CHAPTER 4
BIOLOGICAL RESOURCES

CALIFORNIA NEWT

UPDATE CHRONOLOGY

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PURPOSE

The purpose of this chapter is to provide a comprehensive summary of biological resources in Napa County and a mapped inventory of these features. The data assembled will provide a scientific basis for future regional and site-specific assessments of project impacts and for the evaluation of mitigation measures, conservation proposals, and enhancement opportunities for biological resources. It will also serve as a basis to evaluate current and future policies at the local and Countywide level as they relate to biological resource protection and enhancement.

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LIST OF ACRONYMS AND ABBREVIATIONS

AF	Acre-feet
ACHP	Advisory Council on Historic Preservation
B.P.	Before Present
BCDC	San Francisco Bay Conservation and Development Commission
BDR	Baseline Data Report
BLM	U.S. Bureau of Land Management
CalWild	California Wilderness Coalition
CDF	California Department of Forestry and Fire Protection
CEQA	California Environmental Quality Act
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
County	Napa County
CRHR	California Register of Historical Resources
CWA	federal Clean Water Act
DBH	diameter at breast height
DFG	California Department of Fish and Game
DOQ	Digital orthophoto quad
DOQQ	Digital orthophoto quarter quad
ESA	Federal Endangered Species Act
ESU	Evolutionarily significant unit
FE	Federally endangered
FT	Federally threatened
General Plan	Napa County's General Plan
GIS	Geographic Information System
HCP	Habitat Conservation Plan
ICE	University of California at Davis's Information Center for the Environment
ICE Map	ICE Land Cover Map
LWD	Large woody debris
MBTA	Migratory Bird Treaty Act
MCV	Manual of California Vegetation
MOA	Memorandum of agreement
MSAA	Master Streambed Alteration Agreement
MTBE	Methyl tertiary-butyl ether
MVZ	Museum of Vertebrate Zoology at UC Berkeley
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
NEPA	National Environmental Policy Act
NFD	Not formally defined
NHPA	National Historic Preservation Act
NHPA	National Historic Preservation Act
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NRHP	National Register of Historic Places
NWIC	Northwest Information Center
OHV	Off highway vehicle
PMF	Probable maximum flood
ppt	Parts per thousand
PRC	Public Resources Code
RCD	Napa County Resource Conservation District
Reclamation	U.S. Bureau of Reclamation
SB18	Senate Bill 18
SCC	State species of special concern
SE	State listed as endangered
SHPO	State Historic Preservation Officer
SOD	Sudden Oak Death
SR	State Route
ST	State listed as threatened
SWQCB	State Water Quality Control Board
TNC	The Nature Conservancy of California
UC	University of California
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

INTRODUCTION

This chapter provides a detailed discussion of the biological resources found in Napa County (County). It discusses the federal, state, and local policies and regulations that govern biological resources; methods used to identify and quantify biological resources in the 13 evaluation areas into which the County has been divided; and the biological resources identified, including common biotic communities, typical wildlife, rare/sensitive biotic communities, special-status species, and wildlife movement areas. The chapter also discusses policies and regulations that govern fisheries resources; methods used to identify and quantify fisheries resources in Napa County; and the fisheries resources, including habitat characterization for special-status species, primarily focused on steelhead trout. Finally, the chapter makes conclusions and recommendations.

PURPOSE

This chapter provides information on the nature and distribution of biological resources in the County based on the best data currently available. The purposes of this report are the following.

- Provide a scientific basis for future regional and site-specific level assessments of project impacts and the evaluation of mitigation measures, conservation proposals, and enhancement opportunities for biological resources.
- Serve as the existing conditions section for biological resources chapters/sections in a planned EIR in support of the County's General Plan Update.
- Serve as a basis to evaluate current and future policies at the local and Countywide level as they relate to biological resource protection and enhancement.
- Document the methods and definitions used to establish a Countywide searchable biological resources database.

SPECIALIZED TERMS USED

Alliance: A grouping of vegetation types used by Sawyer and Keeler-Wolf (1995) and Thorne et al. (2004) in the classification of the County's vegetation. The hierarchy of vegetation groupings is as follows.

- Level 1: Class-Subclass.
- Level 2: Group-Formation.
- Level 3: Super Alliance–Alliance.
- Level 4: Super Association–Association.

Anadromous: A life history characteristic of species that live their lives in the sea and migrate to a freshwater river to spawn.

Association: The finest level grouping of vegetation types used by Sawyer and Keeler-Wolf (1995) and Thorne et al. (2004) in the classification of Napa County vegetation. A typical association would be Coast Live Oak–Blue Oak (Foothill Pine) Woodland. See *alliance* for an outline of the classification scheme.

Bankfull: The incipient elevation on the bank where flooding begins. In many stream systems, bankfull is associated with the flow that just fills the channel to the top of its banks; bankfull is the point at which the water begins to overflow onto a floodplain.

Bedload: That portion of alluvium, i.e. deposited material, in a stream that is transported along the streambed and not in suspension in the water column.

Benthic: Pertaining to the substrate of a waterbody or to organisms that live on or in the substrate of a waterbody.

Biological diversity: The variety and complexity of life at all scales. Examples include: genetic, species, ecosystem, and landscape.

Biotic community: Characteristic assemblages of plants and animals that are found in a given range of soil, climate, and topographic conditions within a region.

Catchment: An area characterized by all direct runoff being conveyed to the same outlet.

Climax community: A biotic community that, in the absence of widespread disturbance, maintains a relatively stable assemblage of plant and animal species over very long periods of time (100 years or longer). The early 20th-century belief that the climax community could endure indefinitely is now rejected because climatic stability cannot be assumed over long periods of time (Columbia University 2004).

Critical Habitat: Federal Endangered Species Act designation defined as areas with features that are essential for the "conservation" of the species in question, and which may require special management considerations or protection.

Data layer: A logical set of thematic data described and stored in a map library (e.g., soils, vegetation types, roads) (Environmental Systems Research Institute 1990).

Digital orthophoto quad (DOQ): A DOQ is a digital image of the earth's surface that has been digitally scanned and processed to remove the distortion inherent in aerial photography. Using a digital elevation model and advanced image processing techniques, radial and topographic distortion is removed from the image providing a true planimetric product. A DOQ image typically covers one-quarter of a 1:24,000 scale U.S. Geological Survey (USGS) topographic map plus a little overlap. The resolution of the image is quite high at one square meter per pixel. As a result of this fine cell size, these images consume large quantities of disk space.

Digital orthophoto quarter quad (DOQQ): A digital orthophoto quarter quad (DOQQ) is a subset of a DOQ that covers one quarter of the area of a DOQ. There are four DOQQs in a DOQ (University of Washington Libraries 2004).

Endangered: Species, subspecies, or distinct population segments that are in danger of extinction throughout all or a significant portion of their range (as defined by the federal Endangered Species Act).

Endemic: A species confined to a particular region.

Ephemeral stream: A stream that has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Epibenthic: Pertaining to organisms living specifically at the sediment-water interface.

Evaluation areas: Subdivisions of the County used in this report that are characterized by differing biotic communities.

Evolutionarily Significant Unit (ESU): "[A] population that (1) is substantially reproductively isolated from conspecific populations and (2) represents an important component in the evolutionary legacy of the species" (Johnson et al. 1994).

Extirpated: Species is believed to be eliminated throughout its range, with no restoration potential due to extinction of species. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

Fishery: The place or act of taking fishes or other aquatic organisms for human use.

Floodplain: Geomorphically, a floodplain is a low-relief, relatively planar feature, adjacent to a creek or river, which is inundated by water and sediment during flow events that overtop the banks of the adjacent creek. The floodplain surface is built from the deposition of sediments from the adjacent creek. Hydrologically a floodplain can be defined as a certain water elevation that has an estimated probability of occurrence; e.g., a "100-yr floodplain" is the area that has a 1% chance of inundation in any given year. In a regulatory context, the terms "floodplain," "floodway," and "floodway fringe" have specific meanings that should be considered carefully in flood hazard or management studies.

Forage fish: Fish that serve as food for other fish, especially for commercial or sport fishes.

Gage: An instrument for measuring and indicating a quantity or for testing conformity with a standard.

Game fish: A species targeted by, e.g., anglers for recreational purposes.

Geographic Information System (GIS): An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information (Environmental Systems Research Institute 1990).

Geomorphic: Pertaining to those processes that affect the form or shape of the surface of the earth.

Habitat fragmentation: The process by which an area of habitat is broken into small, isolated patches that are less effective at supporting their constituent species (Meffe and Caroll 1994).

Habitat of limited distribution: A vegetation type as delineated in the Napa Co Environmental Resources Mapping System that covers less than approximately 0.1% of the County (i.e., 500 acres).

Habitat: A physical area characterized by a unique assemblage of species that constitute the biotic community that utilizes and/or inhabits the area and which provides some subset of essential or preferred ecological and biological needs (i.e., reproduction, feeding/foraging, cover/shelter) for each of those species.

Impervious surface: Any surface that prevents or significantly reduces the entry of water into the underlying soil, resulting in runoff from the surface in greater quantities and/or at an increased rate when compared to natural conditions prior to development including, but not limited to, parking lots, driveways, roadways, storage areas, and rooftops. The imperviousness of these areas results from reduced porosity due to paving or compacted gravels.

Intermittent stream: A stream that has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Key indicator species: A species that is indicative of ecosystem change and/or shows clear responses to environmental stresses, indicating potential impacts on environmental systems.

Limiting factors analysis: A quantitative and/or qualitative assessment of conditions that limit the ability of habitat to fully sustain populations of one or more specifically defined species.

Mesic: Characterized by a moderate supply of moisture.

Microphyllous: Having small leaves.

Migration corridor: A pathway along which individuals and/or groups of animals move from one region to another, commonly for the purpose of feeding or breeding. Migration corridors are well-defined areas used over a defined period of time.

Minimum mapping unit: The minimum sizes or dimensions for features that were mapped as lines or areas for a given map scale.

Peak flow: The point of the hydrograph that has the highest flow attained during the melting of a winter snowpack or from a storm event.

Perennial stream: A stream that has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow

Pool-riffle morphology: Pool-riffle morphology is defined by hydraulic characteristics of high gradient streams. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a streaming flow, a smooth surface, and a finer substrate.

Probable Maximum Flood: The most severe flood that may be expected from a combination of the most critical meteorological and hydrological conditions that are reasonably possible in a drainage basin. The probable maximum flood is usually much larger than the 100-year flood.

The federal Endangered Species Act protects fish and wildlife species that have been identified by the U.S. Fish and Wildlife Service and/or the National Oceanic and Atmospheric Administration National Marine Fisheries Service as endangered or threatened. It also protects the habitats in which they live.

Rare: Used to describe a species that is severely limited in distribution and/or overall numbers of individuals.

Salmonid: Fish of the family *Salmonidae*. Includes salmon, trout, char, whitefish, and grayling.

Sclerophyllous: Having hardened leaves.

Sediment transport: The physical processes by which sediment (i.e. material ranging from very fine material such as mud and silt to larger particles such as cobble and boulders) is transported by water in a stream channel. This may include material moving as "bed load" along the bed, or as “suspended load” held in suspension in the water column.

Spawning: Release or deposition of spermatozoa or ova, of which some will fertilize or be fertilized to produce offspring; fish reproduction process characterized by females and males depositing eggs and sperm into the water simultaneously or in succession so as to fertilize the eggs.

Special-status species: Plants and animals that are legally protected under the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), or other federal, state, or local regulations, or are considered sufficiently rare by the scientific community to qualify for such protection.

Superalliance: The second-finest level grouping of vegetation types used by Sawyer and Keeler-Wolf (1995) and Thorne et al. (2004) in the classification of Napa County vegetation. A typical superalliance would be Mixed Oak Woodlands. See *alliance* for an outline of the classification scheme.

Threatened: Species, subspecies, or distinct population segments that are likely to become endangered in the near future (as defined by the ESA).

Trophic. Of or involving the feeding habits or food relationship of different organisms in a food chain.

Watershed: A defined region draining into a river, river system, or other body of water.

Xeric: Characterized by a very small amount of moisture; dry.

POLICY CONSIDERATIONS

This section discusses the federal, state, and local policies and regulations that are relevant to the analysis of biological resources in the County.

FEDERAL POLICIES

ENDANGERED SPECIES ACT

The federal Endangered Species Act (ESA) protects fish and wildlife species that have been identified by the U.S. Fish and Wildlife Service (USFWS) and/or the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) as endangered or threatened. It also protects the habitats in which they live. *Endangered* refers to species, subspecies, or distinct population segments that are in danger of extinction throughout all or a significant portion of their range while *threatened* applies to species, subspecies, or distinct population segments that are likely to become endangered in the near future.

USFWS and NOAA Fisheries administer the ESA. In general, NOAA Fisheries is responsible for protection of ESA-listed marine species and anadromous fish while other listed species come under USFWS jurisdiction.

Key provisions of the ESA are summarized below under the section that implements them.

SECTION 10

Section 10 provides a means for nonfederal entities (states, local agencies, and private parties) that are not permitted or funded by a federal agency to receive authorization to disturb, displace, or kill (i.e.,

take) threatened and endangered species. It allows USFWS and/or NOAA Fisheries to issue an incidental take permit authorizing take resulting from otherwise legal activities, as long as the take would not jeopardize the continued existence of the species. Section 10 requires the applicant to prepare a Habitat Conservation Plan (HCP) addressing project impacts and proposing mitigation measures to compensate for those impacts. The HCP is subject to USFWS and/or NOAA Fisheries review and must be approved by the reviewing agency or agencies before the proposed project can be initiated. Because the issuance of the incidental take permit is a federal action, USFWS and/or NOAA Fisheries must also comply with the requirements of ESA Section 7 and the National Environmental Policy Act (NEPA).

SECTION 7

Section 7 applies to the management of federal lands as well as other federal actions, such as federal approval of private activities through the issuance of federal permits, licenses, funding, or other actions that may affect listed species. Section 7 of the ESA directs all federal agencies to use their existing authorities to conserve threatened and endangered species and, in consultation with USFWS, to ensure that their actions do not jeopardize listed species or destroy or adversely modify critical habitat.

BALD AND GOLDEN EAGLE PROTECTION ACT

The Bald and Golden Eagle Protection Act of 1940 imposes criminal and civil penalties for persons in the U.S. or within U.S. jurisdiction lands who take, possess, sell, purchase, barter, offer to sell or purchase or barter, transport, export or import a bald or golden eagle, alive or dead, or any part, nest, or egg of these eagles; or violates any permit or regulations issued under the Act, without the permission of the Secretary of the Interior. Bald eagles (*Haliaeetus leucocephalus*) may not be taken for any purpose unless the Secretary issues a permit prior to the taking.

CLEAN WATER ACT

The federal Clean Water Act (CWA) was enacted as an amendment to the federal Water Pollution Control Act of 1972, which outlined the basic structure for regulating discharges of pollutants to waters of the United States. The CWA serves as the primary federal law protecting the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. The following discussion gives background information as relevant to biological resources; additional discussion of the CWA is provided in Chapter 17 of the BDR, which discusses water quality in the County.

SECTION 404

CWA Section 404 regulates the discharge of dredged and fill materials into waters of the United States. *Waters of the United States* refers to oceans, bays, rivers, streams, lakes, ponds, and wetlands. Applicants must obtain a permit from the U.S. Army Corps of Engineers (Corps) for all discharges of dredged or fill material into waters of the United States, including wetlands, before proceeding with a proposed activity. Waters of the United States in Napa County are under the jurisdiction of the Corps.

Compliance with CWA Section 404 requires compliance with several other environmental laws and regulations. The Corps cannot issue an individual permit or verify the use of a general nationwide permit until the requirements of NEPA, ESA, and the National Historic Preservation Act (NHPA) have been met. In addition, the Corps cannot issue or verify any permit until a water quality certification or a waiver of certification has been issued pursuant to CWA Section 401.

The federal Clean Water Act serves as the primary federal law protecting the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands.

SECTION 401

Under CWA Section 401, applicants for a federal license or permit to conduct activities which may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval, such as issuance of a Section 404 permit) must also comply with CWA Section 401.

The National Environmental Policy Act mandates all federal agencies or departments to disclose their projects' effect on the environment.

RIVERS AND HARBORS ACT OF 1899

The Rivers and Harbors Act regulates projects and activities in navigable waters and harbor and river improvements. Section 10 prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States and any work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. Section 10 waters in the County include tidally influenced reaches of the Napa River.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

NEPA mandates all federal agencies or departments to disclose their projects' effect on the environment. NEPA was created to ensure federal agencies and other federal actions, such as federal approval of private activities through the issuance of federal permits, licenses, or other actions, consider the environmental impacts of their actions and decisions. NEPA requires all federal agencies, or other entities requiring federal approval, to consider the values of environmental preservation for all significant actions. Federal agencies are required to systematically assess the environmental impacts of their proposed actions and consider alternatives that are less damaging to the environment.

MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act (MBTA) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to

The Migratory Bird Treaty Act enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds.

The California Environmental Quality Act is the regulatory framework by which California public agencies identify and mitigate significant environmental impacts.

protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs. Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of the MBTA. Examples of permitted actions that do not violate the MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. USFWS is responsible for overseeing compliance with the MBTA, and the U.S. Department of Agriculture's Animal Damage Control Officer makes recommendations on related animal protection issues.

STATE POLICIES

CALIFORNIA FOREST PRACTICE RULES

The California Forest Practice Rules (Rules) (Title 14, California Code of Regulations Chapters 4, 4.5 and 10) implement the provisions of the Z'berg-Nejedly Forest Practice Act of 1973. Under the Rules, owners of timberland proposing to convert that timberland to another use (as defined in Section 1102) must obtain a Timberland Conversion Permit from the California Department of Forestry and Fire Protection. As part of the permitting process, the applicant is required to submit a Timber Harvest Plan (THP), prepared by a licensed forester, demonstrating that the timber harvest will incorporate feasible mitigation measures to substantially lessen or avoid significant adverse environmental impacts. A THP can not be approved if implementation of the plan as proposed would result in either a "taking" or finding of jeopardy of listed wildlife species.

CALIFORNIA ENDANGERED SPECIES ACT

The California Endangered Species Act (CESA) protects wildlife and plants listed as endangered or threatened under the act by the California Fish and Game Commission. The CESA is administered by the California Department of Fish and Game (DFG). The CESA prohibits all persons from taking species that are state listed as endangered or threatened except under certain circumstances. The CESA definition of *take* is any action or attempt to "hunt, pursue, catch, capture, or kill." Section 2081 of the Fish and Game Code provides a means by which agencies or individuals may obtain authorization for incidental take of state-listed species, except for certain species designated as "fully protected" under the California Fish and Game Code (see *California Fish and Game Code* below). Take must be incidental to, not the purpose of, an otherwise lawful activity. Requirements for a Section 2081 permit are similar to those used in the ESA Section 7 process, including identification of impacts on listed species, development of mitigation measures that minimize and fully mitigate impacts, development of a monitoring plan, and assurance of funding to implement mitigation and monitoring.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) is the regulatory framework by which California public agencies identify and mitigate significant environmental impacts. A project normally has a significant environmental impact on biological resources if it substantially affects a rare or endangered species or the habitat of that species; substantially impacts riparian habitat, wetlands or other sensitive communities; substantially interferes with the movement of resident or migratory fish or wildlife; or substantially diminishes habitat for fish, wildlife, or plants. Analysis of environmental impacts under CEQA begins by establishing a baseline of current conditions that may be impacted by a proposed project. One of the goals of this report is to establish this baseline at an evaluation area level for biological resources in the County.

CALIFORNIA FISH AND GAME CODE

FULLY PROTECTED SPECIES

The California Fish and Game Code provides protection from take for a variety of species. Certain species are considered *fully protected*, meaning that the code explicitly prohibits all take of individuals of these species except for take permitted for scientific research.

Section 5050 lists fully protected amphibians and reptiles, Section 5515 lists fully protected fish, Section 3511 lists fully protected birds, and Section 4700 lists fully protected mammals.

It is possible for a species to be protected under the California Fish and Game Code, but not fully protected. For instance, mountain lion (*Puma concolor*) is protected under Section 4800 et seq., but is not a fully protected species.

PROTECTION OF BIRDS AND THEIR NESTS

Eggs and nests of all birds are protected under Section 3503, nesting birds (including raptors and passerines) under Sections 3503.5 and 3513, and birds of prey under Section 3503.5. Migratory non-game birds are protected under Section 3800, and other specified birds under Section 3505.

STREAM AND LAKE PROTECTION

DFG has jurisdictional authority over streams and lakes and the wetland resources associated with these aquatic systems under California Fish and Game Code Sections 1600 et seq. California Fish and Game Code Section 1600 et seq. was repealed and replaced in October of 2003 with the new Section 1600–1616 that took effect on January 1, 2004 (Senate Bill No. 418 Sher). DFG has the authority to regulate work that will "substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass

into any river, stream, or lake." DFG enters into a streambed or lakebed alteration agreement with the project proponent and can impose conditions in the agreement to minimize and mitigate impacts to fish and wildlife resources. A lake or streambed alteration agreement is not a permit, but rather a mutual agreement between DFG and the project proponent. Because DFG includes under its jurisdiction streamside habitats that may not qualify as wetlands under the federal CWA definition, DFG jurisdiction may be broader than Corps jurisdiction.

A project proponent must submit a notification of streambed alteration to DFG before construction. The notification requires an application fee for streambed alteration agreements, with a specific fee schedule to be determined by DFG. DFG can enter into programmatic agreements that cover recurring operation and maintenance activities and regional plans. These agreements are sometimes referred to as Master Streambed Alteration Agreements (MSAAs).

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

The San Francisco Bay Conservation and Development Commission's (BCDC's) primary mission is to analyze, plan, and regulate the San Francisco Bay as a unit. BCDC has permit jurisdiction over San Francisco Bay, San Pablo Bay, and the Suisun Marsh—including levees, waterways, marshes, and grasslands—below the 10-foot contour line (as measured off a USGS quadrangle map from mean high water). Any person or public agency other than a federal agency that proposes certain activities in or around these areas must obtain a development permit from the BCDC.

In Napa County, the BCDC's jurisdiction covers the areas listed below.

- Napa River from the southern boundary of the County to the northernmost point of Bull Island.
- Tidal marshes adjacent to the Napa River.
- Salt ponds adjacent to the Napa River.
- Major sloughs.
- Wetlands managed by duck clubs in the vicinity of Skaggs Island.

LOCAL POLICIES

The following policies were excerpted or summarized from the Napa County General Plan and related implementing ordinances.

NAPA COUNTY GENERAL PLAN

CONSERVATION AND OPEN SPACE ELEMENT

FISHERY AND WILDLIFE HABITAT

This section of the County General Plan states that residential, commercial, industrial, recreational, water development, and agricultural projects, including wineries but not including redevelopment of existing vineyard projects, should include management plans for fisheries and wildlife, including provisions to maintain and enhance native vegetation and protect and wildlife and fisheries habitat. It affirms that projects should provide some of the essentials resources for fish and wildlife, such as sufficient oxygen in the water, food, feeding, escape and nesting habitat, and proper water temperature. The County will require developers to mitigate for losses to fishery and wildlife habitat. No net loss of a natural watercourse or drainageway shall occur as part of an approved development project.

This section of the General Plan states that the County will implement a riparian woodland protection ordinance; will provide financial and other incentives to encourage voluntary dedication to the County or its designee (such as a local non-profit land trust) of significant wildlife and fisheries habitat areas; and will encourage programs to protect rare species, such as California clapper rails, black rails, plovers, and red-shouldered hawks.

The County will ensure that development projects implement erosion control and watershed protection measures. This effort will include the establishment of standards for planting and maintaining permanent crops on slopes exceeding 5%, as provided by the County's Conservation Regulations.

RIPARIAN WOODLAND WILDLIFE HABITAT

This section stipulates that natural vegetation retention areas along perennial and intermittent streams shall vary in width in relationship to steepness of the terrain, the nature of the undercover, and type of soil. Developers will be required to mitigate for additional losses of riparian woodland through restoration or payments to wildlife habitat funds.

RESERVOIR HABITAT

This section discusses the County's interest in enhancing waterfowl habitat in shallow, open shoreline areas of reservoirs by planting appropriate vegetation for food.

MARSHLAND HABITAT

This section of the General Plan stipulates that existing salt extraction ponds will be returned to marshlands or other non-urban uses for recreation, fisheries and wildlife habitat at the termination of salt extraction activity. It supports the use of a variety of resources to support the restoration process, including the establishment of County policy to promote, when possible, wildlife use of several specific

The General Plan encourages the preservation of oak trees to maintain diversity of vegetation type and wildlife habitat. Of specific interest is the retention of a mixture of oak species to ensure acorn production.

The San Francisco Bay Conservation and Development Commission has permit jurisdiction over San Francisco Bay, San Pablo Bay, and Suisun Marsh.

marshland areas. Environmental study areas are encouraged, while construction of structures on levees by large lot zoning is discouraged.

OAK WOODLAND—GRASS AND HARDWOODS HABITATS

This section of the General Plan discusses ways of promoting hardwood management so that adequate stands of oak trees remain for wildlife and slope stabilization, soil protection, and soil production. It encourages the preservation of oak trees and other significant vegetation that occur near the heads of drainages to maintain diversity of vegetation type and wildlife habitat. Of specific interest is the retention of a mixture of oak species, which is needed to ensure acorn production. Finally, it recommends replacement of native vegetation when retention of existing vegetation is infeasible.

FISHERIES HABITAT

This section discusses fisheries habitat in Napa River and its tributaries and methods for encouraging healthier fisheries, including reducing sediment influxes from sand and gravel operations and other high sediment-producing land uses; preventing the removal of streamside vegetation; promoting good forest management; enforcing boat speed limits to reduce damage; controlling gravel removal from streambeds; controlling silt production from mines, roads, construction sites and other potential sources; and preventing the removal of streamside vegetation.

SLOUGH AND TIDAL MUDFLATS

This section discusses methods for maintaining functioning and healthy slough and tidal mudflats in the County. It encourages restrictions on filling, dredging, draining and polluting of mudflats and sloughs; utilizing reclaimed wastewater for salinity control; and evaluating proposed marinas and harbors and alternative sites with regard to wildlife habitat and impact on scarce landforms such as marshlands.

LAND USE ELEMENT

This section affirms that the County will limit development in ecologically sensitive areas such as riparian areas, and in physically hazardous areas, except for Oat Hill, which is planned for urban development. The County will develop a controlled-burn program for managing fire hazardous areas; and to reduce wildfire hazard, improve watershed capabilities, promote wildlife habitat diversification, and improve grazing.

NAPA COUNTY CODE

The following policies pertaining to stream setbacks, tree and riparian vegetation protection provisions are excerpted from Napa County Zoning Code: Conservation Regulations, Chapter 18.108.

CHAPTER 18.108.100—EROSION HAZARD AREAS; VEGETATION PRESERVATION AND MANAGEMENT

Discretionary permits for projects in the County's jurisdiction are subject to a number of conditions, requiring the preservation of existing vegetation wherever feasible and where necessary for the preservation of threatened plant or animal species; no removal of trees 6 inches or more in diameter at breast height without authorization and replacement; and revegetation of graded areas.

CHAPTER 18.108.025—GENERAL PROVISIONS, INTERMITTENT/PERENNIAL STREAMS

This section of the County code establishes stream setbacks for clearing for new developments, including agricultural and residential developments, and for replanting of existing vineyards, unless the replanting occurs within the existing vineyard footprint. The stream setbacks vary from 35 to 150 feet in width, as measured from the top of bank, with wider setbacks required on steeper slopes. Where the outboard dripline of upper canopy vegetation is located outside the setback required by the slope steepness, the setback will extend to the outboard dripline. Revegetation of portions of the streamside setbacks may be required as a part of an erosion-control plan.

CHAPTER 18.108.027—SENSITIVE DOMESTIC WATER SUPPLY DRAINAGES

This section of the County code requires the maintenance of 60% of 1993 tree canopy cover and 40% of shrubby and herbaceous cover as part of land uses involving ground disturbance in sensitive domestic water supply drainages.

Ground-disturbing activities must take place during the dry season, between April 1 and September 1 of each year. Installation of winterization measures may take place during other times of the year, but should be in place by September 15 of any given year.

Concentration of runoff will, wherever feasible, be avoided. Those drainage facilities and outfalls that unavoidably must be installed will be sized and designed to handle the runoff from a one-hundred-year storm event without failure or unintentional bypassing.

If a project will increase delivery of sediment or other pollutants from a drainage into a public water supply (reservoir) by more than 1% on an individual project basis or by more than 10% on a cumulative basis, the project will not be approved until a public hearing on the matter has been held and a use permit has been issued. A geotechnical report specifying the depth and nature of the soils and bedrock present and the stability of the area potentially affected will be required for any project located in a sensitive domestic water supply drainage.

CHAPTER 18.108.070 – EROSION HAZARD AREAS--USE REQUIREMENTS

This section of the code stipulates that uses permitted within erosion hazard areas must implement standard erosion control measures in these areas on slopes of 15% or less. Erosion control plans are required for projects in geologically sensitive areas, for agricultural projects on slopes over 5%, and for non-agricultural projects on slopes greater than 15%. Vineyard replanting programs or erosion control plans are required for vineyard replanting on slopes over 5%. Development projects must minimize erosion potential, and must ensure that no portions of a disturbed site are unprotected from erosion between October 15 and April 1, unless approved by the County. Vegetation removal must be minimized.

CHAPTER 16.04 FLOODPLAIN MANAGEMENT

Floodplain management provisions regulate a variety of activities, including the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters.

Floodplain management provisions seek to preserve riparian vegetation in order to preserve fish and game habitats; prevent or reduce erosion; maintain cool water temperatures for fish; prevent or reduce siltation; and promote wise uses and conservation of woodland and wildlife resources of the county. All development activities within riparian zones (50 feet beyond the top of streambanks, or 100 feet beyond the top of the Napa River banks downstream of Zinfandel Lane) must be permitted. Development activities include substantial improvements to a structure. Chapter 16.04.750 sets restrictions on the type and amount of riparian vegetation that may be removed within the riparian zone, and prohibits locating structures within 10 feet of the top of the bank, as well as leaving slopes unprotected.

CHAPTER 16.08. TIMBER HARVESTING

County timber harvesting provisions seek to ensure that timber operations control soil erosion, protect water quality and watersheds, do not cause flooding, use sustained yield practices, control noise, control stand density, use reforestation practices, and prevent and control fires. Timber operations must be permitted by the County. Timber conversion, which involves the removal of substantially all trees in order to use an area as a vineyard or for other agricultural purposes, may be permitted if it complies with the forest practice rules and retains trees that are reasonably necessary for protection of wildlife habitats, watersheds, and aesthetic values.

METHODOLOGY

EVALUATION AREAS

The study area for this report is Napa County. To facilitate regional planning and analysis of biological resources, the County was initially divided into 13 evaluation areas, based on its major physiographic features (mountain ranges and intervening valleys) and jurisdictional divisions (i.e, towns and cities versus County unincorporated lands). The boundaries of these areas were then adjusted to better reflect areas with differing climate, predominant land uses, and biological communities (Map 4-1). This allowed areas known to have concentrations of sensitive biological resources, such as the Napa River Marshes, Knoxville, and Pope Valley, to be analyzed independently from the rest of the County.

The 13 evaluation areas are as follows.

- Napa River Marshes.
- Jamieson/American Canyon.
- Carneros.
- Napa Valley Floor (does not include surrounding hills).
- Western Mountains.
- Eastern Mountains.
- Angwin.
- Livermore Ranch (North Napa Range).
- Southern Interior Valleys (valley bottoms of Wooden and Gordon Valleys and adjoining uplands).
- Central Interior Valleys (valley bottoms of Chiles, Capell, and Soda Valleys and adjoining uplands).
- Pope Valley (includes adjoining uplands).
- Berryessa (includes adjoining uplands and subsidiary valleys to Berryessa Valley).
- Knoxville (includes Upper Putah Creek Area).

These evaluation areas are referred to throughout this chapter in discussions of the distribution of biotic communities, special-status species, and wildlife movement areas. The characteristics of each

evaluation area and relevant management considerations are discussed under *Evaluation Area Characteristics.*

MAPS/DATABASE DEVELOPMENT

Three spatial data layers were assembled from various sources (see discussion below) and used in developing the GIS-based County Biological Database for the analysis of the County's biological resources.

- Land cover layer.
- Special-status species occurrence layer.
- Special-status species habitat layer.

The resulting GIS database can be used to generate customized maps of the County's biological resources, as well as to conduct analyses related to the distribution of the County's biological resources.

Some communities were not mapped because they lacked a clear signature on aerial photographs. This is the case for native grassland communities.

LAND COVER LAYER

The land cover layer was developed from two previously existing datasets. The primary dataset used is a unique land cover map created by the University of California at Davis's Information Center for the Environment (ICE) (Thorne et al. 2004). The other dataset used is the County vernal pools map.

ICE LAND COVER MAP

The ICE Land Cover Map (ICE Map) was developed as a prototype to implement revisions to the vegetation classification system outlined in the Manual of California Vegetation (MCV) (Sawyer and Keeler-Wolf 1995). Its production involved the first large-scale, detailed mapping effort for this new methodology that is being applied throughout California as the new standard for land cover mapping at a regional and local scale. The basic methodology used represents a relatively simple and inexpensive approach to detailed vegetation mapping on a regional scale (Thorne et al. 2004).

The ICE map depicts 59 land cover types in the County, 52 of which are dominated by natural vegetation. The ICE map land cover categories correspond to alliances, superalliances, and associations in the MCV. Table 4-1 illustrates the classification hierarchy used by the MCV. The ICE map divides the County into 29,227 polygons with a total area of 788 square miles (2,042 square kilometers). The minimum mapping unit used was 2.5 acres (1 hectare). The ICE map was produced by digitizing from Digital Orthophoto Quarter Quadrangles (DOQQs) flown in 1993 with 1-meter pixels. Photo interpretation, polygon delineation and attributing were conducted from February to June 2002. A two-person crew spent three months in the field checking polygons from August to October 2002. Approximately 11% of polygons were field verified (Thorne et al. 2004).

Table 4-1. Manual of California Vegetation Classification Hierarchy

The U.S. National Vegetation Classification System Hierarchy		
Level	Primary Basis for Classification	Example
Class	Growth form and structure of vegetation	Woodland
Subclass	Growth form characteristics, *e.g.*, leaf phenology	Evergreen Woodland
Group	Leaf types, corresponding to climate	Evergreen Sclerophyll Woodland
Subgroup	Relative human impact (natural/semi-natural, or cultural)	Natural/Semi-natural
Formation	Additional physiognomic and environmental factors, including hydrology	Winter-Rain Evergreen Sclerophyll Woodland
Super Alliance	Grouping of dominant species not distinguishable by mapping methods	Mixed Oak Woodland
Alliance	Dominant/diagnostic species of uppermost or dominant stratum	Coast Live Oak Woodland
Association	Additional dominant/diagnostic species from any strata	Coast Live Oak - Blue Oak (Foothill Pine) Woodland

From: Terrestrial Vegetation of the United States, The National Vegetation Classification System

ICE MAP LIMITATIONS

While the ICE map is extremely detailed considering its extent, it is limited in its accuracy by the age (in this case, 1993) and the resolution of the imagery used.

Some communities were not mapped because they lacked a clear signature on aerial photographs. This is the case for native grassland communities. As with native grassland communities, herbaceous communities had to be lumped into a few coarse classes because they could not be distinguished to a finer level of detail using the available imagery. Serpentine grasslands were identified where grasslands appeared on the DOQQs in a location where the geology and soils maps of the County indicated serpentine soils (Keeler-Wolf pers. comm.). Serpentine grasslands could not be distinguished visually from non-serpentine grasslands on the basis of the DOQQs. It is likely that many small serpentine areas are not included in the County geology and soil maps, leading them to be mapped as non-serpentine grassland on the ICE map.

Some forest communities also were grouped into coarser classes because of difficulties with resolution. For example, oak assemblages were frequently classified simply as mixed oak. Approximately 3,600 acres were recently burned two areas at the time of the aerial photographs, and it was unclear what

specific vegetation type would regenerate in these areas. Based on topographic position and surrounding land cover, these areas were assigned to one of two general vegetation types: sclerophyllous shrubland or winter-rain sclerophyll forests and woodlands (Keeler-Wolf pers. comm.).

Some communities were not mapped because they occur in patches that are smaller than the minimum mapping unit of 2.5 acres (1 hectare). While the minimum mapping unit was applied to most vegetation types, smaller polygons, down to approximately 0.6 acres, were delineated for sensitive communities including seeps, riparian corridors and other wetlands (Thorne et al. 2004). Nonetheless, some variations in and small patches of these community types were not mapped because of the minimum mapping unit. It was sometimes difficult to distinguish different riparian vegetation types on the DOQQs because air photo signatures were similar and vegetation types changed frequently along stream courses (Thorne et al. 2004).

The land cover map classified 99.2% of the County. Approximately 3,200 acres, 0.6% of the County, were added to the County when boundaries were clarified in 2004, after the mapping effort had been completed; these areas have not been mapped. Another 1,159 acres, approximately 0.2% of the County, were not identifiable on the DOQQs and could not be field-checked due to access constraints (Thorne et al. 2004); these areas remain unclassified.

COUNTY VERNAL POOLS MAP

The ICE map was supplemented with information from a map of the County's vernal pools. This map was based on two data sources: a USFWS report on vernal pools (Holland 1996) and maps and description of vernal pools and vernal pool complexes submitted to the County by California Native Plant Society (CNPS) botanist Jake Ruygt (Napa County 2004). The resolution of this map is limited to approximately 400 feet, as mapping involved manual drawing of vernal pools onto 7.5-minute USGS topographic quadrangles.

SPECIAL-STATUS SPECIES OCCURRENCE LAYER

The special-status species occurrence layer was developed from several previously existing sets of data and consultation with local experts in the field of special-status species. The first step was to generate a list of *special-status species* (ie, species that meet the definition of "rare, endangered, or threatened" under CEQA). A detailed definition of special-status species is provided under *Specialized Terms Used*.

Persons with special expertise in this field, including Jones & Stokes staff, academics, and avocational experts, were consulted. In addition, the California Natural Diversity Database (CNDDB) (2004), the County Rare Plants Map, and the Spotted Owl Database (California Department of Fish and Game 2004a) were consulted. These sources are discussed below.

CALIFORNIA NATURAL DIVERSITY DATABASE

The CNDDB is a database containing information on the location and characteristics of special-status species occurrences. It is maintained by DFG. The accuracy of occurrence data in the CNDDB varies widely, depending on the manner in which the observer documented the occurrence location. The database contains information related to the accuracy of each occurrence, such as the spatial resolution of the occurrence mapping, the year when the occurrence was last documented, and the identity of the person who documented the occurrence. Updated CNDDB data are released every six months. The November 2004 CNDDB dataset was used as the starting point for the special-status species occurrence layer produced for this report.

COUNTY RARE PLANTS MAP

The County has maintained a database of the occurrences of rare plants for the last 30 years. Much of these data were mapped by local CNPS members on 1:24,000 USGS topographic quad maps. Thus, the resolution of these data is limited to approximately 400 feet. The special-status plant occurrences found in CNDDB were supplemented and modified where necessary to reflect the County's rare plants data.

SPOTTED OWL OCCURRENCE DATA

DFG maintains a database of spotted owl occurrences (California Department of Fish and Game 2004a). The database currently contains data on approximately 85,000 occurrences, 39 of which are located in Napa County. Occurrence data in this database are collected from various sources, including DFG personnel, National Park Service staff, California Department of Forestry and Fire Prevention staff, USFWS Staff, and US Forest Service staff. Occurrence data are reviewed and compiled by Glenn Gould of DFG, and information on the accuracy of each occurrence is included in the database. Northern spotted owl (*Strix occidentalis caurina*) occurrences in this database were added to the special-status species occurrence layer.

SPECIAL-STATUS SPECIES HABITAT LAYERS

The land cover and special-status species occurrence layers, together with information on species' natural history taken from CNPS, CNDDB, scientific literature, and expert review, were used to associate special-status species with the specific areas of the County where they are likely to occur. *Breeding Birds of Napa County, California* (Berner et al. 2003) was an important source of information on bird occurrences and habitat.

Maps of potential habitat for each species were produced through the following three-step process.

1. First, a determination was made as to which of the Land Cover Layer's 59 land cover types would provide habitat for a particular species. This determination was made based on information on species habitat requirements in the literature, the CNDDB, and local expertise. Jake Ruygt and

The ICE map depicts 59 land cover types in the County, 52 of which are dominated by natural vegetation. The ICE map land cover categories correspond to alliances, superalliances, and associations in the Manual of California Vegetation.

The new County Biological Database can generate maps of documented species occurrences, potential habitat of special-status species, and sensitive biological communities in the County. The database also contains non-spatial information in a format that is fully searchable.

Access to this database will be available at the County Conservation, Development and Planning Department offices and, when possible, through the Watershed Information Center and Conservancy.

Joe Callizo, Napa County CNPS botanists, reviewed habitat associations for all special-status plants.

2. Second, a map was generated for each species highlighting all land cover types in the County that had been assigned as potential habitat for the species. This map was compared with the documented occurrences of the species in the County. The habitat associations were revised to include land cover types where documented occurrences were reliably located. Because occurrence data are incomplete, an absence of survey data did not preclude a land cover type from qualifying as suitable habitat.

3. Finally, range restrictions were added to the habitat maps. For example, Hoover's wild parsnip (*Lomatium ciliolatum*) is located in chaparral in the northeast of the County, but not in the south or west. Thus, a note describing this range restriction was added to the map of potential habitat for Hoover's wild parsnip.

Jones & Stokes wildlife biologists with expertise in fish, bats, amphibians and reptiles, and birds were involved in producing habitat maps for each of these groups of species. In addition to reviewing habitat associations as described above, Jake Ruygt and Joe Callizo were involved in reviewing potential habitat maps for plant species.

COUNTY BIOLOGICAL DATABASE

The three GIS data layers discussed above (land cover, special-status species, and special-status species habitat layers) were combined with a revised user interface to produce a new County Biological Database. The database can generate maps of documented occurrences and the potential habitat of special-status species. In addition, it can map the sensitive biological communities in the County. The database also contains non-spatial information about special-status species in a tabular format that is fully searchable. This tabular information includes information about species microhabitat requirements (soils, elevation), historical versus current range, and current range restrictions. Access to this database will be available to the public at the County Conservation, Development and Planning Department offices and, when possible, through the Watershed Information Center and Conservancy.

This new database has a range of applications, from project and site-specific environmental review to County-level planning (Figure 4-1). Some uses of the new Biological Database are as follows.

- Identify species or sensitive communities that are likely to occur on a given site to determine which surveys and permits are likely to be necessary to ensure project compliance with state and federal environmental regulations.

- Focus future surveys for special-status species based on the vegetation types actually present on a given site and thus the special-status species that are likely to be found there.

- Provide information about blooming seasons for plant species to aid in scheduling botanical surveys at the appropriate season. This would permit realistic scheduling by applicants of project review.

- Aid in the review of future biological surveys by providing guidance as to which species should have been targeted.

- Identify locations of a given biotic community or special-status species across the County, allowing applicants to redesign their projects to minimize impacts on sensitive biological resources.

- Allow for the incorporation of additional biological data to update and improve the database.

It must be understood that the County Biological Database is a landscape-level tool. The minimum mapping unit of the ICE map on which the maps are based is 2.5 acres (1 hectare). Special-status species occurrence data varies in its resolution, but in many cases is limited to approximately 400 feet. Moreover, small patches of sensitive habitat may occur on a project site that will not be mapped on the County GIS. Site-specific surveys will therefore remain necessary to determine precise community types and locations, as well as potential impact to special-status species. These surveys, however, can now be focused based on the biological resources that the database indicates are likely to be present at a given site.

SENSITIVE BIOTIC COMMUNITY IDENTIFICATION

Biotic communities are the characteristic assemblages of plants and animals that are found in a given range of soil, climate, and topographic conditions across a region. Sensitive biotic communities in the County were identified using a two-step process.

1. An existing list of sensitive biotic communities prepared by the DFG (2003a) was first reviewed by senior Jones & Stokes biologists, and those communities that may occur in the County were identified. Because the community names in the DFG list (2003a) did not correspond directly with the names used in the Land Cover Layer, a determination was made as to which land cover types on the Land Cover Layer correspond to the communities on the DFG list.

2. The areal extent of each land cover types mapped in the County was generated from the land cover layer. Those biotic communities with an areal extent of less than 500 acres in the County (approximately 0.1% of the County) were identified. These communities were discussed with local experts and their conservation importance established. Those that were not already on the original DFG list and that were determined to be worthy of conservation were added to the list.

LAND COVER CONVERSION CALCULATIONS

1. Acres of each biotic community converted to vineyard were calculated in the following manner. The County's 1993 and 2002 Vineyard GIS datalayers contain data on the location and extent of vineyards in Napa County in 1993 and 2002. These data layers were overlaid with the land cover layer to determine approximately how many acres of each biotic community were converted to vineyard between 1993 and 2002. Approximately 60 acres that were in vineyard in 1993 were no longer in vineyards in 2002. These acres were assumed to have reverted to natural areas, and were subtracted from the acres of biotic communities converted to vineyards.

IDENTIFICATION OF WILDLIFE MOVEMENT AREAS

Regional wildlife movement areas in the County were identified using a three-step process.

1. An existing map of landscape linkages prepared by the California Wilderness Coalition (California Wilderness Coalition 2001) was first reviewed.

2. Qualitative analysis of the distribution of natural areas in the County was then undertaken, with particular emphasis along these linkages.

3. The distribution of habitat groupings in the County was analyzed qualitatively to identify linkages for species that depend on these habitat groupings for movement corridors (e.g., black bears [*Ursus americanus*] may move along riparian corridors between patches of coniferous forest).

In addition, a least cost path analysis was conducted to provide an example of one approach to identifying movement corridors quantitatively.

CALWILD MAP

In November 2000, the conference "Missing Linkages: Restoring Connectivity to the California Landscape" was held in San Diego. This conference brought together experts from around California to address habitat connectivity at a landscape scale. Landscape linkages were defined as "large, regional connections between habitat blocks (*core areas*) meant to facilitate animal movements and other essential flows between different sections of the landscape." Based on expert opinion, these landscape scale linkages were identified throughout California and a linkages map was prepared by the California Wilderness Coalition (CalWild) (California Wilderness Coalition 2001). Three linkages were shown in the County (Map 4-2).

The following issues were discussed for each landscape linkage.

- Which species would be likely to use the linkage?
- What type of threat might interfere with the linkage?
- What lands might be used for the linkage, and which natural areas would it connect?

The results of the CalWild study were the starting point for further investigations of regional wildlife corridors within the County.

NATURAL AREAS

The distribution of natural land cover types in the County was analyzed from the perspective of terrestrial wildlife movement, with particular attention to areas identified as linkages by CalWild. This analysis was done qualitatively, as no specific data on animal movement within the County were available. This analysis identified areas of importance for connectivity, features that may be used as corridors, and areas of relatively constrained wildlife movement, where fragmentation and habitat isolation could interfere with wildlife movement as County land use changes through time.

DISTINCT HABITAT GROUPINGS

Not all natural land covers provide corridors for every species. Each species has specific corridor requirements (Environmental Law Institute 2003). In order to approximate the movement requirements of general groups of species, the distributions of three groups of natural land cover types were assessed using the land cover layer: oak woodland-riparian, coniferous forest-riparian, and grassland-riparian.

Not all natural land covers provide corridors for every species. Each species has specific corridor requirements

The following methodology was used to assess the impact of build-out on wildlife movement. A map of developed parcels from the County land use layer was used to identify parcels where some development has taken place. According to the land cover map, many of these parcels were not fully developed in 1993. The buildout analysis assumed that the open space remaining on these parcels in 1993 would be converted to other uses, such as vineyards or housing. All land use categories except open space were considered capable of reducing wildlife movement. Similarly, a map of the primary and secondary roads in the County was overlaid on the Land Cover Layer to qualitatively evaluate the potential effects of roads on wildlife movement. Roads can function as barriers to movement, as well as increasing the amount of edge and decreasing the amount of core habitat in a movement area. The effect of roads on species movement is species dependent. Species that require large tracts of undisturbed core habitat for movement are especially vulnerable to increased road density. Species that avoid roads or suffer high road mortality are also vulnerable (Noss 2000).

LEAST COST PATH ANALYSIS

Finally, a least cost path analysis of a generalized scenario involving a species moving from the southwest of the County to the Northeast was carried out. A *least cost path analysis* provides a method for evaluating potential corridors and identifying areas where corridors can become constricted. Least

cost path analysis is designed using a dataset composed of grid cells. Each cell is assigned a "cost" for moving across the cell into another cell. For example, depending on the requirements of particular species, an urban area might be assigned a high cost, whereas a natural vegetation type such as grassland might be assigned a low cost. Once the cost values are assigned, the shortest or least cost path between different points can be identified, indicating probable corridor locations.

Relative costs were assigned to each of the general biotic communities in the Land Cover Layer (Table 4-2). The least cost path between the southwest and northeast portions of the County was identified. Other paths that are within 5% of the cost of the least cost path were also identified.

Table 4-2. Movement Cost Values Assigned to Napa County Land Cover Types

Land Cover Type	Cost Value*
Winter-Rain Sclerophyll Forests & Woodlands Formation	1
California Bay - Madrone - Coast Live Oak - (Black Oak Big - Leaf Maple) NFD Super Alliance	1
Canyon Live Oak Alliance	1
Eucalyptus Alliance	1
Tanbark Oak Alliance	1
Coast Live Oak - Blue Oak - (Foothill Pine) NFD Association	1
Interior Live Oak - Blue Oak - (Foothill Pine) NFD Association	1
Interior Live Oak - Blue Oak - (Foothill Pine) NFD Association	1
Coast Live Oak Alliance	1
Interior Live Oak Alliance	1
Mixed Oak Alliance	1
Foothill Pine / Mesic Non-serpentine Chaparral NFD Association	1
Foothill Pine Alliance	1
Knobcone Pine Alliance	1
Ponderosa Pine Alliance	1
McNab Cypress Alliance	1
Sargent Cypress Alliance	1
Sugar Pine – Canyon Oak NFD Association	1
California Juniper Alliance	1
Sparse California Juniper-Canyon Live Oak-California Bay-California Buckeye / Steep Rock Outcrop NFD Alliance	1
Coast Redwood - Douglas-fir / California Bay NFD Association	1
Douglas-fir Alliance	1
Douglas-fir - Ponderosa Pine Alliance	1
Coast Redwood Alliance	1
Valley Oak - (California Bay - Coast Live Oak - Walnut - Ash) Riparian Forest NFD Association	1
Valley Oak - Fremont Cottonwood - (Coast Live Oak) Riparian Forest NFD Association	1
Black Oak Alliance	1
Blue Oak Alliance	1
Valley Oak Alliance	1
Oregon White Oak Alliance	1
White Alder (Mixed Willow - California Bay - Big Leaf Maple) Riparian Forest NFD Association	1
Mixed Willow Super Alliance	1
Sclerophyllous Shrubland Formation	1
Scrub Interior Live Oak - Scrub Oak - (California Bay - Flowering Ash - Birch Leaf Mountain Mahogany - Toyon - California Buckeye) Mesic East County NFD Super Alliance	1
Mixed Manzanita - (Interior Live Oak -California Bay - Chamise) West County NFD Alliance	1
Leather Oak - White Leaf Manzanita - Chamise Xeric Serpentine NFD Super Alliance	1
Leather Oak - California Bay - Rhamnus spp. Mesic Serpentine NFD Alliance	1
White Leaf Manzanita - Leather Oak - (Chamise - Ceanothus spp.) Xeric Serpentine NFD Super Alliance	1

Land Cover Type	Cost Value*
California Bay - Leather Oak - (Rhamnus spp.) Mesic Serpentine NFD Super Alliance	1
Chamise Alliance	1
Chamise - Wedgeleaf Ceanothus Alliance	1
Coyote Brush - California Sagebrush - (Lupine spp.) NFD Super Alliance	1
Lotus scoparius Alliance (post-burn)	1
Sparse Bush Lupine / Annual Grasses / Rock Outcrop NFD Alliance	1
Brewer Willow Alliance	1
(Bulrush - Cattail) Fresh Water Marsh NFD Super Alliance	1
(Carex spp. - Juncus spp - Wet Meadow Grasses) NFD Super Alliance	1
Saltgrass - Pickleweed NFD Super Alliance	1
Upland Annual Grasslands & Forbs Formation	1
Perennial Bunchgrass Restoration Sites	1
California Annual Grasslands Alliance	1
Serpentine Grasslands NFD Super Alliance	1
Rock Outcrop	1
Serpentine Barren	1
Riverine, Lacustrine and Tidal Mudflats	2
Vacant	3
Agriculture	5
Urban or Built-up	10
Water	10
Unknown	10

* Higher cost values were assigned to land cover types that are more difficult for most species to traverse. Cost values range from 1 to 10.

The discussion of regional wildlife movement areas in this report focuses on terrestrial reptiles, amphibians and mammals that move long distances. A brief qualitative discussion of movement by birds and fish is also included.

EVALUATION AREAS

Descriptions of biological resources in the 13 evaluation areas are based on information on biological communities and special-status species occurrences contained in the Napa County Biological Database developed as part of this study. Environmental planning and resource management concerns and opportunities for each area were then identified by senior Jones & Stokes ecologists in collaboration with local experts. The Napa County Biodiversity Mapping Report (Underwood and Hollander 2001), the San Francisco Bay Area Gap Analysis (Wild 2002), and *Important Bird Areas of California* (Cooper 2003) also provided valuable sources of information for the discussion. The estimates of habitat fragmentation provided are based on a study by Underwood and Hollander (2001). This study uses road data that in some cases are 20 years old. Their assessment of habitat fragmentation due to roads in thus conservative (i.e., some areas of the County are more fragmented than is apparent from their analysis), particularly in the southwest half of the County.

The County's baylands, at the mouth of the Napa River, are a component of the largest estuarine system on the west coast of North or South America—the San Francisco Bay-Delta—which supports a wealth of aquatic flora and fauna.

CONTEXT

REGIONAL/STATEWIDE BIOLOGICAL CONTEXT

California is considered a global "hot spot" for biological diversity, where species diversity, endemism, and threats to this diversity are all particularly high (Myers et al. 2000, Stein et al. 2000). California is particularly rich in unique plant species and contains globally important sites of plant diversity (Davis et al. 1997). California contains more native biological diversity than any other state, including more endemic species than any other state (1,295 species) (Stein 2002). Threats to this biological diversity are also high relative to the rest of the U.S. California ranks second only to Hawaii in the proportion of species at risk (29%). The County is located within the California Floristic Province, the portion of the state west of the Sierra Crest that is known to be particularly rich in endemic plant species (Hickman 1993, Stein et al. 2000).

COUNTYWIDE BIOLOGICAL CONTEXT

Napa County itself has a high natural level of biodiversity as compared to California as a whole. This situation is attributable to a combination of its topographic diversity, the relatively wide range of elevations (0 to 4,200 feet above sea level) present, and the numerous microclimates found there, creating an unusually diverse array of habitats. The County straddles the North Coast Ranges. The western half of the County is within the Outer North Coast Ranges. This portion of the California

The County's biodiversity provides valuable goods, services, and scientific information. Some of the plants and animals of the County provide goods that are directly utilized for food, fuel, building materials, and other commodities.

Floristic Province is characterized by high rainfall, allowing the growth of the redwood (*Sequoia sempervirens*), mixed-evergreen and mixed-hardwood forests that are its dominant vegetation types (Hickman 1993). The eastern half of the County is located within the Inner North Coast Ranges, characterized by low rainfall and hot, dry summers, resulting in dominance by chaparral and pine/oak woodland (Hickman 1993).

Napa County is particularly diverse from the standpoint of plants. Although the County comprises only 0.5% of California, it contains 1,102 native plant taxa, or 32% of the state's native flora (Thorne et al. 2004). This floristic diversity is a function of the County's diverse landscape, reaching from marshes at sea level to the peak of Mt. St Helena, at 4,200 feet, as well as the County's large variations in climate discussed in the *Climate* chapter. In addition, the County is an area of overlap for many species at the limit of their ranges (Ruygt pers. comm.). Napa County is also home to many wildlife species, including many rare, threatened and endangered species. Coniferous forests in the northwest of the County support populations of the threatened northern spotted owl. The County's baylands, at the mouth of the Napa River, are a component of the largest estuarine system on the west coast of North or South America—the San Francisco Bay-Delta—which supports a wealth of aquatic flora and fauna, including over 130 species of fish and the endangered California clapper rail (*Rallus longirostris obsoletus*). The County's rivers and streams provide habitat for many species of plants, fish, invertebrates, and amphibians, including the threatened California red-legged frog (*Rana aurora draytonii*).

The County's biodiversity provides valuable goods, services, and scientific information. Some of the plants and animals of the County provide goods that are directly utilized for food, fuel, building materials, and other commodities. Three examples are steelhead a popular sport fish; Douglas-fir, an important timber tree; and oak, an important fuel wood source. More importantly, the plants and animals of the County provide critical ecological cohesiveness and many social functions, including erosion control, pollination, soil creation, water quality enhancement, and natural beauty. The County's many species also represent a vast storehouse of scientific information, most of it unexplored and some of it endemic to the County. Information about the natural history and genetics of the County's species may one day be needed to sustain the County's vineyards or provide medical cures. For all these reasons protecting the County's biodiversity is a wise management decision (Meffe and Carroll 1994).

Critical issues of concern and opportunities for protecting biodiversity in the County include the following.

- Planning and/or limiting development to avoid or minimize impacts to sensitive communities, special-status species, and wildlife movement between large and/or critical natural areas.
- Protecting and enhancing the Napa River, Putah Creek, and the other streams in the County.
- Controlling the spread of invasive exotic species.
- Preventing type conversion of biotic communities through changes in natural disturbance regimes, such as fire and flooding.

BIOTIC COMMUNITIES

Biotic communities are the characteristic assemblages of plants and animals that are found in a given range of soil, climate, and topographic conditions across a region. Characterizing the biotic communities in a region is the first step in planning biological resource management. The classification of biotic communities used in this report is based on the MCV, as applied by Thorne et al. (2004). Another commonly used biotic communities classification system for California is Holland (1986). Appendix A provides a crosswalk between the MCV classes on the ICE map and Holland's (1986) system. Note that there is not always a simple correspondence between the two systems.

Naming conventions for plant species follow Hickman (1993). Wildlife species names are according to the following sources: mammal species follow Kays and Wilson (2002), amphibian and reptile species follow Stebbins (2003), and bird species follow the American Ornithologists' Union (1998).

COMMUNITY DESCRIPTIONS

Based on the classification system contained in the Manual of California Vegetation (Table 4-1) and the ICE map, 59 land cover types have been identified in the County. These land cover types have been grouped into the following eight principal biotic communities.

- Grassland.
- Chaparral/scrub.
- Oak woodland.
- Riparian woodlands.
- Coniferous forest.
- Wetlands.
- Open water.
- Agricultural cropland.

In addition to the eight communities above, rock outcrops, while not a biotic community, provide an important habitat feature for many species, and are discussed briefly. Urban or built land is a major land cover type in the County. However, it is not discussed here because it does not contain biological resources of concern. In rare cases, populations of special-status plant species may be found in urban land (see Appendix B). Special status species may be found in wetlands and watercourses in urban areas. These communities are discussed under wetlands and open water.

Table 4-3 indicates how land cover types were grouped into the biotic communities that follow. Table 4-4 summarizes the acreage of each biotic community within each evaluation area, and in the County as a whole. Map 4-3 depicts the distribution of these biotic communities in the County.

GRASSLAND

DISTRIBUTION

Grassland is a relatively common land cover in the County, covering over 53,700 acres or nearly 11% of the County (Map 4-3 and Table 4-3). Large grassland areas are most common in southeastern portion of the County, around the cities of American Canyon and Napa, in Jamieson/American Canyon, Napa Valley Floor, and Napa River Marshes Evaluation Areas. These three evaluation areas contain about 13% of the grassland in the County. The Pope Valley and Knoxville Evaluation Areas in the north together contain about 15% of the County's grassland. However, grassland also occurs elsewhere throughout the County in large patches on flat to gently rolling hills.

TYPES

Three grassland assemblages exist within the County: annual grassland, native grassland and serpentine (bunchgrass) grassland. Of these assemblages, both native grassland and serpentine grassland are considered sensitive communities. Vernal pools, which provide habitat for a number of special-status species, are found in some grassland areas.

ANNUAL GRASSLAND

GENERAL DISTRIBUTION

Non-native annual grassland has only been present in the County since about the mid-1800s, when non-native grasses and forbs introduced from Europe largely replaced the native grassland vegetation (Heady 1988). This land cover has increased in extent and distribution throughout the County since that time, as non-native grasslands have replaced the native grasslands previously present and woodlands that have been cleared. Today, annual grassland covers slightly over 10% of the County (approximately 51,000 acres) and is found scattered throughout the County. The largest and least fragmented annual grasslands in the County are located in the Jamieson/American Canyon Evaluation Area, in the southeastern part of the County. The Pope Valley Evaluation Area, in the north-central part of the County, also contains significant unfragmented annual grasslands.

COMMON PLANTS

California annual grassland, or nonnative grassland, is an herbaceous plant community dominated by nonnative annual grasses (Holland 1986, Sawyer and Keeler-Wolf 1995). In the County, the dominant grasses include wild oat (*Avena*) species, brome (*Bromus*) grasses, wild barley (*Hordeum*) species, Italian ryegrass *(Lolium multiflorum*), medusa head (*Taeniantherum caput-medusae* and annual fescue (*Vulpia*) species.

Species composition of the annual grassland is highly diverse and includes many other native and nonnative forbs. Common species in the County include many clover (*Trifolium*) species, filaree (*Erodium*) species, miniature lupine (*Lupinus bicolor*), Douglas's lupine (*Lupinus nanus*) slender cottonweed (*Micropus californicus* var. *californicus*), birdsfoot trefoil (*Lotus corniculatus*), evening snow (*Linanthus dichotomus*), California poppy (*Eschscholzia californica*), purple owl's-clover (*Castilleja densiflora*), valley tassels (*Castilleja attenuata*), blow wives (*Achyrachaena mollis*), buttercup (*Ranunculus* spp.), star thistle (*Centaurium sp*.), and smooth cat's-ear *(Hypochaeris glabra*).

Barbour and Witham (2004) point out that the conservation value of annual grasslands is generally underestimated. While dominated by nonnative grasses, these grasslands also provide habitat to many native forbs (nine of the common forbs listed above are native).

The annual flora of annual grasslands has the following cycle: germination after the first fall rains, growth in winter, flowering and fruit set in spring, and survival as seeds buried in the soil during the summer drought (Heady 1988). In general, species composition varies according to annual rainfall, slope, exposure, soil type, and the presence of disturbance (Pitt and Heady 1978, Heady 1988). Vernal pools and other seasonal wetlands sometimes occur in this community.

