Chapter 4
BIOLOGICAL RESOURCES

4.1 Introduction

This chapter describes the existing biological resources in the North Coast Study Region (Study Region), provides an overview of applicable federal and state regulations, and describes the potential impacts that may occur to biological resources as a result of implementation of the Proposed Project. Data and information sources used to prepare this chapter include state and federal regulations, a document of methods used to evaluate marine protected area (MPA) proposals in the MLPA Study Region prepared by the Science Advisory Team (MLPA SAT 2010), reference materials from the *Regional Profile of the North Coast Study Region: California/Oregon Border to Alder Creek* (Regional Profile) (MLPAI 2010a), and other relevant literature including scientific analyses published in peer-reviewed journals and books.

The following appendices support this chapter:

- Appendix C: North Coast Study Region Habitat and Species Atlas
- Appendix D: List of Species Most Likely to Benefit from MPAs in the North Coast Study Region

4.2 Regulatory Setting

Federal and state environmental laws, policies, and regulations, and a local plan that are relevant to the biological resources in the Study Region include, but are not limited to:

- Endangered Species Act (ESA)
- Magnuson–Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)
- Lacey Act
- California Endangered Species Act (CESA)
- California Marine Life Management Act
- California Fish and Game Commission Fishing Regulations
- California Fish and Game Commission Waterfowl Regulations
- Porter-Cologne Water Quality Control Act
- Ballast Water Management for Control of Nonindigenous Species Act, Marine Invasive Species Act, and Coastal Ecosystems Protection Act

- Humboldt Bay Management Plan

The following section provides descriptions of these regulations.

4.2.1 Federal Laws, Regulations, and Policies

Endangered Species Act

The ESA of 1973 (16 U.S. Code [USC] 1531–1544) was enacted to protect species that are endangered or threatened throughout all or a significant portion of their range, as well as the protection of habitats on which they depend. The U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NOAA Fisheries) share responsibility for implementing the ESA. In general, the USFWS manages land and freshwater species, while NOAA Fisheries manages marine and anadromous species. As defined by the ESA, *endangered* refers to species that are "in danger of extinction within the foreseeable future throughout all or a significant portion of its range," and *threatened* refers to "those animals and plants likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges."

Endangered Species Act Section 4(d)

Incidental take of a species listed as threatened under the ESA may be broadly authorized under Section 4(d), which authorizes incidental take of such threatened species consistent with certain conditions. Section 4(d) is not applicable to species listed as endangered under the ESA. Through a Section 4(d) rule, the USFWS or NOAA Fisheries may apply take prohibitions for threatened species but exempt certain programs or activities (such as recreational fisheries) if they meet the requirements specified in the rule. The USFWS or NOAA Fisheries may apply a Section 4(d) rule, either at the time of listing or subsequently. A familiar example is the 4(d) rule that protects anglers if they accidentally catch a listed fish species, provided that they release it unharmed.

Endangered Species Act Section 9

Under the ESA, it is illegal for any person, private entity, or government agency to take endangered species without federal authorization. Take of most threatened species is similarly prohibited. *Take* is defined to mean harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in such conduct. *Harm* is defined to mean an act that actually kills or injures fish or wildlife. Take may include significant habitat modification or degradation that actually kills or injures fish or wildlife by substantially impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. The incidental take of listed species can be authorized under Section 7 or Section 10.

Endangered Species Act Section 10

Absent a 4(d) rule or a completed Section 7 consultation, incidental take of a listed species can only be authorized under Section 10. A Section 10(a)(1)(A) permit authorizes the

intentional take of listed species for research or propagation that enhances the survival of the listed species in question. Incidental take by a non-federal entity also may be authorized through a Section 10(a)(1)(B) permit, including approval of a habitat conservation plan. The Proposed Project is not seeking a Section 10(a)(1)(B) permit.

Endangered Species Act Critical Habitat

When a species is proposed for listing as endangered or threatened under the ESA, the USFWS or NOAA Fisheries must consider whether areas of habitat exist that are essential to the species' conservation. Those areas may be proposed for designation as "critical habitat." Under Section 7, all federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat. These requirements apply only to federal agency actions, and only to habitat that has been designated. Critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a federal agency.

Table 4-1 lists special-status plants, fish, and wildlife that are recognized by federal and state agencies as threatened, endangered, or species of concern and are known to occur or may occur in the Study Region.

Table 4-1. Special-Status Species Likely to Occur in the North Coast Study Region

Common Name	Scientific Name	Federal Status	State Status	Other Status
Mammals				
Blue whale	*Balaenoptera musculus musculus*	E		MMPA
Fin whale	*Balaenoptera physalus*	E		MMPA
Humpback whale	*Megaptera novaeangliae*	E		MMPA
North Pacific right whale	*Eubalaena japonica*	E		MMPA
Gray whale	*Eschrichtius robustus*	D		MMPA
Sei whale	*Balaenoptera borealis*	E		MMPA
Sperm whale	*Physeter macrocephalus*	E		MMPA
Killer whale	*Orcinus orca*	PT, SC (NOAA Fisheries)		MMPA
Dall's porpoise	*Phocoenoides dalli*			MMPA
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*			MMPA
Risso's dolphin	*Grampus griseus*			MMPA
Northern right whale dolphin	*Issodelphis borealis*		FP	MMPA
California sea lion	*Zalophus californianus*			MMPA
Northern fur seal	*Callorhinus ursinus*			MMPA
Harbor seal	*Phoca vitulina*			MMPA
Northern elephant seal	*Mirounga angustirostris*		FP	MMPA
Steller sea lion	*Eumetopias jubatus*	T		MMPA
River otter	*Lontra canadensis*			IUCN
Southern sea otter	*Enhydra lutris nereis*	T	FP	MMPA
Birds				
Common loon	*Gavia immer*		SSC(FP)	IUCN
Short-tailed albatross	*Phoebastria albatrus*	E	SSC(FP)	IUCN

Table 4-1. Special-Status Species Likely to Occur in the North Coast Study Region

Common Name	Scientific Name	Federal Status	State Status	Other Status
Black-footed albatross	*Phoebastria nigripes*	SC (FWS)		
Ashy storm-petrel	*Oceanodroma homochroa*	BCC (FWS)	SSC(SP)	IUCN
Fork-tailed storm-petrel	*Oceanodroma furcata*		SSC(FP)	IUCN
American white pelican	*Pelecanus erythrorhynchos*		SSC(FP)	IUCN
American bittern	*Botaurus lentiginosus*	BCC (FWS)		IUCN
White-faced ibis	*Plegadis chihi*	SC (FWS)		
Harlequin duck	*Histrionicus histrionicus*	SC (FWS)	SSC(SP)	
Western snowy plover	*Charadrius alexandrinus nivosus*	T, BCC (FWS)	SSC(FP)	
Black oystercatcher	*Haematopus bachmani*	BCC (FWS)		
Whimbrel	*Numenius phaeopus*	BCC (FWS)		
Long-billed curlew	*Numenius americanus*	BCC (FWS)		
Marbled godwit	*Limosa fedoa*	BCC (FWS)		
Black turnstone	*Arenaria melanocephala*	BCC (FWS)		
Red knot	*Calidris canutus*	BCC (FWS)		
Elegant tern	*Sterna elegans*	BCC (FWS)	SSC(TP)	IUCN
Caspian tern	*Sterna caspia*	BCC (FWS)		
Marbled murrelet	*Brachyramphus marmoratus marmoratus*	T	E	
Cassin's auklet	*Ptychoramphus aleuticus*	BCC (FWS)	SSC(TP)	IUCN
Rhinoceros auklet	*Cerorhinca monocerata*		SSC(TP)	IUCN
Double-crested cormorant	*Phalacrocorax auritus*		SSC(WL)	IUCN
Black-crowned night heron	*Nycticorax nycticorax*	SC		IUCN
Canada goose	*Branta canadensis leucopareia*	D		
Saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*	SC, BCC (FWS)		
Black brant	*Branta bernicla nigricans*		SSC(TP)	
Redhead	*Aythya americana*		SSC(SP)	
Bufflehead	*Bucephala albeola*		SSC(TP)	
Osprey	*Pandion haliaetus*		SSC(WL)	
Northern harrier	*Circus cyaneus*		SSC(TP)	
Golden eagle	*Aquila chrysaetos*		SSC(FP), FP	
Bald eagle	*Haliaeetus leucocephalus*	T	E	
Merlin	*Falco columbarius*		SSC(WL)	
Long-billed curlew	*Numenius americanus*	SC		
California gull	*Larus californicus*		SSC(WL)	
Western gull	*Larus occidentalis*			IUCN
Willow flycatcher	*Empidonax traillii*		E	
Tufted puffin	*Fratercula cirrhata*		SSC(FP)	IUCN
Reptiles				
Loggerhead sea turtle	*Caretta caretta*		T	
Fish				
Tidewater goby	*Eucyclogobius newberryi*	E	SSC(QE)	IUCN
Coast cutthroat trout	*Oncorhynchus clarkii clarkia*		SSC	
Pink salmon	*Oncorhynchus gorbuscha*		SSC(QE)	

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Common Name	Scientific Name	Federal Status	State Status	Other Status
Chum salmon	*Oncorhynchus keta*		SSC(QE)	
Coho salmon—northern California population	*Oncorhynchus kisutch*	T	T	
Chinook salmon—California coastal ESU	*Oncorhynchus tshawytscha*	T		
Chinook salmon—spring-run, Klamath-Trinity rivers pop	*Oncorhynchus tshawytscha*		SSC	
Steelhead—Klamath Mountains	*Oncorhynchus mykiss irideus*		SSC(QT)	
Province ESU summer run				
Steelhead—northern California ESU	*Oncorhynchus mykiss irideus*	T	SSC(QT)	
Green sturgeon	*Acipenser medirostris*	T, SSC[a]	SSC(QT)	
Cowcod	*Sebastes levis*	Overfished, SC (NOAA Fisheries)		
Bocaccio	*Sebastes paucispinis*	Overfished, SC (NOAA Fisheries)		
Canary rockfish	*Sebastes pinniger*	Overfished (NOAA Fisheries)		
Darkblotched rockfish	*Sebastes crameri*	Overfished (NOAA Fisheries)		
Pacific Ocean perch	*Sebastes alutus*	Overfished (NOAA Fisheries)		
Widow rockfish	*Sebastes entomelas*	Overfished (NOAA Fisheries)		
Yelloweye rockfish	*Sebastes ruberrimus*	Overfished (NOAA Fisheries)		
Eulachon	*Thaleichthys pacificus*	T	SSC(WL)	
Bluefin tuna	*Thunnus thynnus*	SC		
Swordfish	*Xiphias gladius*	SC		
White shark	*Carcharodon carcharias*		P	IUCN, CITES, CMS
Invertebrates				
Black abalone	*Haliotis cracherodii*	T, SC (NOAA Fisheries)	P	IUCN
Sandy beach tiger beetle	*Cicindela hirticollis gravida*	SC		
Plants				
Northcoast sand verbena	*Abronia umbellata* ssp. *breviflora*	SC		
Humboldt Bay wallflower	*Erysimum menziesii ssp. Eurekense*	E	E	1B.1
Humboldt Bay owls clover	*Castilleja ambigua ssp. Humboldtiensis*			1B.2
Salt marsh birds beak	*Chloropyron maritimum ssp. Maritimum*	E	E	1B.2

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Common Name	Scientific Name	Federal Status	State Status	Other Status

Notes: ESU = Evolutionary Significant Unit

Index of the listing codes used in Table 4-1

Federal Listing Codes

ESA: Endangered Species Act of 1973 listing codes:

E	Federally listed as endangered
T	Federally listed as threatened
D	Federally delisted
PE	Proposed for federal listing as endangered
PT	Proposed for federal listing as threatened
PD	Proposed for federal de-listing
Candidate	Candidate for federal listing as endangered or threatened
SC	Species of concern
SC (NOAA Fisheries)	Species of concern by the National Marine Fisheries Service
SC (FWS)	Species of concern by the U.S. Fish and Wildlife Service
BCC (FWS)	Birds of Conservation Concern by the U.S. Fish and Wildlife Service

State Listing Codes

CESA: California Endangered Species Act listing codes:

E	State-listed as endangered
T	State-listed as threatened
CE	Candidate for state listing as endangered
CT	Candidate for state listing as threatened
CD	Considered for state delisting as endangered

SSC: Species of special concern listing codes:

QE	Qualify as endangered (fish list)
QT	Qualify as threatened (fish list)
WL Watch list FP	First priority (bird list)
SP	Second priority (bird list)
TP	Third priority (bird list)

Other State listings:

FP	State fully protected animal list
P	Protected species

Other Status Codes

MMPA	Protected under the Marine Mammal Protection Act
IUCN	Included in the World Conservation Union's Red List of Vulnerable Species
CITES	Protected under the Convention of International Trade in Endangered Species of Fauna and Flora
CMS	Protected by the Convention on Migratory Species

California Native Plant Society codes:

1B Rare or Endangered in California and elsewhere

California Native Plant Society Threat Codes:

1 Seriously Endangered in California (over 80% of occurrences Threatened / high degree and immediacy of threat)

2 Fairly Endangered in California (20-80% occurrences Threatened)

[a] All spawning populations of green sturgeon south of the Eel River (the southern Distinct Population Segment (DPS) of the green sturgeon) are listed as federally threatened. Coastal spawning populations of green sturgeon from the Eel River north to the Klamath and Rogue rivers (the Pacific-northern DPS) are federally listed as a species of concern.

Source: MLPAI SAT 2010

Magnuson–Stevens Fishery Conservation and Management Act

The Magnuson–Stevens Fishery Conservation and Management Act (Magnuson–Stevens Act, 16 USC Sections 1801–1884) governs fish populations in the U.S. Exclusive Economic

Zone (EEZ)[1], including all anadromous fish throughout their migratory range except when in a foreign nation's waters, and all fish on the continental shelf. It was signed into law in 1976 (Public Law 94-265) and has gone through several reauthorizations (as amended through January 12, 2007, by the Magnuson–Stevens Fishery Conservation and Management Reauthorization Act, Public Law 109-479). The original act required foreign vessels to apply for permits to fish in U.S. waters. It established eight Regional Fishery Management Councils responsible for the preparation of fishery management plans (FMPs), to achieve the optimum yield from U.S. fisheries in their regions. According to the status of each fish stock, the councils must amend FMPs and also establish framework adjustments to provide specific fishery guidelines, such as catch quota, bycatch caps, and gear restrictions.

The Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-297) reauthorized and amended the Magnuson–Stevens Act to require government observers on board a certain number of fishing vessels, reduce the amount of bycatch caught by fishing vessels, and reduce amounts of overfishing, mostly through scientific management and reporting conducted via fisheries management reports. The SFA also added several new definitions, including definitions for overfishing and overfished. Each FMP is required to specify objective and measurable criteria for determining when a stock is overfished or when overfishing is occurring, and to establish measures for rebuilding the stock. The SFA defines *overfishing* as a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis.

The most recent reauthorization of the Magnuson–Stevens Act was finalized in 2006. Some of the most important changes were the call to end overfishing for all U.S. fish populations through an increase in the role of eco-system-based science in FMP modifications, the strengthening of enforcement of fishing regulations, improved cooperation between state and federal officials, and the use of technology in vessel monitoring.

Essential Fish Habitat

The Magnuson–Stevens Act also requires federal agencies to consult with NOAA Fisheries on actions that could damage Essential Fish Habitat (EFH). The Magnuson–Stevens Act defines *EFH* as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." A single species may use many different habitats throughout its life to support breeding, spawning, nursery, feeding, and protection functions. EFH can include both the water column and the underlying surface of a particular area. EFH has been designated in many locations throughout the Study Region.

The NOAA Fisheries guidelines state that "adverse effects from fishing may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem." The coastal pelagic EFH includes habitats for five species: Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel, and market squid. The Pacific Coast groundfish EFH includes habitats for 83 species of groundfish. EFH for Pacific Coast groundfish is defined as

[1] EEZ is defined by the United Nations Convention on Law of the Sea (UNCLOS 2011) as the portion of oceans extending up to 200 nm in which coastal states have the right to explore and exploit natural resources as well as to exercise jurisdiction over marine science research and environmental protection. Freedom of navigation and over flight, laying of submarine cables and pipelines, as well as other uses consented on the high seas, are still allowed (UNCLOS Articles 56, 58, and 59).

the aquatic habitat necessary to allow groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish EFH for each of the 83 species and their life stages result in more than 400 EFH identifications. When these EFHs are taken together, the groundfish EFH includes all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California seaward to the boundary of the EEZ. The seven "composite" EFH identifications are as follows: estuarine, rocky shelf, nonrocky shelf, canyon, continental slope/basin, neritic zone, and the oceanic zone.

Coho and Chinook salmon EFH also occurs in the Study Region. The EFH for these salmon includes the waters and substrate necessary for salmon production to support a long-term sustainable salmon fishery. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters to the full extent of the EEZ.

The Pacific salmon EFH also includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon. Habitat areas of particular concern (HAPCs) are described in the regulations as subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. These include estuaries, canopy kelp, seagrass, and rocky reef habitats. Although designated HAPCs are not afforded additional protection under the Magnuson–Stevens Act**,** potential impacts on HAPCs are considered in consultation regarding federal projects that may affect designated HAPCs.

EFH Closure Areas

As mentioned above, the Magnuson–Steven Act established eight regional fishery management councils. The Pacific Fishery Management Council (PFMC) is the council with jurisdiction over the 317,690–square-statute-mile (mi^2) EEZ off the coasts of Washington, Oregon, and California. The PFMC manages fisheries for about 119 species of salmon, groundfish, coastal pelagic species (sardines, anchovies, and mackerel), and highly migratory species (tunas, sharks, and swordfish).

In June 2006, EFH protection measures were amended to include implementation of discrete area closures for specific gear types. Closure areas were identified by the PFMC with the intention of minimizing adverse effects of fishing on groundfish EFH, and included EFH, HAPC, and EFH Conservation Areas. Of these, only the EFH Conservation Areas are closed to specific types of fishing. EFH conservation areas in the Study Region are Blunts Reef, Mendocino Ridge, Delgada Canyon, and Tolo Bank.

Federal West Coast Management Plans

Federal jurisdiction over Pacific coast groundfish was established by the Magnuson–Stevens Act of 1976 and implemented in 1982 with the adoption of the initial Pacific Coast Groundfish FMP. This FMP, which was most recently amended in 2005, operates across state boundaries and seeks to provide a balance between conservation, prevention of

overfishing, and maximization of the fisheries' resource (PFMC 2008). The plan covers 88 species of fish (including sharks, roundfish, groundfish, and flatfish), sets limits on harvest levels, establishes policies for periodic review and revision of regulatory requirements and limitations, and outlines programs for rebuilding depleted stocks. Management considerations such as licensing and permitting, size and bag limits, and net restrictions are outlined for commercial and recreational activities.

For federally managed fisheries, any stock assessed to be between 25% and 40% of unfished biomass is managed under "precautionary zone" management, where harvest rates are reduced to slow the depletion rate. Species currently managed under precautionary zone measures include blue rockfish, Pacific whiting, cabezon and sablefish. PFMC adopted new rebuilding analyses for petrale sole and seven rockfish species (*Sebastes* spp.) that are, or were previously, designated as "overfished" (less than 25% of their unexploited spawning population size remains). Petrale sole and five of the rockfish species commonly occur in the Study Region: bocaccio, canary, widow, darkblotched, and yelloweye rockfish all of which have ranges extending to Alaska. Juvenile bocaccio tend to settle in kelp beds after their pelagic larval stage and move to deeper rocky reefs (60–1,550 feet) as adults. Most bocaccio are caught at depths of 250–750 feet. Juvenile canary rockfish also tend to stay closer to the surface before moving to deeper benthic habitats as adults. Canary rockfish are most abundant around depths of 500 feet, but go as deep as 900 feet. Widow rockfish juveniles stay near the surface after their pelagic larval stage, and move to deeper waters as adults. Most widow rockfish were caught at depths of 450 to 750 feet, but have been found as deep as 1,050 feet. Adult widow rockfish of the same size class tend to move together from area to area and show seasonal movement among adjacent grounds. Yelloweye rockfish primarily inhabit high-relief rocky habitats in depths of 60 to 1,200 feet. These species of rockfish take years to reach reproductive maturity. The rebuilding process by which most "overfished" rockfish species reach healthy population levels is expected to require many years or even decades (MLPAI 2010a; MLPAI SAT 2010).

Non-Trawl and Trawl Rockfish Conservation Areas

NOAA Fisheries established a commercial rockfish conservation area (RCA) for the entire length of the west coast of the U.S. in January 2003, to protect and assist in stock rebuilding of lingcod (*Ophiodon elongatus*) and seven species of rockfishes (*Sebastes sp.*). RCAs are set to minimize opportunities for vessels to incidentally take overfished rockfish by eliminating fishing in areas where and times when those overfished species are likely to co-occur with more healthy stocks of groundfish. Trawl and non-trawl areas vary seasonally and regionally. Effective protection equivalent to that of an MPA occurs where the RCA is closed year-round to particular gear types.

National Wildlife Refuge

The National Wildlife Refuge System, managed by the USFWS, is a system of public lands and waters set aside to conserve America's fish, wildlife, and plants. The National Wildlife Refuge System Administration Act, as amended, establishes a unifying mission for the Refuge System, a process for determining compatible uses of refuges, and a requirement for preparing comprehensive conservation plans. The first and foremost mission of the National Wildlife Refuge System is focused singularly on wildlife conservation. The Refuge

System maintains the biological integrity, diversity, and environmental health of these national resources for the benefit of present and future generations of Americans. Currently, the Refuge System covers over 150 million acres, and includes 556 refuges (and other units) and 38 wetland management districts. The National Wildlife Refuges (NWRs) manage a full range of habitat types, including wetlands, prairies, coastal and marine areas, as well as temperate, tundra, and boreal forests. The management of individual refuge system units is dictated by a wide variety of laws, treaties, and executive orders pertaining to the conservation and protection of natural and cultural resources. Among the most important orders and laws and orders affecting the operation and management of refuges are Executive Order 12996, The National Wildlife Refuge System Administration Act (Public Law 89-669), the Refuge Recreation Act (Public Law 87-714), the Endangered Species Act, and the Fish and Wildlife Act of 1956, among others. In and adjacent to the Study Region, the Humboldt Bay NWR includes the Lanphere and Ma-le'l Dunes, a pristine dune ecosystem, and the Castle Rock NWR, a 14-acre island located less than a mile off-shore, which contains the largest breeding population of common murres in California and provides a roost for Aleutian cackling geese during migration.

Marine Mammal Protection Act

All marine mammals are protected under the MMPA of 1972 (16 USC Chapter 31). The Act prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, as well as the importing of marine mammals and marine mammal products into the U.S. NOAA Fisheries is the responsible authority for the marine mammals found in the Study Region.

Migratory Bird Treaty Act

The MBTA of 1918 (16 USC 703–712) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and former Soviet Union, and authorizes the U.S. Secretary of the Interior to 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 (16 USC 703; 50 CFR 10, 21). Most actions that result in taking or 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 game birds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. The 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. Take under the MBTA is also a state law violation (California Fish and Game Code [FGC], Section 3513).

