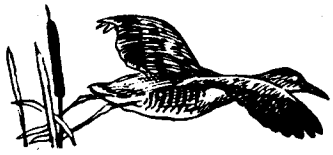
# Salt Marsh Harvest Mouse & California Clapper Rail



**RECOVERY PLAN**

# SALT MARSH HARVEST MOUSE

# AND

# CALIFORNIA CLAPPER RAIL

# RECOVERY PLAN

Published by

U.S. Fish and Wildlife Service

Portland, Oregon

Approved _____
Acting Regional Director, U.S. Fish and Wildlife Service

11/16/84
Date

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THE SALT MARSH HARVEST MOUSE/CALIFORNIA CLAPPER RAIL RECOVERY PLAN, DATED NOVEMBER 16, 1984, PREPARED BY THE U.S. FISH AND WILDLIFE SERVICE IN COOPERATION WITH DR. HOWARD S. SHELLHAMMER, SAN JOSE STATE UNIVERSTIY, THOMAS E. HARVEY, SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE, MONTY D. KNUDSEN AND PETER SORENSEN, U.S. FISH AND WILDLIFE SERVICE, SACRAMENTO ENDANGERED SPECIES OFFICE.

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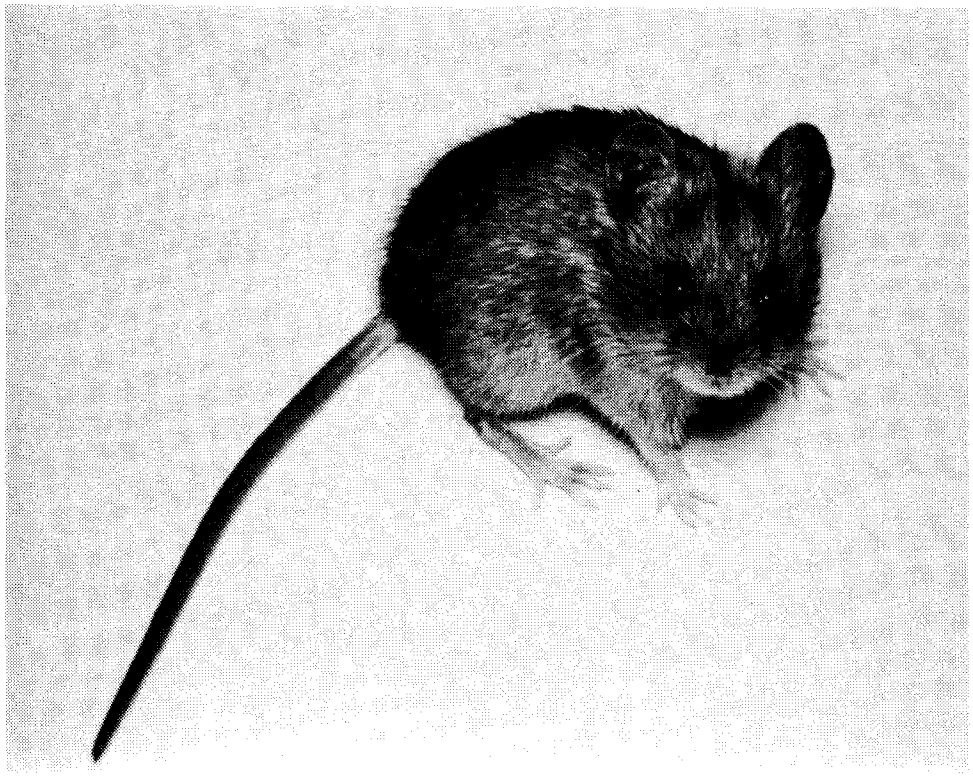
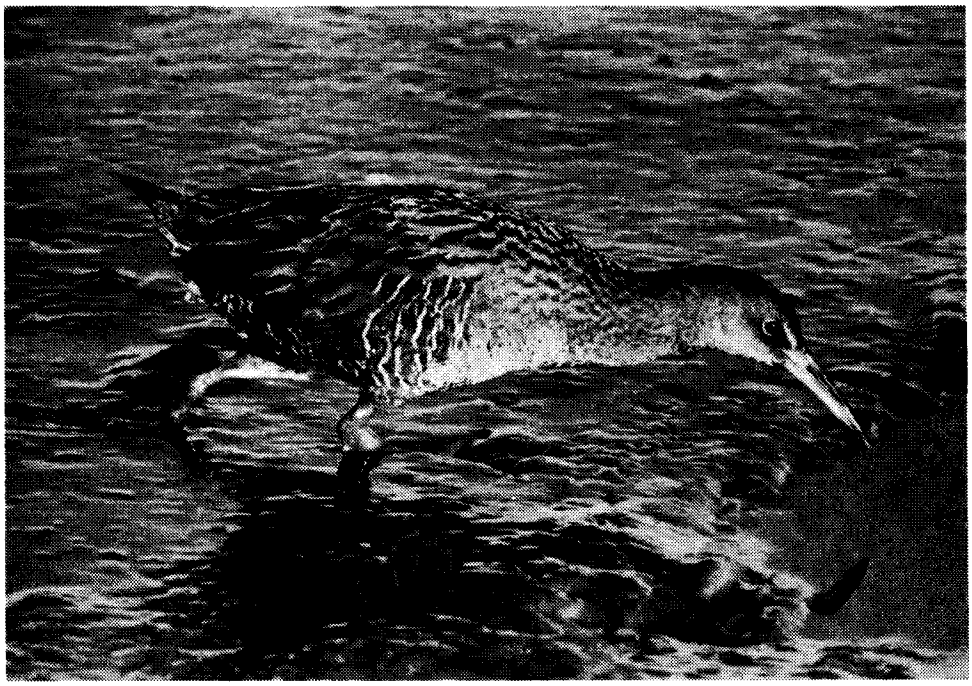


SALT MARSH HARVEST MOUSE (REITHRODONTOMYS RAVIVENTRIS)



CALIFORNIA CLAPPER RAIL (RALLUS LONGIROSTRIS OBSOLETUS)

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# PART I

# INTRODUCTION

The San Francisco Bay complex[1] is the largest estuarine ecosystem in California. It is an extremely intricate "living" system which supports a very diverse and productive biota. The Bay ecosystem, however, is being destroyed and a number of taxa which depend upon it are in danger of extinction. Two such species, the salt marsh harvest mouse (Reithrodontomys raviventris) and the California clapper rail (Rallus longirostris obsoletus) are the primary subjects of this recovery plan.

## Historical Perspective of the San Francisco Bay Ecosystem:[2]

The San Francisco Bay ecosystem has not always been endangered. Two hundred years ago its extensive marshes and unpolluted waters supported sea otters, hundreds of thousands of ducks and shorebirds, and a myriad of other species. Prior to the mid-nineteenth century there was an estimated 734 square kilometers of tidal marshland around the Bay. Only 152 square kilometers of tidal marsh remain today, much of which have been extensively and adversely modified.

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1 The San Francisco Bay complex for the purpose of this recovery plan includes the Bay proper (South San Francisco Bay and San Pablo Bay) and the Suisun Bay and Marsh to its eastern terminus in the Collinsville-Antioch area.

2 Information for this introductory section from Jones and Stokes et al. (1979), but see also Josselyn (1983).

The sea otter disappeared about 1831, and soon afterward the marshes began to decline as a result of the gold rush and associated activities. The Bay area first became a staging place for the miners and later a center of commerce and government. The citizens of San Francisco began extending the city boundaries by filling in the waterfront in the 1850's; and about the same time, immigrants started reclaiming the lands of the Delta for agriculture.

Hydraulic mining in the Sierra Nevada had dramatic effects on the Bay. Literally cubic miles of Sierran soils were washed down the rivers to form shoals in the Suisun and San Pablo Bays. The effects of over three feet of sediments deposited during that time can never be completely known, as the first studies on the benthic fauna did not take place until 1912. Undoubtedly, the increased sedimentation caused many changes in the biota of the bay wetlands.

The marshes of the Delta and the bay began to be diked off for salt-evaporating ponds as early as 1860. By 1959, 581 square kilometers of marshlands and tidelands had been diked off or filled. Diking was relatively easy to accomplish because much of the Bay, especially South San Francisco Bay, was shallow. At one time an estimated 1,471 square kilometers of the original Bay were considered "available for reclamation", and filling proceeded unabated until the San Francisco Bay Conservation and Development Commission (BCDC) was established in 1965. Since the establishment of the Commission, filling and diking of marshlands has slowed considerably.

In the early days unrestricted hunting and fishing also took its toll of the Bay fauna. Several hundred thousand ducks were marketed each year in San Francisco during the 1880's and 90's. Market hunting extirpated tule elk (Cervus nannodes) from the Delta as early as 1850. Commercial fisheries which existed in the past for oyster, clams, shrimp, and crab, declined greatly as a result of over-exploitation in the last part of the 19th century and pollution and water diversions in this century. Numerous non-native species were introduced, some accidentally, some intentionally, including several that flourished. These include the horse or ribbed mussel (Ischadium demissus), the Japanese oyster (Crassostrea gigas), and the striped bass (Morone saxatilus) which has become the most important sport fish in the Bay and Delta waters. The earliest settlers also brought with them house mice (Mus musculus), and Norway and black rats (Rattus norvegicus, R. rattus).

Clearly, the physical, chemical, and biological components of the Bay-Delta ecosystem have been drastically altered by man over the last 150 years. Attempts to "control" the hydrologic regime of the system through diking, damming, water diversions, and water management have resulted in extensive structural and functional changes in the natural ecosystem (Skinner 1962, 1972; Goldman 1971; Jones and Stokes et al. 1979; U.S. Fish and Wildlife Service 1981a). Habitat diversity, species diversity, and the overall carrying capacity of the natural ecosystem all have been dramatically reduced. Some of the effects have been anticipated, others have been largely unanticipated.

Nonetheless, not all species and habitats within the system have been affected equally.

One of the most severely reduced habitats of the San Francisco Bay ecosystem is the tidal marsh/salt marsh community. These marshes provide essential habitat for the salt marsh harvest mouse and California clapper rail and, hence, will be a primary focus of this plan.

Historic Distribution of Tidal Marsh:

Central San Francisco Bay (Figure 1) orginally had approximately 13 square kilometers of tidal marsh, while Suisun Bay had 289 square kilometers. South San Francisco and San Pablo Bays had intermediate amounts, 175 and 258 square kilometers, respectively. Each of these portions of the Bay has had a different pattern of development, as illustrated in Table 1.

Few of the remaining tidal marshes are representative of pristine conditions when all the marsh zones were present and substantial borders of upland vegetation existed. Figure 2 shows the vegetation zones of salt and brackish marshes (upland plant communities have been deleted from the figure). Note that each marsh has three zones: a low marsh of cordgrass (Spartina foliosa) or tules (Scirpus spp.) which receives maximum submergence; a middle marsh of pickleweed (Salicornia virginica), alkali bulrush (Scirpus robustus), or cattails

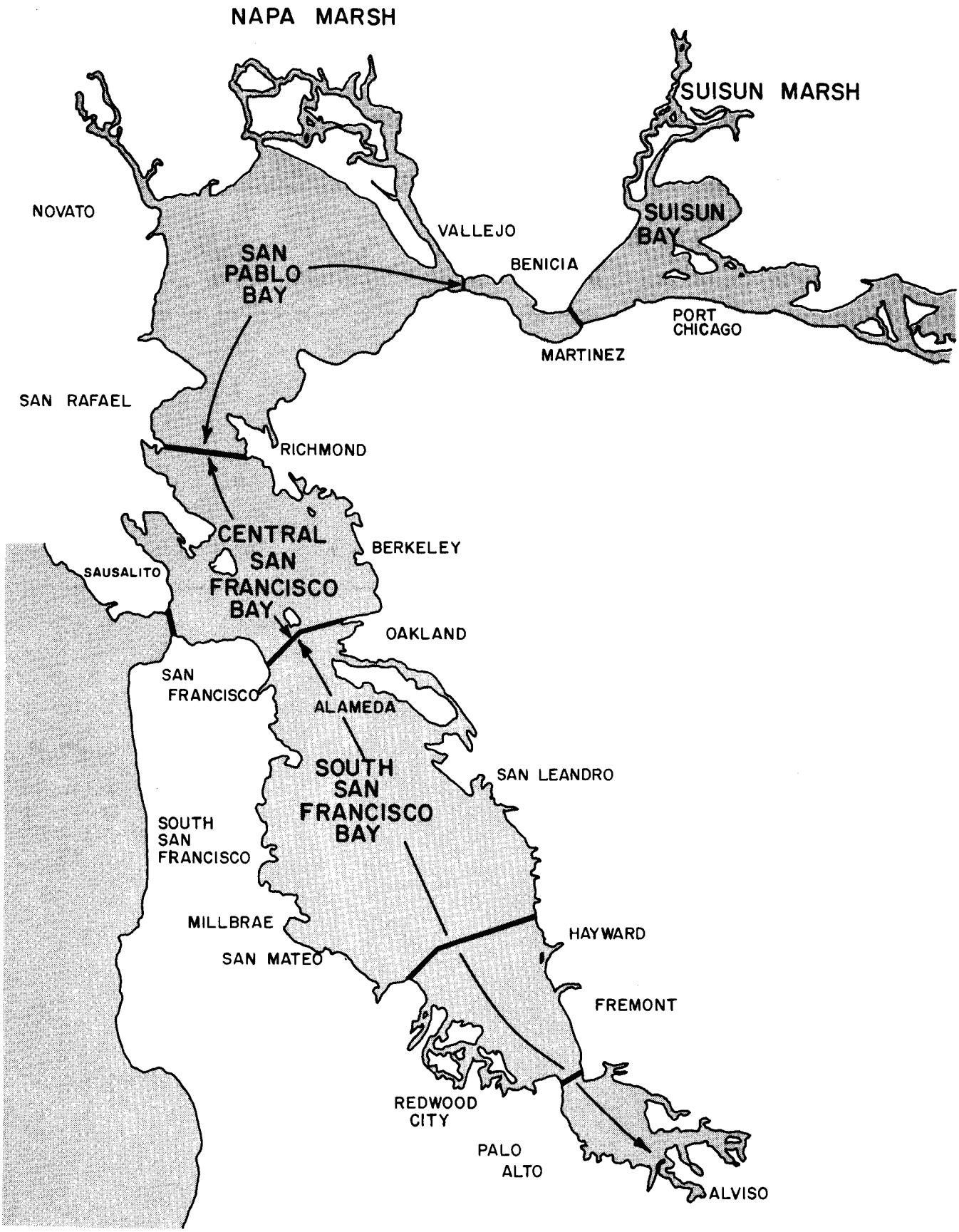


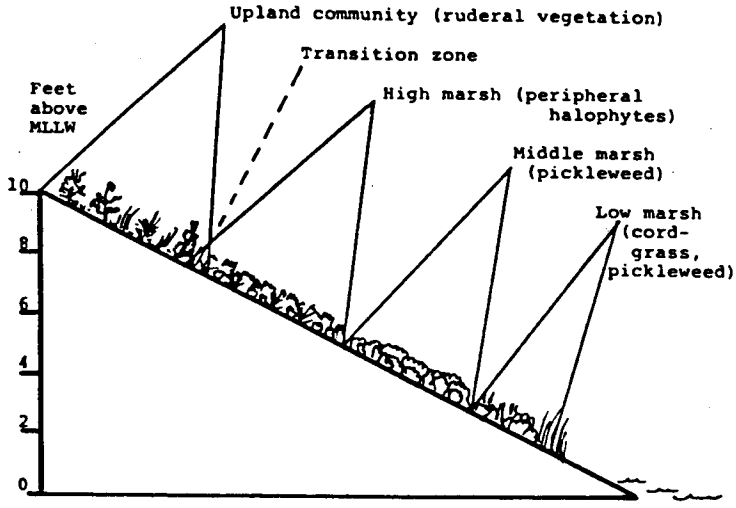

Figure I. Subdivisions of San Francisco Bay.