COMMON WILDLIFE

A variety of reptiles, including the western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), and gopher snake (*Pituophis catenifer*) are characteristic of annual grassland.

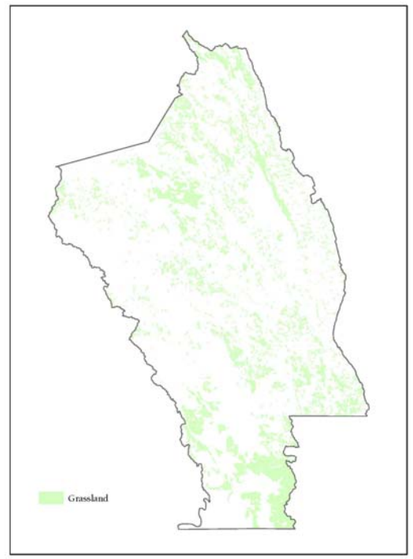
Mammals typically found in this land-cover type include the black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), and coyote (*Canis latrans*).

Common birds that breed in annual grassland habitats include the western kingbird (*Tyrannus verticalis*), loggerhead shrike (*Lanius ludovicianus*), California horned lark (*Eremophila alpestris actia*), Savannah sparrow (*Passerculus sandwichensis*) western bluebird (*Sialia mexicana*), Say's phoebe (*Sayornis saya*) and western meadowlark (*Sturnella neglecta*). Annual grassland also provides important foraging habitat for the golden eagle (*Aquila chrysaetos*), northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), white-tailed kite, red-tailed hawk (*Buteo jamaicensis*), and wintering ferruginous hawk (*Buteo regalis*).

Non-native annual grasslands vary in productivity for wildlife depending on soil type, adjacent land use, and management regime. Different species of wildlife and plants benefit from different grazing intensities or mowing regimes, and frequencies of burning. Annual grasslands can be extremely productive wildlife habitats, providing abundant seed and insects as a food source for small mammals and birds, which in turn provide prey for numerous raptors and other predators.

Blue-eyed grass (*Sisyrinchium bellum*). Species composition of the annual grassland is highly diverse and includes many native and nonnative forbs.

Napa County is home to many wildlife species, including many rare, threatened and endangered species.



Schematic map of County showing distribution of native grassland.

Table 4-3. Napa County Biotic Communities and Associated Land Cover Types

Land Cover Type	Biotic Community	ICE Map Code	MCV Biotic Community (used in ICE map)	Area (in acres)	Percentage of County
Grassland	Annual Grassland	4502	Sparse Bush Lupine / Annual Grasses / Rock Outcrop NFD Alliance	5	0.00
	Annual grassland and Native grassland	7100	Upland Annual Grasslands & Forbs Formation	12,153	2.39
	Annual grassland and Native grassland	7120	California Annual Grasslands Alliance	39,174	7.72
	Native grassland	7101	Perennial Bunchgrass Restoration Sites	256	0.05
	Serpentine grassland	7130	Serpentine Grasslands NFD Super Alliance	2,119	0.42
Total Grassland				**53,706**	**10.58**
Chaparral/scrub	Chaparral	2127	California Juniper Alliance	2	0.00
	Chaparral	4301	Scrub Interior Live Oak - Scrub Oak - (California Bay - Flowering Ash - Birch Leaf Mountain Mahogany - Toyon - California Buckeye) Mesic East County NFD Super Alliance	11,037	2.18
	Chaparral	4302	Mixed Manzanita - (Interior Live Oak -California Bay - Chamise) West County NFD Alliance	8,609	1.70
	Chaparral	4321	Chamise Alliance	30,914	6.09
	Chaparral	4322	Chamise - Wedgeleaf Ceanothus Alliance	7,106	1.40
	Chaparral	4501	Coyote Brush - California Sagebrush - (Lupine spp.) NFD Super Alliance	42	0.01
	Chaparral	4503	*Lotus scoparius* Alliance (post-burn)	29	0.01
	Chaparral	4300	*Sclerophyllous* Shrubland Formation	3,277	0.65
Total Non-serpentine Chaparral				61,017	12.03
	Serpentine Chaparral	4303	Leather Oak - White Leaf Manzanita - Chamise Xeric Serpentine NFD Super Alliance	26,986	5.32
	Serpentine Chaparral	4304	Leather Oak - California Bay - *Rhamnus* spp. Mesic Serpentine NFD Alliance	4,399	0.87
	Serpentine Chaparral	4305	White Leaf Manzanita - Leather Oak - (Chamise - *Ceanothus* spp.) Xeric Serpentine NFD Super Alliance	8,005	1.58
	Serpentine Chaparral	4306	California Bay - Leather Oak - (Rhamnus spp.) Mesic Serpentine NFD Super Alliance	7,176	1.41
Total Serpentine Chaparral				46,566	9.18
Total Chaparral/scrub				**107,583**	**21.20**
Oak Woodland	Deciduous Oak woodland	3121	Black Oak Alliance	2,572	0.51
	Deciduous Oak woodland	3122	Blue Oak Alliance	44,104	8.69
	Deciduous Oak woodland	3123	Valley Oak Alliance	2,903	0.57
	Deciduous Oak woodland	3124	Oregon White Oak Alliance	1,124	0.22
	Evergreen Oak Woodland	1101	California Bay - Madrone - Coast Live Oak - (Black Oak Big - Leaf Maple) NFD Super Alliance	18,252	3.60
	Evergreen Oak Woodland	1122	Canyon Live Oak Alliance	662	0.13
	Evergreen Oak Woodland	1124	Tanbark Oak Alliance	245	0.05
	Evergreen Oak Woodland	1201	Coast Live Oak - Blue Oak - (Foothill Pine) NFD Association	26,374	5.20
	Evergreen Oak Woodland	1202	Interior Live Oak - Blue Oak - (Foothill Pine) NFD Association	18,084	3.56
	Evergreen Oak Woodland	1221	Coast Live Oak Alliance	13,139	2.59
	Evergreen Oak Woodland	1222	Interior Live Oak Alliance	5,297	1.04
	Evergreen Oak Woodland	2128	Sparse California Juniper-Canyon Live Oak-California Bay-California Buckeye / Steep Rock Outcrop NFD Alliance	516	0.10
	Evergreen Oak Woodland, Deciduous Oak Woodland	1223	Mixed Oak Alliance	28,703	5.66
Total Oak Woodland				**161,976**	**31.92**

Table 4-3. Continued

Land Cover Type	Biotic Community	ICE Map Code	MCV Biotic Community (used in ICE map)	Area (in acres)	Percentage of County
Riparian woodland	Mixed Willow woodland	3221	Mixed Willow Super Alliance	542	0.11
	Mixed Willow woodland	5222	Brewer Willow Alliance	272	0.05
	Valley Oak woodland	3101	Valley Oak - (California Bay - Coast Live Oak - Walnut - Ash) Riparian Forest NFD Association	5,721	1.13
	Valley Oak woodland	3102	Valley Oak - Fremont Cottonwood - (Coast Live Oak) Riparian Forest NFD Association	558	0.11
	White alder woodland	3201	White Alder (Mixed Willow - California Bay - Big Leaf Maple) Riparian Forest NFD Association	967	0.19
Total Riparian Woodland				**8,060**	**1.59**
Coniferous forest	Cypress forest	2125	Sargent Cypress Alliance	2,044	0.40
	Cypress forest	2124	McNab Cypress Alliance	2,387	0.47
	Douglas-fir/Redwood Forest	2201	Coast Redwood – Douglas-fir / California Bay NFD Association	2,876	0.57
	Douglas-fir/Redwood Forest	2222	Douglas-fir Alliance	17,280	3.41
	Douglas-fir/Redwood Forest	2224	Douglas-fir - Ponderosa Pine Alliance	9,196	1.81
	Douglas-fir/Redwood Forest	2230	Coast Redwood Alliance	324	0.06
	Pine forest	2122	Knobcone Pine Alliance	5,892	1.16
	Pine forest	2123	Ponderosa Pine Alliance	168	0.03
	Pine forest	2126	Sugar Pine - Canyon Oak NFD Association	3	0.00
	Pine forest	2121	Foothill Pine Alliance	1,874	0.37
	Pine forest	2104	Foothill Pine / Mesic Non-serpentine Chaparral NFD Association	939	0.19
Total Coniferous forest				**42,984**	**8.47**
Aquatic	Freshwater wetlands	6402	(Bulrush - Cattail) Fresh Water Marsh NFD Super Alliance	271	0.05
	Freshwater wetlands	6403	(*Carex* spp. - *Juncus* spp - Wet Meadow Grasses) NFD Super Alliance	282	0.06
	Salt Marsh	6501	Saltgrass - Pickleweed NFD Super Alliance	3,550	0.70
	Streams and reservoirs	9400	Water	28,804	5.68
	Streams and salt marsh	9002	Riverine, Lacustrine and Tidal Mudflats	389	0.08
Total Aquatic				**33,296**	**6.56**
Rock Outcrop	Rock Outcrop	9001	Rock Outcrop	1,687	0.33
	Serpentine Rock Outcrops	9003	Serpentine Barren	51	0.01
Total Rock Outcrops				**1,739**	**0.34**
Agricultural Cropland	Agricultural Cropland	9200	Agricultural Cropland	64,423	12.70
Total Agricultural Cropland				**64,423**	**12.70**
Developed Lands	Developed Lands	9100	Urban or Built-up	26,461	5.21
	Developed Lands	9300	Vacant*	1,782	0.35
Total Developed Lands				**28,244**	**6**
Other	Other	9999	Other	1,159	0.23
	Other	1100	Winter-Rain Sclerophyll Forests & Woodlands Formation	620	0.12
	Other		blank	3,221	0.63
Non-native woodland	Non-native woodland	1123	Eucalyptus Alliance	408	0.08
Total Other				**5,408**	**1.07**
Total				**507,419**	**100**

Note:

* Vacant refers to areas that are unvegetated, apparently due to human disturbance.

Table 4-4. Distribution of MVC Biotic Communities Across Napa County's Thirteen Evaluation Areas

Community Type	Biotic Community	MCV Biotic Community (used in ICE map)	Acreage by Evaluation Areas												
			Angwin	Berryessa	Carneros	Central Interior Valleys	Eastern Mountains	Jamieson/American Canyon	Knoxville Area	Livermore Ranch Area	Napa River Marshes	Napa Valley Floor	Pope Valley	Southern Interior Valleys	Western Mountains
Grassland	Annual Grassland	Sparse Bush Lupine / Annual Grasses / Rock Outcrop NFD Alliance	0	0	0	0	0	0	0	0	0	0	0	5	0
	Annual grassland and Native grassland	Upland Annual Grasslands & Forbs Formation	122	539	833	586	644	2,060	1,327	18	1,314	1,612	1,737	835	526
	Annual grassland and Native grassland	California Annual Grasslands Alliance	52	5,132	552	1,764	7,723	5,917	5,613	298	84	1,047	3,861	3,877	3,254
	Native grassland	Perennial Bunchgrass Restoration Sites	0	0	0	0	0	0	256	0	0	0	0	0	0
	Serpentine grassland	Serpentine Grasslands NFD Super Alliance	0	539	0	152	150	0	853	2	0	5	360	2	54
Total Grassland			**174**	**6,211**	**1,385**	**2,502**	**8,517**	**7,978**	**8,049**	**318**	**1,399**	**2,663**	**5,959**	**4,718**	**3,835**
Chaparral/Scrub	Chaparral	California Juniper Alliance	0	2	0	0	0	0	0	0	0	0	0	0	0
	Chaparral	Scrub Interior Live Oak - Scrub Oak - (California Bay - Flowering Ash - Birch Leaf Mountain Mahogany - Toyon - California Buckeye) Mesic East County NFD Super Alliance	0	5,693	0	620	1,364	0	2,324	0	0	0	226	810	0
	Chaparral	Mixed Manzanita - (Interior Live Oak -California Bay - Chamise) West County NFD Alliance	221	68	6	113	4,252	0	31	2,038	0	1	178	82	1,619
	Chaparral	Chamise Alliance	183	9,543	0	2,072	9,286	0	5,517	341	0	9	1,010	919	2,035
	Chaparral	Chamise - Wedgeleaf Ceanothus Alliance	0	3,201	0	129	137	0	3,329	7	0	0	200	103	0
	Chaparral	Coyote Brush - California Sagebrush - (*Lupine* spp.) NFD Super Alliance	0	0	0	0	17	20	0	0	0	0	0	0	5
	Chaparral	Lotus scoparius Alliance (post-burn)	0	29	0	0	0	0	0	0	0	0	0	0	0
	Chaparral/Scrub	Sclerophyllous Shrubland Formation	0	0	30	17	3,046	0	0	0	0	8	0	174	2
	Total Non-serpentine Chaparral		404	18,536	36	2,951	18,102	20	11,200	2,386	0	18	1,614	2,088	3,661
	Serpentine Chaparral	Leather Oak - White Leaf Manzanita - Chamise Xeric Serpentine NFD Super Alliance	0	6,442	0	2,729	1,084	0	11,650	66	0	2	4,829	9	176
	Serpentine Chaparral	Leather Oak - California Bay - *Rhamnus* spp. Mesic Serpentine NFD Alliance	0	761	0	1,050	359	0	1,602	22	0	0	503	6	96
	Serpentine Chaparral	White Leaf Manzanita - Leather Oak - (Chamise - *Ceanothus* spp.) Xeric Serpentine NFD Super Alliance	0	1,465	0	793	681	0	3,359	93	0	6	1,473	24	111
	Serpentine Chaparral	California Bay - Leather Oak - (*Rhamnus* spp.) Mesic Serpentine NFD Super Alliance	0	1,699	0	1,107	372	0	2,054	33	0	22	1,558	7	324
	Total Serpentine Chaparral		0	10,367	0	5,679	2,496	0	18,664	215	0	30	8,363	45	707
Total Chaparral/Scrub			**404**	**28,903**	**36**	**8,630**	**20,598**	**20**	**29,864**	**2,601**	**0**	**48**	**9,977**	**2,133**	**4,368**
Oak Woodland	Deciduous Oak woodland	Black Oak Alliance	298	156	0	700	395	0	32	161	0	0	386	392	50
	Deciduous Oak woodland	Blue Oak Alliance	1	17,721	0	2,551	2,442	0	10,409	236	0	218	2,889	7,478	157
	Deciduous Oak woodland	Valley Oak Alliance	0	212	54	253	268	20	401	0	0	248	1,179	62	205
	Deciduous Oak woodland	Oregon White Oak Alliance	0	0	0	0	102	0	0	0	0	112	0	0	910
	Evergreen Oak Woodland	California Bay - Madrone - Coast Live Oak - (Black Oak Big - Leaf Maple) NFD Super Alliance	10	265	22	693	4,649	25	0	396	0	526	458	791	10,416
	Evergreen Oak Woodland	Canyon Live Oak Alliance	28	83	0	6	314	0	9	111	0	0	0	112	0
	Evergreen Oak Woodland	Tanbark Oak Alliance	44	0	0	124	9	0	0	0	0	0	68	0	0
	Evergreen Oak Woodland	Coast Live Oak - Blue Oak - (Foothill Pine) NFD Association	45	931	0	5,944	9,279	0	0	165	0	866	2,095	7,050	0

Table 4-4. Continued

Community Type	Biotic Community	MCV Biotic Community (used in ICE map)	Acreage by Evaluation Areas												
			Angwin	Berryessa	Carneros	Central Interior Valleys	Eastern Mountains	Jamieson/American Canyon	Knoxville Area	Livermore Ranch Area	Napa River Marshes	Napa Valley Floor	Pope Valley	Southern Interior Valleys	Western Mountains
	Evergreen Oak Woodland	Interior Live Oak - Blue Oak - (Foothill Pine) NFD Association	0	10,937	0	1,240	0	0	5,574	59	0	0	273	0	0
	Evergreen Oak Woodland	Coast Live Oak Alliance	5	338	105	558	5,837	355	0	0	0	1,283	169	1,000	3,489
	Evergreen Oak Woodland	Interior Live Oak Alliance	0	3,994	0	172	9	0	1,045	0	0	0	16	61	0
	Evergreen Oak Woodland	Sparse California Juniper-Canyon Live Oak-California Bay-California Buckeye / Steep Rock Outcrop NFD Alliance	0	241	0	0	0	0	266	0	0	0	0	10	0
	Evergreen Oak Woodland, Deciduous Oak Woodland	Mixed Oak Alliance	480	3,519	30	2,548	8,571	0	405	969	0	704	3,087	2,630	5,759
Total Oak Woodland			**911**	**38,397**	**212**	**14,789**	**31,877**	**399**	**18,143**	**2,098**	**0**	**3,956**	**10,622**	**19,586**	**20,987**
Riparian woodland	Mixed Willow woodland	Mixed Willow Super Alliance	0	49	21	51	34	66	26	0	1	90	115	31	58
	Mixed Willow woodland	Brewer Willow Alliance	0	30	0	15	74	0	90	17	0	0	47	0	0
	Valley Oak woodland	Valley Oak - (California Bay - Coast Live Oak - Walnut - Ash) Riparian Forest NFD Association	0	261	226	624	410	42	575	0	1	1,957	683	558	383
	Valley Oak woodland	Valley Oak - Fremont Cottonwood - (Coast Live Oak) Riparian Forest NFD Association	0	0	87	0	40	13	51	0	0	270	36	60	0
	White alder woodland	White Alder (Mixed Willow - California Bay - Big Leaf Maple) Riparian Forest NFD Association	0	19	1	52	450	0	5	99	0	27	26	35	252
Total Riparian Woodland			**0**	**359**	**336**	**742**	**1,008**	**121**	**747**	**116**	**2**	**2,345**	**908**	**684**	**692**
Coniferous forest	Cypress forest	Sargent Cypress Alliance	0	961	0	51	1	0	98	0	0	0	933	0	0
	Cypress forest	McNab Cypress Alliance	0	26	0	10	0	0	2,225	43	0	0	84	0	0
	Douglas-fir/Redwood Forest	Coast Redwood - Douglas-fir / California Bay NFD Association	12	0	0	0	105	0	0	13	0	0	70	0	2,675
	Douglas-fir/Redwood Forest	Douglas-fir Alliance	26	0	0	89	4,688	0	0	1,563	0	878	89	0	9,949
	Douglas-fir/Redwood Forest	Douglas-fir - Ponderosa Pine Alliance	1,350	0	0	317	2,557	0	0	2,515	0	22	2,299	0	137
	Douglas-fir/Redwood Forest	Coast Redwood Alliance	0	0	0	8	23	0	0	0	0	16	24	0	253
	Pine forest	Knobcone Pine Alliance	0	0	0	0	2,545	0	40	2,263	0	19	267	0	758
	Pine forest	Ponderosa Pine Alliance	133	0	0	0	10	0	0	0	0	0	25	0	0
	Pine forest	Sugar Pine - Canyon Oak NFD Association	0	0	0	0	0	0	0	3	0	0	0	0	0
	Pine forest	Foothill Pine Alliance	31	276	0	57	389	0	82	237	0	5	643	1	154
	Pine forest	Foothill Pine / Mesic Non-serpentine Chaparral NFD Association	0	418	0	30	33	0	209	152	0	8	10	18	61
Total Coniferous forest			**1,552**	**1,680**	**0**	**562**	**10,351**	**0**	**2,655**	**6,788**	**0**	**947**	**4,443**	**19**	**13,986**
Aquatic	Freshwater wetlands	(Bulrush - Cattail) Fresh Water Marsh NFD Super Alliance	4	0	15	15	33	4	3	0	14	27	123	32	1
	Freshwater wetlands	(*Carex* spp. - *Juncus* spp - Wet Meadow Grasses) NFD Super Alliance	1	10	0	10	54	37	67	1	0	1	40	60	0
	Freshwater wetlands	Vernal pools	None mapped**	Present**	Present**	None mapped**	Present**	Present**	Present**	None mapped**	Present**	Present**	Present**	Present**	Present**
	Salt Marsh	Saltgrass - Pickleweed NFD Super Alliance	0	0	9	0	0	127	0	0	3,407	7	0	0	0
	Streams and reservoirs	Water	94	18,714	258	152	1,171	54	275	11	6,326	681	528	442	99
	Streams and salt marsh	Riverine, Lacustrine and Tidal Mudflats	0	4	0	0	6	0	169	0	198	0	11	0	0
Total Aquatic			**99**	**18,728**	**282**	**177**	**1,264**	**222**	**514**	**13**	**9,946**	**716**	**701**	**534**	**100**

Table 4-4. Continued

Community Type	Biotic Community	MCV Biotic Community (used in ICE map)	Acreage by Evaluation Areas: Angwin	Berryessa	Carneros	Central Interior Valleys	Eastern Mountains	Jamieson/American Canyon	Knoxville Area	Livermore Ranch Area	Napa River Marshes	Napa Valley Floor	Pope Valley	Southern Interior Valleys	Western Mountains
Agricultural Cropland	Agricultural Cropland	Agricultural Cropland	773	267	7,377	2,593	4,166	4,318	569	114	701	30,343	5,455	1,505	6,242
Total Agricultural Cropland			**773**	**267**	**7,377**	**2,593**	**4,166**	**4,318**	**569**	**114**	**701**	**30,343**	**5,455**	**1,505**	**6,242**
Rock Outcrop	Rock Outcrop	Rock Outcrop	0	18	0	9	894	0	73	533	0	9	29	27	95
	Serpentine Rock Outcrops	Serpentine Barren	0	9	0	0	1	0	35	2	0	0	5	0	0
Total Rock Outcrops			**0**	**27**	**0**	**9**	**895**	**0**	**108**	**535**	**0**	**9**	**34**	**27**	**95**
Developed Lands	Developed Lands	Urban or Built-up	921	845	584	400	1,632	2,569	611	43	1,455	16,059	276	174	892
	Other	Vacant	4	92	21	36	305	207	50	25	158	589	13	13	270
Total Developed Lands			921	845	584	400	1,632	2,569	611	43	1,455	16,059	276	174	892
Other	Non-native woodland	Eucalyptus Alliance	0	0	104	0	4	183	0	0	23	65	0	0	29
	Other	Winter-Rain Sclerophyll Forests & Woodlands Formation	0	0	0	0	618	0	0	0	0	0	0	2	0
	Other	Unknown	5	198	28	51	289	6	178	33	79	55	51	149	38
	Other	blank	0	0	257	2	81	101	121	818	1,657	0	41	22	123
Total Other			**9**	**290**	**410**	**89**	**1297**	**497**	**349**	**876**	**1,917**	**709**	**105**	**186**	**460**
Total			**4,843**	**95,707**	**10,622**	**30,491**	**81,605**	**16,123**	**61,610**	**13,501**	**15,420**	**57,795**	**38,479**	**29,565**	**51,657**

Notes:

* Vacant refers to areas that are unvegetated, apparently due to human disturbance.

** Vernal pool acreage is not mapped with sufficient accuracy to report here. However, presence or absence of mapped vernal pools is indicated.

A variety of reptiles, including the common garter snake (*Thamnophis sirtalis*), are characteristic of annual grassland.

SPECIAL-STATUS SPECIES

Appendices B and C provide a list of special-status plants and animals species potentially occurring in annual grassland. Showy Indian clover (*Trifolium amoenum*), bent-flowered fiddleneck (*Amsinckia lunaris*), dwarf downingia (*Downingia pusilla*), adobe lily (*Fritillaria pluriflora*), Colusa layia (*Layia septentrionalis*), northern harrier, and the white-tailed kite are among the special-status species that use annual grasslands in the County for habitat.

In total, 38 special-status plants and 18 special-status animals utilize annual grassland habitat type in the County.

NATIVE GRASSLAND

GENERAL DISTRIBUTION

Native grasslands dominated by a mixture of annual and perennial grasses, such as small fescue (*Vulpia microstachys*), purple needlegrass (*Nasella pulchra*), and nodding needlegrass (*Nasella cernua*), likely occurred in the County in most areas currently occupied by annual grassland (Heady 1988, Wester 1981). Although once extensive in the greater Bay Area and Central Valley, invasion by exotic annual grasses and improper livestock grazing has led to the decline of this land cover type. Some native grasslands contain high concentrations of wildflowers and are referred to as *wildflower fields*. Wildflower fields are recognized as a sensitive community by the DFG.

Historical records do not provide definitive data on the distribution of native perennial grasslands, but research indicates human use of fire may have had a profound impact on the distribution and extent of historic grasslands. Prior to European settlement, native perennial grasslands in the County were likely subject to regular burning by Native American people. Keeley (2002) surmises that because dense scrub or chaparral had little value to Native Americans, they used periodic burning to clear shrubs and provide habitat for fire tolerant native grasses. Keeley (2002) also implies that the current mosaic of grassland is likely a result of historic vegetation management that favored open grasslands over chaparral.

Although once extensive in the greater Bay Area and Central Valley, invasion by exotic annual grasses and improper livestock grazing has led to the decline of this land cover type.

Starting in 1769, another human-made change to the landscape occurred with the introduction and spread of many nonnative plants throughout California. These plants include Mediterranean annual grasses and herbs such as wild oats, bromes, barleys (*Hordeum*), ryegrass (*Lolium*), and thistles (*Centaurea*, *Cirsium*) (Bartolome and Gemmill 1981). European settlers grazing livestock in the study area likely became more widespread after the gold rush of the 1850s. The combination of livestock grazing, drought, and spread of exotic grasses and herbs dramatically altered the native grasslands that occurred in the County prior to the 1850s (Heady 1988). Grazing by livestock and wildlife continues today in almost all of the grasslands in the County, although less intensively than in the past. While most grasslands in the County are dominated by nonnative annuals, small patches of native grasses, below the resolution of the land cover map, are found in many of these grasslands (Rugyt, personal communication; Callizo, personal communication).

It is difficult to estimate the overall acreage of native grassland remaining in the County, but it is likely on the order of thousands of acres, not tens of thousands, covering less than 1% of the County. One significant area of native grassland in the County is located in the Wantrup Preserve in Pope Valley.

COMMON PLANTS

Native grassland is an herbaceous grassland community in which perennial grasses such as purple needlegrass or nodding needlegrass are dominant or co-dominant species (Holland 1986, Sawyer and Keeler-Wolf 1995). In the County, native grassland generally occurs as patches within the larger annual grassland complex. Accordingly, native grassland contains an abundance of nonnative annual grasses mixed with perennial grasses and forbs.

Species commonly found associated with native grassland in the County include slender wild oats (*Avena barbata*), one-sided bluegrass (*Poa secunda*), prairie junegrass (*Koeleria macrantha*), California golden violet (*Viola pedunculata*), common lomatium (*Lomatium utriculatum*), California poppy, Douglas's lupine (*Lupinus nanus*), notched clover (*Trifolium bifidum*), blue dicks (*Dichelostemma capitatum*), ookow (*Dichelostemma congestum*), harvest Brodiaea (*Brodiaea elegans*), smooth tidy tips (*Layia chrysanthemoides*) and arroyo lupine (*Lupinus succulentus*).

COMMON WILDLIFE

The wildlife that use native grassland are the same as those that use annual grassland (see *Common Wildlife* discussion in *Annual Grassland* above).

SPECIAL-STATUS SPECIES

The same special-status species that potentially occur in annual grassland potentially occur in native grassland. However, the likelihood of occurrence for these species is much higher (Appendices B and C). Three subclasses of native grassland are considered sensitive by DFG: creeping ryegrass (*Leymus triticoides*) grassland, purple needlegrass grassland, and one-sided bluegrass grassland. Moreover, the very limited extent of this vegetative community in the County clearly makes native grasslands a sensitive community from a local standpoint.

SERPENTINE BUNCHGRASS GRASSLAND

GENERAL DISTRIBUTION

Serpentine bunchgrass grassland has always been a rare plant community in the landscape (McCarten 1987). Residential and vineyard development, particularly in the last 35 years, has slightly reduced serpentine habitat in the County (California Natural Diversity Database 2004). While serpentine soils are not prime agricultural lands, they may sometimes be used for vineyards, as the serpentine soils provide a natural source of desired stress to the vines (e.g., Silver Oak's Geyserville Vineyard, Louis Martini Winery in St. Helena).

Today serpentine grassland covers about 2,100 acres or 0.5% of the County, making this a sensitive habitat from a local standpoint. Moreover, three subclasses of serpentine grassland found in the County (i.e., creeping ryegrass grassland, purple needlegrass grassland, and one-sided bluegrass grassland) are considered sensitive by DFG. The Knoxville and Berryessa Evaluation Areas contain about 65% of the County's serpentine grassland.

COMMON PLANTS

Serpentine bunchgrass grassland occurs on soils derived from serpentinite and generally has less overall vegetation cover, and less cover of non-native species than the other grasslands discussed (McNaughton 1968, Holland 1986). As a result, the amount of forage provided is lower. The native bunchgrasses typically occur in patches of both single and multiple species (McCarten 1987).

As with other grasslands in the County, the dominant grasses late in the season are nonnative annual grasses, primarily medusa head, goatgrass (*Aegilops triuncialis*) and foxtail brome (*Bromus madritensis*) are nonnative annual grasses, primarily slender wild oats, Italian ryegrass, soft chess (*Bromus hordeaceus*), and foxtail barley (*Hordeum murinum* ssp. *leporinum*). However, nonnative annuals are much less dominant in serpentine areas (Harrison et al. 2003).

Patches of native grasses, including purple needlegrass, small fescue, California melic (*Melica californica*), and one-sided bluegrass and squirreltail grass (*Elymus multisetus*), are scattered throughout. Herbaceous species characteristic of serpentine bunchgrass grassland in the County include California goldfields (*Lasthenia californica*), hayfield tarweed (*Hemizonia congesta*), navarretia (*Navarretia* spp.), willow herb (*Epilobium brachycarpum*), fringed sidalcea (*Sidalcea diploscypha*), warty spurge (*Euphorbia spathulata*), bull clover (*Trifolium fucatum*), lotus (*Lotus* spp.), delphinium (*Delphinium* spp.), annual mountain dandelion (*Agoseris heterophylla*), owl's clovers (*Castilleja* spp.), California plantain (*Plantago erecta*), and blue dicks.

The characteristics of native bunchgrasses in serpentine habitat are generally similar to those in non-serpentine habitats, although serpentine populations may be more tolerant of heavy metals present in the soil and may have lower growth rates compared to non-serpentine populations (Huntsinger et al. 1996).

COMMON WILDLIFE

The types of wildlife that use serpentine bunchgrass grassland are the same as those that use annual grassland (see discussion above). Serpentine grasslands are less productive for wildlife, however, due to the reduced forage and cover available.

SPECIAL-STATUS SPECIES

Serpentine grassland provides habitat to the same suite of special-status wildlife species found in other grassland types. However, 13 special-status plant species are preferentially associated with serpentine grasslands (Appendix B). These species appear to be adapted to the low nutrient levels and high levels of toxic minerals in serpentine soils. Tiburon Indian paintbrush (*Castilleja affinis* ssp. *neglecta*) and Jepson's milk-vetch (*Astragalus rattanii* var. *jepsonianus*) are two of the special-status plant species found in serpentine grasslands.

ECOSYSTEM PROCESSES

The primary sources of disturbance to annual, native, and serpentine grasslands are grazing, fire, and recreation.

Annual grasslands appear to be relatively stable, recovering rapidly following cessation of disturbance (White 1966). Burning appears to have little long-term effect on annual grassland (Heady 1988, Kyser and Di Tomaso 2002). Grazing also appears to have little effect, although overgrazing may affect the species composition (Heady 1988). Both grazing and burning may serve to maintain grasslands, which may otherwise convert over time to chaparral (Keeley 2002).

Non-serpentine native grasslands in the County are generally found as small patches in a mosaic of annual nonnative grasslands. There is great interest throughout California in using disturbance as a tool to increase cover and diversity of native grasses in California grasslands. The effects of disturbance on native species composition, however, are not clear. It appears that the effects of grazing and burning vary depending on their timing and intensity. Some studies have shown that grazing and burning may result in increased numbers of exotic species in non-serpentine grasslands (Harrison et al. 2003). Other studies indicate that these disturbances can result in an increase in cover of native bunchgrass species compared to annual grasses (Bartolome et al. 2004, Dyer 2003).

GRAZING

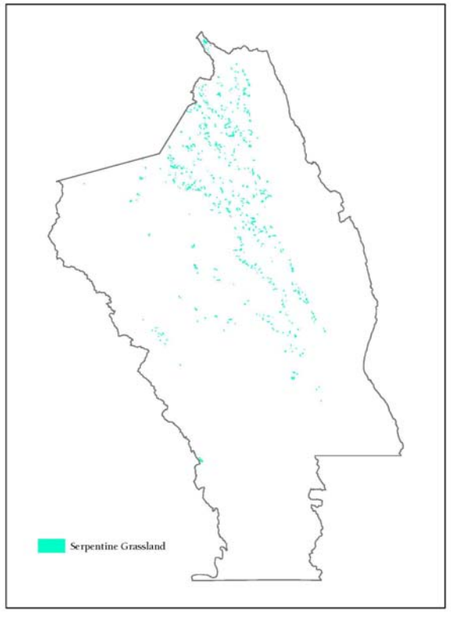
Grazing may have little effect on species diversity in serpentine grasslands (Harrison 1999) or it may alter the species composition, favoring species that are more tolerant of grazing (McCarten 1987). Because invasive nonnatives generally are not tolerant of serpentine soils (with the important exception of goatgrass and medusa head), these species are less invasive in serpentine bunchgrass grasslands that in non-serpentine grasslands (Harrison 1999). Serpentine substrates in the County, as in the San Francisco Bay Region generally, are lighter and more plastic than other crust and mantle rocks, due to their alteration by hydrothermal activity in the subduction zone (Elder 2001). This may explain the observation that serpentine areas appear to be more prone to slumping than non-serpentine areas, and large slumps with accompanying erosion may be present in serpentine bunchgrass grasslands.

FIRE

Grasslands are considered a fire-tolerant community type (Howard 1998). The direct effect of fire on grassland is to remove essentially all of the aboveground biomass. Fires in grassland are therefore described as stand-replacing fires. The immediate effect of this biomass removal on annual grasses is negligible, as they have typically completed their growth cycle before fires occur (Howard 1998). Perennial bunchgrasses suffer a temporary loss of foliage, but regenerate immediately through tillering and regrowth of green foliage that typically remains in the center of grass tussocks (Steinberg 2002).

The immediate effect of a fire in grasslands is typically an increase in annual forb germination and flowering and an increase in overall productivity in response to the light and nutrients made available by the removal of the mulch layer (Harrison et al. 2003). In the 2–3 years following a fire, the elimination of

Serpentine bunchgrass grassland has always been a rare plant community in the landscape. Residential and vineyard development, particularly in the last 35 years, has slightly reduced serpentine habitat in the County.



Schematic map showing serpentine bunchgrass grassland.

A controlled burn of a grassland.

the mulch layer may shift the species composition of grasslands towards annual forbs and small-seeded species such as purple needlegrass (*Nasella pulchra*) and little quakinggrass (*Briza minor*) (Steinberg 2002, Howard 1998). In the absence of heavy grazing, however, a heavy mulch layer will be re-established in approximately three years, and this effect will disappear. Burning appears to have little long-term effect on annual grassland (Heady 1988, Kyser and Di Tomaso 2002, Paysen et al. 2000). In grasslands that are already dominated by non-native annual grasses, non-natives may increase their dominance following fire by outcompeting natives for the newly available space and light. Native grasses may increase their dominance in serpentine grasslands following fire through the same mechanism (Harrison et al. 2003). More discussion on fire is in *Fire Ecology*, included in this report. See Chapter 18.

RECREATION

Recreational use of grasslands in the County includes hunting, bird watching, hiking, mountain biking, horseback riding, and off highway vehicle (OHV) use. OHVs in the County are restricted to the Knoxville area. Recreation may reduce habitat value for wildlife, due to increased human disturbance. Recreation may increase the frequency of fire, as increased access may lead to a greater number of ignitions. Recreation may increase the spread of noxious weeds to areas not yet infested by them, as humans often transport weed seeds on their vehicles and clothing. If recreation is not properly managed through appropriate trail maintenance and prevention of off-trail use, it may be a source of erosion, reducing grassland productivity and degrading streams.

Grasslands in the County provide opportunities for recreation, including horseback riding.

ECOSYSTEM FUNCTIONS

The primary ecosystem functions of grassland in the County are the following:

- maintain water quality through soil retention and by filtering out sediment and nutrients from run-off;
- prevent flooding and minimize channel erosion by slowing surface runoff;
- increase infiltration to groundwater;
- provide wildlife habitat;
- provide fodder for grazing livestock; and
- provide opportunities for recreation, including but not limited to hunting, bird-watching, hiking, horseback riding, and OHV use.

The key characteristics of grassland habitat that enhance these functions are a high-cover of native herbaceous vegetation, a low-cover of woody vegetation, and low to moderate levels of disturbance.

THREATS

The main threat to grasslands today and in the past has been conversion to urban or agricultural uses other than grazing. Non-native invasive species also constitute a threat.

HABITAT CONVERSION

Grasslands in the County have in the past and continue today to be lost to residential, commercial, and industrial development, and conversion to agriculture uses other than grazing. Overlaying the County's 1993 and 2002 vineyard datalayers with the land cover layer indicates that approximately 2,662 acres of grassland (5% of the County's grasslands) were converted to vineyard during this period. Only 0.7 acre of the grasslands converted to vineyards were mapped as serpentine grassland.

While loss of annual grasslands to development is generally not regarded as a significant impact, the San Francisco Bay Area Gap Analysis (Wild 2002) identified annual grasslands as in need of protection for several reasons: less than 20% of grasslands in the Bay Area are protected, this community supports a wide diversity of plant and wildlife species, they have already undergone a severe decline in the County, and they continue to be highly threatened by development.

INVASIVE SPECIES

Grasslands in the County are threatened by the spread of noxious weeds. While non-native annual grasses have dominated much of the grassland in the County for over a century, noxious weeds such as yellow star-thistle (*Centaurea solstitialis*) and Harding grass (*Phalaris aquatica*) may further reduce the cover of native species and degrade habitat for wildlife. Yellow star-thistle reduces grassland forage value and depletes soil moisture levels (Gerlach and DiTomaso 2005). Harding grass can increase fire intensity (Harrington and Lanini 2005). Of particular concern is the spread of barbed goatgrass (*Aegilops triuncialis*) in serpentine grasslands, which have in the past had lower cover of non-native annual grasses and which are critical to the special-status plant species that are endemic to this habitat.

CHAPARRAL/SCRUB

DISTRIBUTION

Chaparral/scrub is the second most common land cover in the County, covering approximately 107,000 acres or 21% of the County (Map 4-3 and Table 4-3). This community is dominated by woody shrubs, with less than 10% cover of trees, and generally occurs in settings that are too hot, dry, rocky, and steep to support tree-dominated habitats (Holland 1986). They occur especially on south and southwest-facing slopes.

Chaparral/scrub occurs on a wide variety of rock types including recent volcanic rocks with shallow soils, serpentinite, slates, and metamorphosed volcanic rock; they do not occur on alluvial soils. The

parent material, particularly serpentinite, often influences species composition. Chaparral shrubs have thick, stiff, leathery evergreen leaves, called sclerophylls, an adaptation to heat and drought.

Chaparral/scrub forms over 20% of the total land area of seven of the 13 evaluation areas. It is particularly abundant in the Knoxville Area, forming almost half of the land cover there. Chaparral/scrub is found throughout the rest of the County and is a dominant land cover in five other evaluation areas, forming between one-fifth and one-third of the land cover in the Berryessa, Central Interior Valleys, Eastern Mountains, Livermore Ranch, and Pope Valley Evaluation Areas.

TYPES

Thorne and his colleagues (2004) recognize 12 alliances within the chaparral/scrub group in the County. Two alliances are dominated by chamise (*Adenostoma fasciculatum*), six are mixed chaparral types, and four are serpentine chaparral (Table 4-3).

Mixed serpentine chaparral is considered a sensitive community by the State of California (California Department of Fish and Game 2000) and a conservation priority for the Bay Area by Wild (2002). The DFG designation of mixed serpentine chaparral corresponds to the four serpentine chaparral alliances found in the County. Moreover, mixed serpentine chaparral was given a high conservation priority score by Wild (2002) (7 out of 10). Vernal pools, which are also a sensitive community, are sometimes found in chaparral/scrub areas of the County (e.g., in Pope and Foss Valleys).

The three most common chaparral/scrub types present are chamise chaparral, leather oak–white leaf manzanita–chamise (a serpentine chaparral), and scrub interior live oak–scrub oak (*Quercus berberidifolia*).

Cypress woodland and foothill pine (*Pinus sabiniana*) woodland are often found in close proximity to chaparral. Foothill pine forest frequently contains chaparral species in the understory. The adaptation of these coniferous forest communities to fire and their ability to grow in steep areas with thin soils results in their association with chaparral communities.

For discussion purposes the chaparral/scrub group has been divided into 3 major sub-groups: chamise-dominated chaparrals (two types), mixed chaparrals (five types), and serpentine chaparrals (four types).

CHAMISE CHAPARRAL

Chamise chaparrals occupy the most extreme, dry, steep south facing slopes and are climax communities, whereas mixed chaparrals occur on more mesic sites.

DOMINANT PLANTS

Chamise-Dominated Chaparral

In the two chamise-dominated chaparrals, the chamise alliance and the chamise-wedge leaf ceanothus alliance, chamise is the dominant species. In chamise alliance, chamise is the sole dominant; other shrubs present in small amounts include toyon (*Heteromeles arbutifolia*), buckbrush (*Ceanothus* spp.), sticky monkeyflower (*Mimulus aurantiacus*), coyote brush (*Baccharis pilularis*) and manzanitas (*Arctostaphylos* spp.).

In the chamise-wedge leaf ceanothus alliance, chamise is co-dominant with wedge leaf ceanothus (*Ceanothus cuneatus*), with associate species similar to those present in chamise alliance. The ground layer is generally sparse in both chamise-dominated types because of the typically continuous canopy cover.

Mixed Chaparral/Scrub

Five types of mixed chaparral/scrub are mapped (Table 4-3), three of which are classified as evergreen sclerophyllous chaparral. The two remaining types are deciduous (deer brush) or microphyllous (coyote brush–California sagebrush [*Artemisia californica*]) and are both very small in extent in the County.

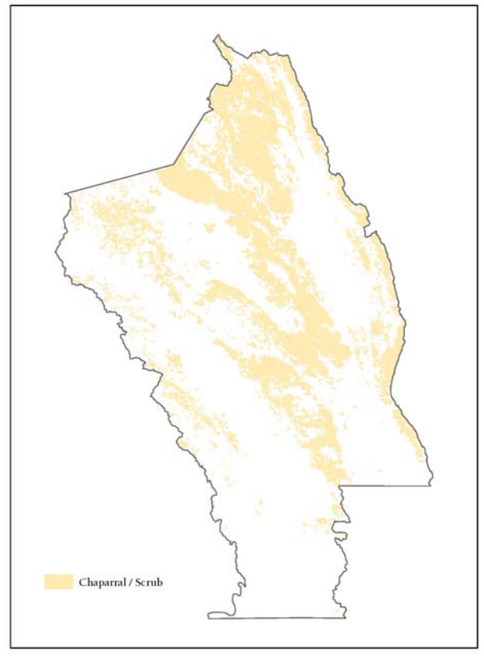
The sclerophyllous chaparral types are dominated by various species of shrubby oaks: interior live oak (*Quercus wislizenii*), leather oak (*Quercus durata*) and scrub oak or manzanitas, and others. Associate species are highly variable depending on type and physical site characteristics, and include California bay (*Umbellularia californica*) on more mesic sites and chamise on xeric sites. Other shrubs present as associates include birch-leaf mountain mahogany (*Cercocarpus betuloides*), flowering ash (*Fraxinus dipetala*), coffeberry (*Rhamnus* spp.), pitcher sage (*Lepechinia calycina*), toyon, sticky monkeyflower, chaparral pea (*Pickeringia montana*), poison oak (*Toxicodendron diversilobum*) and several *Ceanothus* species as minor components.

Serpentine Chaparral

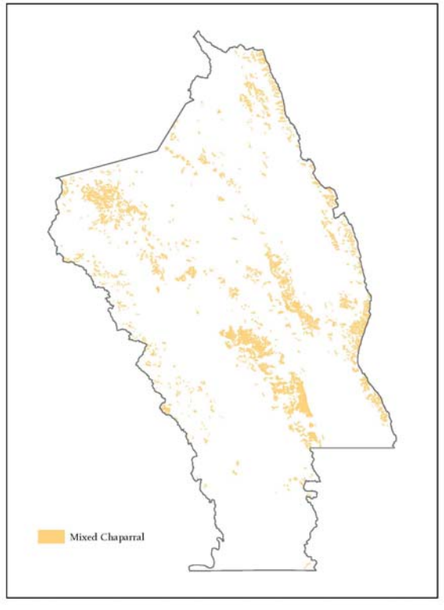
Four types of serpentine chaparral are recognized on the ICE map, and together they form almost 10% of the total land cover of the County (Table 4-3). Serpentine chaparral grows on infertile soils derived from serpentinite rock that have a unique mineral composition with high concentrations of iron and magnesium and low concentration of nutrients such as nitrogen and calcium (Kruckeberg 1984). These harsh soils support a distinctive flora, including many endemic species: Ten percent of California's endemic plants are confined to serpentine soils (Skinner and Pavlik 1994).

The dominant shrubs of serpentine chaparral are usually leather oak, chamise (*Adenostoma fasciculatum*), or white leaf manzanita (*Arctostaphylos viscida*). Species composition is related to aspect, mineral content, and soil moisture levels, and the transition between chaparral types can be subtle. On more mesic, north-trending sites, California bay becomes a dominant, with smaller components of toyon, foothill pine, and cypress species (*Cupressus* spp). On xeric sites, chamise may be dominant. Other shrubs present include musk brush (*Ceanothus jepsonii* var. *albiflorus*), silk-tassel bush (*Garrya congdonii*), toyon, deer brush (*Ceanothus integerrimus*), and fremontia (*Fremontodendron californicum*). Scattered emergent foothill pine trees are generally present.

Chamise chaparrals occupy the most extreme, dry, steep south facing slopes and are climax communities, whereas mixed chaparrals occur on more mesic sites.



Schematic map showing distribution of chaparral/scrub in County.



Schematic map of County showing distribution of mixed chaparral/scrub.

Chaparral/scrub is the second most common land cover in the County. This community is dominated by woody shrubs, with less than 10% cover of trees, and generally occurs in settings that are too hot, dry, rocky, and steep to support tree-dominated habitats.

The ground layer is usually sparse and may include squirreltail (*Elymus multisetus*), oniongrass (*Melica californica*), Torrey's melica (*Melica torreyana*), California fescue (*Festuca californica*), jewelflowers (*Streptanthus* spp.), dwarf wild flax (*Hesperolinon* spp.), Sonoma lessingia (*Lessingia ramulosa*), Coast Range morning glory (*Calystegia collina*), and sickle-leaved onion (*Allium falcifolium*), among others.

GENERAL DISTRIBUTION

Chamise-Dominated Chaparral

The chamise alliance is the most common chaparral type, and is distributed throughout the County except in the extreme southwest. It occurs on the steepest, most xeric south to southwest trending slopes. This type is usually dense and tall (up to 9 feet) with closed canopy cover. Chamise makes up over 70% of the relative cover, although it rarely forms pure stands. The chamise-wedge leaf ceanothus alliance is found on less severe slopes than chamise alliance, and is confined to the eastern portion of the County, occurring mainly in the Knoxville and Berryessa Evaluation Areas.

Mixed Chaparral/Scrub

Mixed chaparral occurs on more mesic sites than chamise-dominated chaparral.

Oak dominated chaparral is found primarily in the east of the County, where it occurs in dense stands, especially along the crest of Blue Ridge, and forms a total of 2% of the total land cover of the County. This type forms 6% of the land cover in the Berryessa area, and from 2%–6% in five other evaluation areas. It transitions to interior live oak forest on more mesic sites.

Manzanita-dominated chaparral occurs in a variety of settings, mostly in the western portion of the County, and also forms a total of 2% of the total land cover. It is especially common in the Livermore Ranch area, covering 15% of the land area.

SERPENTINE CHAPARRAL

Serpentine chaparral is found mainly in the north central portion of the County, especially in the Knoxville area, where they form more than 30% of the total land cover, and also in the hills east of Pope Valley (23% land cover of the Pope Valley Evaluation Area), Central Interior Valleys (19% land cover) and Berryessa area (11% land cover). Small amounts are also found in the Eastern Mountains (4%) and the Western Mountains (2%).

COMMON WILDLIFE

Many species are primarily associated with chaparral, including reptiles such as western rattlesnake (*Crotalis viridis*), California mountain kingsnake (*Lampropeltis zonata*); mammals such as desert cottontail (*Sylvilagus bachmanii*) Sonoma chipmunk (*Tamias sonomae*); and birds such as wrentit (*Chamea fasciata*), California thrasher (*Toxostoma redivivum*), rufous-crowned sparrow (*Aimophila ruficeps*), California quail (*Callipepla californica*), Bewick's wren (*Thryomanes bewickii*), and sage sparrow (*Amphispiza belli*). Most of these species are resident and are rarely found outside of this habitat.

Other species that occur in chaparral are also found in a variety of woodlands and other habitats including many mammals such as ringtail (*Bassariscus astutus*), northern raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*) and puma (mountain lion), as well as birds such as orange-crowned warbler (*Vermivora celata lutescens*), lazuli bunting (*Passerina amoena*), spotted towhee (*Pipilo maculatus*), and California towhee (*Pipilo crissalis*). Mountain lions may also occur in other natural areas in the County, including grassland and oak woodland.

Wildlife populations in chaparral can decline with fire suppression (England 1988). The natural fire return interval in chaparral is approximately 15–35 years (Shlisky et al. 2004). Fire suppression generally results in a local decline of wildlife populations (England 1988). If fires recur too frequently, chaparral may be converted to grassland, with an accompanying change in the diversity and abundance of most small vertebrates (Mayer and Laudenslayer 1988).

SPECIAL-STATUS SPECIES

Appendices B and C list special-status species associated with chaparral in the County. A total of 34 special-status plants are associated with chaparral, often with micro-habitats such as openings, rocky outcrops, or swales within this habitat type. Of these 34 species, 20 are also found in serpentine chaparral (discussed below). Several shrub species are among the special-status plants found in chaparral, including four species of ceanothus.

SERPENTINE CHAPARRAL

A total of 18 special-status plants are associated primarily or exclusively with serpentine chaparral, and a further 16 plant species can occur on both serpentine and non-serpentine substrates. Some of the narrowly endemic serpentine species in the County include Snow Mountain buckwheat (*Eriogonum nervulosum*), Hall's harmonia (*Harmonia hallii*), three species of western flax (*Hesperolinon* spp.), and several species of jewel-flower.

ECOSYSTEM PROCESSES

The primary source of natural disturbance to chaparral/scrub is fire. Several chaparral/scrub types are adapted to recurring fire, and in these communities, many species respond to stand-destroying fire by stump-sprouting or by enhanced seed germination following burns (Holland 1986). The historical fire return interval in fire-adapted chaparral is estimated to be between 15 and 35 years (Shlisky et al. 2004).

Some chaparral/scrub types are successional communities, a result of previous disturbance (primarily fire), and are transitioning to woodland communities. These chaparral/scrub types may persist for

many years as successional stages to oak woodlands, until the slow-growing oaks begin to shade or compete with the shrub species; this shift may take at least 50 years in blue oak (*Quercus douglasii*) woodlands (Mayer and Laudenslayer 1988).

ECOSYSTEM FUNCTIONS

The primary ecosystem functions of chaparral/scrub in the County are the following:

- maintain water quality through soil retention,
- prevent flooding and channel erosion by slowing surface runoff,
- provide wildlife habitat, and
- provide recreational opportunities (hunting and bird-watching).

The key characteristics of chaparral/scrub habitat that contribute to these functions are the dense and continuous canopy cover of short woody vegetation, and low levels of disturbance (i.e., infrequent fires).

THREATS

The main threat to chaparral/scrub lands today and in the past has been conversion to agriculture and alteration of fire regimes.

HABITAT CONVERSIONS

Chaparral/scrub has been and continues to be lost to vineyard development. This community is not as threatened by vineyard conversion as grassland or oak woodland, due to the poorer growing conditions in which it is usually found. Nonetheless, vineyard development is a significant threat to this community. Overlaying the County's 1993 and 2002 vineyard datalayers with the land cover layer indicates that approximately 946 acres of chaparral (1% of the County's chaparral) were converted to vineyard during this period. Only 28 acres of these grasslands were mapped as serpentine chaparral.

FIRE REGIME ALTERATIONS

Altered fire regimes are the greatest threat to chaparral/scrub. Human caused fires that are too frequent can allow invasive plants, especially nonnative annual grasses, to colonize; these species in turn increase flammability, leading to more frequent fires that may eventually convert shrubland to grassland (Keeley 2001). As long as natural fire regimes are maintained, chaparral/scrub is relatively resistant to invasion by nonnative plant species (Barbour and Major 1988), and such species are usually only found in disturbed areas and along edges and ecotones.

OAK WOODLAND

Oak woodland is the most common land cover in the County, occurring on over 167,000 acres (33% of the County's area; see Table 4-3, Map 4-3). It occurs throughout the County across a broad range of elevations, on gentle to steep slopes. Oak woodlands represent over 20% of the cover of seven of the 13 evaluation areas. It is most common in the Southern Interior Valleys evaluation area, where it constitutes almost 70% of the land cover.

The ICE map recognizes 13 vegetation types (alliances or associations) within the oak woodland group (Table 4-3). Six of these are dominated by evergreen oak species, six are dominated by deciduous oak species, and one is a mixture of deciduous and evergreen oaks. The four most common oak woodland types in the County are mixed oak woodlands, (evergreen) coast live oak (*Quercus agrifolia*) woodlands and interior live oak woodlands, and (deciduous) blue oak woodlands. Oregon white oak (*Quercus garryana*) woodland and California bay woodlands are considered sensitive communities by DFG (California Department of Fish and Game 2000). Valley oak woodlands were identified by the *San Francisco Bay Area Gap Analysis* as a high priority for conservation (Wild 2002). Vernal pools, which are also a sensitive community, sometimes occur in the County in oak woodlands.

TYPES

MIXED OAK WOODLAND

Most oak woodlands in the County are mixed oak woodlands, with more than one co-dominant oak species.

GENERAL DISTRIBUTION

Mixed oak woodlands are common throughout the County.

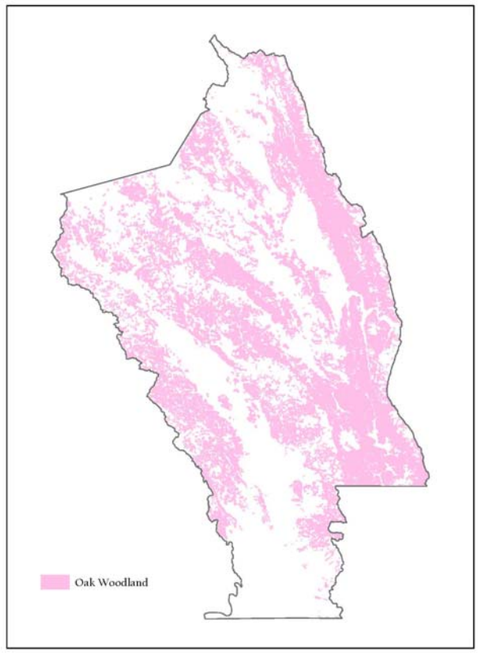
DOMINANT PLANTS

Mixed oak woodlands where interior live oak and blue oak are co-dominants are common east of the Napa River watershed. Other mixed oak woodlands are composed of coast live oak and valley oak in low elevations, with canyon live oak on steep slopes. The mixed oak alliance also includes stands dominated by deciduous oaks, such as California black oak (*Quercus kelloggii*) (see below).

Other tree species found in mixed oak woodlands include big-leaf maple (*Acer macrophyllum*) in wetter areas and madrone (*Arbutus menqiesii*) in drier settings. Conifers such as Douglas-fir (*Psuedotsuga menzeisii*) or Ponderosa pine (*Pinus ponderosa*) form minor components of this community at higher elevations, as does foothill pine at lower elevations.

The understory is characterized by annual grassland species, with patches of shrub species such as hillside gooseberry (*Ribes californica*), and poison oak, vines such as hairy honeysuckle (*Lonicera*

Chaparral/scrub has been and continues to be lost to vineyard development.



Schematic map of County showing distribution of oak woodland.

The coast live oak woodland community is characterized by an open to nearly closed canopy of coast live oak, with madrone and California bay.

Most oak woodlands in the County are mixed oak woodlands, with more than one co-dominant oak species.

hispidula), and herbaceous species such as rigid hedge nettle (*Stachys ajugoides*) and miner's lettuce (*Claytonia perfoliata*) (Sawyer and Keeler-Wolf 1995).

COMMON WILDLIFE

Most wildlife species associated with the mixed oak habitat are also found in other oak woodlands and chaparral. However, birds such as ash-throated flycatcher (*Myiarchus cinerascens*), Hutton's vireo (*Vireo huttoni*), orange-crowned warbler, lark sparrow (*Chondestes grammacus*), Bullock's oriole (*Icterus bullockii*), Lawrence's goldfinch (*Carduelis lawrencei*) and lesser goldfinch (*Carduelis psaltria*) are primarily found in this type of woodland. This habitat shares many of the same mammal and herpetofauna as chaparral described above.

Oak woodlands can be extremely productive for wildlife. Acorns provide an important food source for many species of birds and mammals, as do the numerous insects that feed on oaks. Mature stages of oak woodland development provide suitable or optimal breeding conditions for many wildlife species, with abundant food and large living trees used for nesting (Mayer and Laudenslayer 1988).

SPECIAL-STATUS SPECIES

Appendices B and C list special-status species associated with oak woodlands in the County. Golden eagles forage in oak woodlands, while Lewis's woodpecker (*Melanerpes lewis*) is a winter resident of this community. Clara Hunt's milk-vetch (*Astragalus clarianus*) may grow in openings in oak woodlands, while Brewer's western flax (*Hesperolinon breweri*) is found on serpentine slopes in oak woodlands.

EVERGREEN OAK WOODLAND

GENERAL DISTRIBUTION

Coast live oak woodlands are common at low elevations in the southern Napa watershed. They may be found on gentle slopes in low foothills, especially on the east side of the Napa Valley, as well as on steep southerly slopes where it is found with chaparral species. Interior live oak woodlands are found east of the Napa River watershed. Mixed broadleaf woodlands are found on mesic slopes in central and western County (Thorne et al. 2004)

DOMINANT PLANTS

Evergreen oak woodlands in the County are dominated by coast live oak and interior live oak.

Coast Live Oak Woodland

The coast live oak woodland community is characterized by an open to nearly closed canopy of coast live oak, with madrone and California bay generally under 10–15% relative cover, and a dense understory of poison oak, rigid hedge nettle, and hairy honeysuckle, in addition to perennial grasses and forbs.

Interior Live Oak Woodland

Relatively pure stands of interior live oak are rare in the County. They often include a minor component of foothill pine and coast live oak, and an understory of toyon, buckeye (*Aesculus californica*), bay, coffeberry, Indian warrior (*Pedicularis densiflora*), and Pacific pea (*Lathyrus vestitus*), in addition to perennial grasses and forbs. Shrubs in the understory may include poison oak and yerba santa (*Eriodictyon californicum*).

Mixed Broadleaf Woodlands

Mixed broadleaf woodlands feature California bay or madrone as co-dominants with coast live oak, California black oak, and canyon oak. Douglas-fir and big-leaf maple may comprise up to 5% of the canopy. Such woodlands occur in approximately 4% of the County.

The understory community is typically a mix of hazelnut (*Corylus cornuta*) and oceanspray (*Holodiscus discolor*), and vines such as poison oak, toyon, and California blackberry (*Rubus ursinus*). Grasses are a minor component here including Geyer's oniongrass (*Melica geyeri*) and Torrey's melica. Ferns and leaf litter are prominent on the forest floor.

COMMON WILDLIFE

Many species are primarily associated with oak woodlands, including reptiles such as western skink (*Eumeces skiltonianus*) and northern alligator lizard (*Elgaria coerula*); amphibians such as ensatina (*Ensatina eschscholtzii*) and California slender salamander (*Batrachoseps attenuatus*); and birds such as Nuttall's woodpecker (*Picoides nuttallii*), warbling vireo (*Vireo gilvus*), chestnut-backed chickadee (*Poecile rufescens*), black-throated gray warbler (*Dendroica nigrescens*) and black-headed grosbeak (*Pheucticus melanocephalus*). Typical mammal species found in this habitat include those described for chaparral communities.

SPECIAL-STATUS SPECIES

Appendices B and C list special-status species associated with oak woodlands in the County. Golden eagles forage in oak woodlands, while Lewis's woodpecker is a winter resident of this community. Clara Hunt's milk-vetch may grow in openings in oak woodlands, while Brewer's western flax is found on serpentine slopes in oak woodlands.

DECIDUOUS OAK WOODLANDS

GENERAL DISTRIBUTION

Blue oak woodlands occur primarily east of Chiles Valley to the County line (Thorne et al. 2004). California black oak woodlands are found at higher elevations, especially in the Atlas Peak region.

Valley oak riparian woodlands are found along major riparian corridors, especially along the Napa River and its tributaries.

DOMINANT PLANTS

Deciduous oak woodlands in the County are dominated by blue oak. Blue oak woodlands make up approximately 9% of the County. California black oak becomes a more important component of deciduous oak woodlands at higher elevations, and valley oak is more common along riparian corridors.

Blue Oak Woodlands

Blue oak woodlands vary from closed canopies of blue oak to very open stands. In all cases, blue oak makes up at least 80–90% of relative cover (Thorne et al. 2004). The understory is characterized by annual grassland species, with patches of shrub species such as common manzanita (*Arctostaphylos manzanita*), buckeye, hillside gooseberry, and poison oak (Sawyer and Keeler-Wolf 1995). Foothill pine frequently occurs as a minor overstory tree with less than 15% relative cover.

Valley Oak Woodlands

Valley oak riparian woodlands are characterized by one of two suites of co-dominant tree species, either California bay, coast live oak, walnut and ash, or Fremont cottonwood (*Populus fremontii*) and coast live oak. Valley oak riparian woodlands, while constituting a small fraction of the County's overall area, are especially valuable in terms of protecting water quality and providing wildlife habitat.

If valley oak riparian woodlands are not heavily grazed, they may contain riparian vegetation in the understory, such as bracken fern (*Pteridium aquilinum*), Santa Barbara sedge (*Carex barbarae*), arroyo willow (*Salix lasiolepis*), California rose (*Rosa californica*), common snowberry (*Symphoricarpus albus*), California blackberry, and wild grape (*Vitus californica*). Valley oak woodland also occurs on the open valley floor, where it was historically quite extensive.

