Biological Resources Report
For Clam and Moonstone Beach County Parks
Access Management Plan

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The following is the unabridged report for biological resources at Clam and Moonstone Beaches. Copies of field survey forms are at the end of the report.

1.0 Habitat Types and Associated Plant Communities

The management area described herein includes the area extending from Moonstone Beach south to Hiller Road, west to the wave slope, and east to (and including) the Hammond Trail. Habitat types in the management area include dune systems, wetlands, and coastal scrub. These habitat types support nine vegetation communities that are separated into units called series, based upon dominant vegetation. The classification system described here primarily follows Sawyer and Keeler-Wolf (1995), and is also based on descriptions found in Duebendorfer (1992), Holland (1986), and Pickart and Sawyer (1998). The environment is described based on current conditions, rather than potential vegetation. Wetland systems are classified according to Cowardin et al (1979). Each habitat type, and its associated vegetation communities, is described in detail below.

1.1 BACKGROUND

A multitude of classification systems have been applied to Pacific Northwest coastal communities for various projects in the past. Johnson (1963) surveyed and described dune vegetation and processes between Trinidad Head and Arcata, and Wiedemann (1984) characterized the dune environment for all of the Pacific Northwest. In 1974, Parker studied coastal dune systems and identified vegetation communities from Little River south to the mouth of the Mad River. Parker's work separated dominant vegetation trends into community-types; variations in community-types were described as associated species. LaBanca (1993) resurveyed Parker's study area to document changes to vegetation communities in the same area. His work separated vegetation communities into a hierarchical system of series, associations, and phases, nested within each other and identified by dominant species found within each. Other studies in the vicinity include the works of Shapiro and Associates (1980), Duebendorfer (1986, 1989, 1992), and Pickart (1987, 1990, 1998). Duebendorfer (1992) provides a comparison and breakdown of the various studies conducted in the area, and summarizes the differences of the most common classification systems. To better understand the methods applied in this document, a comparative summary of previous systems used in the management area is summarized in Table 1.

It is important to note that vegetation communities can occur in more than one habitat type. Vegetation communities have been mapped and are on file at the Humboldt County Department of Public Works.

Many habitat and plant communities in the management area are recognized as sensitive by various resource agencies. For example, the California Coastal Commission recognizes several "environmentally sensitive habitat areas" (ESHAs) that are present in the management area. The California Coastal Act (sec. 30240) recognizes dune habitats as ESHAs that shall be protected against significant disruption, and limits development design adjacent to such areas to prevent impacts that would significantly degrade ESHA sites. CDFG recognizes many community types as rare and worthy of consideration by the California Natural Diversity Database (CNDDB) due to highly limited distribution, regardless of presence or absence of rare, threatened, or endangered status species. Sensitive status can therefore be the result of rarity of a community type, value of a community's role in the ecosystem, threats to limited habitats caused by disturbance or degradation from human activities or developments, or protection by state or federal agencies for resources such as wetlands (see below) or rare plants (see below). Additionally, community types such as Coyote Brush and European Beachgrass series may be considered sensitive habitat in part due to their inclusion within larger, sensitive community types such as Northern Coastal Scrub (Sawyer and Keeler-Wolf 1995). Agency consultation should occur prior to any management activity that might affect these areas. A summary of community types, including those designated sensitive, is included in Table 2.2-1.

Table 2.2-1. Plant Communities in the Management Area

Formation	Plant Community	Corresponding Community Reference Number for Maps	Sensitive Natural Community*
Beach strand	Native Dunegrass Series	1	1, 2, 3
Foredunes	Coyote brush series	2	
	European beachgrass series	3	
	Yellow bush lupine series	4	
Dune mat	Sand-verbena- beach bursage series	5	1, 2, 3
Interior dunes	Coyote brush series		
	Yellow bush lupine series		
	European beachgrass series		
	unvegetated	6	2, 3
Deflation plains	Hooker willow series	7	1, 2, 3
Dune hollows	Sedge series	8	1, 2, 3
	Red alder series	9	1, 2, 3
North coast riparian scrub	Salal-black huckleberry series	10	1, 2
Northern coastal scrub	Coyote brush series		
	Hooker willow series		1, 2, 3
	Red alder series		1, 2, 3
	Sitka spruce series	11	1, 2, 3
	Yellow bush lupine series		
	Pampas grass series	12	
Ruderal Vegetation	Other ruderal vegetation	13	

Sensitive Natural Community Designation:
1-Known or believed to be of high priority in California Natural Diversity Database (CNDDB), as indicated by CDFG
2-Environmentally Sensitive Habitat Area (ESHA) as defined by the California Coastal Commission
3-Potential CDFG, ACOE, and/ or Coastal Commission Wetland Status; requires site-specific determinations
** Refer to description of Sensitive Natural Community Types in Section 2.2 for further details.*

1.2 DUNE FORMS

Dune formations present in the management area include beach strand (littoral strip), foredunes, deflation plains, and an interior foredune complex of stabilized dune ridges (Parker 1974; Pickart & Sawyer 1998). The geologic and physical processes of these formations are described in detail in Parker (1974), Wiedemann (1984), and Pickart and Sawyer (1998). A strong association between vegetation communities and dune forms has been documented (Parker 1974). However, introduced plant species may interfere with this relationship (Pickart and Sawyer 1998). Dune forms are described here in association with corresponding vegetation communities.

Table 1. Comparative Summary of Dune Vegetation Community Classification Systems

Dune Form(s)	Sawyer/ Keeler-Wolf (1995)	Johnson (1963)	Parker (1974)	LaBanca (1993)	Holland (1986)	Pickart (1987, 1990)	Pickart (1998)	Duebendorfer (1992)
Littoral Strip (Beach Strand)- Foredune	Native Dunegrass Series	Strand Community	Native dunegrass- sea rocket association (*Elymus- Cakile* & *Convolvulus [Calystegia]- Elymus* communities)	*Elymus mollis* Series	Northern Foredune Grassland	Dunegrass	Native Dunegrass Series	Northern Foredune Grassland
Foredune	European Beachgrass Series	x	European Beachgrass- Australian fireweed association (*Ammophila- Erechtites* association)	Beachgrass Series	Coastal Dunes	European Beachgrass	European Beachgrass Series	European Beachgrass association
Foredune	Yellow Bush Lupine Series	x	Coyote Brush- CA figwort association	Coyote brush- Yellow Bush Lupine	Coastal Dunes, Coastal Scrub, Coastal bluff Scrub	Lupine scrub	Yellow bush lupine Series/ lupine scrub	Yellow bush lupine-ripgut association (as Lupine/ grass type)
Dune Mat	Sand-verbena- Beach bursage Series	Active sand/ Moving dunes Community; Foredune community	Seashore bluegrass-beach pea (*Poa- Lathyrus*) community	N/A	Coastal Dunes	Dune mat	Sand-verbena- Beach bursage Series (*Poa- Lathyrus* phase of dune mat 1987)	Northern dune mat
Interior dunes	Yellow Bush Lupine Series	x	Coyote Brush- CA figwort association	Coyote brush- Yellow Bush Lupine	Coastal Dunes, Coastal Scrub, Coastal bluff Scrub	Lupine scrub	Yellow bush lupine Series/ lupine scrub	Yellow bush lupine-ripgut association (as Lupine/ grass type)
Interior dunes	Coyote Brush Series	x	Coyote Brush-European Beachgrass association (*Ammophila-Baccharis* community); Coyote Brush/ CA figwort association	Coyote brush- European Beachgrass	Coastal Dunes, Coastal Scrub, Coastal bluff Scrub, Chapparal	Beachgrass, lupine, coyote brush mixed	Coyote Brush Series	European Beachgrass Association
Interior dune deflation planes (hollows); Riparian scrubs	Hooker Willow Series	x	*Salix-Rubus* community	*Salix* Series	Riparian Scrub	Woody Hollows	Dune Hollows/ Hooker Willow Series	Woody Hollows
Interior dune deflation planes (hollows)	Sedge Series	x				Herbaceous hollows		Herbaceous hollows

Beach Strand

Beach strand (also known as littoral strip) is located on the immediate beach where abiotic factors, rather than stabilizing vegetation, influence the landscape. High winds, waves and cyclic tidal inundation severely restrict vegetative growth in the beach strand zone. Drift accumulates here, shorebirds nest, and new dunes form if the beach is accreting. Pioneer plant species such as sea rocket (*Cakile maritima*) and native dunegrass (*Leymus mollis*) are often found in the beach strand. This vegetation establishes in the summer and fall, and then is frequently removed by winter storm activity. This cycle repeats itself annually.

Native dunegrass series

In 1974, Parker identified the Elymus [Leymus]-Cakile (Native dunegrass-sea rocket) community type occurring along the seaward extremes of the management area, with a low overall cover (4-8%). LaBanca's subsequent work in the area (1993) separated Native dunegrass into its own series, with two associations (Native dunegrass; Native dunegrass-European beachgrass), and two phases (Native dunegrass; sea rocket). LaBanca observed that Parker's community-type was similar, with the exception of a reduction in abundance of beach bursage (Ambrosia chammissonis), which was included in Parker's community-type. LaBanca observed a low but consistent cover (6%) of the Native dunegrass-sea rocket phase at Clam Beach. Currently, these vegetation types are treated as part of the Native Dunegrass Series (Sawyer and Keeler-Wolf 1995); refer to Table 1. Site visits conducted in winter and spring 2003 observed a very minor component of Native dunegrass series present along the bluffs near the estuary between Murray Rd. and Hiller Rd. Most areas that once consisted of Native dunegrass series have been replaced by European beachgrass series.

Foredunes

On the landward side of the beach strand, a ridge of sand parallel with the beach forms. This formation is a result of the accumulation of sand in and around plants that can tolerate burial by sand (Pickart and Sawyer 1998). While some recognize this first ridge exclusively as the foredune (Johnson 1963, Wiedemann 1984), recent studies have included the complex of semi-stabilized dune ridges and/ or hummocks in a broader application of the foredune description which extends to the deflation plain (Pickart and Sawyer 1998; Humboldt County 1992). The development of the first foredune, known as the primary foredune, has been attributed to the establishment of the non-native, invasive grass known as European beachgrass (Ammophila arenaria) (Cooper 1958 and Wiedemann 1966 in Parker 1974; Crook 1979 in Duebendorfer 1992).

European beachgrass series

European beachgrass (*Ammophila arenaria*) dominates the European beachgrass series (Sawyer and Keeler-Wolf 1995). European beachgrass is an introduced and invasive species that substantially alters the physical and biological conditions of the natural dune environment, consequently leading to a loss of native vegetation (Pickart & Sawyer 1998). European Beachgrass is one of the most widespread herbaceous communities in the local dunes and dominates much of the foredune complex. Few species are found in association with this vegetation type, but native vegetation has been observed growing in openings within, and on the periphery of European beachgrass.
The European Beachgrass Series was described by Parker in 1974 as occurring throughout the Clam Beach foredunes, while another community-type known as beach morning glory-Native dunegrass (*Calystegia soldanella- Leymus mollis*) was observed along the foredunes between Strawberry Creek and Widow White Creek. In 1993, LaBanca observed that the beach morning glory-Native dunegrass type no longer occurred in this area as a dominant community, and instead had been replaced by the European Beachgrass Series. It should also be noted that, while the predominant species that defined the community in both studies was European beachgrass, LaBanca points out that the associated plant species had changed since Parker's study.

Yellow bush lupine series

Other vegetation communities found within the foredune complex include Yellow bush lupine and Coyote brush Series. The Yellow bush lupine series, also described as Lupine scrub, is characterized by the dominance of the non-native shrub, yellow bush lupine (Lupinus arboreus). Like the European beachgrass series, it generally excludes locally native plant species. “Lupine scrub occurs in the foredune complex behind the primary foredune, and on stabilized moving dunes” (Pickart & Sawyer, 1998). Associated species may include figwort (*Scrophularia californica*), European beachgrass, annual fescue (*Vulpia bromoides*), yarrow (*Achillea millefolium*), and ripgut grass (*Bromus diandrus*). Coyote brush (Baccharis pilularis) and wax myrtle (*Myrica californica*) may also be present with less cover. Two associations have been identified: the yellow bush lupine-figwort association is distinguished by the presence of figwort (*Scrophularia californica*), and the yellow bush lupine-ripgut brome association has a dense layer of exotic annual grasses (Pickart and Sawyer 1998). The yellow bush lupine-ripgut association occurs within the management area. Yellow bush lupine has the ability to fix atmospheric nitrogen in the soil. Increased nitrogen in nutrient poor habitats such as dunes has been shown to greatly increase the susceptibility of natural communities to invasion by weedy annual exotics. While Parker (1974) recognized a considerable presence of yellow bush lupine within the management area, he did not consider it abundant enough to identify as a separate community type. However, in 1993 LaBanca suggested that it might play a more important role than it had previously, especially in the interior dune systems.

Coyote brush series

The Coyote brush series may occur on foredunes, and on former moving dunes that have been stabilized with yellow bush lupine or European beachgrass. In some areas, it appears to be replacing the yellow bush lupine series (Pickart & Sawyer 1998). Although yellow bush lupine and European beachgrass may be abundant in this series, the native coyote brush (Baccharis pilularis) is the dominant shrub. In 1974, Parker observed his community-type equivalent of this series occurring predominately on the interior dunes between Little River and Strawberry Creek. By 1993, LaBanca noted that its presence had expanded to interior dunes throughout the management area. LaBanca also observed that associated species composition related to this series had changed significantly between Parker’s and his studies.

Dune Mat

“Dune mat” is an informal term used to describe a habitat type that is typically found throughout the foredune complex and on marginal ridges (Pickart 1998). This habitat is characterized by a somewhat mobile sandy substrate supporting low growing herbaceous and shrubby perennials. Overall plant species diversity in this habitat type is typically relatively high.

Sand-verbena – beach bursage series

Dune mat habitat is dominated by low-growing, matted herbaceous and woody plants such as coast buckwheat (*Eriogonum latifolium*), coast goldenrod (*Solidago spathulata* ssp. *spathulata*), seashore bluegrass (*Poa douglasii*), beach pea (*Lathyrus littoralis*), coastal sagewort (*Artemesia pycnocephala*), beach evening primrose (*Camissonia cheiranthifolia*) and yellow sand verbena (*Abronia latifolia*). This plant community corresponds to the Sand-verbena – beach bursage series described by Sawyer & Keeler-Wolf (1995). Two phases of the dune mat community have been further detailed by Pickart (1998) and Duebendorfer (1989) as the seashore bluegrass- beach pea phase, and the beach sagewort phase. A third phase dominated by red fescue has been described by Pickart (1987), but has not been quantitatively justified (1998).

Parker (1974) recognized the presence of the seashore bluegrass-beach pea community-type solely on longitudinal dunes between Widow White Creek and Mad River. However, this area no longer occurs as a result of the northward migration of the Mad River, which eliminated this habitat and

community (LaBanca 1993). It is worth noting that this community has occurred in the area in the past, particularly because restoration of a portion of this habitat type is being proposed near Vista Point, under a potential mitigation project for California Department of Transportation (Mad River Biologists 2002).

Interior Dunes

The interior foredune complex consists of ridge remnants of other dune forms that have been stabilized by vegetation. Dune ridge formation occurs where sand deposition exceeds erosion. These areas may previously have consisted of moving dunes, longitudinal ridges (parallel with prevailing wind direction), or parallel ridges (parallel to the ocean beach). Occasionally, a break or gap (known as blowouts) in the primary foredune will occur as a result of sufficient disturbance to vegetation cover. Blowouts then develop as the sand becomes exposed to wind and erodes away. Vegetation communities found in the interior dunes include the Coyote brush, Yellow bush lupine, and European beachgrass series. LaBanca's work (1993) indicates that the Yellow bush lupine series was exclusively found between the Little River border and the (former) northern bank of the mouth of the Mad River, primarily on the foredunes, but occasionally on interior dunes between Strawberry Creek and the Mad River.

Deflation Plains

The inland movement of open (unvegetated) sand from the foredune complex creates parabolic dunes. As these dune forms continue to move inland and build up, an eroded expansive basin of unvegetated sand close to the water table remains. These areas are known as deflation plains. Erosion in these areas typically cease upon contact with the damp sand of the water table. During storm events, deflation plains become seasonally inundated by a rising water table, creating what is known as a dune hollow (Pickart and Sawyer 1998). Refer to Section 1.3 below for details.

1.3 WETLAND SYSTEMS

Wetland habitats are classified according to Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979), which uses a hierarchical structure of systems, subsystems, and classes to identify wetland habitat types. Wetland systems occurring within the management area include freshwater (palustrine) emergent wetlands such as herbaceous and woody hollows, coastal riparian scrub (riverine) wetlands associated with creeks and rivers, and some estuarine areas associated with river and creek mouths opening to the sea. Pursuant to the Federal Clean Water Act, wetland habitats such as these are protected as "waters of the United States" and regulated by the U.S. Army Corps of Engineers. The wetlands located within the management area are perennial wetlands that are subject to jurisdiction by the State Coastal Commission, and the Humboldt County Planning & Development Department under the Open Space Element of the General Plan.

Hollows

Dune hollows, as described previously, are formed by seasonal saturation in deflation plains as a result of an increase in water table height (Parker 1974; Pickart and Sawyer 1998). These areas can become seasonal ponds, which are then colonized by hydrophytes that may eventually completely establish and stabilize an area, creating a dense, vegetative cover (Wiedemann 1984).

Hooker willow series

The Hooker willow series consists primarily of Hooker willow (*Salix hookeriana*) and occasionally Pacific wax myrtle (*Myrica californica*), Sitka spruce (*Picea sitchensis*) and coastal pine (*Pinus contorta* ssp. *contorta*). This series occurs primarily in what has been described as woody hollows. While California Department of Fish and Game NDDB does not separate dune hollows from other freshwater marshes and swamps, Duebendorfer (1988, in Pickart 1990) recognizes woody hollows as a subset of

the dune hollows system, and formed in deflation plains behind large moving dunes. Woody hollows are recognized as seasonally inundated freshwater wetlands. They are characterized by shrubs or trees up to 6 meters high (Pickart 1990). Salt rush (*Juncus brewerii*) and slough sedge (*Carex obnupta*) are also dominant in the herbaceous layer. The presence of coastal pine, Sitka spruce and Pacific wax myrtle may indicate the degree of stability of the woody hollows (Duebendorfer 1992). According to the USFWS, woody hollows are classified as part of the Palustrine, Scrub-shrub Class, Broad-leaved Deciduous or Needle-leaved Evergreen Subclass. Water regime is seasonally flooded and water chemistry is fresh (Cowardin et al 1979).

The Hooker willow series was observed by Parker (1974) as occurring between Strawberry Creek and the Mad River. LaBanca noted that areas formerly described by Parker as having a seasonal colonization cycle had become stabilized by hydrophytic vegetation at the time of his study, and that new areas were being colonized by this vegetation type in moist areas behind foredune blowouts. Futhermore, LaBanca noted a decrease in species diversity in these areas compared to the conditions observed by Parker.