Table 1. Present status of the marshes of San Francisco Bay (area in square kilometers)

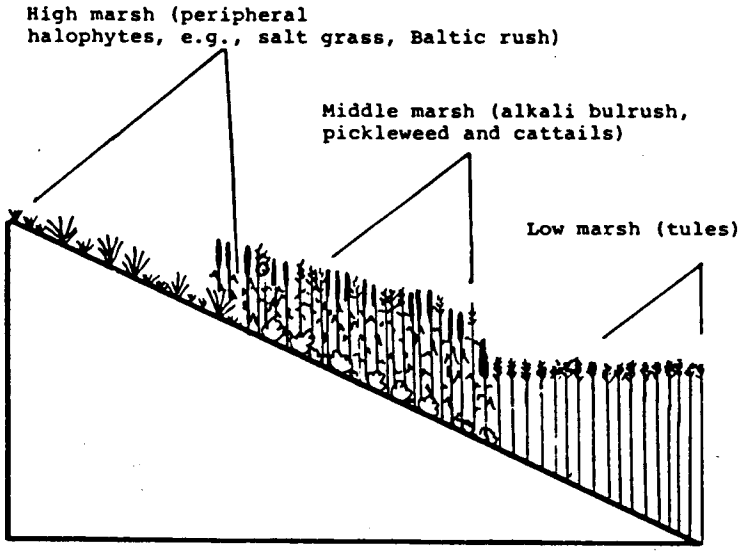
| Part of the Bay[1] | Original extent of Tidal marsh | Existing Tidal marsh | Diked marsh | Diked ponds | Agri-culture | Other uses | % Tidal marsh remaining |
|---|---|---|---|---|---|---|---|
| Southern | 174.8 | 22.0 | 14.3 | 106 | 1.3 | 31.1 | 13 |
| Central | 13.0 | 3.9 | 1.3 | T[2] | T | 7.8 | 30 |
| San Pablo | 257.7 | 70.0 | 23.3 | 36.3 | 107.5 | 20.7 | 27 |
| Suisun | 288.8 | 55.7 | 194.3 | T | 29.8 | 9.1 | 19 |
| Total square kilometers | 734.3 | 151.5 | 233.1 | 142.5 | 138.6 | 68.6 | 21 |

[1] Modified from Table 4, page 15, of Jones and Stokes et al., (1979).

[2] T = Trace




Vegetation zones of a generalized tidal salt marsh in the San Francisco Bay. (Tidal elevations for southern San Francisco Bay.)




Vegetation zones of a generalized brackish marsh in the San Francisco Bay.

Figure 2. Marsh profiles. (from Jones and Stokes et al. 1979)

(*Typha* spp.); and a high marsh of peripheral halophytes, which receives infrequent to no tidal coverage. In pristine marshes, the high marsh zone interdigitates with bordering grasslands. During extreme high tides, upland vegetation acts as a refugium for many marsh animals.

The tidal marshes of today are fragments of the original marshes. Some are narrow strips along outboard dikes. Many have been back-filled so that the upland vegetation and most of the high marsh zones have been eliminated. Others have dikes at their upper edges and the upper marsh zones have been reduced to narrow strips bordering the dikes. Shallow, strip-like marshes lack secondary tide channel networks, thus reducing their value for many birds including rails. Only a few deep marshes remain, like those on the northeastern shore of San Pablo Bay (Figure 3), Fagan Marsh (Figure 6, p 125), or Petaluma Marsh (Figure 7, p 126).

Many marshes around South San Francisco Bay have undergone vegetational changes as a result of land subsidence and increased tidal submergence. Tne marshes from Palo Alto to Alviso changed from predominately middle marsh to low marsh as a result of subsidence. The upper marsh zone was destroyed previously by back-filling or diking.

Outflows of major sewage treatment plants, like the San Jose - Santa Clara Water Treatment Plant near Alviso, have changed the plant and

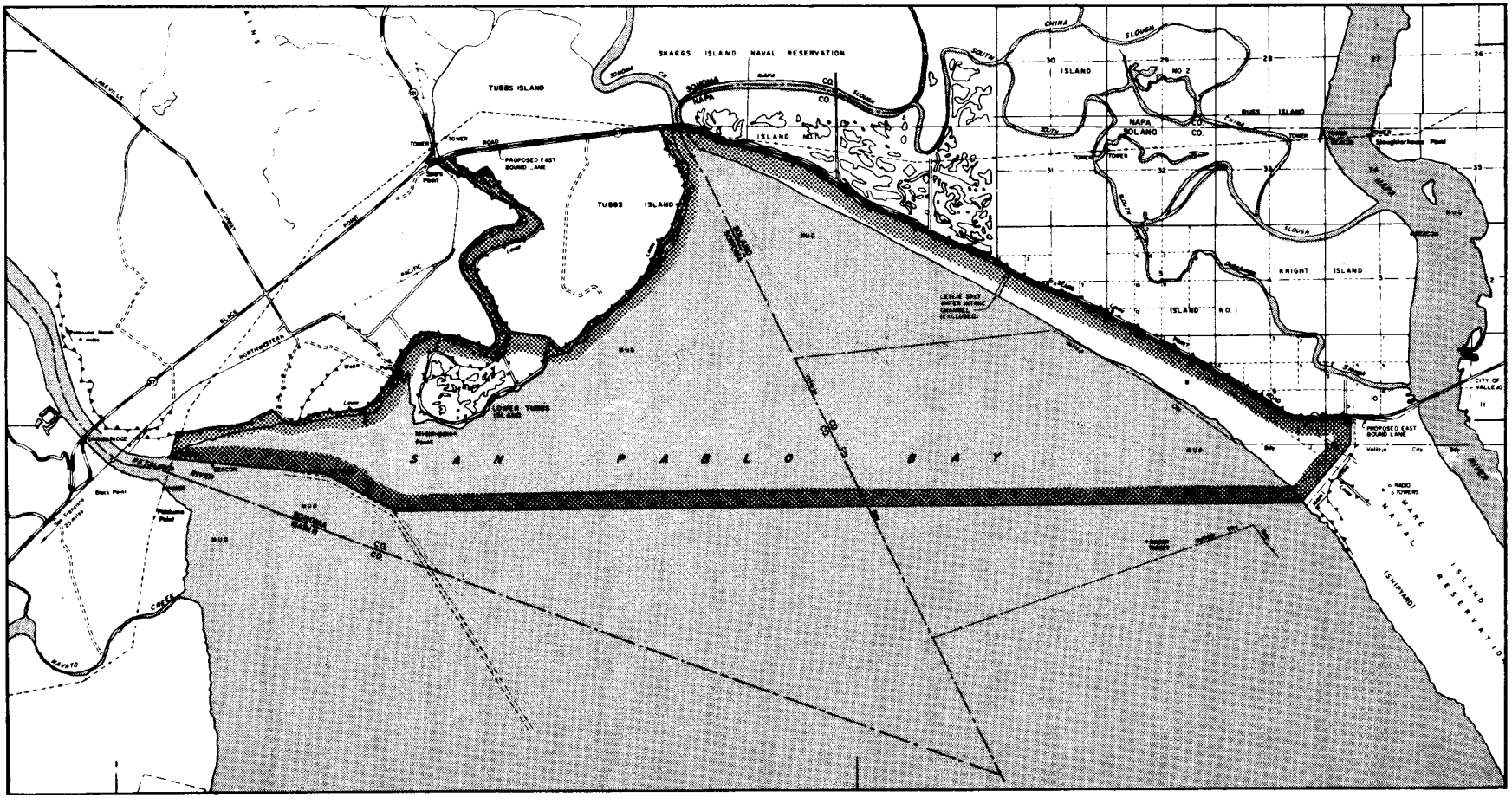



Figure 3. San Pablo Bay National Wildlife Refuge which comprises some of the deeper marshes of the San Francisco Bay Complex.

animal communities of the marshes in South San Francisco Bay. The input of "freshwater" from these treatment plants has shifted the salt balance in portions of the Bay from a salt to a brackish condition. The 380-450 million liters (100-120 million gallons) produced each day by the San Jose - Santa Clara Water Treatment Control Plant maintain the nearby marshes in a brackish condition of only 0.5 parts per thousand (PPT) of salt while the water a few kilometers into the Bay is about 30 PPT salt. The marshes along that outflow have changed from diverse salt marshes to brackish water marshes dominated by alkali bulrush, a species of low value to many salt marsh animals, including the mouse and rail.

Average salinities have increased in the San Pablo and Suisun Bays, where nearly 50 percent of the historic median freshwater flow of the Central Valley no longer reaches those bays because of diversions for agricultural, as well as municipal and industrial uses (Jones and Stokes et al. 1979). Future reductions to 25 percent of historic levels are anticipated. In most of the waterways of Suisun Marsh salinities are now so high that the brackish marshes required by wintering waterfowl can only be maintained by costly intensive management. Because brackish and freshwater marshes are also preferred by nesting waterfowl, and freshwater is required in the early development of ducklings (Gill 1972), reductions in river outflows have made parts of the bay less suitable for nesting waterfowl. Reductions in freshwater outflows, combined with losses of adjacent freshwater wetlands from development have resulted in drastic reductions in populations of breeding waterfowl over most of the Bay.

Diked Marshes:

In addition to tidal marshes, non-tidal (diked) marshes represent a second important wildlife habitat of the Bay. Considerable difference exists between the diked marshes of South San Francisco Bay and those of Suisun Bay. Most of the diked marshes in the South Bay and San Pablo Bay are highly saline and support monotypic stands of pickleweed. Until recently, most of the diked marshes of Suisun Bay (75 percent) were managed brackish marshes with high waterfowl value but little plant or animal diversity. Pickleweed was considered a "weed" of the more saline areas and of little value for waterfowl; hence, waterfowl managers selected against it in favor of alkali bulrush. Mall and Rollins (1972:60) stated that, in the Suisun Marsh, "...almost all flooding activities, in fact almost all land use[s], are directed toward management of the marsh for the purposes of hunting and/or observing waterfowl...". This type of single purpose management has adversely affected many non-target species that inhabit the Suisun Marsh, especially tidal marsh/salt marsh dependent species [such as the salt marsh harvest mouse, the salt marsh wandering shrew (Sorex vagrans halocoetes) and the Suisun shrew (Sorex ornatus sinuosus] (U.S. Fish and Wildlife Service 1981b). Although waterfowl populations are an important management concern, management programs for diked marshes should also include protection for endangered species, and other indigenous species dependent upon that system. Recent changes in waterfowl management in the Suisun Marsh have de-emphasized the importance of alkali bulrush and increased the role

of pickleweed as a species providing cover in a multispecies mixture (Jim Swanson, pers. comm.)*. Whether this change will result in the protection of large areas of pickleweed marsh is uncertain. Preservation of mouse habitat can be ensured only if heterogenous stands of pickleweed are provided (see appendix B page 131).

In that the primary purpose of the Endangered Species Act is to conserve the ecosystems upon which endangered and threatened species depend, the underlying goal of this recovery plan is to conserve the ecosystem supporting the salt marsh harvest mouse and California clapper rail. The primary emphasis of this plan, the restoration and protection of mouse and rail habitat, is viewed as a small, but significant, part of the effort needed to conserve the entire Bay/Delta marsh ecosystem. Only through a broad-based program of ecosystem management can these species be recovered and the diversity of habitats maintained that were once part of the system. It is hoped that a Bay-Delta ecosystem management program will be eventually developed and implemented and that this plan will be useful in that endeavor.

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* CDFG, Region 5, Yountville, CA

Overview-Species Accounts:

The salt marsh harvest mouse (Reithrodontomys raviventris) is endemic to the marshes of San Francisco Bay, while the California clapper rail (Rallus longirostris obsoletus) has been recorded in marshes from Humboldt to San Luis Obispo Counties. The rail is one of 24 subspecies of clapper rails which occur from the northeastern United States and central California, south to the coasts of southeastern Brazil and Peru (Ripley 1977). Federal endangered status was given to both the California clapper rail and salt marsh harvest mouse in 1970 (35 FR 16047, 13 October 1970); the State of California listed these species as endangered in 1971. This recovery plan contains background material on both the salt marsh harvest mouse and the California clapper rail, and presents management recommendations to enable reclassification of these species.

# CALIFORNIA CLAPPER RAIL

## Taxonomy and Description

The California clapper rail was first described as a king rail (*Rallus elegans* var. *obsoletus*) by Ridgway (1874). Since this new form was restricted to saltwater marshes, and the king rail is typically a species of inland freshwater marshes, Ridgway (1880) reclassified it as a clapper rail (*Rallus obsoletus*), but as a geographically isolated species distinct from the other clapper rails (*Rallus longirostris*). All of the Pacific coast clapper rails were then combined into one species by Van Rossem (1929), and this race became *Rallus obsoletus obsoletus*. Subsequently, Oberholser (1937) described 25 clapper rail forms as subspecies of the same species, and the California clapper rail became *Rallus longirostris obsoletus*. Most recently Ripley (1977) included the king rail as a freshwater-adapted subspecies of the clapper rail (*Rallus longirostris elegans*) and settled on 24 subspecies of clapper rails occurring in North, Central, and South America and the Carribbean.

The clapper rail is one of the largest species of the genus *Rallus*, measuring 32 to 47 cm from tip of bill to tail (Ripley, 1977). It has a hen-like appearance, strong legs with long toes, a long, slightly decurved bill, and white undertail coverts which are often exposed when the bird is agitated. Birds from western North America, such as *R. l. obsoletus*, typically possess a cinnamon-buff colored breast, as well as the dark flanks crossed by white bars and the olive-brown

upper parts of other clapper rails. Ripley (1977) described brown and olive color phases of R. l. obsoletus according to the color of the feather edges on the upper body parts.

## Historic and Current Distribution

The salt marshes of South San Francisco Bay, including portions of San Mateo, Santa Clara, and Alameda counties, historically supported the largest populations of California clapper rails (Grinnell 1915, Grinnell and Miller 1944). Clapper rails occurred in San Francisco County prior to the 1880's (Gill 1979). Small populations also existed along western Contra Costa County (Grinnell and Wythe 1927, Grinnell and Miller 1944, and Gill 1979). The number of clapper rails along eastern Marin County apparently fluctuated from the 1880's onward (Grinnell 1915, Grinnell et al. 1918), however breeding records increased after the 1920's (Grinnell and Wythe 1927, Gill 1979). Grinnell (1915) described the species as occurring casually near Petaluma, Sonoma County. Gill (1979) discovered very few historic records for Napa Marsh in western Napa County and believed the eastern limit of R. l. obsoletus was Southampton Bay, Solano County, as reported by Grinnell and Miller (1944). Gill (1979) found no historic records for other parts of Solano County including Suisun Marsh.

Marshes south of San Francisco Bay in Elkhorn Slough (Monterey County), and other marshes adjacent to Monterey Bay were cited by Silliman (1914) as regularly supporting small numbers of California clapper rails. Prior to 1908, however, Elkhorn Slough had limited

tidal access to Monterey Bay and may not have been suitable for clapper rails (Browning 1972).

Numerous records exist for Tomales Bay, Marin County, and small marshes along the outer San Mateo County coast (Grinnell and Miller 1944, Gill 1979).

