-grained sand beaches		Tidal marshes and wetlands	
TERRESTRIAL SYSTEMS			
Moist tundra		Wet tundra	
BIRDS			
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Clangula hyemalis	Long - tailed duck	*Somateria spectabilis*	King eider
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus nerka*	Sockeye salmon
Oncorhynchus keta	Chum salmon	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
MARINE MAMMALS			
Odobenus rosmarus divergens	Walrus	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Rangifer tarandus	Caribou		
SPECIES AGGREGATIONS			
Shorebird nesting and breeding areas		Waterfowl spring and fall staging / stopover areas	
Waterfowl molting areas		Waterfowl wintering areas	

30. Semidi Islands

TOTAL AREA: 66,959 HA
LAND AREA: 3,241 HA
MARINE AREA: 63,718 HA

CONSERVATION STATUS: **HIGH** 92.8%
MEDIUM 7.2%
LOW 0.0%
NONE 0.0%

The Semidi Islands, a group of small islands roughly 90 km off the Alaska Peninsula in the Gulf of Alaska, and the marine environment around them compose this area (Figure 47). The Alaska Maritime National Wildlife Refuge manages this entire area, and the Final Comprehensive Conservation Plan (USFWS 1988) for the refuge identifies the Semidi Islands as a *Special Value Area* (see Appendix 14). The State of Alaska has also designated these islands as a state game refuge.

These islands support a unique collection of birds. Aleutian Canada geese breed only here, on tiny Kaliktagik Island, and on one other island, Buldir Island on the Aleutian chain. The Buldir Island birds are the main breeding population and overall the population trend in Alaska is increasing, but the Semidi Islands population has continued poor recruitment. This decline in numbers is attributed largely to predation by introduced arctic foxes (ACGRT 1982). The islands host one-quarter of the nesting seabirds in the Gulf of Alaska, especially common and thick-billed murres, horned puffins, northern fulmar, storm-petrels, black-legged kittiwake and tufted puffins. Pigeon guillemots also have several significant colonies in this area. The Semidi Islands winter wren, endemic to the islands, nests in open areas with low cover along rocky coasts and cliffs.

Marine mammals frequent these islands. The largest Steller sea lion rookery in this part of the Gulf of Alaska is on Chowiet Island. Harbor seals have 2 significant haulouts on Aghik Island and use other beaches in this area.

TABLE 50. Primary targets in the Semidi Islands Area of biological significance

COASTAL SYSTEMS			
Intertidal and subtidal algal forest		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground			
BIRDS			
Branta canadensis leucopareia	Aleutian Canada goose	*Uria aalge*	Common murre
Cepphus columba	Pigeon guillemot	*Troglodytes troglodytes*	Semidi Islands winter wren
Rissa tridactyla	Black-legged kittiwake		
MARINE MAMMALS			
Eumetopias jubatus	Steller sea lion	*Phoca vitulina*	Harbor seal
SPECIES AGGREGATIONS			
Seabird colonies			

31. Shumagin Islands

TOTAL AREA: 600,669 HA
LAND AREA: 118,907 HA
MARINE AREA: 481,762 HA

CONSERVATION STATUS:
HIGH 4.0%
MEDIUM 58.0%
LOW 0.0%
NONE 38.0%

The Shumagin Islands, a large group of islands off the Alaska Peninsula in the Gulf of Alaska, and the marine environment around them compose this area (Figure 48). The Final Comprehensive Conservation Plan for Alaska Maritime National Wildlife Refuge (USFWS 1988), the principle land manager in the area, identifies the Shumagin Islands as a *Special*

Value Area for the seabirds there, especially horned and tufted puffins, murres, crested auklets, and mew gulls (see Appendix 14). Black-legged kittiwakes and pigeon guillemots also breed here in colonies significant in size on the Alaska Peninsula. In addition to seabirds, waterfowl such as emperor goose and Steller's eider both stage and winter here.

Large numbers of marine mammals rely upon the Shumagin Islands. Northern sea otters congregate at productive kelp beds in the intertidal and subtidal zone along the rocky coast. Harbor seals frequent more than 20 haulouts throughout the islands. Endangered Steller sea lions have 2 rookerieson the outer islands—one-third of all rookeries in this part of the Gulf of Alaska.