Sedge series

The Sedge series is dominated by slough sedge (*Carex obnupta*) and salt rush (*Juncus breweri*), and are found in what is classified as “herbaceous hollows” by Duebendorfer (1992 in Pickart and Sawyer 1998). Herbaceous hollows are also seasonally inundated freshwater wetlands; however they are considerably less stable than woody hollows. Herbaceous hollows are characterized by low growing rushes, sedges, and other herbaceous plants up to four feet in height. Duebendorfer (1989) identified two types of herbaceous hollows on the North Spit: one dominated by salt rush and the other dominated by slough sedge. On the North Spit, Pickart (1990) found that slough sedge tends to dominate wetter areas and salt rush less inundated areas. Associate species in both types of herbaceous hollows include Pacific silverweed (*Potentilla anserina*), springbank clover (*Trifolium wormskjoldii*), and California blackberry (*Rubus ursinus*) (Duebendorfer 1992). For the purposes of this document, areas dominated by salt rush are considered as a dominant phase of the Sedge series. According to the USFWS, herbaceous hollows are considered part of the Palustrine System, Emergent Wetland Class, Non-persistent (seasonally flooded) subclass (Cowardin, et al 1979). Water chemistry is fresh.

North Coast Riparian Scrub

Red alder series

The Red alder series has been described in the past by Holland (1986) as the Red Alder Riparian Forest community. The Cowardin System (1979) classifies the Red alder series as part of the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous subclass, with a Seasonally Flooded water regime, and fresh water chemistry.

The dominant species in the Red Alder series include red alder (*Alnus rubra)* and hooker willow. The understory can be open, but is typically more closed, and usually consists of Sitka spruce, cascara (*Rhamnus purshiana)*, salmonberry (*Rubus spectabilis)*, California bramble (*Rubus ursinus)*, red elderberry (*Sambucus racemosa* var. *racemosa),* huckleberry (*Vaccinium ovatum),* salal (*Gaultheria shallon)*, and an herbaceous layer that includes skunk cabbage (*Lysichiton americanum)*, hedge nettle (*Stachys* spp.), lady fern (*Athyrium filix-femina),* sedges, and others. The Red alder series can also be found in upland sites (see below).

1.4 UPLAND SYSTEMS OUTSIDE OF DUNE FORMS

Northern Coastal Scrub

Northern Coastal Scrub is located along the eastern bluffs bordering portions of the management area. The term Northern Coastal Scrub was first described by Holland (1986) as a community of low shrubs, usually 0.5 to 2 meters tall, usually dense but with scattered grassy openings, and generally occurring on windy, exposed upland coastal sites. Sawyer-Keeler & Wolf (1995) consider coastal scrub habitat as a collection of vegetation series that are determined at each site by dominant cover. The primary vegetation types that have been cross-referenced to this habitat community are the Salal-black huckleberry series, the Coyote brush series, and/or the Yellow bush lupine series. Hooker willow series, Red alder series, and Sitka spruce series can also be found in this habitat at a finer scale. Parker (1974) and LaBanca (1992) have previously recognized coastal scrub in the Willow-blackberry vegetation type.

Ruderal Habitats

Ruderal vegetation is characterized by weedy non-native, herbaceous species that tend to favor disturbance. These areas include roadsides, industrial areas and other areas altered by human disturbance that remain sparsely vegetated.

2.0 Sensitive Plant Resources

A list of regionally occurring Special Status plant species taken from recent California Department of Fish and Game (CDFG) and California Native Plant Society (CNPS) database queries for the Arcata North, Tyee City, Trinidad, and Crannell quadrangles is presented, along with their regulatory status and preferred habitat(s) in Table 2. Within this list, regionally occurring Special Status plant species for which suitable habitat occurs, or may occur in the future as a result of habitat restoration within the management area, are denoted by an asterisk (*) next to the species name. Special Status plant species presently known to occur in the management area are presented in bold type.

2.1 Special Status Species Defined

Special Status plant taxa are species, subspecies, or varieties that fall into one or more of the following categories, regardless of their legal or protection status (California Department of Fish and Game Natural Diversity Database January 2003):

- Officially listed by California or the federal government as Endangered, Threatened, or Rare;
- A candidate for state or federal listing as Endangered, Threatened, or Rare;
- A federal “Species of Concern,” an unofficial designation sometimes seen on USFWS species lists. These indicate former C1 and C2 candidates which changed status in 1996, when the USFWS abandoned the C1/C2 model. However, these taxa still meet the criteria for future listing by the USFWS and are important to include on “potentials lists.”
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act (CEQA) Guidelines;
- A Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Forest Service Sensitive Species;
- Taxa listed in the California Native Plant Society’s *Inventory of Rare and Endangered Plants of California*;
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation;
- Population(s) in California that may be peripheral to the major portion of a taxon’s range but are threatened with extirpation in California; and

- Taxa closely associated with a habitat that is declining in California at an alarming rate (e.g., wetlands, riparian, old growth forests, desert aquatic systems, native grasslands, valley shrub-land habitats, vernal pools, etc.).

The California Native Plant Society (CNPS) Inventory includes five lists for categorizing plant species of concern, which is summarized below. The plants on the CNPS list 1B and 2 are considered rare, endangered, and threatened plants pursuant to Section 15370 of the California Environmental Quality Act (CEQA). The plants on these lists meet the definitions under the Native Plant Protection Act and/or the California Endangered Species Act of the California Department of Fish and Game Code and are eligible for state listing.

- List 1A – Plants that are presumed extinct in California;
- List 1B –Plants that are rare or endangered in California and elsewhere;
- List 2 – Plants that are rare or endangered in California but are more common elsewhere;
- List 3 – Plants for which more information is needed for final listing to be undertaken;
- List 4 – Plants of limited distribution (a watch list), which are uncommon enough that their status warrants monitoring.

Species listed in the CNPS Inventory are further characterized by a rarity, endangerment and distribution code (R-E-D code), which was developed to refine rarity designations. The rarity component addresses the extent of the plant, in terms of both numbers of individuals and the nature and extent of distribution; endangerment refers to the plant's vulnerability to extinction; and distribution focuses on the overall range of the plants. The R-E-D system is summarized below as taken from page 15 of the CNPS Inventory (Skinner & Pavlik 1994):

R (Rarity)

1. Rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time.
2. Distributed in a limited number of occurrences, occasionally more if each occurrence is small.
3. Distributed in one to several highly restricted occurrences, or present in such small numbers that it is seldom reported.

E (Endangerment)

1. Not endangered
2. Endangered in a portion of its range
3. Endangered throughout its range

D (Distribution)

1. More or less widespread outside of California
2. Rare outside of California
3. Endemic to California

Dune mat, Native dunegrass, and the periphery of Lupine scrub and European beachgrass communities are capable of supporting two federally listed plant species: beach layia (*Layia carnosa)* and Humboldt Bay wallflower, (*Erysimum menziesii* ssp. *eurekense*), and at least two state recognized Special Status species: pink sand verbena, (*Abronia umbellata* ssp. *breviflora)* and dark-eyed gilia, (*Gilia millefoliata*). Of the Special Status plant species, pink sand verbena, Wolf's evening primrose, and Lyngbye's sedge are currently known to occur on site. Additionally, Humboldt Bay owl's clover (*Castilleja ambigua* ssp. *humboldtiensis*) was discovered during Spring 2003 floristic surveys in the management area, and an unconfirmed, vegetative beach pea (*Lathyrus japonicus*) individual was located in the management area after the floristic season.

2.2 Species Accounts for Sensitive Plants Known to Occur in Management Area

Pink sand verbena (*Abronia umbellata* ssp. *breviflora*)

Pink Sand Verbena is on List 1B of the California Native Plant Society (CNPS) as endangered in a portion of its range, rare in and outside California, and distributed in a limited number of occurrences (Skinner and Pavlik 1994). Threats to this species include stabilization of the sand dunes by European beachgrass and other non-native species, loss of habitat to development, and vehicle disturbance. Currently, the State of California or the Federal government does not list pink sand verbena as threatened or endangered.

Pink sand verbena occurs from southern Oregon south to Marin County. The preferred habitats for pink sand verbena are beach strand and dune mat, but it also occurs on low sandy hummocks, open, sandy bay edges, and river mouths. It is restricted to coastal sandy habitats and is limited to fine sandy or silty sand beaches with little organic soil; no populations have been found on coarse sand beaches (Roberts 1994)

Pink sand verbena is a member of the four-o'clock family (Nyctaginaceae). There is some confusion as to whether pink sand verbena is an annual or a short-lived perennial that forms a small taproot. C. Roberts (1994) suggests that it could "exhibit different growth strategies under different environmental conditions." Further studies are required, and it is important to note that monitoring and management strategies are different for annual versus perennial plants. Pink sand verbena blooms July through October.

MRB Biologist Stephanie Morrissette, and Caltrans Environmental Planner/Biologist Steve Hansen observed pink sand verbena growing immediately south of the rock slope revetment wall at Clam Beach in the fall of 2001. Other records indicate occurrences observed in 1987 near Moonstone Beach, between Little River and Highway 101, and also along Clam Beach in multiple locations within 1 mile north of Vista Point. Surveys in May 2003 also located pink sand verbena along the beach acces trail near the northern parking lot. Plants were just beginning to bloom at the time of surveys. Floristic surveys were not conducted during this time period, however habitat was determined to occur throughout the planning area in open sandy areas where yellow sand verbena could also be found.

Beach pea (*Lathyrus japonicus*)

One vegetative beach pea individual was located on August 31, 2003 south of Widow White Creek before Murray Road. Because it was observed outside the floristically-appropriate window, identification cannot be confirmed until it blooms, although vegetative characteristics are consistent with those of beach pea. The unconfirmed beach pea specimen was observed growing in a dense thicket of native dunegrass with vetch (*Vicia sativa)* and creeping bent (*Agrostis stolonifera*) also present. It was growing in wet sand immediately adjacent to Widow White Creek just upstream from the Mad River estuary. Dense- flowered cordgrass (*Spartina densiflora*) and arrowgrass (*Triglochin concinnum)* were growing immediately below it, and a more expansive patch of native dunegrass was above it on a relatively steep dune (dry sand).

Beach pea is a CNPS List 2 member of the pea family (Fabaceae). It is a low-growing perennial species that spreads by rhizomes on open sandy beaches and grass-covered foredunes. Trailing stems can grow up to three feet long. Beach pea is characterized by six-to-eight smooth, fleshy leaflets that are usually subtended by a coiled or branched tendril, and three-to-eight blue or purple flowers in each inflorescence. Beach pea can be found in moderately disturbed areas, and its range extends from Alaska to northern California. Beach pea blooms from March through August.

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan
*Asterisks [*] indicate habitat considered present in management area. Species in **bold type** indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
Abronia umbellata* ssp. *breviflora **pink sand verbena** Family: Nyctaginaceae	Federal: None State: None CNPS: 1B R-E-D code: 2-2-1	Disturbed sandy areas, coastal dunes and scrub; <100m (Hickman 1993). Coastal dunes and coastal strand from north coast of California and into Oregon, (Skinner & Pavlik 1994).	Restricted to coastal dune habitats. The preferred habitat for pink sand verbena is dune mat and beach strand, but also occurs on beaches; low, sandy hummocks; open, sandy bay edges; and river mouths. Perennial herb, blooms July-September
**Calamagrostis bolanderi* Bolander's reed grass Family: Poaceae	Federal: None State: Special Status Species CNPS: 1B R-E-D code: 2-2-3	Bogs and fens, Closed-cone coniferous forest, Coastal scrub, Meadows (mesic), Marshes and Swamps (freshwater), North Coast coniferous forest (mesic) 0-185m (Skinner & Pavlik 1994). Bogs, moist meadows, open woodlands < 100m (Hickman 1993).	Blooms June – August
**Carex arcta* northern clustered sedge Family: Cyperaceae	Federal: None State: Special Status Species CNPS: 2 R-E-D code: 2-2-1	Bogs and fens, North Coast coniferous forest (mesic) 60-1,400m (Skinner & Pavlik 1994). Wet meadows, marshes, wet clearings and ditches at low to middle elevations (Pojar & MacKinnon 1994). Wet places, esp. sphagnum bogs; <1400m (Hickman 1993).	Known from the Arcata North quadrangle to occur in the Dows Prairie area of McKinleyville (Skinner & Pavlik 1994). Blooms June – August
**Carex leptalea* flaccid sedge Family: Cyperaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-2-1	Bogs and fens, Meadows (mesic), Marshes and Swamps, 0-700m (Skinner & Pavlik 1994). Bogs, swamps, fens, wet meadows, wet forest openings and shorelines from low to middle elevations (Pojar & MacKinnon 1994). Wet meadows and swamps below 2,300 feet in elevation (Hickman 1993).	Blooms May - July
Carex lyngbyei **Lyngbye's sedge** Family: Cyperaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-2-1	Marshes and swamps (brackish or freshwater). 0-10m (Skinner & Pavlik 1994). Tidal marshes and flats, estuarine meadows, brackish marshes, gravel or cobble beaches (Pojar & MacKinnon 1994). Brackish areas ± 0m (Hickman 1993). Marshes near the coast: Marin, Mendocino, and Humboldt counties; north to Alaska and circumpolar (Mason 1957).	Known to hybridize with *Carex aquatilis* var. *dives* (Hickman 1993). Blooms May – August

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan (cont'd)

*Asterisks [*] indicate habitat considered present in management area. Species in **bold type** indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
**Carex praticola* Meadow sedge Family: Cyperaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-2-1	Meadows (mesic). 0-3200m (Skinner & Pavlik 1994). Meadows, open forest and on stream-banks from low to middle elevations (Pojar & MacKinnon 1994). Moist to wet meadows below 10,500 feet in elevation (Hickman 1993). Meadows and open woods near sea level to 2,000 feet in Coastal Prairie and No. Coast Coniferous Forest plant communities (Munz and Keck 1965).	Blooms May – July
**Carex saliniformis* deceiving sedge Family: Cyperaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 2-2-3	Coastal prairie, coastal scrub, coastal marshes & swamps/ mesic, meadows and seeps; 10-700 feet (CNPS 2001)	Blooms June
**Carex viridula var. viridula* Green sedge Family: Cyperaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-1-1	Bogs and fens, Marshes and Swamps (freshwater), North Coast coniferous forest (mesic). 0-1600m (Skinner & Pavlik 1994). Common in bogs, swamps, fens, wet meadows, dune slacks and lakeshores at low to middle elevations (Pojar & MacKinnon 1994). Sphagnum bogs; 0-1600m (Hickman 1993). Low wet ground near the coast, near sea level; N. Coastal coniferous forests (Munz & Keck 1965).	Blooms June – September
**Castilleja affinis* ssp. *littoralis* Oregon coast Indian paintbrush Family: Scrophulariaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code 2-2-1	Coastal bluff scrub, coastal dunes, coastal scrub/ sandy; 15-100m (CNPS 2001).	Perennial herb. Blooms June.
Castilleja ambigua ssp. humboldtiensis **Humboldt Bay owl's-clover** Family: Scrophulariaceae	Federal: Species of Concern State: Special Status Species CNPS: List 1B R-E-D code: 2-2-3	Marshes and Swamps (coastal salt) (Skinner & Pavlik 1994). Salt marshes of Humboldt Bay; ± 0m (Hickman 1993). Salt marshes about Humboldt Bay (Munz & Keck 1965).	Typically restricted to tidal salt marshes in Humboldt Bay. Occurences are located in tidally-influenced estuarine habitats in management area. Blooms April – August

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan (cont'd)
*Asterisks [*] indicate habitat considered present in management area. Species in **bold type** indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
**Castilleja mendocinensis* Mendocino coast paintbrush Family: Scrophulariaceae	Federal: None State: None CNPS: List 1B R-E-D code: 2-2-3	Coastal bluff scrub, Closed-cone coniferous forests, Coastal dunes, Coastal prairie, Coastal scrub; 0-160m (CNPS 2001).	Perennial herb, hemiparasite. Blooms April - August
Cordylanthus maritimus ssp. palustris Point Reyes bird's-beak Family: Scrophulariaceae	Federal: Species of Concern State: Special Status Species CNPS: List 1B R-E-D code: 2-2-2	Marshes and Swamps (coastal salt) (Skinner & Pavlik 1994). Coastal salt marshes; <10m (Hickman 1993). Coastal salt marsh (Munz & Keck 1965).	Restricted to tidal salt marshes in Humboldt Bay. Blooms June – October
Empetrum nigrum ssp. *hermaphroditum* black crowberry Family: Empetraceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-2-1	Rocky sea cliffs, in coastal scrub; <200m (Hickman 1993). Coastal bluff scrub, Coastal prairie; 10-200m (Skinner & Pavlik 1994).	Blooms April-June
**Erysimum menziesii* ssp. *eurekense* Humboldt Bay wallflower Family: Brassicaceae	Federal: Endangered State: Endangered CNPS: List 1B R-E-D code: 3-3-3	Coastal dunes, 0-10m. (CNPS 2001)	Perennial herb, blooms March-April. Restricted to coastal dunes around Humboldt Bay.
**Erythronium revolutum* coast fawn lily Family: Liliaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-2-1	Bogs and fens, Broadleafed upland forest, North Coast coniferous forest / mesic, streambanks; 0-1065m (Skinner & Pavlik 1994). Open to moderately dense woodlands, edges of rivers, meadows; at low elevations (Pojar & MacKinnon 1994). Streambanks and wet places in woodlands; 0-1000m (Hickman 1993). Margins of swamps and bogs and along wooded streams near the coast, to 3500 ft.	Blooms March – June
Fissidins pauperculus (moss) Family: Fissidentaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 2-2-3	North coast coniferous forests (damp coastal soil); 10-100m (Skinner & Pavlik 1994).	

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan (cont'd)

*Asterisks [*] indicate habitat considered present in management area. Species in **bold type** indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
**Gilia capitata* ssp. *pacifica* Pacific gilia Family: Polemoniaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 2-2-2	Coastal bluff scrub, coastal prairie; 5-300m (CNPS 2001)	*Annual herb, blooms May-August*
**Gilia millefoliata* *dark-eyed gilia* Family: Polemoniaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 2-2-2	Coastal dunes; 2-20m (CNPS 2001)	*Annual herb, blooms April-July*
Hesperevax sparsiflora var. *brevifolia* Short-leaved evax Family: Asteraceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-2-1	Coastal bluff scrub (sandy), coastal dunes; 0-215m (CNPS 2001)	*Threatened by logging and development.* *Annual herb, blooms May-August*
**Lathyrus japonicus* *sand pea* *Family: Fabaceae*	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-3-1	Coastal dunes 1-30m. (CNPS 2001)	*Perennial herb (rhizomatous)* *Blooms May- August*
**Lathyrus palustris* Marsh pea Family: Fabaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D 2-2-1	Bogs and fens, Marshes and Swamps, Coastal prairie, Coastal scrub, and mesic sites in the Lower montane and North Coast coniferous Forests (Skinner & Pavlik 1994). Marshes and mudflats (Pojar & MacKinnon 1994). Moist coastal areas generally < 100m (Hickman 1993). Moist or wet places along the coast (Munz & Keck 1965). Coastal marshes (Mason 1957).	Blooms March – August
**Layia carnosa* Beach layia Family: Asteraceae	Federal: Endangered State: Endangered CNPS List 1B R-E-D code: 3-3-3	Coastal dunes (Skinner & Pavlik 1994). Coastal dunes; <60m. (Hickman 1993). Restricted to dune mat and foredune areas on the North Spit of Humboldt Bay, but also occurs in lower densities along margins of lupine scrub, herbaceous hollows, trails, and open	Blooms May – June

		areas with moving sand (Duebendorfer 1992).	

