CHAPTER XIII. EFFECTS OF PREFERRED ALTERNATIVE ON SPECIAL STATUS SPECIES

The proposed standards are designed to improve overall habitat conditions throughout the Bay-Delta Estuary, including habitat conditions for rare, threatened, and endangered species. This chapter provides both a description of relevant special status species and the effects of the proposed project on these species. The species list was provided by the DFG as part of the California ESA informal consultation process.

The special status species are discussed in three sections. Section I includes species that were identified as occurring within the counties that intersect with the legal boundaries of the Estuary, but inhabit areas outside of the Estuary and will not be adversely affected by the project. Section II includes species that inhabit areas within the Estuary that may be affected by the project, but the species are not likely to be adversely affected by the project. Section III includes species that inhabit areas in the Estuary that may be affected by the project and potentially could be adversely affected by the project. Species discussed include State and federal special status birds, mammals, fish, amphibians, reptiles, plants, and invertebrates. The descriptions of the habitats and the potential impacts of project operations on special status species were compiled from information provided by the DFG, DWR, USFWS, and various publications.

Impacts to special-status species are a component of the environmental impacts analysis and were considered in analyzing potential environmental impacts of the preferred alternative.

SECTION I

The following are special status species that were identified as occurring within the counties that intersect with the legal boundaries of the Estuary, but inhabit areas outside of the Estuary and will not be adversely affected by the project.

BIRDS

Swainson's Hawk
Buteo swainsoni
CA Threatened

Swainson's hawks breed in California and spend the winter in South America as far south as Argentina. Their diet consists of the California vole and a variety of birds and insects. The hawks nest near riparian systems of the Central Valley or use lone trees or groves of trees in agricultural fields. Suitable foraging areas include native grasslands or lightly-grazed pastures, alfalfa and other hay crops, and certain grain and row crops. Unsuitable foraging

habitat includes row crops in which prey are scarce or unavailable due to the density of the vegetative cover, such as vineyards, orchards, rice, and cotton crops (DFG 1992).

The proposed standards are not likely to adversely affect the nesting or foraging habitat of the Swainson's hawk.

Greater Sandhill Crane
Grus canadensis tabida
CA Threatened

Greater sandhill cranes nest in Lassen, Modoc, Plumas, Shasta, Sierra, and Siskiyou counties. The cranes winter in the Central Valley in the Butte Sink area and the Sacramento-San Joaquin Delta near Lodi in San Joaquin County. Wintering grounds include areas with favorable roost sites and an abundance of cereal grain crops. Irrigated pastures are chosen for feeding and resting areas. Their diet includes roots, tubers, grains, toads, frogs, eggs, young birds, small mammals, and various invertebrates (DFG 1992).

The proposed standards are not likely to adversely affect the greater sandhill crane.

Western Yellowbilled Cuckoo
Coccyzus americanus occidentalis
CA Endangered
FED Candidate

The western yellowbilled cuckoo typically nests in willow trees along the north, central, and southern coast, in the Klamath-Modoc region, the Sacramento and San Joaquin valleys, the southern Sierra Nevada, Mojave Desert, and lower Colorado River. The cuckoo has nested in walnut and almond orchards in California, but its natural nesting habitat is in deciduous riparian forest and woodlands of cottonwood-tree willow composition. The major threat to the cuckoo is the loss and degradation of its riparian habitat (DFG 1992).

The proposed standards are not likely to adversely affect the western yellowbilled cuckoo.

MAMMALS

San Joaquin Kit Fox
Vulpes macrotis mutica
CA Threatened
FED Endangered

The historic range of the San Joaquin kit fox included most of the San Joaquin Valley from the vicinity of Tracy south to Kern County. Kit foxes occur in the remaining native vegetation associations of the valley floor and surrounding foothills. Depending on the extent of agricultural development, distribution is spotty within this broad range. In addition,

smaller less dense populations may be found further north and in the narrow corridor between Interstate 5 and the Interior Coast Range from Los Banos to Contra Costa County.

In addition to habitat loss from agriculture, oil, residential and public works development, kit foxes are subject to disease, predation, roadkill, shooting, trapping, and rodenticide mortality (DFG 1992).

The proposed standards are not likely to adversely affect the San Joaquin kit fox.

Riparian Brush Rabbit
Sylvilagus bachmani riparius
CA Candidate For Listing as Endangered
FED Category 1 Candidate Species (Taxa for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened)

The riparian brush rabbit is currently found only at Caswell Memorial State Park (CMSP) on the Stanislaus River at the southern edge of San Joaquin County (DFG 1993). The entire population is restricted to 261 acres of remaining native riparian forest running in a strip along the Stanislaus River (DFG 1992).

The proposed standards are not likely to adversely affect the riparian brush rabbit.

Riparian Woodrat
Neotoma fuscipes riparia
FED Candidate

Historically, the riparian woodrat occupied the native riparian forests along the northern portion of the San Joaquin River and its tributaries, from Stanislaus County to the Delta. This habitat had a brushy understory associated with the forest and adjacent upland areas suitable for cover and retreat from annual floods. The historic ranges of the riparian brush rabbit and the riparian woodrat were nearly identical. Currently, the riparian woodrat and the riparian brush rabbit are known to occur only in CMSP, San Joaquin County, along the Stanislaus River.

The riparian woodrat is declining in population size and appears to be in jeopardy due to loss of habitat. This loss is primarily due to the completion of dams on the main tributaries to the lower San Joaquin River system which has reduced the frequency and severity of flooding. Prior to construction of dams and levees, much of the land that periodically flooded was used as pasture and was uneven in topography with some ground remaining above typical flood levels. These higher areas contained numerous patches of shrubs and trees and probably provided refuge during flooding events. Virtually all areas outside of flood-control levees now have been cleared, leveled, and planted as orchards, vineyards, or annual row crops.

Because the riparian woodrat only lives in the CMSP, the proposed standards are not likely to adversely affect this species.

AMPHIBIANS

California Tiger Salamander
Ambystoma californiense
FED Category 2 Candidate Species (Taxa for which existing information may warrant listing, but for which substantial biological information to support a proposed rule is lacking)

California tiger salamanders occur in the Central Valley from Butte County south to Kern County and in coastal grasslands from the vicinity of San Francisco Bay south at least to Santa Barbara County. One isolated population is known to exist at Grass Lake in Siskiyou County.

Tiger salamanders are most commonly found in annual grassland habitat, but also occur in grassy understory of valley-foothill hardwood habitats and, uncommonly, along stream courses. They occur mostly below 1,000 feet.

The adults spend most of the year in subterranean refugia, especially rodent burrows. The first rains of November usually initiate adult migration to breeding ponds where they remain a few days to several weeks after breeding is completed. Breeding and egg-laying normally occur from December through February. Females lay numerous eggs on both submerged and emergent vegetation and on submerged debris. Aquatic larvae seek cover in turbid water, clumps of vegetation, and other submerged debris. Post-metamorphic juveniles retreat to mammal burrows after spending a few hours of the day in mud cracks near water or tunnels constructed in soft soil.

Tiger salamanders breed and lay eggs primarily in vernal pools and other temporary ponds. They sometimes use permanent man-made ponds if predatory fishes are absent. Streams are rarely used for reproduction. Land under cultivation is unsuitable for these salamanders and major waterways that are swift and deep are not suitable for breeding habitat.

California tiger salamander habitat is not present in the tidal wetlands of Suisun Marsh. The tidal sloughs and permanent and seasonal wetlands all support fish and this salamander does not coexist with fish (DFG unpublished report; DWR 1994).

The proposed standards are not likely to adversely affect the California tiger salamander.

Western Spadefoot Toad
Scaphiophus hammondi
FED Category 2 Candidate Species

The western spadefoot toad occupies valley and foothill grasslands, open chaparral, and pine oak woodlands where temporary pools are present. Open grasslands with shallow temporary pools are considered to be ideal habitat. The western spadefoot toad is found throughout the Central Valley and surrounding foothills from near sea level to the 4,500-foot elevation. Individuals have been observed in the Sacramento Valley to the northeast of the Delta near Sloughhouse and to the northwest near Dunnigan. The nearest documented population to the Suisun Marsh is at the Jepson Prairie Preserve (DWR 1994).

Potential habitat for the western spadefoot toad is not present in the areas of Suisun Marsh influenced by tidal channels. This species is not expected to be adversely affected by the proposed standards.

Red-Legged Frog
Rana aurora draytonii
FED Category 2 Candidate Species, Proposed Endangered

Historically, the red-legged frog extended from the vicinity of Pt. Reyes National Seashore, Marin County, and from about Redding, south to Baja California, Mexico. Its habitat consists of quiet, permanent pools of streams, marshes, and occasionally ponds, and they prefer shorelines with extensive vegetation. This highly aquatic species stays within streamside habitats. The frogs have a period of inactivity from late summer to early winter.

Breeding takes place from January to July with a peak in February in the south, and in March to July in the north. Eggs are laid typically on vertical emergent vegetation such as bulrushes and cattails. Tadpoles require 11-20 weeks to reach metamorphosis. Adult frogs are nocturnal and are closely associated with dense, shrubby, or emergent riparian vegetation associated with deep, still or slow-moving water. Reduction in population levels are due to habitat loss, introduction of exotic predatory species (such as crayfish, largemouth bass, and catfish), and habitat fragmentation (Jennings et al. 1992).

Because the red-legged frog requires freshwater riparian vegetation and the proposed standards are not likely to reduce this type of habitat, the proposed standards are not likely to adversely affect this species.

REPTILES

Giant Garter Snake
Thamnophis couchi gigas
CA Threatened
FED Threatened

The giant garter snake historically occurred in the San Joaquin Valley from Sacramento and Antioch southward to Buena Vista Lake, Kern County. It appears that this snake has been extirpated from Buena Vista Lake and the Tulare Lake basin. The present known distribution extends from near Chico, Butte County, to the vicinity of Burrel, Fresno County. It is one of the most aquatic garter snakes and is usually found in areas of freshwater marsh and low-gradient streams, although it has adapted to artificial habitats such as drainage canals and irrigation ditches, especially those associated with rice farming.

The primary threat to the species is urbanization, such as housing, business, industrial and recreational developments, which often leads to the destruction of wetlands and channelization of streams. Other impacts of urbanization include pollution, destruction of food sources, and predation by native and introduced species (DFG 1992).

The proposed standards are not likely to adversely affect the giant garter snake.

PLANTS

Salt Marsh Bird's Beak
Cordylanthus maritimus maritimus
CA Endangered
FED Candidate

Salt marsh bird's beak grows in the higher reaches of coastal salt marshes, where it receives inundation only at higher tides. Salt marsh bird's beak presently occurs only in scattered sites at fewer than ten remnant salt marshes in San Diego, Orange, Ventura, Santa Barbara, and San Luis Obispo counties (DFG 1992). Because the salt marsh bird's beak is not found within the project area, the proposed standards are not likely to adversely affect this species.

Delta Button Celery
Eryngium racemosum
CA Endangered
FED Candidate

Delta button celery occurs generally on clay soils in lowland areas of riparian and floodplain habitat. Historically, it occurred in Calaveras, Merced, Stanislaus, and San Joaquin

counties. Presently, it occurs primarily in Merced County along the San Joaquin River (DFG 1992).

The proposed standards are not likely to adversely affect the Delta button celery.

Contra Costa Wallflower
Erysimum capitatum var. *angustatum*
CA Endangered
FED Endangered

The Contra Costa wallflower habitat is stabilized sand dunes that are densely covered with herbs, grasses, and shrubs. Only two populations remain, both at the 70-acre Antioch Dunes along the San Joaquin River near Antioch in Contra Costa County (DFG 1992).

The proposed standards are not likely to adversely affect the Contra Costa wallflower.

Antioch Dunes Evening Primrose
Oenothera deltoides howellii
CA Endangered
FED Endangered

The Antioch dunes evening primrose grows in loose sand and semi-stabilized dunes in a small area along the San Joaquin River near Antioch in Contra Costa County, in the same area as the Contra Costa wallflower.

The proposed standards are not likely to adversely affect the Antioch dunes evening primrose.

Pitkin Marsh Indian Paintbrush
Castilleja uliginosa
CA Endangered
FED Endangered

The Pitkin Marsh Indian paintbrush historically was restricted to the wet marsh habitat of upper Pitkin Marsh in Sonoma County (DFG 1992). Loss of marsh habitat has greatly reduced the distribution of this species. Since the late 1970's, only a single plant remains in the wild. Pitkin Marsh Indian paintbrush requires two plants for pollination, so the single known plant cannot reproduce. Because the private landowner on whose property this plant is found will not allow the DFG to manage and monitor the plant, this last plant may be gone.

The proposed standards will not adversely affect the Pitkin Marsh Indian paintbrush.