Although there is little data to help describe this vegetation type, canopy cover is thought to have been open to locally dense with valley oak the dominant tree. Blue oak, California black oak, and coast live oak were probably minor constituents of this community. The understory was similar to that described under native grassland with a mosaic of seasonal wetland interspersed.

COMMON WILDLIFE

Wildlife communities associated with deciduous oak woodland are similar to those described in evergreen mixed oak woodland below. Notable exceptions include relatively rare species including wintering Lewis's woodpecker, yellow-billed magpie (*Pica nuttalli*) and phainopepla (*Phainopepla nitens*).

SPECIAL-STATUS SPECIES

Many special-status species occurring in evergreen oak woodlands also occur in deciduous oak woodlands (Appendix A). Some special-status species are more closely associated with deciduous oak woodlands, sometimes because they are found in the riparian areas or higher elevations where deciduous oak woodlands are found. For example, long-legged myotis *(Myotis volans*) is found in high elevation woodlands, while ringtail cat and marsh checkerbloom (*Sidalcea oregana* ssp. *hydrophila*) are found in riparian woodlands.

ECOSYSTEM PROCESSES

The primary sources of disturbance to oak woodlands are fire, grazing, and disease. Oak woodlands are adapted to frequent, low-intensity fires. Mature oaks can survive such fires, while younger trees regenerate after low-intensity fires by sprouting. Native Americans used fire as a tool to manage oak woodlands, although the frequency of anthropogenic burning during the Native American period is unknown. European ranchers used fire to keep rangeland open and to stimulate forage production, probably burning every 8–15 years (Sandiford 1994).

Fire suppression beginning in the 1950s has changed the fire regime in oak woodlands from frequent, low-intensity fires to infrequent, high intensity, fires. Such high-intensity fires can lead to the loss of oak woodlands.

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of oak woodlands in the County are the following:

- maintain water quality through soil retention and capturing of sediment and nutrients in runoff;
- maintain stream flows into summer by promoting groundwater recharge and storing water;
- prevent flooding and minimize channel erosion by slowing surface runoff;
- provide wildlife habitat;
- provide fodder for grazing livestock;
- provide firewood; and
- provide opportunities for recreation including, but not limited to, hunting, bird-watching, hiking, horseback riding, OHV use.

The key characteristics of oak woodland habitat that contribute to these functions are a mixture of woody vegetation and herbaceous vegetation, and low levels of disturbance.

Mixed broadleaf woodlands feature California bay or madrone as co-dominants with coast live oak, black oak, and canyon oak.

Blue oak woodlands vary from closed canopies of blue oak to very open stands. In all cases, blue oak makes up at least 80–90% of relative cover.

Oak woodlands in the County are threatened by Sudden Oak Death, a fungal disease. The disease has been rapidly spreading in oak woodlands of California's Central Coast since it was first noted in 1995, and has killed tens of thousands of oaks.

White alder riparian forests often include California bay, Oregon ash, and willows.

THREATS

The main threats to oak woodland have been conversion to grazing land and vineyard, disease, lack of regeneration, and firewood production.

HABITAT CONVERSIONS

Oak woodlands in the County are being lost through conversion to agriculture and to a lesser extent residential and commercial development. In some areas, the rate of oak woodland conversion to vineyards is rapid. According to the County's spatial data on the location and extent of vineyards in 1993 and 2002, approximately 733 acres of oak woodlands(0.5% of the total area of oak woodlands in the County) were converted to vineyards during that period. Of these 733 acres, 86 acres were California bay woodlands and 20 acres were Oregon white oak woodlands (0.5% and 2% of these biotic communities in the County, respectively), which are considered sensitive communities by DFG.

DISEASE

Oak woodlands in the County are also threatened by Sudden Oak Death (SOD), a fungal disease caused by the pathogen *Phyophthora ramorum*. The disease has been rapidly spreading in oak woodlands of California's Central Coast since it was first noted in 1995, and has killed tens of thousands of oaks and tanoaks (*Lithocarpus* spp.). Most confirmed cases of SOD in the County are in the west, along the boundary with Sonoma County, where wetter conditions favor the spread of the disease. However, wet years may allow for the spread of the disease throughout the County. Land managers in the County are attempting to minimize the spread of the disease through monitoring, quarantine and sanitation practices.

LACK OF REGENERATION

In addition to threats from land conversion and disease, some areas of oak woodlands, particularly blue oak woodlands (Napa County Resource Conservation District 1996) and valley oak woodlands (Callizo 1983), are declining due to lack of regeneration. Potential causes of this problem include overgrazing, fire suppression, and invasive species. Livestock can eliminate regeneration by browsing or trampling oak seedlings if stocking rates are kept too high and animals are not moved to fresh pasture with sufficient frequency. Fire suppression can result in the buildup of grass thatch and invasive species that choke out oak seedlings. Lack of regeneration can ultimately lead to conversion of oak woodlands to other community types, such as grasslands dominated by invasive exotic annual species.

FIREWOOD PRODUCTION

Harvesting of firewood from oak woodlands is a common use of this community in the County. If firewood harvests are not severe, effects on wildlife and stand structure appear to be negligible (Garrison and Standiford 1997).

OTHER THREATS TO OAK WOODLAND

Recreational use of oak woodlands in the County is similar to recreational use of grasslands, and can pose the same threats if not properly managed.

RIPARIAN WOODLAND AND FOREST

Riparian woodlands and forests are an uncommon but highly valuable land cover in the County, occurring on over 11,000 acres (2%) of the total land area in the County (Table 4-3, Map 4-3). Over half of the County's riparian woodland is found in the Western Mountains (32% of County total) areas and Napa Valley Floor (20%). Eastern Mountains (10%) and Pope Valley (9%) areas also have significant areas of riparian woodland. They occur throughout the County along riparian and stream corridors.

Thorne and his colleagues (2004) recognize the following seven types (alliances or associations) that are strongly associated with riparian and stream corridors.

- Coast redwood alliance.
- Coast redwood–Douglas-fir/California bay NFD (not formally defined) association.
- Valley oak–(California bay-coast live oak-walnut-Oregon ash) riparian forest NFD association.
- Valley oak–Fremont cottonwood–(coast live oak) riparian forest NFD association.
- White alder (*Alnus rhombifolia*) (mixed willow–California bay–big leaf maple) riparian forest association.
- Brewer willow alliance.
- Mixed willow super alliance.

Valley oak woodlands are the most common riparian woodland type in the County, followed by Coast redwood- Douglas-fir/California bay forests.

Several of these communities are considered sensitive by DFG: Brewer willow scrub, mixed willow riparian forests, and Fremont cottonwood riparian forests. The following types of willow riparian forest are also considered sensitive by DFG and are present in the County, but could not be distinguished in aerial photographs: Arroyo Willow, Pacific Willow, Red Willow, and Narrowleaf Willow riparian forests. In the mapping process, they were lumped with mixed willow riparian forests (Thorne et al. 2004). Fremont cottonwood riparian forests are likely to be present in the County, but occur in patches that are too small to map at a regional scale (Thorne et al. 2004).

TYPES

WHITE ALDER RIPARIAN FOREST

GENERAL DISTRIBUTION

White alder (*Alnus rhombifolia*) is the usual dominant in California's montane riparian forests up to about 5,300 feet, but can also be dominant near sea level (Holstein 1984). It is most common in narrow canyons with fast-flowing mountain streams, in the Eastern and Western Mountains Evaluation Areas (Table 4-4).

DOMINANT PLANTS

White alder riparian forests often include California bay, Oregon ash, and willows. At lower elevations, valley oak may also be an important constituent. The understory may include mulefat (*Baccharis salicifolia*), torrent sedge (*Carex nudata*), California polypody (*Polypodium californicum*), ninebark (*Physocarpus capitatus*), spicebush (*Calycanthus occidentalis*), California grape (*Vitis californica*), and brown dogwood (*Cornus glabrata*).

COMMON WILDLIFE

Several species are primarily associated with this habitat, including amphibians such as Pacific tree frog (*Hyla regilla*); birds such as downy woodpecker (*Picoides pubescens*) and yellow warbler (*Dendroica petechia brewsteri*), and yellow-breasted chat (*Icteria virens*); and wide-ranging mammals such as those described for chaparral and oak woodlands. Many bird species associated with oak woodland habitats are also found in riparian woodlands.

Wildlife habitat is greatly enhanced by riparian vegetation, which provides shade, food, and nutrients for aquatic invertebrates that form the basis of the food chain (Riparian Habitat Joint Venture 2004). Coarse woody debris from riparian trees and shrubs is also an important feature of in-stream habitat, forming scour pools and logjams used by amphibians, insects, and fish (Riparian Habitat Joint Venture 2004). Riparian forests and woodland may be the most important habitat for California landbird species, providing breeding and over wintering grounds, migration stopover areas, and movement corridors (Riparian Habitat Joint Venture 2004). The quality of riparian wildlife habitat is enhanced by multilayered, structurally complex vegetation, including canopy trees and a shrub layer, and food sources such as berries and insects.

SPECIAL-STATUS SPECIES

Of the County's 69 special-status wildlife species, 19 depend on this habitat type, while only 2 of the County's 81 special-status plant species do. For example, California Swainson's thrush (*Catharus ustulatus oedicus*) and yellow warbler are summer residents of the County's riparian forests, while ringtail cats are potential year-round residents. Napa County's riparian forests contain some of the last native remaining stands of Northern California black walnut (*Juglans californica* var. *hindsii*), located in Wooden Valley (California Natural Diversity Database 2004).

BREWER WILLOW SCRUB

GENERAL DISTRIBUTION

Brewer willow scrub is found along rivers and stream in areas of serpentine soils. The Eastern Mountains and Knoxville Evaluation Areas contain the largest fraction of the County's Brewer willow scrub (Table 4-4).

DOMINANT PLANTS

Brewer willow dominates riparian scrub in serpentine areas. These areas are characterized by shrubby willows, in contrast to the larger willows found in mixed willow riparian forests. Foothill pine, California bay, Sargent's cypress (*Cupressus Sargentii*) or McNab's cypress (*Cupressus macnabiana*) may occur as very sparse (under 10% cover) canopy trees.

Other common shrubs here include western azalea (*Rhododendron occidentale*) and hoary coffeberry (*Rhamnus tomentella*). Perennials make up an important part of this vegetation type and many serpentine endemics occur in it.

COMMON WILDLIFE AND SPECIAL-STATUS SPECIES

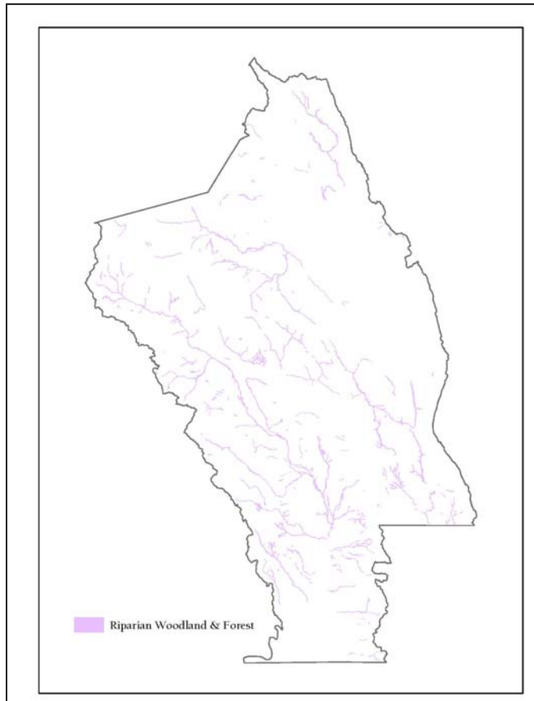
Common wildlife and special-status species found in Brewer willow riparian forests are similar to those found in white alder riparian forests. Many special-status plant species occur here, including Cleveland's butterweed (*Senecio clevelandii*), Cleveland's milkvetch (*Astragalus clevelandii*), swamp larkspur (*Delphinium uliginosum*), serpentine sunflower (*Helianthus exilis*), and nudestem monkeyflower (*Mimulus nudatus*).

MIXED WILLOW FOREST

GENERAL DISTRIBUTION

Mixed willow forests typically occur in narrow bands along streams and are below the minimum mapping unit. Most mapped stands are in the vicinity of small lakes and reservoirs. The Napa Valley floor and Pope Valley are the evaluation areas containing the largest fraction of the County's mixed willow forests (Table 4-4).

Brewer willow dominates riparian scrub in serpentine areas. These areas are characterized by shrubby willows, in contrast to the larger willows found in mixed willow riparian forests.



Schematic map of County showing distribution of riparian woodland.

Mixed willow riparian woodlands and scrub includes Pacific willow, red willow , black willow, sandbar willow, and arroyo willow. These species may be found in pure or in mixed stands.

The herbaceous understory in moister coast redwood forests includes manroot (*Marah fabaceus*), wakerobin (*Trillium* spp.), California polypody, wood fern (Dryopterus arguta), and sword fern (*Polystichum munitum*), while drier Douglas-fir forests include yerba de selva (*Whipplea modesta*).

Recreational use of riparian woodland and forest in the County includes hunting, bird-watching, hiking, mountain biking, and horseback riding.

DOMINANT PLANTS

Mixed willow riparian woodlands and scrub includes Pacific willow (*Salix lucida* ssp. *lasiandra*), red willow (*Salix laevigata*), black willow (*Salix gooddingi*), sandbar willow (*Salix interior*), and arroyo willow. These species may be found in pure stands or in mixed stands.

Other species found in mixed willow riparian forests include Fremont cottonwood, valley oak, coast live oak, California rose, California blackberry, common snowberry, white alder, and big-leaf maple.

COMMON WILDLIFE AND SPECIAL-STATUS SPECIES

Common wildlife and special-status species found in mixed willow riparian forests are similar to those found in white alder riparian forests.

OTHER RIPARIAN FOREST TYPES

General distribution and dominant plants of coast redwood alliance and coast redwood-Douglas-fir/California bay NFD association are discussed with other coniferous forest types below. General distribution and dominant plants of the valley oak-Fremont cottonwood woodlands are discussed with other oak woodland types above.

ECOSYSTEM PROCESSES

Riparian woodlands support one of the most diverse groups of plants and animals in the County on a per area basis. Riparian woodlands are highly productive systems because they receive nutrients and water from higher elevations. High bird abundance and diversity in riparian forests and woodlands result from this productivity (Holstein 1984). Intact riparian woodlands are essential for steelhead trout (*Oncorhynchus* spp.)

The primary sources of disturbance to riparian woodlands and forest are flooding and grazing. Flooding in riparian woodlands removes and damages vegetation while renewing nutrients (Holstein 1984). Frequency of disturbance and inundation affects the composition of riparian woodlands. Because willow species can quickly colonize sand and gravel bars, willow scrub is found in areas that are most frequently disturbed. Larger willows develop in areas that are flooded less frequently. Still less frequently flooded areas further removed from the stream channel develop a riparian forest canopy that may be dominated by valley oak, Fremont cottonwood, and white alder in warmer and drier environments, and by coast redwood in wetter and cooler environments.

Riparian woodlands and forests evolved with grazing by native ungulates as part of their disturbance regime. Grazing creates disturbed areas where colonization and regeneration can occur, as well as providing opportunities for grazing-tolerant plant species to persist. However, overgrazing of riparian areas by livestock or native browsers can destabilize streambanks by removing vegetation, introduce and favor invasive species, and reduce regeneration of tree species (Chaney et al. 1993).

ECOSYSTEM FUNCTIONS

The primary ecosystem functions of riparian woodlands and forest in the County are the following:

- stabilize streambanks;
- maintain cool water temperatures;
- maintain water quality through soil retention and by filtering out sediment and nutrients from run-off
- maintain stream flows into summer by promoting groundwater recharge and storing water
- prevent flooding and minimize channel erosion by slowing surface runoff;
- provide movement areas for wildlife;
- provide wildlife habitat directly and through the input of coarse woody debris and detritus into streams and rivers; and
- provide opportunities for recreation including, but not limited to, hunting, bird-watching, hiking, horseback riding, off-road vehicle use.

The key characteristics of riparian woodland and forest habitat that contribute to these functions are high-cover woody vegetation, moderate-cover herbaceous vegetation, and moderate levels of disturbance.

THREATS

The primary threats to riparian woodlands and forest are land conversion, hydrologic modifications, invasive species, overgrazing by livestock, and recreation.

HABITAT CONVERSIONS

Agricultural conversion in riparian woodlands is common because of the fertility of soils along rivers (Holstein 1984). According to the County's spatial data on the location and extent of vineyards in 1993 and 2002, approximately 60 acres of riparian woodlands and forest (1% of the total area of this community in the County) were converted to vineyards during that period. Of these 60 acres, 3 acres were willow riparian scrub, which is considered sensitive by DFG.

Flood control projects frequently involve removal of riparian woodland vegetation for levee construction and to increase rates of floodwater conveyance, leading to stream incision and disconnection from natural floodplain.

HYDROLOGIC MODIFICATIONS

Even when agricultural and urban development and road crossings do not directly remove riparian vegetation, they may alter the local hydrograph by increasing the rate and volume of surface runoff after rainfall events. This change in surface runoff patterns leads to flashier flooding regimes. More intense flooding for shorter duration alters the composition of riparian forests and woodlands.

INVASIVE SPECIES

Invasive species also threaten riparian woodlands and forests. Invasive species are encouraged by increased sunlight due to clearing of adjacent areas for agriculture. Invasive species, such as giant reed (*Arundo donax*), English ivy (*Hedera helix*), and periwinkle (*Vinca major*), are spreading in riparian areas to the detriment of native vegetation (California Exotic Pest Plant Council 1999). This shift in riparian species composition can reduce native species diversity and habitat value, and alter hydrology.

OVERGRAZING

Overgrazing of riparian areas by livestock or native browsers can destabilize streambanks by removing vegetation, introduce and favor invasive species, and reduce regeneration of tree species (Chaney et al. 1993). One way to protect riparian vegetation from overgrazing is to erecting fences to exclude livestock from the riparian corridor. This technique is being used in Huichica Creek by the Huichica Creek Stewardship Group. Another approach is to change the grazing regime, reducing the grazing pressure overall, and especially during the dry season, when impacts to creeks from grazing is most severe.

RECREATION

Recreational use of riparian woodland and forest in the County includes hunting, bird-watching, hiking, mountain biking, and horseback riding. Development of trails and boating access for recreational use may reduce riparian vegetation in the County. Increased human disturbance of the riparian corridor may also reduce its value for wildlife. For example, disturbance from recreation during breeding season can cause nest failure for birds such as bank swallows (*Riparia riparia*) (Riparian Habitat Joint Venture 2004). Siting trails in the uplands adjacent to the riparian corridor reduces this problem. If recreation is not properly managed through appropriate trail maintenance and prevention of off-trail use, it may be a source of erosion, degrading water quality and habitat quality in nearby streams through increased fine sediment loads.

CONIFEROUS FOREST

Coniferous forests are relatively common in the County, occurring on almost 38,000 acres (7.5% of County, Map 4-3). Almost all coniferous forest (79%) in the County is concentrated in four evaluation areas: Western Mountains, Eastern Mountains, Livermore Ranch, and Angwin. The ICE map recognizes eleven types of coniferous forest in the County (Table 4-3). Four of these are Douglas-fir-redwood forest types, five are pine forest types, and two are cypress woodland.

Sargent cypress woodland, McNab cypress woodland, redwood forest, and old-growth Douglas-fir-Ponderosa pine forest are considered sensitive communities by DFG (2003a).

Alluvial redwood forest and northern interior cypress forests were both identified by Wild (2002) as in need of additional protection. Development does not threaten a high percentage of redwood forest areas. However, this community was identified as needing conservation because it has undergone a documented statewide decline of over 80% of its cover, and only a small percentage of its extent is currently protected. Redwood forests are highly valued by the public because of the unique structure and feeling of these ancient, giant conifers. In addition, redwood forests are unique in that they have the greatest biomass accumulation known for any terrestrial ecosystem (Olson and Sawyer 1999). Northern interior cypress forest was identified as in need of protection because it is very underrepresented in the region's protected areas.

Ponderosa pine forests are considered sensitive communities because they are rare within the County, covering less than 200 acres, and occur at the edge of regional distribution. Ponderosa pine forests in the County are concentrated in the Angwin area. In addition, Ponderosa pine is a significant element of Douglas-fir-Ponderosa pine forests, which cover almost 9,200 acres, or almost 2% of the County.

TYPES

DOUGLAS-FIR-REDWOOD FOREST

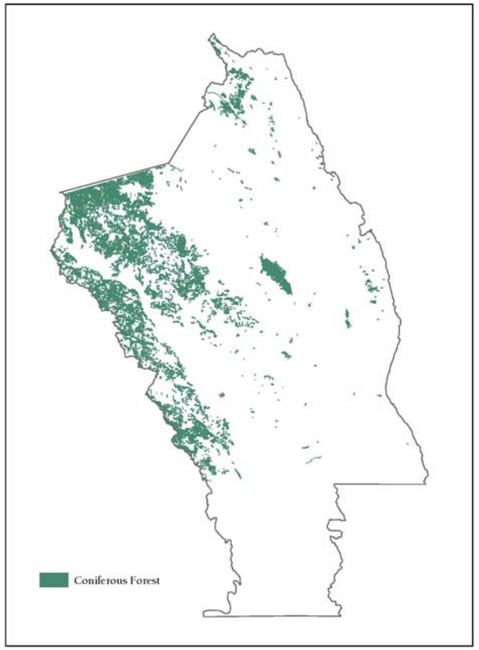
GENERAL DISTRIBUTION

Redwood forests are found in cool, moist valley bottoms. Within the County, about 90% of mapped redwood forests are located in the Western Mountains Evaluation Area, west of Napa Valley, in drainages and mesic, north-trending coves (Thorne et al. 2004). Douglas-fir gains in importance in drier parts of the landscape upslope from valleys and drainages, where fire is more frequent (Olson and Sawyer 1999). Like redwoods, Douglas-fir is found primarily in west County. More than 50% of Douglas-fir forests are located in the Western Mountains Evaluation Area. Approximately 25% of Douglas-fir forests are located in the Eastern Mountains Evaluation Area, and almost 10% in the Livermore Ranch Evaluation Area. Only small patches of this forest type are mapped east of the Napa River watershed, in the Pope Valley Evaluation Area.

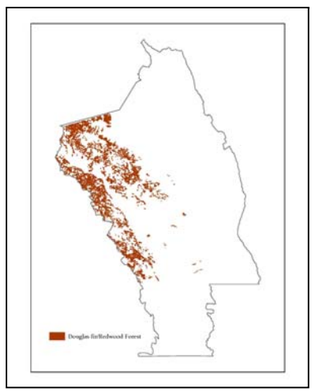
DOMINANT PLANTS

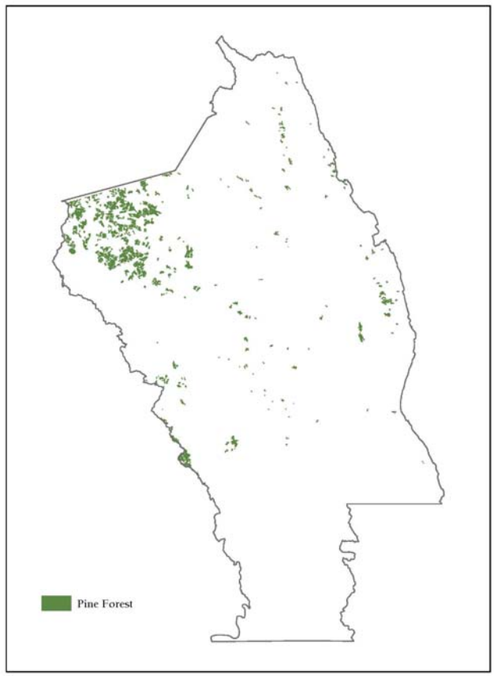
Douglas-fir forests and non-riparian coast redwood stands typically include a small component of tanoaks (*Lithocarpus densiflora*), big-leaf maple, madrone, or California bay. Riparian coast redwoods include white alder trees near drainages. Douglas-fir may also be a co-dominant with Ponderosa pine (MCV 1985).

Shrub associates include California hazel (*Corylus cornuta* var. *californica*), oceanspray, creeping snowberry (*Symphoricarpos mollis*), poison oak, ceanothus (*Ceanothus* spp.), California nutmeg (*Torreya californica*), woodland rose (*Rosa gymnocarpa*), thimbleberry (*Rubus parviflorus*) and manzanita.



Schematic map of County showing distribution of coniferous forest.





Schematic map of County showing distribution of knobcone pine, Ponderosa, foothill, and sugar pine forests.

Knobcone pine and cypress forests are most fire-dependent forest types. Knobcone pines, Sargent cypress, and McNab cypress have serotinous cones that require fire to open and release their seed. Seeds of these species germinate well on the bare mineral soils found after fire, and seedlings thrive in the full sun that is present after a burn.

The herbaceous understory in moister coast redwood forests includes manroot (*Marah fabaceus*), wakerobin (*Trillium* spp.), California polypody, wood fern (Dryopterus arguta), and sword fern (*Polystichum munitum*), while drier Douglas-fir forests include yerba de selva (*Whipplea modesta*).

COMMON WILDLIFE

Wildlife communities primarily associated with Douglas-fir-redwood forests include reptiles such as ring-necked snake (*Diadophis punctatus*) and rubber boa (*Charina bottae*); birds such as hairy woodpecker (*Picoides villosus*), pileated woodpecker (*Dendropus pileatus*), Steller's jay (*Cyanocitta stelleri*), red-breasted nuthatch (*Sitta canadensis*), pygmy nuthatch (*Sitta pygmaea*) (pine only), brown creeper (*Certhia americana*), yellow-rumped warbler (*Dendroica coronata auduboni*), western tanager (*Piranga ludoviciana*), and pine siskin (*Carduelis pinus*); and mammals such as Trowbridge's shrew (*Sorex trowbridgii*) black bear, which is also found in chaparral, and western gray squirrel (*Sciurus griseus*), which is also found in oak woodland.

Wildlife productivity in Douglas-fir-redwood forests, as in coniferous forests generally, depends in part on structural diversity of forest stands on the landscape scale (California Partners in Flight 2002). Habitat features such as snags, forest gaps, unfragmented forest interior habitat, and recently burned areas, are important to maintaining a diversity of wildlife species in coniferous forests.

SPECIAL-STATUS SPECIES

Special-status wildlife species associated with Douglas-fir-redwood forests include the Northern spotted owl, which requires large snags for roosting. Bald eagles are also associated with this forest type. Bald eagles nest and roost in coniferous forests near a body of water suitable for foraging.

PINE FOREST

GENERAL DISTRIBUTION

Close to 6,000 acres (1% of County area) of knobcone pine (*Pinus attenuata*) forest have been mapped in the County, mostly in the Livermore Ranch, Western Mountains, and Eastern Mountains Evaluation Areas, in the northwestern portion of the County. Knobcone pine forests are located primarily on upper slopes and ridges, especially near Detert Reservoir.

Ponderosa pine stands are very rare (less than 170 acres, or 0.03% of the County) in the County. They are found on gentle slopes east of the Napa Valley near the town of Angwin. Ponderosa pine is more commonly found in stands dominated by Douglas-fir, discussed above. Such stands cover over 9,000 acres in the County.

Foothill pine forests are relatively rare in the County, covering less than 3,000 acres or 0.5% of the County's total area. They are primarily located in north County, in the Berryessa, Knoxville, Livermore Ranch, Pope Valley, and Eastern Mountains Evaluation Areas.

Sugar pine (*Pinus lambertiana*) forests have not been mapped, but are thought to occur in small areas in the extreme northwestern portion of the County, above 2,200 feet.

DOMINANT PLANTS

Knobcone pine is generally an emergent to chaparral species such as Eastwood manzanita (*Arctostaphylos glandulosa*), hoary manzanita (*A. canescens*), and buckbrush, or is sometimes a co-dominant with other conifers such as Ponderosa pine.

Ponderosa pine is commonly associated with Douglas-fir and sometimes with knobcone pine. Associated shrubs include manzanita, ceanothus, and poison oak. Grasses and forbs include one-sided bluegrass, bedstraw (*Galium* spp.), and bracken fern (Fitzhugh 1988).

Foothill pine is rarely found in single species stands. It is more commonly found as a co-dominant with California bay, oak species, such as coast live oak interior live oak or blue oak, or with chaparral species, such as manzanita and chamise.

Sugar pine (*Pinus lambertiana*) is associated most strongly with canyon live oak (*Quercus chrysolepis*), as well as less frequently with Ponderosa pine and Douglas-fir. Shrubs found in sugar pine forests include deer brush. Herbaceous associates include goldenback fern (*Pentagramma triangularis*).

COMMON WILDLIFE AND SPECIAL-STATUS SPECIES

Common wildlife and special-status species associated with pine forests are similar to those associated with Douglas-fir–redwood forests. Some fire dependent species, such as Cobb Mountain lupine (*Lupinus sericatus*), may be found in the fire-dependent knobcone pine and Douglas-fir-pine forests, but not in Douglas-fir–redwood forests.

SARGENT AND MCNAB CYPRESS FOREST

GENERAL DISTRIBUTION

Cypress forests are typically found on sites that are more rocky and infertile than the surrounding soils (Jensen 1988). Approximately 2,000 acres (0.4%) of Sargent cypress forest are found in the County. Over 90% of the County's Sargent cypress stands are located in the Berryessa and Pope Valley Evaluation Areas. These stands are located in and adjacent to the Cedar Roughs, on west facing slopes above the southern end of Pope Valley. Some stands were also mapped in riparian areas (Thorne et al. 2004). Sargent cypress in the County typically grows along canyon bottoms.

Approximately 2,300 acres (0.5%) of McNab cypress forest are found within the County. Over 90% of the County's McNab cypress forests are found in the Knoxville Evaluation Area, in the northeastern portion of the County, on rocky serpentine soils.

DOMINANT PLANTS

Sargent cypress may be found dominating dense stands, while McNab cypress more commonly co-occurs with foothill pine, leather oak, whiteleaf manzanita, and white-flowered musk brush (*Ceanothus jepsonii* var. *albiflorus*) (Jensen 1988). Sargent cypress may also occur in more open stands, as it does in Sage Canyon.

COMMON WILDLIFE

Common wildlife species associated with cypress forests are similar to those associated with oak woodland and chaparral.

SPECIAL-STATUS SPECIES

Special-status species associated with the County's cypress forests are serpentine associates, such as drymaria-like western flax. serpentine dwarf flax,

ECOSYSTEM PROCESSES

The principal natural disturbance processes in coniferous forest are fire, disease, and flooding.

FIRE

Knobcone pine and cypress forests are the most fire-dependent forest types in the County. Knobcone pines, Sargent cypress, and McNab cypress have serotinous cones that require fire to open and release their seed. Seeds of these species germinate well on the bare mineral soils found after fire, and seedlings thrive in the full sun that is present after a burn (Jensen 1988). Little information is available on the natural fire interval for these species, but Sargent cypress and McNab cypress are thought to burn approximately every 25 years (Esser 1994).

Douglas-fir, ponderosa pine, and sugar pine forests tolerate low-intensity fires, but may be threatened with replacement by chaparral following the more intense fires that can follow decades of fire suppression. Douglas-fir's thick, spongy bark and the lack of lower branches on older trees help it to survive frequent, low-intensity fires (Morrison and Swanson 1990). Redwood trees are also protected by their thick bark, and can regenerate following fire by seedlings and stump sprouts. Ponderosa pine forests are probably maintained by low-intensity, frequent ground fires, but canopy fires can lead to stand replacement by chaparral communities (Fitzhugh 1988). Sugar pines are susceptible to fire when young, but mature trees can survive most fires. Foothill pines are vulnerable to fire due to their thin bark and high resin content. Fire in foothill pine areas will tend to increase dominance by oak or chaparral species with which foothill pine is associated.

Chaparral replacement of Douglas-fir and other coniferous forest communities on a limited scale due to intense fires likely occurred naturally. However, the conditions prevailing across the landscape due to widespread fire suppression could lead to larger scale type conversions of coniferous forests, especially Douglas-fir forests, to chaparral.

DISEASE

In open coniferous forests, disease and insect infestation are important factors in speeding the decline of mature trees and opening gaps for regeneration. However, disease and insect infestation would generally be expected to affect a small number of trees in a given location. Low-intensity, frequent fires, of the type that were common before fire suppression, killed large numbers of tree seedlings, resulting in open coniferous forests (except in the case of knobcone pine and cypress forests, which tend to form dense stands after a burn). Under these circumstances, disease and insect predation might impact dense stands that had been missed by fires, but would rarely have a severe effect on large areas. Insect predation may have been more widespread following recurring drought years, when trees were severely stressed.

FLOODING

Coast redwoods tend to occur in valleys that are flooded every 30–60 years. This flooding regime suppresses other tree species that are less tolerant of inundation (Olson and Sawyer 1999).

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of coniferous forest in the County are the following:

- maintain water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintain stream flows into summer by promoting groundwater recharge and storing water;
- prevent flooding and minimize channel erosion by slowing surface runoff;
- provide wildlife habitat;
- provide carbon assimilation and sequestration to slow climate change;
- provide forest products including lumber and firewood; and
- provide opportunities for recreation including, but not limited to, hunting, bird-watching, hiking, horseback riding, off-road vehicle use.

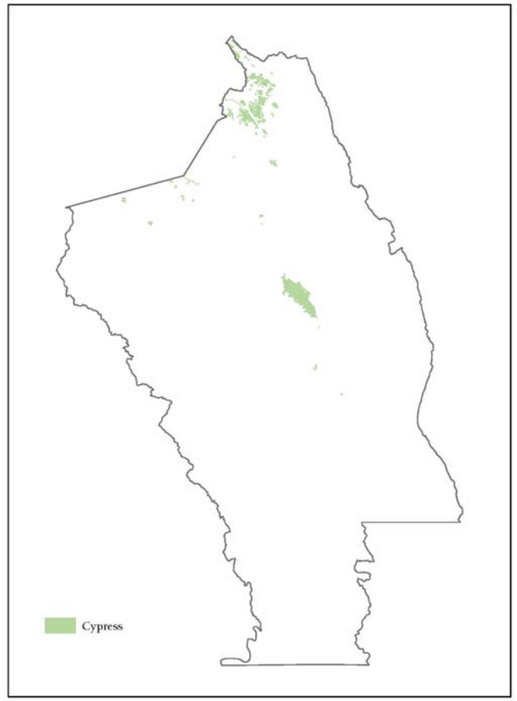
The key characteristics of coniferous forest habitat that contribute to these functions are high-cover woody vegetation, multiple vegetation layers providing complex structure, and low to moderate levels of disturbance.

THREATS

Threats to coniferous forests in the County include land conversions to residential and agricultural use, invasive species, altered fire regimes, timber harvest activities, and recreation.

HABITAT CONVERSIONS

Coniferous forests in the County are undergoing conversion to vineyard development at a rapid rate (California Partners in Flight 2002). According to the County's spatial data on the location and extent of vineyards in 1993 and 2002, approximately 215 acres of coniferous forests (0.5% of the total area of this community in the County) were converted to vineyards during that period. Of these 215 acres, 12 acres were coast redwood forests, 5 acres were Ponderosa pine forests, and 62 acres were Douglas-

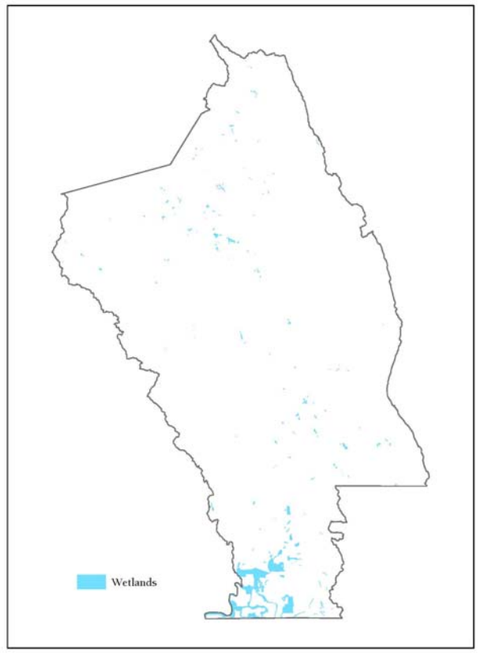


Schematic map of County showing distribution of Sargent and McNab cypress forests.

Fire suppression has resulted in the development of dense forests with many trees severely stressed by competition. Under these conditions, insect and disease problems can spread rapidly.

Sargent cypress may be found dominating dense stands.

McNab cypress commonly co-occurs with foothill pine, leather oak, whiteleaf manzanita, and white flowered musk brush.



Schematic map of County showing distribution of wetlands.

The chief threats to freshwater wetlands, particularly vernal pools and springs and seeps, are vineyard conversion and industrial development. A substantial amount of these rare and important habitat types has been lost in this manner over the past 10 years.

California newt (*Taricha torosa*)

fir-Ponderosa pine forests. Coast redwood forests and old-growth Douglas-fir-Ponderosa pine forests are considered sensitive by DFG, while Ponderosa pine forests are locally rare.

Timber harvest is not occurring rapidly in the County. Timber harvest in the year 2000 was 30 board feet per acre of harvestable timber per year, a very low rate of timber harvest compared to other counties with harvestable timber in the Sacramento Resource Area (Butte, Colusa, El Dorado, Glenn, Lake, Napa, Nevada, Placer, Plumas, Sierra, Tehama, and Yuba Counties). Of these 12 counties, only Colusa County, which had no recorded timber harvest, had a lower rate of timber harvest per acre of timberland per year than the County. Napa County was well below the mean harvest rate of 143 board feet per acre per year, and far below Yuba County, which had the highest rate of harvest, at 418 board feet per acre of timber (Laaksonen et al. 2003).

INVASIVE SPECIES

Invasive species are spreading in some of the County's coniferous forests. Invasives are particularly a problem in redwood forests (Olson and Sawyer 1999). Invasives are less of a threat in cypress forests, which are frequently associated with serpentine soils that resist invasion by exotic species. French broom (*Genista monspessulanus*) is the invasive species of greatest concern in coniferous forests in the County (Stuart 1996, California Exotic Pest Plant Council 1999).

FIRE REGIME ALTERATIONS

Fire suppression in the County has altered the fire regime in coniferous forests from the frequent, low-intensity fires that recurred every 10–20 years that were common in the nineteenth century and earlier (Barret et al. 2004) to less frequent, more intense fires which may lead to the replacement of Douglas-fir, ponderosa pine, and sugar pine forests by other vegetation types. Fire suppression has resulted in the development of dense forests with many trees severely stressed by competition (Ferry et al. 1995). Under these conditions, insect and disease problems can spread rapidly.

A number of insects and diseases introduced to this region from other continents have the potential to cause severe damage to coniferous forests under the dense, competition-stressed conditions created by fire suppression. Various species of bark beetles affect conifers in the County. Foothill pine dwarf mistletoe (*Arceuthobium occidentale*) has infested and killed foothill pines in the Berryessa area. Sudden Oak Death has been found to infect Douglas-fir and redwoods, but it not known whether the fungus will cause mortality in these species.

FLOODING REGIME ALTERATIONS

Adjacent development may alter flooding regimes by removing vegetation, leading to increased surface runoff and more intense, shorter duration floods. This shift in flooding regimes may shift the composition of the redwood forest towards more disturbance tolerant species. It may provide opportunities for incursions by invasive species.

RECREATION

Recreational use is not a substantial threat to coniferous forests in the County, but it has the potential to reduce habitat quality as recreation pressures increase with a growing population. For example, hiking, biking, hunting, and other recreational uses near nest sites during breeding season can lead to nest abandonment (California Partners in Flight 2002). The development of infrastructure for recreation, such as parking areas and trails, can increase forest edge, reducing the value of forest for interior species and increasing nest parasitism by species such as brown-headed cowbirds (*Molothrus alter*) (California Partners in Flight 2002).

WETLANDS

Wetlands occur throughout the County, and are highly diverse in size, type, hydrology, water chemistry, and functions. They may be perennial, holding water year-round, or seasonal, holding water only in the rainy season and drying up in summer. They may be freshwater wetlands, which are generally small in size and distributed throughout the County, or saline, occurring in the south of the County and covering an extensive area at the mouth of the Napa River. Vernal pools are a unique wetland type that occurs in the County. Springs and seeps are also common in the County.

Four wetland communities are considered sensitive by DFG: Coastal and valley freshwater marsh, coastal brackish marsh, northern coastal salt marsh, and northern vernal pool. The communities were also identified as regional conservation priorities by Wild (2002).

Among Napa's biotic communities, Wild (2002) found that coastal brackish marsh and coastal and valley freshwater marsh should have the highest conservation priority. Coastal brackish marsh was prioritized partly because 79% of its statewide extent is located in the Bay Area, and some areas of brackish marsh are at risk of development. Freshwater marsh was prioritized for conservation because 21.6% of the community in the Bay Area was identified as at risk of development, and because there has been a decline of over 80% in the statewide extent of this community. Northern coastal salt marsh was also given a high priority scores (8 out of 10).

The ICE map recognizes four types of wetland habitat: saltgrass-pickleweed (*Salicornia* spp.) salt marsh; riverine, lacustrine, and tidal mudflats (sparsely-vegetated areas associated with rivers, lakes, and the bay); bulrush-cattail freshwater marsh; and *Carex* spp.-*Juncus* wet meadow grasses (Table 4-3).[1] These four habitat types can be divided into two groups: freshwater wetlands and salt marsh, as described below.

TYPES

FRESHWATER WETLANDS

Freshwater wetlands include bulrush-cattail freshwater marsh and *Carex* spp.-*Juncus* wet meadow grasses.

[1] Vernal pools were not mapped as a separate wetland habitat type, but rather as components of the *Carex* spp.-*juncus* wet meadow grasses, California annual grassland, and serpentine annual grassland types because they cannot be distinguished from wet meadows on the aerial photography used. The County maintains a vernal pool data layer, but it is incomplete.

GENERAL DISTRIBUTION

Freshwater wetlands are distributed throughout the County in swales and low-lying areas and around ponds and reservoirs in most of the major valleys. Their combined acreage is very small, only 553 acres, accounting for only 0.1% of the total land area of the County (Table 4-3). Freshwater wetlands are frequent in Pope Valley, which contains 163 acres of wetlands, representing 29% of the County's freshwater wetlands (Table 4-4). Other areas that hold more than 10% of the County's freshwater wetlands are the Eastern Mountains, Knoxville, and Southern Interior Valleys Evaluation Areas.

These figures likely underestimate the extent of freshwater wetlands in the County, as such features are sometimes smaller than the minimum mapping unit of 2.5 acres. This is particularly true in the case of springs and seeps, which were generally too small to be mapped using the methodology employed.

The County's mapped vernal pools are principally located in Pope Valley, the Eastern Mountains, and on the Napa Valley floor.

DOMINANT PLANTS

Freshwater wetlands are characterized by monocots—grasses and grass-like plants in the sedge and rush families—that are tolerant of saturated soils or long-term submergence. Wetlands that hold water for most or all of the year are characterized by dense stands of cattail (*Typha* spp.) and bulrush or tule (*Scirpus* spp).

Ponds may have plants with floating leaves, such as pondweeds (*Potamogeton* spp.), mosquito fern (*Azolla* spp.), and duckweed (*Lemna* spp. and *Wolfia* spp.), or submerged plants, such as Canadian pondweed (*Elodea canadensis*) and *Najas* spp.

Wetlands with more seasonal water supply support sedges (*Carex* spp.) and rushes (*Juncus phaeocephalus, J. effusus*, *J. balticus*, and others). Associated species include other bulrush species, creeping spikerush (*Eleocharis macrostachya*), mannagrass (*Glyceria* spp.), floating water-primrose (*Ludwigia palustris*), water-plantain (*Alisma plantago-aquatica*), umbrella flatsedge (*Cyperus eragrostis*), mint (*Mentha* spp.), buttercup, and smartweeds (*Polygonum* spp.) in perennial wetlands, and Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), Italian ryegrass, curly dock (*Rumex crispus*), and hyssop loosestrife (*Lythrum hyssopifolia*) in more seasonal wetlands.

Vernal pools support a distinctive community of plants adapted to the annual cycle of flooding and desiccation; some plant species in vernal pools are only found in these habitats and are highly restricted in California. Pools are typically dominated by short-lived annual native plants (Holland 1976) that can complete their lifecycles during the inundated and drying phases that characterize the habitat. Vernal pools are well known for the colorful displays of flowers that bloom in concentric circles around individual pools as they dry in spring (Zedler 1987). They are well known for their high level of endemism of plants and animals (Jain 1976), supporting a relatively large number of rare, threatened, or endangered species (Holland and Jain 1988, California Native Plant Society 2001, California Natural Diversity Database 2004). Typical native plant species include several species of downingias (*Downingia* spp.), goldfields (*Lasthenia* spp.), popcornflowers (*Plagiobothrys* spp.), and clovers, as well as gratiola (*Gratiola heterosepala*), coyote thistle (*Eryngium castrense*), spike-rush (*Eleocharis* spp.), woolly marbles (*Psilocarphus brevissimus*), buttercups, pogogyne (*Pogogyne* spp.), quillwort (*Isoetes* spp.), purslane speedwell (*Veronica peregrina*), hairgrass (*Deschampsia danthonioides*), and white navarretia (*Navarettia leucocephala*). Nonnative plants include Italian ryegrass, little quakinggrass, soft chess, lesser hawkbit (*Leontodon taraxacoides*), hyssop loosestrife, birdsfoot trefoil and cut-leaved geranium (*Geranium dissectum*).

COMMON WILDLIFE

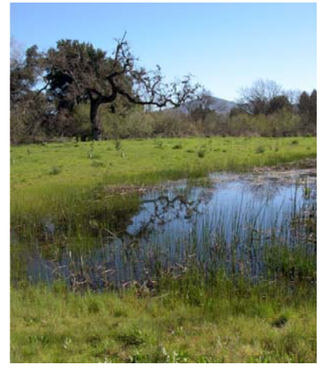
Wildlife species primarily associated with freshwater wetlands include aquatic garter snake (*Thamnophis atratus*), western pond turtle (*Actinemys marmorata marmorata*, formerly *Clemmys marmorata marmorata*), the non-native bullfrog (*Rana catesbeiana*), California newt (*Taricha torosa*), pied-billed grebe (*Podilymbus podiceps*), wood duck (*Aix sponsa*), cinnamon teal (*Anas cyanoptera*), and American coot (*Fulica americana*). Aquatic invertebrates, such as dragonflies, damselflies, water striders (*Gerris remigis*), craneflies, and snails, are common in these wetlands and provide an important food source for other animals. Many mammals visit, ponds including common muskrat (*Ondatra zibethicus*), raccoon, and deer (*Odocoileus hemionus*).

Vernal pools provide habitat for animals that can tolerate the extreme range of conditions that characterize these ecosystems and are able to complete their life cycles in the short period during which pools are wet; these include crustaceans such as fairy shrimp (*Branchinecta* spp.), clam shrimp (*Cyzicus californicus*), tadpole shrimp (*Lepidurus packardi*), seed shrimp (several species in the Podocopida order), and daphnia (*Daphnia* spp.), and other invertebrates such as water beetles, water boatmen (*Corixa* spp.), and aquatic larvae of fly and dragonfly species. Vernal pools are important habitat for migratory birds, including sandpipers, and waterfowl (Silveira 1998). Other birds, such as raptors (hawks, falcons, and kites), herons, and a variety of songbirds, use vernal pool complexes for foraging and as water sources. Many wildlife species use both the vernal pools and the surrounding grassland habitat; for example, many of the typical vernal pool annual plants are pollinated by bee species (*Apis* spp.) that nest in the surrounding uplands and forage in annual grasslands when the pools dry out.

Wetlands are highly productive habitats for wildlife. Coastal wetlands and riparian wetlands are especially productive for plants, because recurrent flooding in these areas delivers influxes of nutrients. The highly productive plant community provides food sources for wildlife. Structural complexity and native vegetation enhance the productivity of wetlands for wildlife, by providing diverse sites for foraging and breeding for native wildlife species.

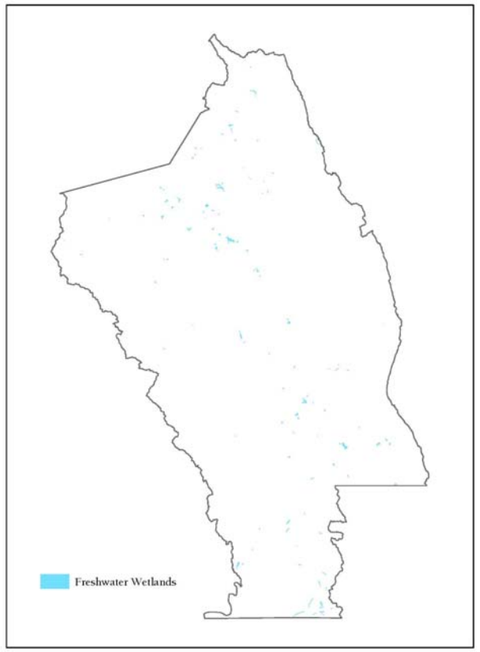
SPECIAL-STATUS SPECIES

Appendices B and C list the special-status species associated with freshwater wetlands in the County. Several special-status plants are associated with freshwater wetlands in a variety of settings, including Suisun Marsh aster (*Aster lentus*), which is also found in brackish marsh, marsh horsetail (*Equisetum palustre*), delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), California loosestrife (*Lythrum californicum*), and California beaked-rush (*Rhynchospora californica*). Several more species are associated with vernal pools and seasonal wetlands and swales. A number of special-status plants are found only in vernal pools, including the endangered Contra Costa goldfields (*Lasthenia conjugens*), Sebastopol meadowfoam (*Limnanthes vinculans*) dwarf downingia, legenere (*Legenere limosa*), Baker's navarretia



Vernal pools support a distinctive community of plants adapted to the annual cycle of flooding and desiccation; some species are only found in these habitats.

Vernal pools provide habitat for animals that can tolerate the extreme range of conditions that characterize these ecosystems and are able to complete their life cycles in the short period during which pools are wet; these include invertebrates such as water beetles, water boatmen, and aquatic larvae of fly and dragonfly species.



Schematic map of County showing distribution of freshwater wetlands.

Freshwater wetlands are characterized by grasses and grass-like plants in the sedge and rush families that are tolerant of saturated soils or long-term submergence.

Wetlands throughout the County are highly diverse in size, type, hydrology, water chemistry, and functions.

(*Naverrretia leucocephala* ssp. *bakeri*) and few-flowered navarretia (*Navarretia leucocephala* ssp. *pauciflora*).

Several special-status wildlife species are associated with freshwater wetlands. Vernal pools provide habitat for vernal pool fairy shrimp (*Branchinecta lynchi*), while freshwater marsh may provide habitat for Northwestern pond turtle. Numerous bird species forage in freshwater marsh, including northern harrier and white-tailed kite.

ECOSYSTEM PROCESSES

The principal natural processes shaping freshwater wetlands are water flows from precipitation, surface and groundwater flows, and associated inputs of sediment, nutrients, metals, and organic matter. Freshwater wetlands play a critical role in ecological processes.

In the hydrologic cycle, freshwater wetlands store precipitation and surface water, slowly releasing it into associated surface water resources, ground water, and the atmosphere (Osmond et al. 1995). The timing, amount, and duration of rainfall and associated surface flows strongly affect the structure and composition of the biological community in freshwater wetlands. Wetter conditions in the western portion of the County explain why more freshwater marshes are found there than in the eastern part of the County, where wet meadows, a less biologically productive wetland community than marsh, predominate.

In biogeochemical cycling, freshwater wetlands store and transform nutrients, organic compounds, metals, and components of organic matter. In addition, freshwater wetlands have extremely high biological productivity, which enables them to enhance water quality and control erosion (Osmond et al. 1995). The amount and type of sediment, nutrients, and other suspended or dissolved materials shape the characteristics of wetlands and the habitat that they provide.

Seasonal wetlands that are transitional between perennial wetlands and upland habitats are transitory, part of the succession of aquatic habitats to upland habitats through gradual siltation. The speed at which this occurs varies depending on the rate of sedimentation, frequency of flooding, and rate of soil development, but the process usually occurs over geologic time so that marshes can be relatively stable for many decades (Mayer and Laudenslayer 1988).

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of freshwater wetlands in the County are the following:

- maintain surface water quality through filtration and decomposition of pollutants,
- recharge groundwater,
- prevent flooding by storing floodwaters,
- provide water for stock and wildlife use,
- provide wildlife habitat, and
- provide opportunities for recreation including, but not limited to, birdwatching and hunting.

The key characteristics of freshwater wetlands that contribute to these functions are intact wetland or riparian vegetation, connectivity of wetlands with their watershed, and a natural hydrologic regime.

SALT MARSH

Salt Marshes include saltgrass-pickleweed salt marsh and the related habitat of riverine, lacustrine, and tidal mudflats.

GENERAL DISTRIBUTION

More than 3,000 acres of salt marsh are mapped in the tidal areas around the mouth of the Napa River, mostly below Cuttings Wharf. Over 96% of the salt marsh is found in the Napa River Marshes Evaluation Area, where it accounts for 22% of the land area. Thousands of acres of salt ponds, mapped as open water in the land cover map, are currently under conversion back to managed wetlands. Restoration to salt marsh is being considered for over 7,000 acres of salt ponds and their associated levees at the mouth of the Napa River in Napa and Sonoma Counties. In addition, nearly 200 acres of associated mud flats are found adjacent to salt marsh and tidally influenced portions of the Napa River. Overall, salt marsh and its related habitats represent less than 2% of the total land area of the County.

DOMINANT PLANTS

Salt marsh in the County is dominated by salt grass (*Distichlis spicata*) and pickle weed. These species are generally dominant in a patchy mosaic. Associate species include alkali heath (*Frankenia salina*), arrow grasses (*Triglochin* spp.), cordgrass (*Spartina* spp.), sea-lavender (*Limonium californicum*), and gumplant (*Grindelia stricta*).

Mud flats are largely unvegetated apart from a variety of algae species, although patches of vegetation are located at the mudflat-marsh fringe, typically including brass buttons (*Cotula coronopifolia*), fleshy jaumea (*Jaumea carnosa*), and Mason's lilaeopsis (*Lilaeopsis masonii*), a special-status species.

COMMON WILDLIFE

Several species are highly adapted to salt marsh habitats and are not found elsewhere in the County, including California black rail, California clapper rail (*Rallus longirostris*), and salt marsh harvest mouse. In addition, many widespread, common aquatic species found in most wetland habitats are also found in salt marshes, including great egret (*Ardea alba*), great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), black-crowned night-heron (*Nycticorax nycticorax*), Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), northern harrier, marsh wren (*Cistothorus palustris*), San Francisco common yellowthroat (*Geothlypis trichas arizela*), and song sparrow (*Melospiza melodia*).

Fish species using salt marshes can be grouped into residents, partial residents, tidal visitors (or tidal transients), and seasonal visitors (or seasonal transients). Residents are those species (e.g., rainwater

killifish [*Lucania parva*]) that complete their entire life cycles in the marsh. Partial residents (e.g., inland silverside [*Menida beryllina*]) are found in the marsh as juveniles throughout the year. Tidal visitors are typically larger fishes (e.g., jacksmelt [*Atherinopsis californiensis*] and flounders) that move into the marsh at high tide to feed on the abundant juvenile fish and invertebrates. Seasonal visitors are species that use the tidal marsh as spawning or nursery areas (e.g., sticklebacks) or as seasonal refuges from predators (e.g., Chinook salmon [*Oncorhynchus tshawytscha*]).

Salt marshes and associated mudflats support a large number of zooplanktonic and benthic invertebrates. Zooplankton are floating and free-swimming invertebrates that are suspended in the water column. They include such species assemblages as rotifers; cladocera; copepods; tunicates; larval forms of annelid worms, gastropods, and bivalves; and a plethora of crustaceans including Dungeness crab (*Cancer magister*). Zooplankton can be found throughout the water column in shallow subtidal and intertidal habitats, as well as in deep bay and channel areas. Benthic invertebrates in their adult life stages are primarily associated with substrates and include sessile invertebrates, infauna, and epibenthos. Sessile invertebrates include sponges, anemones, hydroids, tubeworms, oysters, mussels, barnacles, and other species permanently or semipermanently attached to their substrates. These species are typically dependent on plankton for food and are, in turn, ecologically important as food resources for other invertebrates, fish, birds, and mammals.

A significant decrease in native benthic invertebrate fauna in San Francisco Bay has been documented over the last several decades (URS Corporation 2001). This decline has resulted primarily from habitat loss and the introduction of invasive nonnative species that either compete with or feed on the native benthic invertebrates. It is estimated that 40−100% of the benthic invertebrate fauna in any area of the bay are nonnative species (Carlton 1979, URS Corporation 2001). Asian clam (*Potamocorbula amurensis*), green crab (*Carcinus maenas*), and Chinese mitten crab (*Eriocheir sinensis*) are invasive nonnative species of particular ecological concern that have become well established in the bay.

As discussed above, salt marshes are extremely productive habitats for wildlife, due to the influx of nutrients and the aeration of soils that occurs as a result of tidal action. The ecological benefits that vegetated tidal marsh offers to assemblages of fish species have been well documented (Kneib 1997). Fish migrate with the tides onto the marsh surface to feed and frequently exhibit a fuller gut at high or ebbing tides than at other times (Kneib 1997). Marsh vegetation is known to provide cover from predators for transient and resident fish species (Ryer 1988). Moreover, several transient visitors (mostly species from the silverside family Atherinidae, such as topsmelt [*Atherinops affinis*]) and resident species (e.g., killifish) spawn in marsh vegetation (Kneib 1997).

SPECIAL-STATUS SPECIES

Appendices B and C list special-status species associated with salt marsh in the County. Relatively few special-status plants are associated with salt marsh. They are soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*), Delta tule pea, Mason's lilaeopsis (*Lilaeopsis masonii*), and Marin knotweed (*Polygonum marinense*).

Special-status wildlife species associated with salt marsh and its related habitats in the County include California black rail, California clapper rail, Suisun ornate shrew (*Sorex ornatus*), Samuel's song sparrow (*Melospiza melodia samuelis*), and salt marsh harvest mouse. In addition, short-eared owl (*Asio flammeus*) and saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*) are winter residents, while short-billed dowitchers (*Limnodromus griseus*), red knots (*Calidris canutus*), snowy plover (*Charadrius alexandrinus*), and marbled godwits (*Limosa fedoa*) use the salt marshes during their migration.

Special-status fish species that use the Napa salt marshes include Chinook salmon and steelhead. Juvenile Chinook salmon and steelhead use shallow habitats, including tidal flats, for feeding and as refuge from predators.

ECOSYSTEM PROCESSES

Key ecosystem processes in salt marshes are similar to those described for freshwater wetlands, with the addition of the dominant influence of salinity gradients, which are a function of tidal action and freshwater inputs. Tidal action functions as a recurring, low-level disturbance that restricts the marsh community to species that can tolerate frequent and significant fluctuations in temperature, salinity, and water level. The salinity gradient in the County's salt marshes and other San Francisco Bay tidal marshes are unlike most tidal marshes on California's central coast. Because of their topography and the large freshwater inputs from the Napa River and other drainages, the County's marshes are distributed along a broad and variable salinity gradient (Baye et al. 2000). Consequently, there are significant areas of brackish marsh in the County, which are intermediate in salinity between freshwater and salt marshes.

The broad salinity gradient in the County's marshes is important to species that inhabit both freshwater and marine environments at different points in their life history. Many of these organisms, notably protected anadromous fish, may require brackish marsh habitat in order to gradually adjust to the change in salinity as they move from freshwater to marine environments and back again. Marsh habitat also provides these species with abundant food and cover (Maragni 2000). Productivity in the County's marshes is enhanced because they developed on fine sediments with the capacity to hold high nutrient levels (Baye et al. 2000).

Many widespread, common aquatic species found in most wetland habitats are also found in salt marshes, including great egret (*Ardea alba*).

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of salt marshes in the County are the following:

- maintain surface water quality through filtration and decomposition of pollutants;
- prevent flooding by storing flood and storm surge waters;
- provide wildlife habitat; and
- provide opportunities for recreation including, but not limited to, birdwatching, hunting, and fishing.

The key characteristics of salt marshes that contribute to these functions are intact wetland vegetation, connectivity with tidal influence and freshwater flows from streams and rivers, and a natural hydrologic regime.

THREATS

The primary threats to wetland habitats are habitat conversion, invasive species, water pollution, and altered hydrology.

HABITAT CONVERSION

Although wetlands are generally protected by federal and state law (see *Policy Considerations* above), loss or degradation of saltmarsh, vernal pools, and freshwater wetlands due to fill for development continues in the County (Napa County Resource Conservation District 2003). The chief threats to freshwater wetlands, particularly vernal pools and springs and seeps, are vineyard conversion and industrial development in the American/Jamieson Canyon Evaluation Area. Twelve acres of mapped freshwater wetlands were converted to vineyards in the County between 1993 and 2002. Where vernal pools, springs, and seeps are considered jurisdictional waters of the U.S., proponents of development projects that would impact these areas are required to restore them elsewhere to mitigate impacts.

The chief threats to freshwater wetlands, particularly vernal pools and springs and seeps, are vineyard conversion and industrial development. A substantial amount of these rare and important habitat types has been lost in this manner over the past 10 years.

Habitat conversion is not currently a threat to the salt marsh. Residential and marina development in salt marsh areas have almost completely stopped in Napa County.

INVASIVE SPECIES

Aquatic habitats are readily colonized by invasive species of plants, invertebrates, fish, and amphibians. These species can displace native species or even prey upon them.

Ponds and reservoirs, and associated canals, are often the sites of exotic or nonnative wildlife species introductions and concentrations, including many aquatic invertebrates (e.g., insects, snails, clams, crayfish), many nonnative fish species, and the ubiquitous bullfrog. Bullfrogs are abundant, nonnative amphibians that are common in shallow ponds and other permanent wetlands of the County. This invasive species, along with introduced bass and signal crayfish (*Pacifastacus leniusculus*), can displace or directly prey on many native aquatic species (Zeiner et al. 1990, Jennings and Hayes 1994). Bullfrogs and several species of bass are known to prey on the eggs or tadpoles of the declining foothill yellow-legged frog (*Rana boylii*), as well as potentially preying on western pond turtle hatchlings or juveniles (Moyle 1973, Holland 1991). Hatchlings of wood ducks, mallards (*Anas platyrhynchos*), and even Canada geese (*Branta canadensis*) often fall prey to largemouth bass. When stream flow is high, exotic species can be flushed from ponds and reservoirs into stream and river systems where they can spread and compete with, or prey on, native species.

Many invasive plant species can occur and spread rapidly in seasonal wetlands. Such species include Himalayan blackberry (*Rubus discolor*), giant reed, poison hemlock (*Conium maculatum*), pampas grass (*Cortaderia* spp.), perennial pepperweed (*Lepidium latifolium*), and Harding grass.