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan (cont'd)
*Asterisks [*] indicate habitat considered present in management area. Species in **bold type** indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
**Lycopodium inundata* bog club-moss Family: Lycopodiaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-2-1	Bogs and fens (coastal), Lower montane coniferous forest (mesic), marshes and Swamps (lake margins); 5-1000 m (Skinner & Pavlik 1994). Low elevations on wet shorelines and bogs (Pojar & MacKinnon 1994). Peat bogs, muddy depressions, pond margins; <50 m (Hickman 1993).	Blooms in September, but is identifiable throughout the year.
**Lycopodium clavatum* running pine Family: Lycopodiaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-1-1	Marshes and Swamps, North Coast coniferous forest (mesic); 60-610 m (Skinner & Pavlik 1994). Moist to dry open forests or on edges of swamps and bogs; openings and clearings in roadcuts, often on acid sandy soil (Pojar & MacKinnon 1994). Moist ground, swamps, rarely on trees; <200 m (Hickman 1993).	Blooms July – August, but is identifiable throughout the year.
Oenotheria wolfii Wolf's evening primrose Family: Onagraceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 3-3-2	Coastal bluff scrub, Coastal dunes, Coastal prairie, Lower montane coniferous forests, sandy/usually mesic; 3-800m (CNPS 2001)	Perennial herb Blooms May-October
**Romanzoffia tracyi* Family: Hydrophyllaceae	Federal: None State: Special Status Species CNPS: 2 R-E-D code: 3-1-1	Coastal bluff scrub, Coastal scrub/rocky; 15-30m (CNPS 2001).	Perennial herb. Blooms March - May
Sidalcea malachroides Maple-leaved checkerbloom Family: Malvaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 2-2-2	Broadleaved upland forest, Coastal prairie, Coastal scrub, and North Coast coniferous forests, often on disturbed sites. 2-700 m (Skinner & Pavlik 1994). Woodlands and clearings near the coast; <700 m (Hickman 1993). Along the coast, especially in disturbed areas, below 2000 ft. in the Redwood and Mixed Evergreen forest comm. (Munz & Keck 1965).	Blooms May – August
**Sidalcea malviflora ssp. patula* Siskiyou checkerbloom Family: Malvaceae	Federal: Species of Concern State: Special Status Species CNPS: List 1B R-E-D code: 3-2-2	North Coast coniferous forests, Coastal prairie, and Coastal bluff scrub. 15 –700 m (Skinner & Pavlik 1994). Open coastal forest; gen. <700 m (Hickman 1993). Open grassy slopes and mesas, low elevations; Coastal Prairie, Mixed Evergreen and Redwood Forest plant communities (Munz & Keck 1965).	Blooms May – June

		Forest plant communities (Munz & Keck 1965).	

Table 2. Regionally Occurring Special Status Plant Species for Clam Beach/ Moonstone Beach Management Plan (cont'd)
Asterisks [*] indicate habitat considered present in management area. Species in ***bold type*** *indicate presence in management area*

Rare Plant Species	Status	Preferred Habitat	Comments / Blooming Period
**Sidalcea oregana* ssp. *eximia* coast checkerbloom Family: Malvaceae	Federal: None State: Special Status Species CNPS: List 1B R-E-D code: 3-2-3	Meadows, North Coast coniferous forest, and Lower montane coniferous forest. 5-1340 m (Skinner & Pavlik 1994). Meadows; <1200 m (Hickman 1993). Wet meadows, below 3500 ft. Redwood and Mixed Evergreen Forest communities (Munz & Keck 1965).	Blooms June - August
**Spergularia canadensis* var. *occidentalis* Western sand spurry Family: Caryophyllaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-3-1	Marshes and Swamps (coastal salt). 0-3 m (Skinner & Pavlik 1994). Sea beaches, tidal marshes, mudflats, saline or brackish soil (Pojar & MacKinnon 1994). Salt marshes; <3 m (Hickman 1993). Salt marshes, Humboldt Co. (Munz & Keck 1965).	Blooms June – August
Trichodon cylindricus (moss) Family: Ditrichaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 2-2-1	Broadleafed upland forest, Upper montane coniferous forest / sandy, exposed soil, roadbanks; 50-1500m (CNPS 2001)	
**Viola palustris* marsh violet Family: Violaceae	Federal: None State: Special Status Species CNPS: List 2 R-E-D code: 3-2-1	Coastal scrub (mesic), Bogs and fens (coastal); 0-150 m (Skinner & Pavlik 1994). Wetlands (swamps, fens, marshes, bog margins), wet seepage areas in forests and along streambanks (Pojar & MacKinnon 1994).	Blooms March – August

Lyngbye's sedge (*Carex lyngbyei*)

Lyngbye's sedge is a clonal, halophytic (salt tolerant), perennial sedge of the carex family (Cyperaceae). Its historical distribution is Iceland and the North Pacific coasts of America and Asia (Cayouette 1986). Mason (1957) describes its distribution in California as occurring in marshes near the coast in Marin, Mendocino, and Humboldt Counties. Lyngbye's sedge is a CNPS list 2 species with an R-E-D code of 2-1-1, which means it is considered endangered in a portion of its range, distributed in a limited number of occurrences, but occurs more or less widespread outside of California. Lyngbye's sedge is the dominant sedge in coastal brackish marshes in Oregon, Washington and Alaska. Based on personal observations, Roberts (pers. comm., July 2001) has suggested that this species is a relatively new colonizer of Humboldt Bay and Eel River delta brackish marshes.

Smythe and Hutchinson (1989) have suggested that Lyngbye's sedge can tolerate a variety of salinity and submergence regimes. They also provide anecdotal support for genetic variability within the species by stating that the diversity of habitats occupied by Lyngbye's sedge in the Skagit River delta area has led some researchers to speculate that local populations may be composed of a series of genetically distinct ecotypes. Locally, it is known to hybridize with Carex aquatilis var. dives (Hickman 1993).

Locally, Lyngbye's sedge blooms May through August and becomes dormant during the winter months. It has been found locally along slough banks and remnant slough channels, on island marshes, and on intertidal mud flats (Morrissette 2001b). Historic records indicate that Lyngbye's sedge was found along the mouth of the Little River as early as 1922 (CNDDB 2003).

Wolf's evening primrose (*Oenothera wolfii*)

Wolf's evening primrose is listed under state protection in Oregon as Threatened, and has been proposed for federal listing under the Endangered Species Act (Imper 1997). Currently in California it is on the CNPS list 1B, which indicates that it is rare, threatened, or endangered in California and elsewhere. It is a member of the family Onagraceae. Its range extends from northwestern California to southwestern Oregon. Earliest accounts of Wolf's evening primrose are found near Crescent City, near Trinidad, and south of Cape Mendocino, with occurrences documented as early as 1923. Wolf's evening primrose has been described as biennial, whereby it produces its vegetative, basal rosette the first year, then flowers and dies the second. However, under stressful environmental conditions it may act more like a perennial, taking several years before flowering. The rosette typically dies back (bolts) in April, then flowers in May or June. Flowers are pale yellow and less than 5 cm. across.

Habitat for Wolf's evening primrose includes moderately disturbed sites within one mile of the coast, primarily in northern foredune scrub, along primary foredunes near the beach strand, along coastal bluffs, and roadsides. It favors sites with moist, well-drained soil, minimal competition, and protection from northwestern exposure. . In the management area, it had been successfully introduced at Moonstone Beach along the shoreward edge of the parking lot. However, high storm events in the winter of 2003 appear to have removed these occurrences. This area should be monitored in the future to determine if a seed base remains and reestablishes.

Removal of habitat as a result of road construction, coastal bluff stabilization, and housing development has threatened and removed historic occurrences of Wolf's evening primrose, particularly near Trinidad. In the 1960's, a large population was impacted at Luffenholz Beach as a result of construction of a parking lot (Imper 1997). Mitigation efforts in the area have consisted of reseeding efforts at Luffenholz, along Scenic Drive near Luffenholz and Houda Point, and at Moonstone Beach, where Wolf's evening primrose had been successfully introduced. Currently, the species' greatest threat is hybridization with a garden ornamental primrose (O. glazioviana) that has

naturalized throughout the range of the native Wolf's evening primrose. These hybrids can be seen along Highway 101 near Clam Beach, and along the driveway leading down to Moonstone Beach. Although both species look very similar, especially with increasing hybridization (Imper 1997), there are some characteristics useful in distinguishing the two species, such as flower size and color, degree of pubescence on sepals, degree of overlap in petals, and stem and foliage color.

Humboldt Bay owl's clover (*Castilleja ambigua* ssp*. humboldtiensis*)

A small population of approximately 42 individuals of Humboldt Bay owl's clover was located during floristic surveys in May 2003, in the estuarine wetlands along the base of the bluff immediately south of the Murray Road access trail, and west of the Hammond Trail. There is no historic record of Humboldt Bay owl's clover in the management area. The nearest historic occurrences are located in Big Lagoon and Mad River Slough. Humboldt Bay owl's clover blooms from May until mid-June. Humboldt Bay owl's clover is an annual member of the figwort family (Scrophulariaceae). It is an endemic known only from Humboldt and Marin Counties. Humboldt Bay owl's clover generally grows in open areas within low-growing vegetation. It is thought to be a facultative hemiparasite that parasitizes other plant species by means of haustoria, which are essentially modified roots capable of penetrating and absorbing material from host tissues. Eicher (1994) suggests that Humboldt Bay owl's clover may not be host specific, and may in fact be capable of surviving in the absence of a host. Common associates include pickleweed (*Salicornia virginica*), jaumea (*Jaumea carnosa*), saltgrass (*Distichlis spicata*), sea lavender (*Limonium californicum*), and arrow-grass (*Triglochin maritima* and *T. concinna*). Humboldt Bay owl's clover is characterized in bloom by its purple bracts and pink flowers on a showy spike. Locally, Humboldt Bay owl's clover reaches its peak blooming period between May and mid-June, and then withers rapidly after setting seed, generally from mid June to early July (Morrissette 2001). Individuals found in the area were primarily in flower (85%) at the time of surveys.

3.0 Invertebrate Species with a Known Recreational Component

Pacific Razor Clam (*Siliqua patula*)

The Pacific razor clam is abundant on many beaches from northern California to Alaska. Clamming has been a popular recreational activity at Clam Beach, near the southern limit of the species distribution. For the last 15 years or so, clam populations at Clam Beach were insufficient to support recreational activities. However, during the spring of 2003 as many as 150-200 clammers were present on low tide mornings.

Adult clams live in the surf zone, and offshore as far as one-half mile. People dig them at low tide when their holes are visible in the wet sand and shallow surf. In the early 1990s, clamming drew crowds of 200-300 people to the area from May through July. The California Department of Fish and Game (CDFG) regulates clam harvesting on Clam Beach as described in the Sportfishing regulations:

> 29.45. Razor Clams.
>
> (a) Open season:
>
> (1) Little River Beach in Humboldt County: Between Mad River and Strawberry Creek open only during even-numbered years; between Strawberry Creek and Moonstone Beach open only during odd-numbered years.
>
> (b) Limit: Twenty. The first twenty clams dug must be retained as the bag limit regardless of size or broken condition.

There were no seasonal restrictions on clamming until 1953, when a decline in larger-sized clams prompted CDFG to limit the clamming effort seasonally and regionally. Clam Beach was divided into a south (Mad River to Strawberry Creek) and north beach (Strawberry Creek to Little River) (CDFG 2001). In 1960, a study indicated that alternate-year closures resulted in a decline in older and larger clams at the south beach due to a concentration of clammers there. As a result, all of Clam Beach

was open to clamming from 1971 to 1973. During this time, catch and effort were monitored, and public response was recorded. It was discovered that 86 percent of clamming occurred on the north beach due to easier beach access and greater clamming success. Clam diggers voiced a desire to return to alternate year closures because sizes of clams were declining. In 1974 the alternate-year closure was reinstated, and average clam size and catch-per-digger increased in the years immediately following this change. The abundance of clams declined after the 1982-1983 El Niño (CDFG 2001). In the late 1990's the clam population essentially disappeared from Clam Beach. Various theories sought to explain their absence, including scouring effects on young clams from winter storms, vehicle traffic on the beach, pollution, sediment from the migrating Mad River, overfishing and long term ocean temperature fluctuations. No local studies were done to address this question, so these theories remain speculation, however the return of the clams in 2003 does coincide with the return of cooler waters in the adjacent ocean.

According to CDFG (2001), no current population estimates are available for razor clams in California. The most recent data available is from a sampling program initiated in 1974 at Clam Beach. Estimates of annual clam catch for North Clam Beach between 1974 and 1989 ranged from 1,100 to 116,400. Estimates of annual clam catch for South Clam Beach between 1974 and 1989 ranged from zero to 45,500. Estimates of clam catch for Moonstone Beach (from Little River to the Bluffs) between 1980 and 1989 ranged from zero to 74,800. The annual number of clam diggers during this time period was estimated at between 880 and 12,670 for North Clam Beach, 220 to 6,900 for South Clam Beach, and 50 to 5,510 for Moonstone Beach. Current estimates are needed for Clam and Moonstone Beaches to guide future management considerations.

Pacific Mole Crab (*Emerita analaga*)

Pacific Mole Crabs (commonly called sand crabs) are abundant intertidal sandy beach crustaceans that are commonly used as bait for surf perch fishing. They live along the Pacific coast from Alaska to Baja California in the northern hemisphere and between Ecuador and Argentina in the southern hemisphere. During the reproductive season (February-October), females can produce one clutch per month of 50-45,000 eggs, which take approximately 30 days to develop. During spring and early summer, the young crabs can be present in incredible numbers, and are fed upon by numerous species of migrating shorebirds. Pacific Mole Crabs are found in the sandy intertidal zone throughout the length of the planning area.

4.0 Wildlife Resources

Dune habitat is utilized by a diversity of fauna. Falcons, hawks, vultures, and owls hunt over the area; black-tailed jackrabbits, brush rabbits, striped skunks, porcupines, raccoons, gray foxes, deer mice, and Western harvest mice forage on vegetation, and nests; larvae of leaf-cutter bees can be found in the foredunes (Pickart 1990). Several species of bees, ants, spiders and beetles have been found in the vicinity (Gordon 1984 in Pickart 1990), and there has been some evidence that the solitary bee *Megachile wheeleri* influences nutrient cycling in dunes by incorporating organic matter into the soil (Gordon 1988 in Pickart 1990). *Emphoropsis miserabilis*, a native solitary bee species that is an important pollination vector for native dune mat vegetation is known to occur (CALTRANS 2002). According to Pickart (1990), additional studies on animal activity in plant community structure have been conducted by Shields (1958), Zeevalking and Fresco (1977), Begon et al. (1986), Base (1978), and Petring (1982).

During migration and in winter, a diverse array of shorebird species comprising tens of thousands of individuals inhabits wetland and shore habitat in the Humboldt Bay area (pers. obs. R. LeValley and D. Fix). Many of these species are arctic or subarctic breeders, present only in passage. Most migrate across thousands of miles, in some cases wintering as far south as southern South America. Nearly all these birds exhibit habitat needs that are in some sense specialized. Shallow-water foraging habitat

at freshwater pond margins is favored by many species when available. Freshwater ponds occurring beneath Vista Point southward to the Mad River mouth are important migrational stopover sites utilized by migrant shorebirds. Large flocks of Western and Least Sandpipers and Semipalmated Plovers commonly occur on pond edges. This area is prone to recreational use which creates a sensitive situation for the species using the ponds.

Other shorebirds such as Whimbrels, Sanderlings, Long-billed Curlews and Marbled Godwits forage along the wet sand of the waveslope. Western, California and many other gull species commonly forage along the wrack line and roost on the waveslope. Harbor seals and sea lions may haul out anywhere along the waveslope; a harbor seal haul out site is located at the Mad River mouth.

Table 3. Regionally Occurring Wildlife Species for the Clam Beach/ Moonstone Beach Management Plan

A current list of wildlife species officially listed by the state of California or the federal government as Endangered, Threatened, Candidate, Sensitive, or of Special Concern was obtained from the California Natural Diversity Database. Wildlife species known or suspected to occur within the management area are considered.

*Species in **bold type** indicate known presence in management area.*

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Southern Oregon/Northern California Coho salmon *Oncorhynchus kisutch*	Federal Status: Threatened, State Status: Species of Concern	Designated critical habitat includes all waterways, substrate and adjacent riparian zones below longstanding, naturally impassable barriers (USFWS 1997).	Little River is designated critical habitat for the Southern Oregon/Northern California Coho salmon ESA. Adult Coho use Little River as a migration corridor; Little River estuary may serve as rearing habitat for juvenile coho (A. Berg pers. com.).
Northern California Steelhead ESU- *Oncorhynchus mykiss irideus*	Federal Status: Threatened State Status: Species of Concern	Habitat includes all waterways, substrate and adjacent riparian zones below longstanding, naturally impassable barriers.	Adult steelhead use the Mad and Little Rivers as migration corridors; and river estuaries serve as rearing habitat for juvenile salmonids (A. Berg pers. com.).
California Coastal Chinook salmon ESU *Oncorhynchus tshawytscha*	Federal Status: Threatened State Status: None	Designated critical habitat encompasses accessible reaches of all rivers, including estuarine areas and tributaries with the range of this ESU (USFWS 2000)	Adult chinook use the Mad and Little Rivers as migration corridors; and river estuaries serve as rearing habitat for juvenile salmonids (A. Berg pers. com.).
Tidewater Goby *Eucyclogobius newberry*	Federal Status: Endangered State Status: Species of Concern	They typically occur in from 3 to 6 ft of standing water over a sandy or mixed sandy/silty bottom with sparse vegetation (USFWS 1994). All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts per thousand (USFWS 1994) They are weak swimmers and generally avoid swiftly moving waters (USFWS 1994).	Spawning usually occurs from spring to mid-summer when most estuaries are closed to the ocean (USFWS 1994). Locally, tidewater gobies are found at the mouth of the Smith River; in Lake Earl, Lake Talawa, and the narrows between them; in Freshwater Lagoon, Stone Lagoon, and Big Lagoon; in Humboldt Bay near Jacoby Creek and Mad River Slough (Arcata Bay); and in the north slough of Redwood Creek Estuary (CNDDB 2001).