San Joaquin Salt Bush
Atriplex joaquiniana
FED Category 2 Candidate Species

The San Joaquin salt bush is an annual herb from the goosefoot family (Chenopodiaceae). The San Joaquin salt bush is typically found in chenopod scrub type habitat. Salt bushes and greasewood frequently dominate this habitat type. This plant species is found in fine-textured, alkaline, and/or saline soils in areas of impeded drainage occurring in meadows, seeps, valley and foothill grasslands. The San Joaquin salt bush blooms from April through September. The geographic distribution of the San Joaquin salt bush is in the southern Sacramento Valley, San Joaquin Valley, and the eastern slopes of the inner south coast range. The San Joaquin salt bush may be found in Alameda, Contra Costa, Colusa, Fresno, Glenn, Merced, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, Solano, Tulare, and Yolo counties.

The California Native Plant Society (CNPS) has categorized this plant as rare. A rare listing means that the plant is not presently threatened with extinction, but it may become endangered if its present environment worsens. Currently, the San Joaquin salt bush is threatened by grazing, agriculture, and development.

Due to its habitat requirements, the proposed standards are not likely to adversely affect the San Joaquin salt bush.

California Beaked-Rush
Rhynchospora californica
FED Category 2 Candidate Species

The California beaked-rush is a perennial rhizomatous herb from the sedge family (Cyperaceae). The California beaked-rush is a rare plant occurring in freshwater meadows, seeps, marshes or swamps, in areas from sea level to treeline and on many different substrates. It is adapted to seasonally or permanently saturated soils. It may be surrounded by grasslands, forests, or shrublands. The California beaked-rush blooms from May through July. It is found in southern northwest Sonoma County, the northern and central Sierra Nevada foothills of Butte and Mariposa counties, and the northern San Francisco Bay area.

The CNPS has categorized this plant as rare. Currently the California beaked-rush is threatened by marsh habitat loss.

The California beaked-rush is not likely to occur in the areas affected by the proposed project; therefore, the proposed standards are not likely to adversely affect this plant.

Heartscale
Atriplex cordulata
FED Category 2 Candidate Species

Heartscale, or heartleaf saltbush, grows in alkaline or saline soils and is found in alkali grasslands, alkaline seasonal wetlands, and valley sink scrub vegetation communities. It is most commonly associated with barren, sparsely vegetated sites. It is found in the Sacramento and San Joaquin Valley at elevations less than 200 meters. It has been reported in Tulare, Fresno, Madera, Merced, Stanislaus, San Joaquin, Contra Costa, Solano, and Glenn counties. The closest known populations to the project are west of the Clifton Court Forebay in Contra Costa County. The decline of this species is related to urbanization and agricultural development (DWR 1994).

Heartscale does not occur in areas that will affected by the proposed project; therefore, the proposed standards are not likely to adversely affect this species.

Tiburon Indian Paintbrush
Castilleja affinis neglecta
FED Category 1 Candidate Species

The Tiburon Indian paintbrush is endemic to serpentine-derived soils and south to west-facing slopes within native bunchgrass communities. It occurs at American Canyon in Napa County and at three sites on the Tiburon Peninsula in Marin County (DFG 1992). It is threatened by urban development and mining activities. There is no suitable habitat for this species in the wetlands of Suisun Marsh (DWR 1994).

The Tiburon Indian paintbrush does not occur in the areas that will be affected by the proposed project; therefore, the proposed standards will not adversely affect this species.

Contra Costa Buckwheat
Eriogonum truncatum
FED Category 2 Candidate Species

Contra Costa buckwheat was last seen in 1940 and because recent attempts to rediscover it have been unsuccessful, it is presumed to be extinct. Historic populations ranged from 350 to 1600 feet in elevation (DWR 1994).

The proposed standards will not adversely affect the Contra Costa buckwheat.

Legenere
Legenere limosa
FED Category 2 Candidate Species

Legenere is categorized as Rare by the CNPS. It is found in the bed of vernal pools and in open wet meadows at elevations less than 450 feet. It has been documented in Lake, Napa, Placer, Sacramento, Solano, Sonoma, and Stanislaus counties. The closest known population to the Estuary is north of Suisun Marsh wetlands (DWR 1994).

The proposed standards will not affect vernal pools; therefore, the proposed standards will not adversely affect the legenere.

INSECTS AND OTHER INVERTEBRATES

Lange's Metalmark Butterfly
Apodemia mormo langei
FED Endangered

The Lange's metalmark butterfly is known only from Contra Costa County, where it inhabits the relict Antioch Dunes on the south bank of the San Joaquin River, near its confluence with the Sacramento River. Historically, its range may have included the entire extent of a now-destroyed 500-acre dune system. It is believed that this system was part of a prehistoric desert which extended into California's Central Valley. Its current range comprises only about 15 acres of the remaining dunes.

Lange's metalmark butterfly inhabits stabilized sand dunes and all developmental stages are closely associated with its larval host plant, naked buckwheat. The butterfly eggs are deposited only on this plant. The single greatest threat to the species is habitat destruction (Miriam Green Associates 1993).

The proposed standards will not affect the Antioch Dunes and, therefore, will not adversely affect the Lange's metalmark butterfly.

Sacramento Anthicid Beetle
Anthicus sacramento
FED Category 2 Candidate Species

The Sacramento anthicid beetle has been found in five locations in Sacramento, Solano, Butte, and Glenn counties. The Sacramento anthicid beetle occupies accumulations of loose sand where larvae probably feed on vegetable detritus. The need for loose sand is apparently critical. The loose sand apparently provides a substrate from which wind-deposited food is gleaned and the shifting sands protect the anthicids from terrestrial predators.

Historically, agricultural and economic development activities (land reclamation, flood control, water management, and sand mining) have been responsible for habitat destruction. In general, larger dune systems are continually shifted and reformed by winds, erosion, and new sand deposition. They are constantly renewing suitable microhabitats. Once limited in size and isolated, new dune formation ceases. As the existing dunes are stabilized by encroaching vegetation, new unstabilized formations no longer replace them. In addition, predation by the introduced Argentine ant is considered to represent a significant threat to the species (Miriam Green Associates 1993).

The proposed standards are not likely to affect the habitat of the Sacramento anthicid beetle and, therefore, will not adversely affect this species.

Delta Green Ground Beetle
Elaphrus viridis
CA Endangered
FED Threatened

The only known habitat for the Delta green ground beetle is in Olcott Lake in the Jepson Prairie Preserve in Solano County (Nature Conservancy 1992).

The proposed standards will not affect the habitat of the Delta green ground beetle and, therefore, will not adversely affect this species.

Longhorn Fairy Shrimp
Branchinecta longiantenna
FED Endangered

The longhorn fairy shrimp is reported from 18 pools in three widely-spaced locations along the eastern margin of the Coast Range between Contra Costa and San Luis Obispo counties, and in two locations near Brushy Peak.

The longhorn fairy shrimp inhabits two quite different vernal pools: (1) small clear-water depression pools in sandstone outcrops; and (2) clear to moderately turbid, clay and grass-bottomed pools in shallow swales of short grass, or grass and low shrub vegetation of near-desert conditions.

Fairy shrimp typically complete their life cycle in approximately 2 months. Nearly all fairy shrimp feed upon algae, bacteria, protozoa, rotifers, and bits of detritus. Eggs are either dropped at the bottom of the pond or remain attached to the female until she dies and sinks. The thick-shelled eggs are very tolerant of adverse conditions and hatch when the vernal swale/pool fills again with runoff.

Habitat of the longhorn fairy shrimp may have always been somewhat limited (Miriam Green Associates 1993).

The proposed standards will not affect vernal pools and, therefore, will not adversely affect the longhorn fairy shrimp.

Conservancy Fairy Shrimp
Branchinecta conservatio
FED Endangered

The range of the conservancy fairy shrimp includes the entire Central Valley in highly turbid, ephemeral water located in swales and vernal pools. These vernal swales and pools are created by winter and spring runoff into depressions lined with hardpan clay and may last for several months before drying out. Pools inhabited by the conservancy fairy shrimp are typically large but range in size from 0.37 acres to 10 acres.

Fairy shrimp typically complete their life cycle in approximately 2 months. Nearly all fairy shrimp feed upon algae, bacteria, protozoa, rotifers, and bits of detritus. Eggs are either dropped at the bottom of the pond or remain attached to the female until she dies and sinks. The thick-shelled eggs are very tolerant of adverse conditions and hatch when the vernal swale/pool fills again with runoff.

Much of the suitable habitat for the Conservancy fairy shrimp has probably been lost to agricultural and other development activities since the 1800's. The restriction of the species to small, widely scattered locations renders individual populations extremely vulnerable to localized disturbance (Miriam Green Associates 1993).

The proposed standards will not affect vernal pools; therefore, the Conservancy fairy shrimp will not be adversely affected.

Vernal Pool Fairy Shrimp
Branchinecta lynchi
FED Threatened

The range of the vernal pool fairy shrimp is from the Vina Plains of Tehama County through most of the length of the Central Valley, along the eastern margin of the Central Coast mountains region, to the mountain grasslands north of Santa Barbara. Several disjunct populations are located on the Santa Rosa Plateau and in Skunk Hollow near Ranch California in Riverside County.

Vernal pool fairy shrimp inhabit two quite different pools: (1) small, usually less than 20 inches diameter, clear-water depression pools in sandstone outcrops; and (2) the more common "grassed swale, earth slump or basalt-flow depression pools in unplowed grasslands", from approximately 200 square feet to more than 25 acres.

Although this species ranges over a broad area, locations are rather scattered and the species is not abundant anywhere. Habitat requirements and the currently documented range

suggests that the species once was probably widely distributed in grassland ephemeral pools throughout the Central Valley and in the margins of bordering mountain ranges. Much suitable habitat has been lost to agricultural and other development activities since the 1800's. At the time Europeans arrived in California, there were approximately 6 million acres of vernal pools in the Central Valley. By 1970, approximately 5.4 million acres had been destroyed. Vernal pool habitat continues to decline at a rate of 2 to 3 percent per year (Miriam Green Associates 1993).

The proposed standards will not affect vernal pools; therefore, they will not adversely affect the vernal pool fairy shrimp.

California Linderiella
Linderiella occidentalis
FED Category 1 Candidate Species, Proposed Endangered

The California linderiella is reported to occur from the east side of the Central Valley from east of Red Bluff to east of Madera at elevations between 131 to 551 feet. The species is found in the Sacramento area and from Boggs Lake north of San Francisco Bay in Lake County, and possibly south to Riverside County.

California linderiella inhabits three different types of seasonal pools, which may fill and redry one or more times during any given year depending on the seasonal nature of precipitation and drought: (1) pools in grass-bottomed swales in old alluvial soils underlain by hardpan, containing clear to tea-colored water; (2) mud-bottomed pools with lightly turbid water; or (3) clear water depression pools in sandstone or old lava flows. Pool size varies from about 1 square meter to the 99-acre Boggs Lake (Miriam Green Associates 1993).

The proposed standards will not affect the habitat utilized by California linderiella; therefore, they will not adversely affect this species.

Vernal Pool Tadpole Shrimp
Lepidurus packardi
FED Endangered

The vernal pool tadpole shrimp is found at 14 vernal pool complexes in the Sacramento Valley from the Vina Plains in Butte County, south to the Sacramento area in Sacramento County, and west to the Jepson Prairie region of Solano County. The vernal pool tadpole shrimp is found in pools most commonly located in grass-bottomed swales of unplowed grasslands in old alluvial soils underlain by hardpan, or in mud-bottomed pools containing highly turbid water. Pool sizes vary from approximately 50 square feet to 9 acres.

The proposed standards will not affect vernal pools; therefore, they will not adversely affect the vernal pool tadpole shrimp.

SECTION II

The following special status species inhabit areas within the Estuary that may be affected by the proposed standards, but the species will not likely to be adversely affected by the proposed standards.

BIRDS

Bald Eagle
Haliaeetus leucocephalus
CA Endangered
FED Endangered

The bald eagle winters near lakes, reservoirs, river systems, some rangeland, and coastal wetlands. The breeding range is mainly in mountainous habitats near reservoirs, lakes, and rivers in the northern one-third of the State. The birds are opportunistic in foraging, usually feeding on fish or waterfowl, but capable of preying on other small animals. They often eat carrion. The bald eagle is a rare winter visitor to Suisun Marsh (DFG 1992).

The proposed standards include standards that are intended to improve the habitat for estuarine species; therefore, the proposed standards will not adversely affect the bald eagle.

California Brown Pelican
Pelecanus occidentalis californicus
CA Endangered
FED Endangered

The California brown pelican breeds from the Channel Islands of southern California southward into Mexico. Between breeding seasons, pelicans range as far north as British Columbia, Canada and as far south as Central America. In California, the pelican eats surface schooling fishes such as the Pacific mackerel, Pacific sardine, and northern anchovy. The population segment of interest and concern to the DFG is the Southern California Bight population (DFG 1992).

The proposed standards are not likely to adversely affect the California brown pelican.

