CHAPTER 4: ECOSYSTEMS

Ecosystem Services

Natural ecosystems provide a multitude of services to humankind. Ecosystem services, often referred to as green infrastructure, are the processes by which the environment produces resources such as clean water and pollination of agricultural plants (Ecological Society of America 2008). Traditionally, resource conservation has been directed towards conserving resources solely for their economic use and human consumption (Meffe 2000). Today, the understanding of resource conservation has broadened to include a broader understanding of the ecosystems which produce these resources. Caring for these resources has led to a new management and planning approach known as ecosystem-based management. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, productive, and resilient condition so that it can provide the services humans want and need (Communication Partnership for Science and the Sea 2006).

The services that an ecosystem provides are difficult to impossible for humankind to duplicate. Operating on a grand scale and in such intricate and little understood ways, most ecosystem services could not be replaced by technology (Daily 2008). Calculating the financial value of these services is also difficult. The following are examples of just two services that would be difficult or extremely costly to replicate.

[OPPOSITE] FIGURE 4.1 *The Ventura River Estuary.*

- Medicinal Services: Eighty percent of the world's population relies upon natural medicinal products. Of the top 150 prescription drugs used in the U.S., 118 originate from natural sources: 74% from plants, 18% from fungi, 5% from bacteria, and 3% from one vertebrate (snake species). Nine of the top 10 drugs originate from natural plant products.
- Pollination: One third of human food comes from plants pollinated by wild pollinators. Over 100,000 different animal species – including bats, bees, flies, moths, beetles, birds, and butterflies – provide free pollination. The value of pollination services from wild pollinators in the U.S. alone is estimated at four to six billion dollars per year (Ecological Society of America 2008)

The improved scientific understanding of ecosystems, together with increased public involvement in environmental issues, has lead to the development and implementation of ecosystem-based management strategies (Ecological Society of America 2008). Ecosystem-based management considers the composition, structure, functioning, and key processes of whole ecosystems, including humans, rather than looking at individual issues or resources as has been common practice.

This Vision Plan advocates the comprehensive approach of ecosystem-based management. Eight habitat ecosystems have been identified within the Lower Ventura River project area: estuary, dune, riparian, scrub, chaparral, marine, river, and wetlands and are covered in further detail in this plan. Because ecosystem services directly contribute to a sustainable human well-being, conserving ecosystem services is of utmost importance. Understanding, protecting, and enhancing these valuable systems is considered throughout this plan.

ECOSYSTEM SERVICES

- moderate weather extremes and their impacts
- disperse seeds
- mitigate drought and floods
- protect people from the sun's harmful ultraviolet rays
- cycle and move nutrients
- protect stream and river channels and coastal shores from erosion
- detoxify and decompose wastes
- control agricultural pests
- maintain biodiversity
- generate and preserve soils and renew their fertility
- contribute to climate stability
- purify the air and water
- regulate disease carrying organisms
- pollinate crops and natural vegetation

(Ecological Society of America, 2008)

Biodiversity

Biodiversity is a key component of functioning ecosystems. In order to conserve ecosystem services, it is essential to conserve biodiversity (Noss and Cooperrider 1994). Biodiversity is the variety of life forms (including both the number of species and the genetic variation among species) and the ecosystems they form (Noss and Cooperrider 1994; Forman 1995; Wilson 1988). The variety of organisms that exist today is the result of millions of years of evolutionary processes.

Historically, the rate at which species have been created has exceeded the rate of extinction, but that trend has been reversed today. Conservative estimates put today's extinction rate at 100 to 1,000 times higher than the expected natural extinction rate (International Union for Conservation of Nature 2004). Species and ecosystems are disappearing and this disappearance is irreversible (Wilson 1988). When new species, new genetic variation, or new ecosystems are formed, biodiversity increases. Biodiversity decreases when genetic variation decreases, a species becomes extinct, or when an ecosystem complex is lost (Gallo et al. 2005). Energy flows, nutrient and hydrological cycles, natural disturbance regimes, and feedback mechanisms all contribute to the production and maintenance of biodiversity. Understanding these processes is critical for planning decisions as well as for conservation and restoration efforts.

Biodiversity is not distributed evenly on Earth. In temperate environments, biodiversity is richer, while polar regions have fewer species. California is one of the most biodiverse regions in the world, with a great diversity of plants and animals that are found nowhere else in the world. This biodiversity, however, is seriously threatened. In California, threats to biodiversity include habitat conversion, overuse of biological resources (e.g. logging and grazing), pollution, and climate change (Jensen et al. 1993). Maintaining biodiversity is a crucial component of maintaining ecosystemic functions, and this Vision Plan incorporates planning and design strategies that seek to protect or increase biodiversity.

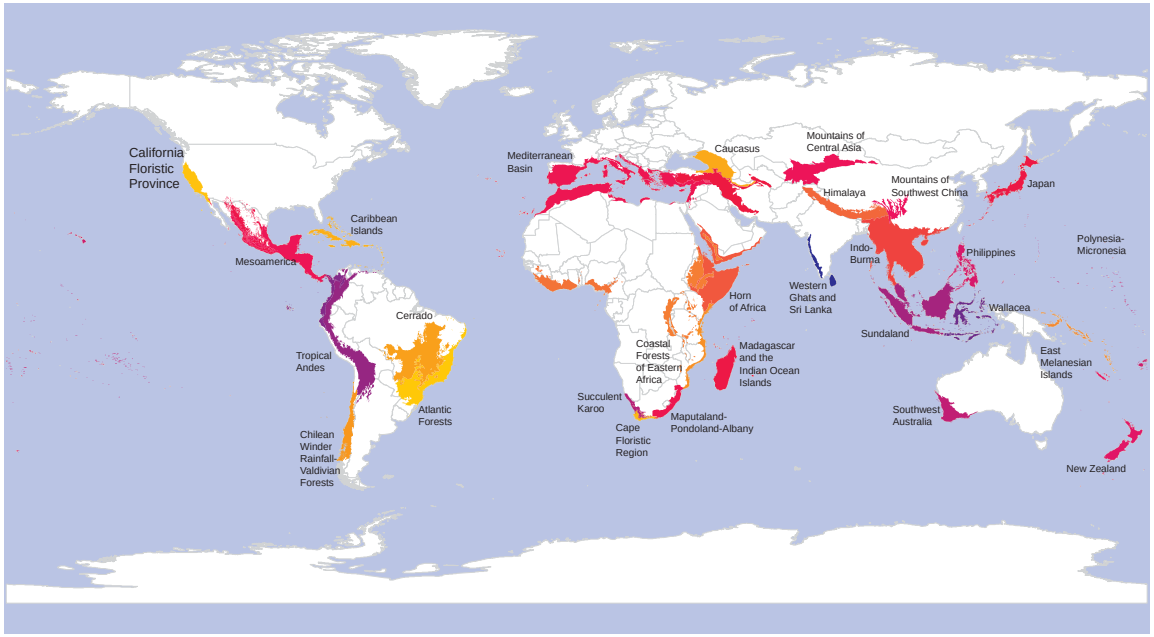


FIGURE 4.2 *Biodiversity hotspots throughout the world. Source: Conservation International.*

California Floristic Province

California is home to an extremely high number of endemic plant species (species found nowhere else on earth). In order to create manageable units for plant research, botanists have divided the continent into geographic units called floristic provinces. California has been divided into three floristic provinces: the California Floristic Province, the Great Basin Province, and the Desert Province. The largest of these provinces is the California Floristic Province (Ornduff et al. 2003). The area extends beyond California into Oregon, Nevada, and Baja California (California Academy of Sciences 2008). Before massive urbanization, many endemic species existed here. According to the California Academy of Sciences, which has been collecting and documenting species for over 100 years, at least 75% of the original habitat of California has already been lost.

The California Floristic Province also provides valuable bird habitat. Although there are fewer than 10 endemic bird species found in the California Floristic Province, more species of birds breed in this region than anywhere else in the United States.