Because of the extreme growing conditions in vernal pools, few nonnative plants are able to survive, and 75–95% of plant species in vernal pools are native (Holland and Jain 1988, Jokerst 1990). Similarly, aquatic predators such as fish and nonnative bullfrogs are usually absent from vernal pools because they cannot survive the long period of desiccation.

Salt marshes and mudflats in the San Francisco Bay region are at risk from the invasion of a hybrid cordgrass (*Spartina alterniflora* x *foliosa*), as well as other invasive cordgrass species, such as denseflower cordgrass (*Spartina densiflora*). The hybrid, which was introduced as part of a misguided restoration effort, is invading salt marsh and mudflat habitat. Other invasive species of cordgrass are also a threat to these communities. Invasive cordgrass species can significantly alter marsh species composition and structure. Impacts of this invasive species include conversion of tidal mudflats to meadow, loss of shorebird foraging habitat, and local extinction of native California Cordgrass (*Spartina foliosa*) (San Francisco Invasive Spartina Project 2001). As of 2003, invasive cordgrasses had not established any significant populations in the Napa salt marshes (Jones and Stokes 2003), although a single individual of denseflower cordgrass was detected in a 2001 survey of the salt ponds (San Francisco Invasive Spartina Project 2001).

WATER POLLUTION

Water pollution threatens the habitat quality provided by wetlands in the County. Pesticides and herbicides entering wetlands in runoff from agricultural fields and rural and urban development may lead to plant and wildlife mortality. Toxic substances from household products in polluted stormwater may have similar effects.

Sediment-polluted waters resulting from agricultural or construction-related erosion may also pose a threat to wetlands. While wetlands can function effectively as filters for excessive sediments, too much fine sediment can partially or completely fill wetlands or reduce the quality of the habitat they provide.

ALTERED HYDROLOGY

Alteration of hydrology is another important threat to wetlands in general and freshwater wetlands in particular. Dams alter flow and sediment transport regimes. Groundwater pumping and surface water withdrawal may also alter flow regimes and wetland hydrology. Levees and dikes reduce flooding from nearby stream channels. These alterations may starve a wetland of needed water, flood it, or cause increased sedimentation and conversion to upland habitat. They often alter the balance between freshwater and saltwater flows in salt marshes.

OPEN WATER

Open water aquatic habitats occur throughout the County, and are highly diverse in size, type, water chemistry, and functions. The ICE map recognizes two types: the open water component of streams and of reservoirs.

TYPES

STREAMS

DISTRIBUTION

Streams are mapped throughout the County and vary from narrow mountain streams to broad lowland rivers. The County contains approximately 6,650 miles of stream channels, including ephemeral washes with a bed and bank but no riparian vegetation or feeder streams.

DOMINANT PLANTS

Few plants grow within fast-flowing streams. A few species that may be found in or adjacent to such streams include torrent sedge, giant chain fern (*Woodwardia fimbriata*), spicebush, and small-fruited bulrush (*Scirpus microcarpus*). Aquatic mosses and filamentous algae that are tightly attached to rocks by strong holdfasts are two groups of plants that can survive the fast current. Low-flow portions of streams and stream edges are often lined with riparian or marsh vegetation, discussed above.

COMMON WILDLIFE

Wildlife species commonly found along streams include green heron (*Butorides virescens*), snowy egret, spotted sandpiper (*Actitis macularia*), wood duck, belted kingfisher (*Ceryle alcyon*), black phoebe (*Sayornis nigricans*), and (rarely in Napa County) American dipper (*Cinclus mexicanus*). Invertebrates that might be found in the County's rivers and creeks include mayflies, alderflies, stoneflies, dragonflies, damselflies, water striders, and caddisflies. Aquatic species such as frogs, salamanders and western pond turtle are found in streams during breeding and larval/juvenile stages.

The Napa River provides habitat for fish species such as striped bass (*Morone saxatilis*), steelhead, green sturgeon (*Acipenser medirostris*), Pacific lamprey (*Lampetra tridentata*), large and smallmouth bass (*Micropterus salmoides, M. dolomieui*), catfish (*Ictalurus* and *Pylodictis* spp.), threadfin shad (*Dorosoma petenense*), yellowfin goby (*Acanthogobius flavimanus*), tule and shiner perch (*Hysterocarpus traski* ssp., *Cymatogaster aggregata*), delta (*Hypomesus transpacificus*) and longfin smelt (*Spirinchus thaleichthys*), prickly sculpin (*Cottus asper*), riffle sculpin (*Cottus gullosus*), carp (*Cyprinus carpio)*, Sacramento sucker (*Catostomus occidentalis*), and threespine stickleback (*Gasterosteus aculeatus*) (Stillwater Sciences and Dietrich 2002). A small run of Pacific lamprey has also been reported from lower Putah Creek (California Natural Diversity Database 2004). Fish species found outside the Napa River watershed, in creeks such as Putah and Eticuera Creeks, include a mixture of natives such as California roach (*Lavinia symmetricus*), Sacramento sucker, and Sacramento Squawfish (*Ptychocheilus grandis*), and non-natives such as mosquito fish (*Gambusia affinis*) and green sunfish (*Lepomis cyanellas*). Rainbow trout (*Oncorhynchus mykiss*) and riffle sculpin are found in Putah Creek below the Monticello Dam (Moyle 1999).

Anadromous fish runs in the Napa River have declined drastically, from historic highs of 6,000–8,000 steelhead and 2,000–4,000 coho salmon (*Oncorhynchus kisutch*), to current levels of less than 2,000 adult steelhead and the complete loss of the coho run (Stillwater Sciences and Dietrich 2002). Fall run Chinook salmon have been documented breeding in lower Putah Creek and the Napa River (Moyle 1999). Fish populations and fish habitat in the County are discussed in detail in *Fisheries Resources* below.

SPECIAL-STATUS SPECIES

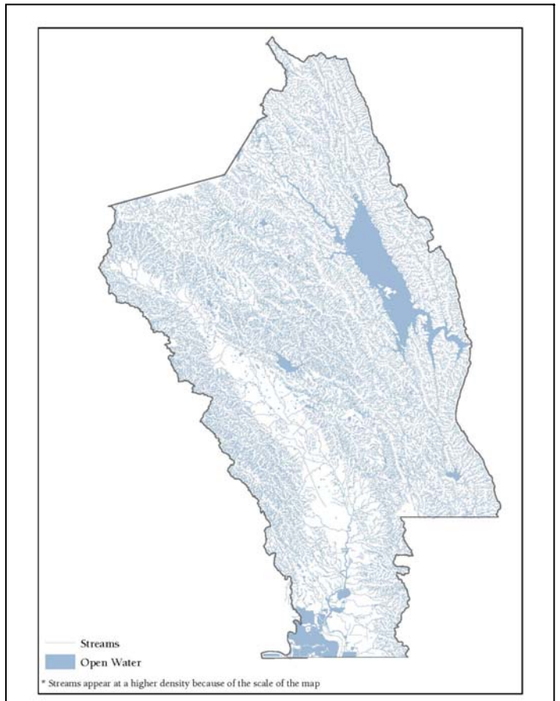
The special-status plants listed for freshwater wetlands can occur along streams if this habitat type is present.

Streams and rivers in the County provide habitat for a number of special-status wildlife and plant species. The Napa River is considered one of the most important streams for the Central California Coast steelhead trout (*Oncorhynchus mykiss*) in the San Francisco Bay Area. Fall/late fall run Chinook salmon also occur in the Napa River. California freshwater shrimp (*Syncaris pacifica*) are found in pools in low-gradient streams such as the Napa River, Garnett Creek and Huichica Creek. Foothill yellow-legged frog and California red-legged frogs also utilize streams for breeding, foraging, and movement habitat.

ECOSYSTEM PROCESSES

Hydrologic cycling and sediment transport are dominant processes shaping the structure and function of streams. Flooding, and erosion are key disturbances for this community. Large rainstorm events reshape stream channels and transport large quantities of sediment down the watershed. Altering the natural hydrologic regime results in bed-load changes in channel structure and sediment transport. The surrounding watershed, nature of the rocks and soils, water chemistry, climate, land use, and gradient all affect water quality by influencing sediment input and transport rates, and rates at which erosional and depositional processes modify the stream channel and adjacent floodplain. Soil, climate, and stream order also affect the structure of riparian vegetation along streams, which in turn influences bank stability, water temperature, and wildlife use.

Streams change greatly in character from their headwaters to their lower reaches. As low-order headwater streams unite to form larger streams and rivers, the water loses much of its clarity and the water temperature rises. Streams with large surface areas exposed to direct sunlight warm more than those shaded by trees, shrubs, and high steep banks (Mayer and Laudenslayer 1988). As streams leave mountainous areas, the gradient is gentler, velocity decreases, and flow volume increases. Shallow and turbulent (e.g., those with riffles and cascades) streams generally have higher oxygen content than deep sluggish streams or streams with high levels of organic materials and contaminants. Many streams in the County experience low-flow or no surface-flow periods during summer and fall.



Schematic map of County showing distribution of open water, including streams.

Streams in the County vary from narrow mountain streams to broad lowland rivers.

Lake Berryessa is the largest public reservoir in the County.

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of streams in the County are the following:

- maintain surface and groundwater quality through filtration and decomposition of pollutants;
- prevent flooding by storing floodwaters;
- recharge the groundwater aquifers;
- service floodplain fertility by flooding and deposition of fine sediments;
- provide water for human, animal, and wildlife use;
- provide wildlife habitat; and
- provide opportunities for recreation including, but not limited to, fishing and boating.

The key characteristics of streams that contribute to these functions are intact wetland or riparian vegetation, connectivity with their floodplains, a lack of barriers to wildlife passage, and a natural hydrologic regime.

RESERVOIRS

GENERAL DISTRIBUTION

Seven major public reservoirs are in the County. Lake Berryessa is by far the largest, covering over 18,000 acres, or nearly 4% of the total land area of the County and approximately 60% of the open water. Other public reservoirs occur throughout the County and include Lake Hennessey, Friesen Lakes, Lake Curry, Rector Reservoir, Bell Canyon Reservoir, Milliken Reservoir, and Kimbal Reservoir. These reservoirs range in size from 15 to 750 acres. In addition, the County contains many smaller private reservoirs.

Reservoirs in the County provide opportunities for recreation, including boating and fishing.

DOMINANT PLANTS

Deepwater aquatic habitats are too deep for emergent plants, but are inhabited by phytoplankton—tiny suspended plants, such as diatoms, desmids, and filamentous green algae that are the basis on which the rest of limnetic life depends (Mayer and Laudenslayer 1988). Most reservoirs lack a well-developed margin of wetland and riparian plants due to their steep-sided slopes and fluctuations in water level. However, where shallow water does occur and draw-down is slow, common aquatic and emergent plants are similar to that as described for freshwater wetlands.

COMMON WILDLIFE

Wildlife species associated with reservoirs in the County include breeding and wintering western grebe (*Aechmophorus occidentalis*), Clark's grebe (*Aechmophorus clarkii*), common merganser (*Mergus merganser*), osprey (*Pandion haliaetus*), bald eagles and wintering ducks and gulls such as lesser scaup (*Aythya affinis*), ruddy duck (*Oxyura jamaicensis*), bufflehead (*Bucephala albeola*), American coot and mallard, California gull (*Larus californicus*), Bonaparte's gull (*Larus philadelphia*) and herring gull (*Larus argentatus*).

Fish species in Lake Berryessa and other reservoirs consist almost entirely of introduced species, including threadfin shad, common carp, bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), and spotted bass (*Micropterus punctatus*) (Moyle 1999).

SPECIAL-STATUS SPECIES

The special-status plants and wildlife listed for freshwater wetlands can occur along the margins of reservoirs if freshwater wetland vegetation is present. Bald eagles nest near Lake Berryessa and Lake Hennessey in the County and use the reservoirs for foraging. Lobb's water buttercup (*Ranuculus lobbii*) occur in few of these wetlands.

ECOSYSTEM PROCESSES

The primary disturbance shaping biological communities associated with reservoirs is annual fluctuation in water level. Most reservoirs fluctuate on an annual basis, being gradually drawn down in summer to supply water for irrigation, power generation, or agriculture. A fluctuation of as little as a meter or two can prevent emergent plants or riparian vegetation from establishing along the shoreline or aquatic plant beds from developing.

Reservoirs are usually built in steep-sided canyons with only small areas of shallow water habitat. Water level fluctuation and limited shallow water habitat area both result in a lack of cover for young fishes in shallow water and a lack of diversity of habitat for adult fishes.

ECOSYSTEM FUNCTIONS

The primary ecosystem functions and services of reservoirs in the County are the following:

- maintain surface water quality through the deposition of pollutants;
- prevent flooding by storing floodwaters;
- recharge groundwater aquifers;
- provide water for human, animal, and wildlife use;
- provide wildlife habitat;

- provide opportunities for recreation including, but not limited to, fishing and boating.

The topography of reservoir sites (generally canyons) enhances their water storage function, while intact wetland vegetation on reservoir margins, such as on the eastern arm of Lake Hennessey, enhances their habitat function.

THREATS

The primary threats to open water habitats are habitat conversion, invasive species, altered hydrology, and recreation.

HABITAT CONVERSION

Channelization of streams results in loss of channel length and cross-sectional area. Culverting of smaller channels results in loss of open water habitat. Removal of riparian vegetation due to agricultural or urban development degrades stream habitat as well, leading to bank instability and increased water temperatures. Alteration of the land surface and changing land use practices can affect surface runoff patterns and sediment yields to creeks (Dunne and Leopold 1983, Mount 1995, Stillwater Sciences and Dietrich 2002). Increasing peak flows in the County's streams, due to increased stormwater runoff and impervious surfaces, has led the Napa River and other streams in the County to incise. This process has led the Napa River and many of its tributaries to lose many of their pool-riffle features (Stillwater Sciences and Dietrich 2002). These features have been replaced by large, deep pools, formed by the scour from increased peak flows. These streams have increased water temperatures and slow-moving water (Stillwater Sciences and Dietrich 2002). This deep pool morphology favors predatory fish species, notably the non-native largemouth bass.

INVASIVE SPECIES

Aquatic habitats are readily colonized by invasive species of plants, invertebrates, fish, and amphibians. These species can displace native species or even prey upon them.

Ponds and reservoirs, and associated canals, are often the sites of exotic or nonnative species introductions and concentrations, including many aquatic invertebrates (e.g., insects, snails, clams, crayfish,), many nonnative fish species, and the bullfrog. Bullfrogs are abundant, nonnative amphibians that are common in shallow ponds and other permanent wetlands of the County. This invasive species, along with introduced bass and signal crayfish, can displace or directly prey on many native aquatic species (Zeiner et al. 1990, Jennings and Hayes 1994). Bullfrogs and several species of bass are known to prey on the eggs or tadpoles of the declining foothill yellow-legged frog, as well as potentially preying on western pond turtle hatchlings or juveniles (Moyle 1973, Holland 1991). Hatchlings of wood ducks, mallards, and even Canada geese, often fall prey to largemouth bass. When stream flow is high, exotic species can be flushed from ponds and reservoirs into stream and river systems where they can spread and compete with, or prey on, native species. In general, the more that a lake or stream is altered by human disturbance, the more likely it is to become dominated by nonnative fish species (Baltz and Moyle 1993).

Several noxious aquatic weeds of open water, for example, Eurasian milfoil (*Myriophyllum spicatum*), and parrot's feather (*Myriophyllum aquaticum*), can be introduced into reservoirs and streams on boats and vehicles. These species have the potential to spread rapidly and displace native species, and their aquatic setting and ability to reproduce asexually by stolons or turions make them particularly difficult to control or eradicate.

ALTERED HYDROLOGY

Alteration of hydrology and environmental change resulting from reservoirs, dams, and diversions is a primary threat to streams. Other causes of altered hydrology include runoff from urban and agricultural areas and encroachment of development on the floodplain, reducing flood storage and sediment deposition areas. Altered hydrology has been identified as the primary cause or a contributing factor in the decline of several fish species (Moyle et al. 1996).

Dams alter flow and sediment transport regimes, adversely affecting area (e.g., spawning gravel) and quality (e.g., water temperature and fine sediment loading) of native species' habitat. They, along with bridges, culverts, water diversions, and on-stream private ponds and reservoirs, block upstream and downstream movement and migration to spawning and rearing habitat. In addition to loss of habitat, fish populations may become isolated, fragmenting metapopulations and adversely affecting their genetic integrity. Dams on major rivers have blocked access by spring-run Chinook salmon to more than 95% of historic spawning and holding habitat, and have greatly reduced access to spawning habitat of other runs of salmon, steelhead, and Pacific lamprey (Moyle et al. 1996).

RECREATION

Motorized boating on the Napa River and in other open water areas, such as Lake Berryessa, can degrade water quality through release of oils and engine fluids into the river, and transport invasive aquatic species on motor propellers. Noise from motor boats can also disturb wildlife.

AGRICULTURAL CROPLAND

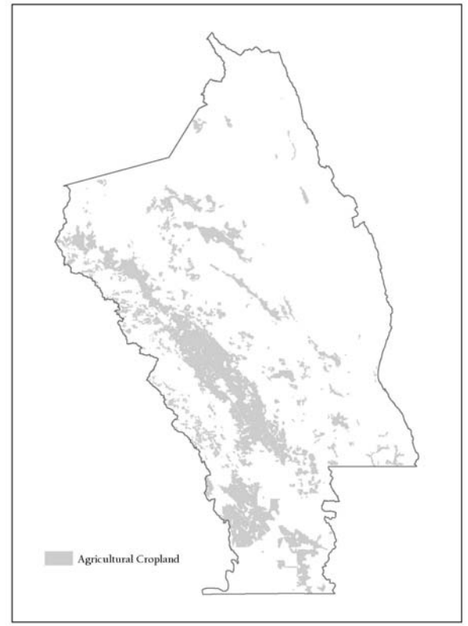
DISTRIBUTION

Agricultural cropland occupies over 64,000 acres (13%) of the County (Table 4-3). Neither pasture nor rangeland has been included in this total. Timberland is not considered agricultural cropland. [1] These lands were mapped as grassland.

Vineyards occupy over 90% of the County's cropland, totaling over 40,000 acres in 2004 (Napa County Agricultural Commissioner 2005). Forage crops (hay) accounted for approximately 193 acres of cropland in 2004, while walnuts, olives, and flowers and nursery products, the next most important crops in terms of sales, totaled less than 300 acres in the County (Napa County Agricultural Commissioner 2005).

[1] Timber is not considered an agricultural crop because large plantation forests with simplified "agricultural" structure are not common in the County. Forests used for timber have more similarities to a natural biotic community, and were mapped as such by the ICE mapping effort.

Channelization of streams results in loss of channel length and cross-sectional area.



Schematic map of County showing areas of agricultural cropland.

The biological value of these agroecosystems depends on several factors, including the level of pesticides and herbicides used; the quantity, type and timing of fertilizers applied; and whether or not a perennial cover crop is maintained.

Olive orchards are dominated by European olive (*Olea europea*).

Vineyard grapes attract many birds, mammals, and insects, especially after the harvest.

Nearly half of the cropland in the County is located in the Napa Valley Floor Evaluation Area. Moreover, the Napa Valley Floor, Carneros, and Western Mountains Evaluation Areas together contain nearly 70% of the County's agricultural cropland. Areas with minimal cropland include the Angwin, Napa River Marshes, Livermore Ranch, Knoxville, and Berryessa Evaluation Areas.

TYPES

Four major types of agricultural cropland exist in the County: vineyard, walnut orchard, olive orchard, and hay. These crops and associated cover crops and weeds are not considered sensitive communities. The biological value of these agroecosystems depends on several factors, including the level of pesticides and herbicides used; the quantity, type and timing of fertilizers applied; and whether or not a perennial cover crop is maintained. These factors affect the diversity of the soil microbial and invertebrate community in particular, and the wildlife community generally. A discussion of agricultural management to minimize ecological impacts is beyond the scope of this report. The interested reader is referred to *Vineyards in the Watershed: Sustainable Winegrowing in Napa County* (Poirier Locke 2002), other publications of the Napa County Resource Conservation District (Napa County RCD), and *California Vineyards and Wildlife Habitat* (Adler 2003).

COMMON PLANTS

Vineyards are dominated by grape vines (*Vitis* spp.). Depending on the management regime, they may contain permanent cover crop plants such as blando brome (*Bromus mollis*), creeping red fescue (*Festucarubra* ssp. *rubra*) or zorro fescue (*F. megaqlura*), rose clover (*Trifolium hirdum*), and/or subterranean clover (*T. subteraneum*), and occassionally native forbs. Native grasses, such as blue wildrye (*Elymus glaucus*) and California brome (*Bromus carinatus*) are increasingly used for cover crops (Poirier Locke 2002). Common weed species in vineyards include puncturevine (*Tribulus terrestris*), crabgrass (*Digitaria* spp.), horseweed (*Conyza canadensis*), johnsongrass (*Sorghum halepense*), and bermudagrass (*Cynodon dactylon*).

Olive orchards are dominated by European olive (*Olea europea*). Walnut orchards are dominated by Persian walnut (*Juglans regia*). The cover crops used in County orchards are similar to those used in vineyards, as are the common weed species.

Hayfields are dominated by forage species such as alfalfa (*Medicago sativa*). Common weeds in hay fields include dandelion (*Taraxacum officinale*), quackgrass (*Elytrigia repens*), bermudagrass, nutsedge (*Cyperus* spp.), and Johnsongrass.

COMMON WILDLIFE

Vineyard grapes attract many birds, mammals, and insects, especially after the harvest (Locke 2002). American robin (*Turdus migratorius*), European starling (*Sturnus vulgaris*), and house finch (*Carpodocus mexicanus*) are the primary bird species that forage on grapes, while wintering ruby-crowned kinglet (*Regulus calendula*) and yellow-rumped warbler forage on insects attracted to decaying grapes left on the vine. Prelimary data indicate that deer and racoons are among the primary wildlife species that consume agricultural grapes (National Wild Turkey Federation 2003). Pocket gophers (*Thomomys* spp.) and meadow voles (*Microtus californica*) are common in vineyards. Meadow voles are most likely to be found in vineyards with dense ground cover (Salmon 2002).

SPECIAL-STATUS SPECIES

Agricultural areas do not provide primary habitat for any special-status species in the County. Tricolored blackbirds (*Agelaius tricolor*) may use vineyards occasionally and briefly for foraging (Hamilton 2004). Red-shouldered hawks and red-tailed hawks sometimes hunt these areas.

ECOSYSTEM FUNCTIONS

The primary ecosystem functions of agricultural cropland in the County are the following:

- provide food products for the human population and
- provide limited wildlife habitat.

The key characteristics of vineyards and orchards that enhance these functions are the maintenance of a permanent cover crop of herbaceous vegetation, particularly when native species are utilized, and limited use of agricultural chemicals that are toxic to wildlife. In addition, the maintenance of corridors of natural vegetation, along creeks and/or connecting larger natural areas, allows wildlife to move through agricultural areas more easily, enhancing their value as wildlife habitat (Hilty and Merenlender 2004).

THREATS

The major threats to wildlife use of agricultural cropland in the County are habitat conversion to residential development and environmentally harmful agricultural practices.

HABITAT CONVERSION

Agricultural cropland is not undergoing rapid conversion to developed land in Napa County.

HARMFUL AGRICULTURAL PRACTICES

Wildlife use of agricultural cropland and adjacent areas is limited by the use of environmentally harmful agricultural practices. A thorough discussion of sustainable agricultural practices is outside the scope of this document (but see Poirier Locke 2002). Agricultural practices that are avoidable and have negative impacts on wildlife include unnecessary fencing that restricts wildlife movement, practices leading to erosion and consequent degradation of water quality, elimination or degradation of riparian vegetation, and the removal of mature trees.

ROCK OUTCROP

Rock outcrops are not treated here as a biological community, because species composition in these sites varies a great deal depending on the surrounding biological community. They are described here because they provide important habitat features for special-status plant and wildlife species.

DISTRIBUTION

Rock outcrops cover approximately 1,700 acres or 0.5% of the County (Table 4-3). Over 50% of the County's rock outcrops are located in the Eastern Mountains Evaluation Area, while an additional 32% are located in the Livermore Ranch Evaluation Areas. Rock outcrops in the County are generally located on the steeper ridgelines of the Sonoma Volcanics.

TYPES

Three types of rock outcrop are recognized in Napa County: volcanic rock outcrops, sandstone rock outcrops, and serpentine barren. Volcanic and sandstone rock outcrops were not distinguished in the land cover layer, as the signature of these two rock outcrops is not easily distinguishable. Taken together, sandstone and volcanic rock outcrops are far more extensive than serpentine barrens. Rock outcrops in eastern Napa County are predominently sandstone of the Great Valley Series, while volcanic outcrops are primarily found in the Livermore Ranch area (the Palisades), and are also common in the area from Mount George to Rector Canyon. Serpentine barrens in the County are found almost exclusively in the Knoxville area. Serpentine outcrops in this area are often associated with steep, unstable slopes and ridgelines. Seeps and springs are found in Knoxville in association with serpentine areas.

COMMON PLANTS

Vegetation is sparse on rock outcrop areas. Lichens are found on the most exposed areas, while ferns and clubmosses may be found in more sheltered portions of the outcrop, such as cracks where soil may collect. Small trees such as leather oak and foothill pine, and shrubs such as chamise, toyon, silver bush lupine (*Lupinus albifrons*), broom snakeweed (*Gutierezia sarothrae*), and hairless gaping keckiella (*Keckiella breviflorus* var. *glabrisepalus*) may be found adjacent to sandstone rock outcrops. Herbaceous species associated with sandstone rock outcrops include dense false gilia (*Allophyllum gilioides*), and splendid mariposa lily (*Calochortus splendens*). Rare species found on sandstone outcrops include modest rock cress (*Arabis modesta*) and Heller's bush mallow (*Malacothamnus helleri*). These species are not designated as special status species despite their rarity, as they are not threatened at this time.

Common shrubs on volcanic outcrops include chamise and manzanita, while common herbs include rock lettuce (*Dudleya cymosa*), naked buckwheat (*Eriogonum nudum*), stonecrop species (*Sedum spp.*), rosin weed (*Calycadenia truncate*), and red beardtongue (*Keckiella cormybosa*).

Serpentine barrens are also sparsely vegetated. Leather oak, white-flowered musk brush, and white leaf manzanita are common woody species in these areas, while jewelflowers (*Streptanthus* spp.), globe gilia (*Gilia capitata*), Jepson's lomatium (*Lomatium marginatum* var. *purpureum*), lace fern (*Aspidotis densa*), sickle-leaved onion, chaparral willowherb (*Epilobium minutum*), variable fruited yellow pincushion (*Chaenactis grabriuscula* var. *heterocarpa*), and big squirreltail are common herbs

COMMON WILDLIFE

Rock outcrops provide a key habitat feature to a variety of species, which may use these areas for nesting, foraging, or other purposes. Rock outcrops absorb heat during the day and radiate it during the night, providing a means for cold-blooded animals like western fence lizards to maintain their body temperature while reducing their energetic expenditure. Bats such as the little brown myotis (*Myotis lucifugus*) and Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*) may roost in rock crevices and use these crevices as a refuge from predators. Rock outcrops provide a vantage point that may be used by raptors to search for prey, or by small mammals to watch for predators. Some raptors and other bird species nest on sheer rock outcrops.

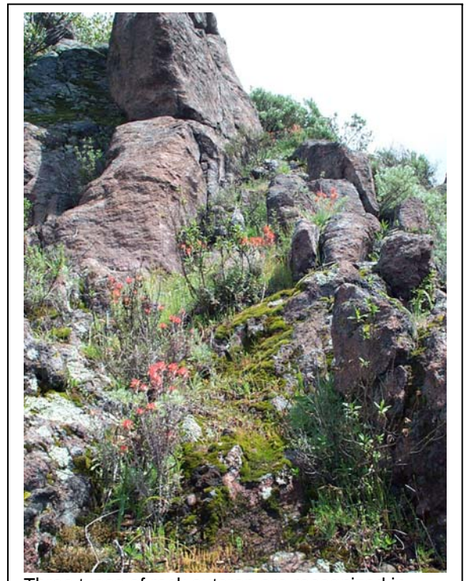
SPECIAL-STATUS SPECIES

Twelve special status plant species in Napa County are associated with rock outcrops. Species associated with volcanic outcrops include Sonoma beardtongue (*Penstemon newberryi* var. *sonomensis*), Colusa layia, and narrow-leaved daisy (*Erigeron angustatus*). Special status plant species found in serpentine barrens include rare jewelflowers, such as Three Peaks jewel-flower (*Streptanthus morrissonii* ssp. *elatus*), green jewel-flower (*Streptanthus breweri* ssp. *hesperides*), and Kruckeberg's jewel-flower (*Streptanthus morrissonii* ssp. *kruckebergii*), as well as Snow Mountain buckwheat.

Seven special status wildlife species in Napa County are associated with rock outcrops. Special status raptors such as peregrine falcons (*Falco peregrinus*) and prairie falcons (*Falco mexicanus*) nest on sheer rock outcrops, while special status bats such as fringed myotis bats (*Myotis thysanodes*) and greater western mastiff bats (*Eumops perotis californicus*) roost in crevices in rock outcrops.

THREATS

Rock outcrops do not face significant threats in Napa County at this time, although vineyard development may occur in rock outcrop areas in relatively level terrain.



Three types of rock outcrop are recognized in Napa County: volcanic rock outcrops, sandstone rock outcrops, and serpentine barren.

SENSITIVE BIOTIC COMMUNITIES

CNDDB SENSITIVE BIOTIC COMMUNITIES

Twenty-three biotic communities in the County are considered sensitive by DFG because of their rarity, high biological diversity, and/or susceptibility to disturbance or destruction

Twenty-three biotic communities in the County are considered sensitive by DFG because of their rarity, high biological diversity, and/or susceptibility to disturbance or destruction (California Department of Fish and Game 2003a). These CNDDB-designated sensitive biotic communities are listed below. The *San Francisco Bay Area Gap Analysis* (Wild 2002) identified some of these sensitive communities as priorities for conservation[2]. They are marked with an asterisk and relevant findings are included in the discussion of individual biotic communities in the following sections.

- Serpentine bunchgrass grassland.
- Wildflower field (located within native grassland).
- Creeping ryegrass grassland.
- Purple needlegrass grassland.*
- One-sided bluegrass grassland.
- Mixed serpentine chaparral.*
- McNab cypress woodland.
- Oregon white oak woodland.
- California bay forests and woodlands.
- Fremont cottonwood riparian forests.
- Arroyo willow riparian forests.
- Black willow riparian forests.
- Pacific willow riparian forests.
- Red willow riparian forests.
- Narrowleaf willow riparian forests.
- Mixed willow riparian forests.
- Sargent cypress woodland.
- Douglas-fir–ponderosa pine forest (old-growth).
- Redwood forest.
- Coastal and valley freshwater marsh.*
- Coastal brackish marsh.*
- Northern coastal salt marsh.*
- Northern vernal pool.*

Note that the sensitive community names used below, which are currently used by the DFG, are based on an older system of habitat classification (Holland 1986). These 23 sensitive communities above correspond in whole or in part to the following 19 land cover types shown in the Land Cover Layer. Conservation priorities are marked with an asterisk.

GRASSLAND COMMUNITIES

- Serpentine grasslands NFD Super Alliance [1] (serpentine bunchgrass).
- Upland annual grasslands and forbs formation [4] (creeping ryegrass, purple needlegrass*, and one-sided bluegrass grasslands and wildflower field).
- California annual grasslands alliance [4] (creeping ryegrass, purple needlegrass*, and one-sided bluegrass grasslands and wildflower field).
- Perennial bunchgrass restoration sites [4] (creeping ryegrass, purple needlegrass*, and one-sided bluegrass grasslands and wildflower field).

CHAPARRAL/SCRUB COMMUNITIES

- Leather oak-white leaf manzanita-chamise xeric serpentine NFD super alliance [1] (mixed serpentine chaparral*).
- Leather oak-California bay *Rhamnus* spp. mesic serpentine NFD super alliance [1] (mixed serpentine chaparral*).

[2] Every community analyzed by Wild (2002) received a conservation prioritization score ranging from one to ten, which took into account endemicity, risk of development, statewide rarity, and degree of protection. Communities receiving scores of seven or greater are reported here as conservation priorities.

- White leaf manzanita-leather oak-chamise-ceanothus xeric serpentine NFD super alliance [1] (mixed serpentine chaparral*).
- California bay-leather oak-*Rhamnus* spp. mesic serpentine NFD super alliance [1] (mixed serpentine chaparral*).
- McNab cypress alliance [1] (McNab cypress woodland).

OAK WOODLAND COMMUNITIES

- Oregon white oak alliance [1] (oregon white oak woodland)
- California bay-madrone-live oak NFD super alliance (California bay forests and woodlands)

RIPARIAN WOODLAND AND FOREST COMMUNITIES

- Mixed willow super alliance [6] (arroyo willow, black willow, pacific willow, red willow, narrowleaf willow, and mixed willow riparian forests)

CONIFEROUS FOREST COMMUNITIES

- Douglas-fir/ponderosa pine alliance (old-growth)[1] (douglas fir/ponderosa pine forest-old-growth)
- Coast redwood alliance [1] (redwood forest)
- Sargent cypress alliance [1] (Sargent cypress woodland)

WETLAND COMMUNITIES

- Saltgrass-pickleweed NFD super alliance [1] (northern coastal salt marsh*)
- Freshwater marsh super alliance [1] (coastal and valley freshwater marsh*)
- Northern vernal pools [1] (vernal pools*)
- Unmapped [2] (coastal brackish marsh* and Fremont cottonwood riparian forest)

Note: two of these communities have not been mapped in the County (see *ICE Map Limitations* above) but are known to be present there. Land cover types containing sensitive communities that are a priority for conservation are marked with an asterisk. The known distribution of these communities in the County is shown in Map 4-4. Acreages in each evaluation area are specified in Table 4-5.

BIOTIC COMMUNITIES OF LIMITED DISTRIBUTION

Other biotic communities in the County are considered sensitive due to limited local distribution. The following six communities each encompass less than 500 acres of cover within the County and are considered by local biological experts to be worthy of conservation. The 500-acre threshold was selected in order to focus regulatory protection on the rarest communities in the County for special protection.

GRASSLAND COMMUNITIES

- Native grassland.

OAK WOODLAND COMMUNITIES

- Tanbark oak alliance.

RIPARIAN WOODLAND AND FOREST COMMUNITIES

- Brewer willow alliance.

CONIFEROUS FOREST COMMUNITIES

- Ponderosa pine alliance.

WETLAND COMMUNITIES

- Riverine, lacustrine, and tidal mudflats.
- Wet meadow grasses NFD super alliance.

The known distribution of these communities in the County is shown in Map 4-4. Acreages in each evaluation area are specified in Table 4-5.

Because only 19 of the 23 sensitive communities recognized by DFG are mapped in the County, inclusion of these six additional land cover types brings the total number of identified sensitive biotic communities to 25 (see Table 4-5). These land cover types cover slightly under 81,500 acres (16%) of the County (see Table 4-5 and Map 4-4).

Table 4-5. Distribution of Sensitive Biotic Communities Across Napa County's Thirteen Evaluation Areas

			Acreage by Evaluation Areas													
Community Type	Biotic Community	MCV Biotic Community (used in ICE map)	Angwin	Berryessa	Carneros	Central Interior Valleys	Eastern Mountains	Jamieson/ American Canyon	Knoxville Area	Livermore Ranch Area	Napa River Marshes	Napa Valley Floor	Pope Valley	Southern Interior Valleys	Western Mountains	Percent of Total County Acreage
Grassland	Serpentine grassland	Serpentine Grasslands NFD Super Alliance	0	539	0	152	150	0	853	2	0	5	360	2	54	
Unmapped, but located within grassland	Annual grassland and Native grassland	Creeping Ryegrass, Purple needlegrass, and One-sided bluegrass grassland, Wildflower field	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	n/a
Unmapped, but located within grassland	Annual grassland and Native grassland	Creeping Ryegrass, Purple needlegrass, and One-sided bluegrass grassland, Wildflower field	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	n/a
Total Sensitive Grassland			**0**	**539**	**0**	**152**	**150**	**0**	**853**	**2**	**0**	**5**	**360**	**2**	**54**	**4.0%**
Chaparral/Scrub	Serpentine Chaparral/Scrub	Leather Oak - White Leaf Manzanita - Chamise Xeric Serpentine NFD Super Alliance	0	6,442	0	2,729	1,084	0	11,650	66	0	2	4,829	9	176	
	Serpentine Chaparral/Scrub	Leather Oak - California Bay - *Rhamnus* spp. Mesic Serpentine NFD Alliance	0	761	0	1,050	359	0	1,602	22	0	0	503	6	96	
	Serpentine Chaparral/Scrub	White Leaf Manzanita - Leather Oak - (Chamise - *Ceanothus* spp.) Xeric Serpentine NFD Super Alliance	0	1,465	0	793	681	0	3,359	93	0	6	1,473	24	111	
	Serpentine Chaparral/Scrub	California Bay - Leather Oak - (*Rhamnus* spp.) Mesic Serpentine NFD Super Alliance	0	1,699	0	1,107	372	0	2,054	33	0	22	1,558	7	324	
Total Sensitive Serpentine Chaparral			**0**	**10,906**	**0**	**5,679**	**2,646**	**0**	**18,665**	**216**	**0**	**30**	**8,363**	**45**	**707**	**1.7%**
Oak Woodland	Deciduous Oak Woodland	Oregon White Oak Alliance	0	0	0	0	102	0	0	0	0	112	0	0	910	
	Evergreen Oak Woodland	California Bay - Madrone - Coast Live Oak - (Black Oak Big - Leaf Maple) NFD Super Alliance	10	265	22	693	4,649	25	0	396	0	526	458	791	10,416	
	Evergreen Oak Woodland	Tanbark Oak Alliance	44	0	0	124	9	0	0	0	0	0	68	0	0	
Total Sensitive Oak Woodland			**54**	**265**	**22**	**817**	**4,760**	**25**	**0**	**396**	**0**	**638**	**527**	**791**	**11,327**	**2.5%**
Riparian woodland	Mixed Willow woodland	Mixed Willow Super Alliance	0	49	21	51	34	66	26	0	1	90	115	31	58	
	Mixed Willow woodland	Brewer Willow Alliance	0	30	0	15	74	0	90	17	0	0	47	0	0	
	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	Unmapped	
Total Sensitive Riparian Woodland			**0**	**79**	**21**	**66**	**108**	**66**	**116**	**17**	**1**	**90**	**162**	**31**	**58**	**0.07%**
Coniferous forest	Cypress forest	Sargent Cypress Alliance	0	961	0	51	1	0	98	0	0	0	933	0	0	
	Cypress forest	McNab Cypress Alliance	0	26	0	10	0	0	2,225	43	0	0	84	0	0	
	Douglas-fir/Redwood Forest	Douglas-fir - Ponderosa Pine Alliance (old growth subseries)	Unmapped	0	0	Unmapped	Unmapped	0	0	Unmapped	0	Unmapped	Unmapped	0	Unmapped	
	Douglas-fir/Redwood Forest	Coast Redwood Alliance	0	0	0	8	23	0	0	0	0	16	24	0	253	
	Pine forest	Ponderosa Pine Alliance	133	0	0	0	10	0	0	0	0	0	25	0	0	
Total Sensitive Coniferous forest			**133**	**1066**	**0**	**69**	**33**	**0**	**2,323**	**43**	**0**	**16**	**3,365**	**0**	**253**	1.4%
Aquatic	Freshwater wetlands	(Bulrush - Cattail) Fresh Water Marsh NFD Super Alliance	4	0	15	15	33	4	3	0	14	27	123	32	1	
	Freshwater wetlands	(*Carex* spp. - *Juncus* spp. - Wet Meadow Grasses) NFD Super Alliance	1	10	0	10	54	37	67	1	0	1	40	60	0	
	Freshwater wetlands	Vernal Pools*	None mapped	Present	Present	None mapped	Present	Present	Present	None mapped	Present	Present	Present	Present	None mapped	
	Salt Marsh	Saltgrass - Pickleweed NFD Super Alliance	0	0	9	0	0	127	0	0	3,407	7	0	0	0	
	Streams and salt marsh	Riverine, Lacustrine and Tidal Mudflats	0	4	0	0	6	0	169	0	198	0	11	0	0	
Total Sensitive Aquatic			**5**	**14**	**24**	**25**	**93**	**168**	**239**	**1**	**3,619**	**35**	**173**	**92**	**1**	**0.52%**
Total Sensitive Community Acreage Mapped			**192**	**12,869**	**67**	**6,808**	**7,641**	**259**	**22,196**	**675**	**3,620**	**814**	**12,951**	**961**	**12,400**	**17.3%**
Total Community Acreage Mapped			**4,843**	**95,707**	**10,622**	**30,491**	**81,605**	**16,123**	**61,610**	**13,501**	**15,420**	**57,795**	**38,479**	**29,565**	**51,657**	
Percent 0f County Sensitive Community Acreage			**4.2%**	**13.4%**	**0.06%**	**22.3%**	**9.3%**	**1.6%**	**36.0%**	**4.9%**	**23.4%**	**1.4%**	**33.7%**	**3.3%**	**24.0%**	

Note: * Vernal pools are not mapped with sufficient accuracy to include acreage in this table, but the presence or absence of documented vernal pools is indicated.

TNC CONSERVATION AREAS

The Nature Conservancy of California (TNC) identified nine conservation areas (Figure 4-2) in 2003 within the three ecoregions (North Coast, Central Coast, and Central Valley) that meet in Napa County. These nine conservation areas cover most of the natural areas remaining in the County, and are listed below.

- Napa River Wetlands.
- Mayacamas Mountains.
- Napa River.
- American Canyon.
- Atlas Peak-Mt George.
- Mount St Helena.
- Pope Valley.
- Blue Ridge/Vaca Mountains.
- Knoxville-Cedar Roughs.

Please note that these areas are delimited based on biological resources, not defined by jurisdictional boundaries. Therefore, they include portions of neighboring counties.

TNC, in collaboration with local experts in a series of workshops, designed detailed conservation plans for each of these areas (The Nature Conservancy of California 2003). TNC also ranked the nine conservation areas according to their conservation priority. Priority scores were based on two factors: conservation value based on the number of biotic communities critical for conservation present, and vulnerability based on the percentage of protected land.

Overall scores gave the Knoxville-Cedar Roughs Area the highest conservation priority, while the Napa River Wetlands had the lowest. Characteristics and ranking of each of these conservation areas are discussed below under the evaluation area(s) into which they fall.

Napa County contains 2.5% of the state's tracked rare plant species on less than 0.5% of the state's area, indicating that the density of rare plant species documented in the County is five times the average for California overall. Many of these rare species occur on specific substrates such as alkaline or serpentine soils, or are associated with specific biotic communities such as oak woodlands or chaparral.

SPECIAL-STATUS SPECIES

Tables 4-6 and 4-7 provide a list of the special-status species found in Napa County. Appendices B and C indicate the biotic communities in which they are likely to occur. Information on the County's special-status species and their habitats has been incorporated into the County's Biological Database, allowing interested parties to rapidly retrieve and analyze information on the likelihood of special-status species or sensitive communities occurring on a particular site or in a particular region of the County.

Native fish, wildlife, and plant species are of aesthetic, ecological, educational, historical, recreational, and scientific value to the County and its people. Various species of fish, wildlife, and plants in Napa County are rare, threatened or endangered, and may not persist in the County without special protection and/or effective protections for special-status species will allow future generations to benefit from the rich diversity of the County's biotic resources.

DEFINITION OF SPECIAL-STATUS SPECIES

Special-status species are plants and animals that are legally protected under the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), or other federal, state, or local regulations, or are considered sufficiently rare by the scientific community to qualify for such protection.

In the County, *special-status plants* are species of plants that meet the definition of "rare, endangered, or threatened" under the California Environmental Quality Act (CEQA)(see Section 15380 of the *State CEQA Guidelines*). Experts in the field of rare plants[3] have determined that this includes all species that meet any of the following criteria.

- Listed or proposed for listing as threatened or endangered under the ESA (50 Code of Federal Regulations (50 CFR 17-12 [listed plants] and various notices in the Federal Register [proposed species]).
- Candidates for possible future listing as threatened or endangered under the ESA (66 FR 54808, October 30, 2001).
- Listed or candidates for listing by the State of California as threatened or endangered under the CESA (14 CCR 670.5).
- Listed as rare under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 et seq.).
- Considered by CNPS to be rare, threatened, or endangered in California (CNPS Lists 1B and 2 in Tibor 2001)

[3] Dr. Rob Preston, Botanist, Jones & Stokes; Dr. David Zippin, Plant Ecologist and Conservation Planner, Jones & Stokes; and Richard Nichols, Botanist, EDAW.

- Considered by local experts in the field of rare plants[4] to be rare in the County portion of its range, although it may be more common elsewhere.

Special-status wildlife are animals that meet the definition of "rare, endangered, or threatened" under CEQA (State CEQA Guidelines Section 15380). Experts in the field of rare animals[5] have determined that this includes all species that meet any of the following criteria.

- Listed or proposed for listing as threatened or endangered under ESA (50 CFR 17-11 [listed animals] and various notices in the Federal Register [proposed species]).
- Candidates for possible future listing as threatened or endangered under ESA (66 FR 54808, October 30, 2001).
- On USFWS Birds of Conservation Concern List (2002).
- Listed or candidates for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5).
- Fully protected under California Fish and Game Code Section 3511 (birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians).
- On DFG's Special Animals List (mammals) (California Department of Fish and Game 2004b).
- On the Point Reyes Bird Observatory (PRBO) and California Department of Fish and Game's draft List of Bird Species of Special Concern (Point Reyes Bird Observatory 2003).
- Considered by local experts in the field of rare animals[6] to be rare in the County portion of its range, although it may be more common elsewhere.

SPECIAL-STATUS PLANTS

Eighty one special-status plant species are thought to occur in the County (Table 4-6). Seventy-eight have been observed, while apparently suitable habitat exists for three more. Of these 81 plants, 73 are forbs, six are shrubs, one is a grass, and one is a tree. For more information on the listing status, habitats, soil affinity, and distribution see Table 4-8. Documented occurrences of these species throughout the County are shown in Figure 4-2. As an illustration of the level of detail contained in the new County Biological Database, documented occurrences of special-status plant species within a sample evaluation area (Pope Valley) are shown in Map 4-6.

Special-status plants are found in all of the principal biotic communities in the County. Just as the County is a hotspot of native plant diversity (Thorne et al. 2004), it is also a hotspot for rare plants, which are particularly concentrated in the central and northwestern portions of the County (California Department of Fish and Game 2003b). The County contains documented occurrences of 55 of the 2,089 rare plant species extant in California that are tracked by the CNDDB (California Natural Diversity Database 2005; California Department of Fish and Game 2003b), shown in Map 4-5. This represents 2.5% of the state's tracked rare plant species on less than 0.5% of the state's area, indicating that the density of rare plant species documented in the County is five times the average for California overall. Many of these rare species occur on specific substrates such as alkaline or serpentine soils, or are associated with specific biotic communities such as oak woodlands or chaparral (Tables 4-6 and 4-8; Appendix B).

Seven of the County's special-status plant species are federally endangered, while one additional species is a federal species of concern. Two of these species are recognized under CESA as state endangered, four are listed as state threatened under CESA, and two are listed under the California Native Plant Protection Act as rare.

Some biotic communities support a disproportionately large number of special-status plants (Map 4-7 and Table 4-8). For example, the 29 special-status plant species associated with the County's serpentine grasslands represent 36% of the County's special-status plant species, but occur on only 0.4% of the County's area (Map 4-7 and Table 4-8). While all of the County's biotic communities must be conserved if its biodiversity is to be protected, communities like serpentine grassland are especially critical for a large number of special-status plant species. Other communities and habitat features that are especially critical for rare plant protection include riparian woodland, wetlands, and rock outcrops.

Particular areas of the County also support certain special-status plants. For example, many special-status plant occurrences in the Pope Valley Evaluation Area are associated with riparian corridors (Maps 4-6 and 4-8). Many of these species are not wetland or riparian species, but are found in undeveloped areas adjacent to stream corridors.

Over 85% of the County's special-status plant species are represented by fewer than ten known occurrences (Table 4-6). Moreover, 38% are represented by only one or two known occurrences. This indicates either extreme rarity in the County, or a lack of survey data. Only one special-status plant species in the County, holly-leaf ceanothus (*Ceanothus purpureus*), is represented by more than 30 known occurrences. Holly-leaf ceanothus is a shrub that is endemic to Napa and Solano Counties and occurs in chaparral on rocky, volcanic slopes. Eight other special-status species are, like holly-leaf ceanothus, nearly endemic to Napa County, only being found there and in one adjacent county. All but one of these eight endemic species are associated with chaparral, which is abundant in the County.

Two plant species, Napa bluegrass (*Poa napensis*) and Calistoga popcornflower (*Plagiobothrys strictus*), are strictly endemic to the County (i.e., they are found nowhere else). Both of these species

Twenty-four of the 796 rare animal species extant in California that are tracked by the CNDDB have been documented in the County. This represents 3% of the state's tracked rare animal species on less than 0.5% of the state's area, indicating that the density of documented rare animal species in the County is six times the average for California overall.

[4] Stephen Rae, Plant Ecologist and Bryologist, MUSCI; Joe Callizo, Botanist and Preserve Manager, Wantrup Preserve; and Jake Ruygt, Botanist and Conservation Committee Chair, Napa Valley Chapter of CNPS.
[5] Dr. David Zippin, Plant Ecologist and Conservation Planner, Jones & Stokes; Dr. Ted Beedy, Ornithologist, Jones & Stokes; and Dr. Ed West, Wildlife Biologist, Jones & Stokes
[6] Dr. Richard Arnold, Entomological Consulting Services, Ltd. and Stephen Rae, Plant Ecologist and Bryologist, MUSCI.

Table 4-6. Special-Status Plant Species Potentially Occurring in Napa County

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Amorpha californica, var. *napensis* Napa false indigo	SC/-/1B	Broadleaf upland forest (openings), chaparral, cismontane woodland		between 450–6,250'	Cascade Range and Central Western California, in Monterey, Marin, Napa, Shasta, and Sonoma Counties	Western Napa County; Rutherford, Kenwood, Sonoma, Detert Reservoir, and St. Helena quads	18
Amsinckia lunaris Bent-flowered fiddleneck	SLC/–/1B	Cismontane woodland, valley and foothill grassland		between 160–1,650'	San Francisco Bay Area, Inner North Coast Ranges, Cascade Range, Klamath Range, in Alameda, Contra Costa, Lake, Marin, Napa, Santa Cruz, Shasta, and Siskiyou Counties	Aetna Springs quad, near Napa-Lake County Line	1
Arctostaphylos manzanita ssp. *elegans* Konocti manzanita	–/–/1B	Chaparral, cismontane woodland, lower montane coniferous forest (volcanic)	Volcanic soils	1,000–5,000'	Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, and Tehama Counties	Northwestern Napa County; Detert Reservoir and Mt. St. Helena quads	4
Asclepias solanoana Solano milkweed	–/–/4, LR	Serpentine chaparral	Serpentine soils		North Coast Ranges-Napa to Trinity	Northern Napa County- Knoxville	1
Aster lentus Suisun Marsh aster	SC/–/1B	Brackish and freshwater marsh		below 500'	Sacramento - San Joaquin delta, Suisun Marsh, Suisun Bay; Contra Costa, Napa, Sacramento, San Joaquin, and Solano Counties	Southern Napa County, near mouth of Napa River; Cuttings Wharf quad	5
Astragalus clarianus Clara Hunt's milk-vetch	E/T/1B	Serpentine grassland and open grassy areas in oak woodland, on thin volcanic or serpentinite soils	Thin volcanic or serpentine soils	between 330–500'	Southern north Coast Ranges, endemic to Napa and Sonoma Counties	Central-Western Napa County (Rutherford and St. Helena quads)	4
Astragalus rattanii var. *jepsonianus* Jepson's milk-vetch	SLC/–/1B	Grasslands and open grassy areas in chaparral, on serpentinite soils	Serpentine soils	between 1,140–2,000'	Southern inner north Coast Range, Colusa, Glenn, Lake, Napa, Tehama, and Yolo Counties	Northern Napa County, in Knoxville and Walter Springs quad	4
Astragalus tener var. *tener* Alkali milk-vetch	SC/–/1B	Grassy flats and vernal pool margins, on alkali soils	Alkali soils	below 200'	Merced, Solano, and Yolo Counties; historically more widespread	Southern Napa County, in Cuttings Wharf quad	1
Atriplex joaquiniana San Joaquin spearscale	SC/–/1B	Alkali grassland, alkali scrub, alkali meadows, saltbush scrub	Alkali soils	below 1,000'	West edge of Central Valley from Glenn County to Tulare County	Southern Napa County, in Cuttings Wharf and Napa quads	3
Balsamorhiza macrolepis var. *macrolepis* Big-scale balsamroot	SLC/–/1B	Rocky annual grassland and fields, foothill woodland hillsides, sometimes serpentine	Rocky soils, sometimes serpentine	below 4,600'	San Francisco Bay region, Sierra Nevada foothills, Coast Ranges, eastern Cascade Ranges, Sacramento Valley	Southern Napa County, in Cordelia quad	2
Brodiaea californica var. *leptandra* Narrow-anthered California brodiaea	SC/–/1B	Broadleafed upland forest, chaparral, lower montane coniferous forest	Often on serpentine	300–3,000'	Lake, Napa, and Sonoma Counties	Mainly in Western Napa County, in Sonoma; St. Helena, Mt. St. Helena, Aetna Springs and Detert Reservoir quads; also in Mt. George, Capell Valley in Eastern Napa County	10
Calochortus uniflorus Large-flowered pink star tulip	–/–/LR	Seeps and swales in serpentine chaparral, low wet meadows in grassland and woodland	Sometimes on serpentine soils		Coast Ranges-Monterey to Oregon border	Calistoga, St. Helena, Conn Valley	11
Calystegia collina ssp. *oxyphylla* Mt. Saint Helena morning-glory	SLC/–/4	Chaparral, lower montane coniferous forest, valley and foothill grasslands (serpentine)	Sometimes on serpentine soils	900–3,500'	Lake, Mendocino, Napa, and Sonoma Counties	Northwestern Napa County	5
Castilleja affinis ssp. *Neglecta* Tiburon Indian paintbrush	E/T/1B	Serpentine grasslands	Serpentine soils		Southern inner north Coast Ranges, northwestern San Francisco Bay region, Marin, Napa and Santa Clara Counties	Southern Napa County, in Cordelia quad	1
Castilleja ambigua ssp. *Ambigua* Salt marsh owl's clover	SLC/–/–	coastal bluffs and grassland		between 0 and 328'	Alameda, Contra Costa, Del Norte, Humboldt, Lake, Mendocino, Monterey, Marin, Napa, Santa Cruz, San Luis Obispo, San Mateo, Solano, Sonoma, and Yolo Counties	Central Napa County, in Yountville, Napa and St. Helena quads; most recent observation in Napa is from 1964	5

Table 4-6. Continued

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Castilleja rubicundula ssp. *rubicundula* Pink creamsacs	SLC/–/1B	Chaparral (openings), cismontane woodland, meadows and seeps, valley and foothill grassland / serpentinite	Sometimes on serpentine soils		Butte, Colusa, Glenn, Lake, and Napa Counties	Knoxville quad, in Northern Napa County	2
Ceanothus confusus Rincon Ridge ceanothus	SC/–/1B	Chaparral, on volcanic or serpentine substrates	Volcanic or serpentine soils		Inner North Coast Range, Lake, Mendocino, Napa, and Sonoma Counties	Western Napa County; Rutherford, Aetna Springs, Detert Reservoir, and St. Helena quads	9
Ceanothus divergens Calistoga ceanothus	SC/–/1B	Chaparral on serpentinite or volcanic, rocky substrate	Rocky volcanic or serpentine soils		North Coast Ranges, Lake, Napa, and Sonoma Counties	Western Napa County, in St. Helena, Calistoga, Detert Reservoir, Mt. St. Helena and Rutherford quads	13
Ceanothus purpureus Holly-leaf ceanothus	SLC/–/1B	Chaparral on volcanic, rocky substrate	Rocky, volcanic soils		Inner North Coast Ranges, Napa and Solano Counties	Central and Eastern Napa County, in Capell Valley, Mt. George, St. Helena, and Yountville quads	33
Ceanothus sonomensis Sonoma ceanothus	SC/–/1B	Chaparral on sandy, serpentinite or volcanic soils	Sandy, volcanic, or serpentine soils		Outer North Coast Ranges, Hood Mountain range, Napa and Sonoma Counties	Western Napa County, in Sonoma, Rutherford, and Detert Reservoir quads	9
Clarkia gracilis ssp. *Tracyi* Tracy's clarkia	–/–/4	Chaparral, usually on serpentine soils	Usually serpentine soils	200–2,000'	Inner North Coast Ranges, Colusa, Humboldt, Lake, Mendocino, Napa, Tehama, and Trinity Counties	Eastern Napa County	unknown
Cordylanthus mollis ssp. *mollis* Soft bird's-beak	E/R/1B	Tidal salt marsh			San Francisco Bay region, Suisun Marsh, Contra Costa, Marin*, Napa, Solano, Sacramento*, and Sonoma* Counties	Southern Napa County, in Cuttings Wharf quad	2
Cryptantha clevelandii var. *dissita* Serpentine cryptantha	SLC/–/1B	Serpentine chaparral	Serpentine soils		Lake and Napa Counties	Eastern Napa County, in Cappel Valley quad	1
Cuscuta howelliana Boggs Lake dodder	–/–/LR	Volcanic vernal pools in chaparral	Volcanic		Napa, Ranges surround; Sacramento Valley and Northern California	Eastern Napa County, in Mt. George, Cappel Valley quads	2
Downingia pusilla Dwarf downingia	–/–/2	Vernal pools and mesic valley and foothill grasslands	Clay soils	1,500'	California's central valley	Southeastern Napa County, in Capell Valley, Yountville, Mt. George and Cuttings Wharf quads	7
Equisetum palustre Marsh horsetail	–/–/3, LR	Freshwater marsh			Lake, Napa, San Francisco, San Mateo Counties	May be throughout County	1
Erigeron angustatus Narrow-leaved daisy	SLC/–/1B	Serpentine chaparral	Serpentine soils		Lake, Napa, and Sonoma Counties	Central and western Napa County, in Yountville, Detert Reservoir, Chiles Valley and St. Helena quads	6
Eriogonum luteolum var. *caninum* Tiburon buckwheat	SLC/–/3	Chaparral, coastal prairie, valley and foothill grassland, on serpentine	Serpentine soils	30–1,600'	Central Inner North Coast Range, northern Central coast, and northern San Francisco Bay area; Alameda, Colusa, Lake, Marin, Napa, Santa Clara, San Mateo, and Sonoma* Counties	Capell Valley, Mt. George, Walter Springs and Detert Reservoir quads	at least 4
Eriogonum nervulosum Snow Mtn. buckwheat	SC/–/1B	Serpentine chaparral	Serpentine soils		North Coast Ranges: Colusa, Lake, Napa, Sonoma, Yolo, and possibly Glenn Counties	Northern Napa County, in Jericho Valley quad	1
Eriogonum tripodum Tripod buckwheat	–/–/4, LR	Rocky slopes in serpentine chaparral	Serpentine soils		Central Coast Range to Sierra Foothills	Northern Napa County (Knoxville)	2
Eriogonum umbellatum var. *bahiiforme* Bay buckwheat	–/–/4	Cismontane woodland, lower montane coniferous forest, rocky or serpentine areas	Sometimes on serpentine soils	2,100–6,600'	Southern North Coast Ranges, Northern South Coast Ranges, and San Francisco Bay Area; Alameda, Contra Costa, Colusa, Glenn, Humboldt, Lake, Mendocino, Monterey, Napa, San Benito, Santa Clara, Siskiyou, San Joaquin, Stanislaus Counties	Northern and Eastern Napa County	Unknown (collected in Napa County in 1919)
Erodium macrophyllum Round-leaved filaree	–/–/2	Open sites, dry grasslands, and shrublands	Clay soils, often friable clay soils	below 4,000'	Sacramento Valley, northern San Joaquin Valley, Central Western California, South Coast, and northern Channel Islands (Santa Cruz Island)	Northern Napa County, in Jericho Valley quad	1

Table 4-6. Continued

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Erythronium helenae St. Helena fawn lily	SLC/–/4	Chaparral, cismontane woodland, lower montane coniferous forest, valley and foothill grassland on volcanic or serpentinite soils	Volcanic or serpentine soils		Lake, Napa and Sonoma Counties	Western Napa County, in Detert Reservoir and Mt. St. Helena quads, possibly elsewhere	9
Fritillaria pluriflora Adobe-lily	SC/–/1B	Adobe soil, chaparral, woodland, valley and foothill grassland	Adobe soils		Northern Sierra Nevada foothills, inner Coast Range foothills, Sacramento Valley, Butte, Colusa, Glenn, Lake, Napa, Plumas, Solano, Tehama, and Yolo Counties	Northern Napa County, in Jericho Valley, Knoxville and Aetna Springs quads	14
Harmonia hallii Hall's harmonia	SC/–/1B	Serpentine chaparral	Serpentine soils	1,500–3,000'	Colusa, Lake, Napa and Yolo Counties	Northern Napa County, in Jericho Valley, Knoxville and Detert Reservoir quads	6
Hesperolinon bicarpellatum Two-carpellate western flax	SC/–/1B	Serpentine chaparral	Serpentine soils		Lake, Napa, and Sonoma Counties	Central Napa County, in Capell Valley, Yountville, St. Helena, Chiles Valley, Walter Springs and Aetna Springs quads	8
Hesperolinon breweri Brewer's western flax	SC/–/1B	Serpentine slopes in chaparral, oak woodlands, and grasslands, often at transition between grassland and chaparral, or in openings in chaparral	Rocky soils on serpentine, sandstone or volcanic substrates	100–2,300'	Southern North Inner Coast Range, northeast San Francisco Bay region, especially Mt. Diablo; known only from Contra Costa, Napa, and Solano Counties	Eastern Napa County, in Capell Valley, Mt. George, and Monticello Dam quads	3
Hesperolinon drymarioides Drymaria-like western flax	SC/–/1B	Closed-cone coniferous forest, chaparral, cismontane woodland, valley and foothill grassland on soils derived from serpentinite	Serpentine soils		Colusa, Glenn, Lake, Napa, and Yolo Counties	Northern Napa County, in Jericho Valley and Knoxville quads	3
Hesperolinon serpentinum Napa western flax	SC/–/1B	Serpentine chaparral	Serpentine soils		Alameda, Lake, Napa and Stanislaus Counties	Northern and Central Napa County, in Detert Reservoir, Aetna Springs, Walter Springs, Chiles Valley, Yountville, Capell Valley, and St. Helena quads	27
Juglans californica var. *hindsii* a.k.a. *Juglans hindsii* Northern California black walnut	SC/–/1B	Canyons, valleys, riparian forest, riparian woodland,		160–660'	Last two native stands in Napa and Contra Costa Counties; historically widespread through southern north inner Coast Range, southern Sacramento Valley, northern San Joaquin Valley, San Francisco Bay region	Southern and Central Napa County, in Capell Valley and Napa quads	3
Lasthenia conjugens Contra Costa goldfields	E/–/1B	Alkaline or saline vernal pools and swales	Alkali or saline soils	below 700'	Scattered occurrences in Coast Range valleys and southwest edge of Sacramento Valley, Alameda, Contra Costa, Mendocino, Napa, Santa Barbara*, Santa Clara*, and Solano Counites; historically distributed through the north coast, southern Sacramento Valley, San Francisco Bay region and the south coast	Southern and Central Napa County, in Capell Valley and Cuttings Wharf quads	2
Lathyrus jepsonii var. *jepsonii* Delta tule pea	SC/–/1B	Coastal and estuarine marshes		below 1,000'	Central valley, especially the San Francisco Bay region, Alameda, Contra Costa, Fresno, Marin, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, and Solano Counties	Southern Napa County, in Cuttings Wharf and Napa quads	12
Layia septentrionalis Colusa layia	SLC/–/1B	Sandy or serpentine soils in grasslands and openings in chaparral and foothills woodlands	Sandy or serpentine soils	300–3,600'	Inner north Coast Range; Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties	Northern and Central Napa County, in Detert Reservoir, Knoxville, Walter Springs, Chiles Valley, Aetna Springs, and St. Helena quads	13
Legenere limosa Legenere	SC/–/1B	Deep, seasonally wet habitats such as vernal pools, ditches, marsh edges, and river banks		below 500'	Primarily located in the lower Sacramento Valley, also from north Coast Ranges, northern San Joaquin Valley and the Santa Cruz mountains	Southern Napa County, in Cuttings Wharf quad	1
Lessingia hololeuca Woolly-headed lessingia	–/–/3, LR	Dry, grassy areas in foothill woodland			Central California, Coast Ranges	Eastern and Central Napa County, in Mt. George and Napa quads	3