American Peregrine Falcon
Falco peregrinus anatum
CA Endangered
FED Endangered

The American peregrine falcon migration and wintering habitat includes most of California, except desert areas. These habitats are varied, including wetlands, woodlands, cities,

agricultural areas, and coastal habitats. The California breeding range, which has been expanding, now includes the Channel Islands, the coast of southern and central California, the inland north coastal mountains, the Klamath and Cascade ranges, and the Sierra Nevada. Nesting sites are typically on ledges of large cliff faces, but some pairs nest on city buildings and bridges. The peregrine falcon feeds on birds that are caught in flight. They are a rare winter visitor to Suisun Marsh (DFG 1992).

Winter foraging habitat for the species is present along tidal sloughs and in the seasonal wetlands of the Suisun Marsh area where waterfowl are present in high densities during October through May. The Delta and Suisun Marsh are used only irregularly by a small number of these raptors. The Estuary harbors an estimated 10-20 wintering American peregrine falcons. There are four nesting pairs known to occur near Central San Francisco, San Pablo, and Suisun bays; however, as of January 1992, none of these pairs were successfully reproducing (DWR 1994).

The proposed standards are not expected to result in a loss of habitat, nesting areas, or winter foraging habitat for this bird. Therefore, the proposed standards are not likely to adversely affect the American peregrine falcon.

California Least Tern
Sterna antillarum browni
CA Endangered
FED Endangered

The California least tern winters somewhere in Latin America, but the winter range and habitats are unknown. The nesting range is along the Pacific coast from southern Baja California to San Francisco Bay. Terns usually arrive in California in April and depart in August. They nest in colonies on bare or sparsely vegetated flat substrates near the coast. The historical nesting habitats of this species have been largely eliminated by development and recreational use. Typical nesting sites are now on isolated or specially protected sand beaches or on natural or man-made open areas in remnant coastal wetlands. These sites are typically near estuaries, bays, or harbors were small fish are abundant. Adverse impacts include wetland development, introduced predators, unnaturally heavy predation by native species, human disturbance, and off-road vehicles. El Niño ocean conditions may diminish the tern's coastal fish food supplies and reduce breeding success (DFG 1992).

The proposed standards are not likely to adversely affect the California least tern's nesting or foraging habitat.

Salt Marsh Common Yellowthroat
Geothlypis trichas sinuosa
CA - Under consideration for designation as a Species of Special Concern
FED Category 2 Candidate Species

The salt marsh yellowthroat, a subspecies of the common yellowthroat, can be found year-round in the San Francisco Bay region. This particular subspecies only inhabits (breeds in) San Francisco Bay, Tomales Bay, and Carquinez/Suisun Bay in central California. Some birds may winter further south. Probably less than 200 pairs remained in 1978, and further reductions have probably occurred. This species principally breeds and winters in brackish to saline emergent wetland habitats. The plant communities preferred by yellowthroats for breeding include brackish marsh, freshwater marsh, and woody swamp areas with dense tangled vegetation for constant concealment. The birds are most often observed in coyote bush or emergent tule and cattail stands close to the water.

The yellowthroat eats insects, especially larvae. Declines of this species are also related to reductions in the vegetation associated with brackish water such as the tidal wetlands. Birds wintering in Bay salt marshes annually disperse from brackish/freshwater breeding sites when they become unsuitable due to seasonal vegetational die-offs.

Losses of tidal salt, brackish, and freshwater marshes around the Estuary have drastically reduced both breeding and wintering habitat for this bird. The distribution and abundance of its habitat has been so reduced or altered in quality that it is estimated that a population decrease of 80-95 percent has occurred. The continuous corridors of salt marshes grading upstream into adjacent brackish/freshwater wetlands, which historically existed around the Bay, have been fragmented through creation of salt ponds, stream alterations, agricultural conversion, and more recently, urban development. This has made successful dispersion of fledglings and seasonal movements by adults difficult. Reduction in freshwater inflow from adjacent creeks and rivers are also believed to negatively affect the population through reduced abundance of marsh vegetation and insects.

Current threats to the subspecies include loss of freshwater marshes, continued degradation of salt marshes by erosion, introduced salt marsh vegetation and predators, loss of breeding areas to flood control practices, urban encroachment, and rising sea level.

It is uncertain whether the salt marsh yellowthroat occurs in Suisun Marsh, although suitable habitat does exist. Reductions in freshwater inflow to estuarine marshes are believed to negatively affect the salt marsh yellowthroat through reduced abundance of vegetation and insects. The intent of the salinity standards proposed for Suisun Marsh is to maintain the historic brackish conditions in this region. Therefore, the proposed standards are not likely to adversely affect the salt marsh yellowthroat.

Aleutian Canada Goose
Branta canadensis leucopareia
FED Threatened

This subspecies of Canada goose breeds in the Aleutian Islands. Its main wintering grounds are in the Central Valley of California. This goose generally leaves the Aleutians in late-September for its southward migration. Following stops along the Oregon coast and the California coast above Crescent City, it arrives in the Central Valley from October to November. The geese use the Sacramento Valley marsh and agricultural areas in early winter. In December and January, Aleutians are typically found using suitable habitat in the upper San Joaquin Valley near Los Banos and south of Modesto. Use of Suisun Marsh by these birds is sporadic. Preferred foraging areas include lightly grazed pasture lands. Aleutians feed on green shoots and seeds of cultivated grains as well as wild grass and forbs. The return migration to the north occurs from late-February through April.

The Aleutian Canada goose was originally listed as endangered by the USFWS due to its severely depleted population. Nest predation in breeding areas was the principal cause. The sport hunting harvest of this reduced population exacerbated the decline. Recovery efforts focused on removal of predators from the breeding islands and hunting restrictions. The population has now rebounded from an estimated wintering population of 800 in the mid-1970's to over 5,000 currently. As a result, the USFWS has recently down-listed this subspecies to threatened. Continued maintenance of suitable wintering habitat, including managed marsh and suitable agricultural lands, such as small grains and pasture, is important for the continuing recovery of this species.

The Aleutian Canada goose infrequently utilizes the areas that will be affected by the proposed project. The proposed standards include standards for the managed marsh in Suisun Marsh which are intended to maintain and improve habitat conditions, in part, for waterfowl. The proposed standards are not likely to adversely affect the Aleutian Canada goose.

Western Snowy Plover
Charadrius alexandrinus nivosus
FED Threatened

The western snowy plover is found along the Pacific coast from northern Mexico to Washington, and inland in the Central Valley of California, the Salton Sea, and Mono Lake. The snowy plover is commonly found from September through March on sandy beaches and bayshore sand flats. It is uncommon to fairly common all year long on salt pond dikes around San Francisco Bay, where nesting occurs. Recent surveys along the coast of northern California document fewer than 100 pairs nesting between Marin County and the Oregon border.

The western snowy plover prefers the dry sand and upper sand flats of open beaches backed by sand dunes and bordered by marsh or brackish lagoons. Nesting is typically solitary and occurs on flat sand and shell mix, with no vegetative cover, and a good supply of amphipods and ground beetles for food.

Most prime nesting habitat, in low dunes, is subject to human disturbance and, consequently, populations have dwindled. The plovers have partially compensated for this loss by shifting their breeding activities in several areas, including San Francisco Bay, to include nesting on salt pond dikes, bare flats, or sand fills (WESCO 1989).

The proposed standards are not likely to adversely affect the nesting or foraging habitat of the western snowy plover.

Tricolored Blackbird
Agelaius tricolor
FED Candidate

The historical breeding range of the tricolored blackbird in California included the Sacramento and San Joaquin valleys and low foothills of the Sierra Nevada from Shasta County to Kern County and along the coast from Sonoma County south to the Mexican border. Although tricolored blackbird populations have declined throughout their range, they continue to breed in the Central Valley up to the low foothills in coastal areas from Sonoma County south to Baja California, and on the Modoc Plateau south to the Honey Lake Valley, Lassen County. A statewide survey conducted during 1968-1972 indicated that 78 percent of the 168 colonies located were in highly agricultural portions of the Central Valley. Populations in this region may have declined by 50 percent from the 1940's.

Tricolored blackbirds nest in dense colonies in the vicinity of fresh water, especially in marshy areas with heavy growths of cattails (*Typha* spp.) and tules (*Scirpus* spp.). In addition to these preferred nesting substrates, tricolored blackbirds also nest in other vegetation, such as willows (*Salix* spp.), thistles (*Centaurea* spp.), mustard (*Brassica* spp.), nettles (*Urtica* spp), blackberries (*Rubus* spp.), salt cedar (*Tamarix* spp.), giant cane (*Arundo donax*), wild grapes (*Vitus* spp.), and wild roses (*Rosa* spp.). Proximity to productive foraging grounds, such as flooded fields, margins of ponds, and grassy fields, is also important in nest site selection.

Within established nesting areas, tricolored blackbirds are extremely sensitive to predators, and even relatively minor disturbances can cause abandonment of entire colonies. Historical literature describes predation by mammals as a cause of major nesting failures. Other observers have also reported massive tricolored blackbird nesting failures due to bird and mammal predators, poisoning, and human disturbance.

The proposed standards are not likely to affect freshwater marshy habitat which may serve as the nesting habitat for the tricolored blackbird; therefore, the proposed standards are not likely to adversely affect the tricolored blackbird.

Loggerhead Shrike
Lanius ludovicianus
FED Category 2 Candidate Species

Typical loggerhead shrike nesting habitat is an open field with a few trees, open woodlands, or scrub. They breed over most of North America from central Canada south to southern Mexico. The loggerhead shrike winters throughout most of the breeding range, but retreats somewhat from Canada. The loggerhead shrike feeds mostly on large insects and other land invertebrates, and also on mice, birds, lizards, and carrion. Its survival is jeopardized by habitat destruction and exposure to pesticides, and possibly from impact with cars on roads within nesting and hunting territories (Erlich et al. 1992).

The loggerhead shrike has been observed in the eastern and western Suisun Marsh. They utilize a number of different habitat types in the marsh including open fields, wetlands, uplands, and open woodlands (Brenda Grewell, DWR, pers. comm., December 1994).

The proposed standards are not likely to adversely affect the habitat or prey of the loggerhead shrike.

FISH

Sacramento Perch
Archoplites interruptus
FED Category 2 Candidate Species

The Sacramento perch is the only native Centrarchid west the Rocky Mountains. This species was once abundant in natural lakes, sloughs, and slow moving rivers of central California. The perch has been largely extirpated from the Delta, but surveys conducted by the DFG caught five Sacramento perch in Suisun Marsh from 1974 to 1979. In July of 1992, a DFG fishery biologist identified a Sacramento perch caught by an angler near Westgate Landing on the south fork of the Mokelumne River. Currently, in California, a viable native population of Sacramento perch exists in Clear Lake, Lake County. Introductions of Sacramento perch have occurred throughout the State in isolated farm ponds and reservoirs.

Sacramento perch can tolerate a wide range of water conditions, such as salinities of up to 17 ppt and water temperatures that exceed 77°F. This adaptation is thought to have evolved in response to historical environmental fluctuations resulting from periods of flooding and drought. Throughout the Central Valley, the Sacramento perch inhabited sloughs, slow-

moving rivers, and lakes that contained areas dominated by rooted emergent and submerged vegetation, which is critical for spawning and nursery habitat of young fish.

The decline of the Sacramento perch has been linked to several factors: competition with introduced species for food and spawning resources, predation by introduced species on eggs and young fish, and habitat alterations. The Sacramento perch's main competition comes from introduced species within its own family, such as black crappie, largemouth bass, smallmouth bass, and bluegill. Competition may have forced the less aggressive Sacramento perch to utilize areas that are less suitable for spawning and feeding. When the perch is forced out of preferred habitats into areas that are less desirable, their reproductive success is limited. In Clear Lake, the Sacramento perch reproduction may be successful only when the population of black crappie is low. Moyle (1976) also reported that catfish and carp have been observed moving across spawning beds of the Sacramento perch eating deposited eggs. The introduction of these and other non-native species happened almost simultaneously with the occurrence of major habitat alterations in the Delta. Reduction in suitable habitat has occurred since the late-1800's when changes in the upstream hydraulic operations (dams, water diversions, and mining) altered the flow patterns of the Delta and its tributary streams. Construction of levees led to the loss of vast amounts of suitable spawning and nursery habitat in the Delta. Rip-rapping of channel and slough edges in the Delta further reduces the remaining habitat.

Stocking of Sacramento perch is currently limited to farm ponds and impoundments. Introductions into impoundments where other Centrarchid species are present have failed, and when stocked into impoundments where no other fish exist, they over-populate and growth becomes stunted (Moyle 1976).

The proposed standards are not likely to adversely affect the Sacramento perch.

Tidewater goby
Eucyclogobius newberryi
FED Endangered

The tidewater goby is endemic to California and is distributed in brackish water habitats along the California coast. This goby is found in shallow lagoons and lower stream reaches where the water is brackish to fresh and 25-100 centimeters (cm) deep. The substrate usually consists of sand and mud, with abundant emergent and submerged vegetation. In the San Francisco Bay and associated streams, nine of ten previously identified populations have disappeared and a survey of streams of the Bay drainage failed to record any populations. Severe salinity changes, and tidal and flow fluctuations, have a detrimental effect on the survival of tidewater gobies (Moyle et al 1989).