Outside of the San Francisco and Monterey Bay areas, reports as early as 1932 stated that clapper rails nested in Humboldt Bay, Humboldt County (Gill 1979), but there are no authenticated records since 1947 (Wilbur and Tomlinson 1976). Brooks (1940) reported a possible breeding population of at least five rails considered to be R. l. obsoletus in Morro Bay, San Luis Obispo County. Despite a 1977 record for Morro Bay (Gill 1979), Harvey (1980a) found no evidence of clapper rails there in 1979. Wilbur and Tomlinson (1976) and Gill (1979) have summarized numerous fall and early winter accounts of presumed dispersing juveniles occurring in residential and agricultural areas along the open coast and east of San Francisco Bay.

Since the mid-1800's, as noted in Table 1, 79 percent or 583 square kilometers of the original tidal marshlands of the San Francisco Bay area have been eliminated through diking, filling, or conversion to salt evaporation ponds (Jones and Stokes, et al. 1979). In South San Francisco Bay, clapper rail populations presently occur in remnant salt marshes such as Bair and Greco Islands (San Mateo County), Dumbarton Point (Alameda County), and in Santa Clara County. In San

Mateo County, rails can be found as far north as San Bruno Point (Gill 1979). Clapper rails can also be found in salt marshes fringing the South Bay outboard of salt evaporation pond levees and along major tidal sloughs. Scattered remnant populations primarily occur near creek mouths in northern Alameda County, western Contra Costa County, and in eastern Marin County. Recent spring records for Richardson Bay, Marin County (Harvey 1980a) indicate that a small breeding population may still occur there.

In northern San Pablo Bay, clapper rails are resident and breed along the Petaluma River as far north as Schultz Creek and along most major tidal sloughs and creeks in Sonoma and Napa counties (Gill 1979). They also occur north to Bull Island on the Napa River. Gill (1979) believed the Napa Marsh clapper rail population became established after 1940 when substantial decreases in fresh water inflow to the marsh had resulted in a shift from a freshwater to a brackish marsh. Spring records for three consecutive years at Southampton Bay, Solano County, indicate that a small breeding population still occurs there (Harvey 1980a).

Gill (1979) predicted clapper rails would extend their range into Suisun Marsh, Solano County, and northern Contra Costa County if reductions in the Sacramento-San Joaquin Delta outflow continued. Recent surveys by Harvey (1980a) have confirmed that a population of at least 25 rails was present through the 1979 breeding season near Joice and Grizzly Islands in Suisun Marsh. A late April record in

1979 at Martinez, Contra Costa County (Harvey 1980a), may also be evidence of breeding.

At least two pairs of clapper rails were discovered in Elkhorn Slough, Monterey County, during recent breeding season surveys (Harvey 1980a), and a minimum of two young were known to have been produced. This is the first verification of nesting at this location since 1972 (Varoujean 1973), but the status of this rail population is unclear. Clapper rails may still occur in Humboldt County or Morro Bay, San Luis Obispo County as vagrants (Gill 1979).

## Natural History

Habitat. Throughout their distribution, California clapper rails occur within a range of salt and brackish water marshes (Harvey et al. 1977). In South and Central San Francisco Bay and along the perimeter of San Pablo Bay, rails typically inhabit salt marshes dominated by pickleweed and cordgrass. Other halophytes usually present include: gum-plant (*Grindelia* spp.), salt grass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia grandifolia*). Brackish water marshes supporting clapper rails occur along major sloughs and rivers of San Pablo Bay and along tidal sloughs of Suisun Marsh. In the past ten years, pickleweed has become more widespread in Suisun Marsh and will increase in abundance if salinity continues to rise (Harvey et al. 1977). This combined with changes in the invertebrate marsh fauna may account for the recent establishment of clapper rails in this region. Within a marsh, clapper rails use networks of small

tidal sloughs as foraging habitat. California Clapper rails have not been recorded in nontidal marsh areas.

Throughout the range of the California clapper rail loss of upper marsh vegetation has greatly reduced available habitat. Most marshes in South San Francisco Bay are adjacent to steep earthen levees which have eliminated upper marsh vegetation and reduced available cover for rails during winter flood tides. High marsh vegetation in Suisun Marsh has also been eliminated by diking and livestock grazing. A site in Suisun Marsh supporting the greatest number of clapper rails in 1979 (Harvey 1980a) is unique because it still retains a well-developed high marsh community (Harvey et al. 1977).

Behavior. The California clapper rail is secretive and difficult to flush in dense vegetation, but once flushed, can frequently be closely approached. Individuals accustomed to the presence of human beings such as those at the City of Palo Alto Baylands, tolerate people on nearby boardwalks while feeding. When evading discovery, rails typically freeze or run through vegetation, hunched over with their necks outstretched and plumage compacted, rather than taking flight. When flushed, clapper rails normally fly only a short distance before landing.

There is no clear evidence of migratory behavior in the California clapper rail, and the extent to which movements occur between different marshes is unknown and in need of investigation. As cited previously, however, numerous accounts exist of juveniles dispersing widely from typical breeding habitat.

Reproduction. Most nesting surveys of the California clapper rail have been conducted in South or Central San Francisco Bay. According to DeGroot (1927), nesting begins in mid-March and extends into July. Two peaks in nesting activity occur; during late April to early May and late June to early July (DeGroot 1927, Applegarth 1938, Gill 1972, and Harvey 1980b). The second nesting peak has been interpreted as late nesters (DeGroot 1927) or second attempts after initial nesting failures (Gill 1972). Estimates of clutch size range from 5.83 (Gill 1972) to 8.51 (DeGroot 1927), with observed clutch sizes ranging from 5 to 14 eggs. Both sexes share in incubation which lasts from 23 to 29 days (Applegarth 1938, Zucca 1954). Eggs are approximately 45 mm in length and light tan or buff-colored with cinnamon-brown or dark lavender spotting concentrated at the broader end.

Clapper rails construct their nests near small tidal sloughs and utilize existing vegetation or drift material as a canopy over the nest platform. The following types of cover have been reported by DeGroot (1927), Zucca (1954), Gill (1972) and Harvey (1980b) as providing nest canopies for clapper rails: cordgrass, pickleweed, gum-plant, salt grass and drift materials. DeGroot (1927) and Harvey (1980b) found pickleweed to be a major component of nest canopies, while Zucca (1954) and Gill (1972) reported more nests in cordgrass. Zucca (1954) suggested that pickleweed was more widely used during summers with disruptive high tides of +6.7 feet or more. Gum-plant and drift materials were believed by Zucca (1954) and Harvey (1980b) to be more widely used early in the summer before the cordgrass had

reached sufficient height to provide nesting cover. Gill (1979) proposed that variations in preferred nesting habitat observed by different investigators may be caused by rainfall-induced fluctuations in the biomass of cordgrass and its availability as nesting habitat. Gill (1972) and Harvey (1980b) both found that dried cordgrass stems were the most commonly used nest platform materials.

Even though pickleweed was the main component of nests found by Harvey (1980b), the majority of nests and calling pairs were within the cordgrass zones of South San Francisco Bay marshes. Furthermore, Gill (1972) calculated higher summer densities of rails in habitat which was dominated by cordgrass. While working with the light-footed clapper rail (R. l. levipes) in Tijuana Estuary, San Diego County, Jorgensen (1975) found nesting densities to be 14 times higher in cordgrass than in the upper pickleweed marsh. He believed the cordgrass habitat and associated nest structure provided more protection from high tides because of the floatability of nests, and from terrestrial predators since nests are located farther from drier uplands. He also believed the uniformity and dense cover of cordgrass provided more protection for adults and young than the more patchy upper marsh areas.

California clapper rails also build "brood" nests as described by Johnson (1973) for the northern clapper rail ( R. longirostris crepitans). These serve as high tide refuges for young rails and consist of a platform of stems without a canopy (Harvey 1980b).

Several authors have noted the tendency of the California clapper rail to construct nests near tidal sloughs (Taylor 1894, Adams 1900, DeGroot 1927). During breeding surveys of South San Francisco Bay and eastern Marin County, a total of 67 nests were found as close as 1.5 m and as far as 11 m from tidal sloughs ranging in width from 0.3 m to 10 m. These tidal channels provide clapper rails with a protected route for movement within the marsh as well as easily accessible foraging habitat and a nearby avenue of escape, particularly for vulnerable flightless young.

Estimates of breeding success in western clapper rail subspecies have been limited to monitoring percent hatching success or percent nest success. Predation of eggs and chicks by the Norway rat and inundation of nests by high tides have been reported as causing nesting failure (Grinnell et al. 1918, DeGroot 1927, Applegarth 1938, Zucca 1954). Zucca (1954) found that abandoned or disrupted nests were most commonly subject to rat predation. He also believed cordgrass and gum-plant nests were disrupted by tides exceeding +6.7 feet. During the 1980 breeding season, Harvey (1980b) reported a 38 per cent hatching success for 31 California clapper rail nests. He also found that 28 of 50 nests successfully hatched the majority of their eggs (56 per cent nest success). In contrast, Jorgensen (1975) reported a hatching success of 64 per cent and a nest success of 86 per cent for the light-footed clapper rail in Tijuana Estuary, California. Massey and Zembal (unpubl. ms) in a two-year study of two populations of the light-footed clapper rail found hatching success ranged from 55 to 86 per cent and nest success from 60 to 74 per cent.

Fledging success is unknown in the California clapper rail and is extremely difficult to estimate in any clapper rail population.

In summary, the most intensive nesting activity of the California clapper rail occurs from mid-March through July and the most heavily used portions of San Francisco Bay salt marshes are the lower, cordgrass-dominated areas within 10 m of tidal sloughs. During the winter, rails may be more widely distributed in marshes and more dependent on upper marsh vegetation for cover, particularly during extreme high tides.

Feeding. The food habits of California clapper rails in South San Francisco Bay were described by Moffitt (1941), who reported that 18 rail stomachs contained 85.5 percent animal matter. The four major food items were the introduced horse mussel, spiders (Lycosidae spp.), clams (Macoma balthica), and yellow shore crabs (Hemigrapsus oregonensis). Williams (1929) also reported clams (M. balthica) as being a principal prey species, while Test and Test (1942) found amphipods in the esophagus of a California clapper rail. At Elkhorn Slough, Monterey County, Varoujean (1972) observed rails feeding on the striped shore crab (Pachygrapsus crassipes). The food habits of clapper rails in upper San Pablo Bay and Suisun Marsh are unknown and should be investigated.

Mortality. Adult clapper rails are taken by several avian predators including the northern harrier (Circus cyaneus) (Evens and Page 1982), red-tailed hawk (Buteo jamaicensis), peregrine falcon (Falco

peregrinus) (DeGroot 1927 and Kelly pers. comm.). Downy young and eggs are also vulnerable to predation by Norway rats (Harvey 1980b). The introduced horse mussel may cause some mortality by inadvertently trapping the bills or feet of birds that have stepped on or probed into the shell (DeGroot 1927).

## Reasons for Decline

Overharvesting by commercial and sport hunting during the period 1850-1913, initially contributed to the depletion of the California clapper rail population. Wilbur and Tomlinson (1976) refer to a report of "thousands" being killed in a single day in 1859. Gill (1979) cited several early newspaper accounts for South San Francisco Bay which referred to 5,000 rails of several species killed during a one-week period in 1897. Reports of taking 30 to 50 a day were not uncommon between 1890 and 1910. After the enactment of the Migratory Bird Treaty Act in 1913, rails regained much of their abundance in the remaining San Francisco Bay marshes (Bryant 1915, Grinnell and Miller 1944). Destruction of habitat, however, continued to reduce local clapper rail populations. DeGroot (1927) documented the accelerated loss of marshes to industry, agriculture, airports, and salt evaporation ponds beginning in the early 1900's. According to Gill (1979), 2,832 hectares of marsh habitat have been lost since 1944.

## Previous Conservation Efforts

Past efforts at maintaining or enhancing the California clapper rail population have consisted primarily of acquiring and preserving habitat. Significant portions of salt marsh in South San Francisco Bay and San Pablo Bay have been acquired by the National Audubon Society, the California Department of Fish and Game (CDFG), and the U.S. Fish and Wildlife Service (USFWS). Areas of prime clapper rail habitat in South San Francisco Bay have been secured by the USFWS as part of the San Francisco Bay National Wildlife Refuge. Marsh restoration projects such as that initiated by the East Bay Regional Park District on the Hayward shoreline, and the CDFG in Redwood City, may also contribute to the conservation of the subspecies.

## Current Status

Gill (1979) proposed that a reduction in the South Bay clapper rail population in 1972 was linked to low rainfall and a resulting decrease in the abundance of cordgrass, the preferred nesting habitat. Other researchers have shown the importance of pickleweed as nesting habitat and have suggested that the relative utilization of cordgrass or pickleweed may vary from year to year depending on the severity of summer high tides (Zucca 1954, Harvey 1980b). California clapper rail populations may cyclically fluctuate (Gill 1979) as do populations of the northern clapper rail in New Jersey (Ferrigno 1966). These fluctuations may be a function of variations in rainfall, tidal flux,

the relative abundance of cordgrass, or other factors which affect the density and reproductive capacity of the breeding population.

Gill (1979), based on surveys conducted from 1971-1975, estimated that the entire California clapper rail population ranged from 4,200 to 6,000 individuals of which 55 percent occurred in South San Francisco Bay and 45 percent in San Pablo Bay. He also reported a mean breeding season density of 1.6 rails/ha in the South Bay. Recent breeding season censuses of two South Bay marshes supporting major rail populations (Harvey 1980b), yielded a mean density of 1.5 rails/ha. This suggests that in marshes offering prime rail habitat, populations have remained stable since the early 1970's. However, increasing "freshwater" effluent from sewage treatment plants has caused brackish vegetation to invade several creeks and sloughs in South San Francisco Bay. In these areas, marsh vegetation is dominated by alkalai bulrush and rail populations have declined. Apparently, the bulrush eliminates foraging areas by overgrowing small sloughs and does not provide suitable nesting habitat. In addition, land subsidence, which has increased tidal submergence in marshes from Palo Alto to Alviso, probably reduced the amount of available nesting habitat.

More intensive census techniques during the last 2-3 years, including the use of airboats in conducting winter high tide censuses, has enabled researchers to obtain nearly absolute rail counts, even when covering marshes of more than 100 ha. Recent winter counts of several

large marshes in the South Bay (P. Kelly, pers. comm.)* have yielded results which are substantially lower than Gill's original (1979) population estimates. Some large South Bay marshes, such as Greco Island, which have been historically cited as supporting major rail populations, do not presently provide optimal habitat and yield much lower numbers than expected when considering their large acreages. In addition, recent censuses of brackish marshes in San Pablo Bay (CDFG unpubl. data) have revealed that habitats in this area do not presently support significant rail populations even though it represents 30-40 percent of the total habitat utilized by the clapper rail. This evident decline in the relative value of the San Pablo Bay brackish marshes for clapper rails may have occurred in response to recent above-average wet winters, which have encouraged the growth of alkali bulrush to the detriment of cordgrass. This new information indicates that the current rail population level throughout its range may be as low as 50 percent of the estimate proposed for the early 1970's. When deriving future population estimates for this subspecies, the relative suitability of each marsh for rails must be ascertained before applying a known density from other locations.

The recent occurrence of clapper rails in Suisun marsh is evidently related to increasing salinity in northern Suisun Bay. Salinity increases have resulted in the spread of pickleweed along the upper

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*CDFG, Region 5, Yountville, CA

and middle marsh zones, which may be providing suitable rail nesting habitat. Clapper rails in this region may be exploiting invertebrates such as mussels and crustacea which have expanded their ranges as a result of increasing salinities, as well as freshwater prey items like crayfish (Pasifastacus leniusculus) and the Asiatic clam (Corbicula spp.). The future status of clapper rails around Suisun Bay may depend on the amount of freshwater outflow from the delta and on management of tidal wetlands in Suisun Marsh.