CALIFORNIA: A BIODIVERSITY HOTSPOT

Due to a high number of endemic species, the California Floristic Province is a world biodiversity hotspot. The number of vascular plant species found in the California Floristic Province is greater than the total number of species from the central and northeastern United States and adjacent parts of Canada, an area 10 times larger than the California hotspot (Conservation International 2008). Current tallies of plant life in California reveal:

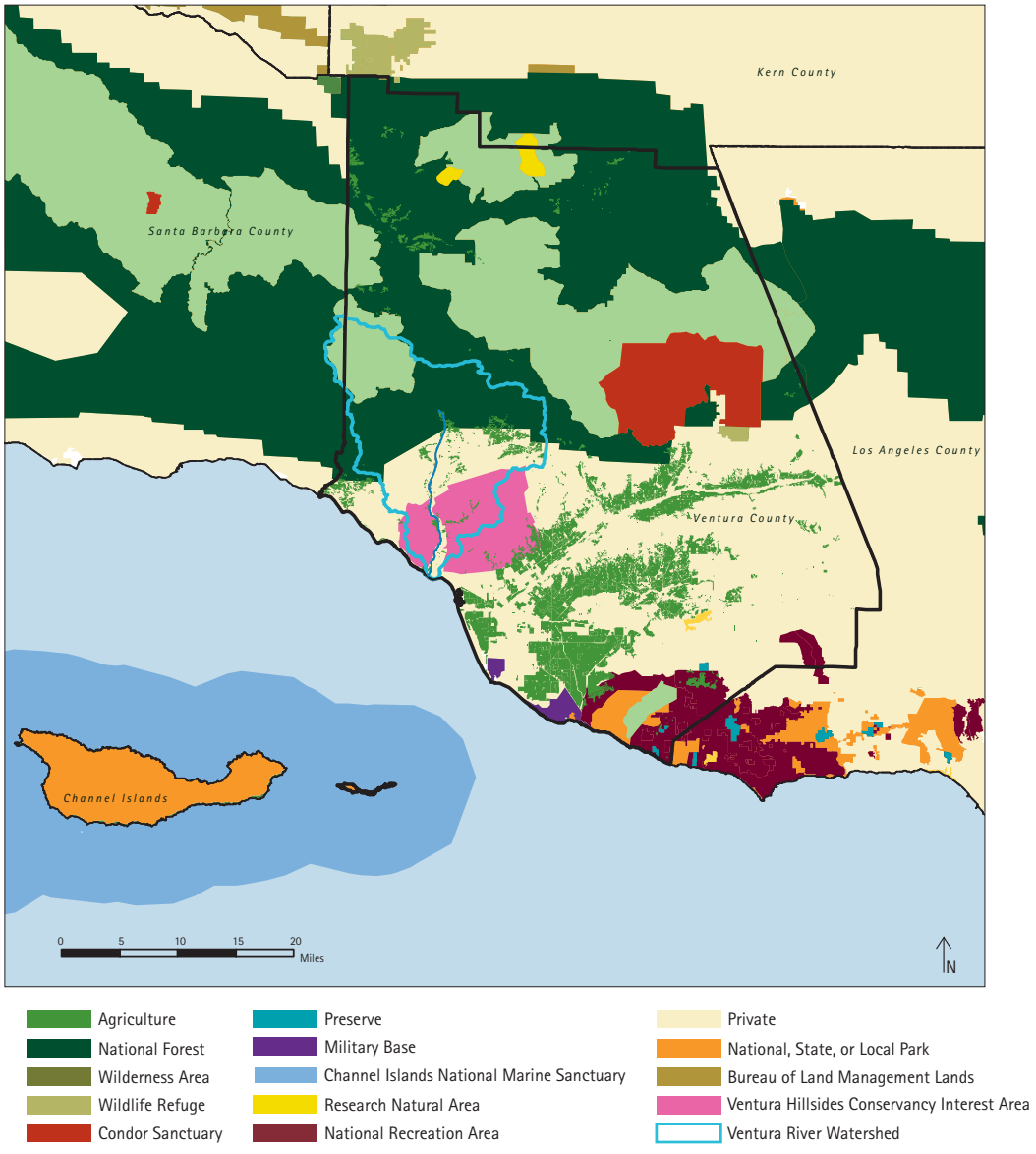
- 6,300 native taxa
- 565 taxa threatened or endangered
- 4,693 distinct species
- 1,169 sub-species
- 1,416 species endemic
- 26 species presumed extinct

(Bittman 2003; California Native Plant Society 2001; Ornduff et al. 2003)

FIGURE 4.3 *The California Floristic Province (shown in red) extends beyond the state of California into Oregon to the north, and Mexico to the south. Data from CA-GAP Project.*

Planning Scales

REGIONAL SCALE: LAND MOSAIC



According to the principles of landscape ecology, land patterns and their spatial arrangement affect the way species exist and interact with each other. Landscape patches, corridors, and matrix combine to create the pattern of the landscape mosaic (Forman 1995) and are a means of determining overall ecological health. The quantity and size of landscape patches play a critical role in determining the genetic makeup and abundance of an area. Movement corridors facilitate the movement of organisms and energy, which determine the extent of connectivity in a landscape. Landscapes with low connectivity are considered fragmented. As fragmentation increases in a landscape, it alters the equilibrium of species diversity, increases the vulnerability of patches to disturbances and invasive species, and decreases species viability.

At the regional scale, the ecological mosaic of the Ventura River area includes national parks and wilderness areas, the island ecosystems and marine sanctuary of the Channel Islands, beaches, and agriculture. Due in part to steep topography, habitat within the northern portion of the region is intact and stable with little disturbance. Due to urbanization, the southern portion of Ventura County shows a large degree of habitat fragmentation, with low levels of movement corridors for terrestrial species. This condition of habitat fragmentation in southern Ventura County threatens the overall ecological health of the region.

FIGURE 4.4 *Managed lands and the ecological matrix. Data from California GAP Biodiversity Atlas; Southern California Association of Governments.*

WATERSHED SCALE: VEGETATION COMMUNITIES

The combination of soil types, topography, Mediterranean climate, and fire cycles all contribute to shaping the vegetation communities in the Ventura River Watershed. The dominant vegetation patterns at the watershed scale include chaparral, coastal sage scrub, woodlands, riparian, wetlands, and agriculture. A relatively high presence of native vegetation continues to exist in the Ventura watershed due to steep topography and limited development on the surrounding hillsides. These vegetation communities provide habitat for a wide variety of native wildlife. In order to protect and enhance native biological resources, existing native vegetation communities must be managed and preserved.

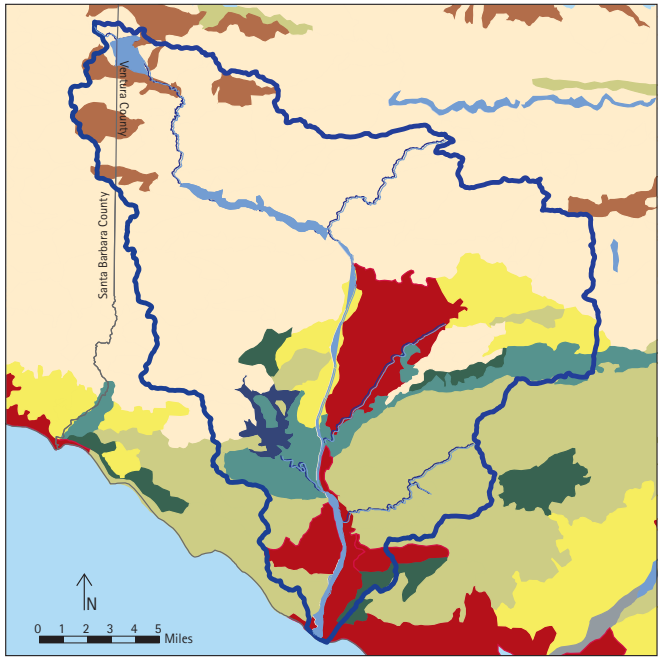


FIGURE 4.5 *Existing vegetation in the Ventura River Watershed. Data from California GAP Biodiversity Atlas.*

SITE SCALE: URBAN AND RIVER INTERFACE

At the site scale, the Lower Ventura River lies west of the city of San Buenaventura and comprises multiple habitat types. Landscape patches include parks, agriculture, estuary and riparian habitat, undeveloped hillsides, urban development, and oil extraction.

