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UNPUBLISHED REPORT

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LISTED SPECIES

Sacramento Winter-Run Chinook Salmon

The State and Federally-listed endangered Sacramento winter-run chinook salmon is a unique population of chinook salmon in the Sacramento River. It is distinguishable from the other three Sacramento chinook runs by the timing of its upstream migration and spawning season. The National Marine Fisheries Service (NMFS) listed winter-run chinook salmon as threatened under emergency provisions of the Endangered Species Act (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 CESA. On June 19, 1992, NMFS proposed that the winter-run chinook salmon be reclassified as an endangered species pursuant to the ESA (57 FR 27416). On August 14, 1992, NMFS proposed critical habitat for the winter-run chinook from Keswick Dam (Sacramento river mile 302) to the Golden Gate Bridge (57 FR 36626).

Prior to construction of Shasta and Keswick dams in 1945 and 1950, respectively, winter-run chinook salmon were reported to spawn in the upper reaches of the Little Sacramento, McCloud, and lower Pit Rivers (Moyle et al. 1989). Specific data relative to the historic run sizes of winter-run chinook 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 (Rectenwald 1989). Construction of Shasta and Keswick Dams blocked access to all of the winter-run chinook salmon's historic spawning grounds.

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.

The first winter-run chinook salmon upstream migrants appear in the Sacramento-San Joaquin Delta during the early winter months (Skinner 1972). On the upper Sacramento River, the first upstream migrants appear during December (Vogel and Marine 1991). 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. The upstream migration of winter-run chinook salmon typically peaks during the month of March, but may vary with river flow, water-year type, and operation of Red Bluff Diversion Dam. Fyke-net sampling for striped bass in the lower Sacramento River suggest that winter-run emigrants can be present there as late as early April (Dave Kohlhorst, pers. comm.)

Since the construction of Shasta and Keswick dams, winter-run chinook salmon spawning has primarily occurred between Red Bluff Diversion Dam and Keswick Dam. The spawning period of winter-run chinook salmon generally extends from mid-April to mid-August with peak activity occurring in June (Vogel and Marine 1991). Aerial surveys of spawning redds have been conducted annually by 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 RM 298 and the upper Anderson Bridge at RM 284. However, significant numbers of winter-run chinook salmon may also spawn below Red Bluff (RM 245) in some years. In 1988, for example, winter-run chinook salmon redds were observed as far downstream as Woodson Bridge (RM 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 (Boles 1988). 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 streamflow conditions and water year type. Once fry have emerged, storm events may cause en masse emigration pulses. Thus, emigration past Red Bluff may occur as early as late July or August, generally peaks in September, and can continue until mid-March in drier years (Vogel and Marine 1991). Emigration past Glenn Colusa Irrigation District (GCID) at river mile 206 is monitored daily by 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 (HDR Engineering Inc. 1993). Data combined from 1981-1992 trapping and seining efforts

show that winter-run chinook salmon outmigrants occur between early July and early May from Keswick to Princeton (RM 302 to RM 158).

The timing and dynamics of rearing and downstream migration are more ambiguous in the lower Sacramento River and Sacramento-San Joaquin Delta. A recent review of chinook salmon data from the San Francisco Bay Study (California Department of Fish and Game, Bay-Delta Division) and other Bay-Delta investigations was conducted by the California Department of Fish and Game for occurrence, distribution, and seasonality of winter-run chinook salmon (Perry 1992). Data spanning 30 years were analyzed using the most recent winter-run chinook salmon size criteria by Fisher (Johnson et al. 1992).

This review showed that winter-run chinook salmon were captured as early as September at Clarksburg in 1973 (Schaffter 1980; Stevens 1989) and as late as June at Carquinez Strait (Messersmith 1966). Brown and Greene (1992) report 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 California Department of Fish and Game identified winter-run chinook salmon juveniles in the northern Delta on November 9, 1992 (California Department of Fish and Game, unpublished data). Available information suggest 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 lower Sacramento River and Delta much earlier (Brown and Greene 1992; Perry 1992; Stevens 1989).

A review of recent fish salvage records from the CVP and SWP indicates that about 80 percent of the outmigrant juvenile winter-run are salvaged prior to April 1. Extensive sampling in the Sacramento River below Sacramento and adjacent channels during the winter/spring of 1992-93 (Marty Kjelson, pers. comm.) 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. Occurrence in 1992-93 in the project area 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 California Department of Fish and Game provides some additional information regarding the freshwater and estuarine life history of winter-run chinook salmon. Back-calculated length at saltwater entry suggests the average size of a winter-run chinook salmon smolt is approximately 118 millimeters while fall-run size at saltwater entry averages 85 millimeters (California Department of Fish and Game, unpublished data). In combination with growth data used to determine the spatial and temporal distribution of winter-run chinook salmon (Johnson et al. 1992), 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.

Delta Smelt

Historically, the delta smelt is thought to have occurred from Suisun Bay upstream to at least the city of Sacramento on the Sacramento River and Mossdale on the San Joaquin River (Moyle et al. 1992, Sweetnam and Stevens 1993). The delta smelt is an euryhaline species (tolerant of a wide salinity range) that spawns in fresh water and has been collected from estuarine waters up to 14 parts per thousand (ppt) salinity (Moyle et al. 1992). For a large part of its annual life span, this species is associated with the freshwater edge of the entrapment zone (mixing zone at the saltwater-freshwater interface), where the salinity is approximately 2 ppt (Ganssle 1966, Moyle et al. 1992, Sweetnam and Stevens 1993).

The delta smelt is adapted to living in the highly productive Sacramento-San Joaquin River Estuary (Estuary) where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment, the historical Estuary probably offered relatively constant suitable habitat conditions to delta smelt, because they could move upstream or downstream with the entrapment zone as reported in USFWS 1994 (Moyle, pers. comm., 1993).

Shortly before spawning, adult delta smelt migrate upstream from the brackish-water habitat associated with the entrapment zone to disperse widely into river channels and tidally-influenced backwater sloughs (Moyle 1976, Radtke 1966, Wang 1991). Migrating adults with nearly mature eggs were taken at the CVP's Tracy Pumping Plant from late December 1990 to April 1991 (Wang 1991).

Delta smelt spawn in shallow, fresh, or slightly brackish water upstream of the entrapment zone (Wang 1991). Most spawning occurs in tidally-influenced backwater sloughs and channel edgewaters (Moyle 1976; Moyle et al. 1992; Wang 1986, 1991). Although delta smelt spawning behavior has not been observed (Moyle et al. 1992), the adhesive, demeral eggs are thought to attach to substrates such as cattails and tules, tree roots, and submerged branches (Moyle 1976, Wang 1991).

Spawning location appears to vary widely from year to year (DWR and Reclamation 1993). 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, in the 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 (Dale Sweetnam, DFG, pers. comm.; Wang 1991). Delta smelt also may spawn north of Suisun Bay in Montezuma and Suisun sloughs and their tributaries (Sweetnam, DFG, pers. comm.).

The spawning season varies from year to year and may occur from later winter (December) to early summer (July). Moyle (1976) collected gravid adults from December to April, although ripe delta smelt were 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.

Delta smelt eggs hatched in 9-14 days at temperatures from 13-16° C during laboratory observations in 1992 (Mager as cited in Sweetnam and Stevens 1993). After hatching, larvae and juveniles move downstream toward the entrapment zone where they are retained by the vertical circulation of fresh and salt waters (Stevens et al. 1990). The pelagic larvae and juveniles feed on zooplankton. When the entrapment zone 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 (Arthur and Ball 1978, 1979, 1980). However, since an invasion of the Asian clam (Potamocorbula amurensis) **in 1986, phytoplankton abundance has dropped dramatically (DWR and USBR 1993). In general, estuaries are among the most productive ecosystems in the work (Goldman and Horne 1993). Estuarine environments produce an abundance of fish as a result of plentiful food and shallow, productive habitat.**

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 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 entrapment zone becomes confined in the deeper river channels, that are smaller in total surface area, contain fewer shoal areas, and are less productive.

Detailed information is not available on the use of the Mokelumne River area by delta smelt. It is likely that delta smelt adults migrate to and through the area on their spawning runs and that larval smelt pass downstream through the area after hatching.

To determine the distribution and timing of delta smelt movements throughout the estuary, the Department has conducted a series of surveys intended to provide crucial information on all life stages of delta smelt from newly hatched larvae to adult. These include tow net surveys conducted from June through August, egg and larvae surveys conducted in the late winter through summer, and midwater trawl surveys in the fall and winter.

The larval surveys conducted by the Department 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 area and sample site locations of the egg and larvae surveys are:

1) Delta Estuary: This area includes Honker Bay, the confluence of the Sacramento and San Joaquin rivers, and the Delta between Antioch and

Medford Island, along the sloughs and channels of the lower San Joaquin River. There were 26 sampling stations in the area: 66, 65, 5, 7, 9, 11, 13, 15, 33, 35, 37, 39, 41, 43, 45, 47, 47, 49, 51, 53, 55, 57, 59, 906, 909, 60, 61.

2) Sacramento River: This area includes Collinsville, Decker Island, Rio Vista, Isleton, Walnut Grove, Locke, Garcia Bend, West Sacramento, Vernalis, Knights Landing, and Grimes. The Sacramento River between Collinsville and Rio Vista is identified as the lower Sacramento River, the section between Rio Vista and West Sacramento as the mid-Sacramento River, and the section above West Sacramento as the upper Sacramento River. There were 32 sampling stations in this area: 17, 19, 21, 23, 25, 27, 29, 32, 72, 725, 70, 71, 73, 735, 74, 745, 75, 755, 76, 765, 77, 775, 78, 785, 79, 795, 80, 805, 81, 815, 82, 825.

3) Mokelumne River: This area includes Potato Slough, White Meat Slough, South Fork Mokelumne River, and North Fork Mokelumne River, all below Walnut Grove. In 1991 the Interagency Ecological Studies Program (IESP), the DFG established the delta smelt habitat pilot study, which expanded the egg and larval sampling program by seven stations: 903, 919, 920, 921, 922,923, 924.

4) The area includes Cache Slough, Steamboat Slough, and the Sacramento River north of Isleton. Four sampling stations were established in this area; 712, 713, 715,717.

The summer townet abundance index is thought to be one of the more representative indices because data has 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 townet 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 is dimensionless (i.e., it 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 Midwater Trawl Survey (FMTS) 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 FMTS provides an indication of the abundance of adult population. The FMTS 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 Sacramento-San Joaquin estuary, as indicated by its abundance in DFG trawl catches (Erkkila et al. 1950; Radtke 1966; Stevens and Miller 1983). Delta smelt abundance from year to year has fluctuated greatly in the past but between 1982 and 1992 their population was 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 (Sweetnam, unpublished data). 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 identified reasons for decline in delta smelt which are multiple and synergistic, order of importance: 1) Reduction in outflows; (modification of habitat is the biggest single reason for listing because both the Delta and Suisun Marsh have been altered by reductions in outflows caused by increased diversion of inflowing freshwater and high outflows). 2) Entrainment losses to water diversions. 3) High outflows. 4) Changes in food organisms. 5) Toxic substances. 6) Disease, competition, and predation. 7) Loss of genetic integrity

These factors are also reflected in reasons for the listing of a species as threatened according to the ESA of 1973: "(A) the present, or threatened, destruction, modification, or curtailment of its habitat or range, (B) over-utilization for commercial, recreational, or educational purposes, (C) disease or predation, (D) inadequacy of existing regulatory mechanisms, or (E) other natural or manmade factors affecting its continued existence". All these factors apply to the delta smelt except over-utilization as the delta smelt is not harvested.

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, on which are found those physical or biological features: 1) essential to the conservation of the species and 2) which may require special management considerations or protection; and specific areas outside the geographical area occupied by the species at the time it is listed (USFWS 1994). Critical habitat for the delta smelt focuses on habitat conditions required during specific life stages (spawning, larval and juvenile transport, rearing and adult migration) .

Critical habitat designations alert Federal and State agencies, other organizations, and the public about the importance of an area in the conservation of a listed species. Designation of the critical habitat for delta smelt provides additional protection under section 7 of the ESA with regard to activities that require Federal agency action. Based primarily on information gathered by the DFG and University of California of Davis, the USFWS proposed the geographic extent of critical habitat to include areas known to constitute important delta smelt spawning habitat. The designated critical habitat for delta smelt is as follows: "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 State of California's Water Code of 1969; 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).

Delta smelt adults use shallow, tidally-influenced, freshwater (less than 2 ppt) backwater sloughs and edgewaters for spawning. To ensure egg hatching and larval viability, spawning areas also should provide suitable water quality (low level of pollutants) and adequate substrates for egg attachment (tree roots and branches, and emergent vegetation). Specific areas that have been identified as important to delta smelt spawning habitat include; Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay. The time of spawning varies from year to year and may start from early December and extend until July (USFWS 1994).

The location of delta smelt spawning may be indicated from previous 1992 and 1993 Delta smelt egg and larvae trawl surveys conducted by DFG. Two hydrologic year types are represented in this sampling effort; 1992 was a dry year and 1993 a wet year. In both years delta smelt larvae were found in all areas sampled including; Suisun Bay, Grizzly Bay, Montezuma Slough, Honker Bay, the Sacramento River upstream to Verona, Cache Slough,

the South and North Forks of the Mokelumne River, and the San Joaquin River upstream to Medford Island. Location of larvae/juvenile delta smelt collected during these studies may reflect spawning areas, however, these distributions do not conclusively reflect spawning areas as larvae collected at one location does not indicate that larvae was spawned at that location.

Sacramento Splittail

The Sacramento splittail is a native minnow that 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 (Moyle 1976; DFG unpublished data). They have been found in Suisun Bay, San Pablo Bay, and Carquinez Strait (Moyle 1976). Splittail may be evenly distributed in the Delta, however a 1987 DFG study found them most abundant in the north and west 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 parts per thousand (ppt) or 15-18 mmhos EC (Moyle 1976). 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 (Moyle 1976; DFG unpublished data). They have been observed to migrate up the Sacramento River and spawn at Miller Park.

The splittail commonly reach 12 to 16 inches in length (30-40 cm). It was formerly a commercially harvested fish but now is sometimes sought by recreational anglers in the Delta and Suisun Bay areas. The splittail is a federal candidate species.