With the establishment of the San Francisco Bay National Wildlife Refuge (SFBNWR), approximately 40 percent of the existing rail habitat in the South Bay and many areas with high potential for marsh restoration are no longer threatened by urban development. Much potential habitat is also available to the clapper rail if it continues to expand into the Suisun Bay region. However, outside the various existing wetland sanctuaries, present and potential rail habitat is still threatened by urban development. The lack of extensive high marsh habitat and the presence of steep earthen levees at most marshes limit potential population expansion. Finally, the California clapper rail, with its relatively restricted geographical range, is vulnerable to environmental threats such as oil spills and other sources of chemical pollution.

# SALT MARSH HARVEST MOUSE

## Taxonomy and Description

Salt marsh harvest mice are small native rodents which look like the much more widely distributed western harvest mouse (Reithrodontomys megalotis) from which they may have evolved (Fisler 1965). There are two subspecies: the northern (R. raviventris halicoetes) in the marshes of the San Pablo and Suisun Bays and the southern (R. r. raviventris) in the marshes of Corte Madera, Richmond and South San Francisco Bay.

The salt marsh harvest mouse was described originally as two species, Reithrodontomys raviventris (Dixon 1908) and Reithrodontomys halicoetes (Dixon 1909) but were soon regarded as conspecifics by Howell (1914). Fisler (1965) and Shellhammer (1967) (on the basis of cytotaxonomic evidence), suggested that these mice were either two separate species or very nearly so.

Salt marsh harvest mice are very small cricetid rodents, weighing an average of 10 grams. This mouse has a head and body length of 69 to 74 mm, a tail length of 65 to 82 mm, a tail to body ratio of 94 to 125 percent and a hind foot length of 17 to 18 mm (Fisler 1965). Fisler (1965) provides precise figures.

When compared with western harvest mice, salt marsh harvest mice have darker ears and backs; slightly thicker, less pointed and more

unicolored tails; and often darker colored bellies. Most representatives of the northern subspecies have whitish bellies. Animals found in the Suisun Bay region have tails that are longer than their head and body lengths. Most individuals of the southern subspecies have cinnamon-colored bellies and shorter tails than their head and body lengths. The cinnamon or rufous colored venter of these southern forms gave rise to the name "red-bellied" harvest mouse, an interesting but inappropriate name for the species as a whole.

It is difficult to differentiate between salt marsh and western harvest mice in the field. Identifying characteristics include the general body color; color of ventral hairs; thickness and shape of the tip of the tail; tail/body ratio; and behavior (Fisler 1965, Shellhammer 1981). Tail length and venter coloration show clinal variation throughout the range of the species. The only significant cranial difference between the two subspecies is the depth of the brain case (Fisler 1965).

## Historic and Current Distribution

Salt marsh harvest mice evolved with the creation of San Francisco Bay some 8,000 to 25,000 years ago. According to Fisler (1965), these mice were found in most of the marshes throughout San Francisco Bay. The wetlands and marshes of the original Sacramento-San Joaquin Delta were probably too fresh to support mice, and hence, the Collinsville-Antioch area probably was, and still is, the eastern

limit of their distribution. During the last two hundred years approximately 79 percent of the tidal marshes of the Bay (583.7 of 734.3 kilometers) have been filled, flooded or converted to other types of vegetation (Jones and Stokes et al. 1979). A large area (233.1 square kilometers or 32 percent of the original total) has been converted into diked wetland, most of which is marginal or inappropriate habitat for harvest mice. Most of the remaining tidal marshes are fragmented strips situated along outboard dikes and along sloughs often separated from one another by considerable distances.

The western limit of the northern subspecies is the marshes bordering the mouth of Gallinas Creek on the upper Marin Peninsula. Narrow, strips of marshes extend northward into and along the Petaluma River and connect to the large Petaluma Marsh. Lower Tubbs Island, further east along San Pablo Bay, is being restored to tidal action by the U.S. Fish and Wildlife Service and will provide a sizable marsh in the future. Many of the marshes in the Napa Marsh are too narrow and too steep to support salt marsh harvest mice, although mice are present along Napa Slough and Sonoma Creek, on Coon Island, and in the Fagan Marsh. The marsh along San Pablo Bay from Sonoma Creek to Mare Island is naturally expanding from sediment accretion and is one of the major refugia for this species in San Pablo Bay. It is the principal marsh within the San Pablo Bay National Wildlife Refuge.

Repeated trapping in the Southampton Bay marsh failed to capture any harvest mice, hence the next populations east of Mare Island are

in the Suisun Marsh. This huge wetland is primarily managed as waterfowl habitat and, until recently, to enhance alkali bulrush, once considered a preferred food for mallard (Anas platyrhynchos) and pintail (A. acuta) ducks. Salt marsh harvest mice in this wetland are present in low numbers in the areas of pickleweed that are scattered among the alkali bulrush. Moderate populations of mice occur in the diked marshes near Collinsville and in both diked and tidal marshes along the Contra Costa County coast.

The southern subspecies of harvest mouse has two San Pablo Bay populations: a moderate-sized population exists near the Richmond landfill, and at one time a population occurred on the California Department of Fish and Game Ecological Reserve at Corte Madera. During 1980, trapping at the Corte Madera Fish and Game reserve failed to confirm the presence of harvest mice (Simons and Shellhammer 1980).

Other populations of the southern subspecies are found in South San Francisco Bay south of the San Mateo Bridge. The only large marshes left in this area are scattered from Dumbarton Point to the headquarters of the San Francisco Bay National Wildlife Refuge in Newark, along Mowry Slough, in the triangular marsh near Alviso, near the Palo Alto Nature Center, and on Greco Island. Although other marshes can be found in South San Francisco Bay, most are narrow, interrupted strips along sloughs and bayside dikes, or highly saline, diked-off marshes with areas of sparse pickleweed. Although salt marsh harvest mice occur in some of these areas, the status and vigor of the populations are unknown.

## Natural History

Habitat. Salt marsh harvest mice are critically dependent on dense cover and their preferred habitat is pickleweed (Fisler 1965; Shellhammer 1977, 1981; Wondolleck et al. 1976). Harvest mice are seldom found in cordgrass or alkali bulrush (Fisler 1965; Shellhammer 1977, 1981; Shellhammer et. al 1982; Harvey and Stanley Associates 1980; Wondolleck et al. 1976). In marshes with an upper zone of peripheral halophytes, mice use this vegetation to escape the higher tides, and may even spend a considerable portion of their lives there. Fisler (1965) noted that mice also move into the adjoining grasslands during the highest winter tides. Additional information on patterns of movements can be found in Fisler (1968).

Throughout much of the range of the salt marsh harvest mouse, however, subsidence and diking have eliminated the important peripheral halophyte zone. This is especially evident around South San Francisco Bay. Few harvest mice survive in such marshes, even though other marsh conditions may be optimal, because there is little or no high tide escape cover.

Studies have shown that the best type of pickleweed association for harvest mice has the following characteristics: one hundred percent cover; a cover depth of 30 to 50 cm at summer maximum; a high percentage cover of pickleweed, i.e. 60 percent or more; complexity in the form of fat hen (Atriplex patula) and alkali heath or other

halophytes. The amount of salt grass, brass buttons ( Cotula coronopifolia), alkali bulrush, or other Scirpus or Typha species, however, should be low. The latter species may be present, but not in large continuous stands, as pure stands of them are avoided by mice. Salt grass and brass buttons provide very poor habitat for harvest mice; they are low-growing, lack stratification, and provide poor cover. Fat hen provides good cover for mice during the summer (Rice 1974), but cannot be used year-round because it is an annual.

Behavior. Salt marsh harvest mice are placid in comparison to western harvest mice or house mice. Their temperament correlates with their habitat. The much more active western harvest mice live in more open environments and use their quickness to escape from predators (Fisler 1965). The less active salt marsh harvest mouse, on the other hand, is so dependent on cover that roads or open areas as small as 10 meters wide appear to act as barriers to movement (Shellhammer 1978). These behavioral differences are so great that they are useful in field identification (Fisler 1965; Shellhammer 1981, 1984).

Salt marsh harvest mice swim well, floating on the surface as Fisler (1965) suggests, "like corks". The western harvest mouse swims violently and poorly and its fur becomes rapidly wetted.

Salt marsh harvest mice do not burrow. The northern subspecies may build nests or cap over old birds nests (Fisler 1965), but the southern form often does not build a nest at all. Nests are often a

loose ball of grasses on the surface of the ground, something which may be abandoned with the next high tide (Shellhammer pers. obs.).

The southern subspecies may become torpid in the early morning. Fisler (1965) suggested this trait was variable from individual to individual. Shellhammer (pers. obs.) has trapped animals so torpid as to appear dead or nearly so, but by keeping them in a pocket for 10 to 15 minutes they warm up to an active state.

Salt marsh harvest mice are partly diurnal. Fisler (1965) suggests that the most placid and least nocturnal individuals live in the densest cover.

Reproduction. According to Fisler (1965) male harvest mice are reproductively active from April through September, although some males appear reproductively active year-long. Although females have a long breeding season that extends from as early as March to November, they apparently have a low reproductive potential. This phenomenon can be explained by the fact that the average litter is relatively small, between 3.72 and 4.21 (Fisler 1965), and females do not have many litters per year. Fisler (1965) estimated that females of the northern subspecies may have only one litter per year. Recent information for the southern subspecies suggests that they too, may have similar productivity. More information on the reproductive biology of the salt marsh harvest mouse is needed.

Feeding. Fisler (1965) noted that salt marsh harvest mice eat green vegetation in addition to seeds. They have longer intestines than the western harvest mouse, which is a seed eater. The northern subspecies of the salt marsh harvest mouse can drink sea water for long periods of time but prefers to drink fresh water. The southern subspecies is unable to drink sea water as its only drinking fluid but prefers moderately saline water (Fisler 1965). These preferences correlate with the habitats that these forms occupy. The northern subspecies typically lives in more brackish marshes where the range of salinities is wide, but the average is not very saline. The southern subspecies, on the other hand, lives in marshes where the average salinity is relatively high and stable. The effect of salinity on the diet of these mice is only partially understood (Fisler 1963, Haines 1964, Coulombe 1970) but may be a critical factor in their management (Fisler*, pers. comm.).

Mortality. Little is known about the natural causes of mortality in this species. Snakes, owls, hawks, and various other potential predators inhabit most marshes, but their impact is not known. Owl pellets were collected by CDFG personnel from the Suisun Marsh in the past, but were not analyzed for salt marsh harvest mouse remains because mouse parts of the western and salt marsh forms could not be differentiated. Life table information is available in Fisler (1971).

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* Fisler, G. F. Professor of Biology at California State University at Northridge.

Reasons for Decline

There are five principal reasons for the decline of the salt marsh harvest mouse: 1) habitat loss; 2) fragmentation of the remaining marshes; 3) widespread loss of the high marsh zone as a result of backfilling; 4) land subsidence; and 5) vegetational change. Most remaining marshes are affected by more than one of these factors.

Marsh destruction has been greatest in the South San Francisco Bay, an area where land subsidence and watershed alterations have also contributed to widespread changes in vegetation composition. Land subsidence of up to 10 feet caused by groundwater pumping, has occurred from Palo Alto to Alviso during the last hundred years and many marshes, like that at Palo Alto, have changed from predominately pickleweed to cordgrass. A resulting decline in harvest mice has accompanied this change. Massive discharges of treated sewage effluent in the Alviso and Sunnyvale areas have lowered salinities of those areas and changed many of the salt marshes to brackish ones dominated by alkali bulrush, a habitat of low value to harvest mice. More diverse brackish marshes composed of various rushes, cattails and pickleweed do, however, support populations of harvest mice. Such areas are found along the Contra Costa coast from Martinez to Antioch.

Only 21 percent of the Bay's original tidal marshland still exists, and approximately 32 percent of that is now diked off. Most of the diked marshland is managed as waterfowl habitat; the majority is in

Suisun Bay. In some diked marshes, however, small areas of high moisture and high salinity support thick pickleweed and moderate populations of mice (Zetterquist 1978, Gilroy and Shellhammer 1980). Many of the remaining tidal marshes have narrow middle and upper zones and, while seemingly productive, are devoid of mice. The once extensive borders of grassland and unsubmerged halophytes, which serve as escape cover for the mice during the highest tides, have been eliminated from most of the remaining tidal marshes. Harvest mice disappear from marshes without escape cover because, during the highest tides, they either move out into the open and are taken by predators, or they drown (Fisler 1965). Many of the marshes around South San Francisco Bay lack harvest mice because they have no escape cover.

Although small marshes separated by water may be recolonized after local extinctions by swimming or rafting animals, those separated by open land or dikes have very low immigration (Shellhammer 1978). Consequently, very few areas are likely to be recolonized by harvest mice once the mice have been extirpated.

In summary, most of the remaining marshes are too small and too widely separated to support viable populations of the mouse. Moreover, backfilling, subsidence, and vegetational change continue to reduce the habitat value of the remaining marshes.

Previous Conservation Efforts

The creation of the San Francisco Bay Conservation and Development Commission in 1965 has slowed the rate of marsh destruction around the Bay. Increased public awareness and funding in the 1970's resulted in the protection of a number of marshes by local, State and Federal government agencies. The San Pablo Bay National Wildlife Refuge (Figure 3) established in 1971, gave protection to the large and valuable marsh along the northeast edge of San Pablo Bay (from Sonoma Creek to near Mare Island). The San Francisco Bay National Wildlife Refuge (Figure 4) created a year later, gave protection to marshes in the South Bay. Although SFBNWR is a relatively large refuge (6070+ hectares at this time, not counting leased State lands) less than 9 percent is marsh. The largest marsh within the SFBNWR is Greco Island, with relatively large marshes at Newark and along Mowry Slough. Most of the other marshes in the refuge are narrow strands bordered by salt ponds. They have undergone considerable vegetational change.