The landscape mosaic at this scale is fragmented. Existing urban development, stream channelization, and roadway patterns contribute to habitat fragmentation by impeding wildlife movement to ecosystem destination areas such as the Ventura River, the estuary, and the surrounding hillsides.

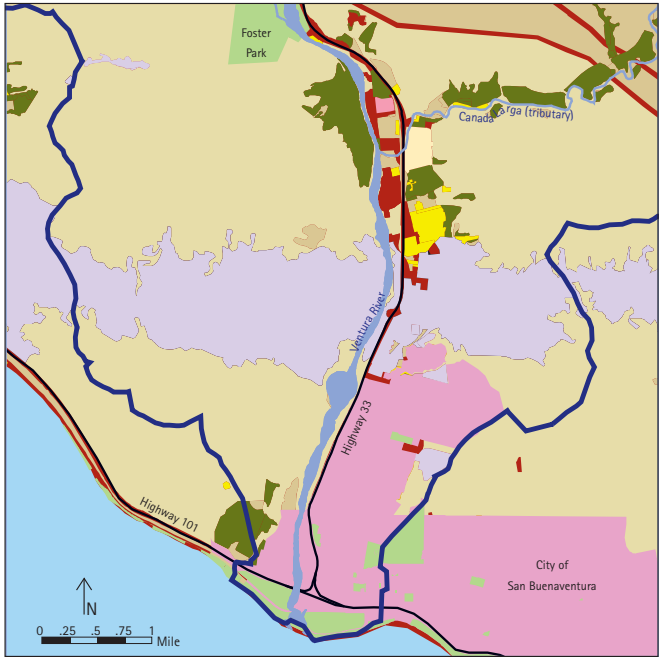
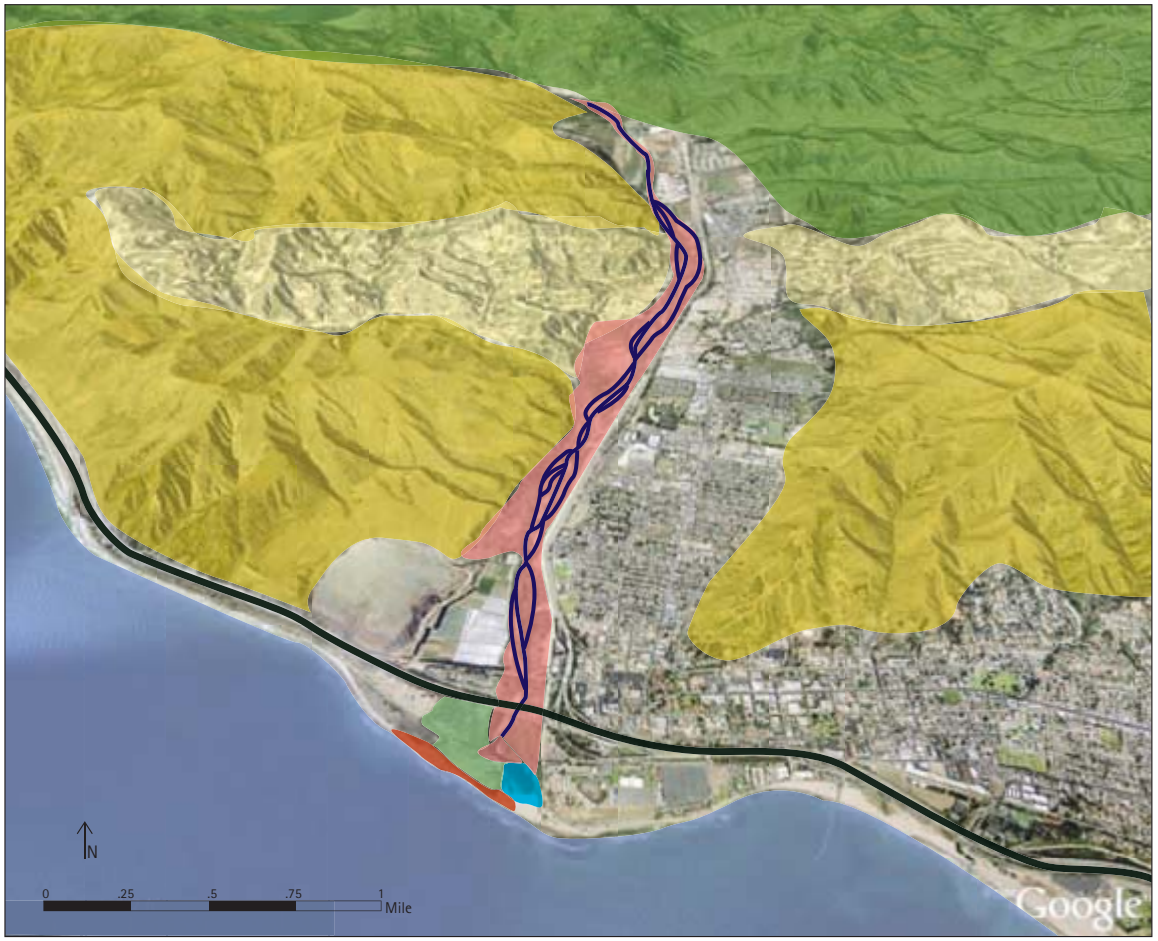


FIGURE 4.6 *Urban/wildlands interface. Data from City of Buenaventura; Watershed Coalition.*

Ecosystem Based Management



Ecosystems within or adjacent to the Lower Ventura River

Chaparral	Riparian	Dune
Coastal Scrub	Wetlands	Marine
Coastal Scrub impaired	Estuary	Ventura River

FIGURE 4.7 *Approximate locations of ecosystems within the Lower Ventura River project area. Photo from Google Earth.*

Citizens of Ventura recognize the presence and importance of biological resources. The General Plans of both Ventura County and the City of Ventura include the goal of preserving and protecting significant biological resources from incompatible land uses and development. Ventura County defines significant biological resources as endangered, threatened, or rare species and their habitats, wetland habitats, coastal habitats, wildlife migration corridors, and locally important species and communities (City of San Buenaventura General Plan 2005; Ventura County General Plan 2010).

Like many coastal and riverine areas in California, the Lower Ventura River is under threat from past and current land use practices and the prospect of future development. Because much of the river corridor has retained its rural character, a number of habitats remain intact. Habitats around the Ventura River area sustain some of the highest diversity of vertebrate species in Southern California; nearly 300 vertebrate species are known in the lower reaches of the Ventura River alone. At least 26 special status species inhabit or utilize the aquatic, riparian, and wetland habitats in the watershed, including 13 listed species (endangered, threatened, or fully protected) and 13 California species of special concern (California Coastal Conservancy 2007).

This Parkway Vision Plan begins by looking at eight ecosystems including and adjacent to the Lower Ventura River. Each ecosystem is reviewed according to three aspects: biological resource for habitat species, impacts affecting the health and vulnerability of the ecosystem, and the natural infrastructure services provided by each ecosystem. Beginning at the northern point of the Vision Plan, the eight ecosystems identified here are: chaparral, coastal sage scrub, river, riparian, wetlands, estuary, dune, and marine ecosystems.

Ecosystems Within the Parkway

CHAPARRAL

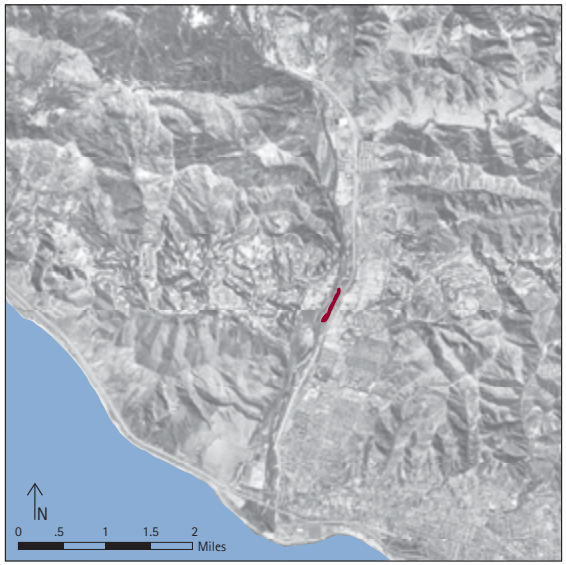


FIGURE 4.8 *Approximate location remnant chaparral stand. Data from California GAP Biodiversity Atlas.*

Chaparral is California's most extensive native plant community. This distinct plant community provides habitat for a multitude of native plant and wildlife species while also contributing a characteristic sense of place to California landscape. Chaparral is a critical biological resource for species adapted to this environment. Seeds from native chaparral plants are eaten by many kinds of insects, birds, and mammals, but with few exceptions, animals do not move seeds long distances from this community (Quinn and Keeley 2006). Because native seeds are not regularly dispersed far away from the parent plants, chaparral is essential for the survival of plant and wildlife species that depend on this habitat. Human encroachment, and the related increase in fire frequencies that development brings, threaten the chaparral ecosystem. In addition to habitat value, chaparral provides additional ecosystem services by providing erosion control on hillsides, allowing for the recharge of underground water supplies, and provides habitat for wild bee populations that can pollinate nearby agricultural lands.