Three endemic mammals have been discovered in the Shumagin Islands—Shumagin Island tundra vole, Popof Island dusky shrew, and Shumagin Arctic ground squirrel.

Native corporations own nearly a third of the land in this area. The State of Alaska, local governments and private individuals own a small percentage.

TABLE 51. Primary targets in the Shumagin Islands Area of biological significance

AQUATIC SYSTEMS			
Mainstem in bedrock valleys		Unconnected small lakes on bedrock	
Small lakes on bedrock			
COASTAL SYSTEMS			
Exposed rocky shores		Mixed sand and gravel beaches	
Exposed tidal flats (moderate biomass)		Sheltered rocky shores	
Exposed wavecut platforms		Sheltered tidal flats	
Fine to medium-grained sand beaches		Tidal marshes and wetlands	
Gravel beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Cepphus columba	Pigeon guillemot	*Rissa tridactyla*	Black-legged kittiwake
Chen canagica	Emperor goose	*Uria aalge*	Common murre
Polysticta stelleri	Steller's eider		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
Eumetopias jubatus	Steller sea lion		
TERRESTRIAL MAMMALS			
Microtus oeconomus popofensis	Shumagin Island tundra vole	*Spermophilus parryii nebulicola*	Shumagin Arctic ground squirrel
Sorex vagrans shumaginensis	Popof Island dusky shrew		
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl wintering areas	
Waterfowl spring and fall staging / stopover areas			

32. Togiak Islands

TOTAL AREA: 230,169 HA
LAND AREA: 34,236 HA
MARINE AREA: 195,933 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 99.2%
LOW 0.0%
NONE 0.8%

The Togiak Islands area comprises the islands in upper Bristol Bay, including Hagemeister, Walrus, Crooked, Summit, and High Islands, and the marine environment and reefs around them (Figure 49). The Alaska Maritime National Wildlife Refuge manages most of the islands within this area. Walrus Island State Game Sanctuary protects almost 4000 ha of that island. Native allottees own less than 1% of the land in this area.

The Bristol Bay Coastal Resource Service Area's Coastal Management Program (BBCRSAB 1988) identified the Togiak Fishing Grounds, including Hagemeister Island and the Walrus Island group, as an *Area Which Merits Special Attention* (see Appendix 14). These marine waters support the largest Pacific herring stock in Alaska, as well as larval and juvenile red king crab.

The Togiak Islands area contains important habitat for other marine and coastal-reliant species. Gray whales and waterfowl migrate through Hagemeister Strait. Audubon identified the Walrus Islands group as an *Important Bird Area in the Bering Sea* for seabirds such as common murre, pigeon guillemot, and black-legged kittiwake (Audubon Alaska 2002). In addition, this group of islands gets it name for the large number of bachelor walruses that haul out on its beaches each summer. The largest concentration occurs on Round Island, where Steller sea lions also haul out.

TABLE 52. Primary targets in the Togiak Islands Area of biological significance

COASTAL SYSTEMS			
Exposed rocky shores		Gravel beaches	
Exposed tidal flats (moderate biomass)		Intertidal and subtidal algal forest	
Exposed wavecut platforms		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Cepphus columba	Pigeon guillemot	*Somateria spectabilis*	King eider
Rissa tridactyla	Black-legged kittiwake	*Uria aalge*	Common murre
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Clupea pallasi	Pacific herring		
MARINE MAMMALS			
Eschrichtius robustus	Gray whale	*Odobenus rosmarus divergens*	Walrus
Eumetopias jubatus	Steller sea lion	*Phoca vitulina*	Harbor seal
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl spring and fall staging / stopover areas	

33. Togiak River

TOTAL AREA: 356,169 HA
LAND AREA: 354,73 HA
MARINE AREA: 1,432 HA

CONSERVATION STATUS:
HIGH 86.0%
MEDIUM 4.0%
LOW 0.0%
NONE 10.0%

This area encompasses the entire Togiak River drainage from its headwaters in the Ahklun and Wood River Mountains and it includes Togiak Lake (Figure 50). These waters are recognized for their diversity of freshwater and anadromous fish species. The Southwest Alaska Conservation Council identified the Togiak River as a *Priority Salmon Conservation Watershed* for 4 species of Pacific salmon, pink salmon excluded (SWACC 2002). Sockeye and chum salmon have the largest runs up the river, with 706,000 and 420,000 fish, respectively, expected each year. The Togiak National Wildlife Refuge, the principal land manager, calls the Wilderness Area of the refuge and the Togiak drainage *Special Value Areas* (USFWS 1986). The Bristol Bay Plan for State Lands (ADNR 1984) identified the upper Togiak River drainage as a priority for conservation. In addition to salmon, this drainage contains northern pike, rainbow trout, rainbow smelt, Arctic char, dolly varden, and Arctic grayling.