The CDFG was very active in acquiring habitat during the 1970's, starting with Coon Island in the Napa Marsh in 1974. Fagan Marsh, acquired by CDFG in 1979, and Coon Island provide excellent habitat for the mouse. Fagan Marsh is one of the few remaining places with a complete transition from aquatic vegetation to peripheral upland vegetation. A similar area, though relatively flat and lacking a refugial zone, is the Petaluma Marsh, much of which was acquired by

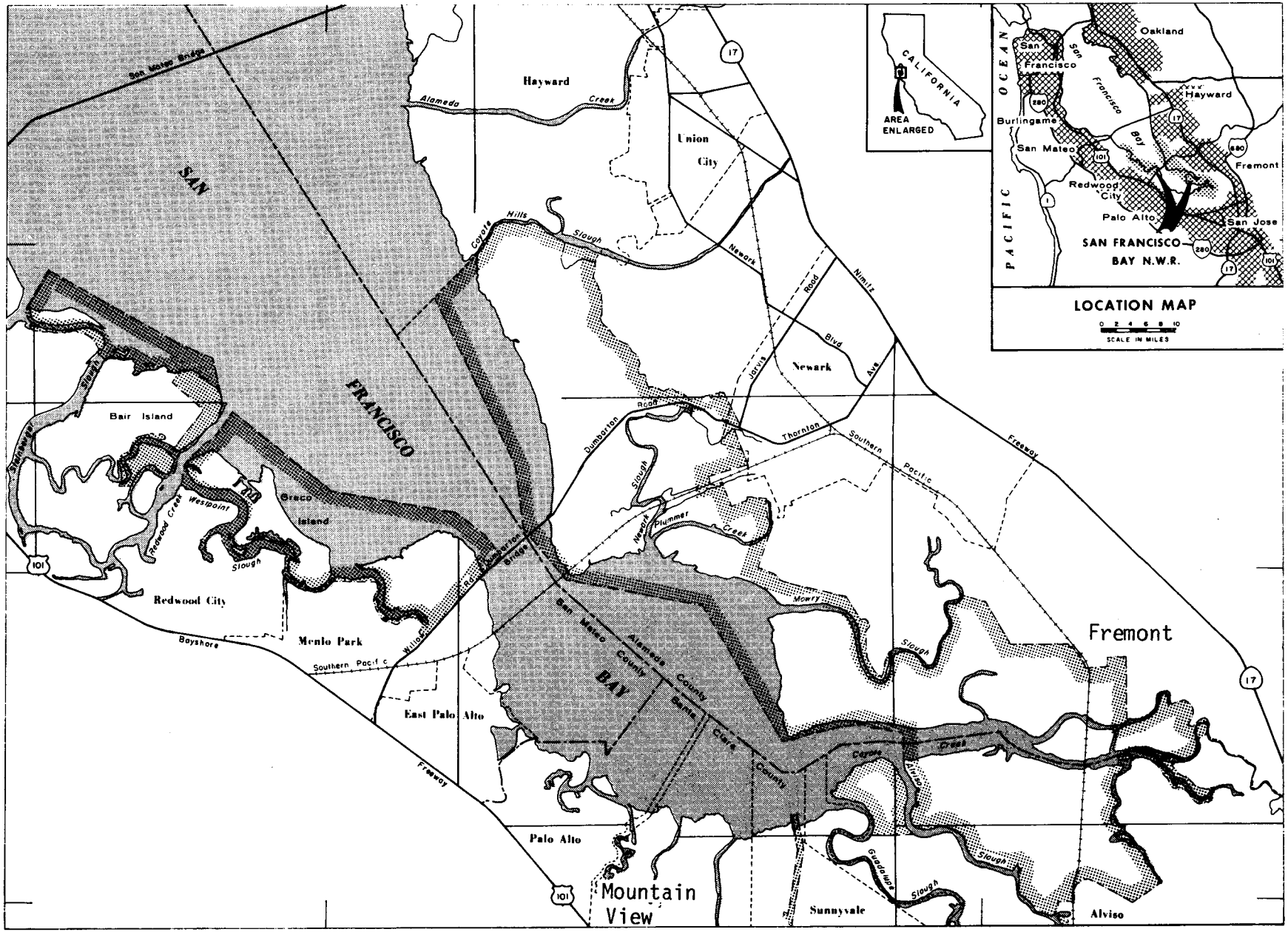


Figure 4. San Francisco Bay National Wildlife Refuge.

CDFG in 1978. Two smaller units bordering San Pablo Bay were added in 1976. Corte Madera Marsh Ecological Reserve (CMMER), a relatively small CDFG parcel (approximately 95 acres), has not been productive for mice. However, the adjacent Muzzi Marsh, recently added to CMMER will enlarge considerably (when restored) the acreage and value for the mouse. The San Pablo Bay State Wildlife Area is a huge area of water and a small strip of marsh along the Marin County coast. This marsh, like most around the Bay, is narrow and diked, and of only moderate value to the mouse. Point Edith Marsh, on the Contra County Coast, is a recent State acquisition. Once rehabilitated, this 411-acre unit will be of considerable value to the recovery effort because it is contiguous with land set aside for the mouse on the Concord Naval Weapons Station.

Enactment of the Suisun Marsh Protection Plan and the establishment of the Suisun Resource Conservation District by the State Legislature largely eliminated marsh destruction in the Suisun Bay. However, the marsh is intensively managed for waterfowl, to the detriment of harvest mouse habitat values. Nonetheless, the State has several large units in Suisun Bay that are important areas for the mouse: Grizzly Island and Joice Island Wildlife areas, which are centrally located in the marsh, and Hill Slough Wildlife Area and Peytonia Slough Ecological Reserve located in the northern portion of the marsh near the City of Fairfield.

Several State Parks contain marshes of varying value to the mouse. China Camp State Park on the Marin Peninsula contains a large, flat pickleweed marsh that produced mice during the last trapping period (Simons and Shellhammer 1981), but which may be reduced in present value because of the lack of adequate upland refugia. The marshland at Benicia State Park (Southampton Bay) appears to have value for the rail but not the mouse.

The City of Palo Alto preserved much of its outer marshland and reestablished marsh vegetation in one previously degraded parcel. The latter unit, the Faber Tract, was planted with cordgrass in 1971 and has been a highly successful restoration project. The area has not been trapped for mice. The nearby Palo Alto City Nature Center Marsh has long supported harvest mice, but its value is declining because subsidence is causing adverse vegetational changes.

## Current Status

There are few accurate density figures for salt marsh harvest mice because their numbers are so low (hence errors of sampling are high), and because most marshes are long strips that preclude the use of grid trapping (and hence make accurate density estimates difficult). Consequently, the number of trap nights needed to trap one animal is used for comparisons (a trap night being one trap set for one night). It took 23,238 trap nights to capture 109 mice in 1980 (Shellhammer 1981), or an average of 213 trap nights per mouse.

The extensive trapping activities of 1980 demonstrated a pattern similar to previous years, i.e., the northern subspecies has more habitat of better quality than the southern form. It took 77 trap nights to capture one mouse in the marshes of San Pablo Bay (Simmons and Shellhammer 1981). The exception to this pattern is the Suisun Marsh, which is diked and managed for waterfowl, where it took 272 trap nights to capture one mouse (Harvey and Stanley Associates 1980).

In 1980, mouse populations in many of the larger marshes around the Bay were either so low as to be too time-consuming to trap or they were devoid of mice. These included Petaluma Marsh, Corte Madera Ecological Reserve, Benicia State Park (Southampton Bay), areas west of Pittsburg, Belmont, New Chicago Marsh near Alviso, along Mowry Slough, and along the Alameda Flood Control Channel. The only major populations (i.e. from three to five animals in 100 to 200 trap nights) were at the mouth of Tolay Creek, Lower Tubbs Island, Fagan Marsh, the marshes near the San Francisco Bay National Wildlife Refuge headquarters in Newark, near the mouth of Old Alameda-Mt. Eden Creek, and the Collinsville marshes (Biosystems Analysis 1980, Gilroy and Shellhammer 1980, Simmons and Shellhammer 1981). The marshes north of Alviso, especially the triangular marsh 1.5 miles north of that town, have declined from their former condition as prime harvest mouse habitat. The most recent major trapping effort there captured very few mice (Anderson et at. 1981).

Earlier surveys, although informative, were either done with too little trapping effort per marsh (Schaub 1971) or were done over

several years (Cummings 1974-75). Hence, while valuable in many respects, these studies did not add major insights to our understanding of the status of the mouse.

The present status of the salt marsh harvest mouse appears to be a few thousand animals at the peak of their numbers each summer, distributed around the Bay marshes in small, disjunct populations, often in marginal vegetation and almost always in marshes without an upper edge of upland vegetation.

# PART II

# RECOVERY

Objective:

The California clapper rail and the salt marsh harvest mouse are endangered because of habitat destruction. Many marshes have disappeared, and the upper zones of those that remain have been largely destroyed or greatly modified. Protecting these species will require the protection and enhancement of existing marshes, the restoration of former habitat, and additional research on their habitat requirements and population trends, especially in San Pablo Bay and Suisun Marsh.

The objective of this plan is to secure and manage about 3,900 hectares of occupied essential habitat under the jurisdiction of Federal, State and local governments, to secure and manage about 3,200 hectares of occupied, unsecured essential habitat (largely private lands), and to restore and/or enhance an additional 7,000 hectares of tidal marsh and diked historic bay lands, thus allow the northern subspecies of the mouse to be upgraded to threatened status and delisting considered, and the rail and southern subspecies of the mouse to be upgraded to threatened status. Delisting the rail and southern subspecies of the mouse may be possible following completion of the above, plus restoration and/or enhancement of an undetermined amount of additional essential habitat (at present estimated at about

3,000 hectares), and completion of marsh restoration efforts on the SFBNWR following cessation of commercial salt production within its boundaries. Resolution of these additional recovery needs will require ongoing research and data on population trends and restorable areas as specified in this plan. At this time it does not appear that enough habitat can be preserved and restored to allow the California clapper rail and southern subspecies of the salt marsh harvest mouse to be delisted.

Restoration of all three taxa to a relatively secure status will require that a mosaic of complete, productive marshes be secured/established throughout the range of both species. Individual marshes must be of sufficient size and habitat quality to support populations of one or both species in perpetuity. In the case of the mouse, sufficiently large areas of marsh should be established to provide a "level 9"* protection (Schoenwald-Cox 1983).

The following general actions are required**:

1) Selected existing marshes must be protected, including those necessary to reduce intermarsh distances. Where possible,

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* A level 9 protection requires that each preserve area should be large enough to contain several populations of minimum viable size.

**Specific areas and estimated acreages are identified in the Narrative and in Appendix D.

marshes should be connected and combined to make the average protected areas larger than at present. Larger marshes generally will support larger and possibly multiple populations of each species and hence, increase the chances of survival.

2) New habitat must be created, including areas rich in pickleweed for the mouse; and areas with unrestricted tidal circulation (e.g., tidal sloughs), healthy invertebrate populations, and suitable nesting habitat for the rail. Considering the numerous declining trends in habitat quality, current evident population declines, and the widespread lack of higher elevation marsh habitat throughout the range of both species, the continued existence, as well as recovery of the mouse and rail depends not only on protection of existing habitat, but also on extensive restoration of former habitat (diked historic baylands).

3) The upper portions of marshes must be restored to provide refugia for both species during high tides, as well as nesting habitat for the mouse and rail in those marshes that have undergone subsidence and subsequent vegetational change. In most cases this will require upland terrestrial buffer zones useable as refugia as the sea level continues to rise (Krone 1982).

4) Additional biological research must be undertaken to assist in recovering both species. Studies are needed on the effects of treated sewage effluents, pollution, flood control, mosquito abatement, and waterfowl management practices on water

salinities, marsh floristics, and habitat suitability for the mouse and rail. Studies also are needed concerning the long-term effects of sea level rise, reduced sediment input to the Bay, marsh erosion, and marsh accretion trends on mouse and rail habitat.

5) Ongoing management will be necessary on all marshes preserved for the mouse and rail.

Many of the recovery actions will be expensive and of long duration, especially the recreation of the upper edges of marshes because the outboard dikes in some areas may have to be moved inland. Most of the actions proposed will benefit many other species of fish, wildlife and plants, and will increase the value of such marshes for outdoor recreation and education. Most of the marshes recommended for preservation and upgrading in this plan are considered important for protection by one or more agencies or groups including the BCDC, CDFG, and various conservation and environmental groups. The cost of some units can be shared by a number of agencies, i.e., secured for waterfowl management, or the preservation of outdoor recreation and education, as well as by land trades via the State Lands Commission.

Step-down Outline

Prime Objective: To secure and manage about 3,900 hectares of occupied essential habitat under the jurisdiction of Federal, State and local governments, secure and manage about 3,200 hectares of

occupied, unsecured essential habitat (largely private lands), and restore and/or enhance an additional 7,000 hectares (approximately) of essential tidal marsh and diked historic baylands, so that the northern subspecies of the mouse can be considered for upgrading to threatened status and eventually delisted, and the rail and southern subspecies of the mouse can be considered for upgrading to threatened status. Delisting the rail and southern subspecies of the mouse may be possible following completion of the above, plus restoration and/or enhancement of an undetermined amount of additional essential habitat (at present estimated at about 3,000 hectares), and completion of marsh restoration efforts on the SFBNWR following cessation of commercial salt production within its boundaries. Resolution of these additional recovery needs will require ongoing research and data on population trends as specified in this plan.

1. Preserve and increase existing populations of the mouse and rail.

    11. Manage existing holdings*.

        111. Develop and implement management plans for mouse and rail habitat on National Wildlife Refuges.

            1111. San Francisco Bay National Wildlife Refuge (SFBNWR).

            1112. San Pablo Bay National Wildlife Refuge (SPBNWR).

        112. Develop and implement habitat management plans for essential marshes administered by the California Department of Parks and Recreation.

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* Appendix C lists the existing holdings that should be managed according to guidelines in Appendix B and the respective task numbers.

1121. China Camp State Park.

1122. Benecia State Recreation Area (R)*.

113. Develop and implement habitat management plans for essential marshes administered by the California Department of Fish and Game.

1131. San Pablo Bay Region.

11311. San Pablo Bay State Wildlife Area.

11312. Petaluma Marsh Wildlife Area.

11313. Corte Madera Marsh Ecological Reserve.

11314. Coon Island Ecological Reserve.

11315. Fagan Marsh Ecological Reserve.

11316. Point Edith Marsh.

1132. Suisun Marsh area.

1133. Other locations.

11331. Elkhorn Slough Estuarine Sanctuary (R).

11332. Bair Island (part).

114. Develop and implement habitat management plans for marshes under Navy jurisdiction.

1141. Avon-Hastings Slough (part).

1142. Port Chicago (Concord Naval Weapons Station).

115. Develop and implement habitat management plans for essential marshes administered by the East Bay Regional Park District.

1151. Alameda South Shore-San Leandro Bay.

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*R = Only rail present.

1152. Hayward Shoreline.

116. Develop and implement habitat management plans for marshes administered by local municipalities.

1161. Mountain View-Sunnyvale Shoreline (cities of San Jose, Sunnyvale, Mountain View and Palo Alto).

1162. Menlo Park-Palo Alto Shoreline (City of Palo Alto).

1163. San Leandro-Hayward Shoreline (cities of Hayward and San Leandro).

117. Develop and implement a habitat management plan for the Nature Conservancy property at Elkhorn Slough (R).

12. Secure and manage unprotected essential habitat.

121. Secure and manage unprotected essential habitat in Central San Francisco Bay.

1211. Marshes on Marin Peninsula.

1212. San Pablo and Wildcat Creeks.

1213. Hoffman Marsh.

1214. Emeryville Crescent.

122. Secure and manage unprotected essential habitat and salt ponds in South San Francisco Bay.

1221. Mt. Eden-Old Alameda Creeks and salt ponds.

1222. Mowry Slough salt ponds.

1223. Guadalupe Slough-Alviso Slough salt ponds.

1224. Bair Island (part).

1225. Point San Bruno.

1226. Mountain View and Sunnyvale shoreline salt ponds.

123. Secure and manage essential habitat in western San Pablo Bay.

1231. Novato Creek.

1232. Gallinas Creek South.

1233. Gallinas Creek North.

1234. Petaluma River Mouth.

1235. Black John Slough.

1236. Petaluma Marsh North.

124. Secure and manage essential habitat in eastern San Pablo Bay.

1241. Lower and Upper Sonoma Creeks and Steamboat Slough.

1242. Second and Third Napa Sloughs (R).

1243. Hudeman Slough (R).

1244. Island Number 1 and Island Number 2.

1245. Skaggs Island.

1246. Coon Island-Fagan Slough.

1247. Napa River.

125. Protect essential mouse and rail habitat in the Suisun Marsh.

1251. Identify areas of essential mouse and rail habitat in the Suisun Marsh.

1252. Secure and manage essential mouse and rail habitat in the Suisun Marsh.

12521. Martinez East.

12522. Martinez West.

12523. McAvoy.

12524. Suisun Slough North.

12525. Collinsville.

1253. Develop and implement management plans for essential mouse and rail habitat in the Suisun Marsh.

126. Identify priorities for securing unprotected essential marshes.

2. Manage existing and potential habitat to reduce limiting factors.

21. Enhance historic tidal marshlands in San Francisco Bay National Wildlife Refuge.

22. Reduce other limiting factors.

221. Eliminate or reduce the adverse effects of industrial pollution.

2211. San Pablo and Wildcat Creeks.

2212. Point San Bruno.

222. Reduce the effects of traffic noise on clapper rails at Hoffman marsh.

223. Reduce effects of human foot traffic on rails and mice at the Emeryville Crescent.

23. Identify other limiting factors for the mouse and rail and implement corrective action.

231. Periodically monitor mouse and rail populations to determine causes of population trends and fluctuations.

232. Evaluate effects of pollutants, sedimentation, and freshwater fluctuations on the invertebrate prey of rails.

233. Identify and resolve management conflicts for rail and mouse populations in the Suisun Marsh.

234. Determine habitat requirements of the salt marsh harvest and California clapper rail in tidal marshes.

235. Determine habitat requirements of the salt marsh harvest mouse and California clapper rail in brackish and non-tidal (diked) marshes.