Historical accounts of 1793 describe chaparral stands in Ventura as continuous and heavy. Though chaparral is primarily outside the floodplain, one remnant of this formerly widespread habitat type occurs in the floodplain. A relatively undisturbed remnant stand exists at the north end of the Ventura River Levee, west of Highway 33. Plant species at this location include lemonade berry, laurel sumac, mountain mahogany, black sage, and greenbark ceanothus (United States Army Corps of Engineers 2004). The chaparral plant community was probably more common in the floodplain prior to agriculture. The two major chaparral series within the study area include chamise and sumac.

COASTAL SCRUB

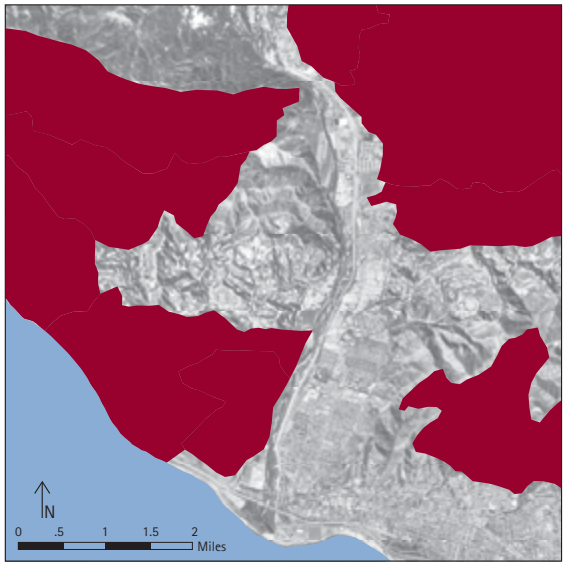


FIGURE 4.9 *Coastal scrub throughout the project area. Data from California GAP Biodiversity Atlas.*

Coastal scrub once dominated Southern California's coastline. Today this habitat is rapidly disappearing, and only scattered pockets remain. As an ecosystem, coastal sage scrub has extremely high levels of species diversity and endemism and supports a number of endangered species including the California gnat catcher (*Polioptila californica*).

Coastal scrub is characterized by drought-deciduous shrubs dominated by black sage (*Salvia mellifera*), white sage (*Salvia apiana*), California sage (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), bush sunflower (*Encelia californica*), toyon (*Heteromeles arbutifolia*), lemonadeberry (*Rhus integrifolia*), and a diversity of other shrubs, herbaceous plants, cacti, and succulents. Threats to the coastal sage scrub community include human encroachment and habitat fragmentation, invasion by non-native species, altered fire cycles, and air pollution (Allen et al. 2005).

Impacts to coastal scrub ecosystem can result in diminished plant diversity. As plant diversity decreases, the diversity of leaf litter also decreases which may lead to a decline in the diversity of fungi in soil. As a result, ecosystem services such as decomposition, soil respiration, and nutrient cycling might slow (Treseder 2006). The loss of these functions may limit the sustainability of coastal sage scrub habitat, as plants and animals depend on these processes, and is currently under study.

RIVER

FIGURE 4.10 *The main channel of the Ventura River. Data from California GAP Biodiversity Atlas.*

Habitat quality in the main channel of the Ventura River is determined by multiple factors. The extent and condition of canopy coverage, degree of embeddedness of cobbles and gravel, and the stream flow conditions of pools, riffles, runs, and glides directly affect the quality of the river as a biological resource. Within the stream channel, the presence of pools, riffles, runs, and glides provide habitat opportunities for a multitude of species, including the endangered species Southern California steelhead trout. The smooth-flowing deep water sections of the river channel, referred to as glides, have minimal suspended or deposited sediment, thereby protecting steelhead trout fish eggs and alevin from suffocation. Riffles, the swifter, turbulent flows over gravel or cobble substrate, help to oxygenate the water and provide navigation clues for spawning steelhead trout. Pools, the deep and slow-moving waters with canopy coverage, provide refuge and cooler water temperatures that are beneficial to young steelhead trout during the warm summer months.

In addition to the ecosystem services that biological resources provide, the shifting Ventura River channel also performs ecosystem services that benefit people's cultural, spiritual, and lifestyle needs in the form of fishing, swimming, and wildlife viewing opportunities.

The health of Ventura River faces numerous threats, including urban runoff, detrimental land use activities, and invasive species. Urban runoff is a significant threat to the Ventura River, as it introduces contaminants to the river and modifies water flow patterns. Land use activities, including agricultural and grazing development, mining and extraction, and extensively developed slopes and paved surfaces, have altered the natural sediment loads of the Ventura River affecting habitat quality and natural flow patterns. Invasive species such as tamarisk and giant

reed have reduced the amount of available water, woody debris, and shading, further impacting water quality and temperature in the river channel. Higher water temperatures and reduced shading also contribute to algal growth, furthering negative impacts upon the Ventura River and limiting the ecosystem services the river can provide.

RIPARIAN

FIGURE 4.11 *Riparian resources along the Ventura River. Data from California GAP Biodiversity Atlas.*

Riparian vegetation occurs within the Ventura River's floodplain. The general pattern of riparian vegetation is to exist in a state of constant succession. Flashy rain events erode the river's steep banks, producing sediment-laden flows that dislodge riparian vegetation and alter the stream channel. When the sediment carried by the river is dropped, this alluvial material provides areas where emergent vegetation can become established. When the interval between intense rain events is several years, rapidly growing riparian vegetation can become mature and well-established (U.S. Army Corps of Engineers 2004). Because the riparian vegetation grows within active portions of the floodplain, plant growth is affected by the dynamic floodplain regimes of sediment scour and deposition and by varying levels of moisture (U.S. Army Corps of Engineers 2004). Floodplain riparian vegetation includes cottonwoods, willows, California black walnut, California sycamores, herbs, and mulefat.

The riparian zone of the Ventura River contributes multiple ecosystem services that both enrich and protect the ecosystem environment. Vegetative canopies (which may be intermittent as described above) provide cooling shade, which aids in maintaining appropriate water temperature and productivity within the river channel. Vegetative canopies also act as a nutrient source by providing detritus in the form of leaf litter and invertebrate fall. In addition, the riparian zone acts as a buffer to the river by preventing erosion, filtering pollutants, and cleaning the stream. Riparian vegetation provides habitat to a multitude of riparian species in the project area.

Riparian vegetation along the Ventura River has been impacted and continues to be threatened by agricultural expansion on the floodplains, urban developments, public works (i.e. the Ventura River Levee and Highway 33), and recreational park developments (Warner and Hendrix 1984).