Swainson's Hawk

The Swainson's hawk was described in early accounts as one of the most common raptors in California (Sharp 1902). The species occurred throughout much of lowland California, hunting in open grassland habitats and nesting along the edges of riparian forests or oak woodlands, or in isolated trees that were scattered across the valley savannas.

Pre-agricultural California supported abundant woodland and grassland habitats, particularly throughout the Central Valley. Since the mid-1800s, these native habitats have undergone a gradual conversion to agricultural uses. Today, native grassland habitats are much reduced in the state, and only remnants of the once vast riparian forests and oak woodlands still exist (Katibah 1983).

The effect of widespread loss of both nesting and foraging habitats on Swainson's hawks has been a significant reduction of the breeding range and the breeding population in California (Bloom 1980). The state currently supports an estimated 550 breeding pairs of Swainson's hawk, representing less than 10 percent of the historic population (California Department of Fish and Game 1988). To provide protection for the remaining population, the State of California listed the Swainson's hawk as a threatened species in 1983.

The largest segment of the California Swainson's hawk population exists in the Central Valley, where an estimated 440 pairs nest (California Department of Fish and Game 1988). Although agricultural conversion of native habitats was probably the primary factor responsible for initial Swainson's hawk declines in the state certain agricultural practices are largely responsible for maintaining current populations. The row, grain, and hay crop farming typical of the mid-section of the Central Valley is compatible with Swainson's hawk foraging habitat needs. The distribution of the Central Valley population is closely correlated with the distribution of these cropping patterns. This region of suitable agricultural foraging habitat is considered essential in maintaining the stability of the Central Valley Swainson's hawk population.

Swainson's hawks usually nest in large, mature trees. Native trees are almost always used, although nests have been found in eucalyptus (Eucalyptus sp.) trees and ornamental conifers. Tree species most commonly used in the Central Valley in decreasing order of frequency include valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), black walnut (*Juglans hindsii*), and willow (*Salix* sp.). Nests are usually of flimsy construction and often blow out of the nest tree during high winds, particularly during winter.

Although nest sites are not found exclusively in riparian habitat, more than 87 percent of the known nest sites in the Central Valley are within riparian systems (Schlorff and Bloom 1983, Estep 1984). Swainson's hawks also nest in roadside trees, isolated individual trees, small groves, and on the edges of remnant oak woodlands.

Swainson's hawks are highly traditional in their use of nesting territories, returning each year to the same nest tree or a tree nearby. Many nest sites in the Central Valley have been monitored annually since 1978, and a program of color banding nesting paries has been ongoing since 1986. These studies show a high degree of nest site and mate fidelity among pairs.

The Swainson's hawk is adapted to foraging in large, open plains and grasslands. In the Central Valley, however, virtually all native foraging habitat has been converted to agricultural uses, restricting Swainson's hawks to areas that support cropping patterns compatible with their foraging requirements. Both the abundance of prey populations and the accessibility of prey to foraging birds determine the suitability and quality of agricultural foraging habitat for Swainson's hawks. The many crop types grown in the Central Valley differ widely with respect to their foraging habitat suitability.

Swainson's hawks hunt aerially almost exclusively in the Central Valley, soaring from 100 to 300 feet above the ground while scanning for prey (Estep 1989). Foraging birds select fields that are most compatible with this type of foraging behavior (i.e., fields that are large, support low cover to provide access to the ground, and provide the highest densities of accessible prey). These habitats include hay and grain crops, lightly grazed pasture lands, and certain row crops, such as tomatoes and sugar beets. Fields lacking adequate prey populations, such as flooded rice fields, or those that are inaccessible to foraging birds, such as vineyards and orchards, are avoided.

Cropping patterns directly affect the foraging behavior, foraging range size, and ultimately the reproductive success of nesting Swainson's hawks. As crops mature, vegetative cover increase, which decreases prey accessibility; as a result foraging birds expand their ranges in search of fields that provide accessible prey. Foraging Swainson's hawks have been observed traveling more than 9 miles from their nest in search of prey (Estep 1989). Later in the season, as crops are harvested, foraging ranges decrease as prey become more accessible near the nest. Prey abundance has also increased by the time harvesting operations proceed. The result is that foraging ranges can fluctuate both seasonally, in response to changes in prey accessibility and abundance, and from year to year in response to changing cropping patterns. Overall foraging ranges (averaging 6,800 acres) ranks the habitat quality of various crops grown in the Central Valley as high, moderate, or low based on their value to foraging Swainson's hawks.

Corn and wheat, the primary crops grown in the central Delta, provide suitable foraging habitat for nesting Swainson's hawks. However, most of the crop types in the central Delta are suitable as foraging habitat only during part of the breeding season. The timing of corn and wheat planting and harvesting are complementary, providing suitable foraging habitat throughout most of the breeding season.

Both corn and wheat provide foraging habitat during the early part of the breeding season. Wheat fields become less suitable in April as the crop matures. Cornfields continue to be suitable for foraging through May. As cornfields mature, they also become unsuitable, but by late June to early July, wheat is harvested and harvested wheat fields again become suitable habitat. Thus, it is possible that suitable habitat is available to foraging Swainson's hawks on central Delta islands throughout most of the breeding season. The central Delta also supports other row, grain, and hay crops and pastures that attract foraging Swainson's hawks.

Swainson's hawks are known to nest in the central Delta and individuals are occasionally observed foraging on the central Delta islands, including the Project area during the breeding season, (Jones and Stokes Associates 1990a, Holt pers. comm.). Pairs that nest outside the Delta may also forage on Delta islands during certain times of the year, particularly during periods of harvest or during periods of foraging range expansion, which occurs when prey is limited near the nest (Estep 1989).

In general however, Swainson's hawks will limit their foraging movements to stay as close to the nest as possible. Thus, foraging frequency declines with distance from the nest. In most cases, nest sites are located near high-quality foraging habitat; thus, hawks will travel far from the nest only if necessary, based on both the crop patterns near the nest and availability of suitable habitat elsewhere.

Although an unusual occurrence at northern latitudes, the Delta is also used by Swainson's hawks during the winter. Swainson's hawks are migratory, and most spend winters in South America. Individuals, however, have been sighted during winter in the Delta over the last 10 years (Holt pers. comm.). In 1990-1991, a group of 29 adult Swainson's hawks was regularly observed on Bouldin Island and neighboring Venice Island for several weeks. These birds appeared to be attracted to the abundance of prey that resulted from the discing and flooding operations on the islands. A key roost area was a stand of eucalyptus trees across the Mokelumne River from Bouldin Island on neighboring Tyler Island, where the group roosted for several weeks. Department surveys of the project area in May of 1994 did not indicate the presence of nesting Swainson's hawks. In addition, surveys conducted for the SIICRP Biological Assessment February and March of 1994 did not indicated the presence of Swainson's hawks.

Mason's Lilaeopsis

Mason's lilaeopsis is a member of the carrot family (Apiaceae), the fourth largest family of flowering plants in California. In 1979, Mason's lilaeopsis was listed as "rare" by DFG. It is also a federal candidate for listing. In addition, Mason's lilaeopsis is in the inventory of rare and endangered plants of the California Native Plant Society in which it is listed a plant of "highest priority".

Mason's lilaeopsis is a low-growing perennial that appears grass-like at a distance. The leaves are reduced to hollow, obscurely septate, cylindrical phyllodes that are produced in short tufts 1.5-7 cm long and less than 1 mm wide. Flowering branches (peducles) are shorter than the leaves. The inflorescence is a simple umbel producing 3-8 flowers.

Mason's lilaeopsis is know from a minimum of 39 sites according to information from the California Natural Diversity Data Base (CNDDB). 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 population positions on exposed banks determined that they occur in the zone between 16 and 36 inches (40 and 90 cm) 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 (75-80 cm) 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 were observed floating in the sloughs suggesting that vegetative reproduction and the formation of colonial 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 (Salix spp.), and in full sunlight. No correlation between riparian or marsh species was observed for plant association preference of Mason's lilaeopsis. 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-levied 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 one 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 levied banks having low viability.

While little data are available on channel water salinity requirements evidence suggests populations are restricted to the fresher portion of the Napa River and locations west of Martinez in the Suisun Bay area and Sacramento San Joaquin Delta. Threats to this species are primarily related to dredging, levee construction and rip-rapping.

California Black Rail

The California black rail *Laterallus jamaicensis spp. coturniculus* is listed as a Category 1 candidate species by the USFWS, and as threatened by DFG.

The California black rail formerly occurred in limited numbers in coastal salt marshes from Tomales Bay, Marin County, south to northern Baja California, Mexico. It also was found in inland freshwater marshes including the Delta and lower portions of the Colorado River (DFG 1983).

In central California, the California black rail occurs in marshes bordering San Pablo Bay and the Napa and Petaluma Rivers. Current population trends are unknown but are felt to be diminishing due to the loss of coastal and freshwater marshes.

The species prefers tidal salt marshes habitat dominated by growths of pickleweed or

bulrushes (Grinnell and Miller 1944, Manolis 1977). Black rail do not occur in areas that are no longer under tidal influence. California black rails are found in high shallow water marshes with little fluctuations in water level (Manolis 1977).

Little is known of the black rail's status in the Delta region. CNDDB records contain references to the species in the vicinity of White Slough, four miles east of Little Potato Slough. Other CNDDB record for black rails at White Slough were reported in May 1981.

Marsh habitat suitable for black rails was identified and mapped in the north Delta during reconnaissance surveys on May and June 1989 (ECOS 1990). Potential black rail habitat identified in the project area consists of areas of bulrush-dominated emergent vegetation around the emergent marsh islands of the South Fork Mokelumne River. California black rail habitat is made up of dense Typha and Scirpus growing from a base of firm soil and inundated by the highest tides.

Western Pond Turtle

The southwestern pond turtle *Clemmys marmorata pallida*, is designated as a Category 2 candidate species by the USFWS and a species of special concern by the DFG. A subspecies of the western pond turtle *Clemmys marmorata*, is distributed from Washington south to Baja California (Stebbins 1985). Many populations have been reduced or extirpated, especially where aquatic habitats have been modified or eliminated (Brattstrom 1988; Holland, unpubl. data). The U.S. Fish and Wildlife Service is considering listing the western pond turtle as threatened or endangered (Federal Register, 1989) principally because of the loss of habitat. The reproductive biology of the western pond turtle is not well known. Storer (1930) reports several anecdotal accounts of pond turtle nesting, and concludes that sand banks along the courses of large rivers, or hillsides in foothill regions, are used for oviposition. He also concludes that nesting occurs up to 400 meters from, and 60 to 90 meters above, stream beds. Holland (1985) indicates that along the central California coast, mating occurs in April and May, and eggs are laid from June through August. Holland (1985) additionally suggests that hatchlings overwinter in nests and emerge in March or April. Incubation in captivity takes 73 to 80 days (Feldman 1982). Feldman (1982) also makes a case for hatchlings overwintering in nests, based on his observations of captives.

As the human population continues to grow in California, riparian corridors and the water itself in many of the arroyos will come under increasing demand for urban and agricultural uses. Without some protection of the arroyos and associated upland areas, the long-term survival of pond turtle populations in central and southern California cannot be assured.

For the western pond turtle, the ongoing loss of suitable nesting habitat may be resulting in inadequate reproduction rates in some areas. Habitat requirements include well

vegetated backwater areas with logs for basking, and open, sunny slopes away from riparian zones for egg deposition. Extensive water diversions for agricultural and other purposes have led to the reduction of western pond turtle numbers in California. Dredging also destroys suitable habitat, as does the construction of dams and reservoirs.

Western pond turtles were observed in surveys preformed by ECOS (1990), adult turtles were noted in the South Fork Mokelumne River. Suitable habitat is found to exist along all watercourses in the project area.

Giant Garter Snake

The giant garter snake is designated a Category 2 candidate species by the USFWS and a threatened species by the DFG. The giant garter snake is a subspecies of the western aquatic garter snake. The giant garter snake formerly occurred on the floor of the Central Valley from Sacramento and Antioch south to Buena Vista Lake, Kern County. Agricultural development , especially the draining of wetlands and channelization of streams has extirpated the giant garter snake from the south San Joaquin valley and lowered its numbers in the north.

The giant garter snake is generally highly aquatic and is associated with permanent or semi-permanent bodies of water in a variety of habitats. Individuals forage primarily for fishes and amphibians during the day from March through October in areas of fresh water, particularly sloughs and marshes (Hansen and Brode 1980), and can be found in areas temporarily flooded such as irrigation canals. The giant garter snake spends the cool winter months in dormancy.

The preferred nocturnal retreats are thought to be holes, especially mammal burrows, crevices, and surface objects. During the day this garter snake often basks on streamside rocks or on densely vegetated stream banks. When disturbed it usually retreats rapidly to water.

Courtship and mating normally occur during the spring. Four to 30 young are born alive in July and August, usually in secluded sites such as under the loose bark of rotting logs or in dense vegetation near pond or stream margins.

The North Fork and South Fork and their rip-rapped levees are maintained in an open condition and appear unsuitable for giant garter snakes. However, small canals and drainage ditches along the landward side of the west levee and adjoining Tyler island support stands of cattail, tule, and other wetland vegetation that may be suitable for giant garter snakes. The landward side of the east levee and adjoining Staten Island appear less suitable than the western Tyler Island side, although agricultural ditches and canals there may be marginally suitable for giant garter snakes (ECOS 1990).

Due to historical sightings and the widespread presence of highly suitable habitat,

the giant garter snake should be considered an inhabitant of all waterways in the Project area (ECOS INC 1990). The absence the giant garter snake during the field observation work of February and March of 1994 may reflect this snake's wary, reclusive habitats and low local densities, rather than its absence from the Project area.

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SPECIES ACCOUNTS

Sacramento Splittail

The Sacramento splittail is a native minnow that 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 (Moyle 1976; DFG unpublished data). They have been found in Suisun Bay, San Pablo Bay, and Carquinez Strait (Moyle 1976). Turner (1966) reported finding them evenly distributed in the Delta, while a later study found them most abundant in the north and west Delta on flooded island areas in association with other native species (DFG 1987).