Viereck and Zasada (1972) recommended setting aside part of the land around Togiak Lake as an ecological reserve due to its shrub thickets, bogs, and scattered tree stands. These ecological communities provide habitat for moose and Canada lynx. American beaver occur in high densities along the riparian corridors.

The Togiak Refuge Wilderness Area contains most of this area. The lower Togiak River passes through lands owned primarily by Native corporations, Native allottees, private individuals, and local governments.

TABLE 53. Primary targets in the Togiak River Area of biological significance

AQUATIC SYSTEMS			
Glacial valley lakes, non-glacial influenced		Small and moderate sized lakes on lightly modified moraine	
Low gradient riverine delta on outwash and alluvial fan		Small lakes in old glacial outwash and floodplains	
Low gradient, braided tributaries to riverine delta		Small lakes on bedrock	
Moraine mainstems that enter large glacial dam lake		Unconnected small and moderate sized lakes in lightly modified moraine	
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Upland spruce-hardwood forest	
Floodplain / outwash plain		Wet tundra	
Moist tundra			
BIRDS			
Cepphus columba	Pigeon guillemot		
FISH			
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Osmerus mordax*	Rainbow smelt

Oncorhynchus keta	Chum salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus kisutch	Coho salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Lynx canadensis*	Canada lynx
Castor canadensis	American beaver		

34. Ugashik

TOTAL AREA: 276,883 HA
LAND AREA: 240,688 HA
MARINE AREA: 36,195HA

CONSERVATION STATUS: **HIGH** 0.0%
MEDIUM 40.1%
LOW 0.0%
NONE 59.9%

The Ugashik area encompasses most of the drainages of the Ugashik and Dog Salmon Rivers, the lower King Salmon River, Upper and Lower Ugashik Lakes, and Ugashik Bay (Figure 51). These marine and freshwater bodies, the tundra matrix of the coastal plain, and the high brush of the uplands provide productive habitats for coastal, aquatic, and terrestrial species.

Audubon identified Ugashik Bay as an *Important Bird Area in the Bering Sea* for waterfowl and shorebirds. Waterfowl use the bay at various life stages (Audubon Alaska 2002). Black scoters nest on the coastal plain, long-tailed ducks winter in the bay, Steller's eiders feed on eelgrass during migration, and king eiders molt in the bay in the fall. The US Fish and Wildlife Service designated this area as critical habitat for Steller's eider for spring staging. Tens of thousands of dunlin, western sandpiper, marbled godwit, and long-billed dowitcher use Ugashik Bay each year (ASWG 2000). The Beringian marbled godwit breeds and nests on the tundra and stages at the bay for fall migration.

The Southwest Alaska Conservation Council calls Ugashik, Dog Salmon, and King Salmon Rivers a *Priority Salmon Conservation Watershed* for 5 Pacific species, including 4.3 million sockeye annually (SWACC 2002). The Final Comprehensive Conservation Plan for Alaska Peninsula National Wildlife Refuge (USFWS 1985c) identifies Ugashik Lakes and Dog Salmon River as a *Special Value Area* (see Appendix 14). The Ugashik Lakes support large concentrations of lake trout and provide key feeding habitat for brown bears. The Ugashik Lakes are also world renowned for large Arctic grayling. Arctic grayling almost disappeared from the northern United States because of overfishing, competition from introduced species, and habitat loss, but Ugashik Lake is still offering trophy grayling and maintaining a healthy population. Dog Salmon River has one of the most important moose concentration areas on the peninsula and supports large numbers of salmon, caribou, and brown bear.