Lacey Act

The Lacey Act (18 USC 42–43, 16 USC 3371–3378) was enacted in 1900 to supplement state laws for the protection of game and birds by prohibiting the transportation of wild animals or birds that were killed in violation of state or territorial law. The act required that shipments of fish and wildlife moving in interstate or foreign commerce be accurately marked and labeled as to their contents. Under this law, it is unlawful to import, export, sell,

acquire, or purchase fish, wildlife, or plants taken, possessed, transported, or sold in violation of U.S. or Indian law, or in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

In 1998, the Lacey Act was amended to prohibit the importation of "injurious" species, including fish (vertebrates, mollusks, and crustaceans), that the USFWS has designated "to be injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States." The zebra mussel (*Dreissena polymorpha*), a nonnative species that is known to have a presence in California, is specifically listed in the Lacey Act as a prohibited species that "shall be promptly exported or destroyed at the expense of the importer or consignee."

4.2.2 State Laws, Regulations, and Policies

California Legislative Authority

The California constitution gives authority to the State Legislature, which may, by statute, provide for the seasons and conditions under which different species of fish may be taken. California law consists of 29 codes, including the Fish and Game Code. Laws in the Fish and Game Code consist of statutes (chaptered bills that have passed through both houses of the Legislature and ultimately were signed by the Governor and recorded by the Secretary of State) and propositions passed by the voters of the state. The Commission was created by the State constitution. The rulemaking powers of the Commission are delegated by the Legislature. The Marine Life Management Act of 1998 (see below) delegated greater authority by the Legislature to the Commission; however, the Legislature still retains sole authority over some commercial fisheries (e.g., Dungeness crab) and joint authority over several others.

The authority and the responsibility of the Commission and the Department to make and enforce regulations governing recreational and commercial fishing are provided by the Legislature, and the Department is the State agency charged with carrying out legislation, regulations, and policies adopted by the Legislature and the Commission.

California Endangered Species Act

Under the CESA (FGC, Sections 2050–2116), the Department has jurisdiction over threatened or endangered species that are formally listed by the state. The CESA is similar to the ESA both in process and substance, with the intention of providing additional protection to threatened and endangered species in California. The CESA does not supersede, but rather operates in conjunction with the ESA. Species may be listed as threatened or endangered under both acts, in which case the provisions of both state and federal laws apply, or the more restrictive act applies. Under the ESA, habitat is protected, while under CESA, it is not. Other differences exist, such as the definition of "take," and the requirement under CESA that funding for mitigation be provided upfront before incidental take can be authorized.

Also, independent of the CESA, state law has established "fully protected" status for certain statutorily identified birds (FGC, Section 3511), mammals (FGC, Section 4700), reptiles and amphibians (FGC, Section 5050), and fish (FGC, Section 5515).

California Marine Life Management Act

The Marine Life Management Act (Assembly Bill 1241; Statutes of 1998, Chapter 1052) was enacted to promote sustainable marine fisheries, primarily through FMPs, based on comprehensive research and analysis of fisheries as well as on sustainable fisheries development. FMPs are planning documents. Their preparation requires considerable research and discussion before adoption. They are prepared by the Department with considerable input from experts and stakeholders and suggest distinct management measures for review and approval by the Commission. FMPs have been prepared for abalone (*Haliotis* spp.), white seabass, nearshore fisheries, and market squid, and are being developed for Pacific herring and California spiny lobster.

California Fish and Game Commission Fishing Regulations

The Commission regulates commercial and sport fishing activities in the Study Region for fisheries over which they have been granted authority. These regulations are codified in the California Code of Regulations, Title 14, Natural Resources.

Commercial Fishing Regulations

The Commission sets regulations for commercial fisheries over which they have authority. These regulations can be found in Title 14 of the California Code of Regulations, and are provided for reference in digest format in the *Digest of California Commercial Fishing Law and License Requirements* booklet (CDFG 2011a). All species may be taken without restriction except those mentioned by name in the most current regulations. Species not mentioned by name are not restricted unless within MPAs, if specified by MPA regulations. Only those types of fishing gear listed in the code may be used and only under the conditions prescribed. All other types of gear mentioned are illegal, unless authorized by the Commission with an Experimental Gear Permit. Because the regulations and statutes may change over time, it is the fisherman's responsibility to be knowledgeable of, and abide by, all laws and regulations in effect at the time the fisherman participates in any commercial fishing activity.

Ocean Sport Fishing Regulations

The Commission sets sport fishing regulations including seasons, bag limits, methods, and areas of take. Rules are subject to change year to year. General provisions applying to the taking and possession of fish by recreational anglers are provided in Fish and Game Code Sections 7100–7400. Specific sportfishing regulations are found in the California Code of Regulations, Title 14, Chapter 4. The Ocean Sport Fishing Regulations booklet is updated annually and is available through the Department's website (CDFG 2011a). Species that are regulated by ocean sport fishing regulation include many species of finfish, invertebrates,

mollusks, crustaceans, and marine plants; some fisheries are closed year-round and others are closed seasonally.

Sport Fishing Regulations for Rockfish Complex

Current California recreational fishing regulations for the popular groundfish complex of rockfish, cabezon, greenling, and lingcod limit catch to particular depth zones (specified regionally). Two management areas exist in the Study Region: the Northern Management Area and Mendocino Management Area. These regulations leave certain areas within state waters restricted from fishing year-round for these species, and may be changed during the season based on catch level estimates.

California Fish and Game Commission Waterfowl Regulations

Fish and Game Code Section 355 authorizes the Commission to set hunting seasons and take limits for waterfowl in the Study Region; the waterfowl season and take limit regulations set by the Commission are listed California Code of Regulations Section 502. The regulations may change annually. The 2011 regulations set open seasons for ducks and geese, including scaup, black brant, American coot and common moorhen.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1969 (Porter-Cologne Act) preserves, enhances, and restores water resources by establishing water quality standards and water discharge regulation. It gives authority to the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs) to implement measures to achieve this goal. Under the Porter-Cologne Act, “any person discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the state” must file a report of the discharge with the appropriate RWQCB. The act defines “waste” broadly, and the term has been applied to a diverse array of materials. Section 13050 includes the regulation of "biological" pollutants by defining them as relevant characteristics of water quality subject to regulation by the SWRCB; aquatic invasive species (AIS) are an example of this kind of pollutant.

Ballast Water Management for Control of Nonindigenous Species Act, Marine Invasive Species Act, and Coastal Ecosystems Protection Act

Well-known pathways of AIS are ballast water and hull fouling of commercial ships. The California State Lands Commission (State Lands) enforces the Ballast Water Management for Control of Nonindigenous Species Act of 1999, the Marine Invasive Species Act of 2003, and the Coastal Ecosystems Protection Act of 2006.

The Marine Invasive Species Program strives to prevent nonindigenous species release from commercial vessels to California waters. The program was begun in 1999, with the enactment of the Ballast Water Management for Control of Nonindigenous Species Act, which addressed the threat of species introductions through ships’ ballast water during a time when federal regulations were not mandatory.

In 2003, the Marine Invasive Species Act was passed, reauthorizing and expanding the 1999 Act. The Marine Invasive Species Act applies to all vessels carrying or capable of carrying ballast water into the coastal waters of the state after operating outside of the coastal waters of the state and to all ballast water and associated sediments taken on a vessel. The act requires that the ship's operator maintain specified information and records related to the vessel and ballast water management, and to make available or provide the information to State Lands.

New technology was developed after enactment of the Marine Invasive Species Act that kills living organisms in ballast water before it is discharged. Consequently, the Coastal Ecosystems Protection Act was written to give authority for State Lands to implement performance standards for the discharge of ballast water and to sponsor programs to evaluate experimental ballast water treatment systems (Muir 2011). The basic requirements for potential AIS in ballast water are zero detectable organisms greater the 50 micrometers and less than 0.01 living organisms per millimeter for organisms between 10-50 micrometers.

4.2.3 Local Plans, Policies, Laws, and Regulations

Humboldt Bay Management Plan

The Humboldt Bay Harbor, Recreation and Conservation District is a special district created by the California State Legislature in 1970. It is a countywide agency with permit jurisdiction over tide, submerged and other, including all of Humboldt Bay. It has adopted the Humboldt Bay Management Plan, which includes eelgrass monitoring, fisheries research, control of nonnative cordgrass, and water quality monitoring.

4.3 Environmental Setting

4.3.1 Ecosystems and Biological Habitats

Ecosystems and habitats in the Study Region include continental shelf habitats, rocky nearshore reefs with kelp forests, sandy beaches, estuarine eelgrass beds, and open waters. Species require specific physical environments, or habitats, and some species need different habitats during the various stages of their life cycles. Protection of "key" habitat types is a critical component of the MPA network design (CDFG 2008a). Key habitat types that protect a diversity of species in the Study Region are illustrated in **Appendix C** and quantified in **Table 4-2.**

During the North Coast MPA planning process, the Science Advisory Team (SAT) considered biogeographic patterns and identified smaller biogeographic subregions, referred to as bioregions, for the purpose of evaluating MPA proposals. Identification of the bioregions was based on a number of factors, including underlying geology, oceanographic patterns, and species distributions. The SAT divided the Study Region into two bioregions, with their boundary located at the mouth of the Mattole River (MLPAI 2010a). Bioregions are regions of distinct biological assemblages distinguished by different community compositions, the presence or absence of certain key species, or disruptions to population connectivity among habitats. Species assemblages between these adjacent bioregions are similar, but with

important subtle differences. For example, a break in population connectivity occurs at Cape Mendocino because of the oceanographic and geomorphologic conditions of the area. A large eddy off Cape Mendocino and a strong upwelling in the area create a potential barrier to connectivity (CDFG 2008a). Each key habitat type should be represented in multiple MPAs across bioregions to provide for dispersal of marine species and to protect against local environmental disaster (e.g., oil spills or other catastrophes) (CDFG 2008a).

Table 4-2. Key Habitat Types in the North Coast Study Region

Habitat	Amount in Study Region (linear mile [mi] or square mile [mi^2])
Intertidal	
Rocky shores[a]	159.1 mi
Sandy beaches	180.4 mi
Coastal marsh	88.6 mi
Tidal flats	66.5 mi
Hardened shores	22.1 mi
Estuary	43.5 mi^2
Eelgrass[b]	7.1 mi^2
Hard-bottom Habitats	
Rocky habitat, 0–30 meters	32.2 mi^2
Rocky habitat, 30–100 meters	33.6 mi^2
Rocky habitat, 100–200 meters	0.7 mi^2
Rocky habitat, >200 meters	0.1 mi^2
Soft-bottom Habitats	
0–30 meters	302.9 mi^2
30–100 meters	456.0 mi^2
100–200 meters	62.8 mi^2
>200 meters	7.7 mi^2
Unknown-bottom Habitats	
0–30 meters	127.9 mi^2
30–100 meters	3.1 mi^2
100–200 meters	0.2 mi^2
>200 meters	0.2 mi^2
Kelp Forest	
Kelp 2008[d]	3.2 mi^2
Kelp 2005	0.1 mi^2
Kelp 2004	0.6 mi^2
Kelp 2003	0.2 mi^2
Kelp 2002	0.4 mi^2
Kelp 1999	1.5 mi^2
Kelp 1989	2.3 mi^2
Canyon Habitat	7.6 mi^2

Table 4-2. Key Habitat Types in the North Coast Study Region

Habitat	Amount in Study Region (linear mile [mi] or square mile [mi^2])

Notes:

[a] Many of the seastacks, offshore rocks, and small islands that occur in the Study Region are not included in the shoreline measurements, and thus the availability of rocky shores is underestimated. Data provided by U.S. Bureau of Land Management indicate that these offshore rocks provide approximately 141 additional linear statute miles of rocky shoreline in the Study Region.

[b] Eelgrass coverage for the North Coast Study Region reflects data that exist for Humboldt Bay.

[c] Fine-scale mapping data for hard- and soft-bottom habitats, collected in 2009, are included in this report. Area measurements for nearshore areas (0–30 meters) may contain inaccuracies because of the high percentage of unmapped habitat as a result of seafloor mapping methodology, and they should be referenced in conjunction with linear proxy numbers.

[d] 2006 kelp data not collected; 2007 kelp data unavailable.

Source: MLPAI 2010a

Depth Zones

Based on information about the depth distributions of fish in California, depth zones in the Study Region have been identified and are presented in **Table 4-3**. The intertidal zone includes habitats such as sandy beaches, rocky shores, tidal flats, and coastal marsh that are subject to periodic tidal inundation. The 0–30-meter depth zone is considered the euphotic zone where light penetrates to support photosynthetic activity. Below 30 meters, light penetration diminishes and different assemblages of species occur. The depth zone from 100–200 meters is the approximate depth of the shelf-slope break, which is an area of high diversity that is characterized by both shelf and slope assemblages. At 200 meters and below, the continental slope drops down to the abyssal plain, where deep-sea communities occur. Several of the habitats mentioned in the MLPA occur in only one depth zone, while others may occur in several depth zones (MLPAI 2010a).

Table 4-3. Depth Zones Identified by the SAT

Meters	Feet
Intertidal	Intertidal
Intertidal to 30 meters	Intertidal to 98 feet
30–100 meters	98–328 feet
100–200 meters	328–656 feet
Greater than 200 meters	Greater than 656 feet

Note:

All depth figures above and throughout this document have been converted from the SAT guidelines, which are provided in meters. The above numbers have been converted from meters and are rounded to the nearest whole number. For reference, 1.00 meters = 0.55 fm = 3.28 feet.

Source: MLPAI 2010a

The majority of the Study Region's habitats occur 100 meters or shallower. In fact, habitats between 0–30 meters and 30–100 meters comprise approximately 93% of the Study Region's area. Habitats greater than 200 meters are extremely rare (**Table 4-4**).

Table 4-4. Depth Zones as Percent of the North Coast Study Region

Depth Zone	Area (mi^2)	Percentage of Study Region
Intertidal to 30 meters	463.04	45.08
30–100 meters	492.61	47.96
100–200 meters	63.63	6.19
200 meters and deeper	7.96	0.77

Note: mi^2 = square statute mile(s)
Source: MLPAI 2010a

Shoreline Types

The shoreline is a transition zone between the terrestrial and marine environments, and it includes many important ecosystems and biological communities. Shoreline intertidal zones in the Study Region include rocky shores, sandy beaches, tidal flats, coastal marshes, and human-made structures such as jetties and seawalls. The MLPA Study Region spans a straight-line distance of approximately 225 statute miles (mi) of the California coastline (with about 517 mi of actual shoreline) from the California/Oregon border to Alder Creek, near Point Arena in Mendocino County. This coastline is dominated by exposed wave-cut platforms in bedrock, fine-to-medium-grained sand beaches, salt marshes, and sheltered tidal flats. The length and percentages of each shoreline type are summarized in **Table 4-5**.

Rocky Shores

Rocky shore habitats and their associated ecological assemblages make up nearly one-third of the shoreline of the Study Region. Rocky shores include headlands and points such as Point Saint George, Patrick's Point, Trinidad Head, Cape Mendocino, Punta Gorda, and Mendocino headlands, as well as much of the coast at Fort Bragg. Exposed wave-cut platforms are the most common rocky shore type in the Study Region and are described below. Rocky intertidal communities vary in composition and structure with tidal height and wave exposure and with underlying geology. Beds of mussels (*Mytilus* spp.), surfgrass (*Phyllospadix* spp.), and algal assemblages from turfs (*Endocladia muricata*, etc.) to low canopies of leathery kelps (*Pterygophora californica, Postelsia palmaeformis*) are distributed in patches throughout the rocky shoreline. The structure created by these beds, turfs, and canopies provides suitable settlement substrate for many larval and juvenile intertidal organisms. Such areas supporting this high biodiversity are referred to as "biogenic habitats." In addition, intertidal boulders, platforms and cliffs, as well as tidepools, are home to many species of snails, barnacles, anemones, crabs, sea stars, and fishes. Also, rocky shores in the Study Region provide important rookery/haulout sites for pinnipeds, including harbor seals, California sea lions, and Steller sea lions (MLPAI 2010a).

Table 4-5. Summary of the Amount of Shoreline Habitats in the North Coast Study Region

Shore Type	Length in Study Region (mi)	Percentage of Total Shoreline in Study Region
Exposed rocky cliffs	37.6	7
Exposed rocky cliffs with boulder talus base	2.1	<1
Exposed wave-cut platforms in bedrock	116.1	22
Sheltered rocky shores	3.5	<1
Fine to medium grained sand beaches	108.9	21
Coarse-grained sand to granule beaches	43.5	8
Mixed sand and gravel beaches	56.7	11
Gravel beaches	34.1	7
Salt marshes	89.5	17
Exposed tidal flats	18.9	4
Sheltered tidal flats	80.6	16
Sheltered human-made structures	8.9	2
Exposed seawall (human-made)	0.1	<1
Riprap (human-made)	29.0	6
Total shoreline length in the Study Region[a]	516.7	100

Notes:

Numerous coves, rocky reefs, and headlands characterize much of the shoreline in the Study Region. Furthermore, many of the seastacks, offshore rocks, and small islands that occur in the Study Region are not included in the shoreline measurements. Data provided by the U.S. Bureau of Land Management indicate that these offshore rocks provide approximately 141 additional linear statute miles of rocky shoreline in the Study Region.

[a] Because of overlap of features, totals for each shore habitat type do not sum to the actual shoreline length in the Study Region. This overlap also leads to some discrepancies with Table 4-1, which includes numbers for dominant shoreline types.

Source: MLPAI 2010a

NOAA's Environmental Sensitivity Index (ESI) program provides a concise summary of coastal resources. Examples of at-risk resources include birds, shellfish beds, sensitive shorelines, and public beaches and parks (National Oceanic and Atmospheric Administration 2008). The following rocky shore types have been mapped in the Study Region (MLPAI 2010a):

- **Exposed rocky cliff:** Characterized by a steep intertidal zone (greater than 30 degrees slope) with little width and little sediment accumulation. Includes strong vertical zonation of intertidal communities. Approximately one-quarter of the rocky shore in the Study Region is this type.
- **Wave-cut rocky platform:** Includes flat rocky bench of variable width, with irregular surface and tidepools. Shore may be backed by scarp or bluff with sediments or boulders at base. Some sediment accumulation occurs in pools or crevices. May support rich tidepool and intertidal communities. Over 70% of the rocky shore in the Study Region is exposed, wave-cut platform in bedrock.
- **Sheltered rocky shore:** Characterized by bedrock shores of variable slope (cliffs to ledges), sheltered from wave exposure. These shores, which comprise less than 1% of the total shoreline in the Study Region, make up roughly 2% of the rocky shores.

Sandy and Gravel Beaches

Over one-third of the shoreline in the Study Region is sandy beach. Sandy beach communities are structured in large part by grain size, slope of the beach, and wave energy. Fine- to medium-grained sand beaches are the most common type in the Study Region, and gravel beaches are the least common type (see Table 4-5). Beaches are dynamic systems, changing with wind and wave action. Generally, sand is eroded from beaches in the winter and redeposited in the summer, resulting in annual changes in beach slope and width. Seasonal fluctuations in sand abundance are affected by the development of hardened shores and human-made sand-retention structures. Beach sand, decaying seaweed, and other detritus support a variety of invertebrate animals. Snails, bivalves, crustaceans, insects, spiders, isopods, amphipods, and polychaetes are among the organisms that inhabit sandy beaches, and several of these provide nourishment for larger vertebrate animals, including coastal populations of the western snowy plover. Many other species, including pinniped mammals, use sandy beaches for resting and rearing young (MLPAI 2010a).

Beach types have been mapped as linear shoreline features and are classified based on grain size (MLPAI 2010a):

- **Fine- to medium-grained sand beach:** Characterized by a flat, wide, and hard-packed beach that experiences significant seasonal changes in width and slope. Upper beach fauna is scarce; lower beach fauna includes sand crabs. These beaches make up less than 25% of all the beaches in the Study Region.
- **Coarse-grained sand beach:** Characterized by a moderate to steep beach of variable width with soft sediments, which may be backed by dunes or cliffs, and scarce fauna. Often located near river mouths and estuaries, this beach type makes up 8% of all the beaches in the Study Region.
- **Mixed sand and gravel beach:** Characterized by a moderately sloping beach with a mix of sand and gravel, which may have zones of pure sand, pebbles, or cobbles. Sand fraction may get transported offshore in winter. More stable substrata support algae, mussels, and barnacles. These beaches make up 11% of all the beaches in the Study Region.
- **Gravel beach:** Beaches composed of sediments ranging from pebbles to boulders; often steep with wave-built berms. Attached algae, mussels, and barnacles are present on lower stable substrata. This beach type makes up 7% of all the beaches in the Study Region.

Hardened (Human-made) Shorelines

Jetties, seawalls, and other human-made structures cover slightly less than 9% of the shoreline in the Study Region. Shorelines around major ports and harbors, especially Crescent City Harbor, Humboldt Bay, and the Noyo River mouth, are predominately human-made shorelines. Structures such as jetties and seawalls provide habitat for intertidal algal (e.g., *Fucus, Mastocarpus, Polysiphonia* spp*.)* and invertebrate (e.g., *Anthopleura spp. Cancer productus, Pachygrapsus crassipes*) assemblages similar to those found in naturally occurring, rocky intertidal areas. The invasive bryozoan, *Watersipora subtorquata* colonizes the submerged surfaces of boats and floating docks in addition to the previously mentioned hardened shoreline structures (MLPAI 2010a).

Coastal Marshes and Tidal Flats

Coastal marshes support high levels of biological productivity and provide habitat for many species. Marshes also regulate the amount of fresh water, nutrient, and sediment inputs into the estuaries and play an important role in filtration for estuarine water quality. Marshes along estuarine margins contribute to the stabilization of shorelines and store floodwaters during coastal storms. Vegetation patterns and dominant species in coastal marshes vary with levels of salinity, which is determined by precipitation patterns and changes in freshwater inputs. Tidal flats are associated with coastal rivers as well as bays and estuaries, including the Smith River mouth, Mad River, Humboldt Bay, the Eel River estuary, and the mouth of the Mattole River. These areas provide essential foraging grounds for migratory bird species because of the presence of invertebrates, including clams, snails, crabs, worms, and the burrowing ghost shrimp (*Neotrypaea californiensis*), as well as eelgrass (*Zostera* spp.). Eelgrass also provides habitat for juvenile fish species (e.g., *Sebastes* spp.) and Dungeness crab (*Cancer magister*), among other species. The following types of marshes and tidal flats have been mapped as linear features of the coastline (MLPAI 2010a):

- **Salt marshes:** Includes intertidal areas with emergent salt marsh vegetation. The width of marsh varies from a narrow fringe to extensive areas and provides important habitat for a variety of species. Salt marshes occur throughout the Study Region; Mad River Slough (in north Humboldt Bay) is a prominent example of this shoreline type.
- **Exposed tidal flats:** Includes intertidal flats composed of sand and mud. The presence of some wave exposure generally results in a higher presence of sand than in sheltered tidal flats; these tidal flats occur in bays and lower sections of rivers. Sediments in tidal flats are generally water-saturated with the presence of infaunal community that attracts foraging shorebirds. They are used as roosting sites for birds. The Entrance Bay portion of Humboldt Bay and the lower Eel River Estuary are examples of this shoreline type.
- **Sheltered tidal flats:** Includes intertidal flats made up of silt and clay (e.g., mudflats). They are present in calm water habitats that are sheltered from wave exposure and frequently are bordered by salt marshes.

Soft sediments support large populations of worms, clams, and snails, among other species, and are important foraging area for shorebirds. Extensive mudflats occur in north and south Humboldt Bay, as well as in the Eel River estuary.