Sacramento splittail are tolerant of brackish water, being caught at salinities as high as 10-12 parts per thousand (ppt) or 15-18 mmhos EC (Moyle 1976). 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 (Moyle 1976; DFG unpublished data). They have been observed to migrate up the Sacramento River and spawn at Miller Park.

The splittail commonly reach 12 to 16 inches in length (30-40 cm). It was formerly a commercially harvested fish but now is sometimes sought by recreational anglers in the Delta and Suisun Bay areas. The splittail is a federal candidate species.

Winter-run Chinook Salmon

The winter-run chinook salmon is one of four recognized chinook salmon races in California. Recent severe declines in the abundance of this race led to its classification as an endangered species by the California Fish and Game Commission pursuant to CESA and as a threatened species by the NMFS pursuant to the Federal Endangered Species Act. It can be distinguished from the other three races by several factors including its migration pattern and timing of events in its life cycle. 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 Sacramento-San Joaquin Estuary soon afterwards. While fall-run smolts typically pass through the Estuary during April, May and June, winter run smolts do so from September through May.

Winter-run chinook salmon spawning historically occurred primarily in the Upper Sacramento, Pit and McCloud river drainage where relatively cool water temperatures prevail in the summer incubation period. The historic run sizes may have numbered over 200,000 spawners. The construction of Shasta Dam in 1942 prevented access to the historical spawning grounds, but summertime releases of cold water from the hypolimnion of Shasta

Lake created favorable habitat conditions in the mainstem Sacramento River below the dam and the winter-run population was able to persist.

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 Shasta Dam in summer and early fall. Another factor contributing to the decline is unsuitable water temperatures. 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 include toxic discharge from Iron Mountain Mine, entrainment at poorly screened diversions, and stranding of juveniles during major flow fluctuations in the rearing area.

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 as well. Limited information specific to the winter-run chinook salmon is also available. 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. 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 main stem Sacramento River into the central Delta through the Delta Cross Channel. 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. 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 through the Cross Channel into the Central Delta than when the gates are open.

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 from unscreened diversions serving managed wetlands from Montezuma Slough 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.

Delta Smelt

The Delta smelt is one of two native resident species of smelt in the Sacramento-San Joaquin Estuary. A recent and continued dramatic decline in its abundance led to the recommendation that it be listed as a threatened species by the State of California (Stevens et al. 1990). The Fish and Game Commission rejected this recommendation pending more information on the species' status. Currently this species is proposed for listing as a threatened species by the U.S. Fish and Wildlife Service (USFWS).

The Delta smelt is a small, slender-bodied fish, with a typical adult size of 2.2 to 2.8 inches (55-70 mm) (standard length), although some may reach 5.2 inches (130 mm). This fish has a small, flexible mouth with a maxilla (upper jaw bone) which does not extend past the middle of the eye. When pressed against the body, the pectoral fins reach less than two-thirds of the way to the pelvic fin bases. The upper and lower jaws contain small, pointed teeth. Live Delta smelt have a steely blue sheen on the sides and appear to be almost translucent (Moyle 1976). Delta smelt, like other members of the family Osmeridae, have an adipose fin. Additional, more detailed descriptive information can be found in Moyle (1976).

The Delta smelt is found only in the Sacramento-San Joaquin River 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. They are also found in Carquinez Strait and San Pablo Bay when high river flows move the salinity gradient downstream. Delta smelt have been found at salinities as great as 10 ppt or approximately 15 mmhos EC, but most of the population occurs at less than 2 ppt or 3 mmhos EC. They school in open surface waters (Moyle 1976).

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 (Stevens et al. 1990). 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 (Moyle 1976).

Delta smelt are euryhaline, and much of the year are typically most abundant in the entrapment zone (Arthur and Ball 1979) where incoming saltwater and outflowing freshwater mix. This mixing effect allows organisms which swim poorly, such as zooplankton and larval fish, to remain in the entrapment zone 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 (Ganssle 1966, Radtke 1966, Moyle and Herbold 1989). Surveys by the San Francisco Bay - Outflow Study, which has sampled fish in the Estuary from San Francisco Bay to the western Delta since 1980, indicate that Delta smelt thin out in San Pablo Bay and are 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; in low flows the population is confined to the channels of the Delta.

As spawning approaches in the late winter and spring, Delta smelt adults migrate to fresh water. The majority of spawning occurs in the dead-end sloughs, the shallow edge-waters of Delta channels, in Montezuma Slough near Suisun Bay and in the Sacramento River upstream from Rio Vista from February through June. Spawning occurs in fresh water at temperatures of 7-15°C. Females produce 1400-2900 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 (40-50 mm) long by August. Adult lengths are reached when fish are six to nine months old (Stevens et al. 1990). Delta smelt are a short-lived species; most die after spawning at one year of age, but some survive to two years.

During the 1980's however, 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 south and east Delta during the 1970's, prior to the overall population decline of the 1980's. (Stevens et al. 1990).

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, 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 (Stevens et al. 1990).

Giant Garter Snake

The giant garter snake is one of the largest garter snakes, reaching 4½ ft (137 cm) in length. The basic color is dull brown with a checkered pattern of well separated black spots on the dorsal side. There is a dull yellow-mid-dorsal stripe, and the lateral stripes are often not developed. The head is elongated with a pointed muzzle.

The original reported range of this state listed threatened species was the San Joaquin Valley from the vicinity of Sacramento and Antioch southward to Buena Vista Lake and the Tulare Lake Basin. The present known distribution extends from the vicinity of Gridley, Butte County, to the vicinity of Burrel, Fresno County and includes areas of permanent freshwater marsh and marsh vegetation along large irrigation canals in the Sacramento-San Joaquin Delta. Loss of suitable wetlands have been the most significant reason for the decline of this species.

Bald Eagle

The bald eagle is a rare permanent resident and uncommon winter migrant in California. Since at least 1977 it has been restricted to breeding primarily in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou and Trinity counties. Approximately half of the winter population is concentrated in the Klamath Basin. It is principally found at lower elevations. Wintering bald eagles are commonly observed at a few favored inland bodies of water in southern California. For example, large concentrations occur at Big Bear Lake, Cachuma Lake, Matthew Lake, Nacimiento Reservoir and San Antonio Reservoir. Bald eagles also use many other California reservoirs and lakes and are infrequently observed using the Suisun Marsh.

Bald eagles generally require large bodies of water providing an abundant source of fish or waterfowl and are seldom found far from the ocean or large lakes. They nest in large dominant live trees which are usually located near a permanent water source. Eagles feed on waterfowl, coots, fish and mammal carcasses. Groups of eagles may feed gregariously.

The bald eagle is both federal and state listed endangered. These birds are highly vulnerable to eggshell thinning induced by ingestion of DDT (dichloro-diphenyl trichloro-ethane) and its primary metabolite DDE (dichloro-diphenyl dichloro-ethylene). Human disturbance such as logging, recreational development and nest disturbance have caused territory abandonment (Thelander 1973).

American Peregrine Falcon

This species nests in the Sierra Nevada, the mountains of northern California and along the coast. It is found inland, during winter, throughout the Central Valley and occasionally on the Channel Islands. It migrates during the spring and fall throughout California. Riparian areas, and coastal and inland marshes are important year-round habitats, while breeding typically takes place in woodland, forest and coastal habitats on cliffs.

It requires protected ledges for cover and preys upon many different bird species, up to the size of ducks. It utilizes cliffs in the vicinity of lakes, rivers or marshes. It stoops from flight to intercept flying prey.

This species is both state and federally listed endangered. Populations have been increasing in recent years. DFG researchers have recorded 106 breeding pairs in California in 1990. This species is highly susceptible to eggshell thinning induced by ingestion of DDT and its primary metabolite DDE. The low reproductive rates for the coastal population is probably due to heavier DDE loads received from migrant prey species. California has established several ecological reserves to protect peregrine nesting sites. The Predatory Bird Research Group (Santa Cruz, CA) has operated a captive rearing program to help augment wild peregrine populations.

Aleutian Canada Goose

This subspecies of Canada goose (B. canadensis) breeds in the Aleutian Islands and its main wintering grounds are in the Central Valley of California (Palmer 1976, Peterson 1961). This species 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 in October to November (D. Yparraguirre, DFG biologist, pers. comm.). Use is focused in Sacramento Valley marsh and agricultural areas in early winter while 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 in the Suisun Marsh is sporadic. The return migration occurs from late February through April. 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 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 were also implemented to speed the recovery. The population has now rebounded from an estimated wintering population of 800 in the mid 1970's to over 5,000 currently (D. Yparraguirre, pers. comm.). 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 are a key component of this species' continuing recovery.

California Black Rail

The California black rail is a rare year-long resident of tidal salt marshes and brackish and freshwater marshes in the San Francisco Bay area, Sacramento-San Joaquin Delta, coastal southern California at Morro Bay, the Salton Sea and lower Colorado River area. Formerly a local resident in coastal lowland marshes from Santa Barbara County to San Diego it still winters there rarely. Significant loss of saltwater, brackish and freshwater wetland habitat 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 (Manolis 1977).

Since 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 saltmarshes dominated by pickleweed or brackish marshes supporting bulrushes, in association with pickleweed. In exclusively freshwater marshes where black rails occur, 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. The black rail is state listed as threatened and is a federal candidate species.

California Clapper Rail

The California clapper rail is listed both by the California Fish and Game Commission and the USFWS as an endangered species. The rail is a coot-sized bird with adults averaging 14-16½ inches (36-42 cm). This long-billed secretive bird is characterized as grayish-brown with a tawny breast, barred flanks, and a short-upturned tail with white beneath (DFG 1978). 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 suitable 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 especially in the Cutoff Slough vicinity are also used by the clapper rail (Figure 8). Surveys conducted by DFG in the late 1970's did identify clapper rail use on the north shore of Contra Costa County in the Martinez area but other than the Suisun Marsh all the sightings were made in San Pablo Bay and other portions of San Francisco Bay.

Salt Marsh Common Yellow Throat

This federal candidate species inhabits the west-central coast of California. This particular subspecies only inhabits (breeds in) San Francisco Bay, Tomales Bay and Carquinez/Suisun Bay in central California. Some may winter further south. Probably less than 200 pairs remained in 1978 and further reductions have probably occurred. It principally breeds and winters in brackish to saline emergent wetland habitats. The yellow throat eats insects, especially larvae but also gleans from the foliage of marsh vegetation. Declines of this species are also related to reductions in the vegetation associated with brackish water such as the tidal wetlands in the study area of this assessment.

Suisun Song Sparrow

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 southwestern tip of Sacramento county (DFG 1989). This species is typically found in high densities in tidally influenced vegetation, where pairs forage only short distances and exhibit high fidelity

Figure 8. Biological Opinion for the Island Slough Wetland Development Project. California Clapper Rail Locations.

to small, defended territories throughout their lifetimes. Tidal marsh vegetation comprised primarily of bulrush (Scirpus sp.) and cattail (Typha sp) provide appropriate escape and nesting habitat. Mud flats at the base of this dense vegetation are used extensively for feeding. Presently this species is a federal candidate species.

They typically don't leave the cover of vegetation; eating at the base of this vegetation when mud is exposed at low tide. They only inhabit appropriate vegetation where there is room to walk between stalks on the mud. They cannot live where it is too dense. They cannot live anywhere where tidal flow is impeded at all such as behind mosquito ditches and dikes or where water flow is controlled. Maintaining/rebuilding levees in the few remaining tidal areas can have a further fragmenting effect.

Young only disperse a short distance from their birthplace. 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. Habitat remains in the Suisun Marsh where state and federal laws regulate the remaining tidal marsh. Threats to remnant Suisun song sparrow populations include the fragmented condition of remaining optimal habitat, toxic substance discharge and accidental oil spills into the bay and vegetation removal in higher marsh and levee areas. Long term changes in channel salinity resulting from changes in Delta outflow could result in changes in the vegetation compensation of the tidal wetland used by this species.

Suisun Ornate Shrew

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 (Rudd 1955). Although little is known about the specific habitat requirements of the shrew, it is usually found at higher marsh elevations not subject to frequent tidal action. Like the other marsh species endemic in Suisun Marsh, its current distribution has been greatly reduced over the past century by widespread destruction of the peripheral halophyte zone of tidal marshes. Less than two dozen marshes within its range may still provide potential habitat for the species (Williams 1983). According to DFG researchers few recent records of this species exist.

In Suisun Marsh and throughout the remainder of its range, the current status and distribution of the Suisun shrew is poorly known. According to Williams (1983), known records for Suisun Marsh are as follows: 0.5 miles NE Cordelia Marsh, 5 (specimens) Museum of Vertebrate Zoology (MVZ); Gray Goose Duck Club, 1.5 miles SW Suisun, 1 California Academy of Sciences (CAS); Grizzly Island, Suisun Bay, 1 Los Angeles County Museum (LACM), 20 MVZ, 5 University of California at Davis (UCD), 2 US National Museum (USNM), 19 (Rudd 1955); Honker Gun Club, near Dutton, Van Sickle Island, 1 CAS;

Suisun City (salt marsh adjacent to Cordelia Sl.), 4 MVZ; Suisun marshes, periphery of Grizzly Island, 13 (Rudd 1955); Van Sickle Island, 1 mile S Dutton, 1 CAS; Van Sickle Island, 1 CAS, 3 UCD.

Salt Marsh Harvest Mouse

The study animal is listed by the USFWS as an endangered species, as provided for by the Endangered Species Act of 1973 (PL 93-205). Originally found throughout the extensive marshes once bordering the San Francisco Bay east to the vicinity of Collinsville, this species is now restricted to scattered populations within its original range. Loss of habitat due to development by diking and filling is the chief factor in its past decline. Current restrictions on filling by BCDC have begun to reduce this impact within its range. Enhancement throughout its range is recommended to improve this animal's status (DFG 1978).

Two subspecies have been identified by Fisler (1965). The subspecies under consideration here, R.r. halicoetes, occurs from the west end of the San Rafael Bridge to Collinsville along the northern edge of the bay and on the south side from Martinez to Pittsburg. The other subspecies, R.r. raviventris, is found along the San Francisco Bay shoreline.