The tidewater goby utilizes the small estuaries associated with coastal streams and are, therefore, dependent on sufficient inflow from the coastal streams to sustain the brackish conditions. While the proposed standards may improve some brackish water habitats in the

Estuary during the spring, it is not likely that the habitat of the tidewater goby will be affected; therefore, the proposed standards are not likely to adversely affect the tidewater goby.

REPTILES

Northwestern Pond Turtle
Clemmys marmorata marmorata
FED Category 2 Candidate Species

The western pond turtle includes two subspecies, the northwestern and the southwestern pond turtle. The northwestern pond turtle occurs from the vicinity of the American River northward to the Columbia River. Within the Estuary, the northwestern pond turtle is found north of San Francisco Bay, while the southwestern pond turtle is found south of San Francisco Bay. These turtles, which are found in water that ranges from fresh to brackish to seawater, inhabits marshes, ponds, and small lakes with abundant vegetation, creeks, slow-moving streams, sloughs with riparian habitat, and irrigation ditches with emergent vegetation. Habitat requirements include well-vegetated backwater areas with logs for basking and open sunny slopes away from riparian zones for egg deposition. Western pond turtles nest up to 400 meters from and 60-90 meters above stream banks on sand banks along the courses of large rivers, or on hillsides in foothill regions. The turtles mate in April and May, and eggs are laid from June through August. The hatchlings overwinter in nests and emerge in March or April. Sexual maturity in pond turtles is thought to occur at about eight years and they may live for 30 to 40 years (DWR 1994, Jennings et al. 1992).

The continuing loss of suitable nesting habitat may result in inadequate reproduction rates in some areas. Extensive water diversion for agriculture and other purposes has led to the reduction of western pond turtle numbers in California. Dredging also destroys suitable habitat, as does the construction of dams and reservoirs.

The northwestern pond turtle can tolerate a wide range of salinities, and their nesting and basking habitat will not be affected by the proposed standards; therefore, the proposed standards will not adversely affect the northwestern pond turtle.

Southwestern Pond Turtle
Clemmys marmorata pallida
FED Candidate

The southwestern pond turtle occurs in coastal drainages from the vicinity of Monterey south to northwestern Baja California Norte in the vicinity of the Sierra San Pedro Martir. Turtles that occur in the Central Valley from south of the American River to the vicinity of Tejon Pass were described as representing an area of intergradation of the two subspecies of western pond turtles (Jennings et al. 1992).

The pond turtle is considered to be thoroughly aquatic in its habitat preference. It selects quieter pools and backwaters in swifter streams. It is more common in areas with muddy or rocky bottoms that are overgrown with aquatic vegetation such as cattails, watercress, or water lilies. They use mudbanks, logs, and cattail mats for basking. Pond turtles seek deep water with masses of waterlogged leaves and brush for escape cover.

The southwestern pond turtle is the most carnivorous member of the genus *Clemmys*. Food consists of aquatic plants, such as yellow pond lily pads, insects, aquatic invertebrates, fish, frogs, snakes, birds, mammals, and carrion. Pond turtles hibernate in winter. The exact extent of the hibernation period varies with season, altitude, and latitude. It is active in March in southern California. Pond turtles hibernate in the mud of stream or pond bottoms. Nesting in central California takes place in late-April and May. Nesting sites are usually located in a sunny place near a pond, stream, or river, but nesting sites may also be in an open field or hillside hundreds of yards from water (DWR 1994).

The southwestern subspecies has declined in abundance due to the loss of aquatic habitat resulting from agricultural development, water diversions, stream channelization, and urbanization.

The southwestern pond turtle can tolerate a wide range of salinities, and their nesting and basking habitat will not be affected by the proposed standards; therefore, the proposed standards will not adversely affect the southwestern pond turtle.

PLANTS

California Hibiscus
Hibiscus lasiocarpus
FED Category 2 Candidate Species

The habitat of the California hibiscus includes river banks and freshwater marsh. The range extends along Butte Creek and the Sacramento River and adjoining sloughs from Butte County to the Delta and to San Joaquin County. The species is common in the south and central Delta: Middle River islands, Woodward Canal, West Canal, Old River near Coney Island, Grant Line Canal, and Bacon Island. In the Delta, it is confined to freshwater marsh habitat on remnant berm islands. It is associated with tules, willows, buttonwillow, and other marsh and riparian species on heavy silt, clay, or peat soils (DWR 1992).

Its range has been diminished by channelization and draining of wetlands. In the southern Delta, levee maintenance, bank erosion, and island submergence have led to the loss of some populations of California hibiscus. Increases in channel water salinity may also pose a threat to this freshwater species. Competition from an invasive introduced iris may displace the hibiscus. The scarcity of remaining habitat prompted the special status (DWR 1992a).

The proposed standards are not likely to increase channel water salinity in the range of the California hibiscus; therefore, the proposed standards are not likely to adversely affect this plant.

Contra Costa Goldfields
Lasthenia conjugens
FED Category 1 Candidate Species

Contra Costa goldfields grows in shallow vernal pools in valley grasslands at elevations less than 300 feet. The historic distribution of the species included: coastal California from Point Arena in Mendocino County south to Santa Barbara; southern San Francisco Bay and around the base of the Diablo Range in Contra Costa County; and the inner coast range around San Pablo Bay, Suisun Bay, and the western Delta. Its current range is limited to Napa and Solano counties. Many historic habitats have been eliminated by urban development and grazing.

Contra Costa goldfields is present in the greater Suisun Marsh area in areas above the influence of tidal channels (DWR 1994); therefore, the proposed standards are not likely to adversely affect the Contra Costa goldfields.

Suisun Slough Thistle
Cirsium hydrophilum var. *hydrophilum*
FED Category 2 Candidate Species

The Suisun Slough thistle is a spiny, biennial herb, 1-1.5 meters tall, with pale lavender-rose flowers. DWR staff has observed and mapped the distribution of this species at two locations in Suisun Marsh in 1991-1994 (DWR 1994). The habitat of the thistle apparently consists of salt to brackish wetlands periodically inundated during high tides. Little else is known concerning the distribution and habitat requirements of this species. Like other candidate and listed species, the variety probably has suffered major population declines because of widespread habitat modification throughout its historic range, the Suisun Marsh.

The proposed standards are not likely to adversely affect the Suisun Slough thistle.

INSECTS

Valley Elderberry Longhorn Beetle
Desmocerus californicus dimorphus
FED Threatened

The range of the Valley Elderberry longhorn beetle extends throughout the Central Valley from Redding to Bakersfield. The beetle is found on elderberry shrubs, associated with riparian vegetation. Specific drainages in which the beetles are located include: the

American, Calaveras, Cosumnes, Feather, Merced, Sacramento, Stanislaus, Tuolumne, and San Joaquin rivers.

All stages of the Valley Elderberry longhorn beetle life cycle are associated with elderberry. Adults lay eggs on the plants and the larvae bore into the plant. After pupation, new adults emerge and use the elderberry for resting, foraging, and mating.

Destruction of riparian habitat is generally accepted as the greatest threat to the species. It has been estimated that approximately 90 percent of California riparian systems have been destroyed since the mid-1800's. Elderberries typically grow on high river terraces (Miriam Green Associates 1993). The proposed standards are not likely to adversely affect the elderberry and, therefore, are not likely to adversely affect the Valley Elderberry longhorn beetle.

SECTION III

The following are special status species that inhabit areas in the Estuary, that may be affected by the project, and potentially, could be adversely affected by the project.

BIRDS

California Black Rail
Laterallus jamaicensis coturniculus
CA Threatened
FED Category 1 Candidate Species

The California black rail is a rare, year-long resident of tidal salt, brackish, and freshwater marshes in the Bay-Delta Estuary, Morro Bay, the Salton Sea, and the lower Colorado River area. Historically a local resident in coastal lowland marshes from Santa Barbara County to San Diego, it still winters there, although rarely. Significant loss of saltwater, brackish and freshwater wetland habitats has contributed to reduced populations. Extreme high tides in tidal marshes and water level fluctuations in freshwater marshes have disrupted nesting attempts. Loss of high marsh vegetation around San Francisco Bay has also eliminated the species as a breeder in the South Bay.

Black rails usually frequent upper marsh zones during extreme high tides. They may depend on the zone where the upper marsh vegetation intergrades with peripheral, upland, or freshwater marsh vegetation for cover. Black rails are carnivorous. They glean and peck for a variety of arthropods (e.g., isopods and insects) from the surface of mud and vegetation.

Black rails occur most commonly in tidal salt marshes dominated by pickleweed, or brackish marshes supporting bulrushes in association with pickleweed. Where black rails occur in exclusively freshwater marshes, bulrushes and cattails are usually present. Rail nests are concealed in dense marsh vegetation, such as pickleweed, near the upper limits of tidal flooding and consist of a loosely-made, deep cup which may be at ground level or elevated several inches high.

Rails are generally found only in tidal marshes containing higher elevation zones. They are present in small numbers in narrow tidal marshes along major sloughs and are absent from nontidal marshes. The black rail is apparently critically dependent on a very narrow, high-marsh zone not subject to extreme and frequent tidal action, where insect abundances are greatest, and where some freshwater influences may exist. The presence of weedy vegetation on dikes adjacent to North Bay marshes provides additional transitional upland cover during extreme high tides. Generally, tidal marshes in the North Bay are at a higher elevation, while South Bay marshes lack any broad, high marsh or transition zones and experience a more extreme fluctuation in tidal height. In the nonbreeding season, black rails disperse widely and relatively greater use of the south Bay has been observed, especially by juvenile rails (SFEP 1992).

Current causes of black rail mortality include shortage of well-developed, high-marsh habitat, contributing to exposure during extreme high tides and subsequent predation by harriers, egrets, herons, short-eared owls, and feral cats. The recently established population of introduced red foxes in the south Bay may also prey on black rails during high tide events in this region. Predation by Norway rats on rail eggs may also occur during nesting. Contaminants such as mercury were detected in clapper rail eggs, near San Francisco Bay, in 1986-1987 at sufficient levels to affect nesting success which could also be adversely affecting the California black rail.

Impact of Proposed Standards. The California black rail occurs in the freshwater tidal marshes in the Delta, eastern and western Suisun Marsh, and salt marshes around San Pablo Bay. California black rails inhabit areas influenced by channel salinity and in areas which are more saline than conditions will be in areas of Suisun Marsh, under the proposed standards. The proposed standards will improve freshwater outflow conditions in the Estuary in the spring which should preserve a gradient of freshwater to brackish to saltwater marsh in the unmanaged tidal marshes. In the managed marsh, the conditions should remain the same in the eastern marsh and become slightly more fresh in the western marsh (see section A.5 of Chapter VII). Because the primary limiting factor adversely affecting the black rail is the scarcity of undiked high marsh habitat, and because the proposed standards and resulting channel salinities are not likely limit their potential habitat, the proposed standards are not likely to adversely affect the California black rail.

California Clapper Rail
Rallus longirostris obsoletus
CA Endangered
FED Endangered

The California clapper rail is a coot-sized bird with adults averaging 14-16½ inches. The original range of the rail included Humboldt and Morro bays, as well as salt marshes in the San Francisco and San Pablo bays, Napa Marsh, Bolinas and Tomales bays, and Elkhorn Slough. Development by diking and filling of rail habitat has reduced its range, but the principal cause of its current decline is predation by the introduced red fox. Rail populations have declined dramatically, especially in the South Bay due to red fox predation. Internal Suisun Marsh sloughs and tidal marshes are used by the clapper rail. California clapper rails are present in tidal marshes along the Grizzly Bay and western Suisun Bay shoreline, Suisun Slough, Cutoff Slough and Hill Slough.

Generally, four features characterize preferred habitat for this subspecies: (1) marshes supporting an extensive system of tidal sloughs, providing direct tidal circulation throughout the site; (2) predominant coverage by pickleweed with extensive stands of Pacific cordgrass in the lower elevation marsh zone; (3) high marsh cover consisting of tall stands of pickleweed, gumplant, and wrack; and (4) abundant invertebrate populations. Lower rail densities in the more brackish marshes of San Pablo Bay and Napa Marsh may be related to variations in freshwater outflow and resulting changes in vegetation (SFEP 1992).

The total clapper rail population was first estimated in the early-1970's at 4,200-6,000 individuals. Based on surveys during 1981-1987, the population was estimated to be about 1,500 individuals, with the difference due to more accurate survey techniques rather than a population reduction. In 1988, the population estimate was about 700 individuals; only 300-500 rails were estimated to exist in 1990-1991. The species may be on the verge of extinction.

Concurrent with this declining population in rails has been the dramatic population increase of introduced red foxes, particularly along the east shore of the South Bay. Other threats to clapper rails include predation of eggs, young, and adults by Norway rats, raccoons, striped skunks, and feral cats. In addition, extremely high tides and the lack of high marsh/transition zone habitat has led to predation on adults by norther harriers, barn owls, short-eared owls, and red-tailed hawks. Also, during 1986-1987, mercury was detected in San Francisco Bay clapper rail eggs at levels sufficient to cause embryotoxic effects in mallard ducks. Sewage effluent is also reducing salt marsh habitat in the South Bay by conversion to brackish marsh (SFEP 1992).