Estuaries and Lagoons

Estuaries provide critical ecosystem services, such as filtering sediments and nutrients from the watershed, stabilizing shorelines, and providing flood and storm protection. Their condition is closely tied to the condition of the surrounding watershed. Estuaries also are utilized for many recreational activities, such as fishing, boating, kayaking, wildlife viewing, and interpretation/education activities (MLPAI SAT 2010).

Estuaries form at the mouths of rivers and streams, where freshwater and saltwater meet. Specific characteristics of estuaries vary, based on salinity. The salinity may change seasonally and over longer time frames, depending on freshwater inputs and creation or

removal of barriers between the estuary and the open coast. Two types of estuaries are found in the Study Region: bodies of water that are permanently or semi-permanently open to the ocean and bodies of water that are seasonally separated from the sea by sand bars, commonly referred to as lagoons. Estuaries contain open water and soft-bottom habitats, coastal marsh, and tidal flats, and in some cases, eelgrass beds. Lagoons, on the other hand, generally have a low level of freshwater inputs. Within estuaries and lagoons, the shoreward boundary of the Study Region was determined by evaluating the extent and presence of salt marsh and brackish vegetation, presence of saltwater species, the known extent of tidal influence, and jurisdictional boundaries. In general, lagoons and estuaries that are open, at least periodically, and are characterized by estuarine vegetation and tidal influence were included in the MLPA planning process. Lagoons that are rarely open and characterized by more freshwater species were not included. Small coastal streams and rivers that empty directly into the Pacific Ocean also were not included (MLPAI 2010a).

The Study Region contains at least a portion of 22 estuaries and lagoons, 16 of which are greater than 0.5 mi^2 in area. Humboldt Bay is the largest estuary in the Study Region and the second-largest estuary in California, after San Francisco Bay. Other relatively large estuaries or lagoons include the Eel River estuary, Lake Earl, Big Lagoon, and the Klamath River estuary. The estuaries that are greater than 0.5 mi^2 are described in more detail below. Some of the estuaries and lagoons are seasonally closed to tidal influence by sand bars. For example, in northern Humboldt County, pocket beaches and partially closed lagoons and estuaries commonly are interspersed between steep, rocky headlands and mountain slopes and meadows. One particularly large stretch does not contain any estuaries or lagoons greater than 0.5 mi^2—the approximately 65-mi stretch of coast between the Mattole River and Ten Mile River estuaries. Other notable gaps without an estuary or lagoon larger than 0.5 mi^2 include at least 15 mi of coastline both north and south of the Klamath River estuary, and the coastline between the Navarro River and Alder Creek estuaries. The aerial extent of estuaries in the entire Study Region totals 43.5 mi^2, representing approximately 4% of the Study Region (MLPAI 2010a).

Estuaries and lagoons are productive coastal ecosystems that play a key role as nursery habitat for many coastal invertebrates and fishes, and serve as roosting and foraging sites for shorebirds and seabirds. Estuarine areas in northern California experience relatively high levels of annual rainfall and large freshwater inputs (e.g., Klamath River, Mad River, Eel River), and therefore generally include freshwater and anadromous species. The most abundant marine species in northern California estuaries are northern anchovy and threespine stickleback, and North Coast estuaries may be dominated seasonally by anadromous species as well as other species that tolerate a wide range of salinity, such as salmon and trout, smelt species, lingcod, and herring. Other species that spend most of their lives in northern California estuaries include bay pipefish, Pacific staghorn sculpin, and several goby species. Marine species that utilize estuaries seasonally, or for part of their life cycle, include pelagic species, particularly Pacific herring, silversides (jacksmelt and topsmelt), and shiner perch, as well as more benthic starry flounder and English sole. Some estuaries also host species of concern other than salmonids, such as the federally endangered tidewater goby and longfin smelt (MLPAI 2010a).

Coastal bays and estuaries in the Study Region, particularly Humboldt Bay, are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. For example, western snowy plover use many North Coast locations as breeding

and wintering sites, including beaches near the mouths of the Smith River, Stone Lagoon, Big Lagoon, Little River (Clam Beach), Mad River, Humboldt Bay, Eel River, and Ten Mile River (MacKerricher Beach). Waterfowl hunting is currently allowed in many coastal areas of the Study Region, such as portions of Humboldt Bay and Lake Earl, as well as near the mouths of North Coast rivers. At least six species of marine mammals, including harbor seal, California sea lion, Steller sea lion, common dolphin, bottle-nosed dolphin, and harbor porpoise, also are known to inhabit North Coast estuaries or ocean waters near the mouths at least seasonally (MLPAI 2010a).

Following are brief descriptions of some of the major estuaries and lagoons in the Study Region:

Smith River Estuary: The Smith River is California's largest undammed river system, flowing freely along its entire course and emptying into the Pacific Ocean approximately 5 mi south of the Oregon border. This is the northernmost estuary in the Study Region, covering an area of 1.06 mi^2. The estuary contains a number of important other habitats, including tidal flats and salt marsh, in addition to at least a portion of two major sloughs (Tillas Slough and Islas Slough). Historically, eelgrass was reported as a common marine plant in the estuary. More recently, small eelgrass beds have been observed in the lower 1-mi portion of the estuary. The Smith River estuary supports at least 28 fish species, including listed species such as the federally threatened coho salmon, Chinook salmon, and steelhead; federally endangered tidewater goby; and state species of special concern including coastal cutthroat trout and green sturgeon[2]. The estuary also serves as a nursery area for Dungeness crabs. Historically, chum salmon have been reported to spawn in the Smith River system. Over 30 species of shorebirds, seven species of wading birds, and at least 24 species of waterfowl are known to use the Smith River and Lake Earl estuaries. Several marine mammals, including harbor seals, California sea lions, and Steller sea lions, sometimes inhabit the estuary but occur more commonly in ocean waters near the estuary mouth. As with many other river estuaries in California, the Smith River estuary has been reduced greatly in terms of size and available habitat from historical levels, largely because of increased sedimentation from activities such as logging and construction, as well as drainage and diking. Areas surrounding the estuary also support agricultural land uses, such as pasture grazing and nursery crop cultivation. Restoration work currently is underway in the coastal area of the Smith River and aims to create habitat for salmonids in particular (the Smith River Estuary Restoration Project). The invasive New Zealand mud snail has been detected in Tillas Slough (MLPAI 2010a).

Lake Earl: Lake Earl, which includes Lake Talawa (Tolowa) because the two water bodies are often connected, is California's largest coastal lagoon (not a lake as the name implies), covering 4.03 mi^2 in area, and originally was part of the Smith River drainage. Lake Earl is located about 2 mi north of Crescent City and 11 mi south of the California/Oregon border. All of Lake Earl and most of Lake Talawa is managed by the Department as the Lake Earl Wildlife Area; the other portion of Lake Talawa, not owned by the Department, is leased by the Department from State Lands, and lands along the western border of the Lake Earl Wildlife Area are owned by the California Department of Parks and Recreation (State Parks). Water level and quality depend on breaching of the barrier beach, which occurs both

[2] Green sturgeon coastal spawning populations from the Eel River north to the Klamath and Rogue rivers are federally listed as a species of concern. Green sturgeon spawning populations south of the Eel River are listed as federally threatened. Statewide, green sturgeon is state listed as a species of concern.

naturally and manually. For example, Lake Earl breached naturally at a water depth of approximately 10 feet in May 2005, and at 9.5 feet in May 2006. Artificial breaching has occurred for at least 75 years, to some extent several times a year, during the fall and winter months to lower water levels, increasing lands available for livestock grazing and preventing flooding of neighboring private property. Water depths typically fluctuate from 4 to 5 feet during the summer to over 10 feet during the winter before mechanical breaching. Manual breaching may occur anytime between late fall and mid-February.

Lake Earl supports at least 15 fish species, including federally threatened coho salmon, Chinook salmon, steelhead, and the largest known population of the federally endangered tidewater goby. Green sturgeon, which is a state species of special concern in coastal spawning populations north of the Eel River, also has been reported in Lake Earl. After artificial breaching events, documented common marine species that enter the lagoon primarily include shiner surfperch, Pacific herring, starry flounder, and sculpins. Lake Earl also is an important area for waterfowl and shorebirds, including special-status species such as the California brown pelican, western snowy plover and bald eagle, as well as the federally threatened Oregon silverspot butterfly. The invasive New Zealand mud snail also has been detected in the narrows between Lake Earl and Lake Talawa (MLPAI 2010a).

Klamath River Estuary: The Klamath River is California's second-largest river by volume, emptying into the Pacific Ocean about 19 mi south of Crescent City. The Klamath River estuary is the fifth largest estuary in the Study Region, encompassing an area of 1.22 mi^2, and includes the lower Klamath River floodplain and associated wetland complexes. The entire estuary is within the boundaries of the Yurok Reservation and provides significant historical and current uses by the Yurok Tribe. The Klamath River estuary supports many anadromous fishes, some of which are listed species, including federally threatened coho salmon, Chinook salmon, and steelhead, as well as state species of special concern such as coastal cutthroat trout, green sturgeon, and eulachon. Longfin smelt also are reported to inhabit the Klamath River estuary. The estuary supports a variety of other commercially important marine species, such as Dungeness crabs, Pacific herring, surf smelt, northern anchovy, and several flatfish species. Harbor seals, Steller sea lions and, to a lesser extent, California sea lions sometimes inhabit the estuary but more commonly occur in the ocean waters near the mouth. The Klamath River estuary also is important to a variety of shorebirds and waterfowl. Several thousand birds are present during peak population periods, from August through May. The Yurok Tribe conducts water quality monitoring and restoration work in both the lower Klamath River and estuary. The Klamath River is identified as an impaired water body because of nutrient enrichment, temperature, and pollutant concerns. The invasive New Zealand mud snail has been detected approximately 2 mi upstream from the estuary, at the Klamath Glen boat ramp (MLPAI 2010a).

Redwood Creek Estuary: The Redwood Creek estuary covers an area of 0.13 mi^2 and is located in northern Humboldt County near the town of Orick, about 8 mi south of the Humboldt/Del Norte County border. The mouth is open to the ocean most of the year, but generally closes at the beginning or middle of summer, when rainfall and river flow are low. The majority of lower Redwood Creek is located within the Redwood National and State Parks. The estuary supports many fish species, including federally threatened coho salmon, Chinook salmon, and steelhead, federally endangered tidewater goby, state species of special concern coastal cutthroat trout, as well as black rockfish, starry flounder, and surfperch. Harbor seals and, to a lesser extent, California sea lions sometimes inhabit the

estuary but occur more commonly in the ocean waters near the mouth. Both shorebirds and waterfowl also use adjacent wet pasture areas. Redwood Creek is identified as an impaired water body in California because of excess sediment load and elevated water temperatures. Lower Redwood Creek and the estuary have been degraded by the 3.5-mi Redwood Creek Flood Control Project levees. The biological and physical functions of the estuary are impaired by the levee channelization project (MLPAI 2010a).

Stone Lagoon: Stone Lagoon is located along Highway 101 and is part of the Humboldt Lagoons State Park, along with Dry Lagoon and Big Lagoon. The boundary of Redwood National and State Parks splits Freshwater Lagoon, the northernmost of these four lagoons, down the middle in the north and south direction. All four lagoons are isolated from the Pacific Ocean by sand barriers, except that Stone Lagoon and Big Lagoon breach naturally and are marine-influenced, typically for a portion of the year. Stone Lagoon encompasses an area of 0.95 mi^2. The barrier dune that forms at the mouth of Stone Lagoon is reported to breach naturally every several years, while Big Lagoon breaches naturally nearly annually and persists longer because of its greater drainage area, fed by more streams. Both Stone Lagoon and Big Lagoon are susceptible to breach during or near the end of the rainy season, between October and April. Only one perennial stream (McDonald Creek) drains into Stone Lagoon. The lagoon supports several listed salmonid species and is listed as critical habitat for the tidewater goby. This area also supports substantial numbers of waterfowl and other water-associated birds, from fall to spring (MLPAI 2010a).

Big Lagoon: Big Lagoon is a large lagoon, located in northern Humboldt County, covering about 2.59 mi^2. Highway 101 runs through the lagoon. Big Lagoon breaches naturally, nearly on an annual basis. When the sandbar is closed, the lagoon is fed mostly by Maple Creek, which is the main tributary. Big Lagoon and its tributaries support federally threatened coho salmon, Chinook salmon, and steelhead, as well as state species of special concern coastal cutthroat trout. The lagoon also is listed as critical habitat for the federally endangered tidewater goby. Sago pondweed and wigeon grass form dense submergent stands in some areas. In addition, Big Lagoon attracts thousands of waterfowl, shorebirds, and many other water-associated birds, according to a 1990–1991 survey, which documented more than 360,000 annual bird-days use. The invasive New Zealand mud snail also is present throughout Big Lagoon (MLPAI 2010a).

Little River Estuary: Little River is a small coastal drainage that enters the Pacific Ocean about 6 mi north of the mouth of the Mad River. The Little River estuary encompasses an area of 0.07 mi^2 and supports runs of federally threatened coho salmon, Chinook salmon, and steelhead, as well as state species of special concern coastal cutthroat trout. Seasonal flooding of the pasturelands also provides habitat for moderate numbers of waterfowl and shorebirds. Western snowy plovers regularly nest at Clam Beach, located immediately south and connected to Little River estuary. Harbor seals sometimes inhabit the estuary but occur more commonly in the ocean waters near the mouth (MLPAI 2010a).

Mad River Estuary: The Mad River enters the Pacific Ocean just north of Arcata and approximately 13 mi north of the entrance to Humboldt Bay. The Mad River estuary encompasses an area of 0.34 mi^2 and supports federally threatened salmonid species (coho, Chinook, and steelhead) and shellfish species. Expansive pasturelands lying to the south of the river provide significant habitat for many water-associated birds when shallow flooding occurs during the rainy season, and occasional dike breaching allows water from the Mad

River to flow into Humboldt Bay. These pasturelands are contiguous with similar habitats near Mad River Slough and Humboldt Bay, and attract thousands of waterfowl and shorebirds. They also are important foraging areas for egrets, herons, and the listed Peregrine falcon. The mouth of the Mad River also is an important haulout site for harbor seals (MLPAI 2010a). The Mad River is identified as an impaired water body (for further discussion about impaired water bodies, see Section 3.4, "Water Quality").

Humboldt Bay: Humboldt Bay is a marine embayment located along the central coast of Humboldt County. Humboldt Bay is the second-largest estuary in California, after San Francisco Bay, and consists of Arcata (North) Bay at its north end, Central Bay, and South Bay. Humboldt Bay is the largest estuary in the Study Region, encompassing an area of 27.44 mi^2. The Humboldt Bay National Wildlife Refuge is located in South Bay. Humboldt Bay contains a number of diverse habitats, including tidal flats, salt marsh, and eelgrass beds. Approximately 40% of the known eelgrass in the state occurs in Humboldt Bay. Eelgrass beds in South Bay are denser than those of Arcata Bay, contain 78%-95% of the total eelgrass biomass in the bay, and are recognized as one of the most important locations of eelgrass growth on the entire U.S. west coast (MLPAI 2010a).

Humboldt Bay is the most economically productive port in the Study Region, and it is the largest port between San Francisco Bay and Coos Bay in Oregon. In 2000, Humboldt Bay was listed as one of 150 U.S. ports to handle more than one million tons of cargo annually. The growing and harvesting of oysters, which takes place in Arcata Bay, represents an important commercial farming activity. More than 60% of the oysters sold in California are grown in Humboldt Bay. At least 110 species of fish have been reported from Humboldt Bay, including many commercially important species that spawn within the bay and several species of salmonids that spawn in the tributaries. At least six fish species listed as threatened or endangered inhabit Humboldt Bay and its tributaries, including coho salmon, Chinook salmon, steelhead, longfin smelt, and the tidewater goby. Humboldt Bay also serves as an important nursery area for a variety of fish and invertebrate species, including English sole, Pacific herring, lingcod, Dungeness crab, leopard shark, rock crabs, some surfperch, and some rockfish. Other large fish species, such as bat rays and green sturgeon, can reach high abundances within Humboldt Bay, particularly during the summer months. The bay also supports recreationally important bivalve species, particularly in South Bay, including gaper clams, Washington clams, and littleneck clams. The Department's annual creel census surveys, conducted from 1975 to 1989, reported annual effort and catch estimates as high as 6,639 diggers extracting 188,000 clams in 1982. A resumption of that study in 2008 showed sport clamming efforts had decreased to an estimated 1,300 diggers extracting a total of 31,189 clams (MLPAI 2010a).

The coastal areas of Humboldt Bay and Eel River (located approximately 5 mi south of Humboldt Bay) together are recognized as a site of international importance for shorebirds by the Western Hemisphere Shorebird Reserve Network. Humboldt Bay supports anywhere from 20,000 to 80,000 shorebirds, depending on the season. Breeding western snowy plover are concentrated at a few locations around Humboldt Bay. The bay serves as an important wintering site for approximately 24 species of waterfowl, as well. Threatened or endangered bird species utilizing the Humboldt Bay ecosystem include marbled murrelet and western snowy plover. Humboldt Bay also is the most important location in California for staging Pacific black brant (*Branta bernicla nigricans*), which feeds on eelgrass almost exclusively. Eelgrass beds attract a large number of other coastal birds as well. Introduced

populations of Canada goose also have become established in the Humboldt Bay area in recent years. Harbor seal is the most common marine mammal in Humboldt Bay, and the bay serves as an important haulout and pupping area seasonally. Breeding populations of harbor seals typically reach their peak in late spring, and pupping occurs mainly in South Bay. Two other marine mammals, the harbor porpoise and California sea lion, also use the bay and nearshore habitats (MLPAI 2010a).

Eel River Estuary: The Eel River enters the Pacific Ocean in southern Humboldt County approximately 10 mi south of Humboldt Bay. The Eel River estuary is the second-largest estuary or lagoon in the Study Region. The estuary includes several types of habitats, including tidal flats, salt marsh, and eelgrass beds. Much of what once was extensive salt marsh and other intertidal habitat has been converted to farmland by dike construction. Native eelgrass populations are found within the estuary, and the invasive dwarf eelgrass was reported in the McNulty Slough area of the Eel River estuary in 2008. The Eel River is one of California's most important spawning streams for federally listed salmonids (coho salmon, Chinook salmon, and steelhead) and state species of special concern coastal cutthroat trout. Green sturgeon, also a state species of special concern, and longfin smelt are known to inhabit the estuary as well. The estuary also supports a variety of commercially important species, such as Dungeness crab, surf smelt (mostly juveniles), northern anchovy, Pacific herring, and several flatfish species. The lower estuary consists of an assortment of bays, tidal flats, sloughs, marshes, and seasonal wetlands and is rich in marine life, including invertebrate species, which provide rich feeding grounds for shorebirds. Census results from 1967 to 1970 (expressed as average total annual bird-use days) are: waterfowl (1,351,960), shorebirds (1,023,825), wading birds (39,420), and other water-associated birds (274,845). At least 31 species of shorebirds, five species of wading birds, as well as a number of waterfowl species and pelagic and coastal birds have been reported in the area. Listed species include western snowy plover, bald eagle, Peregrine falcon, Aleutian cackling goose, and tidewater goby. The Eel River estuary is listed as critical habitat for the tidewater goby. At least six species of marine mammals are known to visit the estuary, including the harbor seal, Steller sea lion, California sea lion, common dolphin, bottle-nosed dolphin, and harbor porpoise. The Eel River is identified as an impaired water body because of a number of concerns, such as timber harvesting and illegal waste disposal (MLPAI 2010a).

Mattole River Estuary: The Mattole River estuary is located near the town of Petrolia, about 40 mi south of Eureka, and covers an area of 0.13 mi^2. The Bear River estuary, a smaller estuary (less than 0.03 mi^2 in area), occurs approximately 14 mi to the north; however, no major estuaries are located within at least 26 mi along the coast from either side of the Mattole River estuary. The Ten Mile River estuary is located approximately 65 mi to the south, while the Eel River estuary and Humboldt Bay are approximately 26 mi and 35 mi to the north, respectively. The Mattole River estuary is similar to Bear River estuary in that virtually all of the lower river is privately owned, agriculture and logging are the most common land use practices, wetland types are limited, and the estuary lacks submerged vegetation. The Mattole River estuary usually is closed by a sandbar a few months of almost every year. The estuary supports several fish species, including federally threatened salmonid species (coho, Chinook, and steelhead) and euryhaline species such as starry flounder. Recreational sport fishing is important in the lower river portion, particularly to local residents. Dungeness crab also may use the estuary, although temporary seasonal sandbar closings may restrict their entry. The estuary also supports large numbers of shorebirds (sandpipers, dunlin, willet, western snowy plover, yellowlegs, godwits, and

killdeer), small numbers of waterfowl, and several species of wading birds such as great blue heron. Other coastal birds that frequent the estuary include kingfishers, grebes, cormorants, loons, pelicans, and a variety of other coastal and pelagic species. Several marine mammals, including the California sea lion, Steller sea lion, harbor seal, and common dolphin, are common in the adjacent offshore waters but are not known to visit the estuary regularly. The Mattole River is identified as an impaired water body because of excess sediment load and elevated water temperatures (MLPAI 2010a).

Ten Mile River Estuary: The Ten Mile River flows into the Pacific Ocean, approximately 8 mi north of Fort Bragg and just north of MacKerricher State Park. The neighboring beach, Ten Mile/MacKerricher Beach, has one of the longest stretches of dunes in California, extending from the river mouth south for approximately 4.5 mi. The majority of the watershed is privately owned. The Ten Mile River estuary encompasses an area of 0.19 mi^2. The estuary supports three species of federally threatened salmonids (coho, steelhead, and Chinook, at least occasionally), Pacific lamprey, and surfperch species. Eelgrass has been reported in the Ten Mile River estuary, but it is not as well mapped as at other locations, such as Humboldt Bay. The estuary is listed as critical habitat for the federally endangered tidewater goby. In addition, Ten Mile River estuary also supports bald eagle and nesting sites for western snowy plover and common merganser (MLPAI 2010a).

Noyo River Estuary: The Noyo River enters the Pacific Ocean along the southern edge of Fort Bragg in central Mendocino County. Concrete breakwaters flank both sides of the harbor entrance, where the Port of Fort Bragg is located. The Port of Fort Bragg supports the only major fishing fleet between Eureka and Bodega Bay. The Noyo River, Big River, Albion River, and Navarro River are known as drowned river valleys that occur along the steep Mendocino Range, primarily in Mendocino County. These four rivers are characterized by particularly long, narrow channels with extensive zones of tidal and marine influence that reach miles upstream. The Noyo River estuary covers an area of 0.11 mi^2. Eelgrass beds have been reported in the Noyo River estuary, although they are not as well mapped as at other locations, such as Humboldt Bay. The Noyo River estuary supports three species of federally threatened salmonids (coho, steelhead, and Chinook, at least occasionally). The estuary also supports Dungeness crab. The estuary serves as an important nesting location for seabirds, such as cormorant species. The Noyo River is identified as an impaired water body because of habitat alteration and excess sediment and debris (MLPAI 2010a).