The mouse is a new world rodent characterized by a rich brown back with underparts a pinkish cinnamon to whitish color. Although difficult to distinguish from the western harvest mouse (Reithrodontomys megalotis), techniques utilizing tail length, head and body length, color, behavior and other characteristics have proved effective (Ingles 1965).

The mouse is crepuscular and partially diurnal in its activity and generally has a very calm temperament. Shellhammer (1977) felt that this behavior explains 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 (Fisler 1965), Recent DFG studies (1981) support this conclusion. During a trapping study, mice were captured in a dense stand of fat hen with no pickleweed present.

Fisler (1965) found that the mouse can not live on a diet consisting exclusively of pickleweed and salt grass (Distichlis sp). His study showed that the mouse required a more varied diet including green and dry plant stems and leaves and plant seeds provided by areas supporting diverse habitat matrices. Most research in the Suisun Marsh, nearby in the Collinsville area, and on the Contra Costa shoreline supports these early findings (Biosystems 1978, Shellhammer 1980).

Most mice were captured in dense, diverse marsh habitats. Sparse cover in poor condition provided poor mouse habitat. These same studies found that pickleweed was the most important habitat component. Its occurrence in areas that supported mice was highly significant. Major exceptions appear to be during high water outflows and high tides in tidal areas and when 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 excellent escape cover (Shellhammer 1977; Biosystems Analysis 1978; 1979). In areas managed for waterfowl, dikes with dense vegetation provide refugia for the mouse when these areas are normally flooded from October through June.

Delta Tule Pea

This climbing perennial herb was distributed historically throughout many Bay Area marshlands, with additional populations known from San Benito, Fresno and Tulare counties (Broich, Oregon State University, pers. comm.). 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. It is currently a federal candidate species.

Its current geographical range is from the Napa River to the Stockton area (CNPS, 1977d). Several populations have been found in various localities of the San Joaquin Valley, although placement of these specimens in this subspecies has been questioned (Hitchcock, 1952). A closely related subspecies, L. jepsonii ssp. californicus, is common along waterways throughout the State. It is distinguished from the Delta tule-pea by the presence of small hairs on most of the plant parts. L. jepsonii ssp. jepsonii in May and June (Munz and Keck, 1968).

CNPS (1977d) lists marsh lands, on drier ground, as habitat of this subspecies. It is common among tule stands in the western Suisun Marsh where in occasionally forms dense tangled masses.

This subspecies was often found trailing through Scirpus (tule) stands along the Suisun Slough in the western portion of the Suisun Marsh. Most of the occurrences listed in the data base computer search had habitat descriptions such as "edge of slough" or "along river bank", implying areas of tidal influence. All of the populations of the Delta tule-pea noted during our 1986 field surveys in other Suisun Marsh localities 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 as endangerment factors (CNPS, 1977d). The plants were not encountered in recently disturbed sites in the western Suisun Marsh.

Suisun Slough Thistle

This spiny, biennial herb, 1-1.5 meters tall with pale lavender-rose flowers, is known only from one site--0.75 miles SSW of Suisun City. It is presently a federal candidate species. Last observed in 1974, the plant is still presumed extant. The habitat of the thistle apparently consists of salt to brackish wetlands periodically inundated during high tides.

Little is known beyond these data concerning the species' distribution and habitat requirements. 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.

Suisun Aster

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

Populations visited during 1986 by DWR botanists, included Suisun Slough, Hill Slough and other western Suisun Marsh waterways. These populations were often dense, but highly restricted to the narrow band of Scirpus 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 populations that we observed in the Suisun Marsh were tidally influenced.

Mason's Lilaeopsis

Mason's lilaeopsis is a member of the carrot family (Apiaceae), the fourth largest family of flowering plants in California. In 1979, Mason's lilaeopsis was listed as "rare" by DFG. It is also a federal candidate for listing. In addition, Mason's lilaeopsis is in the inventory of rare and endangered plants of the California Native Plant Society (Smith and York 1984) in which it is listed a plant of "highest priority".

Mason's lilaeopsis is a low-growing perennial that appears grass-like at a distance. The leaves are reduced to hollow, obscurely septate, cylindrical phyllodes that are produced in short tufts 1.5-7 cm long and less than 1 mm wide. Flowering branches (peducles) are shorter than the leaves. The inflorescence is a simple umbel producing 3-8 flowers.

Mason's lilaeopsis is know from a minimum of 39 sites according to information from the California Natural Diversity Data Base (CNDDB). 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 population positions on exposed banks determined that they occur in the zone between 16 and 36 inches (40 and 90 cm) 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 (75-80 cm) 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 were 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 (Salix spp.), and in full sunlight. No correlation between riparian or marsh species was observed for plant association preference of Mason's lilaeopsis. 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-levied 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 one 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 levied banks having low viability.

While little data are available on channel water salinity requirements evidence suggests populations are restricted to the fresher portion of the Napa River and locations west of Martinez in the Suisun Bay area and Sacramento San Joaquin Delta. Threats to this species are primarily related to dredging, levee construction and riprapping.

Soft-haired Bird's-beak

This state-listed rare and federal candidate species is an annual herb endemic to higher elevations of tidal marshes fringing the shorelines of San Pablo and Suisun Bays. The soft bird's-beak is found in tidal marshes at the north end of the San Francisco Bay and in the Suisun Marsh (CNPS, 1977c). While relatively small (25-40 cm tall), its distinctive gray-green and hairy vegetation contrasts with associated salt marsh vegetation (Joe Callizo, pers. comm.). 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 known sites (Napa River and Montezuma Slough) were visited in 1986 during the course of field work being conducted by DWR botanists and were found in a diverse association of species and were tidally inundated. From the descriptions of habitat in the data base records, most of the sites appear to be tidally influenced. Williams (1982) felt that the soft bird's-beak was not likely to occur in pure stands of pickleweed at the lowest

elevations of the Napa Marsh; he felt combinations of saltgrass and pickleweed at higher elevations was more suitable for this sub-species.

Hispid Bird's-beak

The hispid bird's-beak is a small (15-20 cm high) leafy annual herb. It grows on saline flats in association with Salicornia and/or Distichlis. 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.

A population 1.5 miles NNE from Denverton represents the closest known population to the project area. Because the habitat at this locality more closely resembles the non-tidal conditions found in association with Central Valley populations, it seems probable that any Cordylanthus populations found in tidal (or formerly tidal) wetlands in Suisun Marsh more likely would be C. m. subsp. mollis.

PROJECT EFFECTS OF THE PROPOSED ACTION ON LISTED AND CANDIDATE SPECIES

Construction of the ISDP and post construction management have the potential to impact listed and candidate species in different ways. Following are discussions of how the proposed ISDP could affect these species and whether the proposed project will adversely impact them.

Sacramento Splittail

Adult and juvenile Sacramento splittail are potentially present throughout the year in Montezuma Slough, thus being vulnerable to entrainment by the new diversion for the ISDP. The DFG is including a fish screen at the new intake for the Island Slough Unit which will meet DFG screening criteria. Achieving those criteria will, in the DFG's opinion, avoid the take of the adult and juvenile life forms of this species due to diversions. Placement of the screen flush with the edge of Montezuma Slough will also minimize the potential for the establishment of predatory fish concentrations which could increase predation losses.

In the DFG's opinion, Sacramento splittail eggs will not be vulnerable to diversion impacts. Likewise, larval splittail will typically not be vulnerable in most years. However, in wet years splittail larva may be present in Montezuma Slough during April, May and June. Seasonal wetland management using two leach cycles could result in entrainment of this life form during April and May.

The DFG, as part of its current Delta smelt study, plans to evaluate the extent to which unscreened water diversions entrain Delta smelt. Data collected on splittail as a by product of that evaluation will be used to determine whether operational changes should be implemented. For instance, if diversions do entrain splittail larvae, management could be modified to follow the fat hen water management schedule. That schedule completes its sole leach cycle by early March thus avoiding the potential for impacting splittail larvae.

Winter-run Chinook Salmon

Diversions taken out of Montezuma Slough for the proposed ISDP may affect winter-run chinook salmon fry and smolt in three ways. First, flows in Montezuma Slough will be reduced by up to 20 ft^3/sec. as water will be diverted from Montezuma Slough to serve the newly created wetlands. Second, the diversion could entrain winter-run fry and smolts. Third, the potential effects in combination with past, present and future proposed diversions could cumulatively effect winter-run chinook salmon.

The reduction in flow in Montezuma Slough due to the proposed water diversion will represent a very small fraction of total flow in Montezuma Slough. Likewise, this diversion will not increase the diversion of Sacramento River water into Montezuma Slough. Therefore, no adverse effect is expected from these two factors. The installation of the proposed fish screen will avoid the potential for impact due to entrainment. While the fish screen will eliminate entrapment, the presence of the structure itself could pose a hazard by increasing predatory fish population in its immediate vicinity thus exposing winter-run chinook salmon fry and smolts to increased predation. However, in the DFG's opinion, the fish screen design and placement at the edge of Montezuma Slough to entrainment will also preclude the risk of increased mortality due to increased predatory fish populations in the vicinity of the screen. No adverse cumulative impacts are expected because of the measures being implemented. Any future diversions proposed by DFG will also contain these same measures. In addition, efforts are underway to screen existing DFG diversions.

Delta Smelt

The fish screen being installed to avoid impacts to winter-run chinook salmon and Sacramento splittail will also provide avoidance for impacts to adult and juvenile Delta smelt. However, as with the splittail, larval Delta smelt could be present in Montezuma Slough in the early spring at the same time water diversions are being made to help leach soil salts from the 254 acre seasonal wetland area. The fish screen will not effectively screen larval Delta smelt. No impact is expected to Delta smelt larvae in most water years. However, in wetter years smelt larvae could be entrained by diversions in April and May. The operational modifications discussed for the Sacramento splittail will also be evaluated for the Delta smelt and those changes will be implemented if sampling by the DFG's Delta Smelt project indicates larval Delta smelt are being entrained. For the same reasons discussed for the Sacramento splittail no impacts are expected due to increases in predator populations in

the vicinity of the new fish screen. Delta smelt eggs adhere to substrates and will not be affected by the proposed ISDP.

Giant Garter Snake

The Island Slough Unit does not presently contain suitable habitat for this species in those areas of the Unit proposed for seasonal wetland development. Construction of the intake structure will also not affect suitable giant garter snake habitat. Following wetland development potentially suitable habitat will be developed. However, no specific measures will be taken to introduce this species to the site.

Bald Eagle and American Peregrine Falcon

Since both of these species are rare winter visitors to the Island Slough Unit of the Grizzly Island Wildlife Area and the proposed project will not adversely affect suitable habitat for these species or their prey neither would be adversely impacted by implementation of the ISDP.

Aleutian Canada Goose

Aleutian Canada geese winter occasionally at the Grizzly Island Wildlife Area but have not been observed on the Island Slough Unit. This species will be provided with enhanced feeding and resting opportunities as a direct and intended consequence of the operation of the Island Slough Unit. Positive impacts will result from the implementation of the ISDP by managing portions of the new wetland to provide shallow flooded or exposed areas with low herbaceous vegetation suitable for grazing geese.

California Black Rail

The status of the black rail on the Grizzly Island Wildlife Area is currently not well understood. DFG biologists played taped black rail calls in the spring and summer of 1991 following techniques described by Manolis (1977). However, no response was heard. This coupled with the absence previous records for this species in the project area (Manolis 1977) and limited permanent impact on tidal wetland make it unlikely that the proposed action will result in take of this species. Potentially suitable tidal habitat disrupted during construction will be substantially restored.

California Clapper Rail

Surveys in the Suisun Marsh have shown that population size and distribution is very limited. Past studies have shown clapper rails in the Cut-Off Slough portion of the Joice Island Unit. Surveys conducted in the spring and early summer of 1991 following techniques described by Gill (1979) were not successful in locating California clapper rails in the tidal wetland of the Island Slough Unit. Even though the likelihood is low that this species is found in the project area potential habitat will be impacted from construction of the main intake and fish screen. However, the permanent impact on tidal wetland by the proposed ISDP will be limited. The proposed ISDP would impact 7,700 square feet of tidal marsh. Long term construction impacts will be limited to 1,500 square feet since the remainder of the site will be restored to original ground level and allowed to revegetate. Therefore, there should be no adverse impact on the California clapper rail.

Salt Marsh Common Yellowthroat

While no data exists to document the occurrence of this species in the proposed project area, suitable habitat does exist and construction of the new intake and fish screen could adversely affect it. The consequences of this and recommended measures discussed relative to the Suisun song sparrow also apply to the yellowthroat.

Suisun Song Sparrow

Surveys conducted during the breeding season on behalf of the Bay Institute in 1990 mapped potential Suisun song sparrow habitat and recorded sightings made during the course of the mapping. The nearest sighting made was 0.7 mile to the north and 0.2 mile east of the Grizzly Island Bridge over Montezuma Slough. No sighting was made on the Island Slough Unit. However, this species is only found in tidal areas and is more specific to the relatively narrow bands of tules and cattails now remaining along sloughs and bays. The Island Slough Unit contains 65.6 acres of tidal wetland habitat suitable for the Suisun song sparrow. Therefore, suitable habitat on the Island Slough Unit will be affected during implementation of the ISDP. Nearly 7,200 square feet of this habitat, or less than 0.3%, will be disrupted to allow for the installation of the main intake and fish screen. After installation, 6,200 square feet will be restored. Prior to revegetation this disturbed area will be a mud flat. Although the Suisun song sparrow feeds on mudflats, principally they feed on mudflats underneath existing cover. Therefore, the short term loss of the cover provided by cattails and tules will result in this mudflat not being used for feeding. Since no Suisun song sparrow territories were observed in the area proposed for installing the new intake, and since 84 percent of the area will revegetate within three years, the DFG finds that the permanent loss of 1,000 ft^2, or 0.2 acres of tidal wetland, and short term impact to 5,200 ft^2 will not result in take of this species or result in adverse impacts to its habitat.

Suisun Ornate Shrew

Generally habitat suitable for the salt marsh harvest mouse is also suitable for the Suisun shrew. No adverse project impacts are expected to this species while potential benefits will occur from establishing 100 acres of preferred habitat for the salt marsh harvest mouse.