Table 4-6. Continued

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Lilaeopsis masonii Mason's lilaeopsis	SC/R/1B	Freshwater and intertidal marshes, streambanks in riparian scrub		generally at sea level	Southern Sacramento Valley, Sacramento - San Joaquin River delta, northeast San Francisco Bay area, Alameda, Contra Costa, Marin*, Napa, Sacramento, San Joaquin, and Solano Counties	Southern Napa County, in Cuttings Wharf and Napa quads	1 (about 20 subpopulations)
Lilium rubescens Chaparral lily	–/–/4, LR	Slopes in chaparral and mixed evergreen forest on volcanic soil	Volcanic		North Coast Range Counties	Mt. St. Helena to Hogback Mtn, Mt. George Area	6
Limnanthes vinculans Sebastopol meadowfoam	E/E/1B	Vernal pools and wet meadows			Napa and Sonoma Counties	Central Napa County, in Yountville quad	1
Linanthus acicularis Bristly linanthus	–/–/4, LR	Grassy slopes in foothill woodlands			North Coast Ranges	Central and Eastern Napa County	2
Linanthus jepsonii Jepson's linanthus	SLC/–/1B	Grassy slopes, on volcanics or periphery of serpentine soils	Volcanic or periphery of serpentine soils		Napa, Sonoma, and Lake Counties	Western and Central Napa County, in Rutherford, Chiles Valley, Calistoga, Mt. St. Helena, and St. Helena quads	5
Lomatium ciliolatum var. *hooveri* Hoover's wild parsnip	–/–/4, LR	Rocky slopes and ridgetops in serpentine chaparral	Serpentine soils		Napa, Lake, Colusa, Yolo	Northern Napa County	3
Lupinus sericatus Cobb Mtn. lupine	SLC/–/1B	In knobcone pine-oak woodland, chaparral, on open wooded slopes in gravelly soils	Gravelly soils		Inner North Coast Ranges, Colusa, Lake, Napa, Sonoma	Western Napa County, in Detert Reservoir, Rutherford, Aetna Springs, Calistoga, Sonoma, and St. Helena quads	29
Lythrum californicum California loosestrife	–/–/LR	Freshwater marsh			Coast Ranges and Central Valley, Lake County south to Mexico	Calistoga Geyser field and Jericho Valley	2
Monardella villosa ssp. *globosa* Robust monardella	SLC/–/1B	Openings in northern coastal scrub, chamise chaparral, serpentine chaparral, and mixed evergreen forest; also occurs in grasslands adjacent to these plant communities	Sometimes serpentine soils, sometimes rock outcrops		North Coast Ranges and Eastern San Francisco Bay Area; Alameda, Contra Costa, Humboldt, Lake, Marin, Napa, San Mateo, and Sonoma Counties	Eastern Napa County, in Cappel Valley quad	1
Navarettia cotulifolia Cotula navarettia	–/–/4, LR	Chaparral, foothill woodland, grassland	Adobe (heavy) soils		Reported from 16 counties in coastal and interior North-Central California	Northern Napa County, in Aetna Springs and Walter Springs	4
Navarretia leucocephala ssp. *Bakeri* Baker's navarretia	SC/–/1B	Vernal pools and swales in woodland, lower montane coniferous forest, mesic meadows, and grassland		generally below 5,600'	Inner north Coast Range, western Sacramento Valley, Colusa, Lake, Mendocino, Marin, Napa, Solano, Sonoma, and Tehama Counties	St. Helena quad	1
Navarretia leucocephala ssp. *Pauciflora* Few-flowered navarretia	E/T/1B	Volcanic ash/mud flow vernal pools	Volcanic soils		Lake and Napa Counties	Central and Eastern Napa County, in Capell Valley and Yountville quads	2
Navarretia rosulata Marin County navarretia	SLC/–/1B	Rocky areas in chaparral, Sargent cypress forest	Rocky or serpentine soils		Marin and Napa Counties	North and Central Napa County, in Chiles Valley and Aetna Springs quads	3
Navarettia sinistra ssp. *Pinnatisecta* Pinnate-leaved gilia	–/–/4	Chaparral, lower montane coniferous forest (serpentine or red volcanic)	Serpentine or volcanic	900–6,600'	Inner North Coast Ranges, Glenn, Humboldt, Lake, Mendocino, Napa, Tehama, and Trinity Counties	Collected in 1943 on east side of Mt St Helena	unknown
Penstemon newberryi var. *sonomensis* Sonoma beardtongue	–/–/1B	Rocky areas in chaparral	Rocky soils		Lake, Napa, and Sonoma Counties	Central and northwestern Napa County, in Detert Reservoir, Aetna Springs, and Yountville quads	7
Perideridia gairdneri ssp. *gairdneri* Gairdner's yampah	SC/–/4	Broad-leaved upland forest, chaparral, coastal prairie, valley and foothill grassland, vernal pools, in mesic areas			Kern, Los Angeles*, Mendocino, Monterey, Marin, Napa, Orange*, San Benito, Santa Clara, Santa Cruz, San Diego*, San Luis Obispo, San Mateo*, Solano, and Sonoma Counties	Unknown	at least 1

Table 4-6. Continued

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Plagiobothrys strictus Calistoga popcorn-flower	E/T/1B	Alkaline areas near thermal springs	Alkali soils		Napa County, near Calistoga	Western Napa County, in Calistoga quad	3
Poa napensis Napa blue grass	E/E/1B	Alkaline areas near thermal springs	Alkali soils		Napa County, near Calistoga	Western Napa County, in Calistoga quad	2
Pogogyne douglasii ssp. *parviflora* Small-flowered pogogyne	–/–/3, LR	Serpentine swales in chaparral and grasslands	Sometimes in serpentine soils		Napa, Sonoma, Lake, and Mendocino Counties	Central and western Napa County	6
Polygonum marinense Marin knotweed	SC/–/3	Coastal salt marsh, brackish marsh			Coastal Marin, Napa, Solano, and Sonoma Counties	Southern Napa County, in Cuttings Wharf quad	2
Ranunculus lobbii Lobb's aquatic buttercup	–/–/4, LR	Vernal pools, ditches, and ponds in grassland and woodland			Coast Ranges-Alameda, Contra Costa, Mendocino, Napa, Santa Clara, Sonoma, and Solano Counties	Throughout Napa County	8
Rhynchospora californica California beaked-rush	–/–/1B	Freshwater marshes and seeps, bogs and fens, and in lower montane coniferous forest			Scattered occurrences in Northern California, including Butte, Mariposa, Marin, Napa, and Sonoma Counties	Southeastern Napa County, in Mt. George quad	at least 1
Sidalcea hickmanii ssp. *Viridis* Marin checkerbloom	SLC/–/1B	Serpentine chaparral	Serpentine soils		Sonoma County to San Mateo County	In Mt. George and Calistoga quads	2
Sidalcea oregana ssp. *hydrophila* Marsh checkerbloom	SC/–/1B	Meadows and moist areas in perennial grassland, riparian forest			Inner north coast range, Glenn, Lake, Mendocino, and Napa Counties	Northwestern Napa County, in Detert Reservoir quad	1
Streptanthus barbiger Bearded jewelflower	–/–/4, LR	Serpentine chaparral	Serpentine soils		Lake, Mendocino, Napa, Sonoma, and Tehama Counties	St. Helena quad	6 historic, 1 recent
Streptanthus brachiatus ssp. *brachiatus* Socrates Mine jewel-flower	SC/–/1B	Chaparral, cypress forest, on serpentine	Serpentine soils		Napa and Sonoma Counties	Northwestern Napa County, in Detert Reservoir quad	1
Streptanthus brewerii var. *hesperides* Green jewel-flower	SC/–/1B	Chaparral (openings), cismontane woodland (serpentinite, rocky)	Sometimes rocky, serpentine soils		Lake and Napa Counties	Northern, Central and Western Napa County, in Yountville, Chiles Valley, Detert Reservoir, Rutherford, Aetna Springs, Walter Springs, Knoxville, Jericho Valley, Mt. St. Helena, and St. Helena quads	12
Streptanthus morrisonii ssp. *Elatus* Three peaks jewel-flower	SC/–/1B	Serpentine chaparral	Serpentine soils		Lake, Napa, and Sonoma Counties	Northern Napa County, in Detert Reservoir, Aetna Springs, Knoxville, and Jericho Valley quads	16 (includes all S. morrisonii subspecies)
Streptanthus morrisonii ssp. *Kruckebergii* Kruckeberg's jewel-flower	SC/–/1B	Cismontane woodland on serpentine	Serpentine soils	700–3,400'	Lake, Napa, and Sonoma Counties	Northern Napa County, in Detert Reservoir, Aetna Springs, Knoxville, and Jericho Valley quads	16 (includes all *S. morrisonii* subspecies)
Thelypodium brachycarpum Short-podded thelypodium	–/–/4, LR	Open flat serpentine seeps in chaparral	Serpentine soils		Napa, Colusa, Lake (?), Shasta, Siskiyou, and Trinity Counties	Northern Napa County, in Knoxville quad	1
Trichostema spp. (was *rubisepalum*, may be renamed *napaensis*) Hernandez turpentine weed	–/–/4, LR	Grassy flats in chaparral, foothill woodland, and yellow pine forest	Volcanic		Napa, Tuolomne, Mariposa, and San Benito Counties	Central Napa County	4
Trifolium amoenum Showy Indian clover	E/–/1B	Low elevation grasslands, including swales and disturbed areas, sometimes on serpentine soils	Sometimes serpentine soils		Coast Range foothills, San Francisco Bay region, Mendocino County to Santa Clara County	Southern Napa County, in Cuttings Wharf and Napa quads	2

Table 4-6. Continued

Scientific and Common Names	Status: Federal/State/ CNPS or Other[1]	Habitat			Distribution		
		Biotic Community	Soil Affinity[2]	Elevation Limitations	California Distribution	Known Napa County Locations[3]	Number of Napa County Sites[4]
Trifolium depauperatum var. *hydrophilum* Saline clover	SC/–/1B	Marshes and swamps, vernal pools, valley and foothill grassland (mesic, alkaline)	Sometimes alkali soils	0–1,000'	Alameda , Colusa, Monterey, Napa, San Benito, Santa Clara, San Luis Obispo, San Mateo, Solano, and Sonoma Counties	Western Napa County, in Calistoga quad	1
Triteleia lugens Dark-mouthed triteleia	–/–/4, LR	Broadleafed upland forest, chaparral, lower montane coniferous forest			Lake, Monterey, Napa, San Benito, Solano, and Sonoma Counties	St. Helena quad	3
Viburnum ellipticum Oval-leaved viburnum	–/–/2	Chaparral, cismontane woodland, lower montane coniferous forest		650–4,500'	Contra Costa, Fresno, El Dorado, Glenn, Humboldt, Mendocino, Napa, Shasta, and Sonoma Counties	Southeastern Napa County, in Mt. George quad	2
Zigadenus micranthus var. *fontanus* Marsh zigadenus	–/–/4	Vernally mesic areas in chaparral, cismontane woodland, lower montane coniferous forest, meadows and seeps, marshes and swamps	Often serpentine		North Coast Ranges, San Francisco Bay Area, Inner South Coast Ranges; Lake, Mendocino, Monterey, Marin, Napa, San Benito, Santa Cruz , San Luis Obispo, San Mateo, and Sonoma Counties	Northern Napa County	1

Notes: [1] Status explanations:

Federal

E = listed as endangered under the federal Endangered Species Act.
T = listed as threatened under the federal Endangered Species Act.
PE = proposed for federal listing as endangered under the federal Endangered Species Act.
PT = proposed for federal listing as threatened under the federal Endangered Species Act.
C = candidate species (species for which USFWS has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list).
SLC = species of local concern; species whose status is being monitored by the local USFWS district office, but which has no formal protected status under the federal Endangered Species Act.
SC = species of concern; species for which existing information indicates it may warrant listing but for which substantial biological information to support a proposed rule is lacking.
– = no listing.

State

E = listed as endangered under the California Endangered Species Act.
T = listed as threatened under the California Endangered Species Act.
R = listed as rare under the California Native Plant Protection Act. This category is no longer used for newly listed plants, but some plants listed before the California Native Plant Protection Act was enacted retain this designation.
CE = candidate species for listing as endangered under the California Endangered Species Act.
SSC = species of special concern in California.
– = no listing.

California Native Plant Society

1A = List 1A species: presumed extinct in California.
1B = List 1B species: rare, threatened, or endangered in California and elsewhere.
2 = List 2 species: rare, threatened, or endangered in California but more common elsewhere.
3 = List 3 species: plants about which more information is needed to determine their status.
4 = List 4 species: plants of limited distribution. A watch list.
– = no listing.
* = known populations believed extirpated from Napa County.
? = population location within Napa County uncertain.

Other

LR = considered by local experts to be rare in the Napa County portion of its range, although it may be more common elsewhere.

[2] Affinity to a particular soil type provided only when known or applicable.

[3] General occurrence information is based on incomplete survey data for Napa County. Species may occur in other areas where surveys are lacking.

[4] Source: Special Status Species Occurrences Layer developed for this report. See Methodology section for sources. Data are based on voluntary reporting of incomplete surveys and likely underestimate actual numbers in the field. Occurrences do not necessarily equal populations.

Table 4-7. Napa County Special-Status Wildlife—Habitat and Distribution

Scientific and Common Name	Status	Habitats	California Distribution	Known Napa County Locations	Number of Napa County Sites Documented in County Database*
Accipiter cooperii Cooper's hawk	—/SSC	Nests in a wide variety of habitat types, from riparian woodlands and digger pine-oak woodlands through mixed conifer forests	Throughout California except high altitudes in the Sierra Nevada. Winters in the Central Valley, southeastern desert regions, and plains east of the Cascade Range	Year-round resident; widespread during the winter - uncommon breeder	
Accipiter striatus Sharp-shinned hawk	—/SSC	Dense canopy ponderosa pine or mixed-conifer forest and riparian habitats	Permanent resident in the Sierra Nevada, Cascade, Klamath, and north Coast Ranges at mid elevations and along the coast in Marin, San Francisco, San Mateo, Santa Cruz, and Monterey Counties. Winters over the rest of the state except at very high elevations	Wintering birds found throughout the County, only historical confirmed nesting occurrence was in 1934. 1 CNDDB occurrence. Two recently documented nests in Chiles Valley and Redwood Canyon during the Napa County Breeding Bird Atlas surveys.	1
Acipenser medirostris Green sturgeon	—/SSC	In the Sacramento River, adult sturgeon are in the river, presumably spawning, when temperatures range between 45-58°F. Preferred spawning substrate likely is large cobble, but can range from clean sand to bedrock. Eggs are broadcast-spawned and externally fertilized in relatively high water velocities and probably at depths >3 m. Silt is known to prevent the eggs from adhering to each other.	In California, green sturgeon have been collected in small numbers in marine waters from the Mexican border to the Oregon border. They have been noted in a number of rivers, but spawning populations are known only in the Sacramento and Klamath Rivers.	A small number of individuals infrequently collected in DFG beach seines within San Pablo Bay near Napa Estuary, but not in Napa County (DFG 1999). Not found within freshwater reaches of the Napa River watershed. Individuals may stray into Napa County.	
Agelaius tricolor Tricolored blackbird	—/SSC	Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grainfields. Habitat must be large enough to support 50 pairs. Probably requires water at or near the nesting colony	Permanent resident in the Central Valley from Butte County to Kern County. Breeds at scattered coastal locations from Marin County south to San Diego County; and at scattered locations in Lake, Sonoma, and Solano Counties. Rare nester in Siskiyou, Modoc, and Lassen Counties	Summer resident; breeding known from Pope Valley, Huichica Creek and Buchli Station; 4 CNDDB occurrences, all extant	
Ammodramus savannarum Grasshopper sparrow	—/SSC/LR	Dry grasslands with scattered shrubs for song perches	Sierra foothills, Coast Ranges, and coastal areas from Humboldt County south to San Diego County	Rare summer resident; only two documented records during the Napa County Breeding Bird Atlas surveys.	
Amphispiza belli belli Bell's sage sparrow	—/SSC	Prefers chaparral habitats dominated by chamise	Western Sierra foothills from El Dorado County south to Mariposa County, inner Coast Ranges from Shasta County southward, extending to vicinity of coast from Marin County to San Diego County; from southern San Benito County to San Bernardino County	Year-round resident; locally common but erratically distributed throughout the County's chaparral	
Antrozous pallidus Pallid bat	—/SSC	Occurs in a variety of habitats from desert to coniferous forest. Most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California and oak woodland, grassland, and desert scrub in southern California. Relies heavily on trees for roosts	Occurs throughout California except the high Sierra from Shasta to Kern County and the northwest coast, primarily at lower and mid elevations	Found in suitable habitat throughout the county. 6 CNDDB occurrences, 5 extant and 1 extirpated;	6
Aquila chrysaetos Golden eagle	—/SSC, FP	Nest on cliffs and escarpments or in tall trees overlooking open country. Forages in annual grasslands, chaparral, and oak woodlands with plentiful medium and large-sized mammals	Foothills and mountains throughout California. Uncommon nonbreeding visitor to lowlands such as the Central Valley	Year-round resident; Could occur in suitable habitat throughout the County. There are 4 CNDDB occurrences, (all extant) as well as a few from the Napa County Breeding Bird Atlas and one observation north of American Canyon.	4
Ardea herodias Great Blue Heron (rookery)	—/—/LR	Inhabits estuaries and fresh and saline emergent wetlands. Nests in large trees near fresh and salt water; streams and reservoirs provide foraging habitat	Found throughout California.	Year-round resident; rookeries throughout county, esp. in the tidal region in southern Napa County as well as in Lake Hennessy, Pope Valley and Lake Berryessa	
Asio flammeus Short-eared owl	—/SSC	Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts	Permanent resident along the coast from Del Norte County to Monterey County although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations	Winter resident, known from Fagan Slough	
Athene cunicularia hypugaea Western burrowing owl	—/SSC	Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas. Rare along south coast	Historically known from County, no known breeding records; 1 summer occurrence at Napa Canyon, few records in winter in Pope Valley and the tidal region in southern Napa County	1
Bassariscus astutus Ringtail Cat	—/FP	Inhabit brushy and wooded areas along watercourses in foothill and lower montane canyons; den sites in rocky areas or in hollows in trees; occur from sea level to 8,800 feet in elevation	Widely distributed throughout California except portions of the Sacramento and San Joaquin valleys, Modoc Plateau, eastern Sierra Nevada, and Mojave desert.	Likely to be uncommon in foothills and mountains of Napa County, with known occurrence in the Sulphur Springs region west of St. Helena	
Branchinecta lynchi Vernal pool fairy shrimp	T/—	Common in vernal pools; also found in sandstone rock outcrop pools	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County. Isolated populations also in Riverside County; known from Napa County	1 CNDDB occurrence observed in 2003 south end of Napa airport; Critical habitat designation NW of the city of Napa in a relic vernal pool;	1
Calidris canutus Red Knot	FSCC/—	Tidal mudflats, salt marsh, irrigated pastures, salt ponds	Migrates and winters along the coast and rarely in the Central Valley as well as the Salton Sea, the deserts and Great Basin regions in California.	Found in migration, primarily in the tidal marshes and salt ponds of southern Napa County	

Table 4-7. Continued

Scientific and Common Name	Status	Habitats	California Distribution	Known Napa County Locations	Number of Napa County Sites Documented in County Database*
Carduelis lawrencei Lawrence's Goldfinch	FSCC/—	Open oak woodland, adjacent chapar`ral or grassland where chamise and annual herbs provide food throughout the year; within .3 miles of water	Found year-round in SW portions of state an into northern Baja, summer range extends through coast range, western foothills of the Sierra Nevada and north to Trinity and Shasta counties and occasionally in the Central Valley	Summer resident, Napa Co. but great annual variation in population size and local occurrence; nests in blue oak margins of Lake Hennessey and Lake Berryessa, also observed in Chiles Valley Pope Valley and NW of Napa city	
Catharus ustulatus oedicus California Swainson's thrush	—/SSC	Prefers humid riparian and mixed coniferous/alder forests on the coast, and montane meadows and riparian at inland sites; breeds in thickets of willow and walnut; in the hills it is founding dense cover associated with moist openings in forest	Neotropical migrant; breeds in humid forests along the north coast range and in a few locations in the Cascades and Sierra Nevada ranges	Rare summer resident; historically was common in willow habitat along the Napa River and Conn Creek, presently, only known from Napa River near St. Helena	
Charadrius alexandrinus nivosus (nesting) Western snowy plover (coastal populations)	T/SSC	Coastal beaches above the normal high tide limit in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent	Population defined as those birds that nest adjacent to or near tidal waters, including all nests along the mainland coast, peninsulas, offshore islands, and adjacent bays and estuaries.	Year-round resident; confirmed nesting at Little Island Salt evaporation pond in So Napa Co. and probably in the Huichica Creek Wildlife Area; 3 CNDDB occurrences all presumed extant (all in the Cuttings Wharf quad)	3
Circus cyaneus Northern harrier	—/SSC	Grasslands, meadows, marshes, and seasonal and agricultural wetlands	Occurs throughout lowland California. Has been recorded in fall at high elevations	Year-round resident; nesting confirmed in Napa Marsh area and Lake Berryessa	
Clemmys marmorata marmorata Northwestern pond turtle	—/SSC	Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests. Can use upland habitat up to 0.25 mile from a water body for nesting.	Occurs from the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of Sierra Nevada	Could occur in suitable habitat throughout the County. 15 CNDDB occurrences, all extant	15
Contopus cooperi Olive-sided flycatcher	–/SSC	Nests in large coniferous forests and along forest edges where Douglas fir occurs; will nest in eucalyptus groves	Breeds throughout coniferous forests in California; winters in Central and South America.	Summer resident; common locally in coniferous forests especially at Redwood Canyon, Bothe, and Mt St Helena	
Corynorhinus townsendii pallescens Pale Townsend's (=western) big-eared bat	—/SSC	Mesic habitats; gleans insects from brush or trees and feeds along habitat edges	Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse and Peninsular Ranges, Great Basin, and the Mojave and Sonora Deserts	No published records but within known species range and likely to be found in suitable habitat	5
Corynorhinus townsendii townsendii Pacific Townsend's (=western) big-eared bat	—/SSC	Roosts in caves, tunnels, mines, and dark attics of abandoned buildings. Very sensitive to disturbances and may abandon a roost after one onsite visit	Coastal regions from Del Norte County south to Santa Barbara County	Found in suitable habitat throughout the county; 5 CNDDB occurrences, all presumed extant	
Dendroica petechia brewsteri (nesting) Yellow warbler	—/SSC	Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near stream courses	Nests in California except in the Central Valley, the Mojave Desert region, and high altitudes and the eastern side of the Sierra Nevada. Winters along the Colorado River and in parts of Imperial and Riverside Counties. Two small permanent populations in San Diego and Santa Barbara Counties	Summer resident; known from suitable habitat in Napa Valley, Conn Valley and Gordon Valley as well as other locations	
Desmocerus californicus dimorphus Valley elderberry longhorn beetle	T/—	Stream side habitats below 3,000 feet throughout the Central Valley	Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant	1 extant CNDDB occurrence from Suisun Creek in the Fairfield North quad. Other occurrence close to Napa border with Yolo and Solano quads.	3
Elanus leucurus White-tailed kite	—/FP	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging	Lowland areas west of Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border	Year-round resident; nests in suitable habitat throughout County; 2 CNDDB occurrences (1 extirpated, 1 extant). Several recently documented nests in valleys and the southern region of the County	2
Eremophila alpestris actia California horned lark	—/SSC	Common to abundant resident in a variety of open habitats, usually where large trees and shrubs are absent. Grasslands and deserts to dwarf shrub habitats above tree line	Found throughout much of the state, less common in mountainous areas of the north coast and in coniferous or chaparral habitats	Year round resident; more abundant in winter, breeding records confined to Huichica Creek and Stanly Ranch	
Eucyclogobius newberryi Tidewater goby	E/SSC	Brackish shallow lagoons and lower stream reaches where the water is fairly still but not stagnant. Tidewater gobies have been documented in water with salinity levels from zero to 10 parts per thousand (ppt), temperature levels from 35 to 73 degrees Fahrenheit, and water depths from 5 to 7.5 feet.	Restricted to brackish waters of coastal wetlands. It historically occurred in at least 87 California coastal lagoons from San Diego County to Humboldt County. It has disappeared from most of these sites.	Napa estuary within the historic range, but not collected in any known surveys of the estuary. Considered extirpated from the Napa Estuary.	
Eumops perotis californicus Greater western mastiff bat	—/SSC	Found in a wide variety of habitats from desert scrub to montane conifer. Roosts and breeds in deep, narrow rock crevices, but may also use crevices in trees, buildings, and tunnels	Occurs along the western Sierra primarily at low to mid elevations and widely distributed throughout the southern coast ranges. Recent surveys have detected the species north to the Oregon border	Unknown	

Table 4-7. Continued

Scientific and Common Name	Status	Habitats	California Distribution	Known Napa County Locations	Number of Napa County Sites Documented in County Database*
Falco mexicanus Prairie falcon	—/SSC	Nests on cliffs or escarpments, usually overlooking dry, open terrain or uplands	Permanent resident in the south Coast, Transverse, Peninsular, and northern Cascade Ranges, the southeastern deserts, Inyo-White Mountains, foothills surrounding the Central Valley, and in the Sierra Nevada in Modoc, Lassen, and Plumas Counties.	Year-round resident; confirmed nesting only in Blue Ridge area NE of Lake Berryessa; 4 CNDDB occurrences, all presumed extant, but 2 observed over 20 yrs ago.	1
Falco peregrinus anatum American peregrine falcon	—/E, FP	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large prey populations	Permanent resident along the north and south Coast Ranges. May summer in the Cascade and Klamath Ranges and through the Sierra Nevada to Madera County. Winters in the Central Valley south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range	Year-round resident; documented nesting at two locations in NW Napa County	2
Geothlypis trichas sinuosa Salt marsh common yellowthroat	—/SSC	Freshwater marshes in summer and salt or brackish marshes in fall and winter; requires tall grasses, tules, and willow thickets for nesting and cover	Found only in the San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties	Year-round resident of tidal marsh south of Kennedy Park; 11 CNDDB occurrences, all extant.	11
Haliaeetus leucocephalus Bald eagle	T/E	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin. Reintroduced into central coast. Winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County	Year-round resident; regular winter visitor; 4 CNDDB occurrences all extant; confirmed nesting at Lake Berryessa and Lake Hennessy	
Hypomesus transpacificus Delta smelt	T/T	Tolerant of a wide salinity range. They have been collected from estuarine waters up to 14 ppt salinity. For a large part of their one-year life span, delta smelt live along the freshwater edge of the mixing zone (saltwater-freshwater interface), where the salinity is approximately 2 ppt.	Found only from the Suisun Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano and Yolo Counties. Their historic range is thought to have extended from Suisun Bay upstream to at least the city of Sacramento on the Sacramento River and Mossdale on the San Joaquin River. They used to be one of the most common pelagic (living in open water away from the bottom) fish in the upper Sacramento-San Joaquin Estuary.	Captured in the 20-mm seine surveys of San Pablo Bay (outside of Napa County) conducted by DFG from 1995 through 2001, with the exception of 1997 when delta smelt apparently were absent.	
Icteria virens Yellow-breasted Chat	—/SSC/LR	Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines	Uncommon breeder in California; in Napa nests in a few locations with appropriate habitat, such as along the Napa River near St. Helena	Possibly extirpated from County; historically known as a summer resident from Napa Valley near Calistoga, St Helena and Yountville	
Lampetra ayresi River lamprey	—/SSC	The habitat requirements of spawning adults and ammocoetes have not been studied in California. Presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocoetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 77°F.	In California, recorded only from the lower Sacramento and San Joaquin rivers and from the Russian River. A landlocked population may exist in upper Sonoma Creek (Sonoma County), a tributary to San Francisco Bay.	Infrequently collected in DFG beach seines within San Pablo Bay near the Napa Estuary, but not in the portion of the estuary in Napa County (DFG 1999). Historically collected within the Napa River watershed, but not currently known to occur.	4
Lanius ludovicianus Loggerhead shrike	—/SSC/LR	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches	Resident and winter visitor in lowlands and foothills throughout California. Rare winter visitor on coastal slope north of Mendocino County	Year-round resident; more common during winter; traditional breeding sites in Jamieson Canyon, Lake Berryessa, Pope Valley, Napa airport (possibly extirpated) and near Coombsville	
Laterallus jamaicensis coturniculus California black rail	—/T	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations	Permanent resident in the San Francisco Bay and east-ward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties	Year-round resident; confined to County's southern tidal marsh; 4 CNDDB occurrences, all extant	4
Limnodromus griseus Short-billed Dowitcher	FSCC/—	Tidal mudflats, salt marsh, irrigated pastures, salt ponds	Migrates and winters along the coast and migrates through the Central Valley as well as the Salton Sea, the deserts and Great Basin regions in California.	Found in migration and winter, primarily in the tidal marshes and salt ponds of southern Napa County.	
Limosa fedoa Marbled Godwit	FSCC/—	Tidal mudflats, salt marsh, irrigated pastures, irrigated row crops, salt ponds	Migrates and winters along the coast and the Salton Sea and occasionally in the Central Valley as well as the deserts and Great Basin regions in California.	Found in migration, primarily in the tidal marshes and salt ponds of southern Napa County.	
Melanerpes lewis Lewis's Woodpecker	FSCC/—	Oak savanna, open Jeffrey and Ponderosa pine forest.	Breeds in the Modoc Plateau region and the foothills on the northern Sacramento Valley.	Annual winter resident in Pope Valley with smaller numbers along eastern foothills of Napa Valley and in oak savanna elsewhere in the county. Very sporadic in occurrence with great annual variation in winter population size.	
Melospiza melodia samuelis San Pablo song sparrow	—/SSC	Uses tidal sloughs within pickleweed marshes; requires tall bushes (usually grindelia) along sloughs for cover, nesting, and songposts; forages over mudbanks and in the pickleweed	Found in San Pablo Bay	Year-round resident; found in salt marsh habitats in southern Napa County	*Melospiza melodia samuelis* San Pablo song sparrow
Myotis evotis Long-eared myotis	—/—	Occurs primarily in high elevation coniferous forests, but also found in mixed hardwood/conifer, high desert, and humid coastal conifer habitats	Occurs throughout California except the southeastern deserts and the Central Valley	No published records but within known species range and likely to be found in suitable habitat	

Table 4-7. Continued

Scientific and Common Name	Status	Habitats	California Distribution	Known Napa County Locations	Number of Napa County Sites Documented in County Database*
Myotis thysanodes Fringed myotis	—/—	Found in a wide variety of habitats from low desert scrub to high elevation coniferous forests. Day and night roosts in caves, mines, trees, buildings, and rock crevices	Occurs throughout California except the southeastern deserts and the Central Valley	No published records but within known species range and likely to be found in suitable habitat	
Myotis volans Long-legged myotis	—/—	Most common in woodlands and forests above 4,000 feet, but occurs from sea level to 11,000 feet	Mountains throughout California, including ranges in the Mojave desert	No published records but within known species range and likely to be found in suitable habitat	
Myotis yumanensis Yuma myotis	—/—	Found in a wide variety of habitats from sea level to 11,000 ft., but uncommon above 8,000 ft. Optimal habitat is open forests and woodlands near water bodies	Common and widespread throughout most of California except the Colorado and Mojave deserts	No published records but within known species range and likely to be found in suitable habitat	
Nothochrysa californica San Francisco lacewing	—/—/	Oak woodlands	Vicinity of San Francisco Bay	Historical record from Angwin area	
Numenius americanus Long-billed Curlew	FSCC/—	Tidal mudflats, salt marsh, pastures, row crops, annual grasslands	Migrates and winters along coast, Central Valley, the Salton Sea and occasionally in valleys in the southern and central coast range and in the deserts and Great Basin regions in California.	Found primarily in migration, but also occurs in smaller numbers during winter. Most occurrences in the tidal marshes of southern Napa County, but has occurred sporadically in upper Napa Valley.	
Numenius phaeopus Whimbrel	FSCC/—	Tidal mudflats, salt marsh, salt ponds, irrigated pastures, irrigated row crops, annual grasslands	Migrates along coast, Central Valley, the Salton Sea and occasionally in valleys in the southern and central coast range and in the deserts and Great Basin regions in California.	Found primarily in spring migration, but also occurs in smaller numbers during fall migration. Most occurrences in the tidal marshes of southern Napa County, but has occurred sporadically in upper Napa Valley.	
Oncorhynchus mykiss Central California Coast steelhead trout	T/—	Habitat requirements change as steelhead go through different life phases. Adults require access to natal streams. The majority of spawning occurs in the upper reaches of tributaries. Spawning also requires gravel in areas free of excessive sedimentation with adequate flow and cool, clear water. Escape cover such as logs, undercut banks, and deep pools for is also important. Cool (< 70° F), clean water is essential for survival.	The Historical distribution included all coastal river basins from the Russian River south to Soquel and Aptos Creek, California (inclusive), and the drainages of San Francisco and San Pablo Bays, including the Napa River. Current distribution exists within the same range, but is limited by habitat availability to less developed streams and larger rivers within the range where cooler temperatures persist.	The Napa River watershed appears to support one of the larger steelhead runs in the Bay Area. Anderson (1969) estimated that the Napa River watershed at that time might have supported a run of approximately 500 to 2,000 spawners. Accurate population estimates for the Napa River watershed as a whole are not available (Leidy 1984, Leidy 2001).	3
Oncorhynchus tshawytscha Fall/Late Fall run Chinook salmon Winter run Chinook salmon	C/SSC E/E	Water temperatures and suitable spawning substrates are the greatest habitat demands of Chinook salmon. Coarse gravel must be present in streambeds for successful spawning, and stream temperatures below 61°C are preferred. Chinook commonly spawn in larger mainstem rivers than other salmon species.	Current known distribution of the Fall/late Fall run includes Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek, Yuba River, Feather River, and several other Central Valley streams. The historic distribution of the late-fall run is not known, but likely included the upper Sacramento River and major tributaries now blocked by Shasta Dam. The Winter-run range is comparable to that of fall/late fall run chinook, but with a later run timing (December-March)	Both runs have been observed in the Napa River upstream to the base of the Kimball Canyon Dam north of Calistoga (Leidy and Sisco 1999). These populations may not be self-sustaining and may consist of strays from other basins (NMFS 1999). Winter run Chinook is likely limited to the area around Mare Island Strait in Solano County. This species is less likely to be found in the Napa County portion of the lower Napa River.	
Pandion haliaetus Osprey	—/SSC	Nests in snags, trees, or utility poles near the ocean, large lakes, or rivers with abundant fish populations	Nests along the north coast from Marin County to Del Norte County, east through the Klamath and Cascade Ranges, and in the upper Sacramento Valley. Winters along the coast from San Mateo County to San Diego County	Year-round resident; Nesting documented from Lake Hennessey, Lake Berryessa, and Napa Valley.	
Phalacrocorax auritas Double-Crested Cormorant (rookery)	—/SSC	Rocky coastlines, beaches, inland ponds, and lakes; needs open water for foraging, and nests in riparian forests or on protected islands, usually in snags	Winters along the entire California coast and inland over the Coast Ranges into the Central Valley from Tehama County to Fresno County; a permanent resident along the coast from Monterey County to San Diego County, along the Colorado River, Imperial, Riverside, Kern and King counties and the islands off San Francisco; breeds in Siskiyou, Modoc, Lassen, Shasta, Plumas, and Mono counties; also breeds in the San Francisco Bay Area and in Yolo and Sacramento counties	Year-round resident; Nesting suspected but not confirmed at Lake Hennessy, nesting observed at Huichica Creek Wildlife Area in early 1990s	
Phrynosoma coronatum frontale California horned lizard	—/SSC	Sacramento Valley, including foothills, south to southern California; Coast Ranges south of Sonoma County; below 4,000 feet in northern California	Grasslands, brushlands, woodlands, riparian, pine-cypress, juniper and open coniferous forest with sandy or loose soil; requires abundant ant colonies for foraging.	No CNDDB occurrences. Unlikely	
Pogonichthys macrolepidotus Sacramento splittail	SC/SSC	Found mainly in fresh water, but can live in moderate salinity of up to 10-18 ppt. Splittail lay their adhesive eggs on submerged vegetation in flooded areas in the lower reaches of rivers and sloughs. Larvae utilize the shallow, weedy regions close to spawning sites. As fish reach adult sizes, they move into deeper habitat.	The Sacramento splittail is an endemic fish of the Sacramento and San Joaquin River systems and other drainages of the San Francisco Bay. Currently, the distribution is mostly confined to the delta. Historical distribution ranged from the delta to the upper reaches of the Sacramento, San Joaquin, American, Merced, and Feather Rivers	Known to occur in the Napa and Petaluma Rivers and Petaluma Marsh (U.S. Fish and Wildlife Service 1993, 1996) near the Petaluma River and Novato Creek.	
Progne subis Purple martin	—/SSC/LR	Nests in abandoned woodpecker holes in oaks, cottonwoods, and other deciduous trees in a variety of wooded and riparian habitats including mixed chaparral and conifer slopes at high elevations. Also nests in vertical drainage holes under elevated freeways and highway bridges	Coastal mountains south to San Luis Obispo County, west slope of the Sierra Nevada, and northern Sierra and Cascade ranges. Absent from the Central Valley except in Sacramento. Isolated, local populations in southern California	Summer resident; breeding known from Table Rock, Pope Valley and other possible areas; 4 CNDDB occurrences, all presumed extant but 3 are > 20 yrs old; breeding population probably < 30 pairs	4

Table 4-7. Continued

Scientific and Common Name	Status	Habitats	California Distribution	Known Napa County Locations	Number of Napa County Sites Documented in County Database*
Rallus longirostris obsoletus California clapper rail	E/E	Restricted to salt marshes and tidal sloughs; usually associated with heavy growth of pickle-weed; feeds on mollusks removed from the mud in sloughs	Marshes around the San Francisco Bay and east through the Delta to Suisun Marsh	Year-round resident; confined to County's southern tidal marsh; 8 CNDDB occurrences, all presumed extant	8
Rana aurora draytoni California red-legged frog	T/SSC	Permanent and semi permanent aquatic habitats, such as creeks and ponds, usually, but not always, with submerged and emergent vegetation. May estivate in rodent burrows or cracks during dry periods.	Found along the coast and coastal mountain ranges of California from Marin County to San Diego County and in the Sierra Nevada from Tehama County to Fresno County	Found in suitable habitat; 2 CNDDB occurrences, presumed extant (Wragg Creek and in a tributary to American Creek)	2
Rana boylii Foothill yellow-legged frog	—/SSC	Creeks or rivers in woodland, riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow habitats with rock and gravel substrate and low overhanging vegetation along the edge. Usually found near riffles with rocks and sunny banks nearby.	Occurs in the Klamath, Cascade, north Coast, south Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet	Found in suitable habitat throughout the County. 10 CNDDB occurrences, all presumed extant.	10
Reithrodontomys raviventris Salt marsh harvest mouse	E/E, FP	Salt marshes with a dense plant cover of pickle-weed and fat hen; adjacent to an upland site	San Francisco, San Pablo, and Suisun Bays; the Delta	Found in suitable habitat (tidal marsh) in southern Napa Co.; 5 CNDDB occurrences all extant and all from Cuttings Wharf quad	5
Scaphiopus hammondii Western spadefoot	—/SSC	Shallow streams with riffles and seasonal wetlands, such as vernal pools and stock ponds in annual grasslands and oak savannas. .	Sierra Nevada foothills, Central Valley, Coast Ranges, coastal counties in southern California	Would only occur in the eastern edge of the county. No CNDDB occurrences. Unlikely.	
Sorex ornatus sinuosus Suisun ornate shrew	—/SSC	Tidal, salt, and brackish marshes containing pickleweed, grindelia, bulrushes, or cattails; requires driftwood or other objects for nesting cover	Restricted to San Pablo Bay and Suisun Bay	Found in suitable habitat; 2 CNDDB occurrences both presumed extant but are over 20 years old.	2
Speyeria callippe callippe Callippe silverspot	E/—	Open hillsides where wild pansy (*Viola pendunculata*) grows; larvae feed on Johnny jump-up plants, whereas adults feed on native mints and non-native thistles.	San Bruno Mountain, San Mateo County, and a single location in Alameda County. Historically known from southern portions of Napa County (Arnold pers comm.).	Known from American Canyon	
Spirinchus thaleichthys Longfin smelt	—/SSC	Occupy mostly the middle or bottom of the water column in the salt or brackish water portions of the estuary, although larval smelt are concentrated in near-surface brackish waters. Spawning takes place in fresh water, over sandy-gravel substrates, rocks, and aquatic plants. Spawning in the Sacramento-San Joaquin estuary occurs at water temperatures of 45-58°F. A strong positive correlation exists between winter and spring Delta outflow and longfin smelt abundance the following year.	Rarely found upstream of Rio Vista or Medford Island in the Sacramento-San Joaquin Delta. Adults occur seasonally as far downstream as South Bay but they are concentrated in Suisun, San Pablo, and North San Francisco bays. They are rarely collected outside the estuary.	Infrequently collected in DFG beach seines within San Pablo Bay near Napa Estuary, but outside of Napa County (DFG 1999). Not found within freshwater reaches of the Napa River watershed. Individuals may stray into Napa County.	
Spizella atrogularis Black-chinned Sparrow	FSCC/—/LR	Low-growing chaparral	Breeds in desert mountain ranges in the Mojave, throughout higher elevation chaparral in southern California, but irregularly and locally north in interior coast ranges to Yreka, Siskiyou County, and along western slope of Sierra Nevada to Placer County. Also rarely found on the Modoc Plateau and elsewhere in the Great Basin region of California.	Last confirmed nest in 1984 in SE Palisades; requires young regenerating montane chaparral	
Sterna elegans Elegant Tern	FSCC/—	Near shore ocean, bays, salt ponds, coastal estuaries	Breeds along the coast in southern California and post-breeding dispersal along coast and bays to Humboldt County and rarely to Del Norte County and Oregon.	Birds that have dispersed after breeding are found in July-October in the tidal marshes and salt ponds of southern Napa County.	
Strix occidentalis caurina Northern spotted owl	T/SSC	Dense old-growth or mature forests dominated by conifers with topped trees or oaks available for nesting crevices	A permanent resident throughout its range; found in the north Coast, Klamath, and western Cascade Range from Del Norte County to Marin County	Year-round resident; ~25 breeding territories in western County, and Angwin (unoccupied in 2002)	
Syncaris pacifica California freshwater shrimp	E/E	In pool areas of low-elevation, low gradient, permanent streams; among live tree roots of undercut banks, under overhanging woody debris or vegetation	Endemic to Marin, Napa, and Sonoma Counties; extant populations in Lagunitas Creek in Marin Co., Huichica Creek in Napa Co., and Franz, East Austin, Sonoma, and Salmon Creeks in Sonoma Co.	Known from Huichica Creek; 2 CNDDB occurrences 1 from Huichica Creek and 1 from Napa River/Garnett Creek	2
Xanthocephalus xanthocephalus Yellow-headed blackbird	—/—/LR	Nests in fresh emergent wetland with dense vegetation and deep water, often along borders of lakes or ponds. Forages in emergent wetland and moist, open areas, especially cropland and muddy shores of lacustrine habitat. Has bred, at least irregularly, as high as 2000 m (6600 ft) in San Bernardino Mts.	Breeds commonly, but locally, east of Cascade Range and Sierra Nevada, in Imperial and Colorado River valleys, and fairly commonly in Central Valley. Uncommon in Central Valley in winter, occurring mainly in southern portion. Fairly common in winter in the Central and Imperial valleys; rare and irregular elsewhere, including coastal areas. Occurs as a migrant and local breeder in deserts and along coast of southern California.	Rare summer resident at Huichica Creek Wildlife Area	

Table 4-8. Special-Status Species Associations with Biological Community Types

Land Cover Type	Number of Special-Status Plant Species	Percent Of Total Number of Special-Status Plant Species Present	Number of Special-Status Wildlife	Percent of Total Special-Status Wildlife	Percent of County Area
All Grassland	38	47%	35	31.0%	10.6%
Serpentine Grassland	29	36%	15	31.0%	0.4%
All Chaparral/scrub	49	60%	11	19.0%	21.2%
Serpentine Chaparral	20	25%	9	15.5%	9.2%
Oak Woodland	33	41%	19	27.6%	31.9%
Riparian Woodland	9	11%	18	37.9%	1.6%
Coniferous Forest	38	47%	18	32.8%	8.5%
All Aquatic	**17**	**21%**	34	**60.3%**	**6.6%**
Salt Marsh	4	5%	22	25.9%	0.7%
All Open Water	1	1%	10	15.9%	5.6%
All Wetlands	15	19%	29	42.0%	1.0%
Agricultural Cropland	9	11%	7	5.2%	12.7%
Rock Outcrops	12	15%	3	12.1%	0.3%
Total Special-Status Plants	81*				
Total Special-Status Wildlife			68*		

Note:

* The total numbers of special status plants and wildlife is lower than the sum of the numbers associated with individual community types, because a single species may be associated with multiple biological communities.

Sixty-eight special-status wildlife species are likely to be found in the County: 39 birds, 11 mammals, eight fish, five invertebrates, three amphibians, and two reptiles.

are associated with hot springs in the Calistoga area and both are known from only two well-documented occurrences. Estimated population size is less than 5,000 individuals. These species are representative of a subgroup of the County's special-status plants, namely, those that are associated with specific habitats that have always been rare.

Vernal pool species are another example; five special-status plant species in the County are associated with vernal pools. Only one of the five species, dwarf downingia, is known from more than two documented occurrences. Documented population sizes range from less than 100 individuals to approximately 18,000 individuals, and may vary considerably from year to year (California Natural Diversity Database 2005).

Other rare species in the County tend to occur on sites that have been attractive for either agricultural or urban development, such as level or gently sloping grasslands. These species were probably once more common (Ruygt 1999). Examples of such species include Tiburon buckwheat (*Eriogonum luteolum* var. *caninum*), round-leaved filaree (*Erodium macrophyllum*), and adobe lily.

Special-status plant species, like most native plant species in the County, are adapted to particular fire regimes. Until the beginning of the nineteenth century, frequent fires were common in much of Napa County; fire was a land management tools used by Native Americans and early European settlers (Grossinger et al. 2003). Fire suppression during the last century poses a current threat to special-status species that are adapted to colonize recently burned sites or that depend on fire for regeneration (fire followers or fire-dependent species). For example, germination of Mt. Saint Helena morning-glory (*Calystegia collina* ssp. *oxyphylla*) is enhanced by fire (Callizo pers. comm.). Fire suppression is likely to lead to less frequent, more intense, and larger fires in some biotic communities, such as Douglas-fir forests. Special-status species in these communities that do not tolerate high-intensity fires are threatened by the increased likelihood of such fires.

SPECIAL-STATUS WILDLIFE

Sixty-eight special-status wildlife species are likely to be found in the County (Table 4-7): 39 birds, 11 mammals, eight fish, five invertebrates, three amphibians, and two reptiles. Only 24 of these 68 species have documented occurrences in the Napa County Biological Database (Table 4-7). However, habitat for all 68 species is present in the County, and they are considered by experts to be at least reasonably likely to occur in the County. Table 4-7 summarizes information on the listing status, habitats, California distribution, and known Napa County locations of each species. The documented occurrences of these species throughout the County are shown in Map 4-9. As an illustration of the level of detail contained in the new County Biological Database, documented occurrences of special-status wildlife species within a sample evaluation area (Napa Marshes) are shown in Map 4-10.

Twenty-four of the 796 rare animal species extant in California that are tracked by the CNDDB (California Natural Diversity Database 2005, California Department of Fish and Game 2003b) have been documented in the County. This represents 3% of the state's tracked rare animal species on less than 0.5% of the state's area, indicating that the density of documented rare animal species in the County is six times the average for California overall.

Six special-status wildlife species found in the County are federally endangered (FE), and eight are federally threatened (FT). Two other species are state listed as endangered (SE) or threatened (ST). Species that are federally listed and also state species of special concern (SCC) are so identified. These include the following.

FEDERALLY ENDANGERED SPECIES

- California freshwater shrimp (FE, SE)
- Callippe silverspot (*Speyeria callippe callippe*) (FE)
- Winter-run Chinook salmon (FE, SE)
- Tidewater goby (*Eucylogobius newberryi*) (FE, SSC)
- California clapper rail (FE, SE)
- Salt marsh harvest mouse (FE, SE)

FEDERALLY THREATENED SPECIES

- Vernal pool fairy shrimp (FT)
- Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (FT)
- Central California Coast steelhead trout (FT)
- Delta smelt (FT, ST)
- California red-legged frog (FT, SSC)
- Bald eagle (FT, SE)
- Western snowy plover (nesting coastal populations) (FT, SSC)
- Northern spotted owl (FT, SSC)

STATE LISTED SPECIES

- American peregrine falcon (SE)
- California black rail (ST)

Special-status bird species represent a much higher proportion of all special-status animal species in the County than they do in the state as a whole (Table 4-9; California Department of Fish and Game 2003b). One explanation for this phenomenon is the large number of rare bird species that inhabit the Napa River Marshes.

Table 4-9. Special Status Wildlife in Napa County and the State of California, by Group

	Napa County		California	
	Number	% of total Number of Special Status Wildlife Species	Number	% of total Number of Special-Status Wildlife
Birds	39	57%	135	29%
Mammals	11	16%	120	26%
Fish	8	12%	90	20%
Invertebrates	5	7%	32	7%
Amphibians	3	4%	39	9%
Reptiles	2	3%	42	9%
Total	**68**		**458**	

Wildlife species are generally more difficult to associate with single biotic communities than are plant species, because they commonly use several different communities for different purposes. For example, Lawrence's goldfinch typically breeds in open oak woodland, but also forages in adjacent chaparral or grassland habitats where chamise and annual herbs provide food throughout the year. It also requires a nearby source of water. The fact that most wildlife populations have an ecological requirement for multiple biotic communities underscores the need to conserve landscapes with a balanced mosaic of biotic communities.

Although wildlife species commonly require use of multiple biotic communities for different ecological needs, some wildlife species have a strong association with specific biotic communities, such as salt marsh or mature coniferous forests (Tables 4-7 and 4-8; Appendix B). Communities with relatively small acreage in the County that are strongly associated with many special-status wildlife species, such as salt marsh and riparian woodlands, are therefore especially important to conserve (Table 4-8; Maps 4-11 and 4-12). Special features, such as rock outcrops that occur in a variety of communities and support unique species groups such as bats or special-status raptors are also important for conservation of these species.

Special-status wildlife species utilize virtually every biotic community in the County (Tables 4-7 and 4-8). None of these species are strictly endemic to the County, but a number of them occur in localized areas that would be particularly sensitive to disturbance. These include the roosting areas of bats (pallid bats [*Antrozous pallidus*] and Pale Townsend's big-eared bats); nesting sites of snowy plover, tricolor blackbirds and tree-nesting raptors; streams supporting salmon and amphibians; salt marsh harvest mouse habitat; and vernal pools.

As discussed above, fire suppression has altered the fire regime in the County's biotic communities, reducing the fire frequency. As a result, mosaics of different aged stands of forest and chaparral are probably less common than they were before the 1950s. The prevalence of even-aged forest stands and chaparral across large areas may lead to local declines in species requiring stands of a particular age. For example, black-chinned sparrows (*Spizella atrogularis*) require young regenerating montane chaparral. Black-chinned sparrows may be declining in the County due to the reduction in fires in chaparral in the northwestern portion of the County where the species is found. In contrast, yellow warblers may breed in mature chaparral, although they may also use riparian vegetation for breeding. This species may undergo local declines if extensive fires eliminate their habitat across large areas. Historic fire regimes, with more frequent, less intense fires, most likely resulted in a mosaic of stand ages across the landscape, reducing the probability of local declines in species like the black-chinned sparrow and yellow warbler. More information on fire can be found in *Fire Ecology*, Chapter 18.

WILDLIFE MOVEMENT AREAS

This section describes the importance of wildlife movement areas to species' success, species requirements for movement areas, areas that have potential to be used for wildlife movement, and a generalized least cost analysis of movement corridors in the County. The least cost analysis method can be used to identify wildlife movement corridors based on the ease with which wildlife species can traverse particular land cover types.

IMPORTANCE OF WILDLIFE MOVEMENT AREAS

Wildlife movement areas, or habitat linkages, are areas that provide habitat connections for wildlife between two distinct points. Habitat connections are important to enable periodic migrations, to assure access to food and water and to breeding areas, to maintain genetic diversity, to allow recolonization of habitat where populations have declined or been extirpated, to provide for dispersal of seeds, and to allow for long-term distribution changes that may be necessary as a result of climate change.

Sometimes habitat is fragmented—has been separated or fragmented by topography, changes in vegetation, or other natural or human disturbances or land use changes—creating isolated "islands" of vegetation that may not provide sufficient area or resources to accommodate sustainable populations for a number of species, thus adversely affecting both genetic and species diversity. This process and the resulting landscape are both termed *habitat fragmentation*.

Wildlife habitat is being fragmented throughout California by urban sprawl, roads, conversion of wildlands to intensive agricultural uses, installation of fences that restrict wildlife movement (e.g., deer fences), and other human and natural influences.

Habitat fragmentation is one of the greatest threats to biodiversity and thus to species survival. Habitat fragmentation impedes or prevents the exchange of individuals and genetic material between populations, thereby reducing genetic diversity and threatening the long-term viability of species in the

Wildlife movement areas are important to enable periodic migrations, to assure access to food and water and to breeding areas, to maintain genetic diversity, to allow recolonization of habitat where populations have declined or been extirpated, to provide for dispersal of seeds, and to allow for long-term distribution changes that may be necessary as a result of climate change.

region. Genetic diversity is important in a population because it increases the chances that populations can survive catastrophic events such as fire, disease, drought, gradual habitat changes, and/or invasions by nonnative species. Unrestricted movement of individuals within and between populations is critical for species health and survival. Habitat fragmentation may prevent recolonization of suitable habitat following local extinction of a population from such events. For larger species (e.g., deer, bear, mountain lion, elk [*Cervus* spp.]), long-distance movement and dispersal to find food and mates is critical for their long-term survival in the County.

In addition, movement of wildlife species is important for the maintenance of many plant species that rely on animals to disperse their seeds. Preserving the integrity of existing wildlife movement areas is therefore essential for the long-term viability of many rare and common animal and plant species in the County (California Wilderness Coalition 2001).

Assuring adequate wildlife movement areas can somewhat mitigate the adverse effects of habitat fragmentation.

Assuring adequate wildlife movement areas can somewhat mitigate the adverse effects of habitat fragmentation by (1) allowing animals to move between remaining habitats to replenish depleted populations and increase the available gene pool; (2) providing escape routes from fire, predators, and human disturbances, thus reducing the risk that catastrophic events (such as fire or disease) will result in population or species extinction; and (3) serving as travel paths for individual animals moving throughout their home range in search of food, water, mates, and other needs, or for dispersing juveniles in search of new home ranges.

In addition to reducing wildlife movement, habitat fragmentation also degrades habitat quality for many species through an increase in edge effects. Important characteristics of many natural communities are altered along the interface (edge) between one community and another, especially when one of the two communities has been severely altered by human disturbance. For example, forest areas near a forest-vineyard or a forest-road interface are likely to have increased populations of non-native invasive species, as well as increased sunlight and wind, which can increase structural damage to vegetation (*e.g.,* windthrow) (Noss 2000). Human disturbances, such as hunting and dumping, also increase near edges. Predation by human-associated mesopredators, such as cats and raccoons, and nest parasitism by brown-headed cowbirds may increase near interfaces between natural communities and developed areas. Edge effects have been most extensively studied in eastern North America. Studies in the western United States have not shown clear increases in predation and nest parasitism due to edge effects (Ross 2000). However, increased human disturbances and non-native species populations near edges are likely to have similar adverse effects on habitat quality in eastern and western North America. Edge effects can be pronounced in narrow movement corridors, reducing wildlife movement and other wildlife uses of the corridor, such as feeding, breeding, and resting.

TYPES OF MOVEMENT AREAS

For the purposes of this document, *wildlife movement areas* are defined as contiguous areas of habitat that allow the unimpeded movement of wildlife from one area to another. Movement areas can be any size and shape from a narrow strip of land that functions as a tunnel or conduit (i.e., habitat that permits movement but not breeding or foraging) to a large area of intact habitat that is used for movement and other life functions (Figure 4-3).

REASONS FOR MOVEMENT

Wildlife use movement areas are primarily important for periodic migrations among different habitat types used for breeding, birthing, feeding, or roosting, as well as for immigration or emigration between habitat patches (Meffe and Carroll 1994).

TERRESTRIAL WILDLIFE

Movements of terrestrial wildlife species in the County are closely tied to the location, distribution and quality of movement areas on the landscape. These corridors are defined by the local and regional distribution of suitable habitat and the ecological requirements of the species that use them.

Wide-ranging species such as the mountain lion can move through many habitat types over large areas covering hundreds of square miles in relatively short periods of time. Medium-sized species such as the bobcat, ringtail cat, and deer (*Odocoileus hemionus*) generally move shorter distances on the order of tens of miles, but still favor corridors providing the path of least cost between important habitat patches. Small species such as mice, amphibians, and reptiles are generally restricted in their movement to under 1–2 miles per season or generation. Dispersal of individuals farther than 1–2 miles over several generations is important to maintain genetic diversity in these species.

BIRDS AND BATS

Movement of birds and bats is only loosely tied to habitat corridors because of their ability to fly. More important factors in their local and regional survival rates are lack of suitable migration stopover habitat where migrants rest, forage, and replenish their fat reserves; lack of suitable post-breeding habitat where birds molt and fatten up in preparation for migration; and lack of suitable foraging habitat near nest/roost sites for species with specialized diets such as fish-eating birds (e.g., herons, cormorants, osprey, and bald eagle) and bats.

Birds and bats show three different types of movement: (1) migration—the north-south movement of entire populations of a species during fall and spring; (2) post-breeding dispersal—the movement of adult and immature birds away from their nesting/natal territories to other, more productive regions or habitats (altitudinal "migration" or "upslope drift" is common in California); and (3) daily movements to foraging areas from nesting territories or roosting sites.

AQUATIC WILDLIFE

Movement of aquatic wildlife (generally fish) is related to the quality and type of aquatic habitat available. Anadromous fish like steelhead and Chinook salmon migrate great distances from the ocean to fresh water to spawn. Other fish such as the tule perch complete their life cycles completely within relatively small areas of fresh water. Some fresh water invertebrates live their entire lives in one or two pools covering a few hundred feet of stream channel.

MOVEMENT REQUIREMENTS

TERRESTRIAL WILDLIFE

Species habitat and use requirements in movement areas differ among terrestrial wildlife species. For some species, wider corridors are more readily utilized than narrower ones (Merenlender and Crawford 1998; Hilty and Merenlender 2004). Most native mammalian predators found in the County utilize corridors that are at least 1,000 feet wide more heavily than corridors that are 100 feet wide or narrower (Hilty and Merenlender 2004). However, corridors as narrow as 50 feet are utilized as well, although less frequently and by fewer species (Hilty and Merenlender 2004). Nonetheless, documented use of such narrow corridors by species such as gray fox indicates that these corridors, while less valuable than wider corridors, still have some value for wildlife movement.

Narrowing of these corridors through encroachment, direct habitat loss and degradation will reduce the number of individuals using the pathway due to higher levels of disturbance, competition, and predation, associated with edge effects. Fragmentation of existing corridors by roads or land use changes similarly will increase the vulnerability of species that use them to these factors, as well as direct road mortality. Elimination of corridors would force species to take alternate routes, thereby increasing their energetic costs as well as exposure to many hazards that would characterize the unfamiliar territory. A corridor that does not function properly can become a "death trap," either by isolating individuals from a core population or by not delivering them to habitats that provide resources sufficient for survival and reproduction (Meffe and Carroll 1994).

The scientific community is still trying to establish whether areas identified as wildlife corridors actually function in that capacity in the landscape. Some scientists argue that preserving these areas without documented evidence that species of concern actually use them is not a cost-effective use of limited conservation resources. Others contend that conserving wildlife movement corridors diverts efforts and monies from protecting and conserving larger intact tracts of land that could ultimately be more beneficial to these species (Meffe and Carroll 1994). However, Beier and Noss (2000) found that, despite need for research on fragmentation in sensitive species, a large amount of empirical evidence indicates that wildlife movement corridors facilitate travel for a great number of animals and thus are important in maintaining and enhancing wildlife populations.

BIRDS AND BATS

The movements of birds and bats across unsuitable habitat vary greatly on a daily and seasonal basis. Birds can fly several hundred miles in a single night; bats migrate over comparably long distances.