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Northern Red-Legged Frog ***Rana aurora aurora***	Federal: None State Status: Species of Special Concern	Breeding habitat consists of permanent or temporary water surrounded by dense grassy or shrubby vegetation (Jennings and Hayes 1994). .Adult frogs prefer habitat with patches of dense grassy or shrubby vegetation (Jennings and Hayes 1994).	Northern red-legged frogs tolerate higher salinity levels then most frog species and commonly occur in coastal habitats (D. Ashton pers. comm.). Northern red-legged frogs occur in marshy areas, ponds, stream and estuary edges throughout the management area.
Northwestern Pond Turtle ***Clemmys marmorata marmorata***	Federal Status: Species of Concern State Status: Species of Special Concern	Western pond turtles are habitat generalists associated with permanent or nearly permanent water from sea level to 6000 feet (Holland in Jennings and Hayes 1994). Pond turtles use basking sites, such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks (CDFG 1988). Nest sites generally occur within 1/4 mile of water sources, and are usually characterized by open areas dominated by grasses and herbaceous annuals with a southern exposure (Jennings and Hayes 1994).	Historically northwestern pond turtles were known to inhabit Arcata slew and the Mad River estuary near the fish hatchery (D. Ashton, pers. com.). Suitable pond turtle habitat may exist within the Mad and Little River estuaries where salinity is minimal. Factors limiting turtles in the management area include levels of salinity, fog (aka, amount of sunlight available for basking) and soil suitable for nesting. In coastal habitats northwestern pond turtles tend to occur in reedy cover, making them difficult to detect..
Brown Pelican ***Pelecanus occidentalis californicus***	Federal Status: Endangered State Status: Endangered	Feeding occurs primarily in shallow estuarine waters with the birds seldom venturing more than 2O miles out to sea (USFWS 1995). Sand spits and offshore sand bars are used extensively as daily loafing and nocturnal roost areas (USFWS 1995, Fix and Bezener 2000).	Brown pelicans use the near-shore Pacific Ocean west of the management area and commonly roost at the Mad River mouth. They may occasionally use other beach and coastal promontories for day-roost sites.
Cooper's Hawk ***Accipiter cooperi***	Federal Status: None State Status: Species of Special Concern	Forest and woodland habitat is essential for this species (Fix and Bezener 2000). Nesting may occur in suitable localities such as; Lanphere dunes, Mad River County Park (Harris 1996), and isolated woodlands near Manila. Migrants and wintering birds are found in the woody hollows at Fairhaven, Manila and the Mad River County Park, and in all of the coniferous forests from Lanphere dunes to Samoa.	In northwestern California they are uncommon residents, but regularly seen during migration and winter (Harris 1996). There have been reports of breeding at Mad River and Woodley Island (Harris 1996).

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Sharp-shinned Hawk ***Accipiter striatus***	Federal Status: None State Status: Species of Special Concern	Sharp-shinned Hawks occupy dense to semi-open coniferous, deciduous or mixed forests; occasionally along riparian edges (Fix and Bezener 2000). Nesting may occur in the coniferous forest at Lanphere dunes. Birds in migration and in winter will use woody hollows and coniferous forest.	Rare to uncommon summer breeder and year round resident in wooded areas (Fix and Bezener 2000). Sharp-shinned Hawks are a fairly common migrant from mid-September to mid-April and during fall migration from mid-September to late October (Fix and Bezener 2000).
Northern Harrier ***Circus cyaneus***	Federal Status: None State Status: Species of Special Concern	Summer birds frequent open areas with marsh or tall grass cover on the beach dune brush fields (Harris 1996). Harriers are found in all of the open dune habitats and in the pastures along the western edge of the Arcata Bottoms (R. LeValley pers. obs.).	Typically, nests are on the ground in shrubs, cattails or tall vegetation (Fix and Bezener 2000). Adults with newly fledged young have been seen in July at the Mad River estuary (Harris 1996). In northwestern California this species is a common migrant and winter visitor, but uncommon as a breeder and summer resident (Harris 1996).
White-tailed kite ***Elanus leucurus***	Federal Status: Migratory Nongame Bird of Management Concern State Status: None	White-tailed Kites nest and roost in trees or small bushes in semi-open areas mostly on the coastal plane (Harris 1996). Kites are found in pastures at the western edge of the Arcata bottoms, in open dune habitats on the north and south spit, and at the Mad River Estuary (Harris 1996).	Common resident and breeder especially in agricultural and riparian areas of the coastal plain (Harris 1996).
Bald Eagle ***Haliaeetus leucocephalus***	Federal Status: Threatened State Status: Endangered	Adult and immature eagles from Alaska and the Pacific Northwest migrate along the coast following the salmon runs (Buehler 2000). They are typically situated within two miles of water bodies that support adequate food supply (Lehman 1979, USDI 1986). Bald Eagle nests are usually located in uneven-aged, multi-storied stands with old-growth components (Anthony et al., 1982).	In northern California Bald Eagle populations increase during winter and eagles are occasionally seen along the lower Mad River (Harris 1996). Breeding occurs near the coast along the Mad River near Blue Lake and near Freshwater Lagoon .

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Osprey ***Pandion haliaetus***	Federal Status: None State Status: Species of Concern	Ospreys forage by flying over bodies of water, diving into the water, and snagging a fish with its talons. Ospreys will roost and nest on exposed treetops, towers, pilings or similar structures near lakes, reservoirs, rivers, estuaries and the open seacoast (Fix and Bezener 2000).	This species is a common summer resident and breeder, with a few stragglers over wintering near major feeding areas (Harris 1996). Ospreys often fly over the Clam Beach area and forage over the ocean opposite the management area.
Merlin ***Falco columbianus***	Federal Status: None State Status: Species of Concern	They are found in a wide variety of open habitats where they prey primarily on shorebirds and songbirds (Fix and Bezener 2000). They usually nest in trees or cliffs that offer wide views.	In northwestern California, they are uncommon migrants and winter visitors. They appear each fall in open lowlands along the coast (Harris 1996). Merlins have been observed hunting at Clam Beach within the management area during winter and early spring (S. McAllister pers. obs.). They are a potential predator of Snowy Plovers.
Peregrine Falcon ***Falco peregrinus***	Federal Status: Delisted State Status: Endangered	Although not strictly tied to aquatic habitats, they rely upon populations of flocking birds such as shorebirds and ducks during the colder months, therefore favoring shorelines and shallows (Harris 1996, Fix and Bezener 2000). Preferred nesting sites include inaccessible cliffs on rocky outcrops and in river gorges (Fix and Bezener 2000).	Peregrines regularly occur at the Mad River mouth (Harris 1996) and may hunt at freshwater ponds in the southern portion of the management area and over the outer beach and Mad River and Little River estuaries. Peregrines are not known to nest within the management area but summering birds suggest nesting nearby, possibly at Trinidad Head.
Western Snowy Plover ***Charadrius alexendrinus nivosus***	Federal Status: Threatened State Status: Species of Special Concern	Nesting occurs above the high tide line in sandy substrate, and occasionally on driftwood (LeValley 1999). At the northern section of Clam Beach, on Little River State Beach nesting and brooding has occurred in the 'backdune' area.	Clam Beach is one of three modern breeding sites in Humboldt County. Thirty-five nests were initiated at Clam Beach during the 2002 breeding season, involving 19 adults (Colwell et al. 2002). Snowy Plovers are present year-round at Clam Beach. A recent (1/7/03) winter survey tallied 44 plovers between Mad River and Little River (Mad River Biologists, unpublished data).
Long-billed Curlew ***Numenius americanus***	Federal Status: Species of Concern State Status: Species of Concern	Long –billed Curlews, America's largest sandpiper, has a down curved bill that is over seven inches in length (Fix and Bezener 2000). Long-billed Curlew are present in the Humboldt Bay area during winter and migrational periods.	Although they are most common on tidal mud flats or flooded pastures, curlews also forage in the wetsand of the beach waveslope in the management area.

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Black Oystercatcher ***Haematopus bachmani***	Federal Status: None State Status: None	Although not Federally or State-listed, the Black Oystercatcher is on watchlists for Partners In Flight and Audubon, California, due to statewide population concerns (CNDD 2003).	Black Oystercatchers are resident and breed on both offshore islands and rocks and mainland rocky shores. The rocky intertidal zone at Moonstone Beach is an example of suitable Black Oystercatcher habitat and has long been known as a high use area (D. Fix, pers. com.)
Elegant Tern ***Sterna elegans***	Federal Status: Migratory Nongame Bird of Management Concern State Status: Species of Special Concern	They are strictly coastal, and considered exceptional anywhere inland (Fix and Bezener 2000). Elegant terns breed on islands off Baja and along the coast of Southern California, then migrate north in late spring. Large flocks of these terns follow the Pacific Coast annually; however their dispersal range and numbers this far north may be closely related to warm-water currents.	In northwestern California, these birds are uncommon to common fall visitors (Fix and Bezener 2000). Elegant Terns are found primarily at the Mad River Estuary and along the bayshore near the north and south spits (Fix and Bezener 2000).
Marbled Murrelet *Brachyramphus marmoratus*	Federal Status: Threatened State Status: Endangered	In California Marbled Murrelets nest in old-growth forests within 50 kilometers of the coast from the Oregon border to Big Basin State Park near Santa Cruz. Marbled Murrelets forage in nearshore waters.	Loss of suitable nesting habitat is the primary reason for their decline. Other threats to this species are oil spills and entanglement in commercial fishing nets. Marbled Murrelets forage in nearshore waters, often less than ¼ mile from shore, including Clam Beach. Toxic spills from abandoned vehicles could have adverse impacts on Marbled Murrelets.
Yellow-billed Cuckoo *Coccyzus americanus occidentalis*	Federal Status: Candidate State Status: Endangered	Patch size is a very important landscape feature for Yellow-billed Cuckoos (Laymon and Halterman 1985). While nests are almost always placed in willows, cottonwoods are extremely important for foraging (Laymon and Halterman 1985). The best habitats for nesting are at large sites with high canopy cover and foliage volume, and moderately large and tall trees.	Yellow-billed Cuckoos are very rare to very uncommon breeders in northern California (Fix and Bezener 2000). Breeding pairs arrive in mid-May and depart the breeding grounds between late July and mid-September (Fix and Bezener 2000). There are no breeding records from Humboldt County, although one specimen, caught at Lanphere dunes exhibited a brood patch (Harris 1996). The habitat at the project site is not likely suitable for Yellow-billed Cuckoo.

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Burrowing Owl *Athene cunicularia*	Federal Status: None State Status: Species of Concern	Burrowing owls prefer open landscapes, and occasionally occur along seacoast bluffs and rocky breakwaters (Fix and Bezener 2000). They maybe seen conspicuously perched during daylight. Burrowing owls may be found throughout the study area in open dunes habitat. They are rare to uncommon local breeders or residents (Fix and Bezener 2000) and locally rare migrants and winter visitors (Harris 1996).	Burrowing owls appear in winter on beaches among driftwood, river bottom lands and bay dikes (Harris 1996).
Long-eared Owl *Asio otus*	Federal Status: None State Status: Species of Concern	Long-eared owls are nocturnal predators that hunt in open habitats, but return to dense stands of trees to roost during the day (Fix and Bezener 2000). This species will nest in abandoned hawk or crow nests or occasionally they nest in natural tree cavities (Fix and Bezener 2000).	Long-eared Owls are rare in northwestern California (Harris 1996). Fall migrants have been found in willow and alder hollows (Harris 1996).
Short-eared Owl *Asio flammeus*	Federal Status: None State Status: Species of Concern	Short-eared Owls are a nomadic species, moving in response to prey availability (Fix and Bezener 2000). They forage for rodents mostly at dusk and dawn in open habitats, such as, grasslands, wet meadows, and coastal estuaries (Fix and Bezener 2000). They roost on the ground in overgrown grasslands and dry marshes.	In northwestern California, short-eared owls are common to uncommon migrants and winter visitors (Harris 1996). Breeding has been suspected at the south end of Humboldt Bay on National Wildlife Refuge property.
Little Willow Flycatcher (Empidonax traillii brewsteri)	Federal Status: Species of Concern State Status: Endangered (includes all subspecies)	This species is a rare migrant in the management area, but may be found in riparian woodlands and thickets (Fix and Bezener 2000). Potential nesting habitat does occur as willow hollows and riparian woodland, but evidence of historical breeding is sketchy (Harris 1996).	Rare to uncommon migrant from mid-May to mid-June; locally uncommon to fairly common migrant from late July to late September; local, rare breeder from early June to late August (Fix and Bezener 2000). Suitable nesting habitat exists along the Clam Beach ponds, yet there are no recent summer reports.

Wildlife Species	Status	Preferred Habitat	Occurrence and Comments
Purple Martin ***Progne subis***	Federal Status: None State Status: Species of Concern	The Purple Martin breeds in riparian woodlands, oak woodland, partially logged, broken or burned coniferous forests and montane mixed forests, nesting in cavities (usually old woodpecker holes) of tall trees, often near water (Fix and Bezener 2000). Also breeds where human settlement occurs, often nesting in nest-boxes or gourds (Baicich and Harrison 1997). During migration Purple Martins can be seen over rivers, reservoirs and agricultural areas (Fix and Bezener 2000).	Rare to locally uncommon migrant from late march to mid-May and from August to early October; locally rare to uncommon breeder from April to August (Fix and Bezener 2000).
Black-capped Chickadee ***Parus atricapillus***	Federal Status: None State Status: Species of Concern	This species has increased dramatically in coastal Humboldt county since the 1970s and is now a common resident in willow-dominated habitats throughout the year. Nesting habitat is limited, however, to hollows with sufficiently large trees for nest cavities (Harris 1996). Black-capped chickadees are locally uncommon to common year-round residents in Northern California (Fix and Bezener 2000). Breeding season begins in early April (Baicich and Harrison 1997).	Black-capped chickadees are resident in willow/red alder dominated riparian habitat east of Highway 101 This species has been observed in willow cover within the management area (S. McAllister pers. obs.). Breeding has been documented at Fairhaven and the Mad River estuary (Harris 1996).
California Yellow Warbler ***Dendroica petechia***	Federal Status: None State Status: Species of Concern	Yellow Warblers are uncommon breeding birds of the coastal riparian habitats (Fix and Bezener 2000). In Northern California Yellow Warblers breed from mid-April to late August, they are rare but regular in coastal lowlands in winter (Fix and Bezener 2000).	Yellow Warblers have not been detected breeding in the riparian areas east of Highway 101. Migrants may be in nearly all coastal vegetation during fall migration (mid-August – early October) with a few spring migrants likely in May (D. Fix pers. com.).
Yellow-breasted Chat ***Icteria virens***	Federal Status: None State Status: Species of Concern	The Yellow-breasted Chat's habitat is in riparian deciduous forests of moderate or larger size (Fix and Bezener 2000).	Locally uncommon to common summer resident and breeder in Northern California (Harris 1996). Uncommon breeder from early April to early September (Fix and Bezener 2000). Chats are rarely observed along the coast and have occured within the management area in summer and during migration.

4.1 Sensitive Fish Species Accounts

Southern Oregon/Northern California Coho salmon ESU (*Oncorhynchus kisutch*)
Federal Status: Threatened
State Status: Species of Concern

The Southern Oregon/Northern California Coho salmon ESU (Evolutionarily Significant Unit) was designated as Threatened on June 18, 1997. This ESA includes all natural populations in river basins between Cape Blanco in Curry County, Oregon and Punta Gorda in Humboldt County, California (USFWS 1997). Designated critical habitat includes all waterways, substrate and adjacent riparian zones below longstanding, naturally impassable barriers (USFWS 1997).
In California, major populations are located in the Klamath, Trinity, Mad, and Noyo Rivers and are widely distributed in coastal streams, generally spawning in smaller streams than chinook salmon. However, these populations fluctuate greatly, the general trend being a decline in wild populations of small coastal streams with many historically used streams having lost their coho runs, primarily in the Klamath-Trinity system.

Designated Critical Habitat encompasses accessible reaches of all rivers, including estuarine areas and tributaries with the range of this ESU (USFWS 1997). This includes the Mad and Little River systems. Adult coho use the Mad and Little Rivers as migration corridors; and river estuaries serve as rearing habitat for juvenile salmonids (A. Berg pers. com.). Recreational activities near the mouth of the Mad and Little Rivers may temporarily disturb adult coho as they attempt to migrate up river. The cumulative recreational affects to juvenile coho rearing in the estuary are a greater concern.

Northern California Steelhead ESU- (*Oncorhynchus mykiss irideus*)
Federal Status: Threatened
State Status: Species of Concern

The Northern California Steelhead ESU (Evolutionarily Significant Unit) includes all naturally spawned populations and their progeny in river basins from Redwood Creek, Humboldt County to the Gualala River in Mendocino County, California. This ESU was designated as Threatened by the U.S. Fish and Wildlife Service on September 7, 2000 (USFWS 2000). This species occurs in both the Mad and Little River.

Steelheads exhibit varying degrees of anadromy, differences in reproductive biology, and plasticity of life history between generations (Busby et al. 1994). North American steelhead commonly spend two years in the ocean before entering freshwater to spawn (Busby et al. 1994). Steelhead enter fresh water up to a year prior to spawning. Steelhead differ from other salmonid species in that they may spawn more than once. In some cases, the separation between anadromous steelhead and rainbow trout is obscured (Busby et al. 1994).

Steelhead populations have declined from a combination of factors including habitat loss, overharvest, disturbance, and effects of hatchery practices (Moyle 1995). Accumulation of gravel in stream beds in recent years has reduced the amount of suitable habitat for summer steelhead. Even where habitats are apparently suitable, continuous disturbance by humans such as heavy use of a stream by gold dredgers, swimmers, and rafters may stress the fish (Moyle 1995).

The effects of hatchery fish on wild stocks of summer steelhead are not known, but wild stocks may be decreased through competition, genetic swamping, and increased harvest of wild fish as wild and hatchery fish cannot be distinguished by anglers (Moyle 1995, Busby et al. 1994). Steelhead numbers have not increased in response to management efforts. Reduction in summer carryover habitat has been repeatedly identified as a critical limiting factor (Moyle 1995).

Adult steelhead use the Mad and Little Rivers as migration corridors; and river estuaries serve as rearing habitat for juvenile salmonids (A. Berg pers. com.). Recreational activities near the mouth of the Mad and Little Rivers may temporarily disturb adult steelhead as they attempt to migrate up river. The cumulative recreational affects to juvenile steelhead rearing in the estuary are a greater concern.