Salt Marsh Harvest Mouse

Trapping studies have shown the salt marsh harvest mouse occurs on most units of the Grizzly Island Wildlife Area. However, the Island Slough Unit contains no pickleweed or other suitable dense habitat. Other primary cover types such as upland grass support house mice and western harvest mice. The DFG live trapped the proposed project area in the summer of 1991. However, after 145 trapnights of effort no salt marsh harvest mouse was captured in the Island Slough Unit.

Following development of the 100 acres of preferred salt marsh harvest mouse habitat that species is expected to flourish in the Island Slough Unit.

On the Grizzly Island Wildlife Area, specific parcels have been designated for development of preferred salt marsh harvest mouse habitat. More than 1,000 acres of DFG lands in the Suisun Marsh have been designated for development and management as preferred salt marsh mouse habitat as part of the program to implement the Plan of Protection (Plan). Detailed management for the 1,000 acres is included as part of the Plan. Monitoring of this habitat and salt marsh harvest mouse populations is required in the Plan. The development and management of 100 acres of preferred salt marsh harvest mouse habitat as part of the ISDP will add to this 1,000 acres.

Delta Tule Pea

Intensive botanical surveys conducted in 1988 and 1991 resulted in this plant being found in the vicinity of the proposed project (Figure 9). However, during the survey this plant was not observed in the vicinity of the proposed intake or other areas along the external levees of the Island Slough Unit. Therefore, no adverse impact is expected. The DFG will explore opportunities to establish this plant in the tidally influenced area containing cattail and tules on the east side of the Unit.

Suisun Slough Thistle

Intensive botanical surveys conducted in 1988 and 1991 resulted in no observations being made of this plant in the proposed project area of the Island Slough Unit. Therefore, no adverse impacts are expected. The DFG will explore opportunities to establish this plant in the Unit following completion of the ISDP.

Figure 9. Biological Opinion for the Island Slough Wetland Development Project. Location of Special Status Plant Species.

Suisun Aster

Intensive botanical surveys conducted in 1988 and 1991 resulted in this plant being observed in the vicinity of the proposed project (Figure 9). However, since no observation was made of this plant in the vicinity of the proposed intake or other areas along the external levees of the Island Slough Unit potentially affected by project construction, no adverse impacts are expected. The DFG will explore opportunities to establish this plant in the tidally influenced cattail and tules at the east side of the Unit.

Mason's Lilaeopsis

Potential habitat for this plant exists in the intertidal zone of fresh and brackish marshes where it is frequently inundated by tidal action. Mason's lilaeopsis grows in the intertidal zone along the margins of sloughs and rivers. In the case of the Island Slough Unit, this includes the outboard sides of the exterior levees and the edges of the tidal wetlands on the east side of the Unit. Potential impacts could result from construction of the main intake and fish screen and from on going maintenance. Maintenance of exterior levees, including rip-rapping and exterior water control structures, will be conducted each year. This activity is necessary to maintain the integrity of the area and the water management capabilities for all of the seasonal wetlands. Because habitat for Mason's lilaeopsis occurs on the outboard sides of exterior levees, these activities have the potential to impact the plant. Intensive field inventories by a DFG botanist in 1988 and 1991 found this plant in the vicinity of the ISDP (Figure 9) however, no plants were observed in the vicinity of the proposed intake and fish screen or other project feature along the eastern boundary of the property. Therefore no adverse impact is expected to occur.

Soft-haired Bird's Beak

Soft-haired bird's beak grows in the upland transition border or the upper level of the high tide. While habitat suitable for this species occurs in some units of the Grizzly Island Wildlife Area it does not occur in the Island Slough Unit. The upper margin of the tidal areas on the Island Slough Unit grade rapidly into upland grasses along Grizzly Island Road. Therefore, no impact to this species is expected.

Hispid Bird's Beak

Botanical surveys resulted in no hispid bird's beak being found in the project area. Opportunities will, however, be explored by the DFG to reintroduce this plant in Cell 7 of the Island Slough Unit.

PROJECT CONDITIONS

CESA (Sections 2091 and 2092) requires the DFG to determine and specify reasonable and prudent alternatives consistent with conserving the species, which would prevent jeopardy to the continued existence of the species. The following project conditions constitute those alternatives and will prevent the implementation of the Island Slough Wetland Development Project from jeopardizing any listed species or resulting in the destruction or adverse modification of habitat essential to the continued existence of these species:

1. Following construction of the intake structure affected tidal marsh will be restored and protected in perpetuity. This measure will be consistent with the San Francisco Bay Conservation and Development Commission regulations that do not allow conversion of tidal wetlands to managed wetlands in the Suisun Marsh. Critical protection of tidal wetlands is provided through that regulatory process.

2. The Island Slough Unit shall be surveyed periodically for the California black rail and California clapper rail and, if found, their locations shall be mapped and monitored in perpetuity. Any needed mitigation measures will be developed, and a revised Biological Opinion will be prepared and will receive public review prior to any actions which might affect the species.

3. Create "no activity zones" around any potential nesting areas during the nesting period of the California black rail.

4. Perform maintenance activities such as burning and discing when the black rails or clapper rails are not nesting in the project area.

5. As exterior levees are maintained, sufficient outboard slope will be constructed or retained to allow a minimum width of 10 yards of hardstem bulrush and common cattail to grow. The goal will be to establish or maintain wider tidal benches of approaching 100 yards. The elevation of these benches will be suitable for providing exposed mudflats within the bulrush stands at low tides. goals and objectives for the California clapper rail and California black rail are met, this will also provide protection to Suisun song sparrow habitat.

6. The non-invasive management proposed for Cell 7, the preferred salt marsh harvest mouse habitat cell, will avoid the take of this species. The amount of habitat manipulation in habitat suitable for the mouse on the other 254 acres will also be restricted. In that area, if manipulation of pickleweed and/or fat-hen stands is needed, only 25 percent of a particular stand will be disturbed in any given year. Thus, 75 percent is left undisturbed as mouse habitat.

Development of preferred salt marsh harvest mouse habitat and continuing the management practice of only manipulating 25 percent of a stand of pickleweed and/or fat-hen should preclude any adverse impact on the salt marsh harvest mouse.

INCIDENTAL TAKE

Pursuant to Section 2090 of CESA, the DFG finds that the potential to take winter-run chinook salmon, California clapper rail, California black rail and salt marsh harvest mice incidental to the project does not exist. Loss of salt marsh harvest mice may occur, however, after wetland development as a result of operation and maintenance activities on areas not set aside for the mouse. Section 2091 of CESA requires the Department of Fish and Game to determine and specify to the State Lead Agency "reasonable and prudent measures that are necessary and appropriate to minimize the adverse impacts of the incidental taking." The DFG has determined that if the Project Conditions identified in this Opinion are fully implemented and adhered to during future operation and maintenance activities, then the adverse impacts of any "incidental" take will be minimized.

CONCLUSIONS

If the project construction and operation conditions in this State Biological Opinion are implemented, then it is the DFG's determination that implementation of the ISDP will not jeopardize the continued existence of the winter-run chinook salmon, California clapper rail, California black rail, salt marsh harvest mouse, Mason's lilaeopsis and soft-haired bird's beak. Inclusion of these conditions would also protect the Sacramento splittail, Delta smelt, Suisun song sparrow, and the Suisun shrew.

PROPOSED ISLAND SLOUGH
WETLAND DEVELOPMENT PROJECT

APPENDIX A

SUISUN MARSH MITIGATION AGREEMENT

PROPOSED ISLAND SLOUGH
WETLAND DEVELOPMENT PROJECT

APPENDIX B

COMMENT LETTERS RECEIVED ON
DRAFT INITIAL STUDY AND NEGATIVE
DECLARATION AND RESPONSES

PROPOSED ISLAND SLOUGH
WETLAND DEVELOPMENT PROJECT

APPENDIX C

PUBLIC NOTICES

PROPOSED ISLAND SLOUGH
WETLAND DEVELOPMENT PROJECT

APPENDIX D

SOLANO COUNTY MOSQUITO ABATEMENT DISTRICT
CRITERIA FOR MOSQUITO PREVENTION

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Swainson's Hawk

The Swainson's hawk was described in early accounts as one of the most common raptors in California (Sharp 1902). The species occurred throughout much of lowland California, hunting in open grassland habitats and nesting along the edges of riparian forests or oak woodlands, or in isolated trees that were scattered across the valley savannas.

Pre-agricultural California supported abundant woodland and grassland habitats, particularly throughout the Central Valley. Since the mid-1800s, these native habitats have undergone a gradual conversion to agricultural uses. Today, native grassland habitats are much reduced in the state, and only remnants of the once vast riparian forests and oak woodlands still exist (Katibah 1983).

The effect of widespread loss of both nesting and foraging habitats on Swainson's hawks has been a significant reduction of the breeding range and the breeding population in California (Bloom 1980). The state currently supports an estimated 550 breeding pairs of Swainson's hawk, representing less than 10 percent of the historic population (California Department of Fish and Game 1988). To provide protection for the remaining population, the State of California listed the Swainson's hawk as a threatened species in 1983.

The largest segment of the California Swainson's hawk population exists in the Central Valley, where an estimated 440 pairs nest (California Department of Fish and Game 1988). Although agricultural conversion of native habitats was probably the primary factor responsible for initial Swainson's hawk declines in the state certain agricultural practices are largely responsible for maintaining current populations. The row, grain, and hay crop farming typical of the mid-section of the Central Valley is compatible with Swainson's hawk foraging habitat needs. The distribution of the Central Valley population is closely correlated with the distribution of these cropping patterns. This region of suitable agricultural foraging habitat is considered essential in maintaining the stability of the Central Valley Swainson's hawk population.

Swainson's hawks usually nest in large, mature trees. Native trees are almost always used, although nests have been found in eucalyptus (*Eucalyptus* sp.) trees and ornamental conifers. Tree species most commonly used in the Central Valley in decreasing order of frequency include valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), black walnut (*Juglans hindsii*), and willow (*Salix* sp.). Nests are usually of flimsy construction and often blow out of the nest tree during high winds, particularly during winter.

Although nest sites are not found exclusively in riparian habitat, more than 87 percent of the known nest sites in the Central Valley are within riparian systems (Schlorff and Bloom 1983, Estep 1984). Swainson's hawks also nest in roadside trees, isolated individual trees, small groves, and on the edges of remnant oak woodlands.

Swainson's hawks are highly traditional in their use of nesting territories, returning each year to the same nest tree or a tree nearby. Many nest sites in the Central Valley have been monitored annually since 1978, and a program of color banding nesting paries has been ongoing since 1986. These studies show a high degree of nest site and mate fidelity among pairs.

The Swainson's hawk is adapted to foraging in large, open plains and grasslands. In the Central Valley, however, virtually all native foraging habitat has been converted to agricultural uses, restricting Swainson's hawks to areas that support cropping patterns compatible with their foraging requirements. Both the abundance of prey populations and the accessibility of prey to foraging birds determine the suitability and quality of agricultural foraging habitat for Swainson's hawks. The many crop types grown in the Central Valley differ widely with respect to their foraging habitat suitability.

Swainson's hawks hunt aerially almost exclusively in the Central Valley, soaring from 100 to 300 feet above the ground while scanning for prey (Estep 1989). Foraging birds select fields that are most compatible with this type of foraging behavior (i.e., fields that are large, support low cover to provide access to the ground, and provide the highest densities of accessible prey). These habitats include hay and grain crops, lightly grazed pasture lands, and certain row crops, such as tomatoes and sugar beets. Fields lacking adequate prey populations, such as flooded rice fields, or those that are inaccessible to foraging birds, such as vineyards and orchards, are avoided.

Cropping patterns directly affect the foraging behavior, foraging range size, and ultimately the reproductive success of nesting Swainson's hawks. As crops mature, vegetative cover increase, which decreases prey accessibility; as a result foraging birds expand their ranges in search of fields that provide accessible prey. Foraging Swainson's hawks have been observed traveling more than 9 miles from their nest in search of prey (Estep 1989). Later in the season, as crops are harvested, foraging ranges decrease as prey become more accessible near the nest. Prey abundance has also increased by the time harvesting operations proceed. The result is that foraging ranges can fluctuate both seasonally, in response to changes in prey accessibility and abundance, and from year to year in response to changing cropping patterns. Overall foraging ranges (averaging 6,800 acres) ranks the habitat quality of various crops grown in the Central Valley as high, moderate, or low based on their value to foraging Swainson's hawks.

Corn and wheat, the primary crops grown in the central Delta, provide suitable foraging habitat for nesting Swainson's hawks. However, most of the crop types in the central Delta are suitable as foraging habitat only during part of the breeding season. The timing of corn and wheat planting and harvesting are complementary, providing suitable foraging habitat throughout most of the breeding season.

Both corn and wheat provide foraging habitat during the early part of the breeding season. Wheat fields become less suitable in April as the crop matures. Cornfields continue to be suitable for foraging through May. As cornfields mature, they also become unsuitable, but by late June to early July, wheat is harvested and harvested wheat fields again become suitable habitat. Thus, it is possible that suitable habitat is available to foraging Swainson's hawks on central Delta islands throughout most of the breeding season. The central Delta also supports other row, grain, and hay crops and pastures that attract foraging Swainson's hawks.

Swainson's hawks are known to nest in the central Delta and individuals are occasionally observed foraging on the central Delta islands, including the Project islands, during the breeding season, (Jones and Stokes Associates 1990a, Holt pers. comm.). Pairs that nest outside the Delta may also forage on Delta islands during certain times of the year, particularly during periods of harvest or during periods of foraging range expansion, which occurs when prey is limited near the nest (Estep 1989).

In general however, Swainson's hawks will limit their foraging movements to stay as close to the nest as possible. Thus, foraging frequency declines with distance from the nest. In most cases, nest sites are located near high-quality foraging habitat; thus, hawks will travel far from the nest only if necessary, based on both the crop patterns near the nest and availability of suitable habitat elsewhere.