Big River Estuary: Big River empties into the Pacific just south of the Mendocino Headlands, approximately 10 mi south of Fort Bragg. The lower Big River valley is a classic example of a drowned river valley, eroded by a terrestrial river, and later flooded by sea level rise. The Big River estuary is the largest estuary in Mendocino County, encompassing an area of 0.35 mi^2. Unlike some of the other estuaries in Mendocino County, the mouth of the Big River remains connected to the ocean year-round. The estuary includes extensive tidal mudflat and salt marsh habitat, and is one of the largest relatively undisturbed estuaries along the California coast. The Big River estuary also provides suitable habitat for eelgrass populations, particularly along the margins of shallow channels as far as 3 mi upriver. The estuary supports at least 22 fish species, such as three anadromous species of federally threatened salmonids (coho, steelhead, and Chinook, at least occasionally) and a California species of special concern (eulachon). Other commercially important species occurring in the Big River estuary include Dungeness crab, Pacific herring, surfperch

species, and several flatfish species. Harbor seals have been reported to utilize the estuary as far as 4 mi upstream. The estuary also provides suitable habitat for a multitude of coastal birds, including geese, pelicans, cormorants, egrets, and herons. The Big River is identified as an impaired water body because of concerns related to sedimentation and temperature (MLPAI 2010a).

Albion River Estuary: The Albion River flows into the Pacific Ocean south of Mendocino and approximately 15 mi south of Fort Bragg. The river mouth is connected to the ocean year-round. The Albion River estuary encompasses an area of 0.18 mi^2 and is inhabited by two federally threatened salmonid species (coho and steelhead) and commercially important species, such as Dungeness crab, starry flounder, and surfperch. Eelgrass beds flank both sides of the channel. Harbor seals frequent the estuary, geese and ducks winter there, and great blue herons nest along the river. The Albion River is identified as an impaired water body, mostly because of excess sediment (MLPAI 2010a).

Navarro River Estuary: The Navarro River enters the Pacific Ocean approximately 2 mi south of Albion and 8 mi south of Mendocino. The Navarro River has the largest watershed in Mendocino County, including the Anderson Valley. The estuary covers an area of 0.18 mi^2 and supports two federally threatened salmonid species (coho and steelhead), surfperch species, Dungeness crab, and starry flounder. Shorebirds forage at the river mouth, migratory waterfowl use the estuary as a wintering location, and egrets are permanent residents along the river. The Navarro River is identified as an impaired water body because of sediment and elevated temperature concerns (MLPAI 2010a).

Seagrass Beds

Seagrass habitats are extremely productive ecosystems that support an abundant and biologically diverse assemblage of aquatic animals, many of which are commercially important. The most common type of seagrass in estuaries and sheltered coastal bays in California is *Zostera marina* or eelgrass. A second species of eelgrass has been discovered in Humboldt Bay and the Eel River estuary, the nonnative dwarf eelgrass (*Z. japonica*), which has shorter and narrower leaves than *Z. marina*. Eelgrass is a marine flowering plant that often forms dense beds. Attributed mostly to their structural complexity and high productivity, eelgrass beds provide refuge, foraging, breeding, or nursery areas for a variety of invertebrates, fish, and birds. The long leaves and extensive root system also create a stable environment by reducing water flow and trapping particles, which consequently enhance sediment deposition, improve overall water quality, and increase recruitment of young fish and invertebrates (MLPAI 2010a).

Native eelgrass beds (*Z. marina*) are known to occur mostly in bays and estuaries throughout the Study Region (e.g., Humboldt Bay). As stated previously, approximately 40% of the known eelgrass in the state occurs in Humboldt Bay. Mapped eelgrass beds in Humboldt Bay total 7.08 mi^2. Within the Study Region, eelgrass has also been reported in the Smith River estuary, Crescent City Harbor, Eel River estuary, Ten Mile River estuary, Noyo River estuary, Big River estuary, and Albion River estuary; however, the extent and distribution of eelgrass in these areas is not nearly as well mapped as eelgrass populations in Humboldt Bay (see Table 4-2). Dwarf eelgrass (*Z. japonica*) was first discovered in Humboldt Bay in 2002 on Indian Island, located in the central part of the bay. Dwarf eelgrass is considered to be an invasive species in California waters, mostly because of

potential negative ecological effects and competition with native eelgrass. Eradication efforts began in 2003, with the removal of 284 square meters of dwarf eelgrass. Since then, annual efforts by the Humboldt Bay Cooperative Eelgrass Project have successfully reduced dwarf eelgrass in Humboldt Bay, with less than 5 square meters requiring removal. However, despite continued monitoring and successful control efforts, a new population of dwarf eelgrass was discovered in the Eel River estuary in 2008 (MLPAI 2010a).

The most common type of seagrass along the open coast of California is surfgrass (*Phyllospadix* spp.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero-tide level down to several meters below the zero-tide level. Surfgrass serves as an important habitat for a variety of fish and invertebrates, as well as algae; however, it is not well mapped in the Study Region (MLPAI 2010a).

Kelp Forests

Kelp forests provide important shelter for both juvenile and adult species of fish, offer vertical and horizontal substrate for a variety of marine organisms, and account for a large portion of the primary productivity in nearshore communities. Kelp forests support a large diversity of species, and many fishes and invertebrates depend on the health and robustness of the kelp forest. For example, juveniles of many nearshore rockfish species occur in the midwater or upper kelp canopy. Juveniles and adults of many nearshore rockfish species, as well as cabezon, greenlings, lingcod, and many other species, associate with bottom habitats in kelp forests. This habitat also is an economically valuable living marine resource, supporting both commercial and recreational fishing, diving, and kelp harvesting. Harvested kelp is a source of food (for both human consumption and for aquaculture feed), and it is used for pharmaceuticals, fertilizer products, and industrial applications. Kelp harvesting is allowed in the Study Region and is managed by the Department under regulations adopted by the Commission (MLPAI 2010a). Section 3.1, "Agricultural Resources," provides more information on commercial kelp harvest in the Study Region.

California has two primary canopy-forming kelp: giant kelp (*Macrocystis* sp.*)* and bull kelp (*Nereocystis luetkeana)*. Both species have geographic limitations: giant kelp span the northern and southern hemispheres in temperate waters, and bull kelp are primarily found in the northern hemisphere in temperate to cold waters. These two species exist along the central California coastline in separate or mixed stands. North of Santa Cruz, bull kelp becomes the dominant canopy-forming kelp. Beneath the canopy are understory kelp and, on the bottom substrate, more encrusting or shrub-like algae. The kelp forests in the Study Region are dominated by bull kelp (surface canopy), *Pterygophora californica* and *Laminaria setchellii* (understory), and foliose algae beneath (MLPAI 2010a).

Bull kelp is found on bedrocks, boulders, and reefs and can live at depths of 10 to 70 feet. Bull kelp beds are persistent over time but exhibit marked seasonal and annual changes in the extent of the canopy, primarily because of winter storm activity and changing oceanographic conditions, such as El Niño events. The distribution of bull kelp also can be affected and controlled by several other factors. Physical factors that influence bull kelp distribution include bottom light intensity, nutrients, wave action, shifting sediments, the character of the substrate (rocky, sandy, silty, course-grained), water temperature, water motion, and salinity. Identifying the individual factors influencing a bull kelp bed are often

difficult. For example, higher water temperatures decrease the amount of nutrients available in the water column for uptake. Biological factors that influence *Nereocystis* distribution include grazing, disease, and competition. Direct disturbance to kelp beds may occur through commercial or recreational fishing in or directly adjacent to the beds, and through the harvest of kelp commercially (MLPAI 2010a).

Bull kelp has a typical life span of 1 year. Spores are released in the late fall and gametophytes develop during the winter months. By early spring, the young sporophytes (a mature plant) typically appear. Bull kelp sporophytes are slow-growing for the first 3 to 4 weeks, and then accelerate rapidly to canopy height by midsummer. Bull kelp typically dies by early winter, with the onset of winter storms (MLPAI 2010a).

Table 4-6 presents results of aerial surveys used by the Department to assess the state's kelp resource. Surveys along the entire coastline first were performed in 1999, and they have continued on an annual basis from 2002 through the present. However, the data from 2006 and 2007 were not available for this analysis. One other survey used in this report was performed in 1989 by Ecoscan, a private organization. All surveys have measured the extent of the kelp bed's surface canopy, by using infrared photography and translating those images into geographic information system maps. These numbers are expressed in square miles and include beds of both giant kelp and bull kelp. Total kelp canopy coverage in the waters in the Study Region has ranged from a low of 0.08 mi^2 in 2005, to a high of 2.76 mi^2 in 2008. These numbers reflect a similar trend occurring along the entire coast of California, with kelp persistence shrinking and growing over the same period. The majority of the kelp observed by the survey is found from the Fort Bragg area to the southern end of the Study Region, with patchiness in areas near Crescent City (MLPAI 2010a).

Table 4-6. Kelp Canopy Coverage in the North Coast Study Region

Survey Year	Canopy Coverage (mi^2)
1989	2.30
1999	1.50
2002	0.40
2003	0.20
2004	0.60
2005	0.10
2006	No data north of Pigeon Point
2007	Data collected but not yet processed
2008[a]	3.20

Note: mi^2 = squared statute mile(s)

[a] A small portion of the coastline between Slaughterhouse Gulch (Mendocino County) and Jack Peters Gulch (Mendocino County) was not captured during the 2008 survey because of a gap in the imagery taken during the survey.

Source: MLPAI 2010a

Hard Bottoms/Rocky Reefs

Rocky reefs provide important habitat for a wide range of species. The diverse assemblages of organisms associated with rocky reefs and hard bottoms vary with depth zone and, for

this reason, the SAT considers hard-bottom habitats in each depth zone to be distinct habitats. For example, in the nearshore (less than 100-foot depth), rocky reefs provide hard substratum to which kelp and other algae attach, while in deeper water, hard substratum provides a place for many species of deepwater invertebrates to attach themselves. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish (MLPAI 2010a).

Table 4-7 shows the extent of hard and soft substrata in the Study Region, where rocky reefs are much less common than soft-bottom habitats at all depth zones. Approximately 6% of the total Study Region area can be characterized as hard-bottom at any depth. The majority of rocky substrata in the Study Region is shallower than 100 meters. Because of the difficulty of mapping locations close to shore in the North Coast because of navigational hazards, a significant portion (27%) of nearshore waters are classified as "unknown." To address this issue, the SAT developed a "proxy line" for this nearshore area that indicates the dominant habitat type between 0 and 30 meters in a given location. Available fine-scale data, intertidal habitats, kelp abundance, and expert knowledge are all considered when generating this proxy. Thus, although only 7% of the nearshore area is classified as hard-bottom by area, 23% is classified as hard-bottom using the linear proxy. Examples of hard-bottom habitat include the offshore area near the California/Oregon border and Saint George's Reef in Del Norte County, the nearshore area between Crescent City and the mouth of the Klamath River, from Wedding Rock to Camel Rock in Humboldt County, the nearshore subtidal area ranging from Cleone to the Noyo River mouth, and the nearshore subtidal area off Point Cabrillo in Mendocino County (MLPAI 2010a).

Table 4-7. Approximate Amount of Hard- and Soft-Bottom Habitats by Depth Zone Area

Depth Zone	Hard Substrata (mi^2) (% of depth zone area)	Soft Substrata (mi^2) (% of depth zone area)	Unknown Substrata (mi^2) (% of depth zone area)
0-30 meters	32.2 (7%)	302.9 (66%)	127.9 (27%)
30-100 meters	33.6 (7%)	456.0 (93%)	3.1 (<1%)
100-200 meters	0.7 (1%)	62.8 (99%)	0.2 (<1%)
>200 meters	0.1 (1%)	7.7 (96%)	0.2 (3%)
Total	**66.6 (6%)**	**829.4 (81%)**	**131.3 (13%)**

Notes: mi^2 =squared statute mile(s)
Source: MLPAI 2010a

Sandy and Soft Bottoms

Nearshore and offshore soft-bottom environments range from flat expanses to slopes and basin areas. Soft-bottom habitats lack the complex, three-dimensional structure of hard-bottom substrata and are somewhat less diverse in species assemblages than rocky reefs. However, soft-bottom habitats can vary, depending on the compositional sediment type. Soft-bottom habitats also can be highly dynamic in nature as sediments shift because of wave action, bottom currents, and geological processes. Sandy and soft bottoms provide essential habitat for important, commercially fished species such as Pacific halibut (*Hyppoglossus stenolepis*) and Dungeness crab (*Cancer magister*) (MLPAI 2010a).

The best available data indicate that soft-bottom habitats are much more common than hard-bottom habitats at all depth zones. The majority of the entire Study Region deeper than 100 meters can be characterized as soft-bottom. Using the nearshore proxy described above, over three-quarters of the nearshore zone (from 0 to 30 meters) can be characterized as soft-bottom (see Tables 4-2 and 4-4). As with hard-bottom habitats, soft-bottom habitats in different depth zones are considered separate habitats (MLPAI 2010a).

Underwater Pinnacles

Pinnacles are vertical rocky features that are tens of meters in diameter and height, with a cone-shaped geometry. They can be distinguished from large boulders by their geologic origin. Pinnacles are generally a product of in-place erosional processes acting on rocky outcrops, while boulders are the result of erosional processes in other locations and the resulting movement of large rocks. Pinnacles are probably located in state waters in the Study Region, but they are not well mapped. Pinnacles can be important bathymetric features that attract fish and invertebrates, and they are popular recreational diving locations. Currently, pinnacles are not distinguished from other hard-bottom habitats on substrata maps (MLPAI 2010a).

Submarine Canyons

Submarine canyons are submerged, steep-sided valleys that cut through the continental slope and occasionally extend close to shore. They have high bathymetric complexity, support unique deepwater communities, and affect local and regional circulation patterns. Submarine canyon habitats receive sediment and detritus from adjacent shallow areas and act as conduits of nutrients and sediment to deeper offshore habitats. Canyons provide habitat for young rockfish and flatfish that settle in nearshore waters to grow and move offshore as adults. Canyons also attract concentrations of prey species and provide important foraging opportunities for seabirds and marine mammals (MLPAI 2010a).

Four submarine canyons extend into state waters in the Study Region. All four are located along the Lost Coast, between Cape Mendocino and Point Delgada. From north to south, the canyons are Mendocino Canyon, Mattole Canyon, Spanish Canyon, and Delgada Canyon. Although these canyons have not been extensively studied, the nearby Eel Canyon (located approximately 6 mi offshore of the Eel River mouth, outside of state waters) has been shown to serve an important role in the offshore transport of terrestrially-derived sediments (MLPAI 2010a).

Offshore Rocks and Canyons

Statewide, over 20,000 islands, rocks, and exposed reefs and pinnacles are included in the California Coastal National Monument, managed by the U.S. Bureau of Land Management (BLM). The monument was designated by presidential proclamation in January 2000, and extends along the entire California coast (1,100 mi). The monument extends from the mean high tide line to 12 nautical miles (nm) offshore, and was designed to protect the biological and geological values of offshore rocks and islets and the important forage and breeding grounds of associated marine birds and mammals. Data provided by BLM indicate that these

offshore rocks provide approximately 141 linear mi of rocky shoreline habitat in the Study Region (MLPAI 2010a).

Mainland rocky shores frequently have associated nearshore rocks, rising from just below mean high water to tens of feet above sea level. These numerous rocks and islets provide important foraging and nesting sites for marine birds and are used as haulout sites by pinnipeds. Some of the larger islets include Sugarloaf Island near Cape Mendocino, Green Rock and Flatiron Rock near Trinidad Head, False Klamath Rock north of the Klamath River mouth, and Hunter Rock near the Smith River mouth. All of these islets support multi-species seabird colonies (MLPAI 2010a).

In addition to many nearshore rocks and islets, the Study Region contains two offshore reefs, one isolated offshore rock, and two larger nearshore islands. Blunts Reef, located approximately 3 mi northwest of Cape Mendocino, and Saint George Reef, extending from 2 to 6 mi northwest of Point Saint George, both have a series of wash rocks and islets rising just above sea level. These reefs are historic hazards to navigation, and the largest islet in Saint George Reef, 6 mi offshore, has a lighthouse. Both reefs provide foraging and resting opportunities for marine birds and mammals, and Saint George Reef in particular contains numerous pinniped haulout sites and a seabird nesting colony. Reading Rock, located 5 mi west of Gold Bluffs Beach in Humboldt County, is an isolated offshore rock rising approximately 98 feet above sea level. Seven species of seabirds use the rock as a nesting site, and it is an important pinniped haulout site (MLPAI 2010a).

Two larger, nearshore islands provide haulout and nesting sites for a large number of marine birds and mammals. Prince Island is located near the mouth of the Smith River and harbors nine species of nesting seabirds. Castle Rock is located slightly more than 0.5 mi offshore of Crescent City and provides nesting habitat for eleven species of marine birds, as well as haulout locations for numerous pinniped species. Castle Rock is designated as a National Wildlife Refuge, and it is closed to the public. The island is home to the second largest nesting seabird colony south of Alaska. A number of the offshore rocks and islands are identified by the Yurok Tribe as part of the cultural landscape. In 2006, the BLM created a Steward agreement with the Yurok Tribe, which provides a framework for how the two parties work together to meet the mission of the California Coastal National Monument (MLPAI 2010a).

Oceanographic Habitats

Oceanographic patterns create pelagic habitats that differ from one another with respect to temperature, salinity, chlorophyll content, contaminant loads, and planktonic biological assemblages. Oceanographic characteristics also strongly influence growth, fecundity, and survivorship of many species, as well as dispersal and recruitment patterns of sedentary species that have planktonic phases. Currents, water masses, and temperature strongly influence marine biodiversity. Variations in oceanographic factors determine areas of productivity where krill, squid, anchovy, seabirds, and marine mammals congregate in the pelagic ecosystem. Features such as eddies, upwelling plumes, currents, recirculation cells, and river outflow plumes can be associated with high marine biodiversity, and transport patterns created by these features can significantly affect recruitment patterns of fish and invertebrates in intertidal nearshore communities. The importance of these processes and

their predictability over time is creating a greater emphasis on identifying oceanographic features and mapping their extent and temporal persistence (MLPAI 2010a).

The Study Region is characterized by a three-season oceanographic regime: the upwelling season, the relaxation season, and the storm season. From April through July, the region is dominated by strong upwelling episodes of 3–10 days, during which persistent northwest winds drive surface waters offshore and towards the equator, while deeper waters move onshore and poleward. The relaxation season, from August through November, is characterized by light winds and calm seas, with occasional upwelling events and early winter storms. The storm season lasts through winter and early spring, and brings strong winds, large waves, and increased northward flow along the coast (MLPAI 2010a).

Two large-scale currents dominate the alongshore oceanographic conditions of northern California. The California Current is made up of southward-flowing surface waters and extends more than 100 mi offshore, while the subsurface Davidson Current flows northward and remains closer to shore. During the winter, the California Current tends to move offshore, allowing the Davidson Current to dominate in the nearshore surface waters. At these times, free-floating drifters released in San Francisco Bay have been recorded as far north as Shelter Cove, in as few as 5 days (MLPAI 2010a).

Upwelling Zones

Although the California and Davidson currents are responsible for many of the oceanographic characteristics in the Study Region, smaller processes within these systems contribute to variability in the ocean waters. Cape Mendocino and Point Arena are important upwelling centers, deflecting southward-flowing currents far offshore in upwelling jets and bringing cold, nutrient-rich bottom waters to the surface. At Cape Mendocino, the water flows create a moderately persistent offshore eddy that may create a barrier (albeit a permeable one) to larvae dispersing between areas north and south of the Cape (MLPAI 2010a).

Downwind of major headlands, upwelling is absent and water recirculates in what are called upwelling shadows that also could play important roles in nearshore oceanography. Upwelling shadows retain planktonic organisms, creating increased foraging opportunities and the potential for increased invertebrate recruitment in those areas. Although upwelling shadows in the Study Region have been poorly studied, they are likely to exist south of Crescent City and in the vicinity of Shelter Cove. Additionally, weak upwelling shadows likely exist in the lee of smaller headlands in the Study Region, such as Trinidad Head and the Mendocino Headlands (MLPAI 2010a).

Climate Influences

Two large-scale atmospheric processes also influence the oceanography of the Study Region. El Niño-Southern Oscillation events (ENSO) and Pacific Decadal Oscillations create variable oceanographic conditions worldwide. In northern California, ENSO events generally reduce upwelling of cold, nutrient-rich waters, increase onshore and northward flows, and increase sea surface temperatures. ENSO events occur every several years and generally result in declines of zooplankton and reductions in productivity that can affect

fish, seabird, and marine mammal populations. Pacific Decadal Oscillations occur over much longer timescales (20–30 years) and have large-scale impacts on zooplankton and fish productivity throughout the North Pacific. These two events, coupled with the future potential impacts of climate change, lend a large amount of uncertainty and variability to the oceanographic regime in the Study Region (MLPAI 2010a).

River Runoff

Numerous rivers and streams meet the ocean in the Study Region, including the Smith, Klamath, Eel, Mattole, and Navarro rivers. The heaviest freshwater input occurs north of Cape Mendocino, although numerous small streams and seasonal creeks drain to the Study Region. The larger rivers, such as the Eel and Klamath, not only add large amounts of fresh water to the ecosystem, but also deposit sediment into the nearshore environment. The Eel River has an especially high sediment load, depositing up to 30 million tons of mud and sand in the nearshore environment each year, although much of this is transported to deeper waters through submarine canyons. River plumes in the Study Region typically flow northward in the winter, adding sediment to nearshore habitats primarily north of Cape Mendocino (MLPAI 2010a).

Ecological Linkages

Watersheds and coastal waters have many complex ecological linkages and relationships. Understanding these associations between land use and water quality is important for MPA planning. Watersheds carry nutrients, sediments, and pollution to bays, estuaries, and the ocean. In northern California, urban and agricultural areas have significantly changed the nature of many watersheds. Many rivers and streams have been affected by dike construction. Numerous smaller streams and rivers flow into small estuaries, in which mixing and dilution occur. Many of the estuaries, embayments, coastal lagoons, and remaining wetlands have high importance relative to their small size and the number of resident and migrating species. Studies have shown that some species, including flatfish, rely on intricate linkages between estuarine and coastal environments during different life stages. Some examples of critical ecological relationships along the Study Region are described next for selected marine species (MLPAI 2010a).

- **Marine fish,** such as sole, sablefish, hake, and rockfish, live as adults on the continental shelf and slope or in submarine canyons. They produce pelagic larvae that recruit to estuaries, bays, kelp forests, rock outcrops, and cobble fields. Eelgrass beds are important for spawning and juvenile habitat for certain species, such as shiner perch. The structure of eelgrass beds provides protection from predation for juvenile invertebrates and fishes. Bat rays, leopard and smoothhound sharks, plainfin midshipman, staghorn sculpin, several surf perch, jacksmelt, and topsmelt mate and bear their young in estuarine habitats.
- **Anadromous fish** produce eggs and juveniles in fresh water. The juveniles then pass through estuarine environments to mature at sea and return through the estuaries as adults to migrate upstream in coastal rivers to reproduce. Rivers in the Study Region, such as the Eel River and Klamath River, once supported large numbers of anadromous species. However, because of degradation of watersheds and freshwater ecosystems and the presence of barriers to fish

passage, stocks of native anadromous fish, such as steelhead trout, coho, and Chinook salmon, Pacific lamprey, and sturgeon, are diminished in northern California.