California Coastal Chinook salmon ESU (*Oncorhynchus tshawytscha*)
Federal Status: Threatened
State Status: None

In California, although once abundant, Chinook now exist only in scattered populations and are largely the result of hatchery spawning and are primarily found in the Klamath, Trinity, and Sacramento drainages. Few chinook also occasionally occupy the Smith River, Redwood Creek, Mad River, Mattole River, and Eel River (Moyle 1995). At least eight runs of wild spring-run Chinook occur in California and all are in jeopardy. Aside from continual habitat loss, the foremost threat to this species is over-harvest associated with their preference of deep riverine pools in the summer months prior to spawning, were they are highly visible to poachers (Moyle 1995).
The California Coastal Evolutionarily Significant Unit (ESU) chinook salmon was designated as Threatened by the U.S. Fish and Wildlife Service on December 29, 1999 (USFWS 1999). This ESU includes,all naturally spawned populations in mainstems and tributaries. from Redwood Creek south to Russian R (USFWS 1999).

Designated critical habitat encompasses accessible reaches of all rivers, including estuarine areas and tributaries with the range of this ESU (USFWS 2000). This includes the Mad and Little River. Adult chinook use the Mad and Little Rivers as migration corridors; and river estuaries serve as rearing habitat for juvenile salmonids (A. Berg pers. com.). Recreational activities near the mouth of the Mad and Little Rivers may temporarily disturb adult chinook as they attempt to migrate up river. The cumulative recreational affects to juvenile chinook rearing in the estuary are a greater concern.

Tidewater Goby (*Eucyclogobius newberry*)
Federal Status: Endangered
State Status: Species of Concern

Tidewater gobies typically occur in standing water that is 3 to 6 ft deep over a sandy or mixed sandy/silty bottom with sparse vegetation (USFWS 1994). All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts per thousand (USFWS 1994) Tidewater gobies are weak swimmers and generally avoid swiftly moving waters (USFWS 1994). Spawning usually occurs from spring to mid-summer when most estuaries are closed to the ocean (USFWS 1994). Locally, tidewater gobies are found at the mouth of the Smith River; in Lake Earl, Lake Talawa, and the narrows between them; in Freshwater Lagoon, Stone Lagoon, and Big Lagoon; in

Humboldt Bay near Jacoby Creek and Mad River Slough (Arcata Bay); and in the north slough of Redwood Creek Estuary (CNDDB 2001). Tidewater gobies have potential to occur in the Mad and little river estuaries.

4.2 Sensitive Amphibians and Reptiles

Northern Red-legged Frog (*Rana aurora aurora*)
Federal Status: Species of Concern
State Status: Species of Concern

The northern red-legged frog is medium-sized brown, reddish brown to greenish gray frog with marked dorsolateral folds (Corkran and Thoms 1996). Variable red coloration is present on undersurfaces (Jennings and Hayes 1994). Recent work on vocal sac variation indicates that the previously recognized subspecies actually represent two species (Hayes and Krempels in Jennings and Hayes 1994). Populations with at least some individuals exhibiting features intermediate between Northern (R. a. aurora) and California (R. a. draytonii) red-legged frogs occur between northern Humboldt County and Pt. Reyes National Seashore, Marin County (Jennings and Hayes 1994).

In California, the northern red-legged frog and populations intermediate between Northern and California red-legged frogs extend from Marin County north to the Oregon state line with an elevational range from near sea level to 300 meters.

Northern red-legged frogs require permanent or nearly permanent pools for larval development and may require rains for dispersal (Jennings and Hayes 1994). Breeding habitat consists of permanent or temporary water surrounded by dense grassy or shrubby vegetation. Adult frogs prefer habitat with patches of dense grassy or shrubby vegetation.

As with the California red-legged frog, habitat loss and alteration, over-exploitation, and introduction of exotic predators were significant factors leading to this species decline. Factors including urban encroachment, construction of reservoirs and water diversions, land conversions, industrial and non-industrial forest practices, introduction of exotic predators and competitors, livestock grazing, and habitat fragmentation continue to threaten this species.

Many of the coastal watersheds in the regions where the northern red-legged frog occurs have sustained considerable alteration associated to timber harvest (California Department of Forestry and Fire Protection 1988) and urban development. Exotic predators such as bullfrogs and introduced game fish also occur in a substantial numbers of northwest coastal drainages where northern red-legged frogs are now rarely observed (Twedt 1993 in Jennings and Hayes 1994).

Northern red-legged frogs tolerate higher salinity levels then most frog species and commonly occur in coastal habitats (D. Ashton pers. comm.). Northern red-legged frogs occur in marshy areas, ponds, stream and estuary edges throughout the management area. They have been observed specifically in the wetland area associated with Widow White Creek.

Northwestern Pond Turtle (*Clemmys marmorata marmorata*)

Federal Status: Species of Concern
State Status: Species of Special Concern

Northwestern pond turtles are habitat generalists associated with permanent or nearly permanent water from sea level to 6000 feet (Holland in Jennings and Hayes 1994). Pond turtles make great use of partially submerged logs, rocks, mats of floating vegetation, or open mud banks as basking sites (CDFG 1988). Nest sites generally occur within 1/4 mile of water sources, and are usually characterized by open areas dominated by grasses and herbaceous annuals with a southern exposure. Most oviposition occurs during May and June (Buskirk in Jennings and Hayes 1994). Young turtles are thought to hatch and overwinter in the nest, as hatchling sized turtle have rarely been observed in aquatic sites during the fall (Holland in Jennings and Hayes 1994)

Western pond turtles can be found in much of California. The causes of population decline include habitat loss as well as alteration of aquatic sites used both for feeding and roosting and for nesting; population fragmentation, predation on young, especially by raccoons and introduced predators (e.g. bullfrog), trampling of nest sites by cattle, and commercial harvest for the pet trade (Jennings and Hayes 1994). Surveys in Oregon have indicated that turtles are frequently caught on baited hooks (Jennings and Hayes 1994). Many of these turtles are released with the hook still imbedded, impairing their ability to feed and ultimately causing their death. The Trinity River mainstem population exhibited an age structure dominated by adults relative to a population with a known stable age distribution, thus concluding damming of rivers and streams may also negatively impact juvenile turtles (Reese and Welsh 1998).

Historically northwestern pond turtles were known to inhabit Arcata slough and the Mad River near the Blue Lake fish hatchery (D. Ashton, pers. com.). Observations nearest to the management area have been in the ponds east of Highway 101, however no viable populations have been observed in the management area. Suitable pond turtle habitat may exist within the Mad and Little River estuaries where salinity is minimal although extensive surveys in the 1990's associated with gravel mining operations did not detect them downstream from the Blue Lake bridge (LeValley, pers. Observation). Factors limiting turtles in the management area include levels of salinity, fog (e.g., amount of sunlight available for basking) and soil suitable for nesting. In coastal habitats northwestern pond turtles tend to occur in reedy cover, making them difficult to detect.

4.3 Sensitive Bird Species Accounts

Brown Pelican (*Pelecanus occidentalis californicus*)
Federal: Endangered
State: Endangered
FWS: MNBMC (Migratory Nongame Bird of Management Concern)

On the Pacific Coast Brown Pelicans breed from southern California southward along the west Mexican coast into South America (Galapagos Is.). Brown Pelicans breed regularly in California only on West Anacapa I. Brown Pelicans have also nested elsewhere in the Channel Islands, specifically on Prince I, Santa Cruz I., and Santa Barbara Island. Adding evidence to the case for continued resurgence were hundreds of Brown Pelicans which initiated nesting at Pt. Lobos State Reserve, Monterey County,

during April and May 2000 (Terrill et al. 2000). The previous successful nesting there was in 1959 and the most recent attempt was in 1966. There is a possibility that Brown Pelicans may re-establish small breeding colonies along the central California coast—or colonize previously unutilized sites.

Along temperate North American coasts, birds annually move northward in numbers following the breeding season. A southward passage in late fall leaves very few Brown Pelicans north of central California. As many as 20,000 pelicans now pass into, as well as beyond, California at present (D. Jacques, pers. comm.). These birds feed and molt in California, Oregon, and Washington before returning to Mexico by early winter. In some winters, small numbers persist in and about the larger estuaries into January.

Brown pelicans use the near-shore Pacific Ocean west of the management area and commonly roost at the Mad River mouth. They may occasionally use other beach and coastal promontories for day-roost sites.

Bald Eagle (*Haliaeetus leucocephalus*)
Federal Status: Threatened (1995), Proposed for delisting (1999).
State Status: Endangered

Bald Eagles are common during migration and in winter along major river systems. Adult and immature eagles from Alaska and the Pacific Northwest migrate along the coast following the salmon runs (Buehler 2000). Nesting territories are usually associated with lakes, reservoirs, rivers, or large streams. They are typically situated within two miles of water bodies that support adequate food supply (Lehman 1979, USDI 1986). Bald Eagle nests are usually located in uneven-aged, multi-storied stands with old-growth components (Anthony et al.1982). In California 75% of all nest trees surveyed in 35 nest territories were within 1/4 mile of water(USFS 1977).
In California, the breeding season is January through July or August. A few weeks after leaving the nest, many young eagles migrate hundreds of miles north (CDFG 2002). Resident breeding pairs remain in California during winter, typically in the vicinity their nesting areas, except when winter conditions are too severe and they must move to lower elevations.
In northern California Bald Eagle populations increase during winter and eagles are often seen along the lower Mad River (Harris 1996). Breeding occurs on Mad River neat Blue Lake and near Freshwater Lagoon (R/ LeValley pers. Observation).

Peregrine Falcon (*Falco peregrinus*)
Federal Status: Endangered, (1970); Delisted, (1999)
State Status:
USFS Status: Sensitive

The Peregrine Falcon is a medium-sized falcon found throughout North America. Locally, the peregrine is an uncommon migrant and winter resident and rare summer breeder. Breeding in northern California takes place from early March to late August, but pair formation and courtship apparently begin as early as January, depending upon weather and availability of bird prey. The Peregrine Falcon is monogamous and exhibits extended parental care (Ratcliffe 1980, Ferguson-Lees and Christie 2001). Peregrines commonly demonstrate nest site fidelity (Ferguson-Lees and Christie 2001), returning to either the same nest or nearby alternate sites in successive years.

Peregrine Falcons feed primarily on birds, ranging from the size of warblers to that of medium-sized waterfowl. As they specialize in hunting from a stoop or by tail-chase, expanses of open or semi-open landscape are important to them during foraging. Although not strictly tied to aquatic habitats, they rely upon populations of flocking birds such as shorebirds and ducks during the colder months, therefore favoring shorelines and shallows. During a roughly thirty-year period from the 1940s to the 1970s, populations in North America declined precipitously due to pesticide residues, nest disturbances (including the illegal removing of chicks for falconry) and habitat destruction (Schaeffer and Ehlers 1978, Cade et al. 1985). Recovery of the species led to its removal from the endangered species list in August 1999. However, its status remains in a 5-year review period.

Peregrines regularly occur at the Mad River mouth (Harris 1996) and may hunt at freshwater ponds in the southern portion of the management area and over the outer beach and Mad River and Little River estuaries. Peregrines are not known to nest in the management area but summering birds suggest nesting nearby, possibly at Trinidad Head.

Western Snowy Plover (*Charadrius alexendrinus nivosus*)
Federal Status: Threatened, 1993
State Status: Species of Special Concern
FWS: MNBMC

The Western Snowy Plover is a resident along the Pacific coast from the coast of Washington to Mexico. Breeding occurs primarily from southern Washington to southern Baja California, Mexico (USFWS 2001). The coastal population of the Western Snowy Plover (Charadrius alexandrinus nivosus) was listed as a threatened population under the federal Endangered Species Act in 1993 (USFWS 1993). The Pacific coast population consists of birds that breed on the mainland coast, peninsulas, offshore islands, bays, estuaries or rivers of the United States Pacific coast and Baja California, Mexico (USFWS 1993). Snowy plovers are shorebirds that exhibit moderately strong fidelity to breeding locations; although individuals commonly move long distances between breeding attempts (Colwell et al. 2002).

In coastal California, Snowy Plovers breed from mid-March through mid-August (Colwell et al. 2002). Both sexes incubate, but females tend to incubate more during daylight hours and males more at night (Page et al. 1995). Chicks are precocial, leaving the nest within 24 hrs of hatching (Warriner et al. 1986). Males brood chicks until fledging, (31 days after hatching) leading them to feeding areas and warning them of danger (Page et al. 1995). In Northern California, Snowy Plovers breed and winter along ocean beaches and gravel bars of the Eel River (Colwell et al. 2002).

In 2001 the U.S. Fish and Wildlife Service issued a draft recovery plan for the Pacific coast population of the Western Snowy Plover. Contained in the plan are specific recovery goals for each of six recovery units. Recovery Unit 2, comprising Mendocino, Humboldt and Del Norte counties, is tasked with reaching a breeding population of 150 birds. Currently, we stand at 42% of that goal, with 63 adults observed breeding during the 2002 season (Colwell et al. 2002). Clam Beach is one of three modern breeding sites in Humboldt County. Thirty-five nests were initiated at Clam Beach during the 2002 breeding season, involving 19 adults (Colwell et al. 2002). Nesting occurs above the high tide line in sandy substrate, and occasionally on driftwood (LeValley 1999). At the

northern section of Clam Beach, on Little River State Beach nesting and brooding has occurred in the 'backdune' area. The backdune area is undergoing rapid invasion by European Beachgrass (Ammophila arenaria), reducing the amount of available nesting habitat and warranting efforts to restore the habitat for Snowy Plovers as well as native plant communities. The area below Vista Point where the mouth of the Mad River was formerly, has had increased use by Snowy Plovers over the last two years. The habitat there is highly dynamic as new dunes are forming and woody debris is accumulating.

Snowy Plovers are present year-round at Clam Beach. A recent (January 7, 2003) winter survey tallied 44 plovers between Mad River and Little River (Mad River Biologists, unpublished data).
Snowy Plovers are sensitive to disturbance, especially during the breeding season. Among the potential disturbances are vehicles, unleashed dogs, horses, and people. Additionally, trash and offal left by people attracts predators such as Common Ravens which may increase predation rates on Snowy Plovers.

Black Oystercatcher (*Haematopus bachmani*)
Federal Status: None
State Status: None

Although not Federally or State-listed, the Black Oystercatcher is on watchlists for Partners In Flight and Audubon, California, due to statewide population concerns (CNDD 2003). The Black Oystercatcher is a large, robust, brownish-black shorebird of the intertidal zone (Sibley 2000).
Black Oystercatchers are resident and breed on both offshore islands and rocks and mainland rocky shores. Nonbreeding birds typically roost communally at sites which lie above the high-tide zone and afford a wide view of nearby coastline (Andres and Falxa 1995).They forage almost exclusively in intertidal habitats, on rocky shores exposed to surf action and on sheltered gravel, cobble, or sandy shores and mudflats of bays and sounds (Hartwick 1976, Falxa 1992, in Andres and Falxa 1995).

Long-term degradation of intertidal habitat would almost certainly cause population declines (Sowls et al. 1980). Common Ravens are noted as major egg predators by Ehrlich et al. (1988); specifically, oystercatcher productivity in Prince William Sound, Alaska, was inversely correlated with raven abundance (Andres and Falxa 1995). Hartwick (1974 in Sowls et al. 1980) lists gull predation as an important cause of mortality. Chick mortality is apparently high. Both chicks and eggs are frequently wave-washed (Sowls et al. 1980).
The rocky intertidal zone at Moonstone Beach is an example of suitable Black Oystercatcher habitat and has long been known as a high use area (D. Fix, pers. com.)

Marbled Murrelet (*Brachyramphus marmoratus*)
Federal Status: Threatened
State Status: Endangered

The Marbled Murrelet is a small seabird belonging to the Alcidae family which includes puffins, murres, guillemots and auklets. Their distribution spans from Baja California to the Bering Sea. In California Marbled Murrelets nest in old-growth forests within 50 kilometers of the coast from the Oregon border to Big Basin State Park near Santa Cruz. Loss of suitable nesting habitat is the primary reason for their decline. Other threats to this species are oil spills and entanglement in commercial fishing nets. Marbled

Murrelets forage in nearshore waters, often less than ¼ mile from shore, including Clam Beach. Toxic spills from abandoned vehicles could have adverse impacts on Marbled Murrelets. Several abandoned vehicles have been observed in the management area and therefore pose a real threat.

Little Willow Flycatcher (*Empidonax traillii brewsteri*)
Federal Status: Federal Species of Concern
State Status: Endangered (includes all subspecies)

The Willow Flycatcher, a Neotropical migrant, breeds in riparian and mesic upland thickets in the United States and Canada, wintering from Veracruz and Oaxaca, Mexico south to Panama (AOU 1983). This species forages in riparian and meadow habitats during the nesting season. It arrives on the breeding grounds in May and June and migrates to southern Mexico and Central America in August (Harris et al. 1988, Zeiner et al. 1990). Willow Flycatchers have also been found in riparian habitats of various types and sizes, ranging from small willow-surrounded lakes or ponds with a fringe of meadow, to grasslands, willow lined streams or sapling-dotted boggy areas. Willow Flycatchers have also been found several times in young regenerating Douglas-fir stands in northern Humboldt County, California, with breeding confirmed in 1998 (D. Fix, pers. comm.). The Willow Flycatcher was formerly a common summer resident throughout much of California. The species has now been eliminated as a breeding bird from most of its former range in California (CDFG 2000). Loss and degradation of riparian habitat and destruction of nests through unrestricted livestock grazing and high rates of nest parasitism by Brown-headed Cowbirds have contributed to population reductions (CDFG 2000).

The Little Willow Flycatcher is listed as endangered under the California Endangered Species Act (CESA), and is a Federal species of concern. Historically, it was a common nesting species in the Sierra Nevada, Central Valley, and the central and northern Coast Ranges. Currently, it is found only in isolated populations in the Sierra Nevada and the Cascade Range and occasionally in the northern Coast Ranges (Harris et al. 1988, California Department of Fish and Game 1997).

In the last couple of years, bird surveyors have found a number of Least Willow Flycatchers apparently summering in higher-quality riparian edge at the confluence of the Van Duzen and Eel River (D. Fix, pers. com.). These observations are the nearest known occurrences to the management area. None has ever been reported beyond the spring migration period (about 10 May - 15 June) in the Clam Beach area. The habitat is strictly linear and is interrupted by openings. Suitable nesting habitat exists along the Clam Beach ponds, yet there are no recent summer reports.

Tricolored blackbird (*Agelaius tricolor*)
Federal: Species of Concern
State: Species of Concern
FWS: MNBMC

The male Tricolored Blackbird is distinguished from our locally common Red-wing Blackbird by its shoulder patch, which is much darker red and boarder by white instead of yellow (Terres 1980). Females have blackish-brown underparts and heavy dark brown streaking on the breast; female tricolors are overall darker then female redwings (Fix and Bezener 2000).

The Tricolored Blackbird is common throughout the Central Valley and in coastal districts from Sonoma County south. This bird's distribution is mostly confined to California, with the exception of small, scattered populations in Oregon, Washington and Baja California (Fix and Bezener 2000). Tricolored Blackbirds nest in dense colonies (Fix and Bezener 2000). Such colonies are vulnerable to massive nest destruction by mammalian and avian predators, including Swainson's hawks (Bent 1958).