Although an unusual occurrence at northern latitudes, the Delta is also used by Swainson's hawks during the winter. Swainson's hawks are migratory, and most spend winters in South America. Individuals, however, have been sighted during winter in the Delta over the last 10 years (Holt pers. comm.). In 1990-1991, a group of 29 adult Swainson's hawks was regularly observed on Bouldin Island and neighboring Venice Island for several weeks. These birds appeared to be attracted to the abundance of prey that resulted from the discing and flooding operations on the islands. A key roost area was a stand of eucalyptus trees across the Mokelumne River from Bouldin Island on neighboring Tyler Island, where the group roosted for several weeks.

The above information was taken into consideration when the DFG developed its mitigation guidelines for the Swainson's hawk.

Greater Sandhill Crane

The greater sandhill crane is the largest of four recognized subspecies of sandhill crane (Walkinshaw 1949). The greater sandhill crane is a wetland-associated bird, requiring marsh and meadow habitats during the breeding season, and shallow wet habitats for roosting during winter. This subspecies feeds primarily on invertebrates, roots, tubers, and certain cereal grains during the winter (Schlorff et al. 1983).

Four populations of greater sandhill crane are recognized: Eastern, Rocky Mountain, Colorado River Valley, and Central Valley. The Central Valley population nests from northeastern California to British Colombia (U.S. Fish and Wildlife Service 1978, Pogson and Lindstedt 1988). The entire Central Valley population, estimated at 3,400-6,000 individuals (California Department of Fish and Game 1989), winters in the Central Valley, along with the entire Pacific Flyway population of lesser sandhill crane (*Grus canadensis*) (Pogson et al. 1988).

Seven sites in the Central Valley are considered important wintering sites for the greater sandhill crane: Sacramento-San Joaquin River Delta, Chico, Butte Sink, Angel Slough, Modesto, Merced, and Pixley. The most important of these sites is the Sacramento-San Joaquin Delta, which supports as much 75 percent of the Central Valley population during late winter (Pogson and Lindstedt 1988).

Both roosting and foraging habitat are essential to Central Valley population during winter. Greater sandhill cranes congregate in communal roosts at night, and fly off each morning to forage in suitable fields, pastures, or other shallow wetland habitats. Most traditional foraging areas are near (within 2-3 miles) communal roost sites. Thus, the proximity of foraging habitat to communal roost sites is an important determinant of suitable wintering habitat.

Communal roost sites are typically large fields (100+ acres), flooded with one to ten inches of standing or slowly moving water, and with relatively low-relief shorelines (Pogson and Lindstedt 1988). Most

roost sites in the Central Valley are on private duck clubs, and have been created to attract wintering waterfowl.

Foraging habitat for the Central Valley population varies at different locations in the Central Valley. The primary source of carbohydrates is cereal grains: waste corn in the Delta and Modesto regions and waste rice in the Sacramento Valley (Pogson and Lindstedt 1988). Cranes also forage on wheat sprouts in newly planted winter wheat fields and on sprouts, shoots, tubers, invertebrates, and seeds in fallow fields and in uncultivated habitats (field borders, levees, canal and irrigation ditch banks) (Pogson and Lidndstedt 1988).

Greater sandhill cranes begin arriving in the Central Valley in October. During winter, the distribution of the Central Valley population shifts as cranes move between the major wintering sites. Records from Pogson and Lindstedt (1988) and DFG crane surveys indicate that populations in the Delta are relatively small in October (from zero to about 1,500 cranes) and begin increasing in mid-November to late November. The Delta population peaks in January and February (4,000-5,000 cranes) and declines sharply by March as cranes begin their northward migration.

The increased abundance of cranes in the Delta during January and February coincides with a decline in abundance in the Chico and Butte sink areas. Pogson and Lindstedt (1988) suggest that movement of the population from the northern Sacramento Valley to the Delta may be a traditional occurrence, possibly brought on by changes in food resources or roosting habitat availability. Thus, although greater sandhill cranes winter in the Delta form October through March, they occur in the greatest abundance toward the latter portion of the wintering season.

The central Delta and the Cosumnes and Mokelumne River floodplains provide habitat for the entire Delta wintering population (Pogson and Lindstedt 1988). Delta islands considered important greater sandhill crane winter foraging and roosting habitat include Staten Island, Tyler Island, Brack Tract, and Canal Ranch. Other Delta Islands considered crane winter foraging ares include Grand Island, Terminous Tract, New Hope Tract, and Bouldin Island (Pogson and Lindstedt 1988). Cranes also use Webb Tract extensively. Isolated records of cranes suggest that cranes may also forage on adjacent Delta islands such as Bacon Island and Holland Tract (Figure _____).

Cranes occur primarily on suitable roosting habitat and adjacent suitable foraging areas. Roost sites are limited in the central Delta, although cornfields and wheat fields and other crane foraging habitats are abundant. Thousands of lesser and greater sandhill cranes converge each evening on the few available roost sites in the Delta provided by private duck clubs. Two important roost sites, Woodbridge Ecological Reserve and the Robin Bell property, are owned by the DFG solely for the management of greater sandhill cranes.

Tricolored Blackbird

The tricolored blackbird is largely endemic to California but also occurs in extreme southern Oregon, western Nevada, and northwestern Baja California (Neff 1937). This species' historical breeding range in California included the Sacramento and San Joaquin Valleys and low foothills of the Sierra Nevada from Shasta County south to Kern County, along the coast from Sonoma County south to the Mexican border, and on the Modoc Plateau (Dawson 1923, Grinnel and Miller 1994).

Although tricolored blackbird populations have declined throughout their range, they continue to breed in the Central Valley up to the low foothills (DFG 1988), in coastal areas from Sonoma county south to Baja California, and on the Modoc Plateau south to the Honey Lake Valley, Lassen County (Garrett and Dunn 1981, McCaskie et al. 1975a). 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 (DeHaven et al. 1975a). Populations in this region may have declined by 50 percent from the 1940s (DeHaven et al. 1975a). Tricolored blackbird band recoveries suggest that wintering individuals may travel the entire length of the Central Valley, and from there into the San Francisco Bay-Delta area, the northeastern plateau region of California, and southern Oregon (Neff 1942, DeHaven et al. 1975b).

Nonbreeding tricolored blackbirds forage in large nomadic flocks and often mingle with other blackbirds (Orians 1980). During winter and fall, tricoloreds consume mostly weed seeds and waste grain (especially rice and water grass) from agricultural fields (Crase and DeHaven 1978).

Breeding tricolored blackbirds forage at freshwater marshes, wet pastures, margins of ponds, agricultural fields, barnyards, and feedlots (Beedy and Hayworth 1993). Although breeding tricoloreds may fly 2-4 miles from their colonies to seek food (Neff 1937, Orians 1961), they typically exploit locally abundant and changing food supplies and minimize the distance of their foraging flights (Crase and DeHaven 1977).

Breeding tricolored blackbirds forage opportunistically and glean insects and seeds from dry ground, flooded fields, mudflats, floating algal mats, and low vegetation; occasionally they hawk insects in midair (Beedy and Hayworth 1993). Breeding season foraging studies in Merced County showed that animal matter makes up about 91 percent of the food volume of nestlings and fledglings, 56 percent of the food of adult females, and 28 percent of adult males (Skorupa et al. 1980). The animal taxa most often consumed were beetles (63 percent), butterflies and moths (35 percent), and flies (14 percent). Plant foods eaten most often included oats (27 percent), chickweed (15 percent), and filaree (9 percent) (Skorupa et al. 1980).

Although the dietary water requirements of adult tricolored blackbirds are apparently unknown, observations suggest that breeding colonies need water on or near their colonies (Beedy 1989). Of seven colonies examined by Beedy and Hayworth (1993) , six were situated above standing water and one was within about 200 yards of a flowing canal.

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.) (Grinnell and Miller 1944). 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.) (Neff 1937, DeHaven et al. 1975a, Hosea 1986). Proximity to productive foraging grounds such as flooded fields, margins of ponds, and grassy fields is also important in nest site selection (Grinnell and Miller 1944).

An important link in the tricolored blackbird nesting cycle is the availability of patchy, superabundant food supplies that may not be readily detected by humans. A lack of food may explain why many seemingly suitable habitats are unoccupied by tricoloreds. Thus, the quality, not only the extent, of habitat is of paramount importance (Beedy 1989).

Tricolored blackbirds typically initiate nest building in early or mid-April (Orians 1961), and breeding activity has been observed until early July (Beedy and Hayworth 1993). Rarely, tricolored blackbird populations have been observed nesting during October and November in the Sacramento Valley (Orians 1960, Payne 1969). Generally, nests are concentrated within a fraction of the total area available (Beedy 1989).

This species is the most intensely colonial of all North American passerines (Orians 1980) with as many as 20,000 nests located in an area of 10 acres or less (Dehaven et al. 1975a).

Within established nesting areas, tricolored blackbirds are extremely sensitive to predators, and even relatively minor disturbances can cause abandonment of entire colonies (Beedy 1989). Historical literature describes predation by mammals (Heerman 1853, Mailliard 1914, Evermann 1919) causing major nesting failures. Other observers have also reported massive tricolored blackbird nesting failures due to bird and mammal predators (Neff 1937, Lack and Emlen 1939), poisoning (McCabe 1934), and human disturbance (Beedy and Hayworth 1993).

Southwestern Pond Turtle

The southwestern pond turtle, a federal category 2 candidate species, ranges from San Francisco Bay south into northwest Baja California. It is restricted in its range to land west of the crest of the Sierra Nevada (Pritchard 1979, Behler and King 1979). It can be found from the Lower Sonoran into the Transition life-zones (Stebbins 1954).

The pond turtle is considered to be thoroughly aquatic in its habitat preference (Smith and Brode 1982). It selects quieter pools and backwaters in swifter streams. It has been seen in brackish water (Behler and King 1979, Stebbins 1954, Stebbins 1966, Pritchard 1979, Pope 1939). 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 (Stebbins 1954, Stebbins 1966). Pond turtles seek deep water with masses of waterlogged leaves and brush for escape cover (Van Denburgh 1922).

The southwestern pond turtle is the most carnivorous member of the genus Clemmys (Smith and Brode 1982). Food consists of aquatic plants such as yellow pond lily pads (Stebbins 1954), insects such as aquatic beetles (Pope 1934), and carrion (Stebbins 1966).

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 (Pope 1939, Stebbins 1954).

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 (Pope 1939, Stebbins 1954).

Western Yellow-Billed Cuckoo

The California yellow-billed cuckoo (*C. a. occidentalis*), a California-listed Endangered species, is a subspecies of the yellow-billed cuckoo. The species was once common in the Western states but has been extirpated from much of its previous range including southern British Columbia, Washington, Oregon, Idaho, Utah, and Nevada (Laymon and Halterman 1987).

The cuckoo usually arrives in California in June and departs by late August or early September to winter in South America. It is considered an uncommon to rare summer resident of valley foothill and desert riparian habitats in scattered locations throughout California (Zeiner et al. 1990).

The yellow-billed cuckoo inhabits deciduous riparian thickets or forests with dense, low-level or understory foliage adjacent to slow-moving watercourses, backwaters, or seeps. Willow and cottonwood are usually a dominant components of the vegetation. Within the Sacramento Valley, the cuckoo may also utilize adjacent orchards; along the Colorado River, they may inhabit mesquite thickets when willow is absent (Zeiner et al. 1990).

The cuckoo typically nests in sites with at least some willow, a dense understory of foliage, high humidity, and wooded foraging sites greater than 25 acres in area (Gaines 1977).
Most eggs are laid mid-June to Mid-July with the clutch size averaging 3-4 eggs (Bent 1964).

Surveys conducted in California in 1977 estimated between 122 and 163 breeding pairs. Surveys conducted again in 1986 and 1987 estimated between 30 to 33 pairs (Laymon and Halterman 1988). This represents a 73 to 82 percent decline which is attributed to loss of riparian habitat.

SPECIAL STATUS PLANTS MITIGATION MEASURES

Special status plants - Four special status plants species are know from the vicinity of the proposed project sites. They are:

- Suisun Marsh aster (Aster chilensis var. lentus)
- California hibiscus (Hibiscus californicus)
- Delta tule pea (Lathyrus jepsonii ssp. jepsonii)
- Mason's lilaeopsis (Lilaeopsis masonii)

1. Floristic studies of the areas likely to be affected by the project should be conducted according to the enclosed guidelines. These studies should be carried out in the spring and summer when any rare plant species that may be present are likely to be evident and identifiable (see guidelines 4a and 4b).

The Suisun Marsh aster, California hibiscus and Mason's lilaeopsis are often not identifiable before June.

2. If listed plant species are found on the project site, redesigning the project to avoid or minimize the impacts on these species should be attempted. If impacts are unavoidable, a mitigation and monitoring plan which follows the enclosed format should be developed. Mitigation options may involve restoring the rare plant population and associated habitat on- or off-site and providing for the long-term protection of the mitigation site.

All levee projects must be preceded by preparation and adoption of specific plans detailing the project impacts, mitigation and compensation measures that will reduce project impacts to result in no net loss of riparian, fishery, or wildlife habitat as per Sections 8610 and 8611 of the State Water Code. Monitoring plans to evaluate mitigation/compensation must be prepared and shall include remedial actions necessary if success criteria are not achieved. Annual reports shall be provided to the DFG.

Willow Flycatcher

The willow flycatcher, a state-listed endangered and federal candidate 1 species, was formally a common summer resident throughout California. The breeding range of the willow flycatcher extended wherever extensive willow thickets occurred. The species has now been eliminated as a breeding bird from most of its former range in California. Only five populations of significance remain in isolated meadows of the Sierra Nevada and along the Kern, Santa Margarita, San Luis Rey, and Santa Ynez rivers in southern California. The smallest of these consisted of about six pairs and the largest about 44 pairs. The total population estimate for California is about 200 pairs of willow flycatchers. A survey conducted in late summer 1991 on Department-owned willow riparian habitat at Red Lake, Alpine County, indicated that a significant breeding population exists there. Further study is planned.

The loss of riparian habitat is the principal reason for the decline of California's willow flycatcher population land contraction of the species' range. Impacts to habitat and breeding birds associated with livestock grazing have also been implicated in the decline of the species. Nest parasitism by brown-headed cowbirds (*Molothrus sp.*) may have contributed significantly to population reductions.