WETLANDS

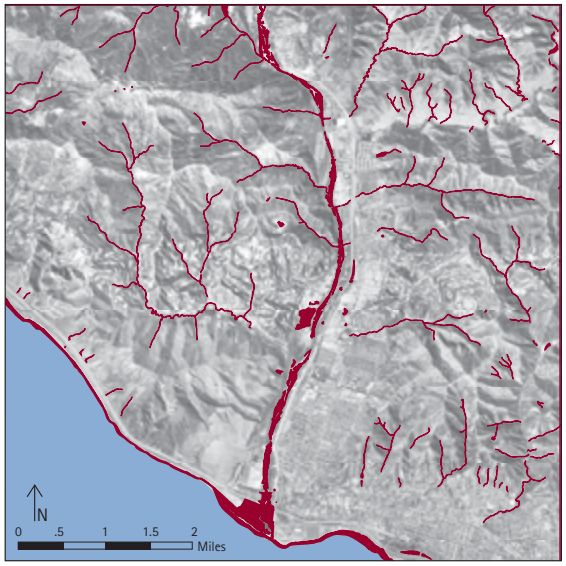


FIGURE 4.12 *Associated wetlands of the Ventura River. Data from California GAP Biodiversity Atlas.*

Wetlands are lands saturated with water, either periodically or all year round. Saturation results from either a water table that is at or near the soil surface and/or as the result of inundation from tidal or freshwater sources. Wetlands are transitional zones, or ecotones, between terrestrial and aquatic systems. Because ecotones are the interface between multiple ecosystems, ecotones have greater than usual diversity of species.

The remaining wetlands habitat of the Ventura River is extremely valuable, providing multiple ecosystem services. The natural vegetation in the Ventura River area consists of all five of the major wetland systems as classified by the United States Fish and Wildlife Service: lacustrine, riverine, palustrine, estuarine, and marine. Wetland habitats provide wildlife with shade, protection from predators, foraging habitat, and nesting and breeding sites, thereby contributing to biological conservation and sustainability. Additional valuable ecosystem services include pollutant reduction by processing sediment, nutrient and pesticides; flood mitigation through floodwater storage and reduction; greenhouse gas emissions reduction through carbon sequestration via soils and vegetation; and water quality sustainability through groundwater recharge.

Although much of the river corridor has retained its rural character (California Coastal Conservancy 2007), wetlands ecosystems of the Ventura River have been degraded. Existing wetlands in the Ventura River area have been degraded by encroachment, habitat fragmentation, water quality degradation, and the introduction of invasive plants and wildlife (United States Army Corps of Engineers 2004).

WETLANDS: ECOSYSTEM SERVICES AND CLASSIFICATIONS

Wetlands have long been regarded as wastelands, but are now recognized for the numerous benefits they provide. Wetlands support more wildlife and plants than any other type of habitat and provide extremely valuable ecosystem services. Some of these services include:

- surface water detention
- coastal storm surge detention
- steamflow maintenance
- nutrient transformation
- sediment and other particulate retention
- shoreline stabilization
- fish, waterbird and other wildlife habitat
- biodiversity conservation
- cultural and recreational opportunities

(Tiner 2003)

In 1979, a comprehensive classification system of wetlands and deepwater habitats was developed for the U.S. Fish and Wildlife Service (Cowardin et al. 1979). Under this system, five major wetlands systems were identified and continue to be used today. The systems are: lacustrine wetlands, which are associated with lakes; riverine wetlands, which are found along rivers and streams; palustrine wetlands, which may be isolated or connected wet areas and include marshes, swamps, and bogs; and marine and estuarine wetlands which are associa¿ted with the ocean and include coastal wetlands, such as tidal marshes (CERES 2008).

VENTURA RIVER ESTUARY AND SECOND MOUTH ESTUARY

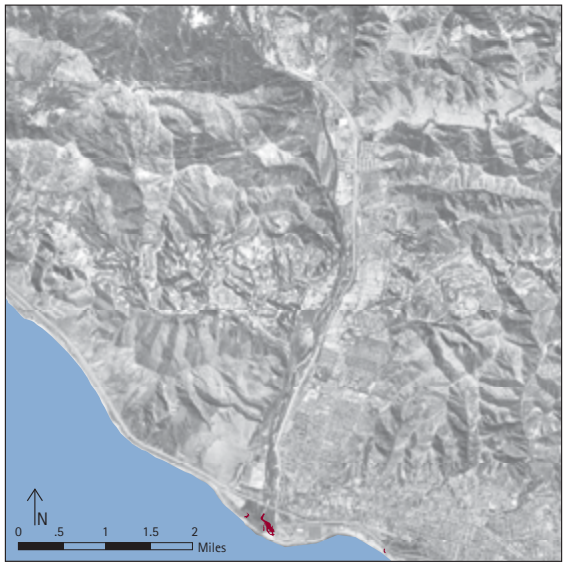


FIGURE 4.13 *The Ventura River Estuary and Second Mouth Estuary. Data from California GAP Biodiversity Atlas.*

The Ventura River Estuary lies directly west of the City of Ventura, at the mouth of the Ventura River. The estuary is bordered on the east by a levee wall, the Omer Rains Trail, and the Ventura County Fairgrounds and on the west by Emma Wood State Beach and Group Campground, the Seaside Wilderness Park, and the Ventura Beach R.V. Resort. The estuary is fed by the Ventura River from the north and borders the Pacific Ocean to the south. Multiple public and private infrastructure projects also cross the estuary, including Highway 101, Main Street, Southern Pacific Railroad tracks, oil and gas pipelines, and electrical transmission lines. These structures have served to impact the estuary by filling in and eliminating portions of the estuary and altering natural regime cycles. In addition, according to the 303(d) list mandated by the Clean Water Act, the water of the Ventura River Estuary has been identified as being impaired by trash with elevated levels of DDT in fish and mussel tissue (State Water Resources Control Board 2007; CERES 1997).

Encompassing approximately 100 acres, the Ventura River Estuary is one of the largest on the southern coast of California (Stoecker 2007). The estuary provides a diverse mix of habitat as well as acclimation opportunities for migrating steelhead trout between fresh and saltwater. The estuary is characterized by short periods of tidal flushing when the mouth is open and longer periods of ponding and lagoon formation when the mouth is closed by sand bar. Water is also supplied to the estuary in the form of freshwater from upstream surface flows, rising groundwater, and effluent from the Ojai Valley Sanitary District (Ferren 1990). The contributions from each of these sources vary from year to year.

The Ventura River Estuary is often contained by a sandbar, which is formed at the point where the estuary meets the ocean. Intense winter storm events send rushing waters along the Ventura River, which periodically remove the sandbar and open the estuary to tidal influence. During times of low-flow runoff, the sand bar re-forms, and fresh water begins to displace saltwater, thereby gradually altering the salinity level of the estuary. The tidal/freshwater regime and the high/low salinity regime have profound effects on the biota of the estuary ecosystem (Ferren 1990).

A smaller estuary, referred to as Second Mouth Estuary exists west of the Ventura River Estuary. The Second Mouth Estuary is an active distributary channel of the river that is currently only flushed by runoff during major floods (Ferren 1990). Prior to the 1970s, the Second Mouth Estuary supported fresh/brackish lagoon and associated wetland and riparian habitat. As a result of construction of a new Southern Pacific Railroad bridge and the laying of oil and gas pipelines along the railroad right-of-way, a majority of the Second Mouth Estuary has been filled in. However, due to a high persistent water table, the estuary does not dry out (Ferren 1990).

Estuaries provide a range of ecosystem services. Estuarine services contribute to biological conservation and sustainability by providing habitat for many fish, shellfish, and birds. Estuaries also improve water quality by acting as natural silt traps, which reduce the amount of sediment and other contaminants that reach coastal waters. Estuaries also build up deposits of mud, silt, and sand, which act as

natural barriers that help to dissipate the energy of storms and large waves that can otherwise threaten shorelines and coastal areas, inland habitats and human communities. When flooding does occur, estuaries act like huge sponges, soaking up excess water. Lastly, the Ventura River Estuary provides wildlife viewing opportunities that serve both local and tourist populations.

VALUABLE ESTUARIES

Estuaries are extremely productive ecosystems in part because the water that is filtering through them brings in nutrients from the surrounding watershed. This same water, however, often brings all of the pollutants that were applied to the lands in the watershed. Therefore, some of the most fertile ecosystems on earth may also be some of the most polluted. Estuaries, like their surrounding wetlands, provide a variety of ecosystem services. Estuaries act as buffer zones, stabilizing shorelines and protecting coastal areas, inland habitats, and human communities from floods and storm surges. When flooding does occur, estuaries often act like huge sponges, soaking up the excess water. Estuarine habitats also protect streams, river channels and coastal shores from excessive erosion caused by wind and water (National Oceanic and Atmospheric Administration 2003).