They breed near fresh water, preferably in emergent wetland with tall, dense cattails or tules, but also in thickets of willow, shrubs or tall herbs (CDFG 2002). Tricolored Blackbirds are summer residents in northeastern California, occurring regularly only at Tule Lake, but have bred as far south as Honey Lake. Although not migratory over most of its range, this species leaves northeastern California in fall and winter, presumably migrating south. Flocks become nomadic in fall. In winter, flocks become more widespread from Marin to Santa Cruz counties and in the Sacramento River Delta (CDFG 2002).

Locally, the Tricolored Blackbird is a rare, sporadic breeding species. In northwestern California it bred only at Alton, Humboldt County, where a small colony persisted from 1992-1999 (D. Fix pers. com.). They are a causal breeder near Fortuna where there are two nesting colonies were discovered in 1992 (Harris 1996). This species sometimes occurs in mixed blackbird flocks in pastures of the Eel River, Smith River and Arcata bottoms (Harris 1996).

4.4 Sensitive Mammal Species Accounts

Steller's Sea Lion (*Eumetopias jubatus*)
Federal Status: Threatened
State Status: None
NMFS Status: Protected by Marine Mammal Protection Act 1972; reauthorized 1994.

The Steller's Sea Lion is a member of the Otariidae or eared seal family. This species exhibits dramatic sexual dimorphism; males weigh on average 440kg, almost twice as much as females (Orr and Helm 1989). These sea lions are sensitive to human disturbance; when hauled out, they will dive into the ocean upon close approach by a boat (Whitaker 1998). Pups are born on offshore islands from mid-May to mid-July (MMC 2002).

Steller's Sea Lions are present on rocky shores and coastal waters along the California coastline (Whitaker 1998). There are small breeding rookeries off the California coast on Año Nuevo, Farallon, Sugar Loaf Rock/Cape Mendocino and (Point) St. George Reef (Whitaker 1998, NMFS 1992). Migration occurs in August, at the end of the breeding season (Schusterman 1981). Males that breed in California spend the nonbreeding months in Alaska and British Columbia, and are rarely seen in California or Oregon outside of the breeding season (NMFS 1992).

The synergistic effects of depleted fish stocks, entanglement in nets and plastics, take by commercial fisheries and shootings have all contributed to the Steller's Sea Lion's decline (Rosen and Trites 2000, Hanni and Pyle 2000, Goldstein et al. 1999).

Counts conducted on Sugar Loaf Rock/Cape Mendocino in the early 1980s and in 1989 resulted in an estimate of 900 adults present per year, producing about 120 pups (Bonnel et al. 1983 in NMFS 1992).The breeding population on St. George Reef increased greatly between the early 1980s (~250 adults, 10-25 pups) to 1990 (674 adults, 124 pups) (Bonnel et al. 1983 in NMFS 1992). Population trends in the past few decades suggest there may be a northward shift in this species' distribution in California. Steller's Sea Lions may forage in the ocean opposite the management area.

California Sea Lion (Zalophus californianus)
Federal Status: None
State Status: None
NMFS Status: Protected by Marine Mammal Protection Act 1972; reauthorized 1994.

As a member of the Otariidae family, these animals have small but distinct external ears are generally brown to dark brown, almost black when wet (Orr and Helm 1989). California Sea Lions are primarily nocturnal hunters, spending most of the day sleeping on islands (Whitaker 1998). These sea lions haul out on offshore rocks, sandy or rocky beaches, and occasionally use caves protected by cliffs (Whitaker 1998). They feed in the cool upwelling waters near the mainland coast, along the continental shelf, and around offshore rocks; they sometimes forage at the sea floor. California Sea Lions are infamous for seizing fish from commercial fishing lines and nets. In Washington, Oregon and northern California they gather around river and stream mouths to prey upon migratory salmon and lamprey (Laake et al. 2001, Reeves et al. 2002).

California Sea Lions are present along the California coast in suitable habitat. They breed mainly on offshore islands, ranging from southern California's Channel Islands south to Mexico (Orr and Helm 1989). Migrating males spend much time out of the water on sandy beaches, flat reefs and offshore islands (Orr and Helm 1989). Females tend to stay close to the rookeries all year.

Although populations are increasing, each year many sea lions drown after becoming entangled in gill nets. The increasing populations of California Sea Lions and Harbor Seals have resulted in increased conflicts with commercial and sport fishing interests. Concern has increased in recent years over the impacts these animals may be having on depressed and declining salmon stocks (NMFS 2002).

Pacific Harbor Seal (*Phoca vitulina richardsi*)
Federal Status: None
State Status: None
NMFS Status: Protected by Marine Mammal Protection Act 1972; reauthorized 1994.

Lacking external ears, this species belongs to the Phocidae family. Harbor Seals do not show much sexual dimorphism, although the males tend to be slightly larger (Orr and Helm 1989). Pelt color is quite variable, ranging from dark brown with spots barely visible to a pale silver-gray with black or dark brown spots (Bigg 1981).

Along the California coast pups are born between March and early May (Orr and Helm 1989). Seal pups are usually born on a reef or sandbar. They are able to swim almost immediately. Weaning takes place at four to six weeks of age, after which there is no further contact between the mother and pup (Stein 1989 in NMFS 1997).

The Pacific Harbor Seal (P. v. richardsi), the smallest subspecies, inhabits the Pacific Coast of North America (Bigg 1981). Harbor Seals are found in appropriate habitats along the entire California coast. They are nonmigratory, generally traveling no greater than 300 km for food, breeding sites, and dispersal of young. Some short movements may be associated with seasonal availability of prey and with breeding. These seals are often found in estuaries and bays. Along the coast they tend to stay fairly close to shore, hauling out on sandbars, small rocks, reefs, and islands (Whitaker 1998). It is thought that Harbor Seals are highly social as a strategy to protect them from predators. These animals are wary; as groups become larger, individual seals are able to spend more time resting and less time being vigilant (Orr and Helm 1989). Additionally, Harbor Seals are able to thermoregulate better in groups than individually (Renyolds and Rommel 1999). Despite their seeming attitude of nonchalance while hauled-out, at least some individuals among a group of Harbor Seals maintain a visual command of their surroundings. They are never far from water; whether on an island, reef, sandbar, or rock, they will flee in to the water at the first sign of danger (Orr and Helm 1989).

Populations of Harbor Seals on the Pacific Coast have increased at a rate of 5.6% a year since the mid 1970s and are presently at historically high levels (Hanan 1996 in NMFS 1997). The population in California was recently estimated at 32,699 (NMFS 1997).

Harbor Seals and California Sea Lions are known to congregate at the mouths of streams and rivers to feed on migratory lamprey and salmonids in Washington, Oregon and California (Laake et al. 2001, NMFS 1997). The National Marine and Fisheries Service (NMFS) is concerned that the co-occurrence of pinnipeds and depressed salmonid stocks may be a significant problem in the recovery of some threatened and endangered populations of anadromous fish (NMFS 1999, Laake et al. 2000). Increasing populations of California Sea Lions and Harbor Seals have also resulted in increased conflicts with public activities, such as angler fishing (NMFS 2002).

Each year from mid-February through the end of June, concerned citizens encounter Harbor Seal pups on beaches and pick them up, thinking they have been abandoned (MMC 2002). Usually the mothers have removed themselves from the pup in order to hunt. This problem has caused many seal pups to be unnecessarily orphaned. Harbor Seals are among the most difficult pinnipeds to approach and are easily disturbed by humans (Orr and Helm 1989). If disturbed too often, they have been known to abandon favorite haul-out sites or their pups. Human activities such sea-kayaking, recreational off highway vehicle driving, and unleashed dogs may affect Harbor Seals at haulout sites.

Harbor Seals occur throughout the year in the management area. They may be seen foraging in the surf or the Mad River estuary daily. Large numbers of seals regularly haul out at the Mad River mouth. Seals may occasionally haul out at other beach locations in the management area. On rare occasions small numbers of seals will haul out on Moonstone beach despite the presence of people; this is likely to escape aquatic predators such as sharks.

Northern Elephant Seal (*Mirounga angustirostris*)
Federal Status: None
State Status: None
NMFS Status: Protected by Marine Mammal Protection Act 1972; reauthorized 1994.

Elephant seals lack external ears, a characteristic they share with all members of the Phocidae family (Whitaker 1998). This species shows a high degree of sexual dimorphism. Upon reaching maturity, the larger males develop an enlarged and elongated nasal snout, hence the species' name. This species color ranges from gray to brown (Le Boeuf and Bonnel 1980).

The Northern Elephant Seal feeds on deepwater marine life such as squid, octopus, ratfish, hagfish and small sharks (Whitaker 1998).

The breeding range of the Northern Elephant Seal is from the Farallon Islands off central California south to Natividad I. off Baja California, Mexico (Orr and Helm 1989).

When not breeding or molting, males migrate along the west coast of North America as far north as Vancouver Island and out to sea up to 60km. Females have a shorter transit and forage in pelagic zones off the California coast during the non-breeding season (Le Boeuf and Bonnel 1980).

Recovered from near extinction, the population has grown logarithmically since the 1960s. The population has increased primarily due to the expansion of breeding areas. Breeding on the mainland has been a successful strategy, one that could not have worked in the past due to predation by grizzly bears, wolves and mountain lions (Le Boeuf and Bonnell 1980). In 1998 the population was estimated to be more than 175,000 animals (Reynolds and Rommel 1999).

Locally, juvenile males, also known as 'punks' haul out on sandy beaches during the nonbreeding season. In 2001 punk males were seen hauled out on Trinidad State Beach (Dr. D. Goley, Humboldt State University pers. comm.) and in July 2002 a punk male napped on Lufenholtz Beach virtually unnoticed by a dozen beach users and their dogs (H. Beeler, pers. obs.). Similarly, Northern Elephant Seals could haul out on beaches within the management area.

REFERENCES AND LITERATURE CITED

AOU (American Ornithologist Union). 1983. Checklist of North American Birds. 6th Edition. American Ornithologist Union. Buteo Books. Shipman, Virginia, USA.

AOU (American Ornithologist Union). 1957. The AOU Checklist of North American Birds. Fifth Edition. American Ornithologists Union. Buteo Books. Shipman, Virginia, USA.

Ainley, D.G. and T.J. Lewis. 1974. The history of Farallon Island marine bird populations 1843-1972. Condor 76: 432-446.

Andres, B.A., and G.A. Falxa. 1995. Black Oystercatcher (*Haematopus bachmani*). *In* The Birds of North America, No. 155 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Anthony, R.G., R.L. Knight, G.T. Allen, B.R. McClelland and J.I. Hodges. 1982. Habitat Use by Nesting and Roosting Bald Eagles in the Pacific Northwest. Trans. N. Am. Wildlife Natural Resources Conference. 68pp.

Aria, K. T. 1996. Coastal Sand Dune Stability, Vegetation, and Management Boundaries: Humboldt Bay North Spit and Vicinity. Map produced by Humboldt State University College of Natural Resources and Sciences for the Nature Conservancy. Arcata, CA.

Ashton, D. 2003. Personal Communication. Herpetologist, Redwood Sciences Laboratory, U.S. Forest Service. Arcata, California, USA.

Baicich, P. J. and C.J.O. Harrison. 1997. A guide to the nests, eggs, and nestlings of North American birds. Second Edition. Academic Press. San Diego, California, USA.

Berg, A. 2002. Personal Communication. Consulting Fisheries Biologist, Alice Berg and Associates. Eureka, California, USA.

Barbour, M. and J. Major. 1977. Terrrestrial vegetation of California. J. Wiley & Sons, New York.

Bigg, D. K. 1981. Harbor seal Phoca vitulina (Linnaeus, 1758) and Phoca largha (Pallas, 1811). Pages 1-27 in: S.H. Ridgway and R.J. Harrison, eds. Handbook of Marine Mammals. Vol. 1: The Walrus, Sea Lions, Fur Seals and Sea Otter. Academic Press. New York, New York, USA.

Blaustein, A.R., J.J. Beatty, D.H. Olson, and R.M. Storm. 1995. The biology of amphibians and reptiles in old-growth forests in the Pacific Northwest. U.S. Forest Service. Pacific Northwest Research Station. General Technical Report PNW-GTR-337.

Botanica Northwest Associates. 1992. Monitoring Plan for Pink Sand Verbena (*Abronia umbellata* ssp. *breviflora*) in the Humboldt County Beach and Dunes Planning Area. Unpublished report submitted to the Humboldt County Planning Department. Eureka, CA.

Bowlby, C. E. 1981. Feeding behavior of pinnipeds in the Klamath River, northern California. Master Thesis, Humboldt State University, Arcata, California, USA.

Boyd, M.J. Department Chair, Humboldt State University Biological Sciences, Arcata, CA. Telephone conversation on December 16, 2002, with Tamara Gedik, Biologist, Mad River Biologists, McKinleyville, CA.

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management 14(2):237-261.

Buehler, D. A. 2000. Bald Eagle (Haliaeetus leucocephalus). The Birds of North America, No. 506. (A. Poole and F. Gill, eds.) The Birds of Northe America, Inc, Philadelphia, PA.

Burger, J. 1981. The effect of human activity on birds at a coastal bay. Biol. Conserv. 21:231-241.

Busby, P.J., T.C. Wainwright and R.S. Waples. 1994. Status Review for Klamath Mountains Province Steelhead. NOAA Technical Memorandum NMFS-NWFSC-19

Cade, T. J., J. H. Enderson, C. G. Thelander, and C. M. White, editors. 1985. Peregrine Falcon populations: their management and recovery. The Peregrine Fund, Boise, Idaho, USA.

California Depratment of Fish and Game. 2002. The Status of Rare, Threatened, and Endangered Animals and Plants of California. California Department of Fish and Game. Website accessed July 2002. www.dfg.ca.gov/hcpb/species/search_species.shtml

----. 2001. California's Living Marine Resources: A status report. Publication SG01-11. California Department of Fish and Game. Website accessed May 2003. http://www.dfg.ca.gov/mrd/status/.

----. 1999. List of California terrestrial natural communities recognized by the California Natural Diversity Database (CNDDB). CDFG Wildlife and Habitat Data Analysis Branch. Sacramento, CA.

----. May 2, 1988. California's Wildlife, Volume I, Reptiles and Amphibians. California Department of Fish and Game, Sacramento, California. 272 pp.

----. January 2002. RareFind 2 personal computer program. Sacramento, CA.

California Department of Transportation (CALTRANS). 2002. Mitigation and monitoring plan for wetland impacts from the riprap placement at the Mad River mouth, Humboldt County, Route 101 Post Mile R94.5- 1992 RSP revetment project and the 1995 RSP revetment extension project. Eureka, CA.

California Natural Diversity Database. 2003. Special animals (670 taxa). California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch. Website accessed 23, February 2003. http://www.dfg.ca.gov/whdab/spanimals.pdf

Cayouette, Jacques. 1986. *Carex lyngbyei* excluded from the flora of eastern North America, and taxonomic notes on related species and hybrids. *Canadian Journal of Botany* **65**:1187-1193.

CNPS. 2001. Inventory of Rare and Endangered Plants of California (sixth edition). Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. California Native Plant Society. Sacramento, CA . x + 388pp.

Colwell, M.A., and K. D. Sundeen. 2000. Shorebird distributions on ocean beaches of northern California. J. Field Ornithol. 71:1-15.

Colwell, M.A., R.R. LeValley, A.N. Transou, S.E. McAllister, J. Hall, C.B. Millett, J.J. Meyer and D. LeValley. 2002. Final report: 2002 snowy plover breeding in northern California, with emphasis on Humboldt County.

Colwell, M.A., R. LeValley, A. Transou, S. McAllister, J. Hall, & C. Millett. 2001. Final report: 2001 snowy plover breeding in Humboldt County, CA. Submitted to MRB Research, Inc.

Corkran, C. and C. Thoms. 1996. Amphibians of Oregon, Washington and British Columbia. Lone Pine Publishing. Redmond, Washington, USA.

Cowardin, L.M., V. Carter, F. Golet, E. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. United States Fish and Wildlife Service. U.S. Department of the Interior. FWS/OBS-79/31.

Duebendorfer, Tom. 1986. Report of mapping survey on North Spit of Humboldt Bay, Humboldt County, CA. Unpublished report submitted to A. Pickart, Natural Resources Division. Humboldt County Public Works Department. Eureka CA.

----. 1989. An integrated approach to enhancing rare plant populations through habitat restoration. Presented at Society for Ecological Restoration and Management Annual Meeting: January 16-20, 1989. Oakland, CA.

----. 1992. Vegetation Classification, Rare Plant Analysis, Impacts, Restoration, and Habitat Management Strategies for the Humboldt County BDMP. Unpublished report prepared for the Humboldt County Planning Department. Eureka, CA.

Ehrlich, P.R., D.S. Dobkin and D. Wheye. 1988. The birder's handbook. Simon & Schuster. New York New York, USA.

Eicher, A.L. 1987. Salt marsh vascular plant distribution in relation to tidal elevation. M.A. Thesis, Humboldt State University. Arcata, California.

Eicher, A.L. 1994. Bracut Marsh Ecological Preserve Sensitive Plant Species Monitoring Final Report. Unpublished report prepared by Botanica Northwest Associates for Redwood Community Action Agency. Arcata, CA.

Emmett, R. L., S. A. Hinton, S. L. Stone, and M. E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries. Volume II: species life history summaries. National Oceanic and Atmospheric Administration Estuarine Living Mar. Resource. Report No. 8 FR 37(3).

Falxa, G. 1992. Prey choice and habitat use by foraging Black Oystercatchers: interactions between prey quality, habitat availability, and age of bird. Ph.D. dissertation, University of California, Davis, USA.

Ferguson-Lees, J. and D. A. Christie. 2001. Raptors of the world. Houghton Mifflin, New York, New York, USA.

Fix, David. Biologist, Mad River Biologists, McKinleyville, CA. Personal communication February 20, 2003 with Heather Beeler, Biologist, Mad River Biologists, McKinleyville, California.

Fix, D. and A. Bezener. 2000. Birds of Northern California. Lone Pine Publishing. Renton, Washington, USA.

Fluharty, M. J. 1999. Summary of Pacific harbor seal, *Phoca vitulina richardsi*, surveys in California, 1982 to 1995. California Department of Fish and Game. CDFG - MR Administrative Report 99 – 1.

Fowler, C., B. Valentine, S. Sanders and M. Stafford. 1991. Habitat suitability index model: Willow flycatcher (*Empidonax trailii*). Unpublished document, USDA-Forest Service, Tahoe National Forest, Tahoe, California, USA.

Gaines, D.A. and S.A. Laymon. 1984. Decline, status and preservation of the Yellow-billed Cuckoo in California. Western Birds 15:49-80.

Grinnell, J. and A. H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27:1-608.

Goldstein, T., S. P. Johnson, A. V. Phillips, K. D. Hanni, D. A. Fauquier, and F. M. D. Gulland. 1999. Human-related injuries observed in live stranded pinnipeds along the central California coast 1986-1998. Aquatic Mammals, 25(1): 43-51.