More than a decade ago, the Department designated the willow flycatcher a "Bird Species of Special Concern" of highest priority. This finding prompted several years of Department studies to further assess the status of willow flycatchers in California. Reports from the Pacific Coast and Southwest resulted in addition of the willow flycatcher to the National Audubon Society's Blue List of declined bird species in 1980 and 1986. In 1984, the willow flycatcher was added to the U.S. Forest Service, Region 5 (most comprised of the State of California) Sensitive Species list. The U.S. Fish and Wildlife Service has also designated the willow flycatcher as a sensitive species for Region 1 (Washington, Idaho, Oregon, California, and Nevada) based on significant declines in this region. The Southwestern willow flycatcher (*E.T. extimus*), with small populations in southern California, was proposed for listing as endangered by the U.S. Fish and Wildlife Service on July 21, 1993.

Giant Garter Snake

The giant garter snake is listed by the State of California as a threatened species. It is endemic to the Sacramento and San Joaquin valleys, where it presently occurs in a clumped distribution pattern from Butte to Fresno counties. It has be extirpated from the San Joaquin Valley south of Fresno County and has recently suffered serious declines in southern Sacramento County (Hansen and Brode 1980; Hansen 1982, 1986, 1988).

The original range of the GGS, as reported by Fitch (1940), was the floor of the Great Valley of California from Sacramento and Antioch southward to Buena Vista Lake. Fox (1951) indicated that intergrades between the GGS and a closely related subspecies, T. e.

The distribution of the GGS in the Sacramento Valley coincides for the most part with the major flood basins, including the American Basin, that historically formed along the Sacramento River.

Before reclamation was undertaken along the river, about 60 percent of the Sacramento Valley was subject to overflow which seasonally filled the broad, shallow flood basins. These basins supported heavy growths of tules. Today, only remnants of these once vast tules stands remain. The GGS inhabits sloughs, low gradient streams, and other waterways where it feeds on small fish and frogs. It finds shelter along banks an in adjacent uplands. It adapts well to man-made waterways as long as they have the primary requirements of (1) enough water during the active (summer) season to supply food and cover, (2) grassy banks for basking, (3) emergent vegetation for cover during the active season, and (4) high ground or uplands that provide cover and refuge from flood waters during the dormant (winter) season (Hanson 1988).

As a result of human activities, wetland habitats and GGS they once supported have been seriously depleted throughout the GGS's original range.

Housing, business, industrial, and recreational development have replaced GGS habitats with broad urban areas entirely unsuitable for these snakes. Wetlands have been drained and streams channelized, concreted, and even routed through underground pipes. Other habitats have been converted to landscaped green belts and managed as parks or other uses detrimental to GGS. Those GGS remaining in or near urban areas have been subjected to a host of hazards including loss of habitat, pollution, destruction of food sources, predation by native and introduced species and removal by amateur and commercial collectors.

While agriculture may benefit GGS under certain conditions by providing habitat and food along irrigation canals, many agricultural practices are detrimental to GGS.

GGS have been lost during tilling, grading, harvesting, and other operation of mechanical equipment within supporting habitats through direct physical injury and through exposure to predators and other stresses related to loss of shelter.

GGS habitats have lost their ability to support GGS when exposed to heavy grazing due to loss of protective plant cover (including tules). Soil compaction resulted in the destruction of underground and aquatic retreats such as rodent and crayfish burrows and other cracks and holes. Remaining GGS have been exposed to predators and other stresses related to loss of shelter.

GGS, functioning near the top of aquatic food chains, have been exposed to a wide array of chemical and other pest control measures. The effects of such measures as agricultural pest control and mosquito abatement (both of which applied large quantities of DDT and its successors within the habitats of GGS) remain unknown. Weed abatement and rodent control measures, especially along canal or other stream banks, has destroyed surface and underground shelter.

Human activities have resulted in widespread introductions of non-native species and redistribution of native species with the potential to compete with or prey on GGS. The terrestrial garter snake (TGS) and Valley garter snake (VGS) and a host of other animals such as skunks, raccoons, and housecats have been provided access to previously aquatic or semiaquatic environments through the conversion of these habitats to other uses.

Large predatory "gamefish" species have also been introduced into nearly all permanent freshwater environments within the Project Area. Since such aquatic predators did not previously occur here, these introductions affected GGS by preying on GGS and by competing with them for smaller forage fish. The tendency of these snakes to enter the water of forage or to escape enemies now places them at greater risk than previously.

GGS is an aquatic feeder specializing in ambushing fish underwater. It also readily takes larvae and young of the widely introduced bullfrog.

A site must provide GGS protection (both in and out of water) from predation and other mortality factors during the active season. This shelter may take the form of vegetation or debris, or the burrows of rodents and crayfish.

Those sites that were populated by GGS provided access to upland retreats during runoff or flooding. Vegetation, burrows, and other shelter from predators at these upland retreats enhance the suitability of the site.

GGS bask during the active season in order to raise the body to activity temperatures. Basking may be an especially important aid to digestion, gestation, and healing and in rewarming the body following emersion in cool waters. While basking spots may be provided by vegetation and debris present within the habitat, dense overstories of riparian growth may block warming sunlight. Conversely, a lack of screening vegetation on a sunny stream bank exposes basking GGS to view by predators. If too few suitable basking spots are present in an otherwise favorable habitat, avian or other predators may concentrate their activates at those spots to the detriment of GGS.

Although the original GGS habitat within the Central Valley has largely been lost, man-made irrigation canals and ditches associated with rice farming and other agriculture now provide important habitat. GGS use the canals for year-round habitat and movement between major population centers. The GGS occurs in a wide variety of canals and ditches in the area. Some are densely vegetated with little disturbance and some have a dirt road along one or both sides. Most of these waterways are ideal for the GGS because they are too small to support large predatory fish, but large enough to provide adequate food and cover.

The rice fields provide important habitat during late summer, when the fields are flooded and contain large numbers of mosquitofish (*Gambusia affinis*), Pacific treefrogs (*Hyla regilla*) and other food items. This food source may be especially important to newborn GGS.

Bald Eagle

The bald eagle, a state- federally-listed endangered species, is a large brown bird of prey which, as an adult, has a white head and tail. The bald eagle occurs widely in North America and winters throughout most of California at lakes, reservoirs, river systems, interior and coastal wetlands, and some rangelands. The breeding range is mainly in mountainous habitat near reservoirs, lakes and rivers in the northern quarter of the State; some pairs also breed in southern California on Santa Catalina Island and mainland Santa Barbara County. The winter population appears to be stable, and the breeding population is increasing in number and range. The size of the winter population varies from year to year and may exceed 1,000 birds some winters (as in 1987-88). Eighty-three breeding pairs occupied breeding sits in 1989. The Pacific Bald Eagle Recovery Plan (1986) establishes geographical goals for population recovery. The multi-agency California Bald Eagle Working Team provides guidance to agencies and groups in management and research matters, and the team is preparing a management plan for bald eagles in California to assist in implementing the recovery plan. Many breeding territories are being maintained and protected under local management plans. Key winter habitats are receiving increasing attention in terms of population monitoring, site protection, and public viewing and education. Several entities, including Pacific Gas and Electric Company and U.S. Forest Service, are currently sponsoring intensive ecological studies. Other research efforts are under way on contaminants, human disturbance, and other issues that affect this species. Several bald eagle studies, including population restoration efforts on the Channel Island, have been supported with Tax Check-off funding assistance.

Bald eagles are occasional winter visitors in the Sacramento-San Joaquin Delta. The bald eagle is predominately a fish-eating bird, however, other prey items may include birds, amphibians, and reptiles. They forage over the lake and hunt from perches in trees along the shoreline, particularly where the banks are steep.

California Black Rail

The California black rail is a rare year-long resident of tidal salt marshes and brackish and freshwater marshes in the San Francisco Bay area, Sacramento-San Joaquin Delta, coastal southern California at Morro Bay, the Salton Sea, and lower Colorado River area. Formerly a local resident in coastal lowland marshes from Santa Barbara County to San Diego, it still winters there rarely. Significant loss of saltwater, brackish, and freshwater wetland habitat 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 (Manolis 1977).

Since 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 saltmarshes dominated by pickleweed or brackish marshes supporting bulrushes, in association with pickleweed. In exclusively freshwater marshes where black rails occur, 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. The black rail is state listed and threatened and is a federal candidate species.

American Peregrine Falcon

This species nests in the Sierra Nevada, the mountains of northern California, and along the coast. It is found inland, during winter, throughout the Central Valley and occasionally on the Channel Islands. It migrates during the spring and fall throughout California. Riparian areas, and coastal and inland marshes are important year-round habitats, while breeding typically takes place in woodland, forest, and coastal habitats on cliffs.

It requires protected ledges for cover and preys upon many different bird species, up to the size of ducks. It utilizes cliffs in the vicinity of lakes, rivers or marshes. It stoops from flight to intercept flying prey.

This species is both state and federally listed endangered. Populations have been increasing in recent years. DFG researchers have recorded 106 breeding pairs in California in 1990. This species is highly susceptible to eggshell thinning induced by ingestion of DDT and its primary metabolite DDE. The low reproductive rates for the coastal population is probably due to heavier DDE loads received from migrant prey species. California has established several ecological reserves to protect peregrine nesting sites. The Predatory Bird Research Group (Santa Cruz, California) has operated a captive rearing program to help augment wild peregrine populations.

Burrowing Owl

The burrowing owl, a California species of special concern, is a year round resident of open, dry grassland and desert habitats and can also be found in grass, forb and open shrub stages of pinyon-juniper and ponderosa pine habitats. It was formerly common in appropriate habitats throughout the state, excluding the humid northwest coastal forests and high mountains. The population of these owls has markedly decreased in recent decades due to conversion of grassland to agriculture, and poisoning of ground squirrels (Zeiner et al. 1990).

The burrowing owl's diet consists mainly of insects but will consume small mammals, reptiles, birds, and carrion. It hunts from a perch, but also hovers, hawks, dives, and hops after prey on the ground (Zeiner et al. 1990).

This owl usually nests in bare, level ground in abandoned burrows of ground squirrels or other small mammals (Verner and Boss 1980). In soft soils it may dig its own burrows and in areas where animal burrows are scarce it may use pipes, culverts, and nest boxes (Robertson 1929). The nest chamber is typically lined with excrement, pellets, debris, grass, feathers, but on occasion it may be unlined.

Throughout the day the burrowing owl moves its perching location to thermoregulate. In the early morning hours it perches in open sunlight and as the warms it will move to the shade or into the burrow (Coulombe 1971.)

Breeding occurs from March through August, with peak in April and May. Clutch size ranges between 2-10 eggs with an average of 5-6. The young emerge from the burrow at about 2 weeks of age and are able to fly by about 4 weeks. The burrowing owl is semicolonial and probably the most gregarious owl in North America.

Riparian Brush Rabbit

There are 13 recognized subspecies of brush rabbit, and eight of these occur in California. Riparian brush rabbits, a subspecies of the brush rabbit, are small brownish cottontail-like rabbits with a white belly, relatively short ears and a small inconspicuous tail. The hind legs are short and hind feet are slender and not covered with long or dense hair. The white belly and ventral tail hairs are gray near the skin, and the ears lack dark areas at the tips (Orr 1940, Ingles 1965, Chapman 1974). Adults are about 13 inches long (300-375 mm). The riparian brush rabbit can be distinguished from other subspecies by its relatively pale color, gray sides and darker back (Orr 1935)., its restricted range and habit requirements, and its skull characteristics. When looking down at the head from above, their cheeks protrude outward rather than being strait or curving inward as in other subspecies (Orr 1935, 1940).
The riparian brush rabbits (*S.b riarius)* was first described by Orr in 1935 with the type locality designated as the west side of the San Joaquin River, two miles north of Vernalis, Stanislaus County, California.

Riparian brush rabbits forage on herbaceous vegetation, including grasses, sedges, clover, forbs, shoots, and leaves within or very close to brushy cover, usually along trails, fire breaks, or at the edge of brushy areas. They seldom venture more than several meters from brushy cover, and do not forage in large open areas. Foraging activity occurs during the early morning and early evening hours (Larsen 1993).

Home ranges are generally small, and are located within and usually shaped by the extent of available brushy areas. The average home range size has been estimated as 957 m^2 for males and 244 m^2 for females. Female home ranges overlapped slightly at the edges, but the core areas did not overlap. Brushy clumps smaller than 450 m^2 are rarely occupied (Larsen 1993). At Caswell Memorial State Park (CMSP), the overall population density of riparian brush rabbits at carrying capacity is estimated to be three animals per hectare (3/ha).

The breeding season of riparian brush rabbits in CMSP occurs from January to May. The gestation period is about 27 days, and three to four young are born in a shallow burrow or cavity lined with grasses and fur and covered by a plug of residual vegetation. The young have fine thin hair and their eyes are closed. They are nursed only at night, and after about 10 days their eyes open. They remain in the nest for about two weeks and continue to nurse for two more weeks after that. The young do not become reproductively active until the following breeding season. Adult females can breed again shortly after birth of a litter. They have about three to four litters during the season, with an average of nine to 16 young produced per female per year. Five out of six rabbits (*Sylvilagus* sp.) do not survive until the next breeding season, so population turnover is rapid (Larsen 1993).

The habits of dispersal are generally unknown. It is assumed that animals may travel a very short distance if necessary to find a suitable unoccupied home range within riparian habitat during the breeding season. They are closely restricted to dense brushy cover and probably are unable or unwilling to disperse through large open areas, so the riparian brush rabbit population is confined to the CMSP. Animals that are displaced farther than 350 m from their home range have extreme difficulty returning to their original territory (Larsen 1993).

Riparian brush rabbits are preyed upon by various native raptorial and carnivorous species that normally occur within the riparian habitat, such as hawks, owls, foxes, and snakes. They are also susceptible to predation by feral dogs and cats. During chance environmental events resulting in flooding or wildlife, they can suffer direct mortality.

The riparian brush rabbit is strictly associated with San Joaquin Valley riparian forests with dense brushy understory. The habitat was found within the floodplain on the valley floor in northern San Joaquin Valley. The original forest and floodplain have been cleared, altered, and degraded. The wholesale destruction of this essential habitat has resulted in the disappearance of the riparian brush rabbit from all but a very tiny portion of its historic range (Williams 1986, 1988, and 1993; Williams and Basey 1986; Basey 1990).