Migration barriers to these species are often seas, oceans, the largest desert regions, and highest mountain ranges, none of which are found in the County. Because of this, there seems to be no need to provide movement corridors for these taxa, although protection of migration stopover habitat, post breeding habitat, and suitable foraging habitat may be needed.

AQUATIC WILDLIFE

Specific characteristics of aquatic movement corridors determine both fish and amphibian use of these corridors. Factors that may be important determinants of movement use include channel width and depth, water quality (i.e., temperature, dissolved oxygen, contaminant load, salinity, suspended sediments) and quantity, riparian vegetation cover, instream woody material, and available pool habitat/structure.

Natural barriers such as waterfalls, rapids, dry reaches, and non-shaded reaches can impede use by some species. Man-made barriers such as dewatered reaches, dams, bridges, culverts, and drop structures, can have detrimental effects on the movement of these species in areas where they occur.

POTENTIAL WILDLIFE MOVEMENT AREAS

Except for the recent study by Hilty and Merenlender (2004) along the western foothills of the Mayacamas Mountains in Sonoma County riparian corridors, wildlife movement has not been well studied in Napa County or analogous landscapes. Despite this, several general conclusions can be drawn based on inferences from regional analyses of wildlife movement and land cover within the County.

CALWILD LINKAGE MAP

The CalWild Linkage Map identifies three major wildlife movement corridors in the County: the Napa River, the Blue Ridge-Berryessa Natural Area West, and the Blue Ridge-Berryessa Natural Area East (Map 4-2).

The *Napa River Corridor* is characterized by open water, freshwater, brackish, and salt marsh. It serves as an important north-south corridor for many riparian-associated birds, mammals, amphibians, and reptiles. However, its greatest ecological importance may be its use by numerous fish species moving from the estuary to the upper Napa River watershed.

The *Blue Ridge-Berryessa Natural Area West Corridor* is characterized by oak woodlands and chaparral, and includes riparian areas along Putah Creek and its tributaries. This corridor provides connectivity between the Knoxville, Berryessa and Central Interior Valley Evaluation Areas. In addition, it connects the County with some areas in southern Lake County.

The *Blue Ridge-Berryessa Natural Areas East Corridor* is the least disturbed of the corridors. Like the Blue Ridge-Berryessa Natural Areas West Corridor, it is characterized by oak woodlands and chaparral, as well as riparian areas along Eticuera Creek and lower Putah Creek. This corridor provides migration and dispersal areas along the Blue Ridge-Berryessa Range. The Blue Ridge-Berryessa Naturals Areas West and East Corridors are utilized by mountain lions as well as by numerous other species.

A corridor that does not function properly can become a "death trap," either by isolating individuals from a core population or by not delivering them to habitats that provide resources sufficient for survival and reproduction.

The Napa River Basin Limiting Factors Analysis indicated that 69 potential man-made barriers (such as dams, bridges, culverts, drop structures) to aquatic species movement have been documented in the Napa River basin since the 1950s.

LAND COVER CONSIDERATIONS

DISTRIBUTION OF NATURAL LAND COVERS

Large patches of intact habitat currently exist in the County, according to a qualitative analysis of the distribution of natural land covers (Map 4-13), that are likely to allow unconstrained wildlife movement. These areas are primarily found in the eastern and northwestern portions of the County.

This analysis also shows that the Napa Valley presents a barrier to east-west dispersal by species that have difficulty crossing roads and agricultural land (Map 4-13). While riparian corridors in a few areas of Napa Valley offer cross-valley movement routes for many species, in other areas of the valley these corridors are too narrow and discontinuous to allow viable movement by most of these species.

ROAD DENSITY

The highest road densities in Napa County are found in towns, cities and other urbanized areas.

The second highest densities, approximately only 20% as dense, are within the agricultural areas on the valley floor and around Angwin. The amount of traffic on these rural roads and the barrier they pose to wildlife movement is considerably less than in urbanized areas.

The eastern portion of the County has the lowest road densities (about 20% of that in the agricultural areas) but major roads such as State Route (SR) 121 (Monticello Rd), SR 128, Wooden Valley Rd, Berryessa-Knoxville Rd, and Chiles-Pope Valley Rd. cross this area. Monticello Rd. is the most heavily traveled of these roads, but only has an average of 2,800 vehicles per day. The other roads in the area carry as few as 600 vehicles per day.

Animals moving from the north to the south of the County along the Blue Ridge-Berryessa Natural Area East linkage must cross SR 128 (Map 4-13), which has approximately 1,000 vehicles per day. Animals moving north to south along the Blue Ridge-Berryessa Natural Area West linkage must cross at least two major roads: Pope Canyon Road and SR 121.

East-west movement in the far northern portion of the County remains relatively unconstrained, although animals must cross SR 29, Butts Canyon Rd, and Berryessa-Knoxville Rd. Butts Canyon Rd. and Berryessa-Knoxville Rd. have approximately 750 and 250 vehicles per day, respectively, and thus pose less of a barrier. However, the timing and magnitude of seasonal movement of some species could potentially result in significant road mortality for some species, even with these relatively low traffic loads.

North-south movement along the western mountains is much more constrained by development and roads than in the eastern part of the County, with road densities in the western mountains comparable to those found on the valley floor. As noted above, east-west movement across the Napa Valley is significantly constrained by development and roads. Construction of wildlife overpasses, underpasses, and tunnels designed for wildlife movement can facilitate passage of many species across these potential movement barriers.

Like roads, fencing may be a barrier to certain wildlife species, or reduce their movement frequency. These effects can be mitigated by designing fences to allow for movement by particular species. Due to the lack of data on fencing distribution in the County and the wide variation in species response to fencing, the effect of fencing on wildlife movement in the County is not discussed here.

DISTINCT HABITAT GROUPINGS

Three distinct habitat groupings important to wildlife movement have been identified: grassland-riparian, oak woodland-riparian, and coniferous forest-riparian. These are described here.

GRASSLAND-RIPARIAN

Grasslands are widely but patchily distributed across the County (Map 4-14). Most are associated with the small valleys between Napa Valley and Lake Berryessa and the rolling hills in the southern part of the County. Connectivity between patches of grassland habitat along grassland links is mostly limited to narrow corridors.

The principal terrestrial species that disperses long-distances between the grasslands in the County is the coyote. Coyotes are also known to use developed and agricultural areas for movement. However, although small mammals and reptiles found in grasslands use them only infrequently for long-distance dispersal, this dispersal is important for the long-term viability of these species in the County.

Existing riparian habitat in grasslands is usually very narrow and does not provide a broad network of links between patches of grassland.

Development in the Jamieson-American Canyon, Carneros, Pope Valley, and Southern Interior Valleys Evaluation Areas is particularly likely to impact the movement of grassland species, unless allowances are made for their movement requirements.

As is the case for oak woodlands and coniferous forests, opportunities for conservation and restoration of corridors connecting large patches of grassland habitat should be identified within the county.

OAK WOODLAND-RIPARIAN

Oak woodlands (Map 4-15) cover almost one third of Napa County and are less patchily distributed most other land cover types. The connectivity between the County's northern and southern oak woodland areas is good, particularly in the eastern County. However, the Napa Valley and Lake Berryessa form two large barriers to movement within the County's oak range.

As with coniferous forests, riparian areas may help connect the habitat across the Napa Valley. However, the distance between the oak woodlands on the east and west side of the valley is substantial, and the riparian areas are narrow. Consequently, they may not be effective movement corridors for many species. Some species such as ringtail cat, bobcat, and mountain lion could

presumably utilize these riparian corridors, although corridors may need to be above a minimum width (1,000 feet) to facilitate frequent use (Hilty and Merenlender 2004). More analysis is needed to more accurately determine the utility of the existing riparian corridors for different species.

Development in the Western Mountains and Eastern Mountains Evaluation Area is particularly likely to impact the movement of oak woodland species, unless allowances are made for their movement requirements.

CONIFEROUS FOREST-RIPARIAN

Coniferous forest habitat (Map 4-16) comprises less than 9% of Napa County, and is patchy in its distribution. Movement between these patches is important for species such as black bears. Riparian corridors connect many of the areas, but their use by different species depends on the width of the riparian corridor and the particular movement requirements of particular species (Hilty and Merenlender 2004). Development in the Western Mountains, Eastern Mountains, Angwin, and Livermore Ranch Evaluation Areas would likely impact the movement and populations of coniferous forest species in these areas, unless accommodations are made to preserve or enhance existing corridors and forest stands.

LEAST COST PATH ANALYSIS

As described in the *Methodology* section, *least cost path analysis* provides a method for evaluating potential corridors and identifying areas where corridors can become constricted. A detailed discussion of the approach used in this report is found in the methodology section above.

Note that this approach does not necessarily identify the actual route that dispersing animals will choose. However, if an animal did choose the least cost path, it would encounter fewer hazards, would spend less time in traveling, and would have a higher probability of finding food and cover, thus increasing its probability of survival (Walker and Craighead 1997).

TERRESTRIAL WILDLIFE

Map 4-17 depicts a weighting of land cover types in the County according to the generalized difficulty for terrestrial wildlife to move across them (Table 4-2). The barriers posed by developed and agricultural areas are reflected in the cost value assignment. In addition, cost values are based on the assumption that areas of open water pose a barrier to some species (Map 4-17, Table 4-2).

Map 4-18 illustrates a general movement scenario for a species moving between the southern Carneros and central Knoxville Evaluation Areas. This analysis was based on the generic movement costs in Table 4-2, rather than on species-specific movement requirements. Nonetheless, this example does serve to identify areas of potential corridor constriction, especially to the north and east of the City of Napa. The inset map in Map 4-18 shows the variability of path width along riparian corridors within a landscape dominated by urban development and agriculture.

According to least cost path analysis, riparian areas emerge as important corridors across Napa Valley, as also reflected in previous discussions.

BIRDS AND BATS

Napa County does not have any major barriers to flight movement of birds and bats. The primary affect of land use changes on these species in the county would be through the loss or degradation of high quality stopover habitat such as riparian woodlands, Douglas-fir/oak woodlands, and/or wetlands.

All benefits derived from maintaining habitat linkages for terrestrial mammals, amphibians and reptiles would likely benefit birds and bats by maintaining their ability to move with minimal effort and risk between areas of suitable habitat during migration and for local movements.

AQUATIC WILDLIFE (FISH AND OTHER AQUATIC WILDLIFE)

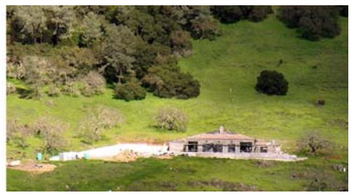
The Napa River Basin Limiting Factors Analysis indicated that 69 potential man-made barriers (such as dams, bridges, culverts, drop structures) to aquatic species movement have been documented in the Napa River basin since the 1950s (Stillwater Sciences and Deitrich 2002). Many of these potential barriers have not been resurveyed recently. Therefore, old barriers may no longer exist and new barriers may have been installed.

The Napa River Basin Limiting Factors Analysis indicated that 69 potential man-made barriers (such as dams, bridges, culverts, drop structures) to aquatic species movement have been documented in the Napa River basin since the 1950s.

No significant impediments to upstream migration of Chinook salmon or steelhead exist on the mainstem of the Napa River (Stillwater Sciences and Dietrich 2002). On stream channels within the Napa River watershed, three large dams on Conn Creek, Bell Canyon, and Rector Canyon were constructed between 1946 and 1959, reducing historically available habitat by approximately 17% (based on the proportion of the drainage basin that was blocked by these dams). Historically, about 300 miles (480 km) of the 1,300 miles (210 km) of stream channels within the Napa River watershed were likely accessible and suitable for spawning and rearing of steelhead in most years (U.S. Fish and Wildlife Service 1968). Prior to the construction of Conn Reservoir in 1946, the Conn Creek system, with its many perennial reaches and likely high-quality habitat, may have been one of the more important tributary watersheds for steelhead spawning and rearing in the Napa River basin.

Information on the Putah Creek and Suisun Creek Watersheds is less extensive. Monticello Dam is the major man-made barrier to fish movement in the Napa County portion of this watershed, and less than 20 culverts and other similar smaller man-made restrictions are likely present in this area as well. In addition, the Putah Diversion Dam and Terminal Dam are located downstream. Several channelized portions of Putah Creek downstream of the Monticello Dam limit habitat quality in Lower Putah Creek. Nonetheless, fall-run Chinook salmon have been documented spawning in Lower Putah Creek (Moyle 1999).

The upper portion of the Suisun Creek Watershed is located in the County and provides a movement corridor for some aquatic species. Several waterfalls downstream of Lake Madigan pose natural barriers to aquatic species movement, such that the portion of the watershed upstream would not be accessible to migratory fish even if the dam at Lake Madigan were not present. Gordon Valley Dam on



Under the potential buildout scenario, an additional 48,730 acres of land would be converted to agricultural or urban/residential use, which would represent a 54% increase in developed land in the County.

Lake Curry, along with several smaller made-made barriers, chiefly bridges and culverts, does block anadromous fish access to potential habitat. The number of additional barriers along the creek downstream to the Suisun Marsh is unknown. Historically, Suisun Creek supported a steelhead run, and steelhead have been observed in the vicinity of the Wooden Valley Creek confluence as recently as 2001 (Leidy et al. 2003).

POTENTIAL IMPACT OF BUILDOUT

Under the potential buildout scenario, an additional 48,730 acres of land would be converted to agricultural or urban/residential use, for a total of 139,614 acres of developed land in the County. This would represent a 54% increase in developed land in the County. No time frame is specified for this buildout scenario. However, if the rate of future development is similar to the rate of agricultural development between 1992 and 2003, then approximately 11,590 acres will be converted from natural areas to agricultural use every 10 years, so that buildout as described above would occur over 120 years. Map 4-19 illustrates the distribution of parcels that are partially used for urban development or intensive agriculture use at present, envisioning them fully converted to these uses in the future. Map 4-19 also indicates the parcels that are not currently used for residential/urban use or intensive agriculture and could be protected to provide for wildlife dispersal and migration after buildout. The Western Mountains, Eastern Mountains, and Pope Valley Evaluation Areas emerge as areas of particular concern.

North-south movement in the Western Mountains and Eastern Mountains areas is already somewhat constrained by roads and development. Buildout would result in severe disruption of wildlife movement in these areas. Pope Valley currently provides a linkage for wildlife between the northwest corner of the County and the eastern portion of the County. Additional residential or agricultural development in the Pope Valley area may isolate areas in the northwest corner of the County and adjacent areas in Lake County from the Cedar Roughs Conservation Area and other areas in Eastern Napa County. Even if intact corridors between these natural areas remain, adjacent development could narrow the corridor's east-west dimension, causing constrictions that would reduce corridor quality. Narrow corridors may not provide the habitat attributes necessary for many species. In addition, a narrow corridor may provide only edge habitat. Some predators are more active in edge habitat, resulting in higher predation rates within narrow corridors (Environmental Law Institute 2003), as well as increased stress resulting in displacement and/or mortality.

EVALUATION AREA RESOURCES

This section of the report discusses biological resources and management issues in the County's 13 evaluation areas.

NAPA RIVER MARSHES EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Napa River Marshes Evaluation Area is located in the south of the County where the Napa River empties into San Pablo Bay. It covers 15,420 acres or just under 3% of the County. Much of this area is undeveloped, with less than 25% of the area in urban or intensive agricultural use. The most common land cover types in this area are former salt ponds (approximately 28% of the evaluation area), salt marsh (22%), open water in the Napa River and associated sloughs (approximately 13%), and annual grassland (9%) (Table 4-5).

Past levee building and salt pond development have greatly altered the habitat found throughout much of this area. Portions of the Napa Salt Ponds are currently being restored to salt marsh by the California Department of Fish and Game. The coastal salt marsh in this area is a valuable and sensitive biological community, and represents about 96% of the salt marsh in the County. This habitat type is expected to increase dramatically (by up to 1,500 acres) over the next 10 years as restoration proceeds.

HABITAT

These salt marshes and the nearby brackish marshes and riparian mudflats provide habitat for a diverse community of plant and wildlife species, including four special-status plants, 13 special-status birds, six special-status fish, and two special-status mammals.

Special-status fish species such as Central California coastal steelhead (*Oncorhynchus mykiss*), fall/late fall-run Chinook salmon, delta smelt, splittail (*Pogonichthys* spp.), and longfin smelt could occur in the Napa River marshes. Most of these species are found in the Napa River that runs through the marshes and also in San Pablo Bay, which abuts the marsh area. Juvenile and adult Central California coastal steelhead use the lower area of the Napa River out to San Pablo Bay as a migration corridor, as well as fall/late fall-run Chinook salmon. Juvenile chinook salmon may also use the tidal mudflats to forage for food. Delta smelt and longfin smelt may also use this area for larvae and juvenile rearing. Larval delta and longfin smelt have been collected in the Napa River (Maniscalco pers. comm.). Sacramento splittail (*Pogonichthys macrolepidotus*) adults and juveniles have also been collected in the Napa River and use tidal marshes for foraging.

Other fish species found in the Napa River salt ponds include staghorn sculpin (*Gymnocanthus tricuspis*), yellowfin goby, striped bass, American shad (*Alosa sapidissima*), inland silverside, Shimofuri goby (*Tridentiger bifasciatus*), longjaw mudsucker (*Gillichthys mirabilis*), and rainwater killifish (Takekawa et al. 2000). Only two species are native (staghorn sculpin and longjaw mudsucker), and the rest are introduced species.

The Napa River wildlife movement corridor begins in the marshlands in this evaluation area. Potential development in this area is limited to grasslands, so terrestrial wildlife movement within this evaluation area is constrained mostly by natural features such as the Napa River, sloughs, and channels.

SENSITIVE BIOTIC COMMUNITIES

Four sensitive biotic communities (freshwater marsh; saltgrass-pickleweed marsh; vernal pools; and riverine, lacustrine, and tidal mudflats) are found in this area. One small area of mixed willow riparian woodland is mapped in this area, as well.

HABITAT PROTECTION

- Much of the salt marsh and all of the former salt ponds in the Napa River Marshes Evaluation Area are part of the San Pablo Bay National Wildlife Refuge (USFWS), the Napa-Sonoma Marshes Wildlife Area (DFG), or the Fagan Slough Ecological Reserve (DFG). These preserves are managed for biodiversity conservation. In addition, significant areas along the Napa River that are currently isolated behind levees are being restored to floodplain wetlands. These areas will be managed for biodiversity and flood control. Unprotected grasslands in the area are subject to vineyard and low-intensity residential development.

- The Nature Conservancy (TNC) also identified this evaluation area as an important conservation area in the County (The Nature Conservancy of California 2003), although it was ranked as a low conservation priority by TNC because it contains only one biological community targeted for conservation in an ecoregional analysis and has low vulnerability to development. Nonetheless, this conservation area is a biological hotspot in the County, and one of the most important areas for special-status wildlife.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Napa River Marshes Evaluation Area.

- Marshlands are particularly sensitive to hydrological changes brought about by upstream agricultural or urban development, dredging, levee building, and channel re-alignment. Capture of freshwater flow by public and private reservoirs in the watershed influences the salinity gradient in the Napa Marsh, a key habitat characteristic for plants and wildlife.

- Domestic and feral cats (*Felis cattus*) pose a threat to the wildlife inhabiting marshes and other natural areas.

- Grasslands in the Napa River Marshes Evaluation Area are under severe threat from vineyard conversion. In the last 30 years almost all of the grasslands present in the area have been converted to vineyard. The Land Trust of Napa County ranks the remaining grasslands northwest and east of the Napa River Marshes as priority areas for biodiversity protection (Land Trust of Napa County 2003). Grasslands adjacent to the marsh enhance the marshes' habitat function by providing adjacent uplands for use as a refuge during flooding events. These uplands are also essential for wintering waterfowl. The habitat quality of the Napa River Marshes Evaluation Area for fish and wildlife would be enhanced by maintaining a grassland buffer around all or a portion of these wetlands.

- Invasive species, particularly tall peppergrass (*Lepidium latifolium*), threaten to displace native plants and degrade habitat quality for native wildlife.

JAMIESON AND AMERICAN CANYONS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Jamieson/American Canyon evaluation area is located in the south of the County, east of the Napa River Marshes. This area contains over 16,000 acres (3% of the County). It includes the City of American Canyon. The most common land cover types in this area are annual grasslands (49%), agriculture (27%), and urban/developed (16%). The Jamieson/American Canyon area includes more grassland acreage than any other evaluation area in the County (approximately 16% of the County's total grassland). Much of this grassland is in relatively large blocks, although vineyard conversion and urban development have resulted in some habitat fragmentation.

Golf course development can endanger serpentine grassland-dependent species.

HABITAT

Most of these grasslands are dominated by annual, nonnative grass species. Nonetheless, they provide habitat for a diverse community of plants and animals, including potential habitat for a large number of special-status species (Maps 7-8 and 7-12). Riparian woodland is also present in this area. Some small serpentine grasslands are found in American Canyon (The Nature Conservancy of California 2003), although they are not defined on the ICE map because of complex geology and poorly defined aerial signature.

Past levee building and salt pond development have greatly altered the habitat found throughout much of this area.

Special-status wildlife species such as white-tailed kite, golden eagle, loggerhead shrike, and the endangered Callippe silverspot breed and forage in the grasslands in this area. These grasslands may also support nesting grasshopper sparrows (*Ammodramus savannarum*). This is one of the most important wintering areas for ferruginous hawk (*Buteo regalis*) in the county. The westernmost Swainson's hawk (*Buteo swainsoni*) nesting territory in the Bay Area was recently established (in 2003 and 2004) here and provided the first county record of this special-status species. Tiburon Indian paintbrush, an endangered plant species, occurs on serpentine grasslands in American Canyon. Big scale balsamroot (*Balsamorhiza macrolepis* var. *macrolepis*), a rare grassland plant species, also occurs in the American Canyon area. No special-status fish species are known to occur in this area.

Much of the salt marsh and all of the former salt ponds in the Napa River Marshes Evaluation Area are part of the San Pablo Bay National Wildlife Refuge (USFWS), the Napa-Sonoma Marshes Wildlife Area (DFG), or the Fagan Slough Ecological Reserve (DFG). These preserves are managed for biodiversity conservation.

SENSITIVE BIOTIC COMMUNITIES

The Jamieson/American Canyon area contains approximately 4% of the County's salt marsh and 7% of the County's freshwater wetlands, both of which are sensitive biotic communities. In addition, small areas of California bay forest and mixed willow riparian woodland are present in this area. Although it is not mapped in this area on the ICE map, serpentine grassland is another sensitive community that occurs here. Vernal pools are found in this evaluation area, as well.

HABITAT PROTECTION

Over 1,100 acres, or 12% of the natural areas in the Jamieson and American Canyon Evaluation Area, have been protected from development by the Land Trust of Napa County in the Creston Station Ranch Conservation Easement and the Newell Open Space Preserve (The Nature Conservancy of California 2003). This area is ranked by TNC as a low conservation priority for the County, because it only contains one ecological system prioritized for conservation in their ecoregional analysis (serpentine bunchgrass), and, due to recent conservation purchases by the Land Trust of Napa County, this area is thought to be only moderately vulnerable to development (The Nature Conservancy of California 2003).

However, the area has already been significantly fragmented; no blocks of habitat larger than 19 square miles (50 square kilometers) undivided by roads remain. The high conservation value of remaining blocks of grassland in this area make limiting additional development here a priority. The Land Trust of Napa County ranks grassland in this area as a moderate to high priority for biodiversity protection.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Jamieson and American Canyons Evaluation Area.

- The Jamieson/American Canyon area contains 45% of the County's mapped eucalyptus (*Eucalyptus* spp.) forests. Eucalyptus forests may offer good opportunities for restoration to native forest types, especially in riparian settings.
- Population of serpentine grassland-dependent species in this area are threatened by quarrying and golf course development.
- Jamieson/American Canyon is one of four areas in the County with confirmed occurrences of SOD (California Oak Mortality Task Force 2003). The disease has been documented in American Canyon. The disease should be monitored and sanitary measures, such as cleaning vehicles and equipment used in infected areas, should be used to prevent its spread.
- While a significant area of grassland in American Canyon is protected, much remains vulnerable to development. Maintaining open grassland habitat is essential to maintaining current use of this area by resident and migratory eagles and other raptors. Use of grasslands in this area by these special status birds is well documented (J. Ruygt pers. comm.).
- A relatively narrow corridor of natural vegetation connects this area to the Atlas Peak-Mount George area. In order to prevent populations in this area from becoming isolated, maintaining this linkage to a north-south movement corridor is important. The encroachment of development on this movement corridor could be particularly detrimental to wildlife species that depend on grassland, such as coyotes.

CARNEROS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Carneros area is located in southwestern County, just north of the Napa River Marshes. It contains 10,622 acres (2% of the County). The most common land cover types in this area are agriculture (70%), grasslands (13%), urban/developed (6%), and oak woodlands (5%).

HABITAT

A portion of Carneros Creek, a tributary to the Napa River, flows through this evaluation area, as does Huichica Creek. These creeks provides habitat for many sensitive species, including the threatened Central California Coast steelhead trout (Leidy et al. 2003). Huichica Creek is one of only 17 creeks that comprise the entirety of the current known distribution of the California freshwater shrimp. The Carneros Creek channel, unlike most creeks in the County, has undergone relatively little channel alteration and retains most of its historic meanders and wetlands (Grossinger et al. 2004).

The grasslands and oak woodland in this area provide habitat for a diverse community of plants and animals, including special-status bird species listed above for Jamieson/American Canyon as well as pallid bat, and showy Indian clover.

SENSITIVE BIOTIC COMMUNITIES

Small areas of the following sensitive biotic communities are mapped in this area: freshwater marsh, salt marsh, California bay forest, and mixed willow riparian woodland (Table 4-5). Remnants of native grasslands, considered a sensitive community by DFG, are present in the Carneros Creek watershed, but are not mapped (Grossinger et al. 2004). Vernal pools are present in the Huichica Creek watershed.

HABITAT PROTECTION

No conservation areas of significant size are located in this evaluation area. However, significant stewardship efforts are underway in both the Huicha Creek and Carneros Creek watersheds.

The Huichica Creek Stewardship Group focused initially on protecting the endangered California freshwater shrimp, through projects such as the development of a special pesticide labeling project to protect shrimp. The Huichica Creek Stewardship Group is now involved in habitat restoration in the uplands and along the creek. Using a demonstration vineyard operated by the Napa County RCD, the Huichica Creek Sterwardship Group promotes sustainable agricultural practices such as the use of native cover crops, putting up fences to keep livestock out of the creek channel, and changing the direction of tillage operations on fields adjacent to the creek.

The Carneros Creek Stewardship has developed a Watershed Management Plan (Carneros Creek Stewardship 2005), and has restored riparian vegetation along the creek.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Carneros Evaluation Area.

- The Carneros evaluation area contains 25% of the County's mapped eucalyptus forests, offering native riparian forest restoration opportunities. Native grasslands in this area should be conserved.
- Due to the comparative lack of channel alteration in Carneros Creek and the lack of fish passage barriers between it and the San Francisco Bay, Carneros Creek has importance as a viable stream for steelhead (Grossinger et al. 2004). Management actions to conserve the value of this stream for steelhead and other species include the restoration of riparian vegetation and careful management of surface and groundwater use to minimize reduction of stream base flow (Carneros Creek Stewardship 2005).
- Fire suppression may have resulted in increased extent and density of chaparral and oak woodlands in the upper Carneros watershed. Prescribed fires or fuel management is recommended to prevent a catastrophic fire that could result in greatly increased sediment delivery to the creek (Grossinger et al. 2004)
- Supporting sustainable agricultural practices in this evaluation area is critical to maintaining good habitat quality, particularly for aquatic species whose habitat may otherwise be degraded by sediment and pesticide inputs.

NAPA VALLEY FLOOR EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Napa Valley Floor area stretches from the southern portion of the County nearly to its northwestern boundary. It contains over 57,700 acres (12% of the County). The Napa River defines this evaluation area, which also contains portions of many of the river's tributaries. The Napa Valley Floor area contains the majority of the County's vineyards and urban areas. Agricultural land comprises 53% of this evaluation area, while urban land comprises 28% of this area. Other common land cover types in the Napa Valley Floor are oak woodlands (11% of the area) and grassland (5%).

HABITAT

The Napa River is a highly valuable biological resource, providing habitat for many sensitive species, including threatened steelhead trout, Chinook salmon, and other special-status fish species discussed under *Napa River Marshes*, Mason's lilaeopsis, and endangered California freshwater shrimp. Additionally, many of the western tributaries and some of the eastern tributaries to the Napa River contain steelhead (Stillwater 2002). Riparian woodlands in this area provide habitat for a diverse community of plants and animals, including special-status species such as Northern California black walnut, Sebastopol meadowfoam, migrating willow flycatcher (*Empidonax traillii*) Yellow-breasted chat and California Swainson's thrush. The lower reach of the Napa River, at the entrance to the Napa Marsh, provides significant habitat for Mason's Lilaeopsis.

The Napa Valley Floor is the only area in the county that still supports a very small breeding population of yellow-breasted chat (Berner et al. 2003).

Numerous municipal and winery waste-water treatment ponds are scattered throughout the valley and support large numbers of wintering and migrating waterfowl, shorebirds, herons, egrets and other waterbirds. A few vernal pools are also found in this area. Vernal pools are a rare habitat that has been heavily impacted by development. Vernal pools in this area tend to occur on volcanic substrates, and are usually found in complexes of small pools (Keeler-Wolf et al. 1998). Hot springs near Calistoga are also a rare and important habitat. The hot springs provide habitat for a unique flora that differs from other wetlands in the region (Keeler-Wolf et al. 1998). Swales and pools and surrounding grasslands associated with the hot springs are the only known locations for the Calistoga popcornflower and Napa bluegrass.

The reach of the Napa River between St Helena and Calistoga is an important area for salmon spawning and California freshwater shrimp (The Nature Conservancy of California 2003). Outside of a relatively narrow strip of freshwater wetlands and riparian forest, most of the land in this area has been converted to agriculture.

Through much of this evaluation area, riparian and stream corridors are narrow and discontinuous. However, they can still function as important wildlife corridors, especially for resident and migratory birds that can effectively move through stretches of fragmented riparian forest. The Silverado Trail parallels the river and deer fence enclosures may function as a potential barrier to mammalian movement to and from the river and the foothills on the eastern side of the valley. The river itself functions as an important wildlife corridor, allowing movement through an otherwise largely inhospitable environment for native wildlife species.

The Napa Valley Floor area stretches from the southern portion of the County nearly to its northwestern boundary; it contains the majority of the County's vineyards and urban areas.

Fire suppression may have resulted in increased extent and density of chaparral and oak woodlands in the upper Carneros watershed. Prescribed fires or fuel management is recommended to prevent a catastrophic fire.

Chaparral in the Western Mountains supports Calistoga ceanothus (*Ceanothus divergens*) and Sonoma Ceanothus (*Ceanothus sonomensis*).

SENSITIVE BIOTIC COMMUNITIES

Approximately 21% of the County's riparian woodlands and 10% of the County's Oregon white oak woodlands are found in this evaluation area. Both of these vegetation types are considered sensitive communities. Small areas of the following sensitive communities are also found in this evaluation area: freshwater wetlands, salt marsh, redwood forest, serpentine grasslands, California bay forest, and serpentine chaparral. In addition, vernal pools and hot springs are found in this area.

HABITAT PROTECTION

No large natural conservation areas are found in this evaluation area, although the Land Trust of Napa County holds significant agricultural conservation easements in the area and DFG manages the 80-acre Napa River Ecological Reserve.

However, significant restoration projects are underway in various locations in this evaluation area. The Napa River Ecosystem Restoration Plan, a joint project of the Napa County RCD and the U.S. Army Corps of Engineers, will be an important step towards protecting valuable biological resources in this area. A project to restore and enhance the Napa River between Rutherford and Zinfandel is currently in the design phase. Restoration projects, including the removal of barriers to fish passage and the creation of pool habitat, are ongoing in Sulphur Creek, (Grossinger et al. 2003) as well as in Mill Creek.

The Napa River area was ranked by TNC as of low conservation value because it contains only three biological communities that have been targeted for conservation by ecoregional analyses (The Nature Conservancy of California 2003). However, the area is still ranked as medium priority for conservation because it is extremely vulnerable to development and degradation, as less than 1% of the land is currently protected.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Napa Valley Floor Evaluation Area.

- The Napa River was listed as "impaired" by the State Water Quality Control Board in 1990 as a result of historical stream channel and floodplain modification resulting in increased bank erosion, sedimentation, and downstream flooding.
- Supporting sustainable farming practices on existing farmland and to the protection of protect riparian habitat are critical steps towards protecting the area's biological treasures. Working with vintners to reduce erosion and restore or enhance the riparian vegetation in the floodplain will improve water quality and habitat quality.
- Invasive species such as giant reed and periwinkle are degrading habitat quality along the Napa River. Preventing the spread of invasive species and reducing existing populations is important for successful habitat restoration.
- Protecting and enhancing contiguous corridors of riparian vegetation along the Napa River and its tributaries will facilitate wildlife movement through this evaluation area. Working with vintners to minimize the installation of deer fencing would also enhance wildlife movement.
- The Napa Valley Floor is one of four areas in the County with confirmed occurrences of SOD (California Oak Mortality Task Force 2003). The disease has been documented in Westwood Hills Park near the City of Napa, and in the vicinity of Calistoga.
- This area also contains 16% of the County's mapped eucalyptus forests, offering potential native forest restoration opportunities.

WESTERN MOUNTAINS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Western Mountains area is located in the Mayacamas Range, west of the Napa Valley Floor. The Mayacamas Mountains are part of the Outer North Coast Ranges, characterized by relatively high rainfall. The Western Mountains area contains over 51,600 acres (10% of the County). Over 40% of the area is covered by oak woodlands, which represent about 13% of the oak woodland in the County. Mixtures of Douglas-fir and redwoods cover approximately 25% of the Western Mountains. Other common land cover types in this area are agriculture (10% of the evaluation area) and grasslands (7%).

HABITAT

This area contains 78% of the County's coast redwood forest, which is a sensitive and extremely rich biological resource that is rare in the County. Much of this redwood forest is found along the tributaries of the Napa River in the northern and central portions of the Western Mountains, which include Ritchie Creek, Mill Creek, Sulphur Creek, Bear Canyon Creek, Redwood Creek, and Dry Creek. These creeks provide potential habitat for steelhead, foothill yellow-legged frog (*Rana boylii*) and the endangered California freshwater shrimp.

The oak woodlands and Douglas-fir-redwood forests in the Western Mountains Evaluation Area provide habitat for a diverse community of plants and animals, including special-status species. For example, the threatened northern spotted owl, olive-sided flycatcher (*Contopus cooperi*), and sharp-shinned hawk (*Accipiter striatus*) may be found in the area's dense coniferous forests. Northern spotted owl has been documented in much of the evaluation area, but documented occurrences are concentrated in the area's central and southern portion (Map 4-9; Underwood and Hollander 2001).

Chaparral in the Western Mountains supports Calistoga ceanothus (*Ceanothus divergens*) and Sonoma Ceanothus (*Ceanothus sonomensis*). The area's ridgelines also have concentrations of sensitive biological resources.

Although only 14% of the Western Mountains Evaluation Area is composed of agricultural cropland or urban/developed areas, the agricultural and residential development that has occurred has extensively fragmented natural areas. Underwood and Hollander's analysis (2001) showed that no blocks of habitat greater than 19 square miles (50 square kilometers) undivided by roads remained, and much of the area had no blocks of habitat greater than 2 square miles (5 square kilometers).

SENSITIVE BIOTIC COMMUNITIES

The Western Mountains area contains 78% of the County's coast redwood forest, 81% of the County's Oregon white oak woodland, 57% of the County's California bay woodland, and 32% of the County's riparian woodland, all considered sensitive biotic communities. Over 700 acres of serpentine chaparral is mapped in the Western Mountains. Old-growth Douglas-fir stands are also located in this area. In addition, small areas of serpentine grasslands and freshwater marsh are mapped in this evaluation area.

HABITAT PROTECTION

Over 2,000 acres of this evaluation area (4%) is protected in conservation areas including Bothe-Napa State Park and the Land Trust of Napa County's Archer-Taylor Preserve. Although TNC did not rank this area's biological resources as of the highest value in the County, the high vulnerability of these resources to loss or disturbance made it one of their top conservation priorities (The Nature Conservancy of California 2003).

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Western Mountains Evaluation Area.

- The primary concern to the area's biological resources is from rural residential development and vineyard conversion, which alters and fragments habitat for many species, and which affects stream hydrology through increased erosion.
- Sudden Oak Death (SOD) poses a threat to oak woodlands in this area. This evaluation area is one of four areas in the County with confirmed occurrences of SOD (California Oak Mortality Task Force 2003). The Western Mountains contain more documented occurrences of SOD than any other area in the County. The moist conditions and large areas of California bay, which is a favored host species for SOD, make the spread of the disease a serious threat to the area's oak woodlands.
- An altered fire regime poses a threat to Douglas-fir forests in this area. Years of fire prevention have led to a buildup of brush in these forests, increasing the risk of high-intensity fires. While Douglas-fir forests benefit from relatively frequent, low-intensity fires, infrequent high-intensity fire can threaten the survival of Douglas-fir stands and lead to their replacement by other vegetation types. Fuel management practices such as understory thinning and brush removal would reduce the threat to these stands.
- Providing linkages between existing conservation areas and protecting additional ones is a high priority due to ongoing fragmentation. Linkages to the Mount Saint Helena area are also critical to preserve the value of this area as a wildlife movement corridor on the west side of the County. Unless development in this area is clustered and maintains movement corridors, movement of species using oak woodlands and coniferous forests could be significantly reduced.
- Maintaining and enhancing biological resources associated with creeks and riparian forest is also of paramount importance in this area.
- Maintaining substantial blocks of mature conifer forest is essential to sustain the spotted owl population.

EASTERN MOUNTAINS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Eastern Mountains area is located east of the Napa Valley Floor. It contains over 81,600 acres (16% of the County). The Eastern Mountains form a ridge demarcating the eastern boundary of the Napa Valley. Notable mountain peaks in this area include Atlas Peak, Haystack, Stags Leap, and Mount George. These mountains are transitional from the moister and cooler Outer North Coast Ranges to the drier and hotter Inner North Coast Ranges. This drier and hotter climate is responsible for the presence of more chaparral (22% of the evaluation area) and grassland (10%) than are present in the Western Mountains. However, as in the Western Mountains, much of the Eastern Mountains area is covered by oak woodlands, which constitute approximately 40% of the area's acreage, and represent over 19% of the oak woodland in the County. Blue oak is more common in this area than in the Western Mountains area. Coniferous forest (12%) is also a common land cover type in this area.

HABITAT

Riparian woodland in this area is found along the tributaries of the Napa River in the Eastern Mountains, which include Moore, Conn, Suscol, Tulocay, Soda Canyon, Sarco, Chiles, Sage, and Milliken Creeks. These creeks provide potential habitat for steelhead and Northwestern pond turtle, while birds such as yellow warbler may be found in the riparian woodlands adjacent to them.

Lake Hennessy, a reservoir found in this area, provides habitat for a number of bird species that nest and/or forage over open water or adjacent marshes, such as great blue herons, bald eagle, osprey (*Pandion haliaetus*) and northern harrier.

The oak woodlands in this area provide habitat for a diverse community of plants and animals, including special-status species such as Lewis's woodpecker, Lawrence's goldfinch, the endangered Clara Hunt's milk-vetch, serpentine dwarf flax (*Hesperolinon serpentinum*), California beaked-rush, and Marin checkerbloom (*Sidalcea hickmanii* ssp. *viridis*).

Lake Hennessy, a reservoir found in this area, provides habitat for a number of bird species that nest or forage over open water or adjacent marshes.

The primary threat to the Eastern Mountains' biological resources is from rural residential development and vineyard conversion, which alters and fragments habitat for many species, and which influences stream hydrology through increased erosion.

The Eastern Mountains Evaluation Area contains the largest remaining vernal pool complexes in the County, located in the southern portion of the evaluation area. The evaluation area also contains more than half (51%) of the County's rock outcrop area. Rock outcrops in this evaluation area include portions of the Palisades in the north of the County and outcrops around Atlas Peak and Mount George in the south and center of the County. Rock outcrops provide a key habitat feature for special-status plants, raptors and bats.

In the northern portion of the evaluation area, in the vicinity of Mount Saint Helena is a diverse assemblage of coniferous forests and chaparral. Coniferous forests in this area include knobcone pine forest and Douglas-fir–Ponderosa pine forests. California red-legged frog has been documented along the creeks in this area (Underwood and Holland 2001). The Douglas-fir and Douglas-fir–Ponderosa pine forests concentrated near the Napa-Lake County line are rich biological communities. Old-growth Douglas-fir forests are present in this area. Many special-status plants have been documented in this area (Map 4-5), as well as northern spotted owls (Underwood and Hollander 2001), and these forests provide potential habitat for many special-status wildlife species (Map 4-11)

The southern portion of the evaluation area, in the vicinity of Atlas Peak and Mount George, contains no areas larger than 19 square miles (50 square kilometers) that remain undivided by roads (Underwood and Hollander 2001), but does contain several areas of greater than 5 square kilometers and was ranked as moderately vulnerable to further development by TNC (2003).

SENSITIVE BIOTIC COMMUNITIES

The Eastern Mountains area includes significant acreages of several sensitive communities: riparian woodlands (10% of the riparian woodland mapped in County), freshwater wetlands (16%), serpentine grassland (7%), Oregon white oak woodland (9%), serpentine chaparral (5%), and California bay woodland (25%). Old-growth Douglas-fir-Ponderosa Pine stands may be present in this area. Vernal pool complexes are present in the Atlas Peak area.

In addition, small areas of the following sensitive communities are mapped in this evaluation area: riverine and lacustrine mudflats, Sargent cypress woodland, redwood forest, Ponderosa pine forest, and tanbark oak woodland.

HABITAT PROTECTION

Preserves in the Eastern Mountains include the Skyline Wilderness Park in the south of the area, the Foote Botanical Preserve, Robert Louis Stevenson State Park, the Land Trust of Napa County's Mead Ranch conservation easement around Atlas Peak, various state lands commission properties, and The Land Trust of Napa County easements. A significant portion of the area around Mount Saint Helena is protected, which will help maintain the unfragmented nature of the area.

Vernal pool complexes are, in part, currently protected by the Mead Ranch Conservation Easement. Others are currently protected within the confines of the Napa City Milliken Reservoir property, while others are unprotected.

TNC ranked the southern portion of this area, around Atlas Peak and Mount George, as having low conservation value because it contained only two biotic communities targeted for conservation by ecoregional analysis, vernal pools and northern mixed chaparral, but also moderately vulnerable to development. TNC ranked the northern portion of this evaluation area as having moderate conservation value, as well as being moderately vulnerable to development (The Nature Conservancy of California 2003).

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Eastern Mountains Evaluation Area.

- The primary concern to the area's biological resources is from rural residential development and vineyard conversion, which alters and fragments habitat for many species, and which influences stream hydrology through increased erosion. While the rugged topography and relatively hot and dry climate in this area reduces its attractiveness for development, it also creates potential problems with erosion and altered hydrology more significant.

- The Eastern Mountains area is one of four areas in the County with confirmed occurrences of SOD (California Oak Mortality Task Force 2003). The disease has been documented in Skyline Park, and elsewhere in the southern portion of the evaluation area.

- Maintaining wildlife movement corridors between the Atlas Peak-Mount George region and the Mount Saint Helena Conservation Area and to the American Canyon area to the south is critical to ensure that sensitive populations in this area do not become isolated. Unless development in this area is clustered, it could impact the movement of coniferous forest species found in the northern portion of the area, and of oak woodland species that are more abundant in the southern portion.

- Much of the Douglas-fir and Douglas-fir-Ponderosa pine forests and serpentine chaparral along the Napa-Lake County line is currently unprotected. The Land Trust of Napa County ranks these areas as high priorities for biodiversity conservation (Land Trust of Napa County 2003).

- Maintaining a natural fire regime is critical to knobcone pine forests and chaparral communities. Preserving large intact blocks of habitat will allow these communities to burn periodically without loss of property or investment.

- Maintaining linkages between this area and the Mayacamas Range will preserve a valuable north-south wildlife corridor in the County west of Napa Valley, as well as providing connectivity for species requiring coniferous forest habitat.

- Expansion of facilities on peaks for the purpose of television, radio and cellular services may interrupt use of these areas by migratory birds.

ANGWIN EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Angwin area is a small plateau located in the north central portion of the County, around the town of Angwin. It contains over 4,800 acres (1% of the County). The most common land cover types in this area are oak woodland (18%) and Douglas-fir-Ponderosa pine forest (28% of evaluation area). Old-growth Douglas-fir-Ponderosa pine forest is considered a sensitive community by DFG (2003a). The Angwin area contains 15% of the County's Douglas-fir-Ponderosa pine forest. The extent of old-growth stands has not been mapped. Other common land covers in this area are urban areas in Angwin itself (16%), and agricultural land (19%).

HABITAT

The Douglas-fir-Ponderosa pine forest in this area provides habitat for a diverse community of plants and animals, including special-status species such as Northern spotted owl, narrow-anthered California brodiaea (*Brodiaea californica* var. *leptandra*) Napa false indigo (*Amorpha californica* ssp. *napensis*), Cobb Mtn. Lupine, and marsh checkerbloom. It is also only one of two locations in the county with pygmy nuthatch. Oak woodland in this area provides habitat for special-status species such as pallid bat. While Conn Creek has been hydrologically altered through the creation of reservoirs for drinking water, it continues to provide riparian habitat for species such as Northwestern pond turtle (CNDDB 2004). Before the construction of the Conn Reservoir in 1946, the Conn Creek system, with its many perennial reaches and likely high-quality habitat, may have been one of the more important tributary watersheds for steelhead spawning and rearing in the Napa River basin.

SENSITIVE BIOTIC COMMUNITIES

As stated above, old-growth Douglas-fir-Ponderosa pine forest is found in this evaluation area. In addition, 79% of the County's Ponderosa pine forest, which is a rare community in the County, is located in this evaluation area. Small areas of the following sensitive communities are also mapped in this evaluation area: tanbark oak woodland, California bay woodland, and freshwater wetlands.

HABITAT PROTECTION

- Preserves in the Angwin evaluation area include the Las Posadas State Demonstration Forest and easements and preserves held by the Land Trust of Napa County in the Linda Falls area and on Sentinel Hill.

- Portions of this area are ranked as moderate or high priorities for biodiversity protection by the Land Trust of Napa County.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Angwin Evaluation Area.

- The primary threat to the area's biological resources is from residential development, timber harvest/conversion, and vineyard conversion, which alters and fragments habitat for many species, and which may influence stream hydrology through increased erosion. In 2003, large-scale erosion compromised the water quality in Lake Whitehead, raising awareness of widespread problems with erosion in the County (Crabbe 2003).

A key concern for biological resources is to minimize impacts from residential development, timber harvest/conversion, and vineyard conversion, which can alter and fragment habitat for many species, and which may influence stream hydrology through increased erosion.

LIVERMORE RANCH EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Livermore Ranch area is located in the northwest portion of the county It contains over 13,400 acres (3% of the County). The most common biotic communities in this area are Douglas-fir-Ponderosa pine (19% of evaluation area), Douglas-fir alliance (12%), knobcone pine forest (17%), and mixed manzanita (15%). Knobcone pine forest in this area provides habitat for a number of fire-dependent species, as well as for the special-status species Cobb Mountain lupine. The Douglas-fir-Ponderosa pine forest in the Livermore Ranch area represents 27% of the total acreage of this community type in the County.

HABITAT

The chaparral habitat in the Livermore Ranch area provides habitat for several special-status plants, Konocti manzanita (*Arctostaphylos manzanita* ssp. *elegans*), Sonoma beardtongue, bay buckwheat (*Eriogonum umbellatum* var. *bahiiforme*), Colusa Layia, narrow-anthered California brodiaea, green jewel-flower, and Rincon Ridge Ceanothus (*Ceanothus confusus*) as well as the only primary wintering habitat for Townsend's solitaire (*Myadestes townsendi*) and thick-billed fox sparrow (*Passerella iliaca megarhynchus*) in the county. A small amount of serpentine chaparral is mapped in this evaluation area. Peregrine falcon nests in the evaluation area on the Palisades Cliffs. These volcanic rock outcrops represent 31% of the County's rock outcrops and are a key habitat feature for raptors and other special-status species.

SENSITIVE BIOTIC COMMUNITIES

White alder riparian woodland (10% of the County's overall acreage for this biotic community) and Brewer willow riparian scrub (6% of the County's acreage) are found along some reaches of Saint Helena Creek, Troutdale Creek, and James Creek in this evaluation area. Brewer willow scrub occurs on serpentine soils and is considered a sensitive community by DFG (2003a). Old-growth Douglas-fir-Ponderosa pine forest is found in this area, although its extent is not mapped. Almost 400 acres of California bay forest and over 200 acres of serpentine chaparral occur in this evaluation area. In

Maintaining connectivity for wildlife movement across the Livermore Ranch area to the western part of the County is important for species such as black bear that depend on coniferous forests.

addition, small areas of the following sensitive communities are mapped in this evaluation area: freshwater marsh, McNab cypress woodland, and serpentine grassland.

HABITAT PROTECTION

Preserves in the Livermore Ranch area include Robert Louis Stevenson State Park, which has received additional lands through the The Land Trust of Napa County, and the Cleary Reserve, a research station owned and operated by the Biological Field Studies Association. TNC ranked this area as having moderate conservation value, as well as being moderately vulnerable to development (The Nature Conservancy of California 2003).

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Livermore Ranch Evaluation Area.

- Maintaining connectivity for wildlife movement across the Livermore Ranch area to the western part of the County is important for species such as black bear that depend on coniferous forests.
- Management concerns related to coniferous forests in this evaluation area are similar to those discussed for the northern portion of the Eastern Mountains Evaluation Area. These concerns include the need to protect Douglas-fir, and Douglas-fir-Ponderosa pine forests from development and the opportunity to maintain wildlife corridors to the Western Mountains in order to benefit species using coniferous forests.
- Maintaining a natural fire regime is critical to knobcone pine forests and chaparral communities. Preserving large intact blocks of habitat will allow these communities to burn periodically without loss of property or investment.

SOUTHERN INTERIOR VALLEYS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Southern Interior Valleys area is located in the southeastern portion of the County. It contains over 29,500 acres (6% of the County). The most common land cover types in this area are oak woodlands (68% of the evaluation area) and annual grasslands (16%).

The freshwater marsh and wet meadows in this evaluation area represent 17% of the County's mapped freshwater wetlands.

Riparian woodland in the Southern Interior Valleys consists of valley oak woodland (approximately 10% of the County's valley oak riparian forest), white alder woodland, and mixed willow riparian forest/scrub.

HABITAT

The oak woodlands in this area provide habitat for a diverse community of plants and animals, including special-status species such as pallid bat. Gordon Valley Creek, Wooden Valley Creek, and part of Suisun Creek flow through the Southern Interior Valleys.

Freshwater marsh, wet meadows, and riparian woodland are found along their banks. The freshwater marsh and wet meadows in this evaluation area provide important foraging and breeding sites for many wildlife species, as well as habitat for wetlands plants such as amphibians such as California red-legged frog.

Yellow warblers breed in this riparian woodland, and the valley elderberry longhorn beetle has been documented in riparian woodland vegetation along Suisun and Wooden Valley Creeks (California Natural Diversity Database 2005). Migrating steelhead have been observed in Suisun and Wooden Valley Creeks (Leidy et al. 2003, Koehler 2002).

SENSITIVE BIOTIC COMMUNITIES

Freshwater wetlands and riparian woodland, discussed above, occur in this evaluation area. Vernal pools are mapped in this area. Over 700 acres of California bay forest is mapped in this evaluation area, as well. In addition, small areas of serpentine grassland and serpentine chaparral are mapped in this evaluation area.

HABITAT PROTECTION

Over 2,000 acres of open space surrounding Lake Curry are located in this evaluation area and managed for water quality protection. These lands are known as the Vallejo Lakes Reservoir Lands. However, the overall percentage of protected land in the evaluation area is low (less than 10%).

The Nature Conservancy ranked this area as a moderate conservation priority, with a moderate number of biological communities that are top conservation targets and a moderate level of vulnerability to development. The Land Trust of Napa County ranks much of this area as high or medium priority for biodiversity protection (Land Trust of Napa County 2003). In particular, the area surrounding Suisun Creek, upstream of Lake Curry, is a high priority for the Land Trust of Napa County for biodiversity protection.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Southern Interior Valleys Evaluation Area.

- Protecting and enhancing the valleys' creeks and associated woodland and wetland habitat are priorities for management of this area's biological resources.

- Riparian woodland and vegetation on Wooden Valley Creek is absent in several reaches, and canopy cover is low in other reaches. Contributing factors include livestock impacts and vineyard encroachment into the riparian corridor.

- An assessment study is currently underway for restoration of steelhead habitat on Suisun Creek. Suisun Creek had steelhead runs in the past, but they were impacted by the construction of Gordon Valley Dam to form Lake Curry. Removing non-native invasive plants along Suisun Creek will also be a focus of this restoration effort.

- Low summer flows in Wooden Valley Creek (Koehler 2002) and Suisun Creek compromise the quality of these creeks for steelhead and other native fish.

- High sediment inputs have resulted in reduced habitat quality for fish and other aquatic species in Wooden Valley Creek (Koehler 2002). Some of this sediment may be a natural result of landslides. However, exposed soil associated with grazing practices, zero cover management under grape vines, tree crops, and between rows in ground crops is common in this watershed (Noss et al. 2002). Reducing erosion in this watershed by managing drainage from roads, grazing, and agricultural cropland, would enhance habitat.

CENTRAL INTERIOR VALLEYS EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Central Interior Valleys area comprises Chiles, Capell, and Soda Valleys, which are located east of the Napa Valley. Chiles Valley and Soda Valley are located within the Napa River Watershed, while Capell Valley is located in the Berryessa Watershed. The evaluation area contains over 30,400 acres (6% of the County). The most common land cover types in this area are oak woodland (50% of the evaluation area), serpentine chaparral (19%), agriculture (9%), grassland (8%), and non-serpentine chaparral (7%).

HABITAT

The serpentine chaparral in this area represents 12% of the County's acreage of this sensitive community, and provides critical habitat for a diverse community of native plants such as narrow-leaved daisy, Brewer's western flax, and Napa western flax (*H. serpentinum*). The oak woodlands in the Central Interior Valleys evaluation area also include almost 10% of the County's remaining valley oak woodlands and are important to wintering Lewis's woodpecker.

This area is notable for the occurrences of one of the few remaining native stands of California black walnut, located in Capell Valley (California Natural Diversity Database 2005).

SENSITIVE BIOTIC COMMUNITIES

As noted above, this evaluation area contains a significant fraction of the County's serpentine chaparral. Other sensitive communities occurring in this evaluation area include serpentine grassland (7% of County's total), riparian woodland (8%), and tanbark oak forest (50% of County's total). Almost 700 acres of California bay forest occurs in this evaluation area. Almost 400 acres of Douglas-fir-Ponderosa pine forest occurs in this evaluation area. It is not known whether any of the Douglas-fir-Ponderosa pine forest contains old-growth stands. In addition, small areas of the following sensitive communities are mapped in this evaluation area: freshwater wetlands, Sargent cypress woodland, McNab cypress woodland, and redwood forest.

HABITAT PROTECTION

The US Bureau of Land Management protects an area along Capell Creek, and the Land Trust of Napa County holds conservation easements on approximately 1,500 acres of vineyards and open space in Chiles Valley. However, a very small percentage of the land in this evaluation area is protected. The Land Trust of Napa County ranks this area as a moderate to low priority for conservation.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Central Interior Valleys Evaluation Area.

- The primary concern to the area's biological resources is from rural residential development and vineyard conversion, which alters and fragments habitat for many species, and which influences stream hydrology through increased surface runoff and erosion. As steep hillsides are converted to vineyards in this area, erosion and its effect on water quality becomes an increasing concern.

- Tanbark oak is particularly vulnerable to SOD, and special care should be taken to prevent the spread of the disease to this evaluation area.

- Lower Soda Creek was extensively redirected in historic times, and anadromous fish habitat was eliminated as a result. Nonetheless, restoration of fish habitat in the creek may be more feasible than in other creeks on the east side of the Napa Valley, as no major dam blocks passage between the Napa River and Soda Creek (Stillwater Sciences and Dietrich 2002).

Chiles Valley. The Central Interior Valleys Evaluation Area contains serpentine chaparral, almost 10% of the County's remaining valley oak woodlands, and one of the few remaining native stands of California black walnut.

In addition, small areas of the following sensitive communities are mapped in Central Interior Valleys evaluation area: freshwater wetlands, Sargent cypress woodland, McNab cypress woodland, and redwood forest.

POPE VALLEY EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

Pope Valley is located east of Angwin . It contains over 38,400 acres (8% of the County). Pope Creek, Burton Creek, Maxwell Creek, and Hardin Creek drain this evaluation area. The most common land

Vineyard conversion has proceeded rapidly in this evaluation area.

cover types in this area are oak woodland (29% of the evaluation area), serpentine chaparral (23%) (a sensitive community), and grassland (15%).

HABITAT

The oak woodlands are known to support large populations of Lewis's woodpecker. Serpentine meadows or swales provides habitat in this area for special-status plants such as serpentine dwarf flax and large-flowered pink star tulip (*Calochortus uniflorus*).

Pope and Maxwell Creeks generally maintain at least a low level of base flow year-round, most likely as a result of the springs and seeps that are common in serpentine substrates. There is limited use of the area's creeks by rainbow trout, as water temperatures are mostly above optimal levels in the summer. However, rainbow trout from Lake Berryessa have been observed spawning in Pope Creek in the winter (Jones 2001).

Especially notable are the vernal pools in this evaluation area, which, although occupying a very small area, provide habitat for a community of wildlife and plant species adapted to their unusual hydrology, such as Baker's navarretia, Lobb's water buttercup, cotula navarretia (*Navarretia cotulifolia*) and the threatened vernal pool fairy shrimp. Vernal pools in the Pope Valley area are small and underlain by a variety of soils including serpentine soils, and may be surrounded by valley oak and blue oak woodland or by serpentine chaparral. Wetlands on the valley floor also provide potential habitat for California red-legged frog. Remaining freshwater wetlands and vernal pools in this area are concentrated in areas adjacent to vineyards. All remaining vernal pools are vulnerable to development activities.

SENSITIVE BIOTIC COMMUNITIES

As noted above, significant areas of serpentine chaparral are found in this area. The Pope Valley area contains significant acreages of three other sensitive serpentine communities, serpentine grassland (17% of the total acreage in the County), Sargent cypress woodland (46%), and Brewer willow scrub (17%). The Sargent cypress woodland in this area is the western portion of Cedar Roughs, which is discussed further in the section on the Berryessa Evaluation Area, below. Other sensitive communities with significant acreage in the Pope Valley area are freshwater marsh (45% of the County's total), riparian woodland (20%), old-growth Douglas-fir-Ponderosa pine forest, and vernal pools. The fraction of Douglas-fir-Ponderosa pine forests in Pope Valley that are old-growth is unknown. Over 450 acres of California bay forest is mapped in this evaluation area.

In addition, small areas of the following sensitive communities are mapped in this evaluation area: riverine mudflats, McNab cypress woodland, redwood forest, and Ponderosa pine forest.

HABITAT PROTECTION

Preserves in this area include the Land Trust of Napa County's 730-acre Wantrup Wildlife Sanctuary and 80-acre Baerwald preserve, both of which protect oak woodlands. A portion of the BLM's Cedar Roughs Wilderness Area is also located in this evaluation area.

The Nature Conservancy ranked this area as a top conservation priority, with highly valuable biological resources that are highly vulnerable to development. The Napa Land Trust ranked the lands linking the Wantrup Preserve and the Knoxville area as high priority for biodiversity protection (Land Trust of Napa County 2003). Few large blocks of habitat remain in this area.

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Pope Valley Evaluation Area.

- Vineyard conversion has proceeded rapidly in this evaluation area (The Nature Conservancy of California 2003).
- Protecting the watersheds that support vernal pools and wetlands in this area from impacts associated with development is important in order to maintain these valuable biological communities.
- Maintaining natural areas as corridors connecting Pope Valley to the Knoxville-Cedar Roughs area, Atlas Peak/Mt. George areas, and Mount St. Helena area is challenging, given the amount of vineyard conversion in Pope Valley. However, such linkages are critical to maintain the long-term viability of wildlife and plant populations in Pope Valley. Movement of grassland-dependent wildlife species could be particularly compromised by additional development in this area.
- Serpentine grasslands and vernal pools are small, patchily distributed features with high biological value. An effort to map these resources with a higher degree of accuracy in this area would help ensure that the resources are considered in future environmental impact analysis. However, lack of access to many sites may make such a mapping effort impracticable.

BERRYESSA EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Berryessa area is located in the central eastern portion of the county. This evaluation area includes Lake Berryessa and the surrounding upland areas, including portions of the watershed of Putah Creek, the major source of water for the lake, and the watersheds of other creeks that supply the lake: Eticuera, Adams, Nevada, Pope, and Capell Creeks. It contains over 95,000 acres (19% of the County). The most common land cover types in this area are oak woodland, mostly blue oak (40% of the evaluation area) and chaparral (30%). One third of the chaparral consists of serpentine types, while two thirds are non-serpentine types. Open water, principally in Lake Berryessa, makes up 20% of the evaluation area. The chaparral in this area provides habitat for a diverse community of plants and animals, including special-status species such as Bell's sage sparrow (*Amphispiza belli belli*).

HABITAT

Serpentine substrates on the slopes to the west of Lake Berryessa provide habitat for special-status plant species, including several occurrences of the highly localized Brewer's western flax (*Hesperolinon brewerii*), modest rock cress, Heller's bush mallow and other species such as green jewel-flower. Bald eagles, osprey, and golden eagles nest around the lake. Foothill yellow-legged frog is found in Eticuera Creek which feeds Lake Berryessa and California red-legged frog is found south of the lake.

Cedar Roughs is named for the 3,000-acre stand of Sargent Cypress located there, which early settlers mistakenly identified as cedar (Anderson 2001). This stand is reputedly the largest Sargent Cypress stand in the world. The Cedar Roughs area provides habitat for a significant black bear population in Napa County.

The Berryessa area is located adjacent to a large, relatively intact area of natural vegetation known as the Blue Ridge-Berryessa Natural Area that extends north to the Mendocino National Forest and east to the Capay and Sacramento Valleys. Its great biological value stems not only from unique or sensitive biological communities, but also from its size and lack of fragmentation. Within Napa County, little fragmentation of this area due to residential development or vineyard conversion has occurred. It is due to this characteristic that it functions as valuable wildlife corridor for north-south movement, as well as providing habitat for wildlife needing large home ranges, such as bald and golden eagles, mountain lions, and bears.