Impact of Proposed Standards. The proposed standards could improve freshwater outflow conditions in the Estuary which should preserve a gradient of freshwater to brackish to saltwater marsh in the unmanaged tidal marshes. Conversion of salt marsh to brackish marsh

or fresh marsh is not expected. In the managed marsh, the conditions should remain the same in the eastern marsh and may become slightly more fresh in the western marsh (see section A.5 of Chapter VII). The proposed increases in freshwater outflow are within the historical ranges of salinities experienced in the recent past and are not expected to adversely affect the California clapper rail.

Suisun Song Sparrow
Melospiza melodia maxillaris
CA - Considered for possible listing as Threatened
FED Category 2 Candidate Species

The Suisun song sparrow is a small, non-migratory bird endemic to the brackish tidal marshes of Suisun Bay and vicinity in Solano and Contra Costa counties, and the southwestern tip of Sacramento County. This subspecies of song sparrow is typically found in high densities in tidally-influenced vegetation, where pairs forage only short distances and stay close to small, defended territories throughout their lifetimes. Territories are typically associated with tidal sloughs, creeks, or the bayshore. Tidal marsh vegetation, comprised primarily of bulrush and cattail, provides appropriate escape and nesting habitat. Mud flats at the base of this dense vegetation are used extensively for feeding.

Song sparrows typically do not leave the cover of vegetation, eating at the base of the vegetation when mud is exposed at low tide. They only inhabit vegetation where there is room to walk between stalks on the mud. They cannot live where vegetation is too dense or where tidal flow is impeded at all, such as behind mosquito ditches and dikes or where water flow is controlled. Environmental disturbances can fragment habitat. Maintaining or rebuilding levees in the few remaining tidal areas can have a further fragmenting effect.

Young only disperse a short distance from their birthplace. A median juvenile dispersal distance from hatching to breeding site is 607 feet for the song sparrows in San Pablo Bay. They also do not take extended flights over unfamiliar, unsuitable habitat. Therefore, fragmentation of their historic habitat greatly limits breeding among subpopulations (SFEP 1992).

Both adults and young are vulnerable to predation during higher high tides which flood their territories forcing the birds into upland areas. Although formerly occurring in great numbers throughout the tidal marsh, Suisun song sparrows are now restricted to disconnected fragments and narrow strips of optimal habitat. They presently exist at 8 percent of their former numbers, and optimal habitat exists at less than 10 percent of that historically available. The song sparrow faces genetic isolation of subpopulations due to habitat fragmentation.

Historically, the Suisun song sparrow was considered to be an abundant permanent resident of marshes surrounding San Francisco Bay. Destruction and conversion of tidal salt and brackish marshes, particularly in the South and Suisun bays, has greatly reduced the numbers

of, and the habitat availability for, this bird. Threats to remnant Suisun song sparrow populations include the fragmented condition of remaining optimal habitat, toxic substance discharges and accidental oil spills into the Bay, and vegetation removal in higher marsh and levee areas. In addition, there is a lack of high marsh nesting cover, resulting in increased vulnerability to high tides and predation by Norway rats and diurnal raptors. Other threats include: ongoing commercial and residential development adjacent to tidal wetlands, which increases the potential for pollution; increased human disturbance; and predation by feral animals. Long-term changes in channel salinity resulting from changes in Delta outflow could result in changes in the vegetation composition of the tidal wetland used by this species (SFEP 1992).

Impact of Proposed Standards. Suisun song sparrows are endemic to the brackish tidal marshes of Suisun Marsh. The birds are physiologically adapted to allow direct consumption of brackish water and are dependent on water in the brackish salinity range. This adaptation to salinity serves to isolate the subspecies from upland subspecies which tolerate only fresh water. Increases in salinity could adversely affect the Suisun song sparrow, as they cannot survive on seawater. A goal of the proposed salinity standards for the Suisun Marsh is to maintain a natural gradient of brackish channel water conditions throughout marsh. The proposed standards should protect channel salinity conditions required by the Suisun song sparrow; therefore, the proposed standards are not likely to adversely affect this species (DWR 1994).

MAMMALS

Salt Marsh Wandering Shrew
Sorex vagrans halicoetes
FED Candidate

Populations of the salt marsh wandering shrew are restricted to salt marshes of San Francisco Bay. Field surveys have been conducted in San Pablo Marsh, Richmond, and Contra Costa County. Suitable habitat is medium-high marsh, about 6-8 feet above sea level, and it extends to lower marsh areas not regularly flooded by tidewater. Suitable areas with this expanse of marsh typically have an abundance of stranded driftwood and other detritus scattered in pickleweed which ordinarily reaches 1-2 feet in height. Under these pieces of wood, moisture is retained fairly well into the autumnal dry period and amphipods, isopods, and other invertebrates are common in most seasons of the year. Nesting and resting cover for shrews is provided by the same driftwood and plant material. The season for births runs from late-February to early-June, with a small amount of breeding occurring in September (Johnston and Rudd 1957).

Most suitable habitat for the salt marsh wandering shrew has been lost to development. This shrew, which prefers a low, dense cover of pickleweed, occurs in low densities.

Impact of Proposed Standards. The proposed standards could improve freshwater outflow conditions in the Estuary in the spring, which should preserve a gradient of freshwater to brackish to saltwater marsh in the unmanaged tidal marshes of the Estuary. In the managed marsh, the conditions should remain the same in the eastern marsh and may become slightly more fresh in the western marsh (see section A.5 of Chapter VIII). The proposed increases in freshwater outflow are within the historical ranges of salinities experienced in the past and are not expected to adversely affect the salt marsh wandering shrew.

Suisun Ornate Shrew
Sorex ornatus sinuosus
CA Species of Special Concern
FED Category 1 Candidate Species

The Suisun ornate shrew is endemic to tidal marshes along the northern shoreline of San Pablo and Suisun bays, from Sonoma Creek eastward to Collinsville. This subspecies inhabits the middle-to-higher marsh elevations where driftwood and litter provide nesting and foraging sites. Suisun ornate shrews occupy a smaller area and more restricted habitat than the endangered salt marsh harvest mouse, discussed below. Few remaining tidal marshes in the Estuary have intact adjacent upland areas where shrews can seek shelter during extreme high tides. It appears that shrews prefer tidal over diked wetlands, but recent findings of salt marsh harvest mice in diked wetlands suggest this habitat may also provide some suitable cover for shrews. Physical structure and species composition of the plant community is probably also important for adequate shrew habitat. The remaining tidal marshes of San Pablo and Suisun bays are broken into small isolated units which rarely have a complete elevational gradient of marshland vegetation (SFEP 1992).

Like the other marsh species endemic to Suisun Marsh, the current distribution of the Suisun ornate shrew has been greatly reduced over the past century by widespread destruction of the peripheral halophyte zone of tidal marshes. Within the historic distribution of this shrew, approximately 58,800 acres of diked marshes are present. Less than two dozen marshes within its range may still provide potential habitat for the species. More extensive habitat currently remains in Suisun Marsh than in San Pablo Marsh. Based on their restricted distribution and shortage of habitat, this species is considered Highest Priority Species of Special Concern by the DFG.

Impact of Proposed Standards. The proposed standards could improve freshwater outflow conditions in the Estuary in the spring, which should preserve a gradient of fresh to brackish to saltwater marsh in the unmanaged tidal marshes. In the managed marsh, the conditions should remain the same in the eastern marsh and may become slightly more fresh in the western marsh (see section A.5 of Chapter VIII). The proposed increases in freshwater outflow are within the historical ranges of salinities experienced in the past and are not expected to adversely affect the Suisun ornate shrew.

Salt Marsh Harvest Mouse
Reithrodontomys raviventris
CA Endangered
FED Endangered

Two subspecies of the salt marsh harvest mouse are endemic to the salt and brackish marshes bordering the San Francisco Bay region. Generally, habitat suitable for the Suisun ornate shrew is also suitable for the salt marsh harvest mouse. The preferred habitat is the mid-to-higher elevation tidal wetlands and adjacent transition zones which provide essential refugia during extreme high tides. These marshes are typically dominated by pickleweed, but a diverse mixture of annual and perennial herbaceous vegetation often characterizes the transitional habitat frequented by the species. Salt marsh harvest mice will also move from tidal and diked marshes into adjacent grasslands in the late spring for limited periods of time.

The northern subspecies, *Reithrodontomys ravivetris halicoetes*, inhabits wetlands bordering San Pablo and Suisun bays, while the southern subspecies, *R. r. raviventris*, occurs in Central and South San Francisco Bay. The mouse is crepuscular and partially diurnal in its activity and generally has a very calm temperament. This behavior might explain the mouse's requirements for dense cover. Dense salt marshes of pickleweed (*Salicornia* sp.), gumplant (*Grindelia* sp.), and fat hen (*Atriplex* sp.) are characteristic of the principal habitat of the mouse and cover appears to be a major factor affecting utilization. The mouse cannot live on a diet consisting exclusively of pickleweed and salt grass (*Distichlis* sp.). The mouse requires a more varied diet, including green and dry plant stems and leaves and plant seeds provided by areas supporting diverse habitat matrices.

Most salt marsh harvest mice are captured in dense, diverse marsh habitats. Sparse cover in poor condition provides poor mouse habitat. Major exceptions appear to be during high water outflows and high tides in tidal areas, and when duck clubs are flooded for hunting or other management purposes. During these times, mice seek refuge in more upland areas or on adjacent levees and for short periods of time on emergent vegetation. These refugia are generally densely vegetated and provide escape cover. In areas managed for waterfowl, dikes with dense vegetation provide refugia for the mouse when these areas are normally flooded from October through June.

Originally found throughout the extensive marshes once bordering the San Francisco Bay east to the vicinity of Collinsville, the salt marsh harvest mouse is now restricted to scattered populations within its original range. Based on historic vegetative composition and tidal elevations, it is estimated that there has been about a 95 percent historical decline in these wetlands, primarily through conversion to salt evaporation ponds and agricultural land (SFEP 1992). Diking of tidal marshes also has greatly reduced the availability of high marsh and transition zone habitat during high tides. This loss of habitat is most serious in the South Bay, where the marshes are narrower and more highly fragmented, the tidal amplitudes are higher, and there has been greater land subsidence from groundwater extraction.

Though poorly documented, it is estimated that about 6,000 acres of diked salt marsh is currently available for the northern subspecies of the mouse, primarily in Suisun Marsh. As a mitigation element of the 1986 Suisun Marsh Protection Plan, the DFG is developing about 1,000 acres of habitat within the Suisun Marsh to be dedicated to the salt marsh harvest mouse (SFEP 1992). Detailed management for the 1,000 acres, and monitoring of this habitat and salt marsh harvest mouse populations, is required in the plan.

Impact of Proposed Standards. The proposed standards could improve freshwater outflow conditions in the Estuary in the spring which should preserve a gradient of freshwater to brackish to saltwater marsh in the unmanaged tidal marshes. In the managed marsh, the conditions should remain the same in the eastern marsh and may become slightly more fresh in the western marsh (see section A.5 of Chapter VIII). The proposed increases in freshwater outflow are within the historical ranges of salinities experienced in the past and are not expected to adversely affect the salt marsh harvest mouse.

FISH

Winter-run Chinook Salmon
Onchorhynchus tshawytscha
CA Endangered
FED Endangered

The State and federally-listed endangered Sacramento winter-run chinook salmon is a unique population of chinook salmon in the Sacramento River system. The winter-run chinook salmon is one of four recognized chinook salmon races in California. It is distinguishable from the other three Sacramento chinook runs by the timing of its upstream migration and spawning season. Adult winter-run salmon pass through the Bay and migrate upstream through the Delta principally from mid-November through mid-June. Spawning occurs from mid-April to mid-August, peaking in late-June or early-July. Winter-run fry begin migrating from spawning areas in early-September and may enter the Estuary soon afterwards, especially when fall storms cause high Sacramento River flows. Peak outmigration through the Delta appears to occur during February and March. In some years, seaward migration can last into May (DFG 1992).

The NMFS listed winter-run chinook salmon as threatened under emergency provisions of the federal ESA in August 1989. The species was formally listed as federally threatened in November 1990. The State of California listed winter-run chinook salmon as endangered in 1989 under provisions of the California ESA. On June 19, 1992, the NMFS proposed that the winter-run chinook salmon be reclassified as an endangered species pursuant to the federal ESA. On August 14, 1992, the NMFS proposed critical habitat for the winter-run chinook salmon from Keswick Dam (Sacramento River Mile 302) to the Golden Gate Bridge. On February 12, 1993, the NMFS prepared a Biological Opinion addressing operations of the CVP and the SWP, and recommended reasonable and prudent alternatives (DFG unpublished report).