- **Shorebirds and waterfowl**, such as black-bellied plover, marbled godwit, long-billed curlew, ruddy duck, brant, and Canada goose, in addition to special-status species such as western snowy plover and marbled murrelets, inhabit coastal lagoons, estuaries, and salt marshes as well as areas near sandy beaches. Large numbers of shorebirds and diving ducks are attracted to eelgrass beds, where they feed on the eelgrass, fish, and invertebrate eggs and young. Many bird species use salt marshes, shallow intertidal flats, and lagoons during their annual migrations. The estuaries, bays, and sandy beaches of coastal California form part of the Pacific Flyway, one of the four principal bird migration routes in North America.
- **Marine mammals**, such as California sea lions, Steller sea lions, northern elephant seals, and harbor seals, have many haulout sites, as well as a few rookeries, on secluded rocks and sand beaches, tidal flats, and estuaries in the Study Region.
- **Coastal and estuarine vegetation** include plants such as macroalgal mats, Humboldt cordgrass (*Spartina densiflora*), pickleweed (*Salicornia virginica*), and eelgrass (*Zostera marina*). Macroalgal mats, composed primarily of *Ulva* and *Enteromorpha* spp., may be carried on tides or currents to the open ocean, where they provide shelter and food for numerous organisms, notably juvenile fishes. Eventually, these mats may wash up on shore, where they supply nutrients to sandy beach and rocky intertidal communities.

4.3.2 Important Regional Species

This section describes some of the biologically important species in the Study Region. These include species that currently receive special protections because of their legal status as protected, threatened, or endangered species; species of special concern; species of economic interest; and species likely to benefit from MPAs.

Special-Status Species

Some species have been designated with a special status under either state or federal law. Both the California state and federal ESAs provide special protections for a variety of fish, marine mammals, birds, and plants. In addition, marine mammals are protected under the MMPA, and migratory seabirds and shorebirds are protected under the MBTA. Also, the Yurok Tribal Trust Species include resources associated with coastal and marine environments in the Study Region and fall under the auspices of federal protection (MLPAI 2010a). These regulations are summarized in section 4.2, "Regulatory Setting," and Table 4-1 provides a list of the special-status species likely to occur in the Study Region. Brief descriptions of selected species are presented next.

Pinnipeds

At least four species of pinnipeds occur in the Study Region. Steller sea lion, northern elephant seal, and California sea lion are historically known to migrate along the coast of northern California. In addition to these, harbor seals are common along the coast and in bays. Although populations of northern elephant seals, California sea lions, and harbor seals increased steadily during the second half of the 1900s, Steller sea lion populations are on the decline (MLPAI 2010a).

California sea lion: California sea lions (*Zalophus californianus*) are found from British Columbia to Mexico, but they are not as common on the North Coast as they are south of San Francisco Bay (MLPAI 2010a).

Steller sea lion: The Steller sea lion (*Eumetopias jubatus*) is the only pinniped in the Study Region that is on the Department's list of Special Animals. Steller sea lion in California are part of the eastern distinct population segment, which extends from southeast Alaska and British Columbia to California. Sugarloaf Island and Cape Mendocino on the North Coast are known to provide essential habitat for rookeries. Steller sea lions also are known to visit several North Coast locations, such as Klamath River mouth, Trinidad Head, and Smith River estuary. Their populations are known to fluctuate with abundances of Pacific herring (MLPAI 2010a).

Pacific harbor seal: Pacific harbor seals (*Phoca vitulina richardsi*) range from the Bering Sea south to Baja California, and they are common in nearshore areas and bays throughout the Study Region. Habitat use has been documented in the Study Region at the Klamath River mouth, where seals were found to utilize the river primarily as a refuge. Other areas in the Study Region used by harbor seals include Humboldt Bay and the mouth of the Mad River (MLPAI 2010a).

Northern elephant seal: The northern elephant seal (*Mirounga angustirostris*) is the largest of all seals, ranging from Alaska to Baja California. Although the California population has steadily recovered since 1980, when protective legislation was passed, these seals are uncommon in the Study Region. A breeding population of northern elephant seals exists on Castle Rock, offshore from Crescent City (MLPAI 2010a).

Cetaceans

Historic records show that humpback whales, fin whales, sei whales, blue whales, sperm whales, gray whales, right whales, and Baird's beaked whales were hunted in the Study Region. Additionally, orcas are sometimes seen from shore in coastal towns, and harbor porpoises frequent the nearshore. See **Table 4-8** for a list of these cetaceans and their scientific names. Studies of stomach contents indicate that sardines (*Clupeidae*) and krill (*Euphausiacea*) are a major food source for humpback whales, whose numbers have declined dramatically from pre-exploitation levels. Also, humpback whale populations in the North Pacific have been found to fluctuate with Pacific herring, which serve as a food source for the whales (MLPAI 2010a).

Table 4-8. Important Cetacean Species in the North Coast Study Region

Common Name	Scientific Name
Gray whale	*Eschrichtus robustus*
Humpback whale	*Megaptera novaeangliae*
Blue whale	*Balaenoptera musculus*
Fin whale	*Balaenoptera physalus*
Sperm whale	*Physeter macrocephalus*
Baird's beaked whale	*Berardius bairdii*
Orca ("killer whale")	*Orcinus orca*
Sei whale	*Balaenoptera borealis*
Right whale	*Eubalaena glacialis*
Harbor porpoise	*Phocoena phocoena*

Source: MLPAI 2010a

Birds

Marbled murrelet: The marbled murrelet (*Brachyramphus marmoratus*) is listed under the CESA as endangered and is listed under the ESA as threatened. This small-bodied seabird forages exclusively on small fish within the nearshore environment. The marbled murrelet is unique in that it nests exclusively in old growth conifer trees within 45 mi of the coast (almost entirely within 15 mi of the coast in California). The vast majority of the state-listed population and a significant portion of the federally listed population nests immediately adjacent to, and subsequently forages and over winters in, the Study Region. Most of the nesting population is found in Redwood National and State Parks, with some murrelets nesting in other state parks or small old growth reserves directly east of the Study Region. In addition, most of the nesting population from Redwood National and State Parks forages directly off the coast of the parks. Sea surveys indicate that the vast majority of marbled murrelets are found from Cape Mendocino north, with the highest densities occurring north of Trinidad (i.e., directly off the coast of Redwood National and State Parks). Very few to no murrelets are found at sea in the southern half of the Study Region, presumably because of the lack of inland nesting habitat south of Cape Mendocino. Murrelets do not fly far from their inland nesting grounds to forage at sea. In terms of ecological linkages, beyond anadromous fish species, only marbled murrelets live both in the marine environment and within the immediately adjacent inland environment. Any MPA, particularly in the northern half of the Study Region, would encapsulate a significant portion of the vital habitat of this endangered species because of its nearshore and localized foraging habits (MLPAI 2010a).

Brant: Brant (*Branta bernicla*) winter and stage along the entire coastline of California. Brant are food specialists during nonbreeding season, eating eelgrass (*Zostera* spp.) almost exclusively. Winter and spring distributions of brant are closely tied with those of eelgrass. In the Study Region, relatively high numbers of wintering and staging brant occur in Humboldt Bay, where eelgrass is plentiful. In Humboldt Bay, numbers of staging brant are higher than might be expected, based solely on eelgrass abundance because of distance from other staging areas. The more extensive eelgrass beds in South Bay support higher numbers of staging brant than Arcata Bay. As brant rely on eelgrass, the health and distribution of the population are affected by destruction of eelgrass habitat by human activity, including dredging, pollution, coastal development and, in the past, oyster mariculture. Brant also may be displaced from healthy eelgrass habitats by human

recreation activities, including boating, hunting, and recreational shellfish harvesting (MLPAI 2010a).

Western snowy plover: The Pacific population of the western snowy plover (*Charadrius alexandrinus nivosus*) occurs throughout the Study Region, and its breeding range extends from Baja California to southern Washington. Western snowy plover are found on beaches, estuarine sand and mud flats, and in human-made salt ponds, and the species feed on invertebrates in the wet sand and surf-cast kelp, and occasionally on insects from low-growing plants. Nesting occurs above the high-tide line on coastal beaches, sand spits, and dunes, and in lagoons and estuaries with appropriate habitat, during the breeding season (March–September). During a breeding season, range-wide survey in June 2002, an estimated 1,501 individuals were found; most were in California. Human harassment and direct destruction of nest sites and breeding habitat, expanding predator populations, and introduced species have contributed to the decline of and continue to threaten the western snowy plover. Western snowy plover are known to nest at the following locations: Gold Bluffs Beach, Big Lagoon, Clam Beach, the south spit of Humboldt Bay, the Eel River Wildlife Area, Centerville Beach, and the Eel River gravel bars in Humboldt County; and Ten Mile River Beach, Manchester Dunes, and Virgin Creek in Mendocino County (MLPAI 2010a).

Tufted puffin: The tufted puffin (*Fratercula cirrhata*) breeds along the coast of the northern Pacific Ocean, from Japan to central or southern California on offshore rocks, and on occasion, mainland cliffs. Tufted puffin breed April through September and occur mostly offshore on the outer continental slope and shelf during this time. Tufted puffin occur throughout pelagic waters in their range during the nonbreeding season. The tufted puffin, once found from the Oregon border to the Channel Islands, is now distributed from the Oregon border (where now only a few sites exist) to the Farallon Islands, and a single possible site in the Channel Islands. Historic breeding locations included Castle Rock in Del Norte County, and Green and Flatiron Rocks (off Trinidad) in Humboldt County. The current breeding range has been little studied, but surveys from 1989 through 1991 estimated 276 breeding puffins in 13 colonies, 57% of which occurred north of Cape Mendocino. Principal breeding sites identified were Prince Island and Castle Rock in Del Norte County, Green Rock in Humboldt County, and Goat Island and Fish Rock in Mendocino County. Possible reasons for the reduction of the tufted puffin's breeding range include oil spills and human alteration of breeding habitat (especially on Farallon Islands and Castle Rock). Other possibilities include climate change and reduction in prey availability (MLPAI 2010a).

Fish

Salmonids: A number of anadromous salmonids (*Oncorhynchus* spp.) occur in the Study Region, although several are considered to be species in jeopardy. For example, pink salmon (*Oncorhynchus gorbuscha*) have been extirpated from the state. The remaining five salmon species have at least some populations listed as threatened or endangered, including Chinook, coho, chum, steelhead, and cutthroat trout. Chinook salmon (*Oncorhynchus tshawytscha*) in California exhibit a wide array of life history patterns that allow them to take advantage of the diverse and variable riverine and ocean environments. At least seventeen distinct runs of Chinook salmon are recognized in California. These runs have been classified into six major groups or Evolutionarily Significant Units (ESUs). The California Coastal ESU includes naturally spawned coastal spring and fall Chinook salmon between Redwood Creek, Humboldt County and the Russian River, Sonoma County, and is

listed as federally threatened. The Southern Oregon and Northern California Coastal Chinook Salmon ESU includes fall-run Chinook salmon in coastal streams from Cape Blanco in Oregon south to the Klamath River. Southern Oregon and northern California coastal Chinook salmon were proposed for federal listing in 1999, but listing was determined not to be warranted. Large populations of spring-run Chinook salmon used to occur in at least 20 streams in the Klamath-Trinity drainage (MLPAI 2010a).

Currently, the principal remaining run in the Klamath drainage is in the north and south forks of the Salmon River and in Wooley Creek, a tributary of the Salmon River. The south and north forks of the Trinity River, and possibly the New River, also support a few fish. The large run of spring Chinook in the mainstream Trinity River apparently is maintained entirely by hatchery production (MLPAI 2010a).

Coho salmon (*Oncorhynchus kisutch*) are distributed throughout the North Pacific and are the most common species encountered offshore of California, after Chinook. Coho enter fresh water from September through January to spawn. Generally, coho salmon spawn in smaller streams than do Chinook salmon. One year after hatching, smolts begin migrating downstream to the ocean in late March or early April. In some years, emigration can begin before March and can persist into July. The amount of time coho salmon spend in estuarine environments is variable, and the time spent there is less in the southern portion of their range. On entering the ocean, the immature salmon remain inshore, congregating in schools as they move north along the continental shelf. Most remain in the ocean for 2 years; however, some return to spawn after the first year. Data on ocean distribution of California coho salmon are sparse, but coho salmon are believed to scatter and join schools from Oregon and possibly Washington (MLPAI 2010a).

In August 2002, the Commission issued a finding that coho salmon warranted listing as a threatened species, from the Oregon border south to Punta Gorda, and as an endangered species, from Punta Gorda south to San Francisco including the Bay. The Central California Coast ESU includes naturally spawning populations in streams between Punta Gorda, Humboldt County and the San Lorenzo River, Santa Cruz County, and is listed as federally endangered. A Southern Oregon/Northern California ESU also exists, including populations between Cape Blanco, Oregon and Punta Gorda, and is listed as federally threatened (MLPAI 2010a).

Other salmonids include chum salmon, coastal cutthroat trout, and steelhead. No fisheries exist in California for chum salmon (*Oncorhynchus keta*) because of limited stocks. The coastal cutthroat trout (*Oncorhynchus clarki clarki*) is one of the three native cutthroat subspecies in California. In California, the native range of the coastal cutthroat begins near the Eel River drainage and includes drainages north to Oregon and beyond into Alaska. Many of the populations are anadromous, "sea-run" cutthroat. Others are freshwater residents, and some travel between the brackish estuaries and the freshwater tributaries. Steelhead (*Oncorhynchus mykiss*) are caught recreationally in streams and rivers from the Central Valley basin north to the California/Oregon border. Steelhead are anadromous, and thus they spend most of their lives in the ocean, returning to freshwater to spawn. Unlike most Pacific salmon, steelhead do not necessarily die after spawning, and repeated spawning is common. A recent estimate of annual statewide abundance of summer-run steelhead is about 2,000 adults. The Northern California ESU is listed as federally threatened; it includes naturally spawning populations residing below impassable barriers

in coastal basins from Redwood Creek, Humboldt County to the Gualala River, Mendocino County (MLPAI 2010a).

Tidewater goby: The tidewater goby (*Eucyclogobius newberryi*) is a small, short-lived fish species restricted to relatively shallow, brackish estuarine waters along the California coastline from Tillas Slough, Del Norte County to Cockleburr Canyon in San Diego County. The tidewater goby was listed as federally endangered in 1994, mostly because of its disappearance from nearly half of its historic locations and the unstable status of remaining populations. However, a 5-year review, conducted by the USFWS in 2007, recommended changing the listing to threatened. Tidewater gobies feed on small benthic invertebrates, such as ostracods and amphipods, and appear to have a generally annual life cycle. They reproduce throughout the year, resulting in constant variability in local abundance, making accurate population estimates difficult. Distribution and health of tidewater goby populations are affected by habitat loss or degradation because they rely on estuarine habitats throughout their entire life cycle, as well as competition and predation by native and exotic species. Critical habitat for tidewater goby includes Lake Earl/Lake Talawa, Stone Lagoon, Big Lagoon, Humboldt Bay, Eel River estuary, Ten Mile River, Virgin Creek, and Pudding Creek (MLPAI 2010a).

Green sturgeon: The green sturgeon (*Acipenser medirostris*) spends most of its life in the ocean, spawns at between 15 and 20 years, and has not been well studied. Limited feeding data suggest that sturgeon feed mainly on benthic invertebrates, including shrimp, mollusks, and amphipods, as well as small fish. They are reported to spawn only in the Sacramento, Klamath, and Trinity rivers, although green sturgeon have been reported from a number of other locations, such as the Smith River estuary and Lake Earl (MLPAI 2010a).

The southern Distinct Population Segment (DPS) of the green sturgeon, which includes all spawning populations south of the Eel River, is listed as federally threatened. The Pacific-northern DPS (including coastal spawning populations from the Eel River north to the Klamath and Rogue rivers) is federally listed as a species of concern. Southern DPS green sturgeon populations move from the Sacramento River and San Pablo Bay to forage in Humboldt Bay (Pinnix 2008). Most of the threats to green sturgeon, including reduced flow, increased sediment, reduction in dissolved oxygen concentration, impassible barriers, and harvest, affect this species during the portion of its lifecycle spent in rivers (MLPAI 2010a).

Longfin smelt: The longfin smelt (*Spirinchus thaleichthys*) is listed as threatened under the CESA and its status is currently unresolved at the federal level. Longfin smelt was once one of the most abundant species in San Francisco Bay and Humboldt Bay; however, populations have declined in most locations; this may be attributed primarily to factors such as water diversion and varying water flows. Longfin smelt is a short-lived, anadromous species that feeds exclusively on zooplankton, typically spawns in freshwater rivers between January and March, and spends most of its adult life in nearshore coastal environments from Alaska to San Francisco Bay. Little information is available on the abundance of longfin smelt in California, especially north of San Francisco Bay; however, they are reported to inhabit several areas in the Study Region, including the Klamath River estuary, Humboldt Bay, and the Eel River estuary (MLPAI 2010a).

Eulachon: The eulachon (*Thaleichthys pacificus*) is another smelt species that occurs in California, although its numbers have declined in recent years and it is listed as a California

species of special concern. On May 17, 2010, NOAA listed the southern distinct population segment of eulachon (which ranges from British Columbia to the Mad River) as a threatened species. In the Study Region, this includes all fish from the Oregon border south to the Mad River mouth. The eulachon is known for its high content of an oil that is used for food and candles. Until the mid-1970s, eulachon supported a fairly consistent river sport dipnet fishery, as well as a dipnet fishery by Native Americans. The commercial catch in California has apparently never been large (maximum reported landings were 3,000 pounds in 1987), but eulachon are important commercially in British Columbia. They are a very important food for predatory marine animals, including salmon, halibut, cod, and sturgeon (MLPAI 2010a).

Eulachon spend most of their lives in the ocean but return to the lower reaches of coastal streams to spawn, usually no farther south than the Klamath River and Humboldt Bay tributaries. In recent years, eulachon numbers have declined drastically and they are now rare or absent from the Mad River and Redwood Creek and scarce in the Klamath River. However, the eulachon and its fishery have been little studied in the past, so it is unknown if the fish are at a low point in a natural population cycle or if they have been reduced by human-related factors (MLPAI 2010a).

Invertebrates

Black Abalone: Although black abalone (*Haliotis cracherodii*) are rare in the Study Region, they have been documented as far north as Mendocino County. Seven species of abalone (*Haliotis* spp.) are found in California: red, white, black, green, pink, pinto, and flat. Black abalone is the only abalone species in the Study Region that is depleted[3] and was recently federally listed as a threatened species. The California State Legislature closed the commercial and recreational abalone fishery south of San Francisco Bay in 1997, because of a decline in the populations and the progression of withering foot syndrome. The *Abalone Recovery and Management Plan*, adopted by the Commission in December 2005, outlines restoration strategies for depleted abalone stocks in central and southern California, and describes the management approach to be used for northern California red abalone and eventually for other recovered abalone stocks (CDFG 2005).

Plants

Humboldt Bay owl's clover: The coastal marshes of Humboldt Bay and the Eel River estuary provide essential habitat for the Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis*). This species is known to occur in Mendocino and Humboldt counties. Although it can occur in high densities in appropriate habitat, coastal development (especially around Humboldt Bay) has resulted in severe habitat loss for this subspecies (MLPAI 2010a).

Lyngbye's sedge: Lyngbye's sedge (*Carex lyngbyei*) grows rhizomatously into dense monotypic stands. It can be found in brackish or freshwater marshes and swamps from zero to a 33-foot elevation. Lyngbye's sedge is present in Del Norte, Humboldt and Mendocino counties.

[3] Although no formal definition for the term *depleted* exists as related to state fisheries management, the Department applies this term to five species of abalone, all of which were previously harvested commercially.

Point Reyes bird's beak: Point Reyes bird's beak (*Cordylanthus maritimus* ssp*. palustris*) is present in salt marshes around Humboldt Bay and the Eel River estuary. Through its action as a hemiparasite, *C. maritimus* has been demonstrated to ameliorate salt stress in the soil, resulting in increased species richness in salt marsh communities where it is present. Point Reyes bird's beak's increasingly fragmented habitat has been greatly reduced by development around Humboldt Bay (MLPAI 2010a).

Species of Economic Importance

Commercial and recreational fisheries are an important component of California's economy. This section discusses some of the economically important species in the Study Region. More information is presented in Appendix B, section B.3, "Potential Socioeconomic Effects of Proposed MPAs."

Fish

Nearshore finfish: The Department uses the term *finfish* to denote fish that are aquatic vertebrates of the superclass *Pisces*, breathing by gills throughout life and having limbs in the form of fins. The *California Nearshore Fishery Management Plan* (NFMP) guides the management of 19 nearshore finfish species: rockfishes (black, black and yellow, blue, brown, calico, China, copper, gopher, grass, kelp, olive, quillback, and treefish), cabezon, California scorpionfish, kelp and rock greenlings, California sheephead, and monkeyface prickleback. Some of these species occur coastwide, while others are rare or do not occur in northern California (e.g*.,* California sheephead, California scorpionfish, calico rockfish, and treefish). Collectively, these species are relatively long-lived, slow-growing fish that take several years to reach maturity and spawn. For example, black rockfish, which is a relatively fast-growing species of rockfish, become sexually mature at 6 to 7 years (14 to 16 inches) and can live to be about 50 years old. Most of the species were seldom harvested commercially until the development of the live-fish fishery during the early 1990s. Seventeen of these 19 species also are included in the federal Groundfish FMP (MLPAI 2010a).

A restricted-access program began in 2003 for the commercial nearshore fishery that affected the take of 10 specific nearshore species. The shallow nearshore group consists of black-and-yellow, China, gopher, grass, and kelp rockfishes, kelp and rock greenlings, California scorpionfish, California sheephead, and cabezon. A total statewide participant capacity goal of 61 permits was specified for these ten species, although as of 2007, 186 permits remain, of which 155 are actively fished (annual landings of permitted species exceeded 100 pounds). A restrictive-permit program also began for eight species of deeper nearshore rockfishes: black, blue, brown, calico, copper, olive, quillback, and treefish rockfishes. The number of permits for these species decreased from 292 in 2003 to 239 permits in 2007, with 105 of the permits actively fished (annual landings of permitted species exceeded 100 pounds) (MLPAI 2010a).

Black rockfish: Black rockfish (*Sebastes melanops*), also known as blacksnapper and black bass, range from Amchitka Island, Alaska to Santa Monica Bay in southern California, but are uncommon south of Santa Cruz. Adults frequently occur in loose schools, 10 to 20 feet above shallow (to 120 feet) rocky reefs, but also may be observed as individuals resting on

rocky bottom or schooling in midwater over deeper reefs (to 240 feet). Tide pools have been identified as important nursery areas for juvenile black rockfish. They may attain a maximum length of 25.5 inches in California, although individuals over 20 inches are rarely observed. The average size observed in commercial and recreational fisheries is 14 to 15 inches in northern California. Black rockfish are an important recreational species, particularly in northern California and are a minor to moderate component of nearshore commercial fishery, with increasing importance north of San Francisco. The Eureka area accounts for 80–90% of all commercial landings in the "black rockfish" market category, which may contain other species, most commonly blue rockfish (MLPAI 2010a).

Monkeyface prickleback: The monkeyface prickleback (*Cebidichthys violaceus*) is a nearshore fish that makes up a relatively minor component of the recreational and commercial catch. The monkeyface prickleback ranges along the Pacific coast from San Quentin Bay in Baja California to central Oregon. It is most common off central California from San Luis Obispo County to Sonoma County, and is uncommon south of Point Conception. The species normally occurs in the intertidal zone, with a depth range extending from the high intertidal to a reported depth of 80 feet. Typical habitat for monkeyface prickleback includes rocky intertidal areas with ample crevices, boulders, and algal cover, including high and low tide pools, jetties and breakwaters, and shallow subtidal areas, particularly rocky reefs and kelp beds. A specialized recreational fishery by shore anglers fishing in rocky intertidal and shallow subtidal habitat exists for this species. The most common fishing method is "poke poling," which normally consists of fishing with a long bamboo pole, a short piece of wire, and a baited hook placed in front of or in holes or crevices in rocks. Skin and scuba divers also spear them (MLPAI 2010a).