Hanni, K D., and P. Pyle. 2000. Entanglement of pinnipeds in synthetic materials at south-east Farallon Island, California, 1976-1998. Marine Pollution Bulletin, 40(12): 1076-1081.

Harris, J.H., S.D. Sanders, and M.A. Flett. 1987. Willow flycatcher surveys in the Sierra Nevada. Western Birds 18:27-36.

Harris, S.W. 1996. Northwestern California Birds. Humboldt State University Press. Arcata, California, USA.

Hassler, T. J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): coho salmon. U.S. Fish and Wildlife Service Biological Report 82(11.70) FR 33(1).

Hartwick, E. B. 1976. Foraging strategy of the Black Oystercatcher (*Haematopus bachmani Audubon*). Canadian Journal of Zoology, 54(2): 142-155.

Helbing, G. L. 1983. Maintenance activity of the Black Oystercatcher *Haematopus bachmani, Audubon*, in northern California. Unpublished M.S. Thesis. Humboldt State Univeristy, Arcata, California, USA.

Hunter, J.E., Schmidt, K.N., Stauffer, H.B., Miller, S.L., Ralph, C.J., and Roberts, L. 1998. Status of the Marbled Murrelet in the Inner North Coast Range of California. Northwestern Naturalist 79:92-103.

Holland, R.F. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* California Department of Fish and Game Nongame Heritage Program. Sacramento CA.

Humboldt County. 1992. Humboldt County Beach and Dunes Management Plan. Unpublished hearing draft report prepared for Humboldt County Planning and Building Department. Eureka, CA.

Imper, David K. 1997. Ecology and conservation of Wolf's evening primrose in northwestern California. Pages 34-40 in T.N. Kaye et al., eds. Proceedings of the Oregon Rare Plant Conference, Conservation and Management of Native Plants and Fungi, Native Plant Society of Oregon. Corvallis, Oregon.

----. Plant Ecologist, U.S. Fish and Wildlife Service, Arcata Office, 1655 Heindon Rd., Arcata CA. Telephone conversation on December 17, 2002 with Tamara Gedik, Biologist, Mad River Biologists, McKinleyville, CA.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Dept. of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA, USA.

Laake, J., R. DeLong and H. Huber. 2001. Pinniped consumption of salmonids in the Columbia River. National Marine Mammal Laboratory. Alaska Fisheries Science Center, National Marine and Fisheries Service. Seattle, Washington, USA.

LaBanca, Tony. 1993. Vegetation changes at coastal dunes between Mad River and Little River, Humboldt County, CA. Master's thesis. Humboldt State University. Arcata, CA.

----. Environmental Scientist, California Department of Fish and Game, Eureka, CA. Telephone conversation on January 22, 2003 with Tamara Gedik, Biologist, Mad Biologists, McKinleyville, CA.

Laymon, S.A. and M.D. Halterman. 1985. Yellow-billed Cuckoos in the Kern River Valley: 1985 population, habitat use, and management recommendations. California Department of Fish and Game, Nongame Bird and Mammal Section Rep. 85.06.

----. 1989. A proposed habitat management plan for Yellow-billed Cuckoos in California. USDA Forest Service General Technical Report PSW-110 p 272-277.

Le Boeuf, B.J. and M.L.Bonnel. 1980. Pinnipeds of the California islands: Abundance and distribution. Pages 475-493 in: Power, D.M., editors. The California islands: proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History. Santa Barbara, California, USA.

Le Boeuf, B. J. and R.M. Laws; editors. 1994. Elephant seals: Population ecology, behavior, and physiology. University California Press, Berkeley. Berkeley, California, USA.

LeValley, R. 1999. Snowy Plover nesting season 1999. Report prepared for Humboldt County Planning Department. Mad River Biologists, McKinlyeville, CA.

Mad River Biologists. 2002. Draft mitigation and monitoring plan for wetland impacts from the riprap placement at the Mad River mouth, Humboldt County, Route 101 Post Mile R94.5. Unpublished report prepared for California Department of Transportation. Eureka, CA.

----. 2002. Humboldt Beach and Dunes cooperative resource management plan (CRMP). Draft unpublished document submitted to Tom Hofweber, Humboldt County Planning and Building Department. Eureka, CA.

Mason, Herbert L. 1957. A flora of the marshes of California. University of California Press, Berkeley and Los Angeles.

McAllister, S. 2003. Personal Communication. Mad River Biologists, McKinleyville, California, USA.

MMC 2002. The Marine Mammal Center. Education, Pinnipedia,. The Marine Mammal Center, Sausalito, California, USA. Website accessed April 2002. http://www.marinemammalcenter.org/learning/education/pinnipeds/pinnipeds.asp

Moyle, P .B. 1995. Fish species of special concern in California. State of California, the Resources Agency, Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California, USA.

National Marine and Fisheries Service. 1992. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, USA.

NMFS 2002. National Marine Fisheries Service, NW region studies on pinniped impacts on salmon. Website accessed April 2002. http://www.nwr.noaa.gov/1seals/factsheet2.htm

National Marine and Fisheries Service. 1997. NOAA-NWFSC Tech Memo-28: Impacts of California Sea Lions and Pacific Harbor Seals on Salmonids and on the Coastal Ecosystems of Washington, Oregon, and California. U.S. Dept Commerce/NOAA/NMFS/NWFSC/Publications March 1997

National Marine and Fisheries Service. 2002. National Marine Fisheries Service, NW region studies on pinniped impacts on salmon. Website accessed April 2002. http://www.nwr.noaa.gov/1seals/factsheet2.htm

Odell, D.K. 1981. California Sea Lion, *Zalophus californianus* (Lesson, 1828). Pages 67-97 in: S.H. Ridgway and R.J. Harrison, eds. Handbook of Marine Mammals. Vol. 1: The Walrus, Sea Lions, Fur Seals and Sea Otter. Academic Press. New York, New York, USA.

Orr, R. T. and R. C. Helm. 1989. Marine Mammals of California. University of California Press, Berkeley. Berkeley, California, USA.

Page, G. W., and L. E. Stenzel. 1981. The breeding status of the snowy plover in California. West. Birds 12:1-39.

Page, G.W., J.S. Warriner, J.C. Warriner, and P.W.C. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). In The Birds of North America, No. 154 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA and The American Ornithologists' Union, Washington, D.C.

Parker, Jerry. 1974. Coastal dune systems between Mad River and Little River, Humboldt County, CA. Master's thesis. Humboldt State University. Arcata, CA.

Paysen, T.E., J. A. Derby, and C. E. Conrad. 1982. A vegetation classification system for use in California: its conceptual basis. General Technical Report PSW-63. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station. Forest Service, U.S. Department of Agriculture. 14p.

Pfister, C., B.A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biol. Conserv. 60:115-126.

Pickart, A.J. 1990. Final management plan for the Mad River Slough and Dunes Cooperative Management Area. In cooperation with the Bureau of Land Management, Louisiana-Pacific Corporation, and The Nature Conservancy.

Pickart and Sawyer, 1998. *Ecology and Restoration of Northern California Coastal Dunes*. California Native Plant Society. Global Interprint, Santa Rosa, CA.

Ratcliffe, D. A. 1980. The Peregrine Falcon. Buteo Books, Vermillion, South Dakota, USA.

Reese, Devin A.;Welsh, Hartwell H., Jr. 1998. Comparative demography of *Clemmys marmorata* populations in the Trinity River of California in the context of dam-induced alterations. Journal of Herpetology, 32(4): 505-515.

Reeves, R. R., B. S. Stewart, P. J. Clampham and J. A. Powell. 2002. National Audubon Society guide to marine mammals of the world. Alfred A. Knopf, Inc. New York, New York, USA.

Reynolds J. E. III and S. A.Rommel. 1999. Biology of Marine Mammals. Smithsonian Institution Press. Washington, USA.

Roberts, Chad. Senior Ecologist, Roberts Environmental Consulting. Personal. communication July 2001 with Stephanie Morrissette, Associate Biologist, Mad River Biologists, McKinleyville, CA.

Roelofs, T. D. 1983. Current status of California summer steelhead (*Salmo gairdneri*) stocks and habitat, and recommendations for their management. Submitted to USDA Forest Service, Region 5, National Marine and Fisheries Services, Portland Oregon, USA.

Sawyer, John. Professor, Humboldt State University, Arcata, CA, and CNPS fellow. Written communication on February 2, 2003, to Tamara Gedik, Biologist, Mad River Biologists, McKinleyville, CA.

Sawyer, John and Todd Keeler-Wolf, 1995. *A Manual of California Vegetation*. California Native Plant Society, Sacramento, CA.

Schaeffer, P. P. and S. M. Ehlers, editors. 1978. Proceedings of the National Audubon Society's symposium on the current status of Peregrine Falcon populations in North America. National Audubon Society Western Education Center.

Schusterman, R. J. 1981. Steller sea lion *Eumetopias jubatus* (Schreber, 1776). Pages 119-141, in: S. H. Ridgway and R. J. Harrison, editors. Handbook of Marine Mammals. Vol. 1: The Walrus, Sea Lions, Fur Seals and Sea Otter. Academic Press. New York, New York, USA.

Serena, M. 1982. The status and distribution of the Willow Flycatcher (*Empidonax traillii*) in selected portions of the Sierra Nevada. 1982. Calififfornia Deptartment of Fish and Game, Wildlife Management Branch Admin. Report No. 82-5. 28 pp.

Shapiro and Associates, 1980. Humboldt Bay Wetland Review and Analysis. Contract No. DACW07-78-C-0082 U.S. Army Corps of Engineers, San Francisco District. Seattle, WA. Volumes I-III.

Sibley, D.A. 2000. National Audubon Society the Sibley guide to birds. Alfred A. Knopf. New York, New York, USA.

Sowls, A. L., A. R. DeGange, J. W. Nelson, and G. S. Lester. 1980. Catalog of California Seabird Colonies. U.S. Deptatment of Interior, Fish Wildlife Service. FWS/OBS-80/37.

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Company. Boston, Massachusetts, USA.

Terres, J. K. 1980. The Audubon society encyclopedia of North American birds. Wings Books, New York, New York, USA.

Terrill, S.B., D.S. Singer, S.A. Glover, and D. Roberson. 2000. Middle Pacific coast regional report. American Birds 54: 323.

Theiss, K. and G. Lester. 1992. Amphibians, reptiles and mammals of the Humboldt Bay Beach and Dunes Study Area. Unpublished report submitted to Humboldt County Planning Department. Eureka, CA.

Trites, A W., and P. A. Larkin. 1996. .Changes in the abundance of Steller sea lions (*Eumetopias jubatus*) in Alaska from 1956 to 1992: How many were there? Aquatic Mammals, 22(3): 153-166.

Tuttle, D. C., R. Stein, and G. Lester. 1997. Snow plover nesting on Eel River gravel bars, Humboldt County. Western Birds 28:174-176

United States Fish and Wildlife Service. 1986. Pacific Bald Eagle Recovery Plan. Portland, Oregon. 163 pp.

----. 1993. Threatened status for the Pacific coast population of the Western Snowy Plover. Fed. Reg. 58:12864-12874.

----. 1994. Endangered status for the tidewater goby. Fed. Reg. 59: 5494.

----. 1997. Endangered and threatened wildlife and plants; Threatened status for the southern Oregon/northern California coast evolutionarily significant unit of coho salmon, U.S. Fish and Wildlife Service Final Rule. Federal Register Vol. 62. No. 117.

----. 1997. Recovery plan for the threatened Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. U.S. Fish and Wildlife Service. Portland Oregon. 203 pp.

----. 1998. Seven coastal plants and the Myrtle's silverspot butterfly recovery plan. Portland, Oregon. 141 pp.

----. 1999. Endangered and threatened wildlife and plants; Determination of threatened status for two chinook salmon evolutionarily significant units (ESUs) in California, U.S. Fish and Wildlife Service Final Rule. Federal Register Vol. 64. No. 249.

----. 2000. Designated critical habitat: critical habitat for 19 evolutionairly significan units of salmon and steelhead in Washington, Oregon, Idaho, and California. U.S. Fish and Wildlife Service Final Rule. Federal Register Vol. 65, No. 32.

----. 2001. Western Snowy Plover (*Charadrius alexandrinus nivosus*) Pacific coast population draft recovery plan. Portland, Regon. Xix + 630pp.

Warriner, J. S., J. C. Warriner, G. W. Page, and L. E. Stenzel. 1986. Mating system and reproductive success of a small population of polygamous snowy plovers. Wilson Bull. 98:5-37.

Wiedemann, A.M. 1984. The ecology of Pacific Northwest coastal sand dunes: a community profile. U.S. Fish and Wildlife Service. FWS/OBS-84/04. 130 pp.

Whitaker W. O. Jr.. editor. 1998. National Audubon society field guide to north American mammals. Alfred A. Knopf Inc., New York, New York, USA.

Whitfield, M.J. 1990. Willow flycatcher reproductive response to brown-headed cowbird parasitism. Master's Thesis, California State University, Chico, California, USA.

Zedler, Joy B. 1997. Adaptive Management of Coastal Ecosystems Designed to Support Endangered Species. Ecology Law Quarterly, pages 735-743.

Attachment 1. Compiled Species List for Clam Beach and Moonstone Beach Project Area

(Species in **bold** indicate sensitive status- refer to text for details)

Scientific Name	Common Name
Abronia latifolia	yellow sand verbena
Abronia umbellata ssp. breviflora	pink sand-verbena
Achillea millefoliata	yarrow
Agoseris grandiflora	agoseris
Agrostis stolonifera	creeping bent grass
Aira praecox	European hairgrass
Aira caryophyllea	silver European hairgrass
Alnus rubra	red alder
Alopecurus sp.	foxtail
Ambrosia chamissonis	beach bursage
Ammophila arenaria	European beachgrass
Anagallis arvensis	scarlet pimpernel
Angelica lucida	seacoast angelica
Antennaria sp.	pussy-toes
Anthoxanthum odoratum	sweet vernal grass
Artemisia pycnocephala	dune sagebrush
Azolla filiculoides	mosquito fern
Baccharis douglassii	marsh baccharis
Baccharis pilularis	coyote brush
Bellis perennis	english daisy
Brassica nigra	black mustard
Briza maxima	quaking grass
Bromus diandrus	rip-gut
Bromus hordeacous	soft chess
Bromus tectorum	cheat grass
Cakile edentula	sea rocket
Cakile maritima	sea rocket
Calandrinia ciliata	red maids
Callitriche heterophylla	water-starwort
Calystegia soldanella	beach morning glory
Cardamine oligosperma	bitter-cress
Camissonia cheiranthifolia	beach evening primrose
Cardionema ramosissimum	sand mat
Carex lyngbyei	**Lyngbye's sedge**
Carex obnupta	slough sedge

Carpobrotus edulis	hottentot fig
Castilleja ambigua ssp. humboldtiensis	**Humboldt Bay owl's-clover**
Ceanothus thyrsiflorus	blue blossom
Cerastium arvense	field chickweed
Chenopodium sp.	pigweed, goosefoot
Claytonia parviflora ssp. parviflora	claytonia
Claytonia siberica	Siberian candy-flower
Cortaderia jubata	pampas grass
Cotula coronopifolia	brass buttons
Cryptantha leiocarpa	smooth seeded cryptantha
Cytissus scoparius	scotch broom
Daucus carota	queen anne's lace
Distichlis spicata	saltgrass
Daucus pusillus	rattlesnake weed
Eleocharis macrostachya	spikerush
Eleocharis pachycarpa	spikerush
Epilobium ciliatum ssp. watsonii	Fireweed, willow herb
Equisetum arvense	common horsetail
Erechtites glomerata	cut-leaved coast fireweed
Erechtites minima	Australian fireweed
Festuca arundinacea	tall fescue
Festuca rubra	red fescue
Fragaria chiloensis	beach strawberry
Gallium aparine	goose grass
Garrya elliptica	silk-tassel
Gaultheria shallon	salal
Geranium dissectum	cranesbill
Geranium molle	dove-foot geranium
Glehnia littoralis ssp. leiocarpa	American glehnia
Glyceria sp.	mannagrass
Gnapthalium sp.	cudweed
Gnapthalium purpureum	cudweed
Heracleum lanatum	cow-parsnip
Holcus lanatus	velvet grass
Hordeum sp.	barley
Hypochaeris glabra	smooth cat's ear
Hypochaeris radicata	rough cat's ear
Juncus articulatus	jointed rush
Juncus brewerii	salt rush

Juncus bufonius var. occidentalis	toad rush
Juncus effusus var. effusus	soft rush
Juncus effusus var. brunneus	soft rush
Juncus effusus var. pacificus	soft rush
Lathyrus littoralis	beach pea
Leontodon taraxacoides	hawkbit
Leucanthemum vulgare	ox-eye daisy
Leymus mollis ssp. mollis	dunegrass
Limonium californicum	sea-lavender
Linaria canadensis	blue toadflax
Lolium perenne	perennial ryegrass
Lonicera involucrata	twinberry
Lotus corniculatus	bird's-foot trefoil
Lotus micranthus	miniature lotus
Lupinus arboreus	yellow bush lupine
Lupinus littoralis	seashore lupine
Lysichiton americanum	skunk cabbage
Maianthemum dilatatum	false lily-of-the-valley
Malus sylvestris	apple
Marah oreganos	coast man-root
Melilotus alba	white sweet clover
Mentha pulegium	pennyroyal
Mimulus guttatus	seep spring monkey flower
Myrica californica	California wax-myrtle
Navarretia squarrosa	skunk weed
Oenanthe sarmentosa	water parsley
Oenothera glazoviana	evening-primrose
Parentucellia viscosa	parentucellia
Petasites palmatus	coltsfoot
Phalaris arundinacea	reed canary grass
Picea sitchensis	Sitka spruce
Pinus contorta ssp. contorta	beach pine
Plantago major	common plantain
Plantago lanceolata	English plantain
Poa annua	annual bluegrass
Poa douglassii	sand-dune bluegrass
Polygonum sp.	knotweed
Polygonum paronychia	dune knotweed
Polypodium glycyrrhiza	licorice fern

Polystichum munitum	sword fern
Potentilla anserina ssp. pacifica	Pacific silverweed
Pteridium aquilinum	bracken fern
Raphanus sativus	wild radish
Rhamnus purshiana	cascara
Ribes sanguineum	red-flowering currant
Rorippa nasturtium-aquaticum	water cress
Rubus discolor	Himalayan blackberry
Rubus parviflorus	thimbleberry
Rubus spectabilis	salmonberry
Rubus ursinus	California blackberry
Rumex acetosella	sheep sorrel
Rumex crispus	curly dock
Rumex maritimus	golden dock
Salicornia virginica	pickleweed
Salix hookeriana	Hooker willow
Sambucus racemosa	red elderberry
Sanicula sp.	sanicle
Scirpus cernuus	low club rush
Scirpus maritimus	scirpus
Scirpus microcarpus	small-fruited bulrush
Scirpus pungens	common three-square
Scirpus setaceous	
Scrophularia californica	California figwort
Silene gallica	catchfly
Solidago spathulata ssp. spathulata	dune goldenrod
Sonchus oleraceus	common sow thistle
Spergularia rubra	sand-spurrey
Spartina densiflora	Chilean cordgrass
Stachys adjugoides	hedge nettle
Tanacetum camphoratum	dune tansy
Trifolium dubium	little hop clover
Trifolium hirtum	rose clover
Trifolium repens	white lawn clover
Trifolium wormskioldii	spring bank clover
Triglochin concinna	arrow-grass
Triglochin maritimum	seaside arrow-grass
Typha latifolia	broad-leaved cattail
Urtica dioica	stinging nettle

Vaccinium ovatum	evergreen huckleberry
Veronica americana	American brooklime
Vicia sativa ssp. nigra	narrow-leaved vetch
Vulpia sp.(myuros or bromoides)	six weeks fescue

LANDFORM AND CLIMATE

Physical Setting

The management area encompasses a 6.5 mile stretch of marine terrace bluffs, dunes, and beach strand. Elevations throughout the study area range from mean low, low water (MLLW), which is considered 0.00 throughout this report, to approximately 100 feet. The average elevation throughout the area is approximately 20 feet above MLLW.