Prior to construction of Shasta Dam in 1945, winter-run chinook salmon were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit rivers. Specific data relative to the historic run sizes of winter-run chinook salmon prior to 1967 are sparse and mostly anecdotal. Numerous fishery researchers have cited Slater (1963) to indicate that the winter-run chinook salmon population may have been fairly small and limited to the spring-fed areas of the McCloud River before the construction of Shasta Dam. However, recent DFG research in California State Archives has cited several fisheries chronicles that indicate the winter-run chinook salmon population may have been much larger than previously thought. According to these qualitative and anecdotal accounts, the winter-run chinook salmon reproduced in the McCloud, Pit, and Little Sacramento rivers, and may have numbered over 200,000. Construction of Shasta Dam blocked access to all of the winter-run chinook salmon's historic spawning grounds.

The subsequent decline of winter-run chinook salmon has been attributed, in part, to the operation of Red Bluff Diversion Dam, which prevented or delayed access to the favorable spawning ground below Keswick Dam in summer and early-fall. Another factor contributing to the decline is unsuitable water temperatures in the upper river. This condition occurs when the water levels are low in Shasta Reservoir and the ability to access cold hypolimnitic water is limited by the dam's spill gate and powerhouse penstock design. The volume of available cold water within the reservoir is also limited. Other mortality factors in upstream areas include toxic discharge from Iron Mountain Mine, entrainment at poorly screened diversions, and stranding of juveniles during major flow fluctuations in the rearing area.

Completion of the Red Bluff Diversion Dam in 1966 enabled accurate estimates of all salmon runs to the upper Sacramento River based on fish counts at the fish ladders. These annual fish counts document the dramatic decline of the winter-run chinook salmon population. The estimated number of winter-run chinook salmon passing the dam from 1967-1969 averaged 86,509. During 1989, 1990, 1991, and 1992, the spawning escapement of winter-run past the dam was estimated at 547, 441, 191, and 1,180 adults, respectively. In 1994, the estimated escapement was 189 adults. Due to the lack of fish passage facilities at Keswick Dam, adults tend to migrate to and hold in deep pools between Red Bluff Diversion Dam and Keswick before initiating spawning activities.

Since the construction of Shasta and Keswick dams, winter-run chinook salmon spawning has primarily occurred between Red Bluff Diversion Dam and Keswick Dam. Aerial surveys of spawning redds have been conducted annually by the DFG since 1987. These surveys have shown that the majority of winter-run chinook salmon spawning in the upper Sacramento River has occurred between the Anderson-Cottonwood Irrigation District (ACID) dam at River Mile 298 and the upper Anderson Bridge at River Mile 284. However, significant numbers of winter-run chinook salmon may also spawn below Red Bluff (River Mile 245) in some years. In 1988, for example, winter-run chinook salmon redds were observed as far downstream as Woodson Bridge (River Mile 218).

Winter-run chinook salmon eggs hatch after an incubation period of about 40-60 days, depending on ambient water temperatures. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 40°F and 56°F. Mortality of eggs and pre-emergent fry commences at 57.5°F and reaches 100 percent at 62°F. Other potential sources of mortality during the incubation period include redd de-watering, insufficient oxygenation, physical disturbance, and water-borne contaminants.

The pre-emergent fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks, depending on water temperatures. Emergence of the fry from the gravel begins during late-June and continues through September. The fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects, and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

The emigration of juvenile winter-run chinook salmon from the upper Sacramento River is highly dependent on stream flow conditions and water year type. Once fry have emerged, storm events may cause emigration pulses. Emigration past Red Bluff may begin as early as late-July or August, generally peaks in September, and can continue until mid-March in drier years. Emigration past Glenn Colusa Irrigation District (GCID) at River Mile 206 is monitored daily by the DFG with a rotary screw trap in the GCID oxbow. DFG trap data show that juvenile winter-run chinook salmon emigration past GCID begins as early as mid-July and may continue through April. Data combined from 1981-1992 trapping and seining efforts show that winter-run chinook salmon outmigrants occur from Keswick to Princeton between early-July and early-May.

The timing and dynamics of rearing and downstream migration are more ambiguous in the lower Sacramento River and the Delta. A recent review of chinook salmon data from the IEP Bay Study and other Bay-Delta investigations was conducted by the DFG for occurrence, distribution, and seasonality of winter-run chinook salmon. This review showed that winter-run chinook salmon were captured as early as September at Clarksburg in 1973 and as late as June at Carquinez Strait. Another document reports high winter-run chinook salmon catches in Montezuma Slough (western Delta) during a major flow event in late November of 1981. Mid-water trawl sampling by the DFG identified winter-run chinook salmon juveniles in the northern Delta on November 9, 1992. Available information suggests that the peak period of winter-run emigration through the Delta extends from late-January through April, but early high flows in November or December may bring juveniles into the lower Sacramento River and Delta much earlier.

Relatively little information is available on how conditions in the Estuary affect winter-run chinook salmon. The majority of research on Delta water quality and hydrodynamic conditions affecting chinook salmon have been conducted with fall-run chinook salmon.

Much of this information can be applied to the winter-run. The principal factors affecting fall-run smolt survival in the Delta are temperature, exports, and diversion off the mainstem Sacramento River into the central Delta. Although winter-run smolts generally migrate through the Estuary earlier in the year than fall-run smolts, when it is very unlikely that Delta waters would be detrimentally warm, elevated water temperature can be a factor in the fall and late-spring. Spring temperatures may also be important to winter-run adults.

Like fall-run chinook salmon, any winter-run smolts diverted into the central Delta are expected to have reduced survival as a result of a longer migration route, exposure to increased predation, higher water temperatures, a greater number of agricultural diversions, and greater exposure to the effects of the CVP and SWP export facilities. Due to periodic closure of the Delta Cross Channel gates during higher levels of runoff in late-winter and early-spring, typically a smaller proportion of winter-run smolts are diverted from the mainstem Sacramento River into the central Delta through the Delta Cross Channel. Although experimental evidence is inconclusive as to whether juvenile salmon are diverted in proportion to the diversion of flow through the Delta Cross Channel, Georgiana Slough, and Montezuma Slough, study results support the conclusion that when the Delta Cross Channel gates are closed, a smaller proportion of juvenile salmon are diverted into the central Delta than when the gates are open.

A review of recent fish salvage records from the CVP and the SWP indicates that about 80 percent of the outmigrant juvenile winter-run chinook salmon are salvaged prior to April 1. Extensive sampling in the Sacramento River below Sacramento and adjacent channels during the winter/spring of 1992-1993 indicated the presence of winter-run-sized juvenile salmon from December 7, 1992 through April 28, 1993, with a major peak occurrence around mid-March and a second, smaller peak in early April. Outmigrants in 1992-1993 undoubtedly extended before and after the December 7 through April 28 period because the sampling captures only a small percentage of emigrants.

Scale analysis performed by the DFG provides some additional information regarding the freshwater and estuarine life history of winter-run chinook salmon. Back-calculated length at saltwater entry suggests that the average size of a winter-run chinook salmon smolt is approximately 118 mm while fall-run size at saltwater entry averages 85 mm. In combination with growth data used to determine the spatial and temporal distribution of winter-run chinook salmon, this back-calculated size at saltwater entry supports the January through April period of peak Delta emigration. This evidence suggests that winter-run chinook salmon are residing in fresh and estuarine waters for 5 to 9 months prior to actively emigrating as smolts to the ocean. This period of in-river and Delta residence exceeds that of fall-run chinook salmon by 2 to 4 months.

Little information is available on how conditions in the Suisun Bay area affect winter-run chinook salmon. For instance, the extent to which winter-run smolts use Montezuma Slough as opposed to the Sacramento River during their downstream migration through the Suisun Bay area is unknown. Smolts migrating through Montezuma Slough are exposed to

potentially higher rates of entrainment due to unscreened diversions from Montezuma Slough serving managed wetlands when compared to a mainstem Sacramento River route through Suisun Bay. Operation of the Suisun Marsh Salinity Control Gates during extended low Delta outflow increases the percentage of Delta outflow entering Montezuma Slough and may increase the percentage of smolts migrating through Montezuma Slough (DFG unpublished report).

The NMFS proposed several reasonable and prudent alternatives for the Delta operations as well as those operations specified for the upstream areas. The 1993 Biological Opinion specified that: (1) the Delta Cross Channel gates be closed from February 1 through April 30; (2) based on real-time monitoring, the Delta Cross Channel gates should be operated to minimize diversion of juvenile winter-run between October 1 and January 31; (3) the 14-day running average QWEST must be zero from February 1 through April 30; and (4) the 14-day running average QWEST must be greater than -2,000 cfs from November 1 through January 31 (DWR 1992).

Impact of Proposed Standards. Delta conditions will be influenced by the proposed standards and, therefore, will affect the survival of winter-run chinook salmon smolts migrating through the Delta. The effect of the standards on winter-run chinook salmon smolts can only be surmised based on what is known about fall-run chinook salmon smolts. Measures that prevent the diversion of the smolts into the central Delta may increase their survival. These measures would include the closure of the Delta Cross Channel gates between the months of February through April, the peak of the outmigration. Closure of the gates during other times should provide additional protection to smolts outmigrating on either side of the peak period. An acoustical barrier on Georgiana Slough may further reduce diversion of smolts into the central Delta.

The preferred alternative specifies standards that are intended to protect a number of different species. The proposed standards to be implemented between February 1 and April 30, a period that overlaps with the timing of the outmigration of winter-run chinook smolts, could benefit winter-run smolts. These standards include: (1) closure of the Delta Cross Channel gates from February 1 through May 20; (2) maximum exports of 1,500 cfs or 100 percent of the 3-day running average San Joaquin River flow at Vernalis, whichever is greater, from April 15 through May 15 (time period may vary); (3) maximum exports of 35 percent of Delta inflow from February through June (February exports may vary from 35-45 percent depending on the January Eight River Index); (4) San Joaquin River pulse flows of 3,110 cfs to 8,620 cfs from April 15 through May 15 (time period may vary), and base flows of 710 cfs to 3,420 cfs from February 1 through April 14, depending on water year type; and (5) Delta outflow standards from February 1 through June 30, ranging from 4,000 to 8,000 cfs.

Implementation of the proposed standards should improve conditions for winter-run chinook salmon migration through the Delta compared to D-1485 conditions. D-1485 has no export

limits between November and April, and the Delta Cross Channel gates are required to be closed between January 1 and April 15 only when the Delta Outflow Index is greater than 12,000 cfs.

Delta Smelt
Hypomesus transpacificus
CA Threatened
FED Threatened

The Delta smelt is one of two native resident species of smelt in the Bay-Delta Estuary. A recent decline in its abundance has caused the Delta smelt to be listed as a threatened species under both the California ESA and the federal ESA.

The Delta smelt is a small, slender-bodied fish, with a typical adult size of 2.2 to 2.8 inches, which is found only in the Bay-Delta Estuary. Most of the year, the population is found in the San Joaquin River below Mossdale, in the Sacramento River below Isleton, and in the Suisun Bay area. Delta smelt have been found at salinities as great as 10 ppt, or approximately 15 mmhos/cm EC, but most of the population occurs at less than 2 ppt, or 3 mmhos/cm EC. They school in open surface waters.

Delta smelt appear to be opportunistic feeders on planktonic copepods, mostly the native *Eurytemora affinis*, and on the introduced *Pseudodiaptomus forbesi* in years when it occurs in high abundance. Also included in the diet are cladocerans, amphipods, and insect larvae. When the population moves downstream to Suisun Bay, the opossum shrimp, *Neomysis*, becomes an important food item.

Delta smelt are euryhaline, and much of the year are most abundant in low salinity areas, most often just upstream of the area where incoming salt and outflowing fresh water mix. It is theorized that this mixing effect allows organisms which swim poorly, such as zooplankton and larval fish, to remain in the area of low salinity rather than being flushed out to sea. Hence, Delta smelt spend their live from the larval period to pre-spawning adulthood in the Delta and brackish areas downstream, particularly the Suisun Bay region. Surveys by the IEP San Francisco Bay-Delta Outflow Study, which has sampled fish in the Estuary from San Francisco Bay to the western Delta since 1980, indicate that the Delta smelt population thins out in San Pablo Bay and is virtually non-existent in San Francisco Bay. The summer-fall geographical distribution is strongly influenced by Delta outflow. As outflow increases, more of the population occurs in Suisun and San Pablo bays. During periods of low outflows, the population is farther upstream.

As spawning approaches in the late-winter and spring, Delta smelt adults migrate to fresh water. The spawning season varies from year to year and may occur from winter (December) to summer (July). Gravid adults have been collected from December to April, although ripe Delta smelt are most common in February and March. In 1989 and 1990,

Wang (1991) estimated that spawning had taken place from mid-February to late-June or early-July, with peak spawning occurring in late-April and early-May.