Kelp and rock greenling: Kelp and rock greenling (*Hexagrammos decagrammus* and *Hexagrammos lagocephalus*) are members of the family *Hexagrammidae* that includes lingcod (*Ophiodon elongates*). They are abundant from Alaska's Aleutian Islands to central California but are occasionally seen as far south as La Jolla, in southern California. Kelp and rock greenling inhabit kelp beds and rocky reefs, but also are known to frequent sandy bottom areas; they are found subtidally to a depth of 150 feet (MLPAI 2010a).

Kelp and rock greenling are highly sought after by recreational anglers and support a minor commercial fishery. Shore-based recreational anglers take them from central to northern California, but they are more frequently targeted in the northern-most sections of the state. Between 1980 and 2006, shore angling accounted for 62% of all sport-caught kelp greenling in California. Current catch data from 2004 through 2006 show a continuation of low catch levels. Significant restrictions in regulations have occurred since the late 1990s that likely account for much of the observed decline. Because of a lack of life history data, no estimates of abundance are available for kelp greenling in California. The recreational kelp and rock greenling fishery is managed under the rockfish, cabezon, and greenling complex that includes sizes, bag, depth, and season restrictions (MLPAI 2010a).

Lingcod: Lingcod (*Ophiodon elongatus*) is the largest member of the *Hexagrammidae* family. Lingcod are found only off the West Coast of North America. They are distributed in nearshore waters from northern Baja California to the Shumagin Islands along the Alaskan Peninsula. Their center of abundance is off British Columbia, and they become less common toward the southern end of their range. Lingcod lack a swimbladder, and thus they rest on the bottom or actively swim in the water column. They are found over a wide range of

substrates at depths from 10 to 1,300 feet, but most occur in rocky areas from 30 to 330 feet. Typically, larger lingcod occupy rocky habitats; larger fish are found on deeper banks and reefs, whereas smaller ones live in shallower waters. Adult lingcod are strongly residential, tending to remain near the reefs or rocky areas where they live. Juveniles tend to disperse and travel over a wider range than adults (MLPAI 2010a).

The character of lingcod fisheries has changed greatly in the past 30 years. In the 1970s, about 85% of the commercially landed lingcod were caught with trawls, whereas hook-and-line gear now account for half of the commercial landings. A shift also has occurred in the lingcod fishery, away from commercial and towards recreational catches. Recreational landings as a percentage of total lingcod landings increased from 20% in the 1970s to about 50% in the late 1990s. The recreational fishery is regulated using seasonal and depth closures, a 22-inch minimum size, and a two-fish bag limit (MLPAI 2010a).

Vermilion rockfish: Vermilion rockfish (*Sebastes miniatus*), are found from the San Benito Islands, Baja California to Prince William Sound, Alaska, and occur over rocky bottoms from the shallow subtidal to 1,400 feet. Vermilion rockfish generally remain on the same reef system on which they settle during their first year. Tagging studies have shown no movement of fish at liberty for 1 to 3 years. Vermilion rockfish are extremely long-lived. The slow growth and long juvenile period make vermilion rockfish very susceptible to overfishing. In the Study Region, vermilion rockfish support a relatively minor commercial fishery and are targeted by recreational anglers. Vermilion rockfish co-occur with other overfished groundfish species, and therefore the sport fishery is managed using bag limits and seasonal and depth closures under the rockfish, cabezon, and greenling species complex (MLPAI 2010a).

Salmon: Of the five species of Pacific salmon found on the West Coast, Chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) are most frequently encountered off California. In 1992, PFMC began to severely curtail the ocean harvest of coho salmon in California because of the depressed condition of most coastal stocks. Following the federal listing of California coho stocks in 1996 and 1997, the NOAA Fisheries extended protective measures to a complete prohibition of coho retention off California. Chinook are the largest of the salmon species and support both recreational and commercial fisheries, although the commercial fishery was closed in recent years.

Chinook spend 2 to 5 years at sea before returning to spawn in their natal streams. The small percentage of Chinook that mature at age 2 are predominately males and are commonly referred to as “grilse,” or “jacks.” The older age classes of Chinook are composed of about equal proportions of males and females. Recovery of coded wire tags in ocean salmon fisheries has provided a better understanding of the temporal and spatial distribution of various Chinook stocks, particularly those from the Central Valley and Klamath Basin. For example, although Central Valley fall Chinook are distributed primarily off California and Oregon, they also are frequently recovered off Washington and British Colombia. Klamath River fall Chinook are more narrowly distributed, primarily between Cape Falcon, Oregon and Point Sur, California (MLPAI 2010a).

During the 1990s, a fishing technique known as mooching gained popularity among salmon sport anglers in California. Mooching is generally used when salmon are feeding on forage fish such as anchovies or herring in fairly shallow nearshore areas. When trolling, the hook

generally sets itself as the salmon attacks the moving prey, whereas during mooching, line is fed out to the salmon when it strikes to encourage the salmon to swallow the bait and hook. Ocean fisheries can have a significant impact on the average age of spawning Chinook because ocean-fishing gear often selects for larger, older fish. Ocean harvests of Chinook must be constrained to meet the spawning escapement goal of the Klamath River fall Chinook (MLPAI 2010a).

Through a Treaty Indian trust, the Yurok and Hoopa Valley tribes are entitled to 50% of the Klamath River fall Chinook harvest, which is calculated as a harvest equal to that taken in all nontribal fisheries (PFMC 2011b).

California halibut: Adult California halibut (*Paralichthys californicus*) range from the Quillayute River, Washington t o Almejas Bay, Baja California. California halibut inhabit soft-bottom habitats, in coastal waters generally less than 300 feet deep, with greatest abundance at depths of less than 100 feet. Adults spawn throughout the year, with peak spawning in winter and spring. Newly settled and larger juvenile halibut frequently are taken in unvegetated, shallow-water embayments and infrequently on the open coast, suggesting that embayments are important nursery habitats. In northern California, California halibut are targeted primarily by recreational anglers by hook-and-line. Although California halibut can be caught from shore, most are caught from boats. Currently, the recreational fishery is managed by using size and bag limits. Over the past century, abundance appears to have been cyclic, which may be because of a number of fishery-dependent and fishery-independent factors. However, protection of bay and estuarine habitats, on which juvenile halibut depend, is important to protect the health of this resource (MLPAI 2010a).

Pacific herring: Pacific herring (*Clupea pallasi*) are found throughout the coastal zone (waters of the Continental Shelf), from northern Baja California around the rim of the North Pacific Basin to Korea. In California, herring are found offshore during the spring and summer months, foraging in the open ocean. Beginning as early as October and continuing as late as April, schools of adult herring migrate inshore to bays and estuaries to spawn. Known spawning areas in California include San Diego Bay, San Luis River, Morro Bay, Elkhorn Slough, San Francisco Bay, Tomales Bay, Bodega Bay, Russian River, Noyo River, Shelter Cove, Humboldt Bay, and Crescent City Harbor. Pacific herring in California have been commercially harvested primarily for their roe, with small amounts of whole herring marketed for human consumption, aquarium food, and bait. The sac-roe fishery is limited to California's four largest herring spawning areas: San Francisco Bay, Tomales Bay, Humboldt Bay, and Crescent City Harbor. Herring abundance fluctuates greatly because of large variations in spawning, which may be tied to multiple events including changing ocean conditions (i.e., low primary productivity, increased temperature, and decreased upwelling), potential displacement by sardine populations, increased predation, and reduced recruitment. For many years, Humboldt Bay supported a small but successful fishery. However, with the observed decline in the spawning population, fishing efforts have declined (MLPAI 2010a).

True smelts: The true smelts of the family *Osmeridae* are small fishes found in cold coastal, estuarine, and freshwater habitats in the Northern Hemisphere. Seven of the 12 species of true smelts occur in California, but only two species (surf and night smelt) support both commercial and recreational fisheries. Surf smelt *(Hypomesus pretiosus)* are the most widely

distributed smelt in California but are only common north of San Francisco Bay. They are schooling, plankton-feeding fish that can reach 10 inches in length. Females typically grow the largest and live the longest (up to 5 years), while males rarely live longer than 3 years. The standard A-frame dip net used to catch this smelt is based on one used by Native Americans in the aboriginal fishery. About 95% of all commercial landings are taken with this gear; the other 5% are captured using purse seines, trawls, or beach seines. The fact that surf smelt *(Hypomesus pretiosus)* spawn on selected beaches at predictable times of the day and year has made them a favorite sport fish. The sport fishery also primarily uses an A-frame dip net and fishing techniques similar to the commercial fishery. Beach seines ("jump nets") up to 20 feet long (with mesh sizes of at least 7/8 inch) also are legal in the sport fishery, as are cast nets (Hawaiian throw nets). The sport catch limit for smelt is 25 pounds per day, a regulation that has been in place for many years (MLPAI 2010a).

Night smelt (*Spirinchus starksi*) range in distribution from Point Arguello in central California to Alaska. Like surf smelt, night smelt are schooling, plankton-feeding fish that are important prey for other fish as well as marine mammals and birds. They rarely exceed 6 inches in length or 3 years in age. Night smelt also are taken in large numbers, both in the commercial and sport fisheries, in much the same ways as surf smelt. Although night smelt are smaller in size and spawn only at night, they represent over 50% of the total commercial smelt landings (MLPAI 2010a).

Surfperch: The surfperch family (*Embioticidae*) are highly sought after, primarily by recreational anglers. As a group, surfperch was the second-most popular species group in terms of the number of fish landed (kept and/or released) by recreational anglers fishing California's ocean waters in 2006. Surfperch also support a comparatively minor hook-and-line commercial fishery. The redtail surfperch (*Amphistichus rhodoterus*) is the primary species taken by recreational beach anglers in northern California. Redtail surfperch are found along sandy beaches and near sources of food and cover, such as piers and jetties. Several species of surfperch prefer similar habitat, while others prefer rocky reefs or kelp beds. Surfperch usually are found in depths of 60 feet or less, with some species occurring as deep as 240 feet. Surfperch stay near the shoreline in relatively shallow water, making them vulnerable to coastal development and pollution (MLPAI 2010a).

Nearshore sharks: Nearshore sharks and rays (Class *Chondrichthyes*) occur in the nearshore zone and utilize bays and estuaries as nursery sites. These species tend to grow slowly, live many years, and have low reproductive rates. Anglers and commercial fishermen take a variety of nearshore sharks and rays throughout California. Many shark, skate, and ray species are taken as bycatch, and they are often discarded because of their low value. Although not targeted by anglers or commercial fishermen, the spiny dogfish probably makes up a significant amount of the bycatch in some fisheries. Bat rays are taken by anglers and commercial fishermen, and most often discarded. Leopard sharks are primarily found in bays, estuaries, and shallow nearshore waters, where they are targeted by anglers. Pacific angel sharks are found from southeastern Alaska to the Gulf of California and from Ecuador to Chile. Pacific angel sharks are bottom-dwelling species, found at depths of 3 to over 600 feet. They often are found in sandy, soft bottoms between rocky reefs. Pacific angel sharks eat mostly queenfish, blacksmith, and market squid. The Pacific angel shark fishery is regulated with gear restrictions and a minimum size limit. Declines in the Pacific angel shark, thresher shark, spiny dogfish, and soupfin shark fisheries were observed before effective management by the Department. Impacts to nearshore shark

populations, other than targeted fishery and bycatch, include loss of nursery habitat and illegal take of pups for marine aquaria trade (MLPAI 2010a).

Invertebrates

Red abalone: The red abalone (*Haliotis rufescens*) exists in a range extending from Oregon into Baja California. Red abalone is the largest abalone in the world, with a record maximum shell length of 12.3 inches. Red abalones inhabit intertidal and shallow subtidal areas in northern and central California. A clear distinction exists between juvenile and adult red abalone habitat, an indication that migration occurs as the abalone grow. Red abalone generally reach sexual maturity at a shell length of 5 inches, but they may become mature as small as 1.6 inches for females and 3.3 inches for males. A popular red abalone sport-only fishery is authorized to the north of the middle of the mouth of the San Francisco Bay only, where SCUBA has always been prohibited and commercial take was only allowed for a 3-year period during World War II. Shore picking and breath-hold diving are the only allowable recreational methods of take in the Study Region, which provides a deep-water refuge for red abalone stocks. The red abalone season is open from April through June, and August through November. The recreational fishery is managed by using a report card system, used to monitor take with a maximum daily limit of three and a yearly limit of 24 red abalone per person. Red abalone populations in northern California have supported a viable recreational fishery for decades. Although legal-sized adults (7 inches) are still relatively abundant, population and fishery data analyzed in 2001 revealed four trends that are of concern: concentration of fishery effort and increased take, evidence of poor recruitment, declines in deep-water stocks, and local depletion (MLPAI 2010a).

Red sea urchin: The red sea urchin (*Strongylocentrotus franciscanus*) is an echinoderm (along with sea stars) that feeds primarily on algae, including kelp. They are found from Baja California, Mexico to Alaska in relatively shallow water (low-tide line to 300 feet). Red sea urchins prefer rocky habitat near kelp and seaweeds. Sea urchins have been shown to reduce kelp abundance in certain areas, creating urchin barrens. This localized reduction in kelp abundance may affect local red abalone abundance. Red sea urchins are harvested for their roe, which is sold mostly as an export product. Statewide landings of red sea urchins in 2008 were 10.3 million pounds, with 2.6 million pounds landed in Fort Bragg. The statewide catch has remained in a relatively narrow range, from 10.3 to 14.0 million pounds since 2002. A small amount of recreational sea urchin take occurs in tide pool areas (MLPAI 2010a).

Dungeness crab: Dungeness crab (*Cancer magister*) range from the eastern Aleutian Islands, Alaska to around Santa Barbara; however, the species is considered rare south of Point Conception. Dungeness crab prefer sandy and sand-mud bottoms but may be found on almost any bottom type. They may range from the intertidal zone to a depth of at least 750 feet, but are not abundant beyond 300 feet. The Dungeness crab population off California, as demonstrated by tagging experiments, consists of five subpopulations, located in Avila-Morro Bay, Monterey, San Francisco, Fort Bragg, and Eureka–Crescent City. The latter three are commercially important. The Department's surveys indicate that the San Francisco and Fort Bragg sub-populations combined are smaller than the subpopulation extending from Eureka into Oregon. Little or no intermixing of the subpopulations occurs. Tagging studies also have demonstrated random movement by both sexes. At times, an inshore or offshore migration may be observed, but most movement is restricted to less than 10 mi. Movement

of up to 100 mi has been noted for individual males, but female movement appears to be much more limited (MLPAI 2010a).

The commercial fishery for Dungeness crab occurs from Avila in San Luis Obispo County to the California/Oregon border, with commercial and recreational seasons beginning in late fall and ending in early summer. Northern California fishing grounds extend from Fort Bragg to the California/Oregon border, with the prime area located between Eureka and Crescent City. Almost all of California's commercial Dungeness crab catch is landed in the trap fishery. Limited sport take of Dungeness crab occurs in central and northern California. The total annual recreational harvest is unknown, but it is believed to be less than 1% of the commercial take. The recreational fishery is managed through seasonal and area closures, gear restrictions, size limits, and a limit on the number of crabs that may be possessed. Either sex may be taken in the recreational fishery. In northern California, the size limit is 5.75 inches across the widest part of the carapace, and the bag/possession limit is ten crabs (MLPAI 2010a).

Clams: Primarily three types of clams (razor, gaper, and Washington) are targeted by recreational clammers in the Study Region. The Pacific razor clam (*Siliqua patula*) ranges from western Alaska to Pismo Beach, California and is generally found on flat or gently sloping sandy beaches with a moderate to heavy surf. Razor clam shells are long and thin, with fragile, shiny valves. Razor clams attain their maximum rate of growth during their first year of life. The growth rate remains high through the second or third year, after which it slows markedly. The largest razor clam on record in California was a 7-inch specimen, taken from Clam Beach in 1979 (MLPAI 2010a).

Beaches in Del Norte and Humboldt counties are some of the best places in California to take razor clams. Clam Beach and Crescent City both support similar fisheries, where beds are divided into north and south beaches with alternate year closures. In both areas, the northern beach was more heavily fished and more productive than the southern beach for many years. The El Niño events of the past two decades have had large storms associated with them, and this may have had some impact on northern California razor clam populations. The razor clam population in the Crescent City area is recovering, but the Clam Beach population is still much diminished from former levels. The recreational daily bag limit is ten per person (MLPAI 2010a).

Gaper clams are found from Alaska to Scammon's Lagoon, Baja California. Both the Pacific (*Tresus nuttalli*) and fat gaper (*Tresus capax*) live in fine sand or firm sandy-mud bottoms in bays, estuaries, and more sheltered outer coast areas. They are found from the intertidal zone to depths of at least 150 feet. The Pacific gaper is the most commonly taken gaper clam in California. A closely related species, the fat gaper, is the predominant gaper clam taken in Humboldt Bay, where it is very common in the intertidal zone. Gaper clams live to a maximum age of 17 years and can attain a length of 10 inches, with a weight of approximately 5 pounds. The fishery for Pacific gapers and the fat gapers is almost exclusively sport, although FGC allows these clams to be harvested commercially in Humboldt Bay. The Pacific and fat gaper support a significant sport fishery that takes place in intertidal areas of bays with sand and mud bottoms. Humboldt Bay is the largest gaper clam fishery in the state, where a take of 25 clams per day is allowed (MLPAI 2010a).

The range of the Washington clam is from Humboldt Bay, California to San Quentin Bay, Baja California. This species lives at depths of 12 to 18 inches in mud, sandy mud, or sand of bays, lagoons, and estuaries. Two principal species of Washington clam are harvested in California. The Washington clam (*Saxidomus nuttalli*) is the principal species sought, and the best-yielding localities include Humboldt Bay. The second popular Washington clam, the butter clam (*Saxidomus giganteus*), formerly known as the smooth Washington clam, is seldom taken south of Humboldt Bay. This clam is common enough to support a minor fishery in only one California locality, near Fields Landing in Humboldt Bay. Sport clammers in Humboldt Bay are permitted to take 50 Washington clams, in combination with no more than 25 gaper clams, per day (MLPAI 2010a).

Coastal Plants and Algae

Botanical gathering is an integral part of diet and medicine for the tribal communities in the Study Region (Tolowa Nation 2010). Tribes gather salmon berries, thimble berries, blackberries, strawberries, goose berries, sea apples, and water cress for subsistence. Additionally, tribal communities utilize grasses and branches of coastal trees for fishing, regalia, structures, and basket-making. Driftwood is used by tribes for smoking fish and mussels, structures, and boats (Noyo River Indian Community 2010).

A variety of marine algae provide habitats and food for invertebrates, fish, and marine mammals in the Study Region. Algae are photosynthetic organisms, varying from small, single-celled forms to multicellular forms such as kelp (Smithsonian National Museum of History 2011). Kelp forests provide shelter for red abalone that is popular with free divers in the Study Region. Some kelp, especially sea palm (*Postelsia palmaeformis*), kombu (*Laminaria* spp.), wakame (*Alaria margintina*), and nori (*Porphyra* spp.), is harvested for food for abalone farms as well as for human consumption. Appendix B provides more detail related to kelp harvesting.

Species Likely to Benefit from MPAs

The MLPA requires that plant and animal species that are likely to benefit from MPAs be identified in order to assist in the design on the MPAs and to prioritize monitoring efforts after the implementation of the MPAs (CDFG 2009). Species were considered if they met the following conditions:

- The species must occur in the Study Region;
- The species is subject to any of the following human disturbances:
  - taken directly or indirectly in commercial or recreational fisheries, targeted for research or collecting, or discarded in a fishery; and/or
  - suffers reduced survival or reproductive success as a result of human disturbance, such as trampling in tidepools or disturbance to breeding, roosting, or foraging sites; and
- The species is characterized by any of the following biological traits:

- Biomass or abundance would increase if particular habitats or locations are protected; and/or
- Adult home range is limited.

Species that met the preceding criteria were then further evaluated by the SAT according to the existing level of human disturbance, including overfishing and habitat degradation, and the biological/life history of each species, including larval distribution, lifespan, fecundity, and importance of the Study Region to overall distribution. Also, each species was ranked according to whether it is a species whose removal causes major ecological change, such as change to the food chain or biodiversity, or if it is a key species that characterizes a habitat type.

More details about the scoring criteria and a list of the species likely to benefit from MPAs in the Study Region are provided in Appendix D. The plants and algae, invertebrates, fish, seabirds, and marine mammals with high scores in the list of species likely to benefit have life history characteristics that make them more conducive to protection by MPAs, such as sedentary behavior, long life spans, slow growth, or associations with habitats that need additional spatial protection. An MPA would be expected to increase the species abundance or spawning biomass if the species were at an abnormally low abundance or abnormally low size frequency (i.e., below the range of natural fluctuations). The species that are likely to benefit from MPAs include ones that are overfished and ones that are currently abundant.

4.3.3 Aquatic Invasive Species

AIS, also known as nonindigenous, exotic, or alien species, are aquatic organisms that are introduced outside their native range. They reproduce rapidly and may threaten ecosystems, human health, and the economy (CDFG 2008b). AIS (such as the European green crab, Japanese eelgrass, Asian overbite clam, Quagga/Zebra mussel, New Zealand mudsnail, and wakame seaweed) have caused ecosystem disruptions and substantial economic impacts through displacement of native species and reductions in biodiversity in California. The primary methods of introduction to marine and coastal ecosystems in California are through ballast water and hull fouling from commercial shipping; other introductions occur through commercial fishing, recreational boating, and releases of aquarium species, bait, or aquaculture species (Ocean Protection Council 2010). The *California AIS Management Plan* is currently being implemented to prevent the introduction of AIS and identify policies and regulations to effectively manage AIS in marine and coastal ecosystems (CDFG 2008b).

The introduction of AIS into California has occurred for centuries and accelerated following the large influx of human settlement from the mid-nineteenth century to the present. Researchers have identified over 600 species that have been introduced into California's coastal and estuarine waters. These species cause damage through reduced diversity and abundance of native plants and animals, degraded wildlife habitat, decreased fishery production, impaired recreational uses, erosion and destabilization of shorelines, and loss of coastal infrastructure through fouling and boring organisms (CDFG 2008b).

Two of the most problematic AIS established in the Study Region are the European green crab (*Carcinus maenas*) and Japanese eelgrass (*Zostera japonica*). The European green crab

was first detected on the West Coast in the San Francisco Bay in the late 1980s, and likely arrived in seaweed packed with bait worms shipped from the Atlantic. Green crabs may prey on juvenile Dungeness crabs as wells as cultured oysters, clams, and mussels (CDFG 2008a). The European green crab is established in Humboldt Bay and associated sloughs (United States Geological Survey 2011).

Japanese eelgrass was first established in the 1950s in the Pacific Northwest, probably arriving as oyster packing material. It grows in dense mats on formerly bare mudflats. It was discovered in 2002 in Humboldt Bay. The eelgrass reduces habitat quality for feeding shorebirds and displaces native burrowing shrimp (CDFG 2008b).

Quagga (*Dreissena bugensis*) and Zebra mussels (*Dreissena polymorpha*) are two freshwater invasive species that have caused harm to California's aquatic ecosystem and can be transported by recreational boats from freshwater to the ocean. The Department has issued strict guidelines for recreational boaters to help prevent the spread of these AIS; however, the spread of these species is not known to have occurred in the Study Region (CDFG 2011b).