Within the management area exists the mouth of the Little River, three creeks named Patrick Creek, Strawberry Creek and Widow White Creek, and a number of poorly defined, shallowly incised, intermittent streams that drain the marine terrace bluffs. Infiltration patterns and flows change depending on the time of year, i.e., seasonal weather patterns. For example, on Moonstone Beach, at least two of these intermittent streams drain the bluffs and, depending on the time of year, either infiltrate into the beach strand or cross the beach strand and drain into the ocean. From Clam Beach, Patrick Creek, and Strawberry Creek, which originate approximately one mile and three miles inland, respectively, converge just inside the management area. Their combined flow then meanders further south, crosses the beach strand, and drains to the ocean. South of the Caltrans revetment, intermittent streams drain the bluffs and create seasonal ponds at the base of the bluffs. Depending on the depth to groundwater as well as the time of year, the ponds infiltrate into the beach strand, drain overland across the beach strand, or accumulate volume and drain south to the mouth of Widow White Creek. Widow White Creek infiltrates into the strand, drains across the beach strand out to the ocean, or drains further south (out of the management area) to the estuary and mouth of the Mad River.

Regional Geology

The management area lies within the Coast Range geomorphic province of California. The area is characterized by northwest trending faults controlling the underlying structure, which is expressed as a northwest trending series of mountains and valleys. Three tectonic plates (the Pacific, North American, and Gorda) meet at the Mendocino Triple Junction (MTJ), which forms the Mendocino fault zone. North of the MTJ is the Cascadia Subduction Zone where the North American Plate overrides the Gorda and Juan de Fuca Plates.

Jurassic to Cretaceous age rocks of the Franciscan Complex form the basement in the region. The Franciscan is dominantly composed of sedimentary, ultramafic, and metavolcanic rocks with minor limestone and blueschist (Harden, 1998). Franciscan rocks form the more resistant seaward facing cliffs. Locally, the Franciscan is mantled by Quaternary dune sands, marine terrace deposits, and the Pleistocene Falor Formation. These younger formations are not as well consolidated or cemented as the underlying Franciscan, and are generally weaker and more easily eroded.

Local Geology

Exposed Franciscan rocks exist in the northern portion of the management area, within the vicinity of Moonstone Beach. These exposed rocks are considered part of the Central Belt Franciscan, comprised dominantly of well consolidated, structurally deformed, and highly sheared sandstone, siltstone and shale with minor conglomerate (Kelley, 1984). Also present in the management area is the Franciscan mélange, composed of individual blocks of greywacke, sandstone, mudstone, conglomerate,

greenstone, serpentine, and chert in a pervasively sheared argillaceous matrix (Kelley, 1984). The Franciscan was uplifted and eroded prior to deposition of younger sediments. North and west of the management area the Franciscan is locally overlain by older uplifted dune sands and marine terrace deposits. The marine terrace deposits and the older Falor Formation are near-shore and shallow-water marine deposits. The Falor Formation, terrace deposits, and dune sands unconformably overly the Franciscan Complex and form the terraces on which the unincorporated community of McKinleyville is sited. The Falor Formation is composed of terrigenous fluvial and marine sediments consisting of pebbly conglomerates, sand, and siltstones with minor plant and animal fossils (Kelley, 1984). Deposition was followed by a period of erosion of the Falor Formation sediments, followed by the deposition of additional shallow-water Quaternary marine deposits about 100,000 years ago. Subsequent uplift of the near-shore sea bottom created the marine terrace that makes up the western part of the McKinleyville terrace (Oscar Larson & Associates, 1997).

The dunes of the management area are characteristic of a retrograding (submerging shoreline) coast. These dune systems are continually undergoing cycles of both destruction and rejuvenation of dune features relative to the submerging landmass (Parker 1974). Dune systems in northern California show evidence of the two most recent episodes of dune activity in the series of cyclic stabilization and rejuvenation events. Rejuvenation events are the result of changes in relative sea level, which in turn are attributed to tectonic activity (Pickart and Sawyer 1998).

The local geological setting is dominated by the presence of a number of faults. The regional geomorphology is structurally controlled by these faults. Motion along the Cascadia Subduction Zone and the subsidiary shoreward faults has resulted in a northeasterly trending compression along the Humboldt County coast, producing a series of folds and thrust faults with some minor normal strike slip faulting. The McKinleyville, Mad River, Trinidad, and Fickle Hill Faults are considered active faults that compose the Mad River Fault Zone (CDMG, 2000a, 2000b, 2002). There are up to nine former marine terraces in the region south of Trinidad, and each slightly older terrace is stepped higher than the younger terraces below and to the west. The overall record suggests several periods of uplift of nearshore rocks, or several individual uplift events. The regional setting suggests that the uplift has resulted from thrust faulting with regional compression northeast of the Mendocino Triple Junction (Oscar Larson & Associates 1997).

Both uplift and subsidence can trigger movement of dunes. Both are hypothesized to occur simultaneously in a single regional event along alternating zones between fault lines (Clarke and Carver 1992). Uplift provides a newly exposed sediment source, and subsidence causes destruction of the dunes by waves. To regain a stable configuration, the coastline responds with gradual seismic rebound, but the net result is dunes that move again and migrate inland over the older dune system (Pickart and Sawyer 1998).

Color variations in the beach strand's sand are an indicator of the mineral content of the sand and provide a clue to the probable origin of the eroded sediments (Wiedemann, 1984). High concentrations of coarse, dark sediments are due to the erosion of ultramafic rocks, most likely associated with the Franciscan Complex. Lighter sediments may be attributed to several probable sources including the Franciscan, Falor, Prairie Creek Formations, and poorly consolidated marine terrace sediments.

Climate

The maritime climate of coastal Humboldt County is characterized by high relative humidity the entire year, and is maintained throughout the dry season (May through September) by fog and clouds. The annual average precipitation from 1971 to 2000 at the Eureka, California, weather station was 38.32 inches. Approximately 90% of annual precipitation occurs between October and April. The mean annual temperature for 1971 to 2000 was 52.9°F, with a maximum and minimum annual temperature of 59.3°F and 46.4°F, respectively (NOAA).

Dune Formation

The Humboldt Bay dune system, in its entirety, extends 34 miles from Trinidad south to Centerville Beach. The management area lies within the northernmost sub-unit of the Humboldt Bay dune system, which extends from Trinidad Head south to the mouth of the Mad River (Pickart and Sawyer, 1998).

The most important sources of material for dune building are sediment deposited at the mouths of rivers and offshore sandbars. Sediment from either of these sources is suspended in seawater and transported along the coast by a longshore current. A longshore current is a stream of water that flows parallel to the beach; it is created by winter storm waves and summer swell. Sand deposited onshore by the longshore current is then moved back and forth by waves breaking onto and receding from the beach. This continual onshore-offshore movement gradually pushes the sand along the beach edge. These processes of sediment deposition along the coast are referred to as littoral drifts (California Coastal Commission 1987). During winter months, sand is transported north from the mouth of the Eel River towards Trinidad Head. During the summer, the littoral current transports sand in a southerly direction, as observed by the abundance of sand at the beach in front of McKinleyville and the North Spit (Parker 1974).

Dune Morphology

Development of characteristic dune forms is dependent on a number of factors. Vegetation, sand moisture, and wind speed control the rate and timing of sand movement and dune formation and migration. Dune system morphology develops primarily as a response to wind pattern. Mean effective wind direction in McKinleyville is N.25°W, and N.38°W at Clam Beach (Parker 1974, NOAA 2003). This shift of thirteen degrees (13°) is explained by the deflection of wind around Trinidad Head and the highlands north of Clam Beach. Stabilized dunes display the same trend as active mobile dunes, which indicate the seasonal wind pattern has been constant for a long time (*ibid*).

The seasonal change in wave conditions also influences dune systems. When there are low waves during summer months, sand moves onshore to form a wide berm and a gently sloping beach profile, which protects the beach from erosion. When there are high waves during stormy winter months, sand erodes from the berm and moves offshore, and deposits on bars. With the absence of a berm in the winter months, there is an increase in erosion and a steeper beach profile (Hofweber 1992).

A common dune system pattern along the Northern California coast consists of two or three sets of parallel dunes, with the recently formed foredunes nearest the beach and the more stabilized backdunes farthest inland (California Coastal Commission 1987).

See 2.1A, Dune formations found in Northern California's active dune system (based on Pickart and Sawyer, 1998), and Figure 2.1B, A cross-section of land forms found in dune systems of the management area. The primary foredune is a ridge of sand parallel to the shore and positioned above the mean high tide line. It includes the entire zone of semi-stabilized ridges and/or hummocks from the upper boundary of the beach to the deflation plain, which is where sand has been eroded to near the level of the summer water table. During storm events, deflation plains become seasonally inundated by a rising water table, creating what is known as a dune hollow between foredune ridges. The moist, stable conditions promote the establishment of hydrophytic vegetation that stabilizes the dune hollows.

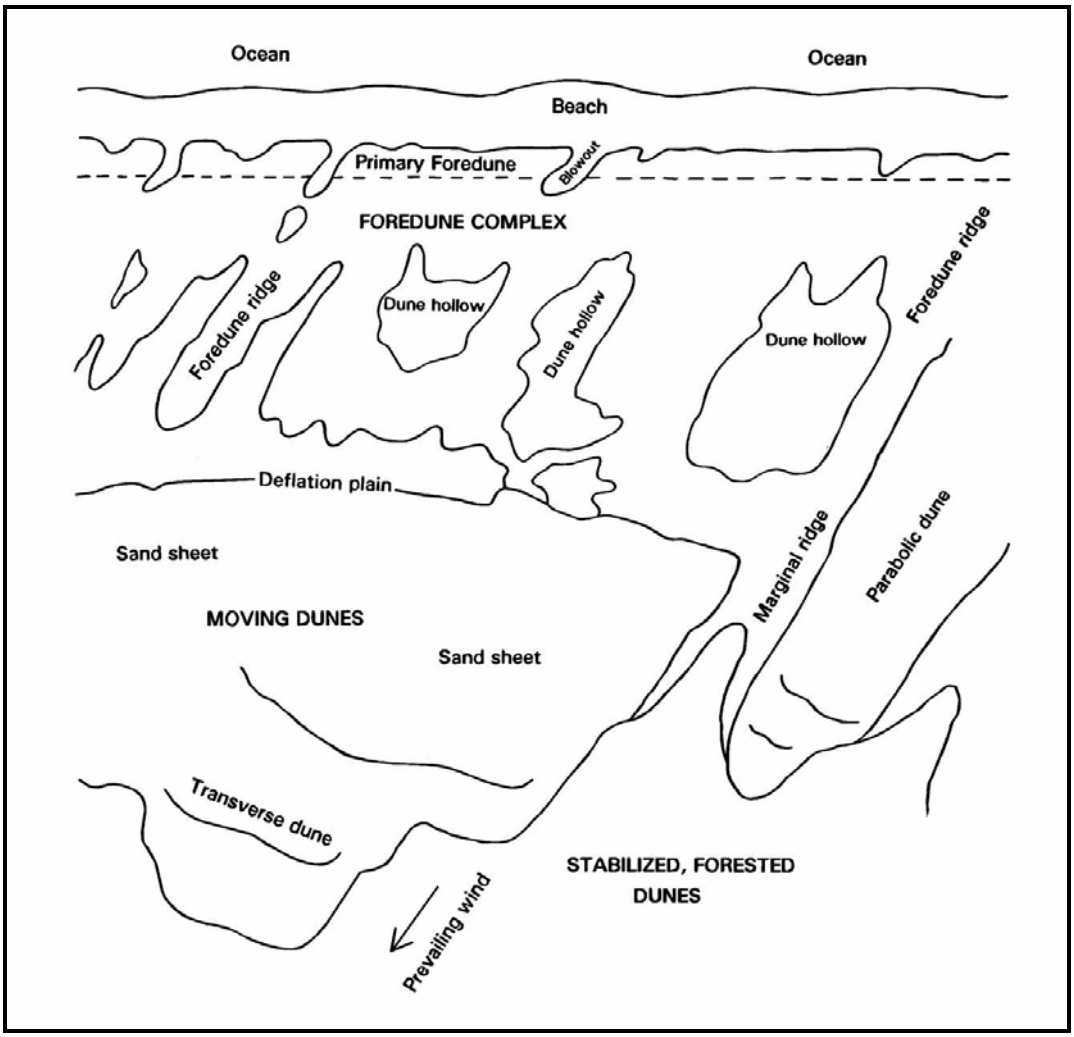

Figure 2.1A. Dune formations found in Northern California's active dune system. (Adapted from Pickart and Sawyer, 1998)

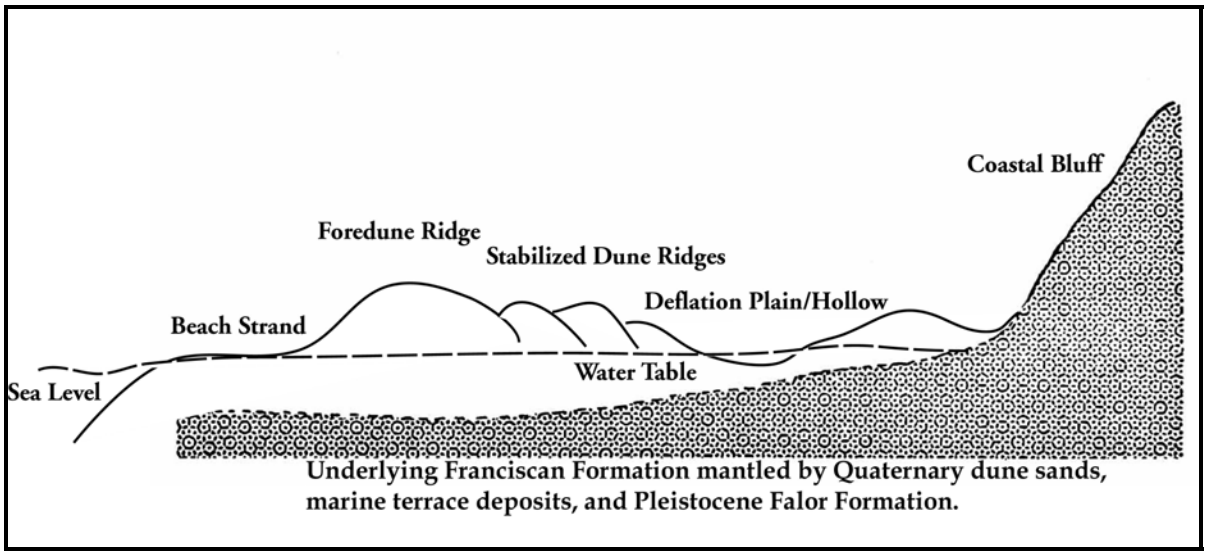

Figure 2.1B. A cross-section of typical dune forms found in the management area.

Within the management area, European beachgrass (*Ammophila arenaria*) dominates the continuous, steep primary foredunes, and has stabilized the once active dune system. Prior to the introduction and establishment of European beachgrass, foredunes were low, rose gradually, and were sparsely vegetated by native plants (Barbour and Johnson 1988). As a dense and aggressive grass on the primary foredune ridge, European beachgrass traps a very high proportion of sand blown off the upper strand, thereby accelerating the vertical development of the foredune ridge and allowing steepened slopes to form. As a result, the inland foredune complex receives diminished sand inputs.

In systems that have not been altered by European beachgrass, a series of longitudinal foredune ridges exists behind the primary foredune and are oriented parallel with prevailing winds. Together with the primary foredune, these ridges comprise the foredune complex where sand is slowly transported inland. Dune instability and major removal of sand from the foredune complex can be caused by a number of forces. Such forces include: mechanical disturbance (such as vehicle paths); burning or removal of the protective vegetative cover; soil nutrient depletion; periods of aridity; trampling; high intensity wind or wave events which cause blowouts; or gradual-to-rapid changes in sea level that result in increased wave attack and the eventual destruction of the primary foredune ridge.

During rejuvenation periods, sand moves inland from the foredune complex in the form of parabolic dunes. Their shape and development is dependent on a large volume of sand, a surface stabilized with vegetation that also exhibits points of weakness, and unidirectional winds capable of sand transport. The slower moving margins of these dunes become stabilized with vegetation, and as the parabolic dune migrates, the stabilized marginal ridges are left behind (Pickart and Sawyer 1998).

Within unaltered systems, parabolic dunes merge into expansive basins of unvegetated sand, or sand sheet. As the sheet migrates inland with the wind a large deflation remains behind. Movement of sand continues until the water table is reached and moist sand is exposed (Parker 1974). The inland margins of dune hollows migrate southeast behind the trailing edge of parabolic dunes (Pickart and Sawyer 1998). Parabolic dunes

and sand sheets, together known as active dunes, culminate in a steep face when they advance against a forest barrier, such as the dunes of the North Spit of Humboldt Bay.

Most of the dunes in the management area have been completely stabilized by vegetation, the type and details of which are discussed in the following section. The exception to this is the southern two miles of the management area, which lie between the Caltrans revetment and the mouth of the Mad River. This two-mile area consists of undeveloped and, as of yet, primarily unstabilized dunes. This dune environment exists as a result of the recent migration of the mouth from this location and the wash of seawater across the former sand spit between the river and ocean.

Mad River Migrations

The mouth of the Mad River is dynamic; its location moves continually. The river mouth has moved along the coastline in a predominately northward migration from Mad River County Park for the past 60 years. By 1991 the mouth reached Vista Point, which was its northernmost terminus in modern history. To prevent wave damage to US Highway 101 and the coastal vista point, the California Department of Transportation installed a rock slope protection revetment at the mouth of the Mad River in 1991-1992. In March of 1999 the river breached the sand spit near Hiller Road, relocating the mouth to its current location at Hiller Road.