DUNE

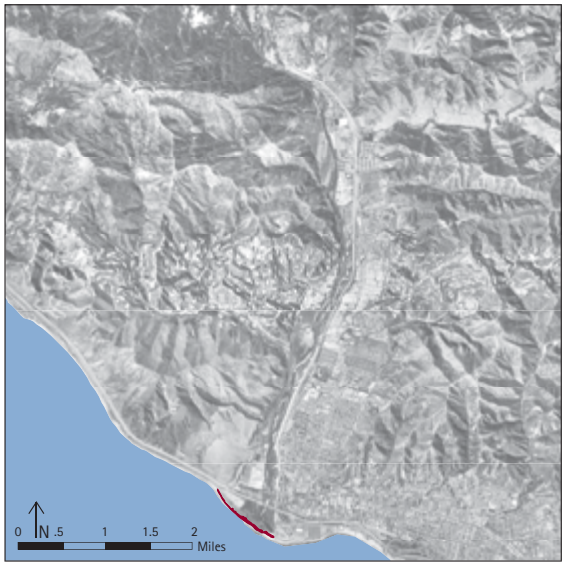


FIGURE 4.14 *Dune habitat along the coast. Data from California GAP Biodiversity Atlas.*

Coastal dunes are one of the most fragile and dynamic natural landforms (Engel and Lortie 2008). Coastal dune habitats in Southern California are considered environmentally sensitive habitat (ESHA) because both the dune habitat and the associated natural community are rare and easily disturbed by human activities. Coastal dune ecosystems are a rare, fragile, and threatened habitat type in California.

Ecosystem services that dune habitats provide include biological conservation and shoreline protection. Dunes support an array of plants and animals that are uniquely adapted to the ecotone between land and sea. Invertebrates dwell in wet or dry sand, shorebirds forage on invertebrates and nest in the dunes, and vegetation provide habitat and stabilizes the structure of the dunes. In addition to habitat value, dune ecosystems are recognized for their aesthetic value and for providing important protection to public infrastructure and private homes from storm events (California Coastal Sediment Management Workgroup 2006).

Because the California coast is a desirable area for industry, tourism, recreation, and residential development, dune ecosystems have been heavily impacted by humans (Pickart, 1998). The cobble and sand that form the dune beach areas adjacent to the Ventura River are created in part by alluvial deposits from the Ventura River and in part by eastward moving littoral drift from up coast rivers and beaches. In the region, dams, impaired rivers, and paved surfaces have altered sediment supply while built coastal structures such as breakwaters, have altered sediment transport. This combination has reduced alluvial deposits and resulted in loss of coastal dune habitat (California Coastal Sediment Management Workgroup 2006).

MARINE

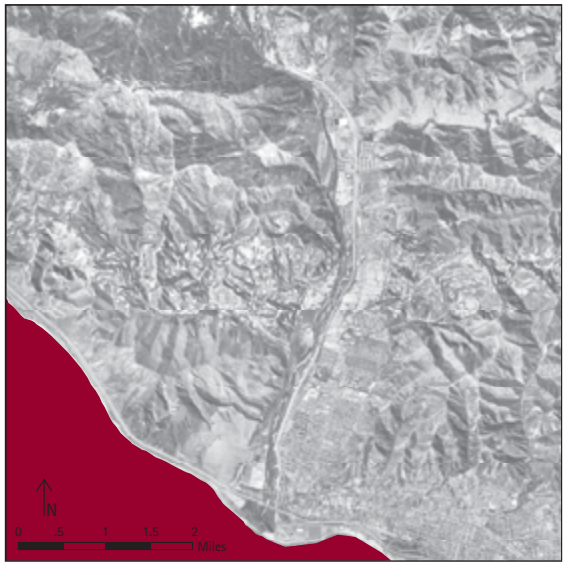


FIGURE 4.15 *The marine ecosystem. Data from California GAP Biodiversity Atlas.*

The marine ecosystem provides a multitude of essential ecosystem services. Marine ecosystem services include the provision of seafood- and fishery-related employment; filtration of terrestrial sediments, pollutants and nutrients; provision of elements of pharmaceutical compounds; nutrient cycling; protection of coasts from erosion; and recreational opportunities. In addition, the marine ecosystem plays a crucial role in the global carbon cycle. Oceanic algae help to fix atmospheric carbon, and, combined with the eventual carbon deposition in deep water, the marine ecosystem directly influences climate trends.

During large storm events, the Ventura River breaches the sandbar that separates the estuary from the ocean and discharges its water into the marine environment. These discharges form plumes as they enter ocean. Plumes contain important sediments and nutrients necessary for the marine ecosystem. Upon entering the sea, ocean currents disperse these terrestrial materials throughout the water column, providing an important base of the marine food chain.

Because the Ventura River is an impaired waterbody, its plumes also introduce pollutants and high bacteria concentrations into the marine environment of the Santa Barbara Channel, while additional sediments block sunlight, impairing photosynthesis. (See Appendix B for further reading on the relationship between river plumes and the marine environment.) The Santa Barbara Channel is a biologically rich ecotone where the cool Northern California Current and warm Southern California Countercurrent come together. The channel supports a large diversity of marine species and habitats, and includes the Channel Islands National Marine Sanctuary, approximately 25 miles from the mainland. Introducing contaminated and sediment-laden waters into the marine environment threatens both biological and chemical processes in the ocean.

Invasive Plant Species

FIGURE 4.16 Arundo donax *near the Ventura River.*

Invasive plant species are introduced plants that thrive in areas outside their natural home range. Without the natural enemies that normally limit the spread of such species in their native home range, these plants adapt and aggressively thrive in new environments (United States Department of Agriculture 2008). Invasive species grow and reproduce more rapidly than native species, while consuming more local resources including nutrients, light, physical space, water, and/or food. The usurping of local resources by invasive species directly affects the equilibrium of an entire ecosystem.

The Ventura River riparian ecosystem is threatened by a number of invasive plant species. Non-native invasive plants include giant reed (*Arundo donax)*, periwinkle (*Vinca major*), cape ivy (*Delairea odorata*), fennel (*Foeniculum vulgare)*, and tamarisk (*Tamarix aphylla*). The most threatening, due to volume and growth habits, is *Arundo donax. Arundo donax* is easily spread. Flood events break ups existing stands and redistribute fragments downstream, which then root and begin new stands.

Although introduced several hundred years ago, *Arundo donax* has rapidly expanded in Southern Californian riparian areas in the last 35 years. Ecosystem degradation by *Arundo donax* is manifested in many ways along the Ventura River. During floods, *Arundo donax* increases stream roughness, creates debris dams, and contributes to bank erosion and instability that alter the shape of the river. During the hot summer months, *Arundo donax* dries out and creates an increased fire hazard. As a non-native species, *Arundo donax* offers little wildlife habitat value to native species while altering canopy coverage for stream habitat (Coffman 2007).

Currently, efforts are underway to remove *Arundo donax* from the Ventura River. Efforts are being concentrated upstream from the Lower Ventura River Parkway planning area. Led by the Ventura County Watershed Protection District, if successful, removal techniques will be applied further down river.

FIGURE 4.17 [ABOVE] AND 4.18 [BELOW] Arundo donax *at Foster Park during the winter and again in the spring.*

Design Species

As an indicator of ecological health, design species representing each of the eight identified ecosystems were chosen to guide the design for this Vision Plan. Some species are relatively specialized in their roles within an specific ecosystem, while others utilize multiple ecosystems for their survival. The loss of any species would compromise the performance of the ecosystem. The design species chosen for this Vision Plan are southern steelhead trout, the California red-legged frog, southwestern willow flycatcher, California least tern, Ventura marsh milkvetch, bobcat, Cooper's hawk, and giant kelp.

Although not an exact measure, design species can begin to indicate the overall health and functioning of each of the eight ecosystems identified. Because the health and population of each species is dependent on ecosystem processes such as disturbance regimes, hydrological cycles, and connectivity, impacts to these ecosystems can manifest as impacts to species.