Understanding the pathways, or the means through which AIS are transported from one place to another, is essential to prevent their establishment and spread. AIS arrive in California through six general pathway categories: commercial shipping, commercial fishing, recreational equipment and activities, trade in live organisms, construction in aquatic environments, and water delivery and diversion systems. The most important pathway for the introduction of AIS in coastal environments is commercial shipping (CDFG 2008b), and this has accounted for one-half to three-quarters of AIS introductions to North America (CDFG 2008b). Commercial shipping can transport AIS through ballast water or hull fouling. Ballast water is taken on by otherwise empty shipping vessels to improve vessel stability, maneuverability, and propulsion. Live marine organisms are regularly transported from source to destination ports when ballast water is discharged. Hull fouling occurs when organisms with sedentary life stages, such as mussels, seaweed, anemones, and sea squirts, attach themselves to the hulls of vessels or become tangled in shipping gear. These organisms then can be transferred from the vessel to coastal waters, where they can become AIS. Recreational fishing vessels do not usually carry ballast water, but they can transport AIS on their hulls and through fishing gear, lines, tackles, and nets (CDFG 2008a).

State Lands currently operates a ballast water monitoring and monitoring program for commercial vessels in state waters. Presently, California is implementing the *California AIS Management Plan* to minimize the harmful ecological, economic, and human health impacts of AIS. The eight major objectives of the *California AIS Management Plan* are coordination and collaboration, prevention, early detection and monitoring, rapid response and eradication, long-term control and management, education and outreach, research, and laws and regulation. For example, the "prevention" objective to minimize and prevent the introduction and spread of AIS throughout California waters aims to identify high priority pathways and improve programs to address them, strengthen enforcement and inspection at entry points, and sustain the state's current ballast water management and proposed hull fouling control program (CDFG 2008a). As part of the recommendations in the laws and regulation objective of the *California AIS Management Plan*, existing policies and policy gaps in California's laws and regulations that manage AIS in marine and coastal ecosystems were identified in a 2011 report: *Managing Coastal Aquatic Invasive Species in California: Existing*

Policies and Policy Gaps (Muir 2011). The report highlights opportunities to create a strategic plan and integrated policy framework to manage and prevent the spread of AIS.

4.4 Impact Analysis

4.4.1 Methodology

Data and information about existing biological resources in the Study Region are compiled in the Regional Profile (MLPAI 2010a). The regulations governing the Proposed Project are shown in Table 2-1 in Chapter 2, "Project Description." Analysis of impacts on biological resources potentially resulting from these regulations was based on research of the effects that the removal of species would have on species populations and habitats.

The Proposed Project would not involve any construction or maintenance activities; therefore, biological resources would not be adversely affected directly through its implementation. The primary adverse effects could result from displacement caused by the prohibition of particular existing fishing activities. Several factors complicate the quantification of potential impacts on biological resources. The proposed MPA network would prohibit take of some species within an area of approximately 136 mi^2. The entire Study Region contains 1,027 mi^2. It is difficult to predict how far consumptive users would travel within the remaining 891 mi^2 of the Study Region, or even outside of the Study Region, and whether they would congregate in certain areas. Furthermore, this analysis cannot determine exactly how much fishing would be displaced. More information regarding how the evaluation of displacement was conducted is presented below.

As a result of these constraints, the approaches taken to evaluate impacts on biological resources in this analysis are as follows:

- Where available, this analysis incorporates projections of displacement to describe qualitatively the impacts on biological resources that could occur as a result of the Proposed Project.
- This analysis estimates the expected location and magnitude of potential impacts based on theoretical analysis from evaluations of existing MPAs in other regions. However, because the proposed MPA network is uncharacteristic of those that have been extensively studied, the comparisons are not conclusive.
- Spatial analysis was conducted through MarineMap, a web-based mapping tool that was developed to assist in the design of MPAs in the MLPA process, which contains oceanographic, biological, geological, and human-use spatial data, obtained by the Department for the Study Region. MarineMap provides qualitative tools to assist in the evaluation of proposed MPAs and MPA networks in relation to the goals of the MLPA (MLPAI 2011).

Evaluation of Displacement

One of the key issues identified by many participants involved in designation of MPAs is the displacement of fishing activities from protected to unprotected areas and the negative effects that may result from redirected fishing effort on fish populations outside of

protected areas. The key question regarding redirected fishing effort would be whether the expected increase in export of fish in all life stages from MPAs could compensate for the increased fishing pressure in areas outside MPAs. If export did outpace extraction, fishery yields should show a net increase or remain the same despite the displaced effort.

Assuming the same amount of fishing pressure in the Study Region before and after an MPA was established, the amount of fishing outside the MPA would increase in proportion to the size of the MPA for the species restrictions applied to the MPA. That is, the fishing that used to occur inside what is now an MPA would be distributed outside the MPA in the remaining nonprotected area in proportion to the size of the MPA. This can be simply calculated. If R is the fraction of area in MPAs within the Study Region, fishing intensity outside the MPAs would increase by a factor 1/(1–R). For example, if 13% of the habitat was closed to fishing in MPAs, the intensity of fishing outside would increase by 1/(1–0.13) = 1.15. That is, if the same number of users were fishing the same number of hours in the remaining 87% of the habitat, the fishing intensity would be 15% higher than before. In this example, in the short term, displacement would increase mortality rates outside the MPAs probably by 15%. However, if MPAs enhanced populations beyond their boundaries through movement of adults or young, these increases could be offset or eliminated by MPA benefits. The increased production within the MPA boundaries necessary to counter the increased fishing intensity outside can be calculated as well. The formula is 1+[1/(1–R)]. For the example above, the result equals 2.15. This means that production inside the boundaries of the MPAs would need to increase by a factor of 2.15 just to balance the added losses outside the MPAs. A higher level of production would be needed to help rebuild depleted populations, one of the goals of the MPLA. The relative time for the Proposed Project or alternatives to achieve the goals of the MLPA also would need to be considered in the impact analysis.

Adaptive Management and Its Role in Evaluating Effects

Adaptive management is a part of the MLPA (FGC, Section 2853[c][3]). The MLPA requires monitoring to determine whether its goals related to biological resources are being met. If the goals of the MPLA (see Chapter 2, "Project Description") are not being met, then either regulatory or management changes could occur to try and meet the goals. Adaptive management requirements were considered in the impact analysis where appropriate. More details regarding adaptive management requirements for the MLPA are discussed in Chapter 2.

4.4.2 Criteria for Determining Significance

The following significance criteria were used to evaluate the impact of the Proposed Project on biological resources. Would the Project:

A. have a significant adverse effect, either directly or through habitat modification, including the introduction of aquatic invasive species, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations by the Department or USFWS;

B. have a significant adverse effect on federally protected wetlands, as defined by the Clean Water Act, Section 404 (including marsh, vernal pool, and coastal

wetlands) through direct removal, filling, hydrological interruption, or degradation through other means;

C. interfere significantly with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

D. conflict with any local policies or ordinances protecting biological resources; or

E. conflict with the provisions of an adopted natural communities conservation plan, or other approved local, regional, or state habitat conservation plan.

4.4.3 Environmental Impacts

Impact BIO-1: Adverse Impacts on Marine Species Populations and Habitats Outside MPAs from Displacement and/or Congestion of Fishing Effort and Other Consumptive Uses Outside MPAs (Significance Criteria A)

This discussion focuses on the potential impact of the Proposed Project on species populations and habitats outside of the MPAs. Because the Proposed Project would limit or prohibit fishing within the boundaries of MPAs, any related fishing effort currently conducted within MPAs would be displaced. However, the MLPA process involved extensive input from stakeholders to avoid placing protected areas near the most popular fishing sites and access points and carefully placing them in such a way that would not lead to congestion of displaced fishing effort (for more details about public involvement in the North Coast MLPA planning process, see Section 6.6, "Environmental Justice"). Nonetheless, because some level of displacement would occur, this section evaluates the potential impacts of the Proposed Project.

A comprehensive review of over 100 no-take reserves worldwide shows that average production inside reserves increases by 400% (Lester et al. 2009). Scientists have found that as quantity and size of individuals inside reserves increase, spillover leads to enhanced stocks outside of protected areas (Harmelin-Vivien et al. 2008; Stobart et al. 2009). Adult spillover and/or larval export to neighboring fished areas could potentially lead to economic benefits to fisheries adjacent to reserve areas (Gaines et al. 2010). In anticipation of spillover, fishing activity may immediately become concentrated around MPAs, a tactic called "fishing the line" (Kellner et al. 2007). If fishing effort greatly increases on the boundaries of the protected areas, biomass and density could decrease outside of the reserve (Harmelin-Vivian et al. 2008). However, if this were to happen, it would most likely be a short-term effect because a gradual and continuous increase in production would be likely (Stobart et al. 2009).

Displacement of fishing effort could potentially cause increases in the incidence of bycatch and modification of habitat (e.g., through fishing gear) in those areas, especially if they became congested. However, the Proposed Project would restrict fishing in only 13.3% of the entire Study Region (see Table 2-2 in Chapter 2, "Project Description"). Furthermore, through the 3 years of MPA network design from 2009 to 2011, local communities were able to provide extensive input concerning the placement of MPAs in relation to popular fishing grounds. Consequently, for example, one of the reasons that the Proposed Project avoided placing an MPA within approximately 10 mi of the Crescent City Harbor was because stakeholders determined that substantial economic hardship would occur to the

local community if additional fishing restrictions were imposed in the vicinity of the harbor (North Coast Regional Stakeholder Group 2010).

Appendix B contains results of a qualitative analysis of the socioeconomic impacts of the Proposed Project. According to an evaluation of the most economically important commercial fisheries (anchovy/sardine, Dungeness crab, herring, rockfish, salmon, seaweed, shrimp, smelt, surfperch, and urchin) landed at six ports, the Proposed Project would affect less than 10% of the area commercially fished under baseline conditions (the number is slightly higher (11.8%) for the rockfish fishery in the Trinidad area). Impacts on recreational fisheries would be most notable for rockfish, surfperch, and urchin commercial fisheries, although in all but a few cases (the Dungeness crab fishery in the Fort Bragg area and the California halibut fishery in the Trinidad area), the area affected would be less than 15% of the total area fished (see Appendix B for more details). A substantial number of the recreational and commercial fisheries either do not occur in the Study Region or would not be affected under the Proposed Project. The Proposed Project is contained within the 3-mile limit which defines the state's waters. There are many important fisheries in state waters outside of the proposed MPAs and in federal waters. If one considers the greater extent of fisheries out to 50 miles, then the proportion affected by the MPAs is much less.

Furthermore, the Proposed Project would create a network of MPAs within a certain distance from one another, according to scientific guidelines (CDFG 2008a). This approach of placing emphasis on size and spacing of protected areas could result in benefits not yet realized in most other protected areas because many existing MPAs are small and isolated (Gaines et al. 2010). Empirical data of a network such as that of the Proposed Project does not yet exist.

The Proposed Project options would produce similar findings. Boundary changes in the Pyramid Point state marine conservation area (SMCA), Ten Mile Beach SMCA, and Sea Lion Gulch state marine reserve (SMR) would not result in discernable differences through the projected models. The optional change to the Reading Rock SMR would only add the addition of noncommercial take by tribes, which is allowed under baseline conditions. The option for the South Humboldt Bay state marine recreational management area (SMRMA) would enlarge the protected area; however, methods used for displaced estuarine fishing would most likely not cause adverse effects to areas outside of the protected area. The option for this area also would include regulations to allow for dredging and other maintenance activities that could be harmful to habitats outside of the MPA, but those could be offset by the allowance of habitat restoration. The options for Double Cone Rock SMCA, Big River Estuary SMCA, and Navarro River SMCA would add additional allowances for take of some species; thus, the Proposed Project options would result in a slightly reduced displacement effects compared to the Proposed Project.

In conclusion, the Proposed Project could increase biomass, individual size, and reproductive potential of marine species, particularly for species with low dispersal and high reproduction. The broad-scale ecosystem protection afforded to habitats within the proposed MPAs can also lead to increased resilience, further protecting biodiversity and associated ecosystem services. The Proposed Project includes all habitat types in all bioregions, encompassing at least some portion of the ranges of most species of interest. The Proposed Project could help sustain various fished populations and provide areas of significantly higher reproductive capacity. Increased reproduction within the proposed

MPAs may lead to long-term fisheries benefits outside their boundaries. In addition, monitoring of the areas outside of the proposed MPAs may indicate whether ecological issues are arising related to displacement, and whether adaptive management measures could alleviate such issues, should they arise. Over the long term, the negative impacts of the displacement of fishing effort, if they were to occur, would be outweighed by the positive benefits of MPAs. Therefore, this impact would be less than significant.

Level of Significance: *Less than Significant*

Impact BIO-2: Adverse Impacts on Marine Species through the Introduction or Spreading of Aquatic Invasive Species (Significance Criterion A)

This discussion evaluates the potential for the proposed MPAs to lead to the introduction of, or exacerbate issues related to, AIS. Several known pathways of AIS exist: ballast water, hull fouling, and releases of aquarium species, bait, or aquaculture species. The Proposed Project would not directly implement activities that would introduce AIS to the Study Region. However, introduction of AIS could occur as an unintended result of increased fishing effort and related vessel traffic in unprotected areas, or increased nonconsumptive vessel traffic within the MPAs.

AIS are a serious threat to marine ecosystems. They can be easily dispersed by currents, tides, and other water flows, and they can devastate the environment and economy (CDFG 2008b). The role of ballast water from ocean-going commercial vessels in introducing and spreading AIS is well-understood and regulated; however, other pathways of AIS, such as recreational vessels and gear, are not regularly monitored for AIS unless as a reactive measure like that of the Quagga/Zebra mussel invasion in southern California. Furthermore, a need remains for a better understanding of the biology of AIS, including the effects of competition with native species. Therefore, research and monitoring would be important for the control of AIS (refer also to Section 6.4, "Research and Education," for more details about ongoing scientific research related to the Proposed Project). Particularly of note, a review of monitoring sites listed on MarineMap shows that the following proposed MPAs would be adjacent to existing sites where biodiversity surveys, including identifying AIS, are conducted on a regular basis:

- Mattole Canyon SMR
- Ten Mile SMR
- Point Cabrillo SMR
- Russian Gulch SMCA
- Van Damme SMCA

Additionally, in the event that vessel traffic increased in unprotected areas, a number of monitoring sites would be in between the following proposed MPAs:

- Point St. George Reef Offshore SMCA and Reading Rock SMCA/SMR
- Reading Rock SMCA/SMR and Samoa SMCA
- Big Flat SMCA and Double Cone Rock SMCA

- Van Damme SMCA and Navarro River Estuary SMCA

The proposed MPAs are expected to reduce the forces that impair the functioning of naturally balanced ecosystems. Scientists have found that the more diverse a marine community is, the better it can protect itself against invasion by nonnative species (Stachowicz et al. 2002). Much of the existing research on native community resilience to invasive species has been conducted on terrestrial plants. In the marine environment, high levels of native species richness and density in a location have been shown to result in limited resources, specifically space, for the establishment of invasive species; however, in some instances, such as when sessile invertebrates are plentiful, they can actually facilitate the attachment of nonindigenous sessile species (Stachowicz and Byrnes 2006). The MLPA requires monitoring and adaptive management (CDFG 2008b); therefore, if it were found that an increase in the spread of AIS was occurring as a result of the Proposed Project, a mechanism would be in place for evaluation and corrective action.

In addition to existing regulations controlling ballast water, several plans and regulations would be in place to control the spread of invasive species. The primary goals of the *California AIS Management Plan* are research, prevention, and early detection; thus, if implemented, regulations recommended by the *AIS Management Plan* would be proactive. On a local scale within Humboldt Bay, the *Humboldt Management Plan* includes measures for the control and removal of AIS (Humboldt Bay Harbor, Recreation, and Conservation District 2007). Although a risk would exist for an increase in AIS from the Proposed Project in particular locations, measures exist and would continue to be implemented for monitoring, evaluating, and controlling AIS. In addition, no evidence suggests that the Proposed Project would exacerbate AIS overall. For these reasons, this impact would be less than significant.

The Proposed Project options would produce similar findings. Boundary changes in the Pyramid Point SMCA, Ten Mile Beach SMCA, and Sea Lion Gulch SMR would not result in discernable differences through the projected models. The optional change to the Reading Rock offshore SMR to an offshore SMCA would only add the addition of noncommercial take by tribes. To reach this area, tribal members would need to travel by boat a minimum of 0.5 mi. The risk of spreading AIS into the MPA would be present only if AIS were attached to a boat used by tribal members. Traveling this distance in traditional vessels is not currently known to be conducted by tribes near the Study Region. See Chapter 5, "Cultural Resources," for further discussion. The option for the South Humboldt Bay SMRMA would enlarge the protected area, so a chance of increased spread through nonconsumptive boating would exist; however, the Humboldt Bay Harbor, Recreation and Conservation District already conducts extensive monitoring inside the Bay, thus any significant presence of AIS would likely be discovered and would be controlled to the extent feasible. The options for Double Cone Rock SMCA, Big River Estuary SMCA, and Navarro River SMCA would add additional allowances for take of some species, thus slightly increasing consumptive recreational vessel traffic and the threat of AIS. None of the options would change the Proposed Project's regulations for commercial fishing, a well known pathway for AIS.

The Proposed Project and the Proposed Project options would not result in adverse impacts on marine species through the introduction or spreading of AIS; therefore, this impact would be less than significant.

Level of Significance: *Less than Significant*

Impact BIO-3: Adverse Impacts on Marine Species Populations and Habitats Inside MPAs from the Removal of a Human Predator (Significance Criterion A)

This impact section evaluates potential adverse changes in the community structure through the prohibition of take of certain species. By prohibiting take of certain species by humans, the Proposed Project would restore protected areas to a more natural ecosystem. This would lead to the return of unaltered predator-prey relationships. However, although this is the expected result of the Proposed Project, other factors could prevent this from happening. For instance, if an overfished predator species failed to recover, prohibiting take of its prey could lead to an increase in its population, setting the natural ecosystem off-balance.

Of particular concern in the Study Region would be the removal of humans as predators of red sea urchins (*Strongylocentrotus franciscanus*). Evidence shows that kelp forests have declined in certain areas as a result of urchin grazing on macroalgae (Behrens and Lafferty 2004; Nichols 2009; MLPA SAT 2010). Such a localized reduction in kelp abundance may consequently negatively affect the abundance of other marine species that are associated with macroalgae (MLPA SAT 2010). Human take of red sea urchins may help alleviate these effects by helping to reduce or contain urchin populations.

Red sea urchins are an economically important commercial fishery in the Study Region. In 2008, 2.6 million pounds of red sea urchins were landed in Fort Bragg. The red urchin is the only urchin species taken commercially in California waters; another abundant urchin species, the purple sea urchin (*Strongylocentrotus purpuratus*), is not commercially viable and is not directly targeted (MLPA SAT 2010). An additional small amount of recreational take of red sea urchins occurs in tide pool areas (MLPAI 2010a). According to records of urchin landings between 2003 and 2008 (MLPAI 2011), the following popular sites for take of urchins would be restricted by the Proposed Project:

- Double Cone Rock SMCA (southern border)
- Ten Mile SMR
- Ten Mile Beach SMCA (northern border)
- Point Cabrillo SMR
- Big River SMCA
- Navarro River Estuary SMCA

However, the Proposed Regulations for MacKerricher SMCA, Russian Gulch SMCA, and Van Damme SMCA would allow for the take of urchins.

The prohibition of urchin take in some protected areas could result in an increase in urchin populations in these areas as well as dispersal to adjacent areas. The relationship between urchins, algae, and abalone is complex; however, it is expected that the proposed MPAs would become more naturally balanced ecosystems that could be more resilient to urchin barrens.

Although a potential would exist for restriction of the take of urchins to result in increased urchin populations in some of the proposed MPAs as well as reductions in urchin predators from increased fishing pressure outside of these locations, other evidence suggests that this would not be a likely outcome. Adult sea urchins are eaten by several predators on shallow rocky reefs in the Study Region, including the wolf eel (*Anarrhichthys ocellatus*) and sunflower sea star (*Pycnopodia helianthodes*). Small sea urchins are eaten by other predators (e.g., other sea stars, crabs, and other species). Sunflower sea stars, in particular, have been shown to be important in controlling urchin populations in cold water ecosystems; and they are not a fishery target, so their natural populations are likely remain high in the Study Region where sufficient prey exist (MLPA SAT 2010). In addition, reports have shown that sea urchins in high densities may tend to have high mortality from disease (Behrens and Lafferty 2004). Little evidence suggests that unfished urchin populations would create urchin barrens in the Study Region (MLPA SAT 2010). In addition, the Proposed Project would include monitoring and adaptive management measures that could alleviate such issues, should they arise. For these reasons, an adverse impact relative to marine species population from the removal of human predators would be less than significant.

The Proposed Project options would result in an identical level of impact in response to the prohibition of take of red sea urchin in some of the proposed MPAs. The only MPA with a proposed option that is an area where urchin take would be an issue is the Ten Mile Beach SMCA. Although the proposed option would involve extending the southern boundary of the SMCA, significant urchin take has only been recorded north of the area where the additional protection would take place.

The Proposed Project and the Proposed Project options would not result in adverse impacts on marine species populations and habitats inside MPAs from the removal of a human predator; therefore, this impact would be less than significant.

Level of Significance: *Less than Significant*

Impact BIO-4: Adverse Impacts Causing Loss or Degradation to Wetlands or Other Sensitive Habitat (Significance Criterion B)

Coastal marshes, estuaries, and lagoons characterize the highly productive wetland ecosystems in the Study Region. Wetlands, as described in regulations of the U.S. Army Corps of Engineers (33 CFR Part 328.3[b]), are a subset of waters of the U.S., and include vegetated areas that are frequently inundated or saturated, such that they support plant communities adapted to saturated soil conditions. Although the majority of the Study Region has sandy and rocky intertidal habitats and open ocean, certain areas (such as the peripheries of lagoons and salt marshes) support wetlands that meet the federal regulatory definition. The following proposed MPAs would include wetland areas:

- South Humboldt Bay SMRMA
- Ten Mile Estuary SMCA
- MacKerricher SMCA
- Big River Estuary SMCA
- Navarro River Estuary SMCA

The Proposed Project would not require any hydrologic modification to wetlands, such as dredging or fill, so it would not have a negative impact on federally protected wetlands. Furthermore, the proposed regulatory changes would not eliminate, replace, or supersede the existing federal and state protections governing wetland areas, such as the CWA, Porter-Cologne Act, or applicable sections of the FGC. Existing requirements governing discharges of fill material or pollutants into wetlands would remain effective, and federal and state permits for these activities would continue to be required after adoption of the Proposed Project.

The Proposed Project would support and/or add additional protection to the wetland areas listed above. The following proposed MPAs include wetlands and would increase take restrictions beyond current regulations: South Humboldt Bay SMRMA, Ten Mile Estuary SMCA, and Navarro River SMCA; they would prohibit take of all living marine resources except recreational take of waterfowl, in accordance with existing waterfowl regulations. MacKerricher SMCA would prohibit take of kelp (in a larger area than the existing MacKerricher SMCA). Big River Estuary SMCA would prohibit take of all living marine resources except the recreational take of Dungeness crab by hoop net or hand and waterfowl. Increasing take restrictions in these areas would be expected to improve wetlands or other sensitive habitat, and thus would benefit these resources.