Within this area, 40% of the land is managed at a medium level for the conservation of biodiversity. The headwaters of the rivers and the Ugashik Lakes are within the Alaska Peninsula National Wildlife Refuge. The State of Alaska manages some of its coastal lands for conservation as the Pilot Point Critical Habitat Area. Some of the coastline is included in the Bristol Bay Fisheries Reserve, which prohibits surface entry permits to develop oil or gas leases on submerged or shore lands on state-owned or controlled land until the

legislature specifically finds that the entry will not constitute danger to the fishery. The majority of land within this area is undesignated state and Native corporation lands.

TABLE 54. Primary targets in Ugashik Area of biological significance

AQUATIC SYSTEMS			
Braided rivers on alluvial terrace on moraine connected to lakes		Small and moderate sized lakes on marine sediments and alluvial outwash	
Low gradient streams on old marine and alluvial coast connected to lakes		Unconnected small and moderate sized lakes in lightly modified moraine	
Moraine mainstems that enter large glacial dam lake		Unconnected small and moderate sized lakes on marine sediments and alluvial outwash	
Small and moderate sized lakes on lightly modified moraine			
COASTAL SYSTEMS			
Coarse-grained sand beaches		Sheltered tidal flats	
Fine to medium-grained sand beaches		Tidal marshes and wetlands	
Sheltered rocky shores		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
High brush		Wet tundra	
BIRDS			
Calidris alpina	Dunlin	*Melanitta nigra*	Black scoter
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Limnodromus griseus	Short-billed dowitcher	*Somateria spectabilis*	King eider
Limosa fedoa beringiae	Beringian marbled godwit		
CRUSTACEAN			
Paralithodes camschatica	Red king crab		
FISH			
Coregoninae subfamily	Whitefish species	*Osmerus mordax*	Rainbow smelt
Esox lucius	Northern pike	*Salvelinus alpinus*	Arctic char
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus nerka	Sockeye salmon	*Thymallus arcticus*	Arctic grayling
Oncorhynchus tshawytscha	Chinook salmon		
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Rangifer tarandus*	Caribou
Lynx canadensis	Canada lynx	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			
Shorebird fall staging/stopover areas		Waterfowl nesting and breeding areas	
Shorebird nesting and breeding areas		Waterfowl spring and fall staging/stopover areas	

35. Urilia Bay

TOTAL AREA: 83,717 HA
LAND AREA: 49,160 HA
MARINE AREA: 34,557 HA

CONSERVATION STATUS:
HIGH 100.0%
MEDIUM 0.0%
LOW 0.0%
NONE 0.0%

This area includes the sandy beaches, bedrock bluffs, and boulder-strewn reaches of Urilia Bay on the north side of Unimak Island (O'Clair and others 1979), plus the upland tundra plain around the bay (Figure 52). Eelgrass beds in the bay attract waterfowl such as emperor geese and Steller's eiders to winter and nest in the area. Audubon includes Urilia Bay as an *Important Bird Area in the Bering Sea* for its importance to waterfowl (Audubon Alaska 2002). This area also has the only known resident population of wild tundra swans in North America. The moist tundra of the uplands provides some of the best bear habitat on Unimak Island, as well as attracting the small Unimak Island caribou herd for calving. The Alaska Maritime National Wildlife Refuge manages all the lands within the Urilia Bay area.

TABLE 55. Primary targets in Urilia Bay Area of biological significance

AQUATIC SYSTEMS			
Low gradient streams on old glacial outwash		Small streams on volcanic mountain alluvium	
COASTAL SYSTEMS			
Coarse-grained sand beaches		*Zostera*	Eelgrass beds
TERRESTRIAL SYSTEMS			
Alpine tundra and barren ground		Moist tundra	
BIRDS			
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
TERRESTRIAL MAMMALS			
Rangifer tarandus	Caribou	*Ursus arctos*	Brown bear
SPECIES AGGREGATIONS			
Waterfowl wintering areas		Waterfowl nesting and breeding areas	

36. Wide Bay

TOTAL AREA: 143,665 HA
LAND AREA: 53,140 HA
MARINE AREA: 90,525HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 98.2 %
LOW 0.0%
NONE 1.8%

This area includes Wide Bay on the southwest coast of the Alaska Peninsula and the uplands immediately surrounding it (Figure 53). The bay contains kelp beds and eelgrass beds, making it key habitat for waterfowl, shorebirds and marine mammals. Eelgrass at Cape Igvak at the north end of the bay attracts migrating waterfowl and shorebirds. The US Fish and Wildlife Service designated Wide Bay as critical wintering habitat for Steller's eider. Sea otters frequent the kelp beds, and harbor seals and Steller sea lions haul out

around the bay. The relatively low elevation of the mountains behind this area makes it an important passage for neotropical passerines.