236. Determine the effects of mosquito control practices on the mouse and rail.

3. Reestablish a California clapper rail population at Humboldt Bay.

31. Select areas for release of birds.

32. Prepare translocation sites to receive birds.

33. Capture and translocate clapper rails to Humboldt Bay.

34. Establish a monitoring/protection program.

4. Reestablish salt marsh harvest mouse populations in formerly occupied habitats and marsh restoration areas.

5. Develop and implement a program for conservation education.

Narrative

1. Preserve and increase existing populations of the mouse and rail.

The most immediate need in assuring the survival of the salt marsh harvest mouse and California clapper rail is to protect and increase existing populations. This will require close coordination among the Service, the California Department of Fish and Game, other State agencies, as well as local (City and County) agencies and private interest groups.

11. Manage existing holdings.

A number of marshes that support populations of the mouse and rail are administered by public agencies and/or private organizations. If protective management were implemented for the mouse and rail on these marshes the likelihood of extinction could be reduced significantly.

111. Develop and implement management plans for mouse and rail habitat on National Wildlife Refuges.

San Francisco Bay and San Pablo Bay National Wildlife Refuges both support substantial populations of the mouse and rail. At present, however, management of rail and mouse habitat on these refuges is inadequate. Reasons for this relate to the lack of personnel and money to undertake the effort. There also is a need for specific management guidance. Increased funding

and manpower are needed to develop and implement management plans for both of these Federal refuges. It is hoped that the general guidelines provided in Appendix II of this plan will help with the development of site specific management plans.

1111. San Francisco Bay National Wildlife Refuge (SFBNWR).

This refuge supports most of the major populations of the southern form of the salt marsh harvest mouse, and substantial habitat for the rail. A management plan for the refuge should be developed and implemented to address protection and management of habitat for these species.

1112. San Pablo Bay National Wildlife Refuge (SPBNWR).

This refuge supports some of the most pristine and deepest marsh areas within the ranges of the rail and northern form of the salt marsh harvest mouse. A management plan for this refuge should be developed and implemented to insure protection of these species on the refuge.

112. Develop and implement habitat management plans for essential marshes administered by the California Department of Parks and Recreation.

Populations of mouse and rail are known from two areas administered by the California Department of Parks and Recreation. These State Park units are in the process of developing management plans to provide secure habitat.

1121. China Camp State Park.

The marshes of China Camp State Park should be censused for both species and mapped for marsh vegetation types and elevations. Special attention should be given to providing an increased peripheral halophyte zone throughout portions of the marsh. Management plans should be developed and implemented to protect both species. Private holdings within the marsh should be secured.

1122. Benecia State Recreation Area (R).

The marshes of this area should be censused for clapper rails. Because fluctuations in rainfall and delta outflow will affect the rail populations at this location, populations should be carefully monitored. Vegetation of the area

should be mapped and surveyed periodically to detect fluctuations in cover and species composition. Consideration should be given to improving tidal circulation in the marsh, as well as controlling sedimentation from adjacent urban development, and limiting foot traffic. A management plan should be developed and implemented for the area to insure protection of the rail.

113. Develop and implement habitat management plans for essential marshes administered by the California Department of Fish and Game.

Twelve marshes administered by the California Department of Fish and Game are known to support populations of the salt marsh harvest mouse and/or the California clapper rail. Protection of habitat for these species on CDFG property should be integrated with other management activities. The primary purpose is to secure and maintain diverse marsh habitats on CDFG lands within the Suisun Marsh.

1131. San Pablo Bay Region.

Five marshes owned or leased by CDFG in the San Pablo Bay region support populations of the rail or mouse, in some cases both. Management plans

for these areas should be developed to protect rail and mouse habitat.

11311. San Pablo Bay State Wildlife Area.

This largely open water management unit has only a narrow fringe of marsh along the west side. Access is limited to boats thus the marshland and tidal flats are relatively secure. A management plan for the higher marsh areas above the mudflats should be developed incorporating the criteria listed in Appendix B.

11312. Petaluma Marsh Wildlife Area.

This management unit lies between the Petaluma River and San Antonio Creek just south of the town of Petaluma. It is a public hunting area but access is by boat only, thus some marshland values are protected. Implementation of a management plan for the area should include measures to protect rail and mouse habitat.

11313. Corte Madera Marsh Ecological Reserve. This reserve, located within the city limits of Corte Madera, lies on the south bank of Corte Madera Creek. It is the largest remaining marsh between Redwood City, San Mateo County, and Northern San Pablo Bay. Gorse (Ulex europaeus), an invasive, exotic shrub is known from portions of the reserve and it is recommended that this plant be eradicated from the site. A management plan for the salt marsh and tidal channel in this area and the newly acquired Muzzi Marsh should be developed and implemented (see Appendix B) for the enhancement and protection of mouse and rail habitat. See Evens and Page (1983) for more specific management recommendations.

Although this marsh supports a fairly large rail population (about 20 breeding pairs), salt marsh harvest mice have not been trapped during the last four censuses (a few mice trapped

in 1975 represent the last known record of their occurrence). For this reason, more intensive mouse censusing should be attempted to determine whether salt marsh harvest mice still occur on site.

11314. Coon Island Ecological Reserve.

This 101 hectare area four miles south of the City of Napa was at one time a duck club. The site supports mouse and rail populations and is considered by CDFG Region 3 to be a potential waterfowl hunting area. A management plan for this area should provide protection for the rail and mouse populations.

11315. Fagan Marsh Ecological Reserve.

This 134 hectare Ecological Reserve lies immediately west of the Napa Airport. Populations of both mouse and rail occur on the site as well as several other candidate species. A management plan is needed to insure protection of the rail and mouse habitat on site.

1131b. Point Edith Marsh.

This marsh is leased by CDFG from the State Lands Commission (166 hectares). The area is bounded on the north by Suisun Bay, on the west by Pacheco Creek, on the south by Waterfront Road and on the east by the Concord Naval Weapons Station. A management plan for this area should incorporate guidelines from Appendix B to insure protection of mouse habitat on site.

1132. Suisun Marsh Area.

Several marshes managed by CDFG in the Suisun Marsh area support rail and mouse populations. Management plans should be developed and implemented for these areas to assure protection of the mouse and rail.

1133. Other locations.

Two additional areas owned and/or administered by CDFG support rail or mouse populations. Management plans are needed for these areas as well.

11331. Elkhorn Slough Estuarine Sanctuary (R).

Elkhorn Slough Estuarine Sanctuary covers approximately 323 hectares and includes substantial areas of tidal marsh and mudflats used by the rail. Implementation of a management plan incorporating protection of the areas used by rails will secure this area.

11332. Bair Island (part).

About 400 hectares of this diked and tidal marshland is leased by CDFG from the State Lands Commission. Both tidal and non-tidal areas of the island provide important rail and highly significant mouse habitat. A management plan for the island should include protection of rail and mouse habitat. Tidal areas should be managed in accordance with the guidelines in Appendix B.

114. Develop and implement habitat management plans for marshes under Navy jurisdiction.

Two marshes under Navy jurisdiction are identified as essential habitat for the mouse and rail. Both

areas included here are designated as portions of a wetland preserve established in February, 1984, through a memorandum of understanding between the Department of the Navy and the Fish and Wildlife Service. As funding and personnel become available, this property as a separate unit of the San Francisco Bay NWR. In the interim, the Navy will prepare and implement a management plan to promote the preservation of endangered species on the preserve in coordination with the Service. Management plans for both of these marshes should incorporate the guidelines in Appendix B.

1141. Avon-Hastings Slough (part).

Two sections comprise this unit of the Concord Naval Weapons Station. The first approximately 236 hectares joins Point Edith Marsh on the west. The second unit (approx. 102 hectares) lies on the south side of Waterfront Road. Management plans for both areas should be developed and implemented to protect mouse and rail habitat.

1142. Port Chicago (Concord Naval Weapons Station).

This area comprises two units of the Concord Naval Weapons Station. The first, approximately 65 hectares, lies between

Anderson Slough on the west, the Naval Station road and tracks on the north, Burton road on the east and Southern Pacific Railroad track on the south.

The second unit, approximately 46 hectares, occurs near a filtration plant near the Port Chicago Highway and Ambrose Road. Management plans for these areas should be developed and implemented to protect mouse and rail habitat.

115. Develop and implement habitat management plans for essential marshes administered by the East Bay Regional Park District.

Several existing marshes and planned marsh restorations to be administered by the East Bay Regional Park District (EBRPD) have been identified as essential to the mouse and rail. Management plans for these marshes should be developed and implemented. In addition, the existing wildlife values (in their nontidal condition) of sites proposed for restoration should be considered before restoration is carried out.

1151. Alameda South Shore-San Leandro Bay.

Essential habitat in this area consists of the tidal marsh and mudflats outboard of the filled areas along the bayshore of Alameda and San

Leandro Bay. A management plan for this site should incorporate the guidelines in Appendix B.

1152. Hayward Shoreline.

Three sites providing essential mouse and potential rail habitat in the Hayward shoreline area are: 88 hectares of nontidal marsh proposed for restoration just north of Sulphur Creek; the Hayward Marsh restoration project, a 90 hectare newly-restored marsh presently supporting primarily mudflats; and 11 hectares of nontidal pickleweed marsh just north of the San Mateo Bridge to be set aside as a mouse preserve.

116. Develop and implement habitat management plans for marshes administered by local municipalities.

Several areas under the jurisdiction of local municipalities have been identified as essential habitat for the mouse and rail. These areas should be secured and management plans developed and implemented for the protection of the mouse and rail populations. Land Protection Plans (LPP) should be developed for each of these sites.

1161. Mountain View-Sunnyvale Shoreline (cities of San Jose, Sunnyvale, Mountain View and Palo Alto).

Essential habitat includes the series of marshes bordering South San Francisco Bay (approximately 43 hectares) within the jurisdiction of the cities of San Jose, Sunnyvale, Mountain View, and Palo Alto. A salt pond (approximately 70 hectares) located between Devils Slough and Guadalupe Slough is also included. This salt pond should be diked off and managed as a diverse salt marsh. This would provide a large contiguous area of high quality salt marsh habitat for the rail and mouse.

1162. Menlo Park-Palo Alto Shoreline (City of Palo Alto).

This is an area of tidal marshes extending from the mouth of Charleston Slough, northwestward to Cooley Landing, within the jurisdiction of the City of Palo Alto. The area is approximately 145 hectares.

1163. San Leandro-Hayward Shoreline (cities of Hayward and San Leandro).

A series of existing nontidal marshes within the jurisdiction of the cities of San Leandro and Hayward totaling approximately 240 hectares of essential mouse and rail habitat is proposed for restoration. Administration of these sites is undetermined at this time, but will probably involve the City of San Leandro, Hayward Area Recreation District (HARD), and the East Bay Regional Park District. Habitat management plans for these areas should be implemented to protect existing mouse and rail habitat.

117. Develop and implement a habitat management plan for the the Nature Conservancy property at Elkhorn Slough (R).

The Nature Conservancy property at Elknorn Slough includes about 80 hectares on the east side of the slough just north of Kirby Park. The property extends north to Hudson's Landing and then continues south along the west side of the slough to a point approximately 0.9 km southwest of Hudson's Landing. A management plan for this area should address protection and possible enhancement of rail habitat.

12. Secure and manage unprotected essential habitat.

Many marshes around San Francisco and Suisun Bays that provide rail and mouse habitat are threatened with destruction or modification. The following 27 areas have been identified as essential to the survival of the mouse and rail. They are needed to provide a large mosaic of protected marshes to insure the survival and genetic continuity of both species. It should be noted that areas to be secured for the mouse and rail may not be limited to just these 27 areas. Moreover, title of any existing or historic salt marsh may or may not involve state ownership under the Public Trust. A determination of ownership of such marshes requires investigations on a parcel by parcel basis. LPPs should be developed for each of the following areas.

121. Secure and manage unprotected essential habitat in Central San Francisco Bay.

At this time five unprotected sites in the central region of San Francisco Bay have been identified as extant or potential habitat for the mouse and rail.

1211. Marshes on Marin Peninsula.

Despite formerly extensive habitat and numerous historical records, the southern subspecies of the salt marsh harvest mouse has been largely extirpated from the Marin Peninsula (only two

small populations are known to exist and both are threatened by development). Similarly, only one secure, relatively large California clapper rail population persists in the area. Habitat loss has been so widespread that only small remmants of historic habitat, or only recently restored wetlands are currently extant. These areas encompass a variety of land ownerships, largely local government and private holdings. Management actions specific to the habitat requirements of the mouse and rail are needed on these remaining (and future restoration) areas if these species are to survive over the long-term on the Marin Peninsula.

The 36 hectare marsh at Richardson Bay should be secured and managed as a separate holding. While the salt marsh harvest mouse apparently has been extirpated from the salt marshes fringing Richardson Bay, a small clapper rail population may still persist. Most or all potential habitat for the mouse and rail is currently under study for marsh enhancement in the Richardson Bay Special Area Plan, sponsored by the San Francisco Bay Conservation and Development Commission. Any restoration

projects implemented under this plan should focus on opportunities to enhance habitat conditions for the mouse and rail, either from the standpoint of maintaining remnant populations that may still exist, or of maintaining the option for future reintroductions. The high recreational value of this area indicates that if mouse or rail use is to be enhanced, public use must be carefully managed.

The approximately 60 hectare area along the San Rafael Bayfront apparently supports the last two known populations of the salt marsh harvest mouse (southern subspecies) on the Marin Peninsula and represents the northern most population on the west side of San Francisco Bay. The area is diked from tidal influence and proposed for urban development. This area should be secured and managed as a separate unit.

1212. San Pablo and Wildcat Creeks.

Approximately 202 hectares of rail and mouse habitat occur along San Pablo and Wildcat Creeks in Contra Costa County. The close proximity of this marsh to an oil refinery and

the Richmond City dump raises questions concerning threats from pollution and toxic materials. This area contains the only significant population of the southern subspecies of the mouse in the central Bay. In addition to securing this site, studies of pollution effects should be undertaken (see task #2211).

1213. Hoffman Marsh.

This 14 hectare site in Contra Costa County historically supported clapper rails and may still support some birds. The site is close to a major highway (I-180) and the nearby traffic may affect rail use of the area. Most of the area is owned by the Southern Pacific Railroad. A small portion of the marsh at the south may be part of the freeway easement owned by Caltrans. Mice may have occurred here historically but are now absent. It may be suitable for mice but it is felt that the lack of migratory corridors has effectively prevented reestablishment. The site should be secured and the effects of traffic noise on rails studied (see task #222).

1214. Emeryville Crescent.

This 51 hectare area of tidal marsh and mudflats lies to the east of Highway 17/80 near Powell Street. Portions of the area receive substantial foot traffic. The ownership is undetermined. This site supports mouse and rail populations and therefore should be secured and managed according to the guidelines in Appendix B.

122. Secure and manage unprotected essential habitat and salt ponds in South San Fancisco Bay.

Five unprotected marshes and salt pond areas in the South San Francisco Bay Region are identified as essential for the mouse and rail. The greatest marsh destruction within the ranges of these two species has occurred in this portion of the bay, primarily as a result of urban expansion and accompanying secondary effects. Only the largest remaining sites in this region have been identified for recovery purposes. These should be secured and managed.