The Proposed Project options would vary slightly in protection afforded to wetlands, compared to the Proposed Project. Specifically, the South Humboldt Bay SMRMA would extend east across the South Bay. This would protect a larger area from take of biological resources; however, this proposed option would allow existing dredging and other maintenance activities to continue that could degrade the wetlands. Any damage caused by maintenance activities could be balanced by the allowance by the proposed option for habitat restoration activities. The other proposed options would increase protections in wetlands. As such, no adverse impacts would occur.

Level of Significance: *No Adverse Impact*

Impact BIO-5: Impacts on Marine Species Populations and Habitats within MPAs (Significance Criteria A and C)

The MLPA Master Plan (CDFG 2008a) mandates that MPA networks should include representation of a variety of marine habitats, and each of these habitats should be represented in multiple MPAs across biogeographical regions, upwelling cells, and environmental and geographical gradients. The strong association of bottom-dwelling marine species with particular habitat types and variation in species composition across latitudinal and depth inclines leads to the conclusion that habitat types would need to be represented across each of these larger environmental gradients to capture the large range of biodiversity in California's waters. As a result, protection of all the key habitats along the California coast are a critical component of the MPA network. Each habitat type provides particular ecological services by harboring a different set of species or life stages, having special physical attributes, or being used in ways that differ from the use of other habitats. Key habitat types considered in design of the proposed MPA network are:

- sand beach
- rocky intertidal

- estuary
- shallow sand
- deep sand
- shallow rock
- deep rock
- kelp
- shallow canyon
- deep canyon

Only 0.3% (3 mi^2) of the Study Region is designated as MPAs, and all existing MPAs are in the southern portion of the Study Region; thus, they mostly contain similar physical conditions. The existing MPAs include a relatively shallow depth range of zero to 184 feet, less than 2 mi of beach, less than 8 mi of rocky shores, and less than 1 mi^2 of each classification of bottom type (see Chapter 2, "Project Description" for more details about the existing MPAs). The Proposed Project would increase the amount of protected area to 13.3% (136 mi^2) of the Study Region (see Table 2-4, in Chapter 2, for sizes of the individual proposed MPAs). Table 2-5 shows the amounts of different key habitat types represented by the Proposed Project. The entire proposed network of MPAs in the Study Region would include 20 mi of beaches, 25 mi of rocky shores, almost 6 mi of coastal marsh, and a variety of hard- and soft-bottom habitats at different depths.

The rationale for each proposed MPA and Special Closure in the Proposed Project are shown in **Table 4-9**. Special Closures are not MPAs, but they are small locations that protect sites such as breeding areas for seabird and marine mammal populations (see Chapter 1, "Introduction," for more detail). The regulations for Special Closures may restrict human activities including access. Some are year-round closures and others are only closed for part of the year, such as during the breeding season for particular species.

Table 4-9. Habitats and Species in the Proposed Project

MPA Name	Bioregion	Species and Habitats Protected
Pyramid Point SMCA	Northern	Large offshore rocks support Aleutian Canada geese and breeding birds, including some of California's only breeding Fork-tailed Storm-Petrels and Tufted Puffin, a large rookery of Great Blue Heron, Snowy Egret (farthest north in the western U.S.) and Black-crowned Night-Heron. Contains shallow rocky reef important for nearshore rockfish and captures 14 mi^2 of foraging habitat for pinnipeds and cetaceans. Captures beach, rocky shore and offshore rocks, and 0-30m soft replicates.
Point St. George Reef Offshore SMCA	Northern	Contains the only offshore banks north of Point Reyes in state waters. Designed to capture replicates for 30-100m hard, 30-100m soft, and extremely rare 100-3,000m soft habitats.
Reading Rock SMR	Northern	Clustered with Reading Rock SMCA with beaches, rocky shores and soft 0-30 m habitat replicates, and is adjacent to Redwood National and State Park lands. Designed to protect both fish species and marine mammals. Captures soft 30-100 m habitat and hard 30-100 m habitats.

Table 4-9. Habitats and Species in the Proposed Project

MPA Name	Bioregion	Species and Habitats Protected
Reading Rock SMCA	Northern	Adjacent to Redwood National and State Park lands. Designed to protect both fish species and marine mammals. The California sea lion, Pacific Harbor seal, and Steller sea lion use rocky outcroppings in this area as a haulout. Captures beaches, rocky shores and soft 0-30 m habitats and is clustered with the Reading Rock SMR, which captures soft 30-100 m and hard 30-100 habitats.
Samoa SMCA	Northern	Necessary to meet beach habitat spacing and replication guidelines. Captures beaches, soft 0-30m and soft 30-100m habitats.
South Humboldt Bay SMRMA	Northern	Protects sensitive eelgrass habitat as well as coastal marsh, mudflats and channels that provide habitat for rays and leopard sharks.
South Cape Mendocino SMR	Northern	Capture a wide range of biodiversity habitats, and designed to protect bird and pinniped colonies. The California sea lion and Pacific Harbor seal use rocky outcroppings in this area as a haulout. It captures rocky shores, hard 30-100m and soft 0-30m habitat replicates.
Mattole Canyon SMR	Northern	Captures a variety of diverse habitats including upwelling zones, submarine canyons, offshore reef structures, and improves research opportunities provided by marine ecosystems that are subject to minimal human impacts.
Sea Lion Gulch SMR	Southern	This replaces an existing MPA (SMR) at Punta Gorda with a larger SMR. Captures a wide range of biodiversity habitats and designed to protect bird colonies. Also designed to provide research opportunities. The Steller sea lion uses rocky outcroppings in this area as a haulout. Very remote area with limited human usage.
Big Flat SMCA	Southern	Captures rockfish habitat. The Steller sea lion uses rocky outcroppings in this area as a rookery and haulout. The Pacific Harbor seal uses this area as a haulout as well.
Double Cone Rock SMCA	Southern	Captures rocky shore habitat. Designed to protect a high diversity of benthic species, including both hard bottom and soft bottom communities. It is a rarely visited remote area. An important crab and salmon area, it is the only preferred sized MPA in the southern bioregion.
Ten Mile SMR	Southern	Captures rocky shoreline, beaches, offshore islets, surf grass, kelp beds, hard and soft substrates, and is designed to protect estuarine communities. The reserve also includes Pacific Harbor seal haulouts and rookeries, and critical nesting and breeding bird habitat.
Ten Mile Beach SMCA	Southern	Captures soft bottom habitat. Connects the estuarine MPA to the offshore SMR.
Ten Mile Estuary SMCA	Southern	Designed to protect fish and bird communities associated with areas of diverse estuarine habitat, larval source, and enhances reproductive capacity of numerous invertebrate species. Designed to protect spawning and nursery grounds for populations that are found offshore. Also captures prime shorebird and waterfowl habitat, feeding areas for pinnipeds, as well as a habitat and transportation corridor for river otters.
MacKerricher SMCA	Southern	This is an existing MPA proposed to be retained and modified to simplify boundaries and take regulations. The Pacific Harbor seal uses rocky outcroppings in this area as haulouts and rookeries

Table 4-9. Habitats and Species in the Proposed Project

MPA Name	Bioregion	Species and Habitats Protected
Point Cabrillo SMR	Southern	The rapid depth drop-off close to shore, and the presence of urchin, abalone, kelp and other marine species, presents unique underwater features that have been studied by the Department for over 20 years. The Pacific Harbor seal uses rocky outcroppings in this area as haulouts and rookeries
Russian Gulch SMCA	Southern	This is an existing MPA proposed to be retained and modified to simplify boundaries and take regulations.
Big River Estuary SMCA	Southern	Designed to protect fish and bird communities associated with areas of diverse estuarine habitat, larval source, and enhance reproductive capacity of numerous invertebrate species. Designed to protect spawning and nursery grounds for populations that are found offshore. Also captures prime shorebird and waterfowl habitat, feeding areas for pinnipeds, as well as a habitat and transportation corridor for river otters.
Van Damme SMCA	Southern	This is an existing MPA proposed to be retained and modified to simplify boundaries and take regulations.
Navarro River Estuary SMCA	Southern	Designed to protect fish and bird communities associated with areas of diverse estuarine habitat, larval source, and enhance reproductive capacity of numerous invertebrate species. Protects spawning and nursery grounds for populations that are found offshore. Also protects prime shorebird and waterfowl habitat, feeding areas for pinnipeds, as well as habitat and transportation corridor for river otters.
Special Closures		
Southwest Seal Rock Special Closure	Northern	Designed to protect an important Steller sea lion breeding and haulout site from vessel disturbances. Steller sea lions are listed as threatened under the Federal ESA and are a California species of special concern and are known to breed on Año Nuevo, San Miguel and Farallon islands, Southwest Seal Rock and Sugarloaf Island.
Castle Rock Special Closure	Northern	Designed to protect bird colonies and pinnipeds inhabiting the largest and most structurally diverse nearshore island in California. Eleven species of birds breed on the 14-acre Castle Rock National Wildlife Refuge, including 3 special status species, and the island is a primary staging area for the fully recovered Aleutian Canada Goose. Two of the 4 pinniped species known to regularly inhabit Castle Rock NWR also breed on the island. This area was identified by the SAT as a hot spot bird breeding location.
False Klamath Rock Special Closure	Northern	Designed to protect approximately 45,000 breeding and roosting birds from vessel disturbances and disturbance by humans during low tides. This rock is part of a larger colony that is of global importance. Breeding species known to utilize False Klamath Rock include Black Oystercatcher, Brandt's Cormorant, Common Murre, Double-crested Cormorant, Pelagic Cormorant, Pigeon Guillemot, Tufted Puffin (species of special concern), and Western Gull. This area was identified by the SAT as a hot spot marine bird breeding location.
Sugarloaf Island Special Closure	Northern	Designed to protect an important Steller sea lion breeding and haulout site from vessel disturbances. This island also supports eight species of breeding birds, including Tufted Puffin. This area was identified by the SAT as a hot spot for marine mammals because of the Steller sea lion rookery.

Table 4-9. Habitats and Species in the Proposed Project

MPA Name	Bioregion	Species and Habitats Protected
Steamboat Rock Special Closure	Northern	Designed to protect breeding birds, including Brandt's Cormorant, Common Murre, Pigeon Guillemot and Western Gull. The island supports approximately 10,000 breeding birds. This area was identified by the SAT as a hot spot marine bird breeding location.
Rockport Rocks Special Closure	Southern	Designed to protect breeding birds including Black Oystercatcher, Brandt's Cormorant, Common Murre, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet and Western Gull. Works together with Vizcaino Rock Special Closure with approximately 11,500 breeding birds in the complex. These small islands support more than 2,500 nesting seabirds. This area was identified by the SAT as a hot spot marine bird breeding location.
Vizcaino Rock Special Closure	Southern	Designed to protect breeding birds including Black Oystercatcher, Brandt's Cormorant, Common Murre, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet and Western Gull. This special closure supports approximately 8,800 breeding birds. Works together with Rockport Rocks Special Closure with approximately 11,500 breeding birds in the complex. This area was identified by the SAT as a hot spot bird breeding location.

Note: m = meter(s), mi^2 = square statute mile(s), MPA = marine protected area, NWR = National Wildlife Reserve, SAT = Science Advisory Team, SMCA = state marine conservation area, SMR = state marine reserve, SMRMA = state marine recreational management area

Source: MLPAI 2010b; MLPAI 2010c

The SAT identified two bioregions that characterize the MLPA Study Region; the Mattole River divides the two bioregions (MLPA SAT 2010). Evaluation of habitat types represented in the different bioregions helps assess if proposed MPAs would include adequate quantities of the marine communities and species diversity that exist in the Study Region. The Proposed Project would include 77 mi^2 in the Northern Bioregion and 59 mi^2 in the Southern Bioregion. Therefore, an increase in protection would occur in a wide range of habitats.

Many species require different habitats at different stages of their life cycle. For example, nearshore species may occur in offshore open ocean habitats during their larval phase (CDFG 2008a). The exchange of larvae among MPAs is a fundamental biological rationale for MPA networks. Movement out of, into, and between MPAs, by juveniles, larvae, eggs, or spores of marine species depends on their dispersal distance. As with adult movement patterns, the dispersal of juveniles, larvae, and eggs varies enormously among species. Some move very little distance, while others disperse great distances.

The proposed MPAs only would be connected through the dispersal of young if they were close enough together to allow movement from one MPA to another. Any given spacing of MPAs would undoubtedly provide connectivity for some species and not for others. The Proposed Project would minimize the number of key or threatened species that would be left isolated by widely spaced MPAs (CDFG 2008a). Thus, protection of these habitats, as well as protective networks that would ensure connections between habitats, could likely be critical to MPA success. A lack of conclusive empirical data is available because most

existing reserves are limited by their size and isolation and cannot achieve this goal (Gaines et al. 2010).

Although numerous species could benefit from the prevention of further degradation of the marine ecosystem, studies have shown that the largest conservation gains come from protecting populations that are naturally abundant but have been historically overfished (Gaines et al. 2010). According to the SAT, overfished groundfish populations in particular could increase as a result of implementation of the Proposed Project (MLPA SAT 2010). In contrast, as the natural ecosystem is restored in the protected areas, some species may decrease if the number of their predators increased (see discussion under Impact BIO-3).

During the planning process for the Proposed Project, the SAT classified proposed MPAs by the level of protection (LOP) that they would provide to biological resources. Table 2-1 shows LOPs of the proposed MPAs. SMRs would provide the highest level of protection; however, great variation would exist in the type and magnitude of activities that may be permitted in SMCAs and SMRMAs. Because of limited time and resources for analysis by the SAT, assignments of LOP are limited to removal of species either directly or indirectly through incidental take. The LOPs do not include non-fishing activities, such as mortality from pollutants sources or entrainment from power plants, both of which are known to cause adverse impacts. This could result in misleading classifications of levels of protection statewide (CDFG 2008a). Additionally, several of these classifications do not reflect the gear limitations, and as such may overstate the amount of fish that would be likely to be taken in some of the MPAs. In total, six of the 20 proposed MPAs were identified as offering very high levels of protection, according to the SAT classifications.

The Proposed Project would protect a significant amount of key habitat types for a diversity of species in the Study Region. Threatened and endangered species are currently protected by state and federal regulations; the Proposed Project would add additional protection to their habitats, nursery sites, and migration corridors. The proposed MPAs and Special Closures would benefit, through reduced incidence of accidental take and through habitat protection, many species identified as a candidate, sensitive, or special status species in local and regional plans and state and federal regulations. The MPA network would potentially protect movement corridors of native and migratory wildlife. The Special Closures, in particular, were designed to protect a number of nursery and nesting sites for native and migratory species. As a result, the Proposed Project would result in beneficial effects on species populations, habitats, movement corridors, and nursery/nesting sites inside MPAs.

Likewise, the Proposed Project options would also benefit species and habitats inside the MPAs. The options would extend the boundaries of several of the MPAs (Pyramid Point SMCA, South Humboldt Bay SMRMA, Sea Lion Gulch SMR, and Ten Mile Beach SMCA) so that they would be more easily distinguishable; thus, they could improve in compliance with the regulations. The option for Reading Rock SMR would allow take by tribes. This would provide less protection from tribal take for the species inside this MPA; however, regulations would be the same as under the Proposed Project for nontribal take.. The Double Cone Rock SMCA option would remove the restriction of take of some species from boats or floating devices; thus, this option would benefit species and habitat inside the MPA less than the Proposed Project. The Big River Estuary SMCA option would add the prohibition of take of waterfowl, making this option more protective than the Proposed

Project. The Navarro River SMCA option would add the allowance of take of salmon and reduce the amount of species protection inside the MPA.

Overall, the Proposed Project would provide protection for, and have no adverse impacts on, species populations and habitats inside MPAs.

Level of Significance: *No Adverse Impact*

Impact BIO-6: Impacts on an Adopted Natural Communities Conservation Plan, Conservation Habitat Conservation Plans, or Local, Regional, State, or Federal Policies or Ordinances for the Protection of Biological Resources (Significance Criteria D and E)

The majority of the Study Region includes offshore state waters that do not fall within the jurisdiction of local governments. No natural communities conservation plans or habitat conservation plans exist for the Study Region, so these are not discussed further. However, some areas of the Proposed Project overlap with local plans and ordinances in lagoons and estuaries. Many of the proposed MPAs would be adjacent to beaches that are within state, county, or local jurisdictions (see Section 6.1, "Land Use," and Section 6.3, "Recreation," for more details concerning the impact of the Proposed Project on adjacent parks and beaches). Additionally, the Study Region has a long history of fishing. Consequently, over the years many state policies and plans have been implemented for the protection of fish and wildlife in the Study Region.

Currently, five MPAs are in the Study Region. The Proposed Project would extend the boundaries of four existing SMCAs (MacKerricher, Point Cabrillo, Russian Gulch, and Van Damme). It would remove protection currently provided by the Punta Gorda SMR. Instead, it would designate larger areas directly north and south of Punta Gorda as SMRs (Mattole Canyon SMR and Sea Lion Gulch SMR). Additionally, the Humboldt Bay NWR includes an existing conservation plan on lands that are adjacent to two of the proposed MPAs (Samoa SMCA and South Humboldt Bay SMRMA) and one of the special closures (Castle Rock Special Closure). Although the Proposed Project does not overlap the land protected by the Humboldt Bay NWR, the Proposed Project would complement the conservation efforts of these conservation plans.

Table 4-10 identifies existing regulations and plans within the areas of the individual MPAs of the Proposed Project and shows the consistency of the regulations for the proposed MPAs. The regulations for the Proposed Project are shown in Table 2-1. In all areas except for the Punta Gorda SMR, the Proposed Regulations would be more protective than the existing ones. The Proposed Project would remove protection from an existing MPA, Punta Gorda SMR. All other regulations for the Proposed Project would be consistent with existing local plans, as well as with state and federal regulations, for the protection of biological resources.

Table 4-10. Proposed MPAs which Overlap with Existing Regulations and Plans Protecting Biological Resources in the North Coast Study Region

MPA Name	Existing Policies and Adopted Plans	Consistency of Proposed Regulations with Existing Regulations
Pyramid Point SMCA	**Fish and Game Code (FGC), Section 8219:** Prohibits commercial take of salmon year-round within 3 mi of mouths of Smith and Klamath rivers out to 3 nm due west of the river mouth, and within 2 mi of mouth of Eel River, between August and September **Title 14, California Code of Regulations (CCR), Section 27.75:** No recreational take of salmon within 3 nm of the mouths of the Smith and Klamath rivers out to 3 nm due west of the river mouth**14 CCR 165(c)(5)[1]:** Kelp beds open for lease to harvest	Consistent
Point St. George Reef Offshore SMCA	**50 Code of Federal Regulations (CFR) 660.70–660.79:** Yelloweye Rockfish Conservation Area and Rockfish Conservation Area	Consistent
Reading Rock SMR	**14 CCR 165(c)(5)**: Kelp beds closed to harvesting **50 CFR 660.70–660.79:** Rockfish Conservation Area	Consistent
Reading Rock SMCA	**50 CFR 660.70–660.79:** Yelloweye Rockfish Conservation Area and Rockfish Conservation Area	Consistent
Samoa SMCA	**14 CCR 165(c)(5):** Kelp beds are closed	Consistent
South Humboldt Bay SMRMA	**FGC, Section 8279**: Unlawful to sell any Dungeness crab taken from Humboldt Bay, including the entrance of that bay, and the Pacific Ocean within a radius of 1 mi from the extreme western point of the north jetty at the entrance of the bay and for a radius of 1 mi from the extreme western point of the south jetty at the entrance of the bay **Humboldt Bay Management Plan**: Implements policies for ecosystem-based management and protection of sensitive habitats	Consistent
South Cape Mendocino SMR	**14 CCR 165(c)(5):** Kelp beds open for lease **50 CFR 660.130(D):** Blunts Reef and Mendocino Ridge Essential Fish Habitat (EFH) Conservation Areas	Consistent
Mattole Canyon SMR	**14 CCR 165(c)(5):** Kelp beds open for lease **Federal Register Vol. 71, No. 86** **50 CFR 660.130(D):** Mendocino Ridge EFH Conservation Area **50 CFR 660.70–660.79**	Consistent
Punta Gorda SMR (not included in the Proposed Project)	**24 CCR 623(b)(1):** Existing Punta Gorda SMR	Not Consistent

Table 4-10. Proposed MPAs which Overlap with Existing Regulations and Plans Protecting Biological Resources in the North Coast Study Region

MPA Name	Existing Policies and Adopted Plans	Consistency of Proposed Regulations with Existing Regulations
Sea Lion Gulch SMR	**14 CCR 165(c)(5):** Kelp beds open for lease **Federal Register Vol. 71, No. 86** **50 CFR 660.130(D):** Mendocino Ridge EFH Conservation Area **50 CFR 660.70–660.79:** Yelloweye Rockfish Conservation Area and Rockfish Conservation Area	Consistent
Big Flat SMCA	**14, CCR 165(c)(5):** Kelp beds open for lease	Consistent
Double Cone Rock SMCA	**14 CCR 165(c)(5):** Kelp beds open for lease	Consistent
Ten Mile SMR	**14 CCR 165(c)(5):** Kelp beds open for lease	Consistent
Ten Mile Beach SMCA	**14 CCR 165(c)(5):** Kelp beds open for lease in part of the MPA and closed to harvest in another portion of the MPA	Consistent
Ten Mile Estuary SMCA	**14 CCR 165(c)(5):** Kelp beds closed	Consistent
MacKerricher SMCA	**24 CCR 623(b)(2):** Existing MacKerricher SMCA **14 CCR 165(c)(5):** Kelp beds closed	Consistent
Point Cabrillo SMR	**24 CCR 623(b)(3):** Existing Point Cabrillo SMCA **14 CCR 165(c)(5):** Kelp beds closed	Consistent
Russian Gulch SMCA	**24 CCR 623(b)(4):** Existing Russian Gulch SMCA **14 CCR 165(c)(5):** Kelp beds closed	Consistent
Van Damme SMCA	**24 CCR 623(b)(5):** Existing Van Damme SMCA **14 CCR 165(c)(5):** Kelp beds closed	Consistent

Notes: mi = statute mile(s), nm = nautical mile(s), SMCA = state marine conservation area; SMRMA = state marine recreational management area; SMR = state marine reserve

[1] **14 CCR 165(c)(5):** Designates kelp beds statewide for commercial kelp harvest. The Study Region contains 12 areas. Nine of the areas are closed. Leases for the three open areas must be obtained from the Commission.

Source: MLPAI 2011

The MPLA has similar goals to the existing plans and policies. The Proposed Regulations would be consistent with existing local, state, and federal policies and ordinances protecting biological resources; thus, no adverse impact would occur to existing local, state, or federal plans and policies. The options to the Proposed Project would slightly modify some of the MPA boundaries from those of the Proposed Project. The existing policies and plans for these options are identical to those described above for the Proposed Project, with the following additions:

- Pyramid Point SMCA option: The option would move the southern boundary 0.33 mi south, where it would abut Prince Island. This would add additional

protection next to Prince Island, which is currently managed by the BLM and Smith River Rancheria.

- South Humboldt Bay SMRMA option: This option would move the eastern border to the eastern shore of the bay, and the northern border would move slightly south. This option would include an area already regulated by FGC, Section 8279 to protect Dungeness crab. This area already is under the jurisdiction of the *Humboldt Bay Management Plan*. Additionally, extending the South Humboldt Bay SMRMA to the eastern shore would extend the SMRMA into an area currently under protection through the Humboldt Bay NWR. The proposed option would not conflict with the existing conservation plans.

Overall, no adverse impacts on local, regional, state, or federal policies or ordinances for the protection of biological resources would result.

Level of Significance: *No Adverse Impact*