The Final Comprehensive Conservation Plan for Alaska Peninsula National Wildlife Refuge (USFWS 1985c), the primary land manager, identifies the Pacific coast of the refuge, including Wide Bay, as a *Special Value Area* (see Appendix 14). The State of Alaska and private parties also own land within this area.

TABLE 56. Primary targets in Wide Bay Area of biological significance

AQUATIC SYSTEMS			
Low gradient rivers on moraine		Low gradient streams on old glacial outwash	
COASTAL SYSTEMS			
Exposed tidal flats (moderate biomass)		Gravel beaches	
Exposed wavecut platforms		Sheltered tidal flats	
TERRESTRIAL SYSTEMS			
Coastal forest		High brush	
BIRDS			
Chen canagica	Emperor goose	*Polysticta stelleri*	Steller's eider
Histrionicus histrionicus	Harlequin duck		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus kisutch*	Coho salmon
MARINE MAMMALS			
Enhydra lutris kenyoni	Northern sea otter	*Phoca vitulina*	Harbor seal
TERRESTRIAL MAMMALS			
Ursus arctos	Brown bear		
SPECIES AGGREGATIONS			
Shorebird nesting and breeding areas		Waterfowl wintering areas	
Waterfowl spring and fall staging / stopover areas			

37. Wood-Tikchiks

TOTAL AREA: 778,159 HA
LAND AREA: 778,159 HA

CONSERVATION STATUS: **HIGH** 4.3 %
MEDIUM 74.2%
LOW 0.0%
NONE 21.5%

This area is composed of mountains, mixed forests, tundra, lakes and rivers and is named after the two major watersheds that drain the area: the Wood River and the Tikchik River (Figure 54). Two sets of large lakes with short interconnecting rivers make up each of the drainages. The Wood River Lakes drain an area of 366,000 ha, and the Tikchik Lakes drain an area of 385,000 ha. The waters of these two lake systems contribute 1.6 million sockeye salmon to the Bristol Bay run, or almost 20% of the largest sockeye run in the world. The Southwest Alaska Conservation Council considers the Agulowak River, the Wood River,

and the Tikchik Lakes to be *Priority Salmon Conservation Watersheds* for sockeye. In addition, there are significant numbers of 4 other species of Pacific salmon, rainbow trout, Arctic grayling, Arctic char and dolly varden. Northern pike are native to some of the lakes in the area, and the Wood River has a significant population (Dye and others 2002). Lake trout occur in the Tikchik Lake system, but not the Wood River Lakes.

The dominant vegetation includes mixed coniferous/birch forest and tundra. In general, white spruce and mixed spruce-birch forest as well as muskeg and willow-alder thickets exist up to 900-ft elevation. Viereck and Zasada (1972) recommended setting aside part of the land around Nerka Lake as an ecological reserve due to its white spruce and birch forests interspersed with sphagum bogs. Above this are bare rock, heath tundra, and alpine meadow. At the lowest elevations, wet tundra or marsh is common.

The Wood-Tikchik area offers important habitat for moose, especially in lowland forests near lakes and rivers. Caribou from the Mulchatna Herd frequent much of the area where tundra and open boreal forest is found. Animals from the Kilbuck Herd tend to only be found in the northern areas of the site near Nishlik and Upnuk lakes. Brown and black bear can be found throughout the site as can wolverine, wolves, and fox. Lynx and marten are found in the more wooded portions; lynx are predominantly in the southwest corner and marten in the wooded area east of the Wood-Tikchik lakes. Beaver thrive throughout the site in most streams and large lakes. Also common are muskrats, weasels, mink, ground squirrels and microtenes. Marmots are found in the rocky, higher elevations. This area provides staging, nesting, molting or year round habitat for waterfowl, shore birds, passerines, raptors and sea birds.

The majority of this area is owned by the State of Alaska. The Bristol Bay Plan for State Lands (ADNR 1984) identified the Wood-Tikchiks unit and Wood River drainage as priorities for conservation. Toward that goal, Wood-Tikchik State Park, the largest state park in the country, was established to protect fish and wildlife populations, and to support traditional subsistence and recreational activities—in that order of priority. This area also includes some of the Wilderness Area of Togiak National Wildlife Refuge. The remainder is primarily undesignated state lands, with some private, Native allottee, Native corporaation, Bureau of Land Management, and municipal lands.