The majority of spawning occurs from February through June in the dead-end sloughs, in the shallow edge-waters of Delta channels, in Montezuma Slough near Suisun Bay, and in the Sacramento River upstream of Rio Vista. Spawning location appears to vary widely from year to year. Sampling of larval smelt in the Delta suggests spawning has occurred in the Sacramento River, Barker Slough, Linsdey Slough, Cache Slough, Georgiana Slough, Prospect Slough, Beaver Slough, Hog Slough, Sycamore Slough, San Joaquin River off Bradford Island including Fisherman's Cut, False River along the shore zone of Frank's Tract and Webb's Tract, and possibly other areas. Delta smelt also may spawn north of Suisun Bay in Montezuma and Suisun sloughs and their tributaries.

Spawning occurs in fresh water at temperatures of 7-15° Celsius. Females produce 1,400-2,900 demersal adhesive eggs on rock, gravel, tree roots, and submerged vegetation. After hatching, larvae drift downstream to the mixing, or entrapment, zone. Growth is rapid, with juveniles reaching 1.6-2 inches long by August. Adult lengths are reached when fish are 6 to 9 months old. Delta smelt are a short-lived species; most die after spawning at 1 year of age, but some survive to 2 years (Stevens et al. 1990).

During the 1980's, the Delta smelt population decreased substantially and has remained low. In the past, Delta smelt populations have declined but always recovered the following year. The population reductions began in the southern and eastern Delta during the 1970's, prior to the overall population decline of the 1980's.

Data indicate that abundance of a Delta smelt year class largely depends on environmental conditions affecting survival of eggs and young fish, rather than the abundance of adult spawners. However, to investigate the cause of the population decline, the DFG evaluated the following factors: Delta outflows, water diversions, food supply, reverse flows, water temperatures, and water transparency. The analysis was unable to point to any one environmental factor as controlling Delta smelt population abundance.

The pelagic larvae and juveniles feed on zooplankton. When the low salinity habitat is located in Suisun Bay, where there is extensive shallow-water habitat within the euphotic zone (depths less than four meters), high densities of phytoplankton and zooplankton may accumulate. However, since an invasion of the Asian clam (*Potamocorbula amurensis*) in 1986, phytoplankton abundance has dropped dramatically. When the 2 ppt isohaline is contained within Suisun Bay, young Delta smelt are dispersed more widely throughout a large expanse of shallow water and marsh habitat than when the 2 ppt isohaline is upstream in the deeper Delta channels. Dispersion in areas downstream from Collinsville reduces their susceptibility to entrainment in Delta water diversions and distributes juvenile Delta smelt among the extensive, protective, and highly productive shoal regions of Suisun Bay. In

contrast, when located upstream, the low salinity habitat becomes confined in the deeper river channels which are smaller in total surface area, contain fewer shoal areas, and are less productive.

To determine the distribution and timing of Delta smelt movements throughout the Estuary, the DFG conducted a series of surveys intended to provide crucial information on all life stages of Delta smelt from newly-hatched larva to adult. These surveys included tow-net surveys conducted from June through August, egg and larva surveys conducted in the late-winter through summer, and mid-water trawl surveys conducted in the fall and winter.

The larval surveys conducted by the DFG were initially designed to monitor striped bass eggs and larvae in the Estuary. Because early life stages of Delta smelt are similar to striped bass after hatching, this survey gives a good overview of larval distribution and can be used to identify general spawning areas.

The summer tow-net abundance index is thought to be one of the more representative indices because data have been collected over a wide geographic area (from San Pablo Bay upstream through most of the Delta) for the longest period of time (since 1959). The summer tow-net survey determines abundance and distribution of juvenile Delta smelt and provides data on the recruitment potential of the species. Except for two years since 1983 (1986 and 1993), this index has remained at consistently lower levels than experienced previously.

An abundance index is used to estimate a proportion of the population because sampling an entire population is nearly impossible and a mark-recapture study using Delta smelt cannot be done because the fish is too fragile. An index has no unit of measurement. By systematically sampling specific locations throughout the Estuary and using the same amount of sampling effort (i.e., same net, same technique), that proportion may be compared through time. Changes in the value of the annual abundance index are assumed to represent annual changes in the population. Therefore, an assessment of whether the population has increased or decreased can be made. It indicates that the smelt population has varied dramatically from year to year but declined to low values in the early 1980's and has remained at a severely low level with the exception of a small increase in 1986 and 1993. Only three times before this decline did the index fall below 10 during the 31 year record, and these low values were only for one year at a time.

The fall mid-water trawl survey, conducted during September through October, covers the entire range of Delta smelt distribution and provides one of the two best measures of late juveniles and adult Delta smelt in a large geographic area (San Pablo Bay upstream to Rio Vista on the Sacramento River and Stockton on the San Joaquin River). The mid-water trawl provides an indication of the abundance of the adult population. The mid-water trawl provides a better measure of abundance because it samples pre-spawning adult Delta smelt. An index based on pre-spawning adults, rather than on juveniles which are vulnerable to high mortality, provides a better estimate of Delta smelt stock and recruitment.

Delta smelt were once the most common pelagic fish in the upper Estuary, as indicated by its abundance in DFG trawl catches. Delta smelt abundance from year to year has fluctuated greatly in the past but, between 1982 and 1992, their populations were consistently low. In 1993, numbers increased considerably, apparently in response to a wet winter and spring. During the period of 1982-1992, most of the population was confined to the Sacramento River channel between Collinsville and Rio Vista. The actual size of the population is unknown. However, the pelagic life style of Delta smelt, short life span, spawning habits, and relatively low fecundity indicate that a fairly substantial population probably is necessary to keep the species from becoming extinct.

The Delta Native Fish Recovery Team, formed to respond to the issues surrounding the listing of the Delta smelt, tentatively identified the following reasons for the decline in Delta smelt in order of importance: (1) reduction in Delta outflows; (2) entrainment losses to water diversions; (3) high outflows; (4) changes in food organisms; (5) toxic substances; (6) disease, competition, and predation; and (7) loss of genetic integrity. The reasons for the decline are probably multiple and synergistic.

The USFWS has proposed critical habitat of Delta smelt to include all of Suisun Bay and the Delta. The declaration of critical habitat means that all habitat-altering activities taking place within the region have to be analyzed as to their effect on Delta smelt and then modified if their effect is likely to be significant. Critical habitat for Delta smelt are those specific areas within a geographic area occupied by the species, in which are found physical or biological features: (1) essential to the conservation of the species; and (2) which may require special management considerations or protection (USFWS 1994). Critical habitat for the Delta smelt focuses on habitat conditions required during specific life stages such as spawning, larval and juvenile transport, rearing, and adult migration.

Critical habitat designations alert federal and State agencies, other organizations, and the public to the importance of a geographical area in the conservation of a listed species. Designation of the critical habitat for Delta smelt can provide additional protection with regard to activities that require federal agency action. Based primarily on information gathered by the DFG and researchers at the University of California at Davis, the USFWS proposed the following critical habitat for Delta smelt: "Areas of all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bay); the length of Montezuma Slough and the existing contiguous waters contained within the Delta, as defined by section 12220 of the State of California's Water Code (a complex of bays, dead-end sloughs, channels typically less than 4 meters deep, marshlands, etc. as follows: bounded by a line beginning at the Carquinez Bridge which crosses the Carquinez Strait thence northeasterly along the western and northern shoreline of Suisun Bay, including Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; thence upstream to the intersection of Montezuma Slough with the western boundary of the Delta as delineated in section 12220 of the Water Code; thence following a boundary and including all contiguous water bodies contained within the statutory definition of the Delta, to its

intersection with the San Joaquin River at it confluence with Suisun Bay; thence westerly along the south shore of Suisun Bay to the Carquinez Bridge" (USFWS 1994).

Impact of Proposed Standards. The conclusion of the USFWS is that restoration of the Delta smelt to a sustainable population size is likely to require maintenance of the low salinity habitat in Suisun Bay and maintenance of net seaward flows in the lower San Joaquin River during the period when larvae are present (USFWS 1994 and 1995).

The proposed standards are intended to protect a number of different species in the Estuary. The salinity, flow, and operational standards implemented between February 1 and June 30 could benefit the Delta smelt. These proposed standards include: (1) the Delta outflow standards from February through June; (2) closure of the Delta Cross Channel gates from February through May 20 and partial closure from May 21 through June 15; (3) maximum exports of 1,500 cfs or the flow at Vernalis, whichever is greater, from April 15 through May 15; (4) maximum exports between 35 and 45 percent in February, and 35 percent in March through June; and (5) San Joaquin pulse flows of 3,110 cfs to 8,620 cfs from April 15 through May 15, and base flows of 710 cfs to 3,420 cfs from February through April 14 and from May 16 through June, depending on water year type.

The proposed conditions during the spring months may benefit Delta smelt in comparison to the conditions under D-1485. D-1485 has significantly lower outflow requirements and less restrictive export limits.

Sacramento Splittail
Pogonichthys macrolepidotus
FED Proposed Threatened

The Sacramento splittail is a native minnow that commonly reaches 12 to 16 inches in length and lives mostly in the slow-moving stretches of the Sacramento River up to the Red Bluff Diversion Dam, in the Delta, and in the Napa and Suisun marshes. They have been found in Suisun Bay, San Pablo Bay, and Carquinez Strait. Splittail may be evenly distributed in the Delta; however, a 1987 DFG study found them most abundant in the northern and western Delta on flooded island areas in association with other native species.

Sacramento splittail are tolerant of brackish water, being caught at salinities as high as 10-12 ppt, or 15-18 mmhos/cm EC. During spring, they congregate in dead-end sloughs of the marsh areas of the Delta, and Napa and Suisun marshes, to spawn over beds of aquatic or flooded terrestrial vegetation. They have been observed to migrate up the Sacramento River and spawn at Miller Park.

Currently, the Sacramento splittail population lives largely in the shallow, low salinity habitat of Suisun Bay and Suisun Marsh but, in early-spring, adults migrate upstream through the Delta to spawn near the mouths of the rivers along the Delta's eastern edge. Although this migration pattern predominates for most of the splittail, lower concentrations of the species

can be found in most locations in the Delta throughout the year. In recent years, fewer numbers of newly-spawned splittail have moved across the Delta, back to Suisun Bay. The scarcity of shallow habitats upstream and the increase of salinity in Suisun Bay and Suisun Marsh have greatly restricted the habitat required by this species.

Sacramento splittail recruitment is correlated with annual Delta outflow. Years of higher outflow may provide better cues to direct successful migration upstream by adults, larger areas of flooded vegetation on which the adults can spawn, higher flows to transport the newly-spawned young downstream, and larger areas of suitable habitat in Suisun Bay and Suisun Marsh (Federal Register Vol. 59 No. 4).

Impact of Proposed Standards. The proposed standards are likely to improve the estuarine habitat for Sacramento splittail. The outflow standards between February and June, export limitations, and the San Joaquin River pulse flows should increase the amount of annual outflow in the spring and, therefore, improve splittail recruitment.

Although the proposed conditions during the spring months may benefit the Sacramento splittail, but the effect of the conditions in the Delta during the other months of the year is unknown.

Spring-Run Chinook Salmon
Onchorhynchus tshawytscha
(May be petitioned for listing)

Spring-run chinook salmon were once the most abundant race of salmon in California's Central Valley, and one of the largest runs on the Pacific coast. Large spring-run populations occupied 26 streams in the Sacramento-San Joaquin drainage, principally in the middle reaches of the San Joaquin, Feather, Upper Sacramento, McCloud and Pit rivers and their tributaries. By 1992, however, wild spring-run populations were less than 0.5 percent of the historic runs which numbered up to a million fish (NHI 1994).

Overall population trends for spring run chinook salmon have been documented as declining for many decades. More than 20 historically large populations of spring-run salmon have been extirpated or reduced nearly to zero since 1940. The remnant wild spring-runs on Mill, Deer, Butte, and Big Chico creeks have exhibited statistically significant declines over the same period.

Four tributaries to the Sacramento River, Mill, Deer, Chico, and Butte creeks, consistently support annual spawning populations of spring-run chinook salmon. Several other tributaries occasionally have spring-run salmon present or have recently supported small numbers of them. These tributaries include Antelope, Battle, Beegun, Clear, and South Fork Cottonwood creeks. Historically, spring-run salmon occupied the headwaters of all major river systems in California where natural barriers were absent. Spring-run salmon are known to have occurred in the San Joaquin, Merced (near Yosemite), Stanislaus, Tuolumne,

Mokelumne, American, Yuba, Feather, McCloud, Pit, and upper Sacramento rivers. Most of the former spring-run habitat was eliminated by water development and dam construction, preventing access to the headwater areas. It is estimated that nearly 85 percent of the former salmon habitat was lost by 1928, primarily spring-run headwater habitat (NHI 1994).