Since South San Francisco Bay offers the most suitable habitat for the clapper rail and supports the greatest population of the southern subspecies of the mouse, high priority should be given to securing and managing these areas. Also, since Leslie Salt Company is the

primary owner of the majority of salt ponds in the South Bay, any restoration project involving large segments of their property would be highly desireable. Prior to proposing complete restoration, however, the existing wildlife values of these nontidal habitats should be considered and incorporated into management plans.

1221. Mt. Eden-Old Alameda Creeks and salt ponds.

This area of approximately 2800 hectares in Alameda County supports a small year-round mouse and rail population in the 144 hectares of marsh at the mouths of Mt. Eden and Old Alameda Creeks. Habitat at these locations is being adversely affected by flood control activities and is not in optimal condition for these species. The adjacent salt ponds have a high potential for restoration and are currently threatened with development. Marsh restoration proposals at this location should also consider the existing wildlife values of the nontidal habitats.

1222. Mowry Slough salt ponds.

This area of high salinity salt ponds and crystallizers, has approximately 1050 hectares, and is bounded on the north, east and south by

the San Francisco Bay NWR. Once commercial salt production has ceased, the area should be incorporated into the refuge and restored to tidal action.

1223. Guadalupe Slough-Alviso Slough salt ponds.

This area of salt ponds, approximately 610 hectares, provides a substantial amount of potentially restorable diked salt marsh habitat. The northern tip of this area (150 hectares) is part of the SFBNWR. The remainder should be annexed when salt production ceases. When returned to a marsh condition, this large unit will provide a major area of saline marsh between the brackish water influences of the large waste water treatment plants on Guadalupe Slough and Artesian Slough-Coyote Creek in the Alviso area.

1224. Bair Island (part).

In addition to the State and Federal lands at Bair island, an additional 741 hectares of unprotected salt ponds and marshes occur along Smith, Corkscrew, and Steinberger Sloughs and Redwood Creek should be secured. These areas should be added to the State property or the SFBNWR lands (159 hectares) on Bair Island.

Once the private lands have been secured in public ownership, the abandoned salt ponds along Smith, Corkscrew, and Steinberger Sloughs should be enhanced and managed for the benefit of mouse and rail and a diversity of other species. This will provide a series of large protected marshes connecting the various segments of Bair Island. Management of portions of the island should follow the guideline described in Appendix B.

1225. Point San Bruno.

This area of 9 hectares in San Mateo County supports a small year-round clapper rail population and is currently threatened by adjacent heavy industry. This location also marks the present northern distributional limit of the California clapper rail in San Mateo County. This area should be secured and managed (see also task #2212). A Land Protection Plan should be prepared for this site.

1226. Mountain View and Sunnyvale shoreline salt ponds.

The 70 hectare area of salt ponds south of the mouth of Guadalupe Slough should be diked off

and managed as diverse salt marsh. This would provide a large contiguous area of high quality salt marsh habitat for the mouse and rail.

123. Secure and manage essential habitat in western San Pablo Bay.

Seven marshes have been identified as essential habitat for the mouse and rail in the western San Pablo Bay region.

1231. Novato Creek.

This is an area of tidal marshes, dikes, uplands, and mudflats beginning on the south side of the Petaluma River adjacent to Day Island Wildlife Area (CDFG), extending southeast past Petaluma Point, and continuing south to the mouth of Novato Creek. This area also includes the marsh and tidal mudflats on both sides of Novato Creek outboard of dikes beginning at the Creek mouth and extending upstream 1.0 km and southeast of the Northwestern Pacific Railroad bridge. This area supports a substantial breeding population of rails. The area should be maintained for the benefit of the rail. Any flood control activities should be implemented in a manner that minimizes impacts to the rail population.

1232. Gallinas Creek South.

This 46 hectare marsh in Marin County constitutes one of the best harvest mouse marshes on the Marin Peninsula. At present it is in private ownership. The marsh should be secured and incorporated into the China Camp State Park.

1233. Gallinas Creek North.

This marsh, which includes part of the public land at Hamilton Air Force Base, is an important area for both the mouse and rail. The unsecured portion of the marsh (approximately 188 hectares) should be secured and incorporated into the San Pablo Bay State Wildlife Area.

1234. Petaluma River Mouth.

These marshes constitute 92 hectares in Sonoma and Marin Counties and provide important habitat for both the rail and mouse. The sites should be secured and incorporated into the San Pablo Bay National Wildlife Refuge.

1235. Black John Slough.

This fairly large marsh (344 hectares) in Marin County which is seasonally flooded (about 25%)

provides suitable habitat for both the mouse and rail. The area should be secured and tidal action restored or managed as diked marsh if tidal salinities are too low. It could be made part of the Petaluma Marsh Wildlife Area.

1236. Petaluma Marsh North.

This is a large (412 hectare) marsh in Sonoma County adjacent to the Petaluma Marsh Wildlife Area (CDFG). This area, if secured, would provide a large contiguous addition to the wildlife area. It is one of the few remaining areas around the Bay with an upper transition zone. If possible, this transition zone should be expanded.

124. Secure and manage essential habitat in eastern San Pablo Bay.

Ten units of marsh and slough habitat within this region have been identified as essential habitat for the mouse and rail. Given the current lack of development, Napa Marsh offers a unique opportunity to maintain and restore relatively natural habitat values over a large, contiguous area.

1241. Lower and Upper Sonoma Creeks and Steamboat Slough.

Lower Sonoma Creek is a 98 hectare area of

tidal marsh and mudflats that occurs along Sonoma Creek near the west approach of Highway 37. It is an important area for the rail. The site should be secured and managed as an independent unit.

Upper Sonoma Creek and Steamboat Slough provide areas of important rail habitat in Sonoma County. They include about 176 hectares of tidal marsh and mudflats along Sonoma Creek near the mouth of Second Napa Slough and several branching sloughs. These sloughs and adjoining marshes should be secured and managed for the protection of the mouse and rail.

1242. Second and Third Napa Sloughs.

This additional series of branching sloughs and mudflats near Sonoma Creek, Sonoma County, provides important habitat for the rail. This area should be secured and managed. The previous unit (Upper Sonoma Creek-Steamboat Slough) could be combined with it to form one large contiguous unit.

1243. Hudeman Slough.

This 157 hectare series of tidal marshes and mudflats occurs along Hudeman Slough and its

tributaries in Sonoma County. This area should be secured and managed along with the above two units.

1244. Island Number 1 and Island Number 2.

The approximately 1400 hectares of Island Number 1 should be secured and most of it opened to tidal action. At present, the island is composed of a mixture of active and inactive salt ponds and diked off agricultural lands. Recreation of tidal marsh on Island Number 1 will provide a large salt marsh close to several others including Skaggs Island and the marshes of the San Pablo Bay National Wildlife Refuge on the south side of Highway 37.

The 675 ha Island Number 2 also should be included but is slightly less important to the two species than Island Number 1. Also included in these two areas are the tidal sloughs and associated marshlands along South, Dutchman, and China sloughs totaling approximately 425 hectares. Once salt production ceases all the salt ponds should be secured and managed. An effort should be made to recreate the full complement of historic habitats that once existed in the marsh for the

benefit of endangered species, waterfowl and shorebirds. A Land Protection Plan should be prepared for these two areas.

1245. Skaggs Island.

This island of about 1850 hectares of diked agricultural land, administered by the U.S. Navy, should be secured with most of it opened to tidal action. This would also include the tidal sloughs and associated marshlands along Napa Slough (about 462 hectares). Marsh restoration should be designed to provide habitat values for waterfowl and shorebirds, in addition to endangered species values.

Marsh restoration on Skaggs Island, in combination with similar efforts on Islands No. 1 and 2, would result in a large, contiguous marsh, representing the restoration of tidal influence to a high percentage of the currently diked-off Napa Marsh complex. In total, restoration of these or equivalent areas should provide for the long-term habitat needs of the mouse and rail in this general area.

1246. Coon Island-Fagan Slough.

Important portions of both Coon Island and

Fagan Slough are privately owned and, therefore, subject to development. About 130 hectares on Coon Island need to be secured and added to the existing Coon Island Ecological Reserve (CDFG, 101 hectares). Approximately 51 hectares immediately west of Fagan Marsh and the 44 hectare Bull Island should be secured and added to the Fagan Marsh Ecological Reserve (CDFG, 134 hectares).

1247. Napa River.

Approximately 514 hectares of tidal marsh and mudflats along the Napa River provide important rail and mouse habitat. This area includes sites near the mouth of South Slough, Slaughterhouse Point, mouth of White Slough and near the Highway 37 bridge.

125. Protect essential mouse and rail habitat in the Suisun Marsh*.

Suisun Marsh consists of approximately 1,722 hectares of State and privately-owned brackish water marshes along Suisun and Montezuma Sloughs and some major tributaries. Areas designated as essential habitat

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* Marshes within the Suisun Area Administered by CDFG are discussed under number 113.

within the Suisun Marsh were found to support salt marsh harvest mice, breeding clapper rail populations or suitable rail breeding habitat. Sites specifically identified for the rail are the following. Joice Island North, Joice Island South, Suisun Slough North.

At present mouse habitat in the Suisun Marsh exists primarily as a by-product of waterfowl management activities. A mosiac of large areas of preferred salt marsh harvest mouse habitat should be established throughout the marsh. There should be five to ten areas on private land of 40 to 100 hectares each, for a total of 500 or more hectares of preferred mouse habitat. The smallest areas must be of the highest quality habitat, as the amount of habitable vegetation in small areas will drop to critically small levels during the winter. These areas of mouse habitat should be distributed throughout the marsh but not located on the extreme western, northwestern or northeastern edges of the Suisun Marsh Protection Zone as these areas support very poor habitat.

Initial surveys of the California clapper rail in the Suisun Marsh indicate that rails are restricted to tidal marshes along sloughs which possess extensive low tide foraging habitat, dense stands of low marsh vegetation such as tules or cattails, and undisturbed

high marsh vegetation which provide additional nesting habitat. Restoration of historic tidal marshes with these conditions should be encouraged.

1251. Identify areas of essential mouse and rail habitat in the Suisun Marsh.

At present six areas of essential mouse and rail habitat in the Suisun Marsh have been identified (areas under CDFG ownership are not included here). However, it is highly likely that other significant habitat for the mouse and rail exists in the Suisun. It is therefore necessary that additional areas be surveyed and examined for the presence of the mouse and rail. The U.S. Soil Conservation Service (SCS) is now in the process of developing marsh management plans for the Suisun Marsh. It is likely that some mapping and habitat information will soon be available from SCS.

1252. Secure and manage essential mouse and rail habitat in the Suisun Marsh.

As areas of essential mouse and rail habitat are identified it will be necessary to provide viable alternatives for securing those areas. Specific strategies will require the cooperation of the Suisun Resource Conservation

District, California Department of Fish and Game, and the U.S. Fish and Wildlife Service. At present six such areas are known.

12521. Martinez East.

This 150 hectare State-owned area includes about 18 hectares of upland habitat. The tidal marsh begins approximately at the eastern city limits of Martinez. This site, which supports both the mouse and rail, should be secured by transferring title to State Parks or California Department of Fish and Game.

12522. Martinez West.

This 42 hectare marsh lies just east of the Martinez Marina. The site supports small populations of rails, and should therefore be secured and included with the previous unit (12521).

12523. McAvoy.

The marshes at McAvoy occur on the eastern unit of the Concord Naval Weapons Station. There are three contiguous marsh areas included here.

The western unit, approximately 67 hectares, lies north of the railroad tracks and on the northwest of the the McAvoy Road. The second unit, approximately 18 hectares, is the island north of the McAvoy Boat Harbor. The eastern unit, approximately 97 hectares, lies just east of the previous unit. The entire area should be secured and managed to protect both the mouse and rail.

12524. Suisun Slough North.

This 169 hectare area of tidal marsh mudflats and uplands occurs along the east and west sides of Suisun Island from Goat Island to the mouth of Wells Slough. Because the area supports significant mouse and rail populations, it should be secured.

12525. Collinsville.

This area includes two diked-off marshes totaling approximately 132 hectares just northeast of Montezuma Island. These marshes provide important habitat for the mouse and are its inland most

occurrence. The two marshes should be secured and managed as diked marshes. Because habitat conditions are below optimum at present, planting or seeding of saltmarsh plants and/or modification of the flooding regime may be required to improve the habitat for the mouse.

1253. Develop and implement management plans for essential mouse and rail habitat in the Suisun Marsh.

Management plans for various duck clubs may require modification to prevent adverse impacts to rail and/or mouse habitat. Also, an ongoing monitoring program should be established to evaulate the effectiveness of the management program in protecting mouse and rail populations in the Suisun Marsh. Aerial monitoring accompanied by adequate ground truthing is recommended.

126. Identify priorities for securing unprotected essential marshes.

Because there are many marshes requiring protection, a priority list must be established to identify those in most critical need of protection. In this way the limited funding available can be used most effectively.

It is important that large areas of appropriate marsh habitat be secured throughout the ranges of the mouse and rail to insure their continued existence. Fewer large reserves would provide a better strategy to preserve these species than numerous small reserves because isolation and urbanization, generally, adversely affect small areas to a greater extent than large ones. Each area should be large enough to support several populations of each species. This is most critical for the less mobile mouse.

2. Manage existing and potential habitat to reduce limiting factors. Mouse and rail populations in many marshes are limited by various factors including but not limited to: reduced upland habitat, poor tidal circulation, and pollution. Proper management of marshes may include increasing plant cover, securing upland habitat, restoring tidal circulation, and eliminiating or reducing pollution so that mouse and rail populations can increase.

21. Enhance historic tidal marshlands in San Francisco Bay National Wildlife Refuge.

One of the principal causes of the decline in mouse and rail populations is the diking off of historic salt marsh to provide more agricultural land, salt ponds, or dry uplands for construction of homes or buildings. In some cases siltation has prevented tidal circulation. To establish and

maintain good quality rail and mouse habitat, certain management actions will be required. Specific management actions will need to be determined on a site-by-site basis.

A large amount of rail and mouse habitat could eventually be restored by returning tidal action to the salt evaporation ponds within the San Francisco Bay National Wildlife Refuge and other nearby ponds. Specific sites where tidal flows should be restored must be determined during development of site specific management plans. Moreover, because these salt ponds currently provide important feeding, nesting, and roosting habitat for grebes, waterfowl, shorebirds, and terns, studies should be undertaken to determine how to maintain optimal conditions for these groups while at the same time providing sufficient habitat for the mouse and rail. Future management of these salt ponds must also consider the nesting habitat requirements of other endangered or rare dike-nesting species [i.e., snowy plovers (Charadrius alexandrinus nivosus), California least tern [Sterna antillarum (=albifrons) brownii]. Increasing the diversity of habitats for the harvest mouse and clapper rail could also improve the wildlife habitat value of these areas for other listed, rare or key species (plant and animal) now associated with this environment, such as the salt marsh yellowthroat (Geothlypis trichas sinuosa), San Francisco song sparrow (Melospiza melodia pusillula; M. m. samuelis), salt marsh wandering shrew (Sorex vagrans halocoetes) and

Point Reyes birds-beak (Cordylanthus maritimus palustris). A better understanding of the effects of salinities on salt marsh harvest mouse populations will be necessary to provide detailed marsh management guidelines.

22. Reduce other limiting factors.

In some marshes industrial pollution, traffic noise and foot traffic may reduce the productivity of mice and rails. In addition habitat requirements and basic life history information about the mouse and rail is lacking. Thus some limiting factors probably are not known and may be identified only after careful field studies. A number of tasks are required to accomplish this.