TABLE 57. Primary targets in the Wood-Tikchik Area of biological significance

AQUATIC SYSTEMS	
Bedrock mainstems that enter glacial dam lake	Small and moderate sized lakes on lightly modified moraine
Bedrock mainstems that enter glacial dam lake, not connected to river	Small lakes in old glacial outwash and floodplains
Glacial valley lakes, non-glacial influenced	Small lakes on bedrock
Large braided rivers on old glacial outwash channels or alluvial terraces	Unconnected small and moderate sized lakes in lightly modified moraine
Moraine mainstems that enter glacial dam lake not connected to river	Unconnected small lakes on bedrock
Moraine mainstems that enter large glacial dam lake	
TERRESTRIAL SYSTEMS	
Alpine tundra and barren ground	Lowland spruce-hardwood forest
Floodplain / outwash plain	Moist tundra
High brush	Upland spruce-hardwood forest

BIRDS			
Clangula hyemalis	Long - tailed duck	*Melanitta nigra*	Black scoter
FISH			
Esox lucius	Northern pike	*Oncorhynchus tshawytscha*	Chinook salmon
Oncorhynchus gorbuscha	Pink salmon	*Salvelinus alpinus*	Arctic char
Oncorhynchus keta	Chum salmon	*Salvelinus malma*	Dolly varden
Oncorhynchus kisutch	Coho salmon	*Salvelinus namaycush*	Lake trout
Oncorhynchus mykiss	Rainbow trout	*Thymallus arcticus*	Arctic grayling
Oncorhynchus nerka	Sockeye salmon		
TERRESTRIAL MAMMALS			
Alces alces	Moose	*Lynx canadensis*	Canada lynx
Castor canadensis	American beaver	*Rangifer tarandus*	Caribou
Gulo gulo	Wolverine	*Ursus arctos*	Brown bear
Lantra canadensis	River otter		
SPECIES AGGREGATIONS			
Shorebird nesting and breeding areas		Waterfowl nesting and breeding areas	

38. Yantarni

TOTAL AREA: 96,960 HA
LAND AREA: 28,296 HA
MARINE AREA: 68,664 HA

CONSERVATION STATUS:
HIGH 0.0%
MEDIUM 54.0%
LOW 0.0%
NONE 46.0%

This area includes Yantarni and Nakalilok Bays on the south side of the Alaska Peninsula and the small islands offshore (Figure 55). Harbor seals haul out on several of these islands. Black-legged kittiwakes and pigeon guillemots also nest in large colonies on the islands. Emperor geese winter along the Pacific Coast, concentrating at Yantarni Bay, and these geese also stage their sping and fall migrations here.

More than half of this area is managed by the US Fish and Wildlife Service, primarily as part of the Alaska Peninsula National Wildlife Refuge. The Final Comprehensive Conservation Plan (USFWS 1985c) for the refuge identifies the Pacific coast as a *Special Value Area* (see Appendix 14). The other major landholders in the area are Native corporations, and private individuals own a small percentage of the land.

TABLE 58. Primary targets in the Yantarni Area of biological significance

AQUATIC SYSTEMS	
Braided rivers on alluvial terrace on moraine	Mainstem in bedrock valleys
COASTAL SYSTEMS	
Exposed tidal flats (moderate biomass)	Fine to medium-grained sand beaches
Exposed wavecut platforms	
TERRESTRIAL SYSTEMS	

Coastal forest		Floodplain / outwash plain	
		High brush	
BIRDS			
Cepphus columba	Pigeon guillemot	*Rissa tridactyla*	Black-legged kittiwake
Chen canagica	Emperor goose		
FISH			
Oncorhynchus gorbuscha	Pink salmon	*Oncorhynchus kisutch*	Coho salmon
MARINE MAMMALS			
Phoca vitulina	Harbor Seal		
TERRESTRIAL MAMMALS			
Ursus arctos	Brown bear		
SPECIES AGGREGATIONS			
Seabird colonies		Waterfowl wintering areas	
Waterfowl spring and fall staging/stopovers			

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