SENSITIVE BIOTIC COMMUNITIES

Several communities in the evaluation area are considered sensitive by the DFG, almost all of them on serpentine substrates: serpentine chaparral (22% of the county's total), Brewer willow (11%), serpentine grasslands (25%), and Sargent cypress (47%). In addition, 9% of the County's mixed willow riparian woodland is found in the Berryessa Evaluation Area. Over 250 acres of California bay forest is mapped in this evaluation area. In addition, small areas of the following sensitive communities are mapped in this evaluation area: freshwater wetlands, lacustrine mudflats, and McNab cypress woodland.

HABITAT PROTECTION

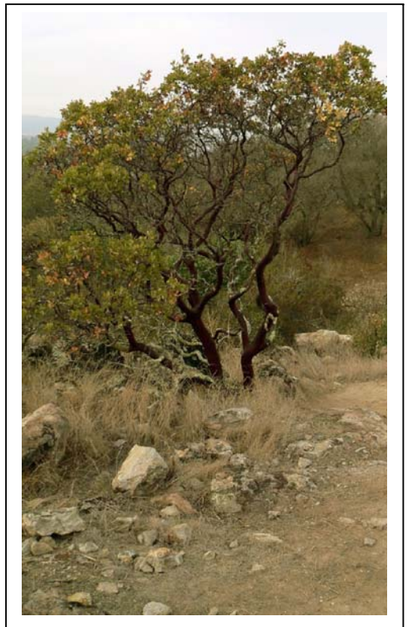
Protected areas in the Berryessa evaluation area include much of the 5,880-acre BLM Cedar Roughs, which protects the largest known stand of Sargent cypress. Cedar Roughs has been designated by the BLM as a Wilderness Study Area (WSA) and an Area of Critical Environmental Concern (ACEC) to protect its botanical values. At the south end of the lake, the University of California's Stebbins Cold Canyon Preserve protects chaparral habitats, and the Quail Ridge Wilderness Preserve preserves 837 acres on the Quail Ridge peninsula.

The Nature Conservancy ranked this area as a moderate conservation priority, with a moderate number of biological communities that are top conservation targets and a moderate level of vulnerability to development. The Land Trust of Napa County ranks much of this area as high or medium priority for biodiversity protection (Land Trust of Napa County 2003).

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Berryessa Evaluation Area.

- Lake Berryessa, located within hours of the major population centers of San Francisco and the Bay Area and Sacramento, is likely to experience increasing pressure from recreational activities; the BLM's Visitor Services Plan is attempting to address long-term recreational needs and their environmental impacts.
- Residential development has occurred around Lake Berryessa in several residential subdivisions (Berryessa Highlands, Berryessa Pines, Berryessa Estates, and others) approved and developed in the 1960s.
- Sediments and wildlife in Lake Berryessa have high levels of mercury as a result of inputs from historical mercury mines upstream, and natural background sources could also play a role.
- Disturbance of this area due to the invasive species and altered hydrology from Lake Berryessa is a concern.
- Overgrazing is a problem in this evaluation area. Overgrazing can degrade riparian corridors, as it results in excessive erosion and compromises water quality. Overgrazing also degrades habitat quality for regional flora and fauna.



Land cover in the Knoxville Evaluation Area includes chaparral. In the chamise alliance, chamise is the sole dominant; other shrubs present in small amounts include manzanitas (*Arctostaphylos* spp.).

KNOXVILLE EVALUATION AREA

BIOLOGICAL RESOURCES

LAND COVER

The Knoxville Evaluation Area is located in the extreme north of the County, north of Lake Berryessa. The evaluation area contains over 61,600 acres (12% of the County). The most common land cover type in this area is chaparral (52%). Serpentine chaparral makes up more than half of this acreage (30% of the evaluation area), while non-serpentine types such as chamise chaparral and chamise–wedgeleaf ceanothus chaparral account for 22% of the evaluation area. Other common land cover types in this area are oak woodlands (30%) and grassland (13%).

HABITAT

The chaparral in this area provides habitat for a diverse community of plants and animals, including special-status species such as pink creamsacs (*Castilleja rubicundula* ssp. *rubicundula*) and adobe lily.

Streams are mapped throughout the County and vary from narrow mountain streams to broad lowland rivers.

The serpentine chaparral and grasslands also provide habitat for several other sensitive plant species, including Hall's harmonia, drymaria-like western flax (*Hesperolinon drymarioides*), and several others.

Protected raptors such as osprey, golden eagle and bald eagle have nested in the evaluation area. This is the primary region in the County for the locally rare greater roadrunner (*Geococcyx californianus*).

The evaluation area contains the watersheds of Putah Creek and Eticuera Creek, the major sources of water for Lake Berryessa. These creeks and their tributaries in the southeastern portion of the evaluation area provide habitat for foothill yellow-legged frog and northwestern pond turtle.

The Homestake Mine (now in reclamation) and McLaughlin Reserve area, located in the northernmost tip of the County, contains a particularly high density of special-status plant species occurrences (Map 4-14). While this high occurrence density may be partly associated with the intensive survey effort associated with the permitting of the Homestake Mine and subsequent efforts by researchers at the reserve, some of the density reflects the extensive size of the serpentine landmass here. This concentration of serpentine soils has promoted the evolution of several regional endemic species and supports a number of other more broadly distributed serpentine endemics. The high density of special-status species is also a function of the mosaic of serpentine seeps, serpentine chaparral, and serpentine grassland in this area. Serpentine seeps in the area provide habitat for special-status species such as serpentine sunflower, Cleveland's butterweed, Cleveland's milkvetch, swamp larkspur, and bare monkey flower (*Mimulus nudatus*). Townsend's western big-eared bat (*Corynorhinus townsendii townsendii*) has been documented in abandoned mine tunnels in this area.

The Knoxville Evaluation Area's habitat value is further enhanced by its relatively unfragmented state, as there is little development and there are few roads (Underwood and Hollander 2001).

SENSITIVE BIOTIC COMMUNITIES

A large proportion of the Knoxville evaluation area is underlain by serpentine substrates, and as a result, this evaluation area contains significant proportions of the County's sensitive serpentine communities: serpentine chaparral (39% of the county total), Brewer willow (33%), McNab cypress (93%), and serpentine grasslands (40%). The Knoxville area also contains 44% of the mudflats and 24% of the *Carex-Juncus* wet meadows. A relatively large native grasslands restoration site (256 acres) is located in this evaluation area. Native grasslands are considered a sensitive community by the DFG.

In addition, small areas of the following sensitive communities are mapped in this evaluation area: freshwater marsh, Sargent cypress woodland, and mixed willow riparian woodland.

HABITAT PROTECTION

A large proportion of chaparral and grassland in the evaluation area is public land or within protected areas. The Knoxville Wildlife Area protects 8,104 acres of grassland and chaparral and is one of the few areas in California that protects serpentine habitats. It is managed by the Bureau of Land Management (BLM), the University of California (UC) Natural Reserve System and the Blue Ridge/Berryessa Natural Area Conservation Partnership and is part of the multi-county 300,000-acre Blue Ridge/Berryessa Natural Area. Adjacent to the Knoxville Wildlife Area is the Homestake McLaughlin Mine Conservation Easement that protects an additional 6,000 acres (including lands in Yolo and Lake counties) and will be part of UC Davis's Natural Preserve System. The Land Trust of Napa County's 270-acre Missimer Snell Valley Wildflower Preserve is located in this evaluation area.

TNC (2003) identified this area as being of the highest priority for conservation. The Land Trust of Napa County ranked areas linking protected land in Knoxville with protected land in Cedar Roughs as high or medium priority for biodiversity protection (Land Trust of Napa County 2003).

MANAGEMENT CONSIDERATIONS

The following management considerations apply to the Knoxville Evaluation Area.

- The public lands in the Knoxville area are the only legal Off Highway Vehicle (OHV) use area in Napa County. In the past, OHV use on public lands in the Knoxville evaluation area has resulted in heavy impacts, and erosion, meadow degradation, and streambed erosion have been reported by the BLM. In addition, OHVs have damaged water quality systems installed by the Homestake Mine designed to reduce cinnabar and mercury contamination of Lake Berryessa (Napa County Sheriff 2003). Currently, sensitive areas are closed to OHV use and the area is actively patrolled by law enforcement agencies.

- Commercial mining activity has not ceased, and mercury leaching from historical mines is a potential source of contamination to creeks in the evaluation area.

- A key management consideration for the Knoxville Evaluation Area is maintaining connectivity between this area and the Cedar Roughs area, which share similar biotic community types. While wildlife movement between these two areas is currently mostly unconstrained, residential development around Lake Berryessa could reduce the quality of the linkage between these two areas.

- Maintaining connectivity to natural areas in the Blue Ridge–Vaca Mountains area, as well as the Atlas Peak-Mount George area, will preserve a relatively unconstrained north-south wildlife movement route through the County.

- The area is threatened by noxious weeds, a legacy of overgrazing (Anderson 2001).

FISHERIES RESOURCES

INTRODUCTION

This section provides a detailed discussion of the fisheries resources found in the County. It describes the physical watershed characteristics of the County, including hydrology, geology, sediment transport, and water quality attributes that are intimately tied to fisheries habitat within the County. The section also discusses the primary special status and common fisheries communities that occur in the County. The section concludes with an analysis of presence of steelhead, a key indicator species in the watershed, within the County as based on flow characteristics, slope, and the location of barriers within the watershed.

PURPOSE

This section provides information on the nature and distribution of steelhead/rainbow trout (*Onchorhyncus mykiss*) utilization in Napa County based on the best data available at time of printing, with additional discussion of the potential utilization of Napa County's watersheds by other fish species. The purposes of this report are the following.

- Provide a scientific basis for future Countywide, regional and site-specific level assessments of project impacts and the evaluation of mitigation measures, conservation proposals, and enhancement opportunities for biological resources in Napa County.
- Serve as the existing conditions section for biological resources discussion in a planned Countywide General Plan Update.
- Serve as a basis to evaluate current and future policies in the County as they relate to biological resource protection.
- Document the methods and definitions used to establish a Countywide searchable biological resources database.

METHODOLOGY

The analysis was specifically focused to provide a scientifically defensible basis for determining known and potential utilization of the County's streams by steelhead trout. Steelhead trout was the only species rigorously analyzed for the following reasons.

- Steelhead are listed both under the federal and state endangered species acts (ESA and CESA, respectively).
- Steelhead are the listed species with the most extensive historical and current distribution within the County. All other listed fisheries in the watershed occur within a subset of the current extent of steelhead utilization. Thus, policy based on steelhead habitat would be inclusive of all special-status fisheries in the watershed.
- Steelhead are particularly susceptible to the effects of urbanization and modification of streams (e.g., negatively impacted by changes in sedimentation, loss of habitat, alteration of flows, and alterations to the temperature regime). Thus, impacts to the species are an indicator of the health of the system for other special-status species.

WATERSHED CHARACTERIZATION

Fish habitat is, to varying degrees, defined by the geomorphic characteristics of the watersheds. In Napa County this includes the Napa River Watershed, the Putah Creek Watershed, and the Suisun Creek Watershed. Technically, Lake Berryessa is a catchment within the Putah Creek Watershed, isolating the upper watershed from the lower watershed since the completion of Monticello Dam in 1957. While water is released from the dam downstream, fish movement is not possible between the upper and lower watersheds and, thus, does not provide habitat for anadromous fisheries, including steelhead.

In the following sections, known physical characteristics of the Napa River, Lake Berryessa, and Suisun Creek Watersheds will be discussed, with specific emphasis on those attributes most relevant to fisheries in each watershed. In the Napa River Watershed, the physical attributes of concern are hydrology, geology, sediment transport, and land use. This is due to the extensive development of the watershed, which has resulted in alteration of flows necessary for steelhead migration, alteration of bedload movement and sediment inputs, and disconnection of channel from floodplain habitat. In the Napa River Watershed, sediment transport is of specific concern, due to the listing of the Napa River as impaired for sediment by the State Water Resources Control Board (SWRCB).

In the Putah Creek Watershed, the attributes of concern include hydrology, geology, and water quality. All of the concerns are related, whether directly or indirectly, to the significant alteration of the catchment resulting from the construction of Monticello Dam.

HYDROLOGY/WATER QUALITY

Napa County has a Mediterranean climate characterized by warm, dry summers and cool, moist winters. The majority of annual precipitation occurs as rain that falls during the winter and early spring. The highest rainfall occurs on the western side of the Napa River Watershed. Between 1961 and 1990, the average annual precipitation was 35–40 inches (89–102 cm) in the western portion of the watershed, and 20–25 inches (51–64 cm) in the eastern portion of the watershed (Western Regional Climate Center 2002). Rainfall gages also show a north-south trend of precipitation in the watershed, while the average daily maximum temperature decreases to the south (Western Regional Climate

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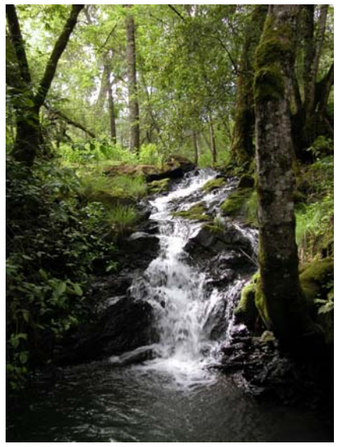


Channels with slopes of 10–20% are commonly dominated by bedrock and boulders, and are frequently crossed by woody debris, creating what is known as cascade topography.

Center 2002). This is the result of coastal fog keeping the lower valley cooler. A more detailed discussion of climate is provided in Chapter 3, Climate and Air Quality, in this BDR.

County streams are mapped throughout the County and vary from narrow mountain streams to broad lowland rivers (see Map 4-20). Peak flows in the Napa River are rainfall-dominated and occur between November and early April, with the majority in December through February. The Napa River Limiting Factors Analysis (Stillwater Sciences 2002) analyzed peak flows using instantaneous peaks from the USGS Napa River near St. Helena gage between 1929 and 1996 (Table 4-10). Based on the discharge record, the 1.5-year recurrence interval flow (a typical recurrence interval for bankfull flow) at St. Helena was approximately 4,200 cfs (120 cms), while the 10-year flow was approximately 12,500 cfs (354 cms). The flood of record at the St. Helena gage between 1929 and 2004 was 16,900 cfs (478 cms) in February 1987.

Table 4-10. Instantaneous Peak Flow Magnitudes for the Napa River at St. Helena Gage (Number 11456000) Between 1929 and 1996

Return Period (years)	Discharge (cfs)
1.5	4,225
2	6,007
5	10,157
10	12,450
50	16,155
100	17,271

Source: U.S. Geological Survey 2005.

The Putah Creek Watershed provides the water supply for Lake Berryessa and is derived from the 568-square-mile drainage basin above Monticello Dam. The elevation of the basin ranges from 182 feet at the dam to 4,722 feet at the upper end of Putah Creek, with most of the basin lying below 1,500 feet. Four principal creeks flow into Lake Berryessa: Putah Creek, the main drainage of the basin; Capell Creek; Pope Creek; and Eticuera Creek. Lake Berryessa has a storage capacity of 1,600,000 acre-feet (AF) at elevation 440 feet, the top of the conservation pool. The average annual in flow to the reservoir is 369,000 AF and the annual firm yield is 201,000 AF.

The Lake Berryessa water level may fluctuate from 455 feet to a minimum elevation of 253 feet. A water level of 309 feet is considered dead storage elevation. During the severe drought of 1977, the level was lowered to 388 feet. The latest Probable Maximum Flood (PMF) approved August 28, 1984 (and signed in January 1986) has a peak inflow of 275,000 cfs, a 2-day volume of 586,000 acre-feet, and a 10-day volume of 873,200 acre-feet, and is preceded by the 100-year flood. Flood routing studies indicate the PMF would overtop the dam parapet walls by 6 feet (elevation 462 feet) for 51 hours. The reservoir floodplain, from elevation 440 feet to 455 feet, can be encroached at various times.

Oversight of the water quality of Lake Berryessa is provided jointly by U.S. Bureau of Reclamation (Reclamation) and the California Department of Health Services. Reclamation collects monthly samples at Lake Berryessa for analysis of fecal coliform bacteria, as well as for water samples taken quarterly from Putah Creek below the dam to determine the presence of biological agents such as *Giardia* and *Cryptosporidium*; inorganic materials such as chloride, fluoride and sulfate; and a variety of minerals including mercury, arsenic, barium and zinc. The California Department of Health Services test for many of the elements monitored by Reclamation, but takes its samples in the vicinity of the lake's concession resorts.

Water quality from all the sources currently meets the standards for drinking water supplies as specified under Title 22 of the State of California. However, in 1987, the Napa County Department of Environmental Health issued warnings advising people to limit their consumption of certain Lake Berryessa fish due to potential mercury contamination.

GEOLOGY/GEOMORPHOLOGY

The Napa River Watershed is a northwest-trending structural and topographic depression (Map 4-21) (Hearn et al. 1988) that has largely evolved since the early Pleistocene (about 2 million years ago) as a result of downwarping associated with regional folding and faulting (Wright and Smith 1992). The watershed is located at the southern end of the northern California Coast Range province. The elevations of surrounding peaks range between less than 1,000 to more than 4,000 feet. The elevation of the valley floor drops from about 340 feet near Calistoga to about 50 feet near Napa (Stillwater Sciences 2002).

The valley bottom area of the Napa Valley can be differentiated into two important geomorphic units: alluvial fans and valley fill. All valley floor deposits are very porous and permeable. The Napa River has intermittent flow for most of its course in the valley floor during the dry summer period, except in the lower reaches, where groundwater recharge creates perennial stream conditions. The dominant vegetation in the valley floor terrain is agricultural crops, orchards, and vineyards, along with grassland/herbaceous areas (Stillwater Sciences 2002).

Lake Berryessa is located in the northeastern portion of Napa County, among the hilly to steep mountains of the California Coast Range. The eastern shores and both ends of the lake are underlain predominantly by Cretaceous Knoxville sandstone and shale, over which the Bressa, Dibble, Los Gatos, Maymen, Sobrante, and Tehama soils series formed. The western side of the lake is bounded by Jurassic Franciscan sedimentary and associated intrusive rocks, such as serpentine and dolerite. The Montara, Hambright, and Henneke soils developed over those materials.

The Suisun Creek Watershed is located along the southeastern portion of Napa County. Upper Suisun Creek falls within Napa County and the lower portion of Suisun Creek is in Solano County and empties in Suisun Marsh and Bay.

SEDIMENT TRANSPORT

Sediment transport throughout any watershed can have a variety of effects on any fish population. Such effects include the direct abrasion of gills resulting from high concentrations of fine sediment in the water column; changes in channel characteristics and habitat attributes that have indirect impacts on species, including the filling of refuge habitat in pools; and sedimentation of spawning gravels that results in poor oxygenation of steelhead eggs. Additionally, deposition of excessive fine sediment on the stream bottom could eliminate habitat for aquatic insects; and reduce density, biomass, number, and diversity of aquatic insects and vegetation (Jones & Stokes 2004). These effects can be directly tied to the way material is mobilized and deposited throughout a watershed. It is important to remember, however, that the appropriate concentrations, size and mobilization of sediments provide habitat-forming functions within the watershed that can be beneficial to steelhead.

Generally, sediment transport functions that result in alterations of channel characteristics and habitat attributes correlate with channel slope (as described in Montgomery and Buffington 1998); hence, a map of channel gradient through the network gives a first approximation of expected channel morphology and processes (Map 4-22, Table 4-11).

Slopes steeper than 0.2 (20%) are often shallow cuts into hillslope materials, are frequently dry (i.e. ephemeral), and provide very limited localized fish habitat.

Channels with slopes between 0.1 and 0.2 are commonly dominated by bedrock and boulders, and are frequently crossed by woody debris, creating what is known as cascade topography. Finer gravel may be locally trapped in small pockets on the rough bed or behind woody debris jams. These channels, which typically drain small areas, tend to dry seasonally as well, and have very limited annual sediment transport. These reaches provide habitat for a vast array of fish species who use habitat features such as boulders and woody debris as cover from potential predators or places for predators to seek prey. These reaches provide ample passage, with appropriate flow, and can provide spawning habitat for fisheries.

Channel slopes between 0.05 and 0.10 commonly have boulder-rich beds that are organized into shallow and relatively immobile steps between small pools, creating what is known as step-pool topography. This topography may include channels with slopes as low as 0.02. In the presence of appropriate hydrology and water quality, these reaches provide a limited range of habitat for certain fish species. These channel reaches provide refuge zones for smaller fishes or juveniles of certain species, such as steelhead.

Channels with slopes between 0.001 and 0.02 are usually gravel-bedded with bar and pool topography. The gravels in these channels tend to move on an annual basis. The presence of large woody debris in streams with slopes in the 0.001 to 0.10 range has the potential to substantially alter channel morphology, creating deeper pools, more abundant patches of finer gravels, and complex habitat favorable to fish.

On the Napa River, the bed becomes sand-dominated where the channel slope drops below about 0.001, which occurs in the vicinity of Imola Avenue in Napa (WET, Inc. 1990). The river downstream of this area has experienced historic aggradation (i.e., accumulation) with sand and associated flooding (WET, Inc. 1990) (Stillwater Sciences 2002). The majority of the mainstem Napa River has slopes between 0.001 and 0.02 (0.1-2%) (Stillwater Sciences 2002).

Table 4-11. The Distribution of Channel Gradients Throughout the Napa River Watershed

Channel gradient	Length (miles)	Length (km)
> 0.2	261	421
0.1-0.2	296	476
0.05-0.1	226	364
0.02-0.05	233	376
0.001-0.02	295	475
< 0.001	23	36

Source: Stillwater Sciences 2002.

Large rainstorms that sweep across the Napa River Watershed periodically induce shallow and deep-seated landsliding/soil movements. These landslides pose a risk to structures and roads, and may introduce large quantities of sediment to specific reaches of channels. The USGS, in cooperation with California Geological Survey and California Department of Forestry and Fire Protection, have mapped shallow and deep-seated landslides, debris flows, earthflows, and gullies in portions of the Napa River Watershed (Nilsen and Turner 1975, Dwyer et al. 1976, Durham 1979a, Durham 1979b, Nilsen et al. 1979, Ellen et al. 1997, Wentworth et al. 1997, Godt et al. 1999). The maps reveal a dense network of gullies in the southwestern portion of the watershed, with numerous shallow landslides and small earthflows scattered across the watershed. While the gully mapping agrees with observed conditions in the Carneros and Redwood Creek Watersheds, the shallow landslide and debris flow mapping likely underestimate the current conditions across the Napa River Watershed (Stillwater Sciences 2002).

Based on comparison with landslide occurrence elsewhere, data on local landsliding were classified into the following hazard classes by Stillwater Sciences (2002): stable areas, low instability areas, moderate instability areas, high instability areas, and chronic instability areas. Areas classified as "stable" are locations where the landscape is not sufficiently steep to expect shallow landslides to occur. Deep-seated landslides involving the underlying bedrock may occur in such areas but are not included in the model. Shallow landslide hazard modeling, completed by Stillwater Sciences (2002), showed that the majority of the Napa River Watershed is stable, with few areas of high or chronic instability (Table 4-12).

Large rainstorms that sweep across the Napa River Watershed periodically induce shallow and deep-seated landsliding/soil movements. These landslides pose a risk to structures and roads, and may introduce large quantities of sediment to specific reaches of channels.

Table 4-12. Summary of SHALSTAB Results for the Napa River Watershed

Hazard Class	Area (acres)	Total (%)
Stable	206,437	83.6
Low instability	23,361	9.5
Moderate instability	14,763	6
High instability	2,287	0.9
Chronic instability	22	<0.1
Total	246,870	100

The areas of highest instability are in the northern portion of the watershed. This area has the greatest relief of any part in the Napa River Watershed, and also the steepest slope. The hills on the southeastern portion of the watershed are the most stable portion of the watershed, with regard to potential for shallow landsliding, excluding the valley floor. These landslides can result in the catastrophic alteration of habitat; the negative effects of sedimentation that normally occur under gradual conditions can occur in very short periods of time under landslide conditions, with severe short-term effects on local fisheries. While landslides are events that naturally occur, the effects of development (e.g., road-cutting, slope modification, and hydrologic alteration) can increase the frequency and extent of landslides or create landslide hazards in areas where the would not naturally occur.

By the 1840s, the primary land uses in the Napa River Watershed were agricultural activities. Vineyards were first developed in the 1860s, and up until 1960 the valley floor was used primarily for a combination of orchards, field crops, and vineyards, with localized urban development.

LAND USE

By the 1840s, the primary land uses in the Napa River Watershed were agricultural activities, including grazing, field crops, and timber production. Vineyards were first developed in the 1860s, and up until 1960 the valley floor was used primarily for a combination of orchards, field crops, and vineyards, with localized urban development in the cities of Napa and Towns of Yountville, St. Helena, and Calistoga. The area under grape production in the Napa River Watershed rapidly increased from approximately 15 square miles in 1970 to 49 square miles in 1996 (about 25% of which occur on hillsides, and the remainder on the valley floor and alluvial fans) (Napa County RCD 1997). Timber was intensively harvested in certain parts of the watershed until the 1950s. Groundwater pumping rates peaked between 1910 and 1950 and gradually decreased until water pumping to support frost protection once again increased groundwater extraction. However there was relatively little frost pumping between 1973 and 2000 (Stillwater Sciences 2002). Approximately 34 square miles of the watershed are currently developed for urban uses, including areas that are managed for recreational use, industrial and commercial development, and both high and low density residential housing (Table 4-13). Exclusion of approximately 17% of the Napa River Watershed to anadromous migration occurred when three major dams (Conn, Bell, and Rector dams) were built on the major tributaries to the Napa River within a short time period (1946 to 1959). Direct in-channel alterations include river-bottom dredging on the mainstem Napa River from its mouth to about 15 river miles upstream to improve navigation, intensive removal of large woody debris (LWD) and channel clearing, channelization (i.e., channel/tributary straightening), and levee construction in the 1960s and 1990s for flood control. These land cover changes, in-channel activities, and water use practices have altered the physical processes that shape the quality, abundance, and connection of habitat for salmonids and other native fish and wildlife species.

According to USGS map data, forests (evergreen, deciduous, and mixed) cover approximately 35% of the watershed (Table 4-13). Residential (low and high intensity) and industrial/commercial/ transportation development categories combined account for a little under 8% of the watershed. All agricultural cover types combined, including orchards and vineyards (12.9%), pasture/hay (5.6%), row crops and small grains (each less than 0.1%), account for nearly 19% of the watershed, with another 22.6% in grasslands and other herbaceous cover types that are often used as rangeland.

Table 4-13. Areal Extent of Land Use/Land Cover Types in the Napa River Watershed

Land Use/Cover Type	Acres	Mi^2	Km^2	Total (%)
Open Water	14,110	22.0	56.7	5.2
Low Intensity Residential	16,630	25.9	66.9	6.1
High Intensity Residential	106	0.2	0.4	< 0.1
Industrial/ Commercial/ Transportation	4,181	6.5	16.8	1.5
Bare Rock/Sand/Clay	1,363	2.1	5.5	0.5
Quarries/Mines/Gravel Pits	758	1.2	3.1	0.3
Transitional Barren	203	0.3	0.8	0.1
Deciduous Forest	1,578	21.2	54.6	5.0
Evergreen Forest	58,277	90.9	234.3	21.5
Mixed Forest	25,205	39.3	101.3	9.3
Shrubland	18,966	29.6	76.2	7.0
Orchards/Vineyards	34,902	54.4	140.3	12.9
Grasslands/Herbaceous	61,428	95.8	246.9	22.6
Pasture/Hay	15,100	23.6	60.7	5.6
Row Crop	335	0.5	1.3	0.1
Small Grains	343	0.5	1.4	0.1
Urban/Recreation Grass	1,030	1.6	4.1	0.4
Woody Wetland	392	0.6	1.6	0.1
Emergent Herbaceous Wetland	4,388	6.8	17.6	1.6
Total	257,932	423	1,091	100

FISHERIES ASSEMBLAGE

NAPA RIVER

The Napa River Watershed supports an assemblage of twenty-two native fish species, including several threatened and species of concern such as steelhead/rainbow trout, fall-run Chinook salmon,

Pacific lamprey (*Lampetra tridentata*), delta smelt (*Hypomesus transpacificus*), and Sacramento splittail (*Pogonichthys macrolepidotus*) (Leidy 1997). The Napa River is estimated to have historically supported a run of 6,000–8,000 steelhead, and as many 2,000–4,000 coho salmon (USFWS 1968). By the late 1960s, coho salmon had been extirpated, and steelhead had declined to an estimated run of less than 2,000 adults (USFWS 1968, Anderson 1969). The present-day run of steelhead is believed to be fewer than a few hundred adults (Stillwater Sciences 2002). Much less information is available to determine the historical abundance of Chinook salmon. However, examination of Napa River's habitat and hydrology indicates that potential habitat was historically, and is presently, available; and captures of wild Chinook salmon juveniles in the mainstem Napa River indicate that successful reproduction occurs under present conditions (DFG 1987, Stillwater Sciences 2004). Furthermore, historical ecology work indicates that Sonoma Creek Watershed (an adjacent watershed with similar physical form and hydrology) supported fall- run Chinook in the 1880s (Sonoma Ecology Center 2002). California freshwater shrimp, which are known to occur in the Napa River and a few of its tributaries, are federally listed as endangered (USFWS 1988) and are currently restricted to only a few watersheds in the North Bay and coastal Marin and Sonoma counties (USFWS 1998).

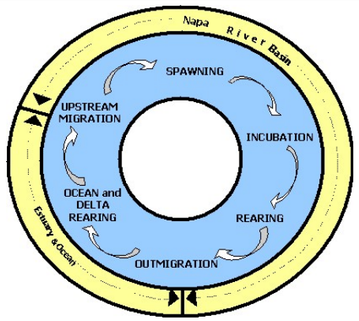
Introductions of exotic fish species have impacted most freshwater ecosystems in California, and in some cases have dramatically altered food web dynamics and the species composition of fish communities (Moyle 2002). In addition, habitat alterations can have a dramatic impact on the species composition of a fish community by deleteriously affecting some species and favoring others. The impacts of introduced fish generally occur episodically and unpredictably, depending on factors such as the fecundity of the introduced species, its feeding habits, and habitat requirements. Habitat alterations, however, generally occur gradually with somewhat more predictable impacts on the composition of the fish community. For example, the shift of a river system from a pool-riffle morphology to a morphology dominated by large, deep pools with increased water temperatures and slow-moving water often provide the preferred habitat of predatory fish species, many of which are exotic, such as largemouth bass (*Micropterus salmoides*) (Stillwater Sciences 2002).

A total of 42 fish species, both native and non-native, were identified from DFG, USEPA documents and the Napa River monitoring database (U.S. Army Corps of Engineers and Napa County Flood Control District n.d.). Twenty species are non-native and twenty-two species are native (Table 4-14).

Table 4-14. Freshwater Fish Species Occurring in the Napa River Watershed

	Common Name	Scientific Name
Non-native	American shad	*Alosa sapidissima*
	yellowfin goby	*Acanthogobius flavimanus*
	shimofuri goby	*Tridentiger bifasciatus*
	wakasagi	*Hypomesus nipponensis*
	striped bass	*Morone saxatilis*
	goldfish	*Carassius auratus*
	carp	*Cyprinus carpio*
	golden shiner	*Notemigonus crysoleucas*
	mosquitofish	*Gambusia affinis*
	rainwater killifish	*Lucania parva*
	threadfin shad	*Dorosoma petenense*
	white catfish	*Ameiurus catus*
	channel catfish	*Ictalurus punctatus*
	green sunfish	*Lepomis cyanellus*
	bluegill	*Lepomis macrochirus*
	white crappie	*Pomoxis annularis*
	black crappie	*Pomoxis nigromaculatus*
	inland silverside	*Menidia beryllina*
	smallmouth bass	*Micropterus dolomieui*
	largemouth bass	*Micropterus salmoides*
Native	steelhead/rainbow trout	*Oncorhynchus mykiss*
	Chinook salmon	*Oncorhynchus tshawytscha*
	chum salmon	*Oncorhynchus keta*
	delta smelt	*Hypomesus transpacificus*
	Sacramento sucker	*Catostomus occidentalis*
	prickly sculpin	*Cottus asper*
	riffle sculpin	*Cottus gulosus*
	Pacific lamprey	*Lampetra tridentata*
	hardhead	*Mylopharodon conocephalus*
	Sacramento pikeminnow	*Ptychocheilus grandis*
	threespine stickleback	*Gasterosteus aculeatus*
	California roach	*Hesperoleucus symmetricus*
	tule perch	*Hysterocarpus traski*
	Sacramento splittail	*Pogonichthys macrolepidotus*
	white sturgeon	*Acipenser transmontanus*
	Pacific staghorn sculpin	*Leptocottus armatus*
	longjaw mudsucker	*Gillichthys mirabilis*

Introductions of exotic fish species have impacted most freshwater ecosystems in California, and in some cases have dramatically altered food web dynamics and the species composition of fish communities.



Steelhead exhibit one of the most complex life histories of any salmonid (i.e., trout or salmon) species (Watershed Information Center and Conservancy of Napa County n.d.[a]).

After spending 2–3 years in the ocean, steelhead return to their natal stream to spawn when they are 4 or 5 years old.

	Common Name	Scientific Name
	longfin smelt	*Spirinchus thaleichthys*
	northern anchovy	*Engraulis mordax*
	Pacific herring	*Clupea harengeus*
	speckled sanddab	*Citharichthys stigmaeus*
	starry flounder	*Platichthys stellatus*

Sources: Based on information derived from Leidy 1997, DFG surveys, ACOE 2005, and Moyle 2002.

CENTRAL CALIFORNIA COASTAL STEELHEAD

The Central California Coastal steelhead is the only existing evolutionarily significant unit (ESU) that is present in the Napa River Watershed. The Central California Coast ESU includes river basins from the Russian River, (inclusive), to Aptos Creek and the drainages of San Francisco and San Pablo Bays (62 FR 159; August 18, 1997). The abundance of steelhead populations in the Russian and San Lorenzo Rivers is less than 15% of that in the 1960s. Comparable data are not available for other streams in which this ESU occurs. Steelhead populations in most tributaries to San Francisco and San Pablo Bays have been extirpated (McEwan and Jackson 1996). Central California Coast steelhead spawn in the Napa River system as well as in other streams entering San Pablo Bay, Suisun Bay, and San Francisco Bay.

Steelhead exhibit one of the most complex life histories of any salmonid (i.e., trout or salmon) species. Because of mixed genetic stock from past hatchery releases and changes in flow timing and magnitude associated with water resources development projects, coastal steelhead in the Napa River migrate upstream from October (larger basins) through late November (in smaller basins) and may be present in rivers through June (Moyle 2002). Spawning typically occurs from late December to April, with most spawning occurring in January–March. Unlike Chinook salmon, which die after spawning, steelhead can survive spawning and live to spawn more than once.

Steelhead require relatively clean, cool (less than 57°F) water in which to spawn successfully. Similar to fall Chinook salmon, female steelhead construct redds in suitable gravels, primarily in pool tailouts and heads of riffles. The eggs hatch anywhere from 19 days to 80 days after spawning, depending on water temperature, with warmer temperatures result in faster hatching times (Shapovalov and Taft 1954, Barnhart 1991). After hatching, alevins remain in the gravel for an additional 2–5 weeks while absorbing their yolk sacs, and then emerge in spring or early summer (Barnhart 1991).

After emergence, steelhead fry move to shallow-water, low-velocity habitats, such as stream margins and low-gradient riffles, and forage in open areas lacking instream cover (Hartman 1965, Everest et al. 1986, Fontaine 1988). As fry grow and improve their swimming abilities in late summer and fall, they increasingly use areas with cover and show a preference for higher velocity, deeper mid-channel areas near the thalweg (the deepest part of the channel) (Hartman 1965, Everest and Chapman 1972, Fontaine 1988).

Juvenile steelhead occupy a wide range of habitats, preferring deep pools as well as higher velocity rapid and cascade habitats (Bisson et al. 1982, Bisson et al. 1988). During the winter period of inactivity, steelhead prefer low-velocity pool habitats with large rocky substrate or woody debris for cover (Hartman 1965, Raleigh et al. 1984, Swales et al. 1986, Fontaine 1988). During periods of low temperatures and high flows that occur in winter months, steelhead seek refuge in interstitial spaces in cobble and boulder substrates (Bustard and Narver 1975, Everest et al. 1986). Juvenile emigration typically occurs from April through June.

Steelhead juveniles spend a minimum of 1 year, but typically 2 years, in fresh water before emigrating to the ocean as smolts. Emigration appears to be more closely associated with size than age, with 6–8 inches (15–20 cm) being most common for downstream migrants. Smolt emigration generally occurs from November–May, although, based on salvage data at the state and federal pumping plants in the Delta, the peak months for emigration in most years appear to be March and April. After spending 2–3 years in the ocean, steelhead return to their natal stream to spawn when they are 4 or 5 years old.

Critical habitat was designated on August 12, 2005 for Central California Coastal steelhead. Critical habitat includes most coastal streams from the Russian River to the north to Año Nuevo Creek and its tributaries to the south. The Napa River is included in this designation and is defined as the Napa River Hydrologic Subarea, which includes the Napa River and most of the tributaries. The primary constituents of critical habitat include fresh water spawning sites with water quality and quantity and substrate that support spawning, incubation and larval development. Fresh water rearing sites also need water quantity and quality to maintain physical habitat conditions that support juvenile growth and development. Fresh water migration corridors should be free of obstruction and excessive predation, with water quality and quantity and in-water cover, such as large woody material, large rocks and boulders, and aquatic vegetation that supports juvenile and adult mobility and survival (NOAA 2005).

Juvenile steelhead have been observed in all of the tributaries (except dry reaches) and the mainstem Napa River which were surveyed from the 1950s to 1997 by DFG and Napa County RCD, and Stillwater Sciences from 2001–2005. Western tributaries include Cyrus Creek, Ritchie Creek, York Creek, Sulphur Creek, Bear Canyon Creek, Dry Creek, Redwood Creek, Pickle Canyon, Huichica Creek, and Napa Creek. Eastern tributaries include Kimball Creek, Garnett Creek, Dutch Henry, Bell Canyon Creek, Conn Creek, Moore Creek, Chiles, Sage, Rector, Soda, Milliken, Sarco, Tulucay, Murphy, and Suscol Creeks. Juvenile and smolt steelhead were captured in the mainstem Napa River below the Napa First Street bridge (Stillwater 2004). In recent reconnaissance surveys on the Rutherford reach (Oakville Cross Road to Zinfandel Lane) on the mainstem Napa River, juvenile trout ranging in size from 125 to 275 mm were observed in pools, riffles, and runs (J&S file information 2005).

CENTRAL VALLEY FALL/LATE-FALL CHINOOK SALMON

The Central Valley fall/late fall-run Chinook salmon (*Oncorhynchus tshawytscha*) was listed as a candidate species under the federal ESA on September 16, 1999 (64 FR 50394). The Central Valley fall/late fall-run Chinook salmon has no special status under the state ESA, and there is no current listing for critical habitat.

Adult fall/late fall-run Chinook salmon migrate up the Sacramento River from July through November, and spawn from October to December. Raleigh et al. (1986) found that water temperatures ranging from 46º to 55ºF are optimal for migrating adults. Andrew and Geen (1960 in Raleigh et al. 1986) reported that temperatures warmer than 55 Fº increased mortality of female Chinook salmon prior to spawning. Chinook salmon spend 2–4 years maturing in the ocean before returning to their natal streams to spawn. All adult salmon die after spawning (Moyle 2002, Beauchamp et al.1983, Allen and Hassler 1986).

Chinook salmon spawn in areas of relatively swift water (0.24 to 1.2 m/sec) with suitable gravel, where the females deposit their eggs. Although maximum useable gravel size depends on fish size, a number of studies have determined that Chinook salmon require gravel ranging from approximately 3 millimeters (mm) to 150 mm (0.1 to 5.9 in) in diameter. Fines should be less than 40% and depth at a minimum of 0.24 m (0.8 ft) (Raleigh et al. 1986).

Eggs and larvae require temperatures between 39 and 54ºF for the highest survival rates (Myrick and Cech 2001). Eggs generally hatch in approximately 6–12 weeks, and newly emerged larvae remain in the gravel for another 2–4 weeks until the yolk is absorbed (Moyle 2002, Beauchamp et al. 1983, Allen and Hassler 1986). Emergence occurs during January through April.

Juveniles typically rear in fresh water for up to 5 months before migrating to sea. After emerging, Chinook salmon fry seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Myrick and Cech (2001) observed maximum growth rates at a water temperature of 66ºF. Suitable cover habitat includes areas with instream and overhead cover in the form of undercut banks; downed trees; and large, overhanging tree branches. The organic materials forming fish cover also help provide sources of food, in the form of both aquatic and terrestrial insects.

Some juvenile Chinook salmon were captured in the mainstem of the Napa River on newly created floodplain below the Napa First Street bridge (Stillwater 2004). Chinook salmon were also identified on the mainstem Napa below Trancas and from Trancas to Calistoga. Unidentified salmonid species were seen on the mainstem Napa and in some tributaries, but Chinook salmon were not positively identified on any of the tributary streams noted above (Stillwater 2002). In a survey done in 2004 by Napa RCD, spawning adult Chinook salmon were observed in a 3.6-mile stretch of the mainstem Napa River at Rutherford. Approximately 200 live Chinook adults were observed and 62 redds. Two of the carcasses recovered were hatchery fish (Koehler 2005).

FRESHWATER SHRIMP

The historical distribution of California freshwater shrimp is unknown, but the species probably once inhabited most perennial lowland streams in Marin, Napa, and Sonoma counties (USFWS 1998). Biologists believe that widespread alteration of lowland perennial streams has probably resulted in significant reductions in the species' range and abundance. California freshwater shrimp were listed as federally endangered by the U.S. Fish and Wildlife Service in 1988 (USFWS 1988). California freshwater shrimp are also listed as endangered under the California Endangered Species Act (USFWS 1998).

The reproductive biology of the California freshwater shrimp has not been formally described. Reproduction seems to occur once a year, with mating beginning in September. The shrimp exhibit relatively low fecundity; adult females produce approximately 50 to 120 eggs. The eggs adhere to the female's anterior appendages through the winter months (December through March), and young postlarvae (approximately 0.2 inch in length) hatch between late May and early June (USFWS 1998, Cox 2000). Larvae grow rapidly during the summer through a series of molts and reach a mean postorbital length of about 0.75 inch by fall, although no data are available regarding the timing and conditions that induce molting. The growth rate declines during summer months, although feeding continues throughout the year. Age 1+ shrimp are sexually mature and indistinguishable from adult shrimp by autumn (Cox 2000). Some shrimp apparently reproduce a second time.

California freshwater shrimp are found in low-elevation (less than 380 ft), low-gradient (generally less than 1%) coastal lowland streams that flow year-round or contain perennial pools (USFWS 1998). They are typically observed in quiet, moderately deep (1–3 ft), stream reaches with riparian and aquatic vegetation and structurally complex banks, exposed roots, overhanging woody debris, or overhanging vegetation. This species can tolerate seasonal temperature extremes, but not salty or brackish water (Cox et al. 1994). No data are currently available for defining the species' optimal temperature and/or stream flow requirements, or its temperature tolerances. It appears to be able to tolerate water temperatures greater than 73ºF and non-flowing stream conditions that would be detrimental to native salmonids (USFWS 1998). Under laboratory conditions, juvenile and mature shrimp have been observed to tolerate standing water at 80ºF for extended periods (USFWS 1998).

Steelhead require relatively clean (i.e., free from excessive fine sediment), cool (less than 57°F) water in which to spawn successfully; a slope within the species' ability to overcome (whether a natural characteristic of the system or a human-made feature); and—ultimately, the most pertinent characteristic—a perennial source of water in the channel within which the species can reside.

OTHER FISH SPECIES

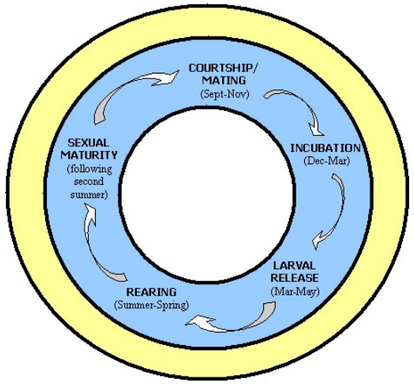
DELTA SMELT

Delta smelt, a federally and state-listed threatened species, are indigenous to the San Francisco Bay estuary (Moyle 2002). They spawn in the upper Delta, in the Sacramento River above Rio Vista, and Suisun Marsh (Moyle 2002). They also spawn in the Napa River system (Fawcett 2001).

The spawning season varies from year to year and spawning occurs in freshwater and brackish areas at the ends of dead-end sloughs. Critical habitat has been designated in Suisun Bay and Goodyear, Suisun, Cutoff, and Montezuma Sloughs, as well as the Sacramento–San Joaquin River Delta (59 FR 65256 December 19, 1994).

Adults begin migrating upstream in September or October, and spawning typically takes place between February and July (Moyle 2002). The adhesive eggs are attached to submerged plants and roots and hatch in about 2 weeks. Larvae then drift downstream to the "mixing zone," where fresh and salt waters meet and the vertical circulation pattern retains the larvae in the mixing area (Moyle 2002).

The mixing zone is a highly productive area for planktonic organisms, on which larvae, juveniles, and adults feed. Adult smelt also eat larger items, such as opossum shrimp (*Neomysis mercedis*). Delta smelt of all sizes generally follow the freshwater edge of the mixing zone, where salinity is about 2 parts per thousand (ppt), as the zone moves up and down the estuary. When the zone is within Suisun Bay,



California freshwater shrimp are listed as federally endangered by the U.S. Fish and Wildlife Service and as endangered under the California Endangered Species Act. Although the reproductive biology of the California freshwater shrimp has not been formally described, reproduction seems to occur once a year. The shrimp exhibit relatively low fecundity (Watershed Information Center and Conservancy of Napa County n.d.[b]).

smelt disperse throughout shallow water (less than 13 feet deep) and marsh habitat, and may remain there after the mixing zone moves back upstream, out of Suisun Bay.

Degradation and loss in estuarine habitat, coupled with increased entrainment and change in water flow direction, has caused a significant decrease in delta smelt population. Increased entrainment and a reverse in flow patterns is due primarily to water being diverted into and out of the Delta. A relationship has been found between the number of juvenile delta smelt salvaged at the state and federal pumps and both the percentage of inflow diverted and total Delta outflow (59 FR 65257, December 19, 1994).

Larval delta smelt have been found in the Napa River by DFG 20 mm larval surveys in 2001. Larvae were found from March through May, with April having the highest number of fish. The 20 mm tows were discontinued after 2001 (ACOE 2005).

SACRAMENTO SPLITTAIL

Sacramento splittail is a state species of special concern, and was delisted from its threatened status by the USFWS on September 22, 2003 (FR 68:183).

Sacramento splittail are large minnows (up to 40 cm. length) that are primarily freshwater fish, but which can live in salinities up to 18 ppt (Moyle et al. 1995). They were once abundant throughout the Central Valley, but are now mostly confined to the Sacramento/San Joaquin Delta, Suisun Bay, Suisun Marsh, Napa Marsh, and Napa and Petaluma Rivers, except in wet years, when they occupy a broader range of habitats (Moyle et al. 1995; Moyle 2002).

Splittail spawn from late January through July, although the peak is usually from March through May. Spawning takes place among submerged and flooded vegetation in sloughs and the lower reaches of rivers. Larvae remain in shallow, weedy areas near the spawning sites for 10–14 days, then move to deeper areas as they grow. Reproduction is apparently much more successful in wet years than in dry years (Moyle 2002). Splittail are bottom-feeders, consuming a variety of benthic and epibenthic animals and detritus (Moyle et al. 1995).

Adult and juvenile splittail have been captured throughout the Napa River (below Napa First Street Bridge) in surveys performed by Stillwater Sciences. Juvenile splittail use the newly created floodplain areas and adults are caught in the open water habitat in the mainstem river. A total of 738 splittail have been captured, comprising 5.11% of the total fish population (ACOE 2005).

LONGFIN SMELT

Longfin smelt, a federal species of concern and state species of special concern, are true smelt, similar in size and appearance to delta smelt. They are seasonally common in San Pablo Bay (Moyle et al. 1995, Moyle 2002). Spawning may occur between November and June, but mostly occurs between February and April, from Montezuma Slough and upper Suisun Bay to the lower reaches of the Sacramento and San Joaquin Rivers (Moyle 2002).

Longfin smelt can live in a wide range of salinity levels. The eggs are attached to rocks, plants, or other submerged objects, and take about 40 days to hatch. Larvae stay near the water surface, which helps to rapidly transport them downstream to food-rich nursery areas in Suisun and San Pablo Bays. Larvae rapidly grow to juvenile size, reaching 2.4–2.8 inches by the age of 9 or 10 months (Moyle et al. 1995). The main food of adults is opossum (mysid) shrimp, which are epibenthic animals, suggesting that longfin smelt must spend a lot of time near the bottom. According to Moyle et al. (1995), adults and juveniles spend most of their time in the middle and bottom of the water column, whereas larvae stay near the surface.

Larval longfin smelt have been caught in all years of sampling on the Napa River in surveys performed by Stillwater Sciences. Larval fish were caught from March to May, with the highest numbers caught in March. The highest numbers were caught by the DFG 20 mm larval tows in 2001, and the rest were caught with various sampling techniques such as otter trawls (ACOE 2005).

LAKE BERRYESSA

DFG introduced largemouth bass, smallmouth bass, and red-eared sunfish to Lake Berryessa in 1957. Largemouth bass was intended to be the reservoir's principal game fish, supported by red-eared sunfish as its primary food source for fish in the lake. Eventually, cold-water species including Kokanee salmon, silver salmon, brown trout, and rainbow trout were introduced. Threadfin shad were then introduced as the primary forage fish. During this same period, channel catfish, white crappie, and black crappie were introduced to the lake, which increased the warm water fisheries. A list of fish species known to currently inhabit the lake is provided in Table 4-15.

Table 4-15. Freshwater Fish Species Occurring in Lake Berryessa

Common Name	Scientific Name
largemouth bass	*Micropterus salmoides*
smallmouth bass	*Micropterus dolomieui*
channel catfish	*Ictalurus punctatus*
white catfish	*Ictalurus catus*
black crappie	*pomoxis nigromaculatus*
bluegill	*Lepomis macrochirus*
carp	*Cypriaus carpio*
golden shiner	*Notemigonus crysoleucas*
silver salmon	*Oncorhynchus kisutch*
squawfish	*Ptychocheilus grandis*
threadfin shad	*Dorosoma petenense*
brown trout	*Salmo trutta*
rainbow trout	*Oncorhynchus mykiss*
brook trout	*Salvelinus fontinalis*

In addition to emphasizing warm water fish, the DFG began a trophy trout program by stocking additional rainbow trout, brown trout, and silver salmon. The only type of trout presently being planted in the lake is rainbow. Brown trout were last stocked in 1982 and silver salmon in 1976. Neither has been reported in recent years. Approximately 100,000 trout are planted in the lake each year, usually in the spring. Half of the releases are of the Coleman Kamloops strain and the remainder are the Eagle Lake strain. In February 2001, the DFG made the first planting of Chinook salmon, an activity that continued into 2003. In March 2002, a planting of kokanee salmon also occurred.

SUISUN CREEK WATERSHED

The upper section of Suisun Creek falls within Napa County, which ultimately connects to Suisun Marsh and Suisun Bay in Solano County. Steelhead enter Suisun Creek and can migrate upstream. Wooden Valley Creek (a tributary to Suisun Creek) was surveyed by RCD in 2002 for steelhead presence. A list of fish species known to currently inhabit Wooden Valley Creek is provided in Table 4-16.

Table 4-16. Freshwater Fish Species Occurring in Wooden Valley Creek

Common Name	Scientific Name
rainbow trout	*Oncorhynchus mykiss*
bluegill	*Lepomis macrochirus*
green sunfish	*Lepomis cyanellus*
California roach	*Hesperoleucus symmetricus*
threespine stickleback	*Gasterosteus aculeatus*
mosquitofish	*Gambusia affinis*
sculpin	*Cottus spp*
other cyprinds	*Unidentified spp*

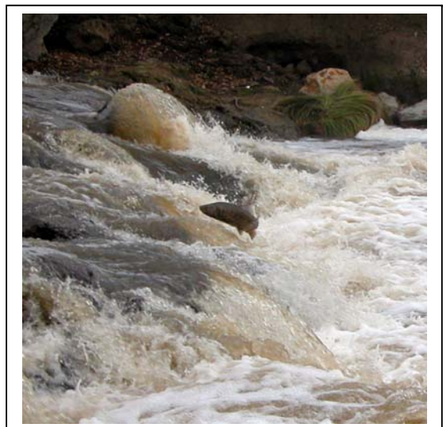
Source: Koehler 2002.

The extent to which steelhead currently and historically used the Napa River Watershed and other watersheds in Napa County is dependent on the physical characteristics of each system.

CHARACTERIZATION OF STEELHEAD UTILIZATION IN NAPA COUNTY

The extent to which steelhead currently and historically used the Napa River Watershed and other watersheds in Napa County is dependent on the physical characteristics of each system. As discussed above, steelhead require relatively clean (i.e., free from excessive fine sediment), cool (less than 57°F) water in which to spawn successfully; a slope within the species' ability to overcome (whether a natural characteristic of the system or a human-made feature); and—ultimately, the most pertinent characteristic—a perennial source of water in the channel within which the species can reside.

A variety of circumstances can limit the suitability of steelhead habitat. While an entire watershed/catchment may contain hundreds of miles of suitable habitat, a single barrier (e.g., waterfall, dam, or other barrier) can disconnect steelhead from those suitable habitats. This is the case in the watersheds upstream of Lake Berryessa, in Napa County, which are disconnected from the Sacramento River Basin by Monticello Dam, built on Putah Creek in 1957. Conversely, a watershed can have hundreds of miles of accessible habitat, but much of the watershed could be ephemeral in nature or have slopes that prohibit the hydrology needed for migrating/spawning steelhead. In most watersheds in Napa County, including the Napa River Watershed, the reality is a combination of these factors.



The gradient or slope of a stream channel not only influences the flow/hydrology of the channel segment, but is also a key factor in the physiological stress that a fish would need to overcome to pass up the stream channel.

While known presence is an easy determinant of utilization, it is only part of the picture. Year-to-year changes in conditions can alter habitats in ways that block viable habitat or open up formerly blocked habitats (e.g., the formation of critical riffles/barriers due to seasonal bedload movement or the seasonal movement of debris/log jams). For this reason, and because presence surveys throughout all accessible stream reaches in the Napa Watershed are prohibitive in cost, other factors than presence can be more useful indicators of utilization. The primary factors that will be taken into account in determining steelhead utilization in the Napa River Watershed are as follows.

- *Hydrology*. Perennial flow or intermittent flow with timing of flow appropriate to meet the needs of the species.
- *Slope*. Most utilized 4%–8 %, but steelhead can physically reside in stream gradients up to 20%.
- *Barriers*. Minimum passage requirements for adult steelhead is usually set at a minimum passage depth of 0.8 feet with a water velocity not exceeding 6 feet per second (fps) over a distance no greater than 60 feet (DFG 2003, Bates et al. 2003).
- *Presence*. As recorded by qualified staff, as discussed below.

This study assesses channels in the Napa River Watershed with respect to their likelihood to provide habitat for steelhead. While the original intent was to provide an assessment of the entire County, the data does not yet exist to facilitate the current analysis in either the Putah Creek or Suisun Creek watersheds. The analyzed streams fall into the following categories.

- *Accessible habitat*. A stream segment provides accessible habitat when it is perennial, the slope is appropriate, and there are no barriers.
- *Potential habitat*. A reach includes potential habitat when it has the proper characteristics but has some kind of temporary disruption; for instance, the stream is intermittent, or there is a partial barrier, and do not have document presence of steelhead.
- *Disconnected potential habitat*. Reaches above man-made barriers that historically provided habitat or that historically likely provided habitat for steelhead are considered to provide disconnected potential habitat.
- *Non-accessible habitat or naturally excluded, non-viable habitat*. Stream segments that do not meet the passage criteria for hydrology or slope, and/or lie behind existing natural barriers are considered to be unavailable as habitat to steelhead.

It is important to keep in mind that these criteria are general in nature. They provide a broad characterization of potential habitat for steelhead and are limited in scope to the species' ability to access streams. Local site conditions might reveal specific exceptions to the broad characterizations discussed above, and the specific quality of accessible habitats can vary greatly, given the extensive habitat modifications that have occurred throughout the Napa Valley. Characterization of these specific habitat quality issues is a part of the Stillwater Sciences Limiting Factors Analysis of the Napa River Watershed and may need to be otherwise assessed on a site-specific basis.

PREVIOUS STUDIES

Stillwater Sciences conducted a Napa River basin limiting factor analysis for salmonids, known as Phase I of the limiting factors analysis (Stillwater Sciences 2002). DFG, Napa County RCD and the Friends of the Napa River have also performed numerous studies to determine where juvenile and adult steelhead occur in the Napa River Watershed and various physical habitat assessments for spawning and rearing steelhead. Stillwater Sciences has conducted monitoring in the mainstem Napa River over the past 4 years (2001–2005) for the Corps to monitor fish use of the newly restored and created open water, marsh plain, and floodplain habitats, with an emphasis on native fish species (Stillwater Sciences 2004).

The main use of existing data in the following assessment is to define known steelhead presence in Napa County streams. Specific data on habitat quality from the studies has been included in the *Watershed Characterization* section, but is not being used to define the extent of accessible habitat.

HYDROLOGY AND HYDRAULIC MODELING

The primary characteristic defining whether or not steelhead can access a reach is the presence (or absence) of flowing water in which to swim during the key developmental periods. Flow is needed to allow adults to return to natal streams, for oxygenating redds (nest of fish eggs covered with gravel) after spawning, and for providing habitat for rearing juveniles.

Surface flow in the stream network was modeled in MIKE 11 developed by DHI Water and Environment (DHI Water and Environment 2005). Required data are boundary conditions, channel and lake geometry, and control structure operations. MIKE SHE (DHI Water and Environment 2005) acts as a dynamic boundary condition that exchanges overland flows and groundwater base flows with MIKE 11. For all basins, a stream network was extracted from the DEM. For purposes of flow routing, the extensive river network was simplified for each subbasin to include one principal drainage in each of the 189 subbasins for downstream flow routing. In order to maintain a relatively uniform drainage density, two or three principle drainages were included in the network for some of the larger subbasins identified.

For the Napa River Watershed model, surface water calibration data for the 1999–2003 simulation period is available for nine locations. The USGS has average daily discharge data at two locations along the Napa River, one near the City of St. Helena and another further downstream near the City of Napa. The Napa County RCD has stream water levels and discharge at Huichica Creek, Salvador Creek, Carneros Creek, and Milliken Creek. Finally, the City of Napa has provided the inflows (Conn Creek, Sage Creek, and Chiles Creek), outflows (releases), and water levels for Lake Hennessey.

This analysis initially simply determines the basic character of the modeled streams as perennial, intermittent, or ephemeral. Ephemeral streams will not be analyzed further, because the stream type

does not support seasonal habitat functions for steelhead. In the future, additional analyses could be completed to determine whether intermittent channels would be expected to provide flow during key migratory periods for adults and juveniles.

CHANNEL GRADIENT

The gradient or slope of a stream channel not only influences the flow/hydrology of the channel segment, but is also a key factor in the physiological stress that a fish would need to overcome to pass up the stream channel. While it is commonly accepted that steelhead "prefer" (i.e., are most commonly observed in) stream gradients of 4–8%, it is physiologically possible and known for salmonids to be present in streams with gradients up to 20% (Cramer 1998). However, generally slopes of greater than 12% over any significant distance (i.e., greater than 100 feet) are not utilized by most salmonids. Any subcatchment or stream segment upstream of a channel segment of greater than 20% is considered inaccessible to steelhead and, thus, would not be considered usable, potential habitat.

BARRIERS

Barriers, whether natural or man-made, can disconnect large usable (i.e., meeting the above two criteria) portions of a watershed such that migratory steelhead cannot access the upstream portion. While resident rainbow trout populations (the non-anadromous form of *O. mykiss*) can be productive upstream of such barriers, these features functionally become barriers to gene flow. Man-made barriers can abruptly remove miles of natal streams that were historically utilized from potentially large segments of a watershed's steelhead population.

For the purposes of this analysis, we will describe habitat behind barriers in two ways. Habitat that is disconnected due to natural barriers and that is not expected to be utilized at any point in the future, save some catastrophic geologic change that eliminates the barrier, is not considered to have potential to be utilized by steelhead. This corresponds to the category "Non-accessible habitat or naturally excluded, non-viable habitat" described above.

Secondly, habitat disconnected by man-made barriers, that would have historically provided usable habitat, but is not expected to in the future, unless a specific opportunity or need results in the removal of the barrier, is categorized as "disconnected potential habitat." This categorization could be used as a basis for restoration potential of the watershed based on the amount of usable habitat that lies behind each barrier. Only complete barriers are considered as completely blocking access to habitat within the context of this analysis, as it is assumed that populations can migrate in and out of partial reaches at high flows (although those high flows necessary for passage might not occur within a given water year). All barriers were mapped into GIS by the RCD based on all known sources of data for barriers in Napa County as shown in Map 4-23.

DAMS

Monticello Dam is the largest impoundment in the County and is located within the Putah Creek Watershed. The dam effectively closes off the watershed to steelhead/anadromous migration.

Twenty-eight dams were identified in the Napa River Watershed with individual water storage capacities greater than 28 acre-feet[7] ($3.4x10^4$ m^3) (DSOD 2000 cited in Stillwater Sciences 2002), The total storage capacity of these 28 dams is 43,800 acre-feet ($5.4x10^7$ m^3), which is approximately 30% of the average annual runoff of 148,000 acre-feet ($1.82x10^8$ m^3) (as measured at the U.S. Geological Survey [USGS] Napa River gage at Napa). Seventy-one percent of the total reservoir storage in the Napa River Watershed is in Conn Creek Reservoir (Lake Hennessey), which was built in 1948.

Other significant dams include Rector Creek, Bell Canyon, and Milliken dams, which along with Conn Creek Dam provide over 91% of the total reservoir storage in the watershed. The dams were constructed between the late 1800s and 1990, with the majority constructed in the 1940s and 1950s. All of these dams are located on the tributary streams along the eastern side of the watershed, and effectively block every major east side tributary between St. Helena and Napa, except Soda Creek. Kimball Canyon Dam, near the headwaters of Napa River is a complete barrier to upstream migrating adult steelhead (Leidy et al. 2005). DFG surveyed the lower 4.1 miles of Carneros Creek in June 1981, and noted three dams were present and considered to be barriers to migration, two of them 10 feet high and one 6 feet high (Harris and Ambrosins 1981). Hinman Reservoir dam is a fish passage barrier on Hinman Creek (tributary to Hopper Creek) about 2.5 miles upstream from the mouth (Leidy et al. 2005).