Riparian brush rabbits occupied the native riparian forest within the natural floodplain along the northern portion of the San Joaquin River and its tributaries from Stanislaus County to the Delta (Orr 1940). During historical times, this area had ample brushy understory associated with the forest and suitable upland areas for cover and retreat from annual floods. The riparian brush rabbit occurred within suitable habitat throughout this area (Larsen 1993).

All evidence indicates that riparian brush rabbits are now completely dependent on the remaining suitable habitat in CMSP. Recent surveys along rivers within the historic range were conducted by Williams and Basey (1986) and Basey (1990) and concluded that no riparian brush rabbits were found anywhere outside CMSP. A current census of the riparian rush rabbit population was conducted during January 1993 in CMSP by Williams (1993). The current population size is 213 to 312 individuals. The population is presently at carrying capacity at the CMSP due to the recent drought conditions. Based on the estimated historic abundance, there is only 0.23% of the original population still surviving.

During the mid 1970s and 1980s, this population drastically dropped yearly to a low of 10 to 20 individuals during flooding. In one year during the 1970s, the survivors were removed from trees and shrubs by CMSP personnel in boats and released on solid ground (Williams and Basey 1986, Basey 1990).

The major cause of decline for the riparian brush rabbit in California has been the destruction, fragmentation, and degradation of the San Joaquin Valley native riparian forest habitat within their historic range (Williams and Basey 1986, Basey 1990). In addition, the remaining riparian habitat is severely fragmented, highly disturbed, regularly subjected to prolonged flooding, and thus, is not likely to provide adequate support for viable populations of riparian brush rabbits. Even if there were suitable habitat areas, it is not possible for the animals to disperse from the Park to these fragments of habitat on their own (Larsen 1993).

Riparian brush rabbits are strictly confined to areas with dense brushy and herbaceous ground cover within riparian forests. They seldom venture more than one to two meters from brushy cover. Some large shrubs, small bushy trees, large trees, and snags must be present, along with brushy areas that are at least 460 m^2 in size and some raised areas with appropriate cover. Open areas and areas subject to prolonged flooding, where ground cover and litter are regularly removed and willows predominate, are not typically used by riparian brush rabbits. Typical vegetation forming essential habitat within the riparian forest for riparian brush rabbits includes Wild Rose (*Rosa* sp.), Coyote Brush (*Baccharis* sp.), Blackberries (*Rubus* sp), Elderberries (*Sambucus* sp.). Wild Grape (*Vitus californicus*), Box Elder (*Acer negundo*), Valley Oak (*Quercus lobata*), and Cottonwoods (*Populus* sp).

Within the historic range of riparian brush rabbits, prior to any attempts to reestablish populations, extensive habitat restoration must be undertaken. This will require construction of mounds, revegetation with native habitat, and provision of cover on flood levees to provide protection during flooding. Cover must be maintained at a height of at least 21 cm for riparian brush rabbits (Williams 1988, 1993).

Riparian Woodrat

The riparian woodrat, a subspecies of the dusky-footed woodrat, is a California Species of Special Concern and a Federal Category 2 Candidate. The historic range of the riparian woodrat occupied the native riparian forests within the natural floodplain along the northern portion of the San Joaquin River and its tributaries from Stanislaus County to the Delta. This type of habitat had a brushy understory associated with the forest and adjacent upland areas suitable for cover and retreat from annual floods (Orr 1940). This historic range is nearly identical to the historic range of the riparian brush rabbit (Larsen 1993). Currently, the riparian woodrat and the riparian brush rabbit are known to occur only in CMSP, San Joaquin County, along the Stanislaus River (Williams and Basey 1986).

The riparian woodrat is declining in population size and appears to be in jeopardy (Williams 1986) 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.

The riparian woodrat lodge is constructed of sticks and other litter in tree cavities, snags, logs, or downed woody material.

Mason's Lilaeopsis

Mason's lilaeopsis is a member of the carrot family (Apiaceae), the fourth largest family of flowering plants in California. In 1979, Mason's lilaeopsis was listed as "rare" by DFG. It is also a federal candidate for listing. In addition, Mason's lilaeopsis is in the inventory of rare and endangered plants of the California Native Plant Society (Smith and York 1984) in which it is listed as a plant of "highest priority".

Mason's lilaeopsis is a low-growing perennial that appears grass-like at a distance. The leaves are reduced to hollow, obscurely septate, cylindrical phyllodes that are produced in short tufts 1.5-7 cm long and less than 1 mm wide. Flowering branches (peduncles) are shorter than the leaves. The inflorescence is a simple umbel producing 3-8 flowers.

Mason's lilaeopsis is known from a minimum of 39 sites according to information from the California Natural Diversity Data Base (CNDDB). 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 population positions on exposed banks determined that they occur in the zone between 16 and 36 inches (40 and 90 cm) 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 (75-80 cm) 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 were observed floating in the Delta 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 (*Salix* spp.), and in full sunlight. No correlation between riparian or marsh species was observed for plant association preference of Mason's lilaeopsis. 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-levied areas consisted primarily of tule and cattail marshlands. Mason's lilaeopsis is rarely observed in association with rock revetment under conditions when siltation occurs in a manner that provides a suitable substrate.

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 one 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 levied banks having low viability.

While little data are available on channel water salinity requirements, evidence suggests populations are restricted to the fresher portion of the Napa River and locations west of Martinez in the Suisun Bay area and Sacramento-San Joaquin Delta. Threats to this species are primarily related to dredging, levee construction and riprapping.

Delta Tule Pea

This climbing perennial herb was distributed historically throughout many San Francisco Bay and Delta marshlands, with additional populations known from San Benito, Fresno, and Tulare counties (Broich, Oregon State University, pers. comm.). 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. It is currently a federal candidate species.

Its current geographical range is from the Napa River to the Stockton area (CNPS 1977d). Several populations have been found in various localities of the San Joaquin Valley, although placement of these specimens in this subspecies has been questioned (Hitchcock 1952). A closely related subspecies, *L. jepsonii* ssp. *californicus*, is common along waterways throughout the State. It is distinguished from the Delta tule-pea by the presence of small hairs on most of the plant parts (Munz and Keck, 1968).

CNPS (1977d) lists marsh lands, on drier ground, as habitat of this subspecies. It is found among tule stands in the western Suisun Marsh and Delta where in occasionally forms dense tangled masses. Most of the occurrences listed in the data base computer search had habitat descriptions such as "edge of slough" or "along river bank", implying areas of tidal influence. All of the populations of the Delta tule-pea noted during field surveys in Suisun Marsh localities were confined to the edges and water side of levees (sometimes the crest) of tidally influenced streams. Drainage of marshy areas and salinity changes are considered as endangerment factors (CNPS, 1977d).

California Hibiscus

TO BE COMPLETED

Suisun Aster

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

Winter-Run Chinook Salmon

The Sacramento River winter-run chinook salmon is distinguishable from the other Sacramento River chinook races by the timing of its upstream migration and spawning season. Before 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 (Moyle et al. 1989). Specific data relative to the historic run sizes of winter-run chinook salmon prior to 1967 are anecdotal with some reports indicating runs that were substantially similar to or even larger than runs that occurred prior to the mid-1960s. Construction of Shasta Dam blocked access to all of the winter-run chinook salmon's historic spawning grounds.

Completion of the Red Bluff Diversion Dam (RBDD) in 1966 enabled escapement estimates of all salmon runs to the upper Sacramento River. The estimated numbers of winter-run chinook salmon passing the dam annually from 1967-1969 averaged 86,509 fish. During 1989, 1990, 1991, 1992, and 1993, however, the spawning escapement of winter-run chinook salmon past the dam was estimated at 547, 441, 191, 1,180, and 341 fish, respectively. The current population is thought to be dangerously low since spawning populations of 400 to 1,000 fish are considered necessary to maintain genetic diversity in the winter-run chinook salmon population (52 FR 6041).

The first upstream adult migrants appear in the Sacramento-San Joaquin Delta during the early winter months (Skinner 1972), and move into the upper Sacramento River during December (Vogel and Marine 1991). Adult winter-run migrate to and hold in deep pools between RBDD and Keswick dam prior to initiating spawning activities. The arrival of winter-run chinook salmon in the spawning habitat typically peaks during March, but the peak may vary with river flow, water year type, and operation of the RBDD.

Eggs hatch after incubating about 40-60 days, depending on water temperature. Maximum survival of incubating eggs and preemergent fry occurs at water temperatures between 40 and 56 degrees Fahrenheit. Increased mortality of eggs and preemergent fry commences at 57.7 degrees Fahrenheit and reaches 100 percent at 62 degrees Fahrenheit (Boles 1988). Other potential sources of mortality during the incubation period include redd dewatering, insufficient oxygenation, physical disturbance, diseases, and water-borne contaminants.

Larval incubation lasts approximately 2-4 weeks, depending on water temperature. Emergence of the fry from the gravel begins during late June and continues through September.

The emigration of juvenile winter-run chinook salmon from the upper Sacramento River is highly dependent on individual behavior and streamflow conditions. Storm events can cause emigration of significant proportions of the juvenile population. Emigration past Red Bluff may occur as early as late July or August, generally peaks in September, and may continue through mid-March especially in drier years (Vogel and Marine 1991). During the combined periods of 1978-1979 and 1981-1989, an average of 60 percent of the total downstream emigration past RBDD occurred in September and October (Vogel and Marine 1991).

Numerous factors have contributed to the decline of the Sacramento River winter-run chinook salmon population. The principal factors thought to be responsible for this decline include blockage or interference with adult passage to suitable spawning and rearing areas in the upper Sacramento River (e.g., RBDD and

Anderson-Cottonwood Irrigation District dam) temperature induced mortality during egg incubation and early fry development, entrainment of juveniles by water diversion, high levels of juvenile mortality due to downstream passage problems at the RBDD, and the diversion of outmigrating juveniles from the Sacramento River into the central Delta via the Delta Cross Channel and other natural waterways where their survival is lower. Other factors that may have adverse effects on winter-run chinook salmon include toxic discharges (particularly from Iron Mountain Mine) and delays in adult migration through the Delta.

The operation of the intake to the Tracy Pumping Plant in the south Delta is a part of Central Valley Project (CVP) and the operation of the intake to the _____ pumping plant also in the south Delta is part of the State Water Project (SWP). The National Marine Fisheries Service (NMFS) issued a biological opinion with respect to CVP and SWP operations on _____ which prescribes reasonable and prudent alternatives to avoid jeopardy to winter-run chinook salmon from CVP and SWP operations (National Marine Fisheries Service_____). NMFS has also issued its biological opinion, on _____, that the Delta Wetlands Project will not jeopardize the continued existence of the winter-run chinook salmon or result in the destruction or adverse modification of critical habitat (National Marine Fisheries Service _____).

Delta Smelt

The delta smelt is a small, slender fish about 2-3 inches long endemic to the Sacramento-San Joaquin Estuary. Adult smelt spawn in freshwater, primarily in the channels and sloughs of the Delta (Moyle, et al. 1992). Adults begin migration to freshwater spawning areas during November through January.

During January through June, adhesive demersal eggs are spawned over aquatic vegetation, rocks, gravel, tree roots, and other submerged substrates (U.S. Fish and Wildlife Service 1993b). The eggs hatch within 9-14 days depending on water temperature and the buoyant larvae are carried by currents downstream to the upper end of the entrapment zone (EZ) i.e., the saltwater/freshwater interface of the Sacramento-San Joaquin Estuary.

Larvae and juvenile smelt generally rear in or upstream of the EZ (U.S. Fish and Wildlife Service 1993b). The EZ may be located in the channels of the Delta, in Suisun Bay, or further downstream, depending on the volume of Delta outflow. Location of the EZ in the Delta (i.e., reponding to Delta outflow less than about 10,000 cfs [Kimmerer 1992]) is believed to provide less favorable conditions than is provided when the location of the EZ is in Suisun Bay. The decline of the smelt population since 1983 may be associated with the occurrence of the EZ in the Delta channels, especially during the drought years 1987-1992 when monthly Delta outflow generally averaged less than 7,000 cfs during the spawning and rearing periods.

The one-year life span and relatively low fecundity of delta smelt contribute to their vulnerability to extinction when population abundance is low. Factors that may reduce population abundance and drive the species toward extinction include (Moyle and Herbold 1989):

- reduced Delta inflow and outflow;

- extremely high Delta outflow (relatively rare flood events, i.e., 1983)

- entrainment in water diversions;

- perturbations to the smelt's food web (reduced abundance of phytoplankton and zooplankton, competition and predation by introduced species);

- presence of toxic substances (agricultural, industrial, and municipal discharges) in the smelt habitat; and

- loss of genetic integrity caused by reduced abundance of adult smelt.

The USFWS issued a biological opinion for the operation of the CVP and SWP, which prescribes reasonable and prudent alternatives to avoid jeopardy to delta smelt and Sacramento splittail from CVP and SWP operations. The USFWS issued its biological opinion that the Delta Wetlands Project will not jeopardize the continued existence of the delta smelt and Sacramento splittail or result in the destruction or adverse modification of their critical habitat on _____ (U.S. Fish and Wildlife Service _____).

Sacramento Splittail

The Sacramento splittail is a native minnow that 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 (Moyle 1976; DFG unpublished data). They have been found in Suisun Bay, San Pablo Bay, and Carquinez Strait (Moyle 1976). Turner (1966) reported finding them evenly distributed in the Delta, while a later study found them most abundant in the north and west Delta on flooded island areas in association with other native species (DFG 1987).

Sacramento splittail are tolerant of brackish water, being caught in salinities as high as 10-12 parts per thousand (ppt) or 15-18 mmhos EC (Moyle 1976). 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 (Moyle 1976; DFG unpublished data). They have been observed to migrate up the Sacramento River and spawn at Miller Park.

The splittail commonly reach 12 to 16 inches in length (30-40 cm). It was formerly a commercially harvested fish but now is sometimes sought by recreational anglers in the Delta and Suisun Bay areas. The splittail is a federal candidate species and is now a proposed threatened species.

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