SOUTHERN STEELHEAD TROUT

Oncorhynchus mykiss irideus

Ecosystem: Estuary, River, Riparian

FIGURE 4.19 *Steelhead trout. Source: Wikimedia Commons.*

Southern California steelhead trout (*Oncorhynchus mykiss irideus*) are anadromous fish, hatching in streams, migrating to the ocean as adults, and returning to streams to spawn. When drought events or damming of rivers blocks steelhead trout access to the ocean, steelhead trout can convert to non-migrating resident fish.

Southern California steelhead trout are an excellent design species for the Ventura River. Listed as a federally endangered species, steelhead trout are an indicator of river condition because the steelhead trout population is dependent on a healthy, functioning river. Steelhead trout require cool and clean water, use all parts of the river during their life cycle, and are dependent on healthy river processes. Increased water flow during winter rains coincide with steelhead trout spawning season. This increased river current creates the attraction flow which steelhead trout seek to swim against on their way to spawning grounds. Increased water flow also creates periodic "flushing flows" (Noss 1994) that help to clean and maintain the gravelly cobble beds used by adult steelhead trout for spawning and by young fry for escape cover. Riparian canopy cover aids in maintaining water temperature while detritus from plant and invertebrate litter provides nutrients. In the Ventura River Estuary, smolting steelhead trout develop characteristics which enable them to acclimate to seafaring conditions before moving on to the ocean.

Before the construction of the Matilija Dam in 1948, the Ventura River supported a large and consistent steelhead trout run (National Oceanic and Atmospheric Administration 2008). In 1946, the Department of Fish and Game estimated there were between 4,000 and 5,000 fish. By 1996, the most recent estimate placed the steelhead trout run size at fewer than 200 adults (Busby et al. 1996). Major contributors to steelhead trout decline include inadequate stream flows, temperature change in the river, impeded access to historic spawning and rearing area, and human activities that alter sediment regimes. In addition, hatchery practices and rainbow trout planting may have led to genetic introgression (U.S. Army Corps of Engineers 2004).

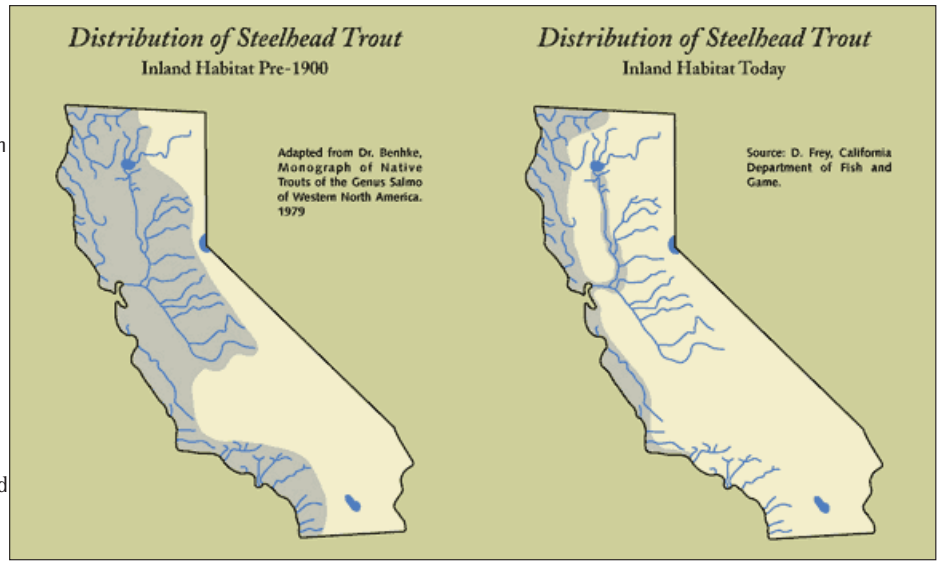


FIGURE 4.20 *Steelhead trout distribution. Source: Caltrout.org*

CALIFORNIA RED-LEGGED FROG

Rana aurora draytonii

Ecosystem: River, Riparian

FIGURE 4.21 *California red-legged frog. Photo: Chris Brown, Wikimedia Commons.*

The U.S. Fish and Wildlife Service has listed the California red-legged frog as a threatened species since June 1996. Historically, the red-legged frog used to exist from Marin County on southward to Baja California. Today, more than 70% of their historic habitat has been eliminated and the California red-legged frog can be found from Sonoma to Riverside. In addition to loss of habitat, the California red-legged frog is also threatened by the introduced and much larger bullfrogs (*Rana catesbiana*), which prey on the red-legged frog.

Habitat requirements for the California red-legged frog include deep pools with dense stands of overhanging willows and cattails. Frog eggs are attached to emergent vegetation, young frogs inhabit slow-moving, shallow riffles, and older frogs can be found close to deep pools with riparian cover that offers shelter from predators (United States Fish and Wildlife Service 2005). Arroyo willow habitat is essential to the red-legged frogs survival: vibrations transmitted along willow branch are used to detect approaching predators and prey (California Department of Fish and Game 1994).

The red-legged frog occurs upstream of Matilija Dam, but there are few recent records of its occurrence in the Lower Ventura River. However, suitable habitat occurs along the Lower Ventura River. Suitable habitat has been identified from the Main Street bridge to the confluence with San Antonio Creek, where there are shaded pools and well developed riparian woodland. Potential sites include upstream of the Main Street Bridge, downstream of Shell Road in a large stand of willows on the right side of the river, and several sites between the Ojai Valley treatment plant and Foster Park, where large established trees provide shade, rootwads, and undercut banks (URS Corporation 2000).

CALIFORNIA RED-LEGGED FROG

During the late 1800s and early 1900s, the California red-legged frog was harvested for food in the San Francisco Bay area and the Central Valley, with approximately 80,000 frogs harvested annually. As the frogs became more rare, market demand for them increased. Bullfrogs (*Rana catesbiana*) were introduced in California around 1896 to help satisfy the demand for frog legs as the red-legged frog population dwindled. Ironically, the native red-legged frog soon become prey for the much larger bullfrog, a threat to the red-legged frog's existence that continues today (United States Fish and Wildlife Service).

SOUTHWESTERN WILLOW FLYCATCHER

Empidonax trallii extimus

Ecosystem: Riparian, Wetlands

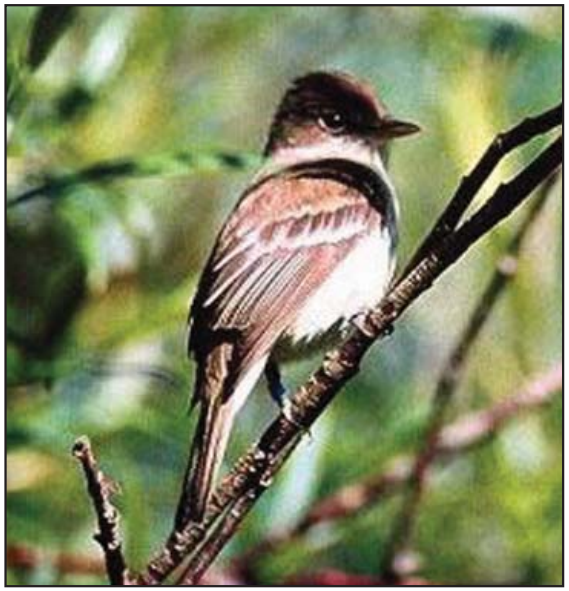


FIGURE 4.22 *Southwestern willow flycatcher. Photo: United States Fish and Wildlife Service.*

The Southwestern willow flycatcher is a small, migratory bird that forages and breeds in dense riparian habitats along rivers, streams, and wetlands, and migrates along riparian corridors. The historic range of the Southwestern willow flycatcher includes Southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico.

Since 1995, the Southwestern willow flycatcher has been a federally listed endangered species. Decline and vulnerability of the flycatcher include habitat fragmentation and low numbers of current population, predation by cowbirds, and habitation loss and degradation due to invasive species and degraded hydrological regimes.

One of the most important habitat characteristics for the willow flycatcher is the presence of dense vegetation, from understory to canopy. The willow flycatcher prefers shade and slow-moving water. Because the river channel is relatively narrow with faster flowing water, the Ventura River does not provide ideal habitat for the willow flycatcher. However, the riparian corridor of the Ventura River may provide a migration path for the willow flycatcher to and from populations in northern Santa Barbara County.