Spring-run chinook salmon were heavily exploited by the early gill-net fishery in the Sacramento-San Joaquin Delta. A large canning industry, although short-lived, targeted spring-run salmon because of their superior condition when captured during their annual spawning run. Early reports by the California Fish Commissioners reported annual gill-net landings in excess of 700,000 spring-run salmon. Before completion of Friant Dam, nearly 50,000 spring-run salmon were counted on the San Joaquin River. As in the San Joaquin drainage, the Sacramento River populations were dramatically reduced following the construction of barrier dams in the 1940's. The most critical barriers were the closures of Shasta Dam on the Sacramento River in 1945 and Friant Dam on the San Joaquin River in 1948. The spring-run chinook salmon became extinct in the San Joaquin drainage and in the mainstem Sacramento River. Spring-run stocks are now limited to spawning in Mill and Deer creeks and possibly Big Chico, Butte and several other east valley creeks (NHI 1994). Spring-run salmon in the Feather and Sacramento rivers have become hybridized with fall-run salmon because of their forced coexistence below major reservoirs.

The majority of adult spring-run chinook salmon migrate into the Bay-Delta Estuary from mid-March though June. Some evidence from tagging studies indicates freshwater entry into the lower river may actually begin in mid-February. Both spring- and winter-runs migrate coincidentally, with each race segregating into separate holding and spawning areas apparently influenced by suitable water temperatures for spawning and reproductive success. No winter-run salmon migrate into Mill, Deer, Chico, or Butte creeks where summertime water temperatures are adequate for holding adults but lethal to incubating salmon eggs.

Spring-run spawning times have been poorly documented and reported as occurring at a variety of times. The most thorough record appears in the reports from the Baird Hatchery on the McCloud River. Adult spring-run salmon begin entering tributaries in early-March, continuing though April, and peaking in May. The upstream movement concludes by the end of June effectively isolating spring-run salmon in the headwater holding and spawning areas. Spawning takes place from mid-August to the first week in October. Recent spawning stock surveys in Deer Creek have confirmed that the onset of spawning begins in late-August and continues into early-October. There appears to be some variation in spawning times within different drainages, possibly related to water temperatures. Those populations spawning at higher elevations such as Mill and Deer creeks spawn approximately 3 weeks earlier than those in Butte and Chico creeks, where spawning activity is first noted in mid-September. Within Deer Creek, spawning begins first at upstream areas and occurs progressively later at lower elevations.

Additional complexity and variability of spring-run life history results from the different emergence times within different drainages. Early migration extending from early-December

through June appears to be the dominate time of juvenile emigration in Butte and Chico creeks. However, some yearling salmon have been collected in January and February, which indicates some unknown portion of the juveniles oversummer in the creeks to outmigrate in the following fall. Conversely, yearling emigration from mid-October through March predominates in Mill and Deer creeks. The fall migration out of the drainage appears to respond to seasonal runoff events. Early season storms stimulate early outmigration (NHI 1994).

Impact of Proposed Standards. Spring-run chinook salmon smolt survival may well be influenced by Delta conditions during the outmigration period, primarily November through January. How the spring-run smolts are affected can only be surmised based on what is known about the influence of Delta conditions on fall-run chinook smolts. Measures that prevent the diversion of the smolts into the central Delta and provide a net seaward outflow may increase spring-run smolt survival through the Delta. The operation measures that would create such conditions include the closure of the Delta Cross Channel gates, limits on export pumping, and minimum Delta outflows.

During the November through January period, the proposed measures that will provide protection for spring-run chinook salmon include: (1) minimum Delta outflows based on water year type; (2) closure of the Delta Cross Channel gates up to a total of 45 days based on monitoring (flows, turbidity, etc.); (3) minimum Sacramento River flows at Rio Vista based on water year type; and (4) a limit on export pumping of less than 65 percent of Delta inflow.

Green Sturgeon
Acipenser medirostris
FED Recommended for Category 2 Candidate Species

Green sturgeon have been taken in salt water from Ensenada, Mexico to the Bering Sea and Japan. They are found in the lower reaches of large rivers from the Sacramento-San Joaquin Delta northward, including the Eel, Mad, Klamath, and Smith rivers. Although spawning has not been confirmed in the Delta, juveniles are common in freshwater areas, especially in the summer. The diet of green sturgeon appears to consist primarily of neomysids and amphipods (Moyle 1976).

Impact of Proposed Standards. It is not clear what conditions are detrimental to the green sturgeon or whether the proposed standards would improve conditions for this species. The proposed standards are not likely to adversely affect the green sturgeon.

Longfin Smelt
Spirinchus thaleichthys
FED Recommended for Category 2 Candidate Species, Petitioned for Listing

The longfin smelt occurs from the Bay-Delta Estuary in California to Prince William Sound in Alaska. Longfin smelt is an euryhaline species with a 2-year life cycle. Spawning occurs in fresh water over sandy-gravel substrates, rocks, or aquatic plants. Spawning may take place as early as November and extend into June, although the peak spawning period is from February to April. After hatching, larvae move up into surface water and are transported downstream into brackish-water nursery areas. Delta outflow into Suisun and San Pablo bays has been positively correlated with longfin smelt recruitment because higher outflow increases larval dispersal and the area available for rearing. The longfin smelt diet consists of neomysids, although copepods and other crustaceans also are eaten. Longfin smelt are preyed upon by fishes, birds, and marine mammals (Federal Register Vol. 59 No. 4).

In the Bay-Delta Estuary, the decline in longfin smelt abundance is associated with freshwater diversion from the Delta. Longfin smelt may be particularly sensitive to adverse habitat alterations because their 2-year life cycle increases their likelihood of extinction after consecutive periods of reproductive failure due to drought or other factors. Relatively brief periods of reproductive failure could lead to extirpations (Federal Register Vol. 59 No. 4).

Although the southernmost populations of longfin smelt are declining, little or no population trend data are available for estuaries in Oregon and Washington. The listing of a Bay-Delta Estuary population segment is also not warranted at this time because that population does not seem to be biologically significant to the species as a whole, and may not be reproductively isolated (Federal Register Vol. 59 No. 4).

Impact of Proposed Standards. The proposed standards may improve conditions for longfin smelt. The standards that may improve the estuarine habitat for longfin smelt include the Delta outflow standard, export limitations, and San Joaquin River pulse flows. Between February and June, the outflow standard should benefit the longfin smelt by providing transport flows for eggs and larvae downstream to low salinity habitat. The abundance of longfin smelt is correlated with outflow during the months of December through May. Conditions from December through February may affect the longfin smelt.

PLANTS

Delta Tule Pea
Lathers jepsonii jepsonii
FED Category 2 Candidate Species

This climbing perennial herb was distributed historically throughout many Bay area marshlands, with additional populations known from San Benito, Fresno, and Tulare

counties. Because of widespread habitat losses from the filling and diking of wetlands, its current distribution is largely restricted to fresh and brackish tidal wetlands bordering San Pablo and Suisun bays and tidal wetlands in the Delta.

Delta tule pea is found along the water side or crest of river and canal banks in brackish and freshwater marshes and riparian woodlands on drier ground at or above the zone of tidal influence. It is common among tule stands in the western Suisun Marsh where it occasionally forms dense tangled masses (DWR 1992a). This subspecies has been found trailing through tule stands along the Suisun Slough in the western portion of the Suisun Marsh. Populations of the Delta tule pea noted during field surveys in Suisun Marsh were confined to the edges and water side of levees (sometimes the crests) of tidally influenced streams.

Drainage of marshy areas and salinity changes are considered endangerment factors.

Impact of Proposed Standards. The proposed standards will maintain a continuum of fresh to brackish marsh in Suisun Marsh and the unmanaged tidal wetlands; therefore, the proposed standards are not likely to adversely affect the Delta tule pea.

Suisun Marsh Aster
Aster chilensis var. *lentus*
FED Category 2 Candidate Species

This robust, perennial herb, 1-2 meters tall, is known from various areas throughout Suisun Marsh and the Delta. It typically occurs along tidal sloughs in salt to brackish marshes.

The Suisun Marsh aster is located in Suisun Slough, Hill Slough, and other western Suisun Marsh waterways. These populations are often dense, but highly restricted to the narrow band of tule alongside the streams. One population was noted on the land side of a levee bordering Suisun Slough; however, these plants were closely associated with a small drainage ditch which eventually drained into Suisun Slough. All of the observed populations observed in the Suisun Marsh were tidally influenced.

Impact of Proposed Standards. The proposed standards will maintain a continuum of fresh to brackish marsh in Suisun Marsh and the unmanaged tidal wetlands; therefore, the proposed standards are not likely to adversely affect the Suisun Marsh aster.

Mason's Lilaeopsis
Lilaeopsis masonii
CA Rare
FED Category 2 Candidate Species

Mason's lilaeopsis is a member of the carrot family (Apiaceae), the fourth largest family of flowering plants in California. It is a low-growing perennial that appears grass-like at a distance.

Mason's lilaeopsis is know to be located in 39 sites according to the California Natural Diversity Data Base, maintained by the DFG. The overall distribution of the plant includes Contra Costa, Napa, Solano, Sacramento, and San Joaquin counties. The plant is restricted to the tidal zone and grows in disturbed muddy banks and flats, and occasionally on rotting wood. Measurements taken of populations on exposed banks indicate that they occur in the zone between 16 and 36 inches above the high and low tide equilibrium point (i.e., above the zero flood level). The highest densities of plants were found to occur at 30 to 32 inches above tidal equilibrium.

The formation of habitat is primarily due to natural disturbance of riparian or marsh vegetation as a result of bank failure and erosion. The plants appear to colonize new habitat both vegetatively and by seed deposition. Entire plants of Mason's lilaeopsis have been observed floating in the sloughs, suggesting that vegetative reproduction and the formation of clonal populations may be important in colonization. The rhizomatous nature of Mason's lilaeopsis allows it to reproduce vegetatively. It is likely that some populations are composed mostly of clones from individuals that initially colonized the habitat.

The plants grow successfully in the shade of riparian shrubs, such as willows, and in full sunlight. No correlation between riparian or marsh species and Mason's lilaeopsis was observed. The associated species were a function of local habitat conditions. Highly-disturbed, steeply-sloping levees supported herbaceous perennial associates. Older levees with more gentle slopes and small islands supported riparian shrubs, and non-leveed areas consisted primarily of tule and cattail marshlands. Mason's lilaeopsis was not observed in association with rock revetment.

The habitat of Mason's lilaeopsis is generally considered transient. The rate of habitat formation, colonization, and eventually loss varies as a function of bank stability. Steep levee banks are unstable and the viability of a population of Mason's lilaeopsis may be as short as 1 year after colonization. More stable situations, such as those on riparian islands, may support a population for over 20 years, based on historical information obtained from topographic maps of islands in the sloughs. In summer, habitat viability is directly related to the level of human development, with leveed banks having low viability.

While little data are available on channel water salinity requirements, evidence suggests populations of Mason's lilaeopsis are restricted to the fresher portion of the Napa River and locations west of Martinez in the Suisun Bay area and the Delta. Threats to this species are primarily related to dredging, levee construction, and riprapping (DFG unpublished report).

Impact of Proposed Standards. The proposed standards will maintain a continuum of fresh to brackish marsh in Suisun Marsh and the unmanaged tidal wetlands; therefore, the proposed standards are not likely to adversely affect the Mason's lilaeopsis.

Soft Haired Bird's-beak
Cordylanthus mollis mollis
FED Category 1 Candidate Species

This annual herb is endemic to higher elevations of tidal marshes fringing the shorelines of San Pablo and Suisun bays. The soft haired bird's-beak grows in the upland transition border or the upper level of the high tide. It is found in tidal marshes at the north end of the San Francisco Bay and in the Suisun Marsh. While relatively small (25-40 cm high), its distinctive gray-green and hairy vegetation contrasts with associated salt marsh vegetation. Recent known locations are limited to several areas in Napa Marsh, South Hampton Bay, the confluence of Cutoff Slough and Montezuma Slough (west of Beldons Landing) in Suisun Marsh, and several locations along the northern Contra Costa County shoreline.

Two locations of the species (near Napa River and Montezuma Slough) are in a diverse association of species and are tidally inundated. Most of the sites appear to be tidally influenced. The soft haired bird's-beak is not likely to occur in pure stands of pickleweed at the lowest elevations; rather, the combination of saltgrass and pickleweed at higher elevations are more suitable.

Impact of Proposed Standards. The proposed standards will maintain a continuum of fresh to brackish marsh in Suisun Marsh and the unmanaged tidal wetlands; therefore, the proposed standards are not likely to adversely affect the soft-haired bird's beak.

Hispid Bird's-beak
Cordylanthus mollis hispidus
FED Category 2 Candidate Species

The hispid bird's-beak is a small (15-20 cm high) leafy annual herb. It grows on saline flats in association with pickleweed and/or saltgrass. Known from only a few populations, the subspecies extends from the Sacramento-San Joaquin Delta and southern Sacramento Valley south through the San Joaquin Valley to Kern County.

It seems probable that any *Cordylanthus* populations found in tidal wetlands in Suisun Marsh more likely would be the subspecies *C. m. mollis* (DFG unpublished report).

Impact of Proposed Standards. The proposed standards will maintain a continuum of fresh to brackish marsh in Suisun Marsh and the unmanaged tidal wetlands; therefore, the proposed standards are not likely to adversely affect the hispid bird's-beak.

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