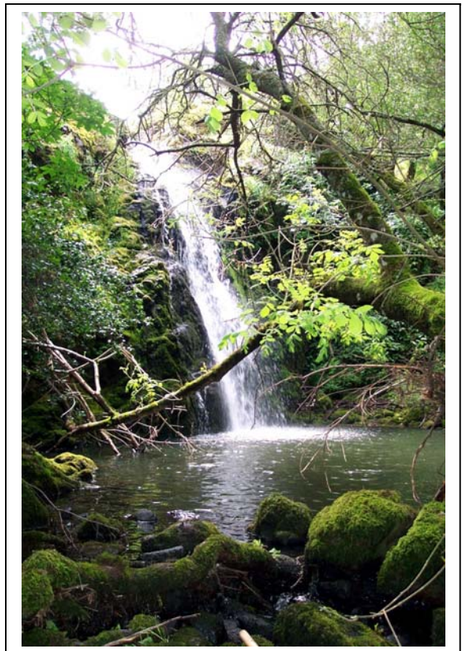
York Creek, near St. Helena, has two diversion dams located in the channel that are impassable. Nash Creek has a diversion dam located approximately 0.7 miles upstream from the mouth (Lee 1974).

OTHER BARRIERS

Additional barriers in the Napa River Watershed include road crossings where culverts and other in-channel structures (natural or human-made) may occur that form potential barriers. Stillwater Sciences (2002) identified 69 in-channel structures in the Napa River Watershed from various sources that were known barriers or suspected impediments to migration. However, these barriers were not field-verified for accuracy. Additionally, there are over 220 lakes or reservoirs and areas where roads cross streams that were not assessed for barriers.

From various DFG surveys done throughout the years, many barriers were identified throughout the tributaries. Some of the barriers include the following.

- Huichica Creek has a 6-foot waterfall located 1.75 miles upstream of Highway 121 and is likely to be a complete barrier to upstream migrating adults (Ellison 1980).
- Tulucay Creek has a barrier at the Green Valley Road crossing (Harris and Ambrosins 1981).
- Milliken Creek, 2 miles upstream of the Silverado Country Club, there is a 20-foot diversion dam (Tyler and Holstine 1975).



Barriers, whether natural or man-made, can disconnect large usable (i.e., meeting the above two criteria) portions of a watershed such that migratory steelhead cannot access the upstream portion.

[7] An acre-foot is the volume of water that would inundate one acre of land to a depth of one foot and is equivalent to approximately 326,000 gallons (1.23 x 106 liters).

Due to its diversity, Napa County's diverse and unique assemblage of flora and fauna is a biological resource of statewide and national importance.

- At Soda Creek, a natural fall (Soda Canyon Falls) is located 3 miles upstream from the mouth and is a barrier to migration (Leidy et al. 2005).
- Hopper Creek has a natural waterfall located immediately downstream of the reservoir (Pinkham 1976).
- Jericho Canyon Creek has a 15-foot chute located approximately 0.5 miles upstream of Old Toll Road Bridge (Albert and Thompson 1970).
- Fagan Creek has a 15-foot drop on the south side of Highway 12 (Leidy et al. 2005).

STEELHEAD PRESENCE SURVEYS

Surveys have been conducted by several people and agencies within the watershed (R. Leidy, the RCD, DFG, Stillwater Sciences, etc.) to determine the physical presence of steelhead. Much of this information is summarized in the Stillwater Sciences Limiting Factor's Analysis of the Napa Watershed (2002). This dataset provides the functional basis for determining the utilization of the watershed.

In this analysis, all streams in which steelhead have been found in these studies will be assumed to be "accessible habitat" along the entire reach of the stream that meets all of the three previous discussed criteria. While the extent of accessible habitat utilization provides a good check against the current analysis, the presence/absence data has not been mapped due to the inherent problems in mapping and defining extents for point or transect data in the context of a continuous watercourse. The analysis focuses instead on hydrology, slope, and barriers, with the known presence data providing a "common sense" check of the validity of the analysis. The following is a discussion of known presence

AREAS OF KNOWN STEELHEAD PRESENCE

From January 2001 to July 2005, Stillwater Sciences conducted surveys on the Napa River for the Army Corps of Engineers. A total of eight steelhead were captured, all between the Highway 12 bridge and the Napa First Street bridge. Six of the fish were yearling smolts, and two were juveniles. Two of the fish were caught in Horse Shoe bend on the floodplain, three were captured on newly restored floodplains, and three were captured near the First Street bridge in the main channel (ACOE 2005).

Ecotrust and FONR surveyed most of the tributaries to the Napa River and their tributaries between July and August 2001 and again between May and September 2002. Trout were observed in almost all tributaries. The highest densities were observed in west-side tributaries (Ecotrust and FONR 2001). Table 4-17 shows streams in which steelhead presence is documented.

For periods when fish were not observed during the Ecotrust and FONR surveys, the Napa RCD was contacted regarding the creeks. In Table 4-17, streams were marked as "Potential to Occur" when documentation shows that fish utilize these creeks intermittently over the years.

Table 4-17. Freshwater Fish Species Occurring in the Napa River Watershed, By Reach

Reach Name	Present	Potential to Occur	Comments
Mainstem Napa River	X		
Western Tributaries (North to South)			
Cyrus Creek	X		
Diamond Mountain Creek	X		
Nash Creek			Dry
Ritchie Creek	X		
Mill Creek	X		
York Creek	X		
Sulphur Creek	X		
Heath Canyon Creek	X		
Iron Mine Creek	X		
Hinman Creek		X	
Hopper Creek		X	
Bear Canyon Creek		X	
Dry Creek	X		
Montgomery Creek	X		
Wing Canyon Creek	X		
Segassia Canyon Creek	X		
Redwood Creek	X		
Pickle Canyon Creek	X		
Browns Valley Creek	X		
Napa Creek	X		
Carneros Creek	X		
Huichica Creek	X		
Eastern Tributaries (North to South)			
Kimball Creek	X		
Jericho Creek	X		
Garnett Creek	X		
Simmons Creek	X		
Dutch Henry Creek	X		
Bell Canyon Creek	X		
Conn Creek		X	
Moore Creek	X		
Chiles Creek	X		
Sage Creek	X		
Rector Creek	X		
Soda Creek	X		

Reach Name	Present	Potential to Occur	Comments
Milliken Creek	X		
Sarco Creek	X		
Tulucay Creek	X		
Murphy Creek	X		
Spencer Creek	X		
Fagan Creek			No known occurrence
Suscol Creek	X		
American Canyon Creek			No known occurrence

AREAS OF POTENTIAL STEELHEAD PRESENCE

Hopper Creek was surveyed in 2001 by Ecotrust and FONR, but no trout were found. Napa County RCD suggested that the creek is likely to be used in some years (Leidy et al. 2005). Hinman Creek also may be used (J. Koehler pers comm as cited in Leidy et al. 2005.) and Conn Creek was used historically, but no fish were found in 2001. See Table 4-17 above.

AREAS OF KNOWN STEELHEAD EXCLUSION

The areas of known exclusion include the areas above permanent human made dams or natural barriers such as waterfalls that are discussed in the *Barriers* section above. Many dams occur on the eastern side of the watershed. Other areas include reaches with intermittent flows, ephemeral drainages, and areas with a slope greater than 20% (See Map 4-24).

Fagan and American Canyon Creeks occur downstream in the Napa River and enter into the Napa River tidal slough. Steelhead have never been observed in either of these two creeks but it is unknown why they do not inhabit either of these creeks (Leidy et al. 2005).

NEW BIOLOGICAL DATABASE

The newly developed Napa County Biological Database provides an important tool for protecting the County's biological resources. The database maps potential habitats for special-status species in the County. It does so by combining a detailed land cover map (ICE map) of the County (Thorne et al. 2004) with information about probable distribution and potential habitat of the County's special-status species. Appendix D lists the data layers used in the database, and Appendix E provides detailed instructions for its use.

The potential habitat maps in the database can be used for project-level environmental review as well as for regional planning (Figure 4-1). The database can be used to inform project proponents about sensitive biological resources that may occur on their project sites. The County will be able to provide a project proponent with a list of mapped biotic communities on their site, as well as the special-status species that are likely to occur there—which will be extremely useful in project planning and environmental mitigation. It will provide information at an early stage whether and when biological surveys need to conducted in order to determine whether special-status species are present.

The database can also be used for regional conservation planning. The database provides information about the distribution of sensitive species, habitats, and communities across the County. This information will be useful in planning development and land management on a County or evaluation area level. It can be utilized to update the Open Space and Conservation Element of the County's General Plan, to identify conservation priorities, and to direct development away from sensitive areas.

The applicability of the Biological Database should come with some caveats. The ICE map does not provide an exhaustive and completely accurate map of biological resources on a site, because some resources are below the minimum mapping unit and/or do not have an identifiable signature in earlier aerial photographs. These resources will have to be identified in the course of site-level surveys for proposed projects. However, the database provides the best information that is available on a County-wide scale.

The newly developed Napa County Biological Database provides an important tool for protecting the County's biological resources. The database maps potential habitats for special-status species in the County.

CONCLUSIONS AND REPORT UPDATE RECOMMENDATIONS

- Due to its diversity, Napa County's diverse and unique assemblage of flora and fauna is a biological resource of statewide and national importance.
- This biodiversity provides valuable goods, ecosystem services, recreational opportunities, and potential scientific information that are highly useful to society. Thus, protecting this diversity is a wise management decision.
- Twenty-five sensitive biotic communities (out of 52 natural land cover types total) are found in Napa County.
- Critical biological areas in the County include the following.
  - the Napa River Marshes, a critical and important habitat for many special- status wildlife species and some special- status plants,
  - the Napa River and its tributaries, which support a regionally- significant anadromous fish run,
  - the Knoxville Area, which supports a high concentration of serpentine-dependent plant species,
  - vernal pool complexes in Pope Valley and the Eastern Mountains area,

Management of biological resources in each evaluation area should be tailored to the biological resources in that area and the threats to those resources.

- old-growth Douglas-fir forests in the Western Mountains Evaluation Area and, Livermore Ranch areas Evaluation Area, and other parts of the County, which provide habitat for old-growth-dependent species such as northern spotted owl and other species.

- Eighty-one special- status plant species and 68 special-status wildlife species may be found in Napa County. Two plant species found in the County are found nowhere else in the world (Napa bluegrass and Calistoga popcornflower), and nine additional plant species are only found in Napa County and its neighboring counties.

- Several biotic communities and habitat features are critically particularly important to protect due to their relatively limited extent in the County and their importance to a large number of special- status plant and/or wildlife species. These communities and features are the following.

  - Riparian woodland, freshwater wetlands (including vernal pools), and streams, which support a disproportionately high number of the County's special-status plant and wildlife species.

  - Rock outcrops, which provide habitat for many special- status plant species and are used by special-status raptors and bats.

  - Salt marsh, which is an important biotic community for the County's special status- wildlife species, many of which are only found in this community.

  - Serpentine grassland, which occupies 0.4% of the County and provides potential habitat for 38% of the County's special-status plant species, some of which are only found in this community.

- Maintenance of wildlife movement corridors is important to conserve the diversity of wildlife and plants found within Napa County. Riparian corridors are particularly valuable for movement by many species, and are especially critical in the Napa Valley because of the limited extent and fragmented distribution of other natural land cover in this area.

- Management of biological resources in each evaluation area should be tailored to the biological resources in that area and the threats to those resources, detailed in the discussions above.

- Non-native invasive species are a threat to nearly all of the biotic communities in the County. A comprehensive approach to controlling the spread of these species and reducing their extent is critical needed to conserving conserve the County's biological resources.

- Habitat loss due to agricultural and residential development threatens the County's biological resources. In addition to direct habitat loss as a result of development, alterations of natural hydrology and water quality due to urban and agricultural development can have detrimental effects on degraded downstream biotic communities, particularly on wetlands and streams.

- Sustainable agricultural practices are important to reduce the impacts of vineyards and livestock grazing on biological resources.

- Fire suppression in the County has increased the likelihood of high-intensity large fires in some biotic communities, such as coniferous forests. Not only do such fires pose a threat to human lives and property, they can result in the reduction or loss of sensitive biotic communities. The use of fuel management or prescribed burns to reduce this risk is recommended.

- The biological database developed as part of this Baseline Data Report is an important tool for planning the protection of the biological resources in Napa County.

CONCLUSIONS AND REPORT UPDATE RECOMMENDATIONS FROM FISHERIES RESOURCES

In this analysis, the key element is the application of known physical constraints to the limitations of steelhead physiology. The application of physical criteria limiting steelhead movement has resulted in four categories of habitat classification as listed below and shown in Map 4-25. Total amount of each habitat is shown below in Table 4-18.

1. Accessible habitat.
2. Potential habitat.
3. Disconnected potential habitat.
4. Natural exclusion/non-viable habitat.

There are 195 miles of accessible habitat in the Napa River Watershed that could potentially support steelhead trout. These streams provide viable movement throughout their respective watersheds and access to spawning habitat. These streams provide for the rearing and/or outmigration of juveniles. Irrespective of the quality of the habitat within these streams, they are accessible year round and provide potential habitat for steelhead.

There are 521 miles of potential habitat in the Napa River Watershed that are (1) accessible and intermittent, (2) inaccessible at low flows (due to partial barriers) and perennial, or (3) inaccessible at low flows (due to partial barriers) and intermittent. All of these stream categories are seasonally limited and may provide winter access to steelhead and may provide spawning habitat. However, these streams are limited in their year-round habitat viability and may result in compromised conditions for juvenile rearing and/or outmigration.

There are 26 miles of disconnected potential habitat in the Napa River Watershed that is inaccessible due to man-made structures within both the Napa and Lake Berryessa Watersheds. While these

streams consist of both perennial and intermittent drainages, there are all not accessible to returning steelhead. These streams do provide habitat for resident fish species, including rainbow trout (non-anadromous *O. mykiss*). Some sections of these drainages, primarily in the upper Napa River Watershed, are also severely fragmented due to the presence of several permanent barriers over the course of relatively short stream distances (less than 1000 meters).

There are 2,774 miles of potential habitat in the Napa River Watershed that is naturally excluded from steelhead access or has physical characteristics that do not support the presence of fish. This grouping could logically be divided into two separate groups, but for the purposes of this analysis (defining access for steelhead) it is not. Naturally excluded streams are segments of a watershed that lie above longstanding natural barriers to movement of steelhead, but can provide suitable habitat for resident fisheries, including rainbow trout. Non-viable habitat defines stream channels that have slopes greater than 20% and/or are ephemeral in nature. These streams do not provide viable, physically accessible habitat for fisheries. While, technically, ephemeral streams can provide accessible habitat for very short periods of time (usually a matter of hours) these habitats are not nearly as important as the organic material mobilized in these channels into more accessible portions of the watershed. Such events provide trophic material (food) for fisheries in the perennial and intermittent reaches of the catchment.

Table 4-18. Breakdown of Stream Accessibility for Steelhead in the Napa River Watershed

Type of Habitat*	Length (mi)
Accessible habitat	195
Potential habitat	521
Disconnected potential habitat	26
Natural exclusion/non-viable habitat	2,774
Total	**3,516**

Notes
* Dataset does not include the Berryessa side of Napa County. Napa River Watershed only.

RECOMMENDATIONS

BIOLOGICAL DATABASE EXPANSION

- Expand the newly developed biological database (described in this report) as follows to make it more complete.
- Add documented records of special-status wildlife species from the Museum of Vertebrate Zoology (MVZ) at UC Berkeley. Tthe MVZ database contains 145 records of the pallid bat for Napa County, most with downloadable spatial coordinates (http://elib.cs.berkeley.edu/mvz/).
- Add as many known locations for special-status plants as possible. The current database does not include all of the known locations.
- The GIS database used in the fisheries resources analysis provides a preliminary analysis of habitat accessibility in Napa County. As better or updated data for hydrology and barriers in the County's watersheds becomes available, it should be incorporated into the existing GIS database. This will ensure that the database provides the most current and accurate information possible.
- Additional analyses on fisheries resources could also be completed to determine whether intermittent channels would be expected to provide flow during key migratory periods for adults and juveniles. Additionally, if feasible, this analysis could be further refined by coordinating this use analysis with other key habitat quality conditions (such as temperature and dissolved oxygen) that could limit habitat in certain portions of the watershed.
- Adding special-status species records to the database could be done by the County's GIS staff.

BIOLOGICAL DATABASE MAINTENANCE

- Update on a regular schedule as follows the expanded biological database so as to increase over time its accuracy and completeness and maintain and enhance its overall usefulness.
- Add new ICE Vegetation Layer to database when it becomes available.
- Add documented reports of special-status species occurrences, and other unmapped sensitive biological resources, to the database every 3 months.
- Update maps to include new state-documented special-status species occurrences every 6 months when they become available from CNDDB.
- Document vegetation changes from wildfire once a year using CDF data.
- Update the land cover map every other year to reflect urban and agricultural development as well as other changes in land cover.
- Survey and map vernal pools every 5 years and add the results to the database so as to ensure that the map reflects current conditions.

Except for the recommended vernal pool survey, the work required can be done by County Conservation Division staff. On average, this work will consume approximately one-twelfth of a full-time

Sustainable agricultural practices are important to reduce the impacts of vineyards and livestock grazing on biological resources.

equivalent staff person per year.[8] Cost for the vernal pool survey is estimated to be $15,000, for an annual cost of $3,000 per year.[9]

REFERENCES

REFERENCES CITED

Adler, S. 2003. *Vineyards and Wildlife Habitat*. Sacramento, CA: California Association of Winegrape Growers. Available: <www.cawg.org.>

Albert, B. and J. Thompson. 1970. *Stream Survey, Unnamed Tributary to Garnett Creek (Jericho Canyon Creek)*. July 1. California Department of Fish and Game.

Allen, M. A. and T. J. Hassler. 1986. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest). Chinook Salmon.* U.S. Fish and Wildlife Service. (Biological Report 82 (11.49) TR EL-84-4.)

American Ornithologists' Union. 1998. *The AOU Checklist of North American Birds*, 7th edition. The Union, Washington, D.C.

Anderson, C. 2001. Taking in a Slice of Nature: Visiting Cedar Roughs Wildlife Area. *Outdoor California* May-June 2001.

Anderson, K. R. 1969. Steelhead Resource, Napa River Drainage, Napa County. Memorandum to Files. December23. California Department of Fish and Game, Region 3.

Army Corps of Engineers. 2005. Napa River Fisheries Monitoring Program. Available: <http://www.napariverfishmonitoring.org/>.

Baltz, D. M. and P. B. Moyle. 1993. Invasion Resistance to Introduced Species by a Native Assemblage of California Stream Fishes. *Ecological Applications* 3:246-255.

Barbour, M. and C. Witham. 2004. The Surrounding Sea: A Revised Look at Annual Grasslands. *Fremontia* 32(2): 8–9.

Barbour, M.G. and and J. Major (eds.). 1988. *Terrestrial Vegetation of California*. Special Publication no. 9. California Native Plant Society. Sacramento, CA.

Barnhart, R. A. 1986. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest). Steelhead.* June. (Biological Report 82 [11.60], TREL-82-4.) U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Coastal Ecology Group, Waterways Experiment Station. Slidell, LA.

———. 1991. Steelhead. *Oncorhynchus mykiss*. Pages 324-336 in *Trout*, J. Stolz and J. Schnell, editor. Harrisburg, Pennsylvania: Stackpole Books.

Barrett, N., N. Sugihara, R. Siemers, and H. Safford. 2004. *Fire Regime Condition Class (FRCC) Interagency Handbook Reference Conditions.* Potential Natural Vegetation Group: California Annual Grassland (Without Shrubs or Trees). Available: <http://www.frcc.gov/docs/PNVG/West/AGRA2_description.pdf.>

Bartolome J.W., J.S. Fehmi, R.D. Jackson, and B. Allen-Diaz. 2004. Response of a Native Perennial Grass Stand to Disturbance in California's Coast Range Grassland. *Restoration Ecology* 12(2): 279–289.

Bartolome, J.W. and B. Gemmill. 1981. The Ecological Status of *Stipa pulchra* (Poaceae) in California. *Madrono*, 28:172-184.

Bates, K. M, R. J. Barnard, B. Heiner, J. P. Klavas, and P. D. Powers. 2003. *Design of Road Culverts for Fish Passage*. Olympia, WA: Washington Department of Fish and Wildlife.

Baye, P., P.M. Faber, and B. Grewell. 2000. Tidal Marsh Plants of the San Francisco Estuary. In P.R. Olofson, (ed.), *Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish, and Wildlife*. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. Oakland, CA: San Francisco Bay Regional Water Quality Control Board.

Beauchamp, D.A., Shepard, M.F. and Pauley, G.B. 1983. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest). Chinook Salmon.* U.S. Fish and Wildlife Service, FWS/OBS-82/11.6:7 REL 82.4, Washington, D.C.

Berner, M., B. Grummer, R. Leong, and M. Rippey. 2003. *Breeding Birds of Napa County, California*. Ann Smith (ed.). Vallejo, CA: Napa-Solano Audubon Society.

Bisson, P. A., K. Sullivan, and J. L. Nielsen. 1988. Channel Hydraulics, Habitat Use, and Body Form of Juvenile Coho Salmon, Steelhead Trout, and Cutthroat Trout in Streams. *Transactions of the American Fisheries Society* 117: 262-273.

Bisson, P., J. L. Nielsen, R. A. Palmason, and L. E. Grover. 1982. A System of Naming Habitat Types in Small Streams, with Examples of Habitat Utilization by Salmonids During Low Streamflows. Pages 62-73 in N. B. Armantrout (ed.), *Proceedings of the Symposium on Acquisition and Utilization of Aquatic Habitat Inventory Information.* Bethesda, Maryland: American Fisheries Society, Western Division.

Bustard, D. R. and D. W. Narver. 1975. Preferences of Juvenile Coho Salmon (*Oncorhynchus kisutch*) and Cutthroat Trout (*Salmo clarki*) Relative to Simulated Alteration of Winter Habitat. *Journal of the Fisheries Research Board of Canada* 32: 681-687.

California Department of Fish and Game (CDFG). 1987. Memorandum to file from F. Gray, Fisheries Biologist, Yountville, California.

[8] In other words, the effort will require five months every five years.
[9] This includes the cost of mapping the pools and integrating them into the existing dataset

———. 2000. The Status of Rare, Threatened and Endangered Animals and Plants of California. Delta Smelt. Available:< http://www.dfg.ca.gov/hcpb/cgi-bin/more_info.asp?idKey=ssc_tespp&specy=fish&query=Hypomesus%20transpacificus>.

———. 2003a. *List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Database*. September. Sacramento, CA: Vegetation Classification and Mapping Program, Wildlife and Habitat Data Analysis Branch, DFG.

———. 2003b. *Atlas of the Biodiversity of California.* Sacramento, CA: California Resources Agency.

———. 2004a. *Spotted Owl Database*. Wildlife and Habitat Data Analysis Branch. Database description and contact information available: <www.dfg.ca.gov/habitats/rap/pdf/summaries/0028-summary.pdf>.

———. 2004b. *Special Animals List*. Wildlife and Habitat Data Analysis Branch. Accessed October, 2004. Available: <www.dfg.ca.gov/whdab/pdfs/spanimals.pdf>.

———. 2005. . The Status of Rare, Threatened and Endangered Animals and Plants of California 2000–2004. Species Accounts—Fish. Available: <http://www.dfg.ca.gov/hcpb/species/t_e_spp/t_efish.pdf>.

California Exotic Pest Plant Council. 1999. *The CalEPPC List: Exotic Pest Plants of Greatest Ecological Concern in California*. Available: <http://www.cal-ipc.org/file_library/4898.pdf>.

California Native Plant Society. 2001. *California Native Plant Society's Inventory of Rare and Endangered Plants of California*, 6th edition. Tibor, D. P., ed. Sacramento, CA: California Native Plant Society.

California Natural Diversity Database. 2005. *Records Search of Napa County*. California Department of Fish and Game. Sacramento, CA.

California Oak Mortality Task Force. 2003. *Oak Mapper: Monitoring Sudden Oak Death with GIS.* Accessed: December 14, 2004. Available: <kellylab.berkeley.edu/OakMapper/viewer.htm>.

California Wilderness Coaltion (CalWild). 2001. *Missing Linkages: Restoring Connectivity to the California Landscape*. Available: <www.calwild.org/resources/pubs/linkages/>.

Callizo, Joe. 1983. Where are Napa Valley's Valley Oaks? *Fremontia* 11:30.

Carlton, J. T. 1979. Introduced Invertebrates of San Francisco Bay. Pages 427– 444 in T. J. Conomos (ed.), *San Francisco Bay: The Urbanized Estuary.* San Francisco: Pacific Division of the American Association for the Advancement of Sciences.

Carneros Creek Stewardship. 2005. *Carneros Creek Watershed Management Plan*. Prepared for Carneros Creek Watershed Stewardship and Bay-Delta Authority Watershed Program. February. Available: <http://www.napawatersheds.org/Content/10031/Carneros_Creek_Watershed_Assessment_and_Management_Plan.html>.

Chaney, E., W. Elmore, and W.S. Platts. 1993. *Managing Change: Livestock Grazing On Western Riparian Areas.* Prepared for the U.S. Environmental Protection Agency by the Northwest Resource Information, Center, Inc., Eagle, Idaho.

Columbia University. 2004. Ecology. In *The Columbia Encyclopedia*, Sixth edition New York: olumbia University Press. Available: <www.bartleby.com/65/>.

Cooper, D. 2003. *Important Bird Areas of California.* Los Angeles, CA: Audubon California. p. 286.

Cox, W. 2000. *California Freshwater Shrimp (*Syncaris pacifica*).* Prepared for Workshop on Freshwater Shrimp, Californ ia Department of fish and Game, Yountville, California.

Crabbe, N. 2003. Erosion Threatens Angwin Water Supply. *Napa Valley Register*. January 26, 2003.

Cramer, S.P. 1998. Risk of Extinction for Cutthroat Trout in the Umpqua Basin. S.P. Cramer & Associates, Inc. Submitted to Ronald Yokum, Attorney. (Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon St., Portland, OR 97232.)

Daniels, J. and L. Pagano. 2004. *Post-Project Appraisal of Lower Ritchie Creek Dam Removal, Napa County.* Water Resources Center Archives: Hydrology. University of California, Multi-Campus Research Unit. Available: <repositories.cdlib.org/wrca/hydrology/daniels>. Last revised: April 1, 2004.

Davis, S. D., V. H. Heywood, O. Herrera-MacBryde, J. Villa-Lobos, and A. C. Hamilton (eds.). 1997. *Centres of Plant Diversity: A Guide and Strategy for Their Conservation. Volume 3: The Americas.* Cambridge, United Kingdom: The World Wildlife Fund for Nature and the World Conservation Union (IUCN).

Dunne, T. and Leopold, L. 1983. *Water in Environmental Planning*. New York: W.H. Freeman and Company.

Durham, J. B. 1979a. Geology and Landslides of the St. Helena 15' Quadrangle, California. CDF, Title II Data Compilation Project, scale 1:62,500.

———. 1979b. Geology and Landslides of the Calistoga 15' Quadrangle, California. CDF, Title II Data Compilation Project, scale 1:62,500.

Dwyer, M. J., N. Noguchi, and J. O'Rourke. 1976. Reconnaissance Photointerpretation Map of Landslides in 24 Selected 7.5' Quadrangles, Lake, Napa, Solano, and Sonoma Counties, California. USGS OF report 76-74, scale 1:24,000.

Dyer, A.R. 2003. Burning and Grazing Management in a California Grassland: Growth, Mortality, and Recruitment of *Nassella pulchra*. *Restoration Ecology* 11(3):291–296.

Ecotrust and FONR 2001. *Results of Hankin-Reeves Standard Uncalibrated* O. mykiss *Survey of Napa River Tributaries*.

Elder, W.P. 2001. Geology of the Golden Gate Highlands. Pages 61–86 in Stoffer, P.W and L.C. Gordon (eds.), *Geology and Natural History of the San Francisco Bay Area: A Field-Trip Guidebook*. (U.S. Geological Survey Bulletin 2188.) Available: <www.nps.gov/prsf/geology/geoguide.pdf>.

Ellen, S. D. R. K. Mark, G. F. Wieczorek, C. M. Wentworth, D. W. Ramsey, and T. E. May. 1997. Map showing principal debris-flow source areas in Napa County, California. USGS Open file 97-745 E.

Ellison, J. 1980. *Stream Survey Huichica Creek*. Report dated January 24.

England, A. S. 1988. Mixed Chaparral. Pages 104-105 in K. E. Mayer and W. F. Laudenslayer, Jr. (eds.), *A guide to Wildlife Habitats of California*. California Department of Forestry and Fire Protection.

Environmental Law Institute. 2003. *Conservation Thresholds for Land Use Planners*. Environmental Law Institute: Washington D.C. ELI project code 003101. Available: <www.elistore.org>.

Environmental Systems Research Institute. 1990. *Understanding GIS: The Arc/Info Method.* New York: Geoinformation International and John Wiley and Sons.

Esser, Lora L. 1994. *Cupressus macnabiana*. In *Fire Effects Information System*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Available: <www.fs.fed.us/database/feis/>. Accessed: August 4, 2005.

Everest, F. H., G. H. Reeves, J. R. Sedell, J. Wolfe, D. Hohler, and D. A. Heller. 1986. *Abundance, Behavior, and Habitat Utilization by Coho Salmon and Steelhead Trout in Fish Creek, Oregon, as Influenced by Habitat Enhancement.* Annual Report 1985. Project No. 84-11. Prepared by U. S. Forest Service for Bonneville Power Administration, Portland, Oregon.

Everest, F.H. and D.W. Chapman. 1972. Habitat Selection and Spatial Interaction by Juvenile Chinook Salmon and Steelhead Trout in Two Idaho Streams. *Journal of the Fisheries Research Board of Canada* 29(1): 91-100.

Fawcett, Michael. 2001. *Mare Island Dredge Disposal, Environmental Assessment Fisheries Impact Analysis.* February 21.

Ferry, G.W., R.G. Clark, R.E. Montgomery, R.W. Mutch, W.P. Leenhouts, and G.T. Zimmerman. 1995. Altered Fire Regimes Within Fire-Adapted Ecosystems. In *Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems*. U.S. Department of the Interior, National Biological Service.

Fitzhugh, E.L. 1988. Ponderosa Pine. Pages 56-57 in Mayer, K.E. and W.F. Laudenslayer, Jr. (eds.), *A Guide to Wildlife Habitats of California*. State of California, Resources Agency, Department of Fish and Game. Sacramento, CA.

Fontaine, B. L. 1988. *An Evaluation of the Effectiveness of Instream Structures for Steelhead Trout Rearing Habitat in the Steamboat Creek Basin*. Master's thesis. Department of Oregon State University, Corvallis, Oregon.

Friedman, G.B. 2004. County Ag Growth Steady, but Water Worries Persist. *Napa Valley Register.* June 4, 2004.

Garrison, B.A. and R.B. Standiford. 1997. Effects of Wood Cutting on Wildlife Habitat in Blue Oak Woodlands in the Northern Sacramento Valley. *Oaks 'n' Folks* 12(1). Available: <http://danr.ucop.edu/ihrmp/oak56.htm>.

Gerlach, Jr., J.D. and J.M. DiTomaso. 2005. *Centaurea solstitialis.* In *California Invasive Plant Council Database*. Berkeley, CA: California Invasive Plant Council. Available: <ucce.ucdavis.edu/datastore/detailreport.cfm?usernumber=28&surveynumber=182>.

Godt, J. W., W. Z. Savage, and R. Wilson. 1999. Map showing location of damaging landslides in Napa County, California resulting from 1997-98 El Niño rainstorms. USGS Miscellaneous Field studies, Map MF-2325-A.

Grossinger, R., C. Striplen, E. Brewster, and L. McKee. 2003. *Ecological, Geomorphic, and Land Use History of Sulphur Creek Watershed: A Component of the Watershed Management Plan for the Sulphur Creek Watershed, Napa County, California*. (Technical Report of the Regional Watershed Program, SFEI Contribution 69), Oakland, CA: San Francisco Estuary Institute.

———. 2004. *Ecological, Geomorphic, and Land Use History of Carneros Creek Watershed: A Component of the Watershed Management Plan for the Carneros Creek Watershed, Napa County, California*. (Technical Report of the Regional Watershed Program, SFEI Contribution 70), Oakland, CA: San Francisco Estuary Institute.

Hamilton, W. J. 2004. Tricolored Blackbird (*Agelaius tricolor*). In *The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-Associated Birds in California.* California Partners in Flight. Available: www.prbo.org/calpif/htmldocs/species/riparian/tricolored_ blackbird.htm.

Harrington, K. and T. Lanini. 2005. *Phalaris aquatica.* In *California Invasive Plant Council Database*. California Invasive Plant Council, Berkeley, CA.Available: <ucce.ucdavis.edu/datastore/detailreport.cfm?usernumber=67&surveynumber=182>.

Harris, L., and Ambrosins, CDFG. 1981. Memo to file. Re: Carneros Creek, Napa County. June 29 and July 1.

Harrison, S. 1999. Local and Regional Diversity in a Patchy Landscape: Native, Alien and Endemic Herbs on Serpentine Soils. *Ecology* 80: 70-80.

Harrison, S., B.D. Inouye and H.D. Safford. 2003. Ecological Heterogeneity in the Effects of Grazing and Fire on Grassland Diversity. *Conservation Biology* 17(3):837–845.

Hartman, G. F. 1965. The Role of Behavior in the Ecology and Interaction of Underyearling Coho Salmon *(Oncorhynchus kisutch*) and Steelhead Trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada* 22: 1035-1081.

Heady, H. 1988. Valley Grassland. Pages 491-514 in M. G. Barbour and J. Major (eds.), *Terrestrial Vegetation of California*. New York, NY: Wiley Interscience, John Wiley and Sons.

Hearn, B. C. Jr., R. J. McLaughlin, and J. M. Donnelly-Nolan. 1988. Tectonic Framework of the Clear Lake Basin, California. In *Late Quaternary Climate, Tectonism, and Sedimentation in Clear Lake, Northern California Coast Ranges, Geological Society of America, Special Paper* 214: 9-20.

Hickman, J.C. (ed.). 1993. *The Jepson Manual: Higher Plants of California*. Berkeley: University of California Press.

Hilty, J. A. and A. M. Merenlender. 2004. Use of Riparian Corridors and Vineyards by Mammalian Predators in Northern California. *Conservation Biology* 18(1):132-137.

Holland, D. C. 1991. *A Synopsis of the Ecology and Status of the Western Pond Turtle (Clemmys marmorata) in 1991*. Prepared for the U.S. Fish and Wildlife Service, National Ecology Research Center, San Simeon Field Station. Holland, R.F. 1996. Mapping Project for the Vernal Pool Recovery Plan Methodology.

Holland, R.F. 1976. The Vegetation of Vernal Pools: A Survey. In Jain, S. (ed.), *Vernal Pools: Their Ecology and Conservation*. Institute of Ecology Publication No. 9, pp. 11-15. University of California, Davis.

———. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* October. Sacramento, CA: California Department of Fish and Game.

———. 1996. Great Valley Vernal Pool Distribution, Photorevised 1996. In C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren Jr., and R. Ornduff (eds.), *Ecology, Conservation, and Management of Vernal Pool Ecosystems: Proceedings from a 1996 Conference.* Sacramento: California Native Plant Society (CNPS). Available: <www.cnps.org/programs/vernalpools.htm>.

Holland, R.F. and S.K. Jain. 1988. Vernal Pools. In Barbour, M.J. and J. Major (eds.), *Terrestrial Vegetation of California*. California Native Plant Society Special Publication No. 9. pp. 515-531.

Holstein, G. 1984. California Riparian Forests: Deciduous Islands in an Evergreen Sea. In Warner, R.E., and K.M. Hendrix (eds.) *California Riparian Systems: Ecology, Conservation, and Productive Management*. Berkeley, CA: University of California Press.

Jennings, M.R., and M.P. Hayes. 1994. Decline of Native Ranid Frogs in the Desert Southwest. In P.R. Brown and J.W. Wright (eds.), *Proceedings of the Conference on the Herpetology of the North American Deserts*. Southwestern Herpetologists Society, Spec. Publ. 5.

Jensen, D.B. 1988. Closed-Cone Pine-Cypress Vegetation. In K.E. Mayer and W.F. Laudenslayer, Jr., (eds.), *A Guide to Wildlife Habitats of California.* 1988. Sacramento, CA: State of California, Resources Agency, Department of Fish and Game.

Jokerst, J.D. 1990. *Sacramento County Vernal Pools: Their Distribution, Classification and Management*. Prepared for Jones & Stokes.

Jones & Stokes. 2003. *Draft EIR/EIS for the Napa River Salt Marsh Restoration Project*. Prepared for the California Coastal Conservancy. April.

———. 2004. *Administrative Draft NOAA Fisheries Biological Assessment Programmatic Authorization for Caltrans' Routine Maintenance and Repair Activities Related to Aquatic/Riparian Resources, Districts 1, 2, and 4.* June.

Jones, W. 2001. *Draft Current Stream Habitat Distribution Table:California Coastal Salmon and Steelhead*. NMFS California Anadromous Fish Distributions. National Marine Fisheries Service. Long Beach, CA.. Available: <http://swr.nmfs.noaa.gov/hcd/napa.pdf>.

Kays, R.W. and D.E. Wilson. 2002. *Mammals of North America.* (Princeton Field Guides.) Princeton: Princeton University Press.

Keeler-Wolf, T., D.R. Elam, K. Lewis, and S.A. Flint. *California Vernal Pool Assessment.* (Preliminary Report). 1998. Last revised: January 31, 2005. Sacramento, CA: California Department of Fish and Game. Available: <www.dfg.ca.gov/whdab/wetlands/vp_asses_rept/>.

Keeley, J. E. 2001. Fire and Invasives in Mediterranean-Climate Ecosystems of California. In T. P. Wilson and K. E. M. Galley (eds.), *The First National Congress on Fire, Ecology, Prevention and Management Proceedings: Fire in the Control and Spread of Invasive Species*. Tallahassee, FL: Tall Timbers Research Station.

———. 2002. Native American Impacts on Fire Regimes of the California Coastal Ranges. *Journal of Biogeography* 29(3):303–320.

Kneib, R. T. 1997. The Role of Tidal Marshes in the Ecology of Estuarine Nekton. *Oceanography and Marine Biology: An Annual Review* 35:163–220.

Koehler, J. 2002. *Habitat Inventory Report: Wooden Valley Creek & White Creek*. Napa Resource Conservation District. Napa, CA. Available: <http://www.napawatersheds.org/Content/10144/Wooden_Valley_Stream_Habitat_Inventory.html> .

Koehler, J. 2005. *Napa River Fisheries Study: The Rutherford Dust Society Restoration Reach, Napa County, California*. January 2005.

Kruckeberg, A. 1984. *California Serpentines: Flora, Vegetation, Geology, Soils, and Management Problems*. University of California Press, Berkeley.

Kyser G.B., J.M. DiTomaso. 2002. Instability in a Grassland Community after the Control of Yellow Starthistle (*Centaurea solstitialis*) with Prescribed Burning. *Weed Science* 50(5)648-657.

Laaksonen-Craig, S, G.E. Goldman, and W. McKillop. 2003. *Forestry, Forest Industry, and Forest Products Consumption in California*. (Pub. 8070) University of California: Division of Agriculture and Natural Resources.

Land Trust of Napa County. 2003. *Conservation Vision 2010: A Map to the Future.* Available: <napalandtrust.org/newsletters/LT_2010vision.pdf>.

Lee, D. P., CDFG. 1974. *Stream Survey of Nash Creek*. May 23.

Leidy, R. A. 1997. Native Fishes in Bay Streams. In *State of the Estuary, 1992-1997*. San Francisco Estuary Project, Oakland, California.

Leidy, R.A., G.S. Becker, and B.N. Harvey. 2003. *Historical Distribution and Current Status of Steelhead* (Oncorhynchus mykiss) *in Streams of the San Francisco Estuary, California.* Prepared for Center for Ecosystem Management and Restoration, Oakland, California. Available: <www.cemar.org/pdf/solano.pdf>.

———. 2005. Historical Distribution and Current Status of Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). In *Streams of the San Francisco Estuary, California*. Center for Ecosystem Management and Restoration, Oakland, CA.

Locke, J.P. 2002. *Vineyards in the Watershed: Sustainable Winegrowing in Napa County.* Napa, CA: Napa Sustainable Winegrowing Group.

Maragni, DB. 2000. Chinook Salmon. In P.R. Olofson (ed.), *Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish, and Wildlife*. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. Oakland, CA: San Francisco Bay Regional Water Quality Control Board.

Mayer, K.E. and W.F. Laudenslayer, Jr., (eds.). 1988. *A Guide to Wildlife Habitats of California.* Sacramento, CA: State of California Resources Agency, Department of Fish and Game.

McCarten, N. 1987. Serpentine Plant Communities of the San Francisco Bay Region. In Elias, T. (ed.), *Conservation and Management of Rare and Endangered Plants: Proceedings from a Conference of the California Native Plant Society*. Sacramento, CA: California Native Plant Society.

McEwan, D. and T. A. Jackson. 1996. *Steelhead Restoration and Management Plan for California*. Management Report. Sacramento, CA: California Department of Fish and Game, Inland Fisheries Division.

McNaughton, S. J. 1968. Structure and Function in California Grasslands. *Ecology* 49:962-972.

Meffe, G.K. and C.R. Carroll. 1994. *Principles of Conservation Biology*. Sunderland, MA: Sinauer Associates.

Merenlender A, Crawford J. 1998. *Vineyards in an Oak Landscape: Exploring the Physical, Biological, and Social Benefits of Maintaining and Restoring Native Vegetation in and Around the Vineyard*. Oakland, CA: University of California, Division of Agriculture and Natural Resources Publication 21577.

Merenlender, A.M., C. Brooks and G. A. Giusti. 2001. *Policy Analysis Related to the Conversion of Native Habitat to Vineyard: Sonoma County's Vineyard Erosion and Sediment Control Ordinance as a Case Study*. Available: <danr.ucop.edu/ihrmp/policy_paper.pdf>.

Montgomery, D. R., and J. M. Buffington. 1998. Channel Processes, Classification, and Response. In R. J. Naiman and R. E. Bilby (eds.), *River Ecology and Management*. New York: Springer-Verlag.

Morrison, P.H. and F.J. Swanson. 1990. *Fire History and Pattern in a Cascade Range Landscape*. (General Technical Report PNW-GTR-254.) Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. May.

Mount, J.F. 1995. *California Rivers and Streams: The Conflict Between Fluvial Process and Land Use*. Berkeley, CA: University of California Press.

Moyle P. B., R. M. Yoshiyama, and R. A. Knapp. 1996. Status of Fish and Fisheries. In *Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Chapter 33*. Davis, CA: University of California, Centers for Water and Wildland Resources.

Moyle, P. B. 1973. Effects of Introduced Bullfrogs, *Rana catesbeiana*, on the Native Frogs of the San Joaquin Valley, California. *Copeia* 1973 (1):18–22.

———. 1999. The Putah-Cache Bioregion Project: The Curious Naturalist's Annotated Fish List. Davis, CA: *Putah-Cache Bioregion Project.* Available: <bioregion.ucdavis.edu/where/fishlist.html>.

———. 2002. *Inland Fishes of California*. Second edition. Davis, CA: University of California Press.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. *Fish Species of Special Concern in California*. Second edition. Final Report for Contract No. 2128IF.

Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca, and J. Kent. 2000. Biodiversity Hot Spots for Conservation Priorities. *Nature* 403:853–858.

Myrick, C. A. and J. J. Cech, Jr. 2001. *Temperature Effects on Chinook Salmon and Steelhead: a Review Focusing on California's Central Valley Populations*.

Napa County Agricultural Commissioner. 2005. 2004 Agricultural Crop Report. Available: <http://www.co.napa.ca.us/fileframe.asp?section=Business&Title=Crop%20Report>.

Napa County Resource Conservation District (Napa RCD). 1996. *Napa River Watershed Owner Manual.* Available: <www.naparcd.org/ownermanual.htm>.

———. 1997. *Napa River Watershed Owner's Manual*. Napa, CA: Napa County Resources Conservation District.

———. 2003. *Threatened and Endangered Listed Species of Napa County*. December. Last revised: December 2003. Available: <www.naparcd.org/threatenedendangered.htm>.

Napa County Sheriff. 2003. *Application For State Off-Highway Vehicle Grant or Cooperative Agreement.* Available: <www.co.napa.ca.us/GOV/Departments/23500/Linked/OffRoad.pdf>.

Napa County. 2004. *Vernal Pool Layer.* Compiled by the Napa County Conservation and Planning Department from reports by J. Ruygt and R.Holland, 1996.

National Wild Turkey Federation. 2003. *NWTF to Fund Research, Offer Solutions That Benefit Both Landowners and Wildlife*. Last revised February 10, 2003. Available: <www.wheelinsportsmen.org/nwtf_newsroom/press_releases.php?id=130>.

Nature Conservancy of California (TNC). 2003. *Conserving the Landscapes of Napa County.* San Francisco, CA.

Nilsen, T. H. and B. L. Turner. 1975. *Influence of Rainfall and ancient Landslide Deposits on Recent Landslides (1950-71) in Urban Areas of Contra Costa County, California*. U. S. Geological Survey Bulletin 1388.

Nilsen, T. H., R. H. Wright, T. C. Vlasic, and W. E. Spangle. 1979. *Relative Slope Stability and Land-Use Planning in the San Francisco Bay Region, California*. U. S. Geological Survey professional paper 944. 96 p.

NOAA Fisheries. 2005. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. 50 CFR Part 226. Available: <http://www.nwr.noaa.gov/1salmon/salmesa/crithab/SWR-CHD-81205.PDF>. Last updated: August 12, 2005.

Noss R., R. Amundson, D. Arnold, M. Bradbury, S. Collinge, B. Grewell, R. Grosberg, L. McKee, P. Northen, C. Swanson, and R. Yoshiyama. 2002. *Solano County, Natural Community Conservation Plan, Habitat Conservation Plan. Report of Science Advisors*.

Noss, R.F. 2000. *Habitat Fragmentation as a Cumulative Impact of Winery Expansion and Other Development in Napa County, California*. Unpublished report. San Francisco, CA: Sierra Club.

Olson, D. and J. Sawyer. 1999. Northern California Coastal Forests. In Ricketts, T.H., E. Dinerstein, D.M. Olson, C.J. Loucks, et al. (eds.), *Terrestrial Ecoregions of North America: A Conservation Assessment.* World Wildlife Fund—United States and Canada. Washington, D.C.: Island Press.

Osmond, D.L., D.E. Line, J.A. Gale, R.W. Gannon, C.B. Knott, K.A. Bartenhagen, M.H. Turner, S.W. Coffey, J. Spooner, J. Wells, J.C. Walker, L.L. Hargrove, M.A. Foster, P.D. Robillard, and D.W. Lehning. 1995. WATERSHEDSS: *Water, Soil and Hydro-Environmental Decision Support System*. Last revised: December 10, 2003. Available: <www.water.ncsu.edu/watershedss/>.

Paysen TE, Ansley RJ, Brown JK, Gottfried GJ, Haase SM, Harrington MG, Narog MG, Sackett SS, Wilson RC. 2000. Fire in Western Shrubland, Woodland, and Grassland Ecosystems. Pages 121–159 in Brown, J.K. and J.K. Smith (eds.), *Wildland Fire and Ecosystems: Effects of Fire on Flora*. Ogden, (UT): U S Department of Agriculture Forest Service, Rocky Mountain Research Station. General Technical Report RMRS-GTR-412-Vol. 2.

Pinkham, C. CDFG. 1976. *Stream Survey Hopper Creek*. August 11.

Pitt, M.D. and H.F. Heady. 1978. Responses of Annual Vegetation to Temperature and Rainfall Patterns in Northern California. *Ecology* 59: 336-350.

Point Reyes Bird Observatory (PRBO) and California Department of Fish and Game. 2003. *California Bird Species of Special Concern: Draft List and Solicitation of Input.* Available: www.prbo.org/cms/index.php?mid=252&module=browse. Last revised: October, 17 2003.

Poirier Locke, J. 2002. *Vineyards in the Watershed: Sustainable Winegrowing in Napa County*. The Napa Sustainable Winegrowing Group.

Raleigh, R. F., W. J. Miller, and P. C. Nelson. 1986. *Habitat Suitability Index Models and Instream Flow Suitability Curves: Chinook Salmon*. U.S. Fish and Wildlife Service Biological Report 82(10.122).

Raleigh, R.F., T. Hickman, R.C. Solomon, and P. C. Nelson. 1984. *Habitat Suitability Information: Rainbow Trout*. U.S. Fish. and Wildlife Service. FWS/OBS-82/10.60.

Reed, F. Noss and Paul Beier. 2000. Arguing over Little Things: Response to Haddad et al.. *Conservation Biology* 14:5, 1546-1548.

Riparian Habitat Joint Venture (RHJV). 2004. Version 2.0. *The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian Associated Birds in California*. California Partners in Flight. Available: <www.prbo.org/calpif/pdfs/riparian.v-2.pdf>.

Robinson, J. and J. Alexander. 2002. Version 1.0. *The Draft Coniferous Forest Bird Conservation Plan: A Strategy for Protecting and Managing Coniferous Forest Habitats and Associated Birds in California.* Point Reyes Bird Observatory, Stinson Beach, CA: California Partners in Flight (CalPIF). Available: <www.prbo.org/calpif/htmldocs/conifer.html>.

Ruygt, J. 1999. Rare Plants. *Napa Sustainable Winegrowing Group Newsletter*. Summer. Available: <www.nswg.org/n2.rareplants.htm>.

Ryer, C. H. 1988. Pipefish Foraging: Effects of Fish Size, Prey Size, and Altered Habitat Complexity. *Marine Ecology Progress* (Series 48.) 37–45.

Salmon, T.P. 2002. Biology and Control of Rodents in Vineyards. *Wine Business Monthly* 9:5. Last revised: May 1, 2002. Available: <www.winebusiness.com/html/MonthlyArticle.cfm?dataId=17097>.

San Francisco Invasive Spartina Project (SFISP). 2001. *Distribution of Invasive Spartina Populations by Species, 2000–2001 Survey.* Oakland, CA: California Coastal Conservancy. Available: <www.spartina.org/maps_findings.htm>.

Sandiford, R.B. 1994. The Role of Fire in California's Oak Woodlands. *Oaks 'n' Folks* 9:2. Available: <http://danr.ucop.edu/ihrmp/oak31.htm>.

Sawyer, J. and T. Keeler-Wolf. 1995. *A Manual of California Vegetation.* Sacramento, CA: CNPS Press.

Shapovalov, L. and A.C. Taft. 1954. *The Life Histories of the Steelhead Rainbow Trout (Salmo gairdneri gairdneri) and Silver Salmon (Oncorhynchus kisutch) with Special Reference to Waddell Creek, CA*. California Department of Fish and Game. Fisheries Bulletin 98.

Shlisky, A, S. Barrett, and N. Sugihara. *Fire Regime Condition Class (FRCC) Interagency Handbook Reference Conditions. Potential Natural Vegetation Group: Xeric Chaparral*. Last revised: June 8, 2004. Available: <www.frcc.gov/docs/PNVG/West/CHAP1_Description.pdf>.

Silveira, J. G. 1998. Avian uses of vernal pools and implications for conservation practice. Pages 92-106 in: C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren, Jr., and R. Ornduff, editors. *Ecology, Conservation, and Management of Vernal Pool Ecosystems*. Sacramento, CA: California Native Plant Society.

Skinner, M.W. and B. Pavlik. 1994. Inventory of Rare and Endangered Vascular Plants of California. *California Native Plant Society, Special Publication No. 1, Fifth Edition*. Sacramento, CA.

Sonoma Ecology Center. 2002. *The Oral History Project*. Sonoma, CA.

Stebbins, R.C. 2003. *Western Reptiles and Amphibians, 3rd edition*. (Peterson Field Guides) New York: Houghton Mifflin.

Stein, B. A. 2002. *States of the Union: Ranking America's Biodiversity*. Arlington, VA: NatureServe. Prepared for The Nature Conservancy, Arlington, VA. Available: www.natureserve.org/Reports/stateofunions.pdf.

Stein, B. A., L. S. Kutner, and J. S. Adams. 2000. *Precious Heritage: The Status of Biodiversity in the United States.* New York: Oxford University Press.

Steinberg, P.D. 2002. Nassella pulchra. In U.S. Department Agriculture, Forest Service *Fire Effects Information System*. Available: <http://www.fs.fed.us/database/feis/plants/graminoid/naspul/all.html>.

Stillwater Sciences and W.E. Dietrich. 2002. *Napa River Basin Limiting Factors Analysis*. June. Prepared for San Francisco Bay Water Quality Control Board and California State Coastal Conservancy. Prepared by Stillwater Sciences, Berkeley, California and W.E. Dietrich, Department of Earth and Planetary Sciences. Berkeley, CA: University of California.

Stillwater Sciences. 2002. *Napa River Basin Limiting Factors Analysis*. Final Technical Report. Prepared for San Francisco Bay Water Quality Control Board and California State Coastal Conservancy.

———. 2004. *Napa River Fisheries Monitoring Program*. Final Report 2004. Prepared for the U.S. Army Corps of Engineers. December.

Stuart, J.D. 1996. *Coast Redwood Forest Health*. Research presented at the Conference on Coast Redwood Forest Ecology and Management, Arcata, CA: Humboldt State University. June 18–20, 1996.

Swales, S., R. B. Lauzier, and C. D. Levins. 1986. Winter Habitat Preferences of Juvenile Salmonids in Two Interior Rivers in British Columbia. *Canadian Journal of Zoology* 64: 1506-1514.

Takekawa, J. T., A. K. Miles, D. H. Schoellhamer, G. M. Martinelli, M. K. Saiki, and W. G. Duffy. 2000. *Science Support for Wetland Restoration in the Napa- Sonoma Salt Ponds, San Francisco Bay estuary, 2000 progress report.* Unpublished progress report. Davis and Vallejo, CA: U.S. Geological Survey.

Taylor, Ross N. and Michael Love. 2003. *California Salmonid Stream Habitat Restoration Manual. Part IX: Fish Passage Evaluation at Stream Crossings*. California Department of Fish and Game. Available: <http://www.dfg.ca.gov/nafwb/pubs/2003/FishPassage.pdf>.

Thorne, J.H., J.A Kennedy, J.F. Quinn, M. Mccoy, T. Keeler-Wolf, and J. Menke. 2004. A Vegetation Map Of Napa County Using The Manual of California Vegetation Classification and its Comparison to Other Digital Vegetation Maps. *Madroño* 51:4, 343-363.

Tyler, R. and C. Holstine. 1975. *Stream Survey Milliken Creek*. November 3 and December 5. California Department of Fish and Game.

U.S. Army Corps of Engineers and Napa County Flood Control District. No date. Napa River Fisheries Monitoring Program (FMP). Available: <http://www.napariverfishmonitoring.org/>.

U.S. Fish and Wildlife Service (USFWS). 1968. *Analysis of Fish Habitat of Napa River and Tributaries, Napa County, California, with Emphasis Given to Steelhead Trout Production.* October 21, 1968. Memorandum from a USFWS Biologist to Files.

———. 1988. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the California Freshwater Shrimp. Federal Register 53: 43224-43889.

———. 1998. *California Freshwater Shrimp* (Syncaris pacifica Holmes) *Recovery Plan*. Portland, Oregon.

———. 2002. *Birds of Conservation Concern 2002*. Arlington, VA: Division of Migratory Bird Management. Available: <migratorybirds.fws.gov/reports/bcc2002.pdf>.

U.S. Fish and Wildlife Service and California Department of Fish and Game. 1968. Analysis of Fish Habitat of Napa River and Tributaries, Napa County, CA with Emphasis Given to Steelhead Trout Projection. October 21.

Underwood, E. C. and A. D. Hollander. 2001. A Biodiversity Assessment of Napa County. Unpublished report. Prepared for the Land Trust of Napa County.

University of Washington Libraries. 2004. Washington State Geospatial Data Archive. Available: <wagda.lib.washington.edu/help/doqq_arcview.html>.

URS Corporation. 2001. Proposed SFO Runway Reconfiguration Program Biology Technical Report. June 15. Prepared for the City and County of San Francisco Planning Dept. and Federal Aviation Administration, Burlingame, CA. Oakland, CA.

U.S. Geological Survey. 2005. *USGS Real-Time Water Data for California*. Available: <http://waterdata.usgs.gov/ca/nwis/uv?11458000>.

Watershed Information Center and Conservancy of Napa County. No date(b) CA Freshwater Shrimp Life Cycle. Available: <http://www.napawatersheds.org/docManager/12132/shrimp.gif>.

———. No date(a). Steelhead Migration. Available: <http://www.napawatersheds.org/docManager/12131/steelhead.gif>.

Wentworth, C. M., S. E. Graham, R. J. Pike, G. S. Beukelman, D. W. Ramsy, and A. D. Barronet. 1997. Summary Distribution of Slides and Earth Flows in the San Francisco Bay region, California. USGS Open File Report 97-745 C.

Wester, L.L. 1981. Composition of Native Grasslands in the San Joaquin Valley, California. *Madroño* 28:231–241.

Western Regional Climate Center. 2002. Cited in Stillwater Sciences 2002 p 5. Available: <http://www.wrcc.dri.edu/>.

WET, Inc. 1990. *Napa River Sediment Engineering Study, Phase I and II*. Prepared for U. S. Army Corps of Engineers, Sacramento, CA.

White K.L. 1966. Structure and Composition of Foothill Woodland in Central Coastal California. *Ecology* 47: 229–237.

Wild, Kathryn. 2002. *San Francisco Bay Area Gap Analysis: A Preliminary Assessment of Priorities for Protecting Natural Communities.* November. Prepared for the California State Coastal Conservancy, Oakland, CA.

Wright, T. L. and N. Smith. 1992. Right Step from the Hayward Fault to the Rodgers Creek Fault beneath San Pablo Bay. In Borchardt, G. et al. (eds.), *Proceedings of the Second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area*. California Department of Conservation, Division of Mines and Geology Special Publication, 113, p. 401-417.

Zedler, P.H. 1987. *The Ecology of Southern California Vernal Pools: A Community Profile*. U.S. Fish and Wildlife Service Biological Report 85 (7.11).

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, M. White. 1990. *California's Wildlife. Volume 1 Reptiles and Amphibians*. Sacramento CA: California Department of Fish and Game.

OTHER DOCUMENTS USED

Anderson, K. R. 1969. Steelhead Resource, Napa River Drainage, Napa County. California Department of Fish and Game, Region 3. Memorandum to Files, 23 December.

California Department of Fish and Game (CDFG). 1999. Report on the 1980–1995 Fish, Shrimp, and Crab Sampling in the San Francisco Estuary, California. (Technical Report 63.) November. Stockton, CA.

California Native Plant Society. 2004. Inventory of Rare and Endangered Plants of California. Version 6.04. Last revised: July 6, 2004. Sacramento, CA. Available: <http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi>.

Calvert, C. 2004. Statement of the Deputy Assistant Secretary, Land and Minerals Management, Department of the Interior to the Senate Energy and Natural Resources Committee Subcommittee on Public Lands and Forests. (Hearing on S. 738, Northern California Coastal Wild Heritage Act.) Last revised: July 21, 2004. Available: <www.doi.gov/ocl/2004/S738.htm>.

Knight, A.W. and R.L. Bottorff. 1984. The Importance of Riparian Vegetation to Stream Ecosystems. In Warner, R.E., and K.M. Hendrix (eds.), California Riparian Systems: Ecology, Conservation, and Productive Management. Berkeley, CA: University of California Press.

LeBuhn, Gretchen. 2002. Oak Woodland Bees in a Vineyard Landscape. Oaks 'n Folks 18:12.

Leidy, R. A. 1984. Distribution and Ecology of Stream Fishes in the San Francisco Bay Drainage. Hilgardia 52:1–175.

———. 2001. Steelhead (*Oncorhynchus mykiss irideus*). Pages 101–104 in Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish, and Wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. P. R. Olofson (ed.). Oakland, CA: San Francisco Bay Regional Water Quality Control Board.

Leidy, R. A., and J. Sisco. 1999. Historical Distribution and Current Status of Steelhead (*Oncorhynchus mykiss irideus*), Coho Salmon (O. kisutch), and Chinook Salmon (O. tshawytscha) in Streams of the San Francisco Estuary, California. Oakland, CA: San Francisco Estuary Institute.

Miles, A. K., Fregien, S., Takekawa, J. Y, Martinelli, G. M., Schoellhamer, D. H., Duffy, W. G., Schlosser, J. P., Saiki, M. K. 2001. Science Support for Wetland Restoration in the Napa-Sonoma Salt Ponds, San Francisco Bay Estuary. Last revised: February 1, 2001. Available: <sfbay.wr.usgs.gov/access/saltponds/>.

Moyle, P. B. 2002. Inland Fishes of California, Revised and Expanded. Berkeley: University of California Press.

National Marine Fisheries Service (NMFS). 1999. Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California. Federal Register 64: 50394–50415.

Rolston III, H. 1994. Our Duties to Endangered Species. In G.K. Meffe and C.R. Carroll (eds.), Principles of Conservation Biology. Sunderland, MA: Sinauer Associates.

University of California Natural Reserve System. 1999. Natural History of McLaughlin Reserve. Available: <nrs.ucdavis.edu/mclaughlin/naturalhis/NaturalHistory.htm>.

U.S. Fish and Wildlife Service (USFWS). 2005. National Wetlands Inventory. St. Petersburg, Florida: U.S. Fish and Wildlife Service, National Wetlands Inventory. Last revised: July 1, 2005. Available: <wetlands.fws.gov/>.

———. 1993. Fish and Wildlife Coordination Act Draft Report. (Petaluma River Section 205, Flood Control Study.) Sonoma, CA.

———. 1996. Sacramento–San Joaquin Delta Native Fishes Recovery Plan. Portland, OR.

Waddell, K.L. and P.M. Bassett. 1997. Timber Resource Statistics for the Sacramento Resource Area of California. Resource Bulletin. (PNW-RB-220.) Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Walker, R. and L. Craighead. 1997. Analyzing Wildlife Movement Corridors in Montana Using GIS. Wildlands Report No. 11. Available: <http://www.wildlands.org/research.html>.

PERSONAL COMMUNICATIONS

Callizo, J. Botanist and Wantrup Reserve Manager. E-mail, November 11, 2005.

Keeler-Wolf, Todd. Senior Vegetation Ecologist, Wildlife and Habitat Data Analysis Branch, California Department of Fish and Game. Meeting, February 27, 2004.

Maniscalco Donna. Fisheries Biologist, Jones and Stokes Associates. E-mail, August 5, 2005.

Ruygt, J. Botanist and Conservation Committee Chair, California Native Plant Society. Meeting, July 12, 2004, and e-mail, November 9, 2005.