CALIFORNIA LEAST TERN

Sterna antillarum browni

Ecosystem: Dune, Estuary

FIGURE 4.23 *California Least Tern. Photo: United State Fish and Wildlife Service.*

The California least tern is a state and federally listed endangered species. The historic breeding range of the California least tern extended along the coast from San Francisco Bay to southern Baja California, and it was once common along the coast. Today, the breeding range of the terns is limited to the San Francisco Bay and a few areas along the coast from San Luis Obispo County to San Diego County, including a breeding population in Oxnard at Ormond Beach and Point Mugu. The decline of the California least tern is attributed to the disappearance of nesting and foraging habitats, predation by feral and exotic species, increased overwash as a result of degraded dune systems, and increasing human disturbance to breeding colonies (United States Fish and Wildlife Service 2005).

VENTURA MARSH MILKVETCH

Astragalus pycnostachyus var. lanosissimus

Ecosystem: Dune

The California least tern is a migratory species that arrives in California by late April to breed and begins to depart by August. It nests on coastal dunes and forages in estuaries and dunes. Though suitable breeding habitat occurs at the Ventura River Estuary, California least terns have not been known to breed there, possibly due to extensive beach erosion (Wetlands Research Associates, Inc. 1992). During the post-breeding season, least terns have been observed at the Ventura River mouth and at nearby beaches. Young California least terns often use the estuary at the Ventura River for foraging and loafing before beginning their journey south (Hunt and Lehman 1992).

FIGURE 4.24 *Ventura marsh milkvetch. Photo: California Department of Fish and Game.*

The Ventura marsh milkvetch is a state and federally listed endangered species. Once thought to be extinct, the only known population of the plant exists on a one-acre portion of an abandoned oil-field waste site near the city of Oxnard. The milkvetch's historic range included coastal Ventura, Los Angeles, and possibly Orange County. It was once found in the Ballona wetlands and in Santa Monica, but it has not been found at these locations for nearly a century (U.S. Fish and Wildlife Service, 2001).

Ventura marsh milkvetch habitat is the well-drained soils of open sites along the coast, often on bluffs or flats near bodies of brackish water or with a relatively high water table, in association with dune or coastal shrub vegetation. Five major threats to the milkvetch have been identified:

- herbivory of seedlings and shoots by nonnative milk snails
- herbivory of seeds by weevils
- infestation by cucumber mosaic virus, which is spread by aphids
- alien weed competition (primarily ice plant and white sweet clover)
- catastrophic loss of the last remaining population (Center for Plant Conservation 2008)

Within the project area, opportunities exist for creating a potential Ventura marsh milkvetch restoration site. The dune and wetland habitat west of the Ventura River offers natural barrier protection through landscape features and so could be considered for restoration.

BOBCAT

Lynx rufus californicus

Ecosystem: Chaparral, Coastal Sage Scrub, Riparian

FIGURE 4.25 *Bobcat. Source: Wikimedia Commons.*

The California bobcat ranges from southern Canada to southern Mexico. The bobcat inhabits rocky and brushy areas near springs or other perennial water sources, primarily in foothills of chaparral and scrub habitats.

Bobcat home range estimates start at .23 square miles for California, with females generally having smaller home ranges than males. The home ranges of male and female bobcats may overlap, but home ranges of females rarely overlap with each other (Tesky 1995). For denning and resting cover, bobcats utilize rock piles, brush piles, hollow trees, and logs. Even in the harsh climate of the Mojave Desert, bobcats have been observed resting next to fallen Joshua Trees.

The loss of large, relatively undisturbed habitat and adequate linkages between habitats (habitat fragmentation) are a serious threat to the persistence of bobcats, as is disturbance from human recreation and vehicle collisions. Bobcats are solitary and active both day and night, though generally are more nocturnal. For bobcats, preserving open space of sufficient quantity and quality for adult females is necessary for population viability (Riley et al. 2003). The hillsides of Ventura are a critical habitat link for bobcats to the Los Padres National Forest in the northern part of the Ventura River Watershed and to the Santa Monica Mountains.

COOPER'S HAWK

Accipiter cooperii

Ecosystem: Riparian, Woodlands

FIGURE 4.26 *Cooper's Hawk. Source: Wikimedia Commons.*

The Cooper's hawk is a species in decline (Remsen 1978) and is deemed a species of special concern by the California Department of Fish and Game. Reduction in the sighting of breeding pairs of Cooper's hawk have been reported throughout Southern California.

Cooper's hawks nest and breed in riparian and oak woodlands, preferring older, less dense canopy coverage. The loss of riparian habitat, including the loss of nest trees from depletion of the water source and invasion of exotic species is a major threat to breeding hawks.

Cooper's hawks have been sighted north of the Main Street bridge, and in the riparian corridor between the Shell Road Bridge and Foster Park. Nesting for the hawk likely occurs upstream in the Ventura River riparian corridor and adjacent oak woodlands, beginning near the Canada Larga area (Hunt 1994).

GIANT KELP

Macrocystis pyrifera

Ecosystem: Marine

FIGURE 4.27 *Giant kelp. Source: Wikimedia Commons.*

Giant kelp forests are among the most productive communities in the world. They are comparable to tropical rain forests. Kelp forests provide food and shelter for many other species. In Southern California, giant kelp grows in the Southern California Coastal Bight, from Pt. Conception to northwestern Baja California.

Kelp favors nutrient-rich, cool waters with rocky bottoms that are supplied by freshwater delivery and ocean currents (see Appendix B When the River Meets the Sea: River Plumes, the Marine Environment, and Low Impact Development for more information on marine ecology). Giant kelp is considered a good indicator of climate and ocean conditions due to its sensitivity to temperature change.

The health of kelp forests faces many threats: harvesting, grazing by sea urchins, sedimentations and pollution. Currently, kelp forests exist west of the Ventura River, along the less developed coastal areas. Kelp forests may have existed in the ocean where the Ventura River discharges to the sea, but currently do not. This is possibly due to the degraded state of sediment and nutrient delivery of the Ventura River.

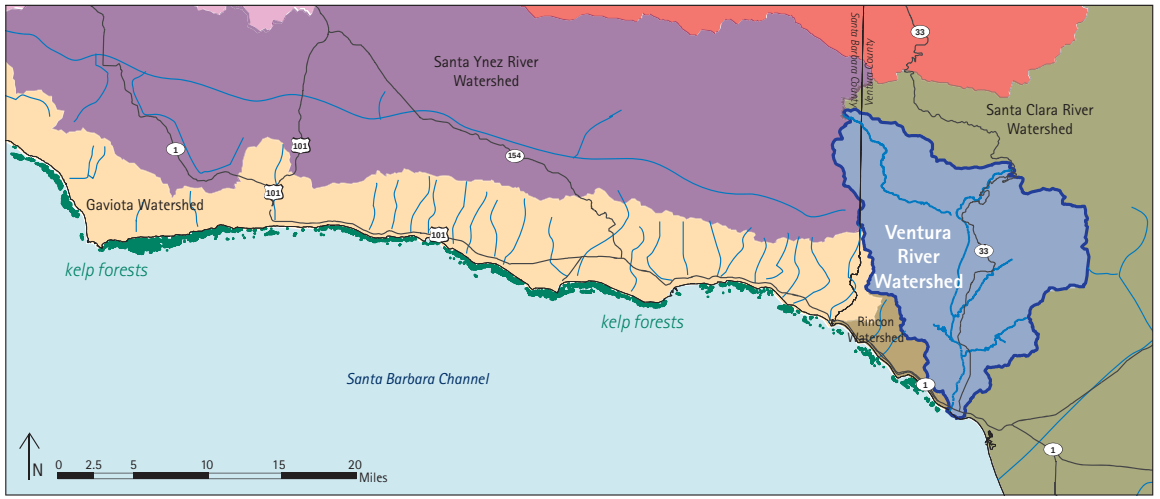


FIGURE 4.28 *Kelp forests along the Ventura and Santa Barbara Coast. Data from Channel Islands National Marine Sanctuary.*

River parkways provide flood protection benefits for communities by providing wider corridors along our waterways that help store, and provide safe corridors for the passage of, storm waters.

California River Parkways Act of 2004
California Public Resources Code §5751(e)