221. Eliminate or reduce the adverse effects of industrial pollution.

Industrial pollution may be adversely affecting several marshes within the ranges of the mouse and rail. Two marsh areas, San Pablo/Wildcat Creeks and Point San Bruno, have been identified as suffering from pollution.

2211. San Pablo and Wildcat Creeks.

The marshes lying along these two creeks may be seriously affected by pollution from the nearby oil refineries and city dump. The impacts of pollution require examination and, if possible,

measures must be devised to reduce the adverse effects.

2212. Point San Bruno.

Heavy industry adjacent to this small (9 hectare) marsh may be adversely affecting the small year round clapper rail population here. The population may be declining because of pollution from the adjacent industrial areas. This problem should be studied and protection plans developed and implemented.

222. Reduce the effects of traffic noise on clapper rails at Hoffman Marsh.

The possible effects of traffic noise on rail use at Hoffman Marsh should be investigated. It may be possible to create some type of noise barrier to increase rail use of the area.

223. Reduce the effects of human foot traffic on rails and mice at the Emeryville Crescent. Adverse impacts to this marsh are the result of trampling by human beings. The site is easily accessible to foot traffic and is used extensively by bird watchers, and driftwood sculptors. The adverse effects of these activities should be elminated or at least reduced.

Construction of a boardwalk or hiking path to restrict these activities may help. Restrictive signing might also prevent some trampling effects. These possibilities and others should be examined. The most cost effective should be implemented.

23. Identify other limiting factors for the mouse and rail and implement corrective action.

Other inherent biological or ecological characteristics of the mouse and rail may prevent or inhibit the rapid recovery of these species. For example, little is known of the breeding ecology of both species. Reproductive success, food habits, and other intrinsic characteristics may reduce their potential for recovery. In addition, extrinsic factors such as waterfowl management, flood control activities, mosquito abatement practices, and blockage of migration corridors may prevent their recovery or reestablishment in various marshes. These various possibilities need to be examined and evaluated, and appropriate management actions developed and implemented.

231. Periodically monitor mouse and rail populations to determine the causes of population trends and fluctuations.

Wide fluctuations in population levels have been documented for the mouse and several subspecies of clapper rail. It is not known whether this is a

natural or man-caused phenomenon. It is suspected that low breeding success for both species relates, in part, to the adverse effects of high tides in marshes lacking sufficient upland habitat. In addition, predation by rats may be critically high. These factors should be investigated as they relate to rail breeding success.

The low population of California clapper rail now remaining increases the likelihood of extinction. Those birds isolated in small remnant marshes are especially vulnerable to extirpation. Regular censuses and banding studies are needed to evaluate and interpret population changes at individual marshes and thoughout its range.

232. Evaluate the effects of pollutants, sedimentation,and freshwater fluctuations on the invertebrate prey of rails.

One reason for the continually low rail population may be the lack or low numbers of appropriate invertebrate food items. Pollution, sedimentation, and freshwater fluctuations all have the potential to significantly affect the benthic invertebrate prey of rails. These factors should be examined as they pertain to rail food items.

233. Identify and resolve management conflicts for rail and mouse populations in the Suisun Marsh.

The primary land use within the Suisun Marsh is waterfowl management. Marsh management plans for the various areas in the Suisun affect not only the salt marsh harvest mouse and California clapper rail, but many other salt marsh associated species such as the Suisun shrew ( Sorex sinuosus), birds beak (Cordylanthus mollis mollis, C. mollis hispidus) and undoubtedly other lesser known organisms (plants and animals) that historically occurred in the once extensive and diverse marshes of the Suisun. Although waterfowl are a very important management concern, the entire mosaic of native species which depend on the wetlands of the Suisun should be considered in any management program for the marsh.

With this goal in mind, portions of Suisun Marsh should be secured and managed for diverse assemblages of salt marsh, brackish marsh, freshwater marsh, and upland species. This will require management, not only of the biotic resources, but also of the dynamic hydrologic regime (tidal and freshwater) that was historically part of the system. It is essential that optimal freshwater and tidal flows be maintained, simulating the historic flow regimes as much as possible. This will require that additional Delta and

River exports of freshwater be carefully evaluated and balanced for the protection of the biotic resources of the Suisun ecosystem.

234. Determine habitat requirements of the salt marsh harvest Mouse and California Clapper rail in tidal marshes.

Although some studies of the mouse and rail have been undertaken in tidal marshes, life history and ecological information is still incomplete. Additional studies of mouse and rail movements, food and nesting habits, and habitat requirements in tidal areas are needed.

235. Determine habitat requirements of the salt marsh harvest mouse and California Clapper rail in brackish and non-tidal (diked) marshes.

Little is known of the life history of the salt marsh harvest mouse and California Clapper rail, especially in San Pablo Bay and the Suisun Marsh. To effectively manage and recover the mouse and rail, we must know their habitat preferences and reproductive requirements in areas of varying habitat quality. This information will assist in future management and recovery actions.

236. Determine the effects of mosquito control practices on the mouse and rail.

Some of the methods used by mosquito abatement districts to control flooding and marsh mosquitoes in marsh areas may affect mouse and rail populations. The effects of these practices need to be evaluated.

3. Reestablish a California clapper rail population at Humboldt Bay.

The California clapper rail historically inhabited the tidal wetlands of Humboldt Bay. Diking and marsh reclamation led to the extirpation of the clapper rail from this region during the mid-1960's. Only about 10 percent of the original fringing tidal wetlands remains there today. A large percentage of the diked areas that were tidal wetlands have not been filled. Some of these exist as seasonal brackish or freshwater wetlands, but most exist as seasonally flooded pasture lands. These areas could be restored to tidal marsh relatively easily. Some areas of seemingly suitable habitat still exist and reestablishment of a secure rail population would contribute significantly to its recovery.

31. Select areas for release of birds.

Narrow, linear marshes, which typically do not provide suitable habitat for rails, characterize most of the wetlands currently bordering Humboldt Bay. Examples include Mad River Slough and the mouth of Jacoby Creek. Indian Island, approximately 240 acres, appears to be the only area

suitable for translocating rails. However, this area alone may not be large enough to assure the long-term maintenance of a population at Humboldt Bay. Other areas of marshland may be required to sustain the population.

32. Prepare translocation sites to receive birds.

Before translocation can be undertaken suitable habitat must be restored. This will involve breaching dikes and restoring tidal influence. Potential areas for tidal wetland restoration include Humboldt Bay NWR lands in south Humboldt Bay and the Mad River Slough area. A feasibility study for tidal marsh restoration should be conducted. A careful evaluation of the existing marshes should also be conducted to identify other potential translocation sites. During this phase, criteria should be established for actually translocating birds. These guidelines should consider the number, sex ratio, and ages of birds to be translocated. Criteria relating to site suitability could be developed (in part) based on studies undertaken in the San Francisco Bay Region (task #'s 231, 232, 234, 235) but site specific studies may also be necessary. Capture and release techniques should also be developed, as well as criteria to determine what constitutes successful translocation and establishment.

33. Capture and translocate clapper rails to Humboldt Bay.

Once sites have been selected and prepared, and criteria and

techniques developed, rails should be captured and translocated to appropriate sites at Humboldt Bay.

34. Establish a monitoring/protection program.

A monitoring and protection program for translocated rails must be established prior to the actual movement of birds. Trends in habitat quality, population numbers and post translocation survival should be monitored. These and other parameters, including various degrading influences (natural or man-caused) should be monitored on at least an annual basis.

4. Reestablish salt marsh harvest mouse populations in formerly occupied habitats and marsh restoration areas.

Many of the marsh restoration and enhancement objectives identified in this plan will create mouse habitat distant from areas currently occupied by the mouse. Because mice are not capable of colonizing habitat widely separated from existing populations, certain marsh restoration projects will not benefit the species unless mice can be introduced to the area.

The concept of translocating salt marsh harvest mice introduces several problems, including genetic considerations, effects on donor populations, judging the habitat suitability of areas considered for translocation, criteria for determining success of the effort, etc. Any translocation program necessarily would be experimental, and should not be attempted without careful study

of all the potential problems involved. Small-scale experimental studies, including asessment of all potential variables that might influence the feasibility and success of translocation, should be conducted prior to large-scale endeavors.

Because of experimental uncertainties, translocation cannot be considered an appropriate technique for offsetting the effects of habitat losses from construction projects. Rather, translocation is viewed only as a means to further the recovery of the species.

5. Develop and implement a program for conservation education.

A concerted effort should be made to inform and educate the general public and local governments about the salt marsh harvest mouse and California clapper rail and their habitat requirements. Assistance should be provided to local governments in their land use planning to help carry out the objectives of this plan. Informative pamphlets, flyers, posters, or other literature should be developed and provided to the public and implementing agencies. The CDFG and USFWS should inform and educate property owners and hunters in waterfowl management areas, such as Suisun Marsh, as to the presence and importance of harvest mice and clapper rails.

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# PART III

## IMPLEMENTATION SCHEDULE

Table 1 is a summary of actions and costs for the salt marsh harvest mouse/California clapper rail recovery program. It is a guide to meet the objectives of the Recovery Plan, as discussed in Part II, Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agences are responsible to perform the tasks, and the estimated costs to perform them. Implementing Part III is the action of the recovery plan that, when accomplished, will bring about the recovery of these endangered species. Initiation of these actions is subject to the availability of funds.

## GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Diesease control
7. Other management

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

## RECOVERY ACTION PRIORITIES

1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

2 = An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

3 = All other actions necessary to provide for full recovery of the species.

PART III
IMPLEMENTATION SCHEDULE

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.)[1] | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manage existing holdings | | | | | | | | | | | |
| M-3 | Develop and implement management plans for mouse and rail habitat on SFBNWR. | 1111 | 1 | Continuous | 1 | RE | | 10 | 10 | 10 | |
| M-3 | Develop and implement management plans for mouse and rail habitat on SPBNWR. | 1112 | 2 | Continuous | 1 | RE | | 10 | 10 | 10 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at China Camp State Park. | 1121 | 2 | Continuous | | | CDPR | 4 | 4 | 2 | |

Abbreviations:

CCC - California State Coastal Conservancy
CDFG - California Department of Fish and Game
CMV - City of Mountain View
CSJ - City of San Jose
CSV - City of Sunnyvale
CPA - City of Palo Alto
CSL - City of San Leandro
COE - U.S. Army Corps of Engineers
DPR - California Department of Parks and Recreation
EBRPD - East Bay Regional Park District
FWS - U.S. Fish and Wildlife Service
SE - Endangered Species, FWS
Acq - Land Acquisitions, FWS
RE - Refuges, FWS
PG&E - Pacific Gas and Electric Company
TNC - The Nature Conservancy
BCDC = Bay Conservation and Development Commission

† Indicates lead agency
[1] Continuous= once action has begun it will continue indefinitely
Ongoing = currently underway

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Develop and implement a habitat management plan for the rail at Benicia State Recreation Area. | 1122 | 2 | Continuous | | | CDPR | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at San Pablo Bay State Wildlife Area. | 11311 | 2 | Continuous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Petaluma Marsh Wildlife Area. | 11312 | 2 | Continuous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Corte Madera Marsh Ecological Reserve. | 11313 | 1 | Continuous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail and Coon Island Ecological Reserve. | 11314 | 2 | Continuous | | | CDFG | 3 | 3 | 2 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Fagan Marsh Ecological Reserve. | 11315 | 2 | Continuous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Point Edith Marsh. | 11316 | 2 | Continous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management Plan for CDFG-owned marshes in the Suisun Marsh. | 1132 | 2 | Continuous | | | CDFG | 10 | 10 | 10 | |
| M-7 | Develop and implement a habitat management plan for the rail at Elkhorn Slough Estuarine Sanctuary. | 11331 | 2 | Continuous | | | CDFG | 3 | 3 | 2 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Bair Island State Wildlife Area. | 11332 | 1 | Continuous | | | CDFG | 3 | 3 | 3 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Avon-Hastings Slough. | 1141 | 2 | Continuous | 1 | SE | <br>Navy* | 2<br>2 | 2<br>2 | 2<br>2 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Port Chicago (Concord Naval Weapons Station). | 1142 | 2 | Continuous | 1 | SE | | 2 | 2 | 2 | |
| | | | | | | | Navy* | 3 | 3 | 3 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail at Alameda South Shore-San Leandro Bay. | 1151 | 1 | Continuous | | EBRPD | | 3 | 3 | 3 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail along the Hayward Shoreline. | 1152 | 1 | Continuous | | EBRPD | | 5 | 5 | 5 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail along the Mountain View-Sunnyvale Shoreline. | 1161 | 1 | Continuous | 1 | SE | | 2 | 2 | 2 | |
| | | | | | | | CSJ | 1 | 1 | 1 | |
| | | | | | | | CSV | 1 | 1 | 1 | |
| | | | | | | | CMV | 1 | 1 | 1 | |
| | | | | | | | CPA | 1 | 1 | 1 | |
| | | | | | | | CDFG* | 3 | 3 | 3 | |
| M-7 | Develop and implement a habitat management plan for the mouse and rail along the Menlo Park-Palo Alto Shoreline. | 1162 | 1 | Continuous | 1 | SE | | 1 | 1 | 1 | |
| | | | | | | | CPA | 1 | 1 | 1 | |
| | | | | | | | CDFG* | 3 | 3 | 3 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Develop and implement a habitat management plan for the mouse and rail along the San Leandro-Hayward shoreline. | 1163 | 1 | Continuous | | SE | | 1 | 1 | 1 | |
| | | | | | | | CDFG | 1 | 1 | 1 | |
| | | | | | | | CSL* | 2 | 2 | 2 | |
| M-7 | Develop and implement a habitat management plan for the rail at Elkhorn Slough Nature Conservancy property. | 117 | 2 | Continuous | | | TNC | 2 | 2 | 2 | |
| Secure and manage unprotected essential marshes | | | | | | | | | | | |
| A-7 | Secure and manage marshes on Marin Peninsula. | 1211 | 1 | Continuous | | Acq | | 2 | 2 | 2 | 23 hectares |
| | | | | | | SE | | 2 | 2 | 2 | |
| | | | | | | | CCC | 1 | 1 | 1 | |
| | | | | | | | CDFG* | 3 | 3 | 3 | |
| | | | | | | | Marin Co. | 1 | 1 | 1 | |
| | | | | | | | BCDC | 1 | 1 | 1 | |
| A-7 | Secure and manage San Pablo and Wildcat Creeks. | 1212 | 1 | Continuous | | | EBRPD* | 2 | 2 | 2 | 202 hectares |
| | | | | | | | CDFG | 2 | 2 | 2 | |
| A-7 | Secure and manage Hoffman Marsh. | 1213 | 3 | Continuous | | | Cal Trans CDFG* | To be determined | | | 14 hectares |
| A-7 | Secure and manage the Emeryville Crescent. | 1214 | 1 | Continuous | | | CDFG* CCC | To be determined | | | 51 hectares |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-7 | Secure and manage Mt. Eden-Old Alameda Creeks and salt ponds. | 1221 | 1 | Continuous | 1 | SE Acq. | EBRPD* CDFG | To be determined | | | 790 hectares |
| A-7 | Secure and manage Mowry Slough salt ponds | 1222 | 1 | Continuous | 1 | RE | | To be determined | | | 790 hectares Estimated cost $3,000 k |
| A-7 | Secure Guadalupe Slough-Alviso Slough salt ponds. | 1223 | 1 | Continuous | 1 | RE | | To be determined | | | 460 hectares |
| A-7 | Secure and manage the unprotected portions of Bair Island. | 1224 | 1 | Continuous | 1 | RE* Acq. | CDFG | To be determined | | | 741 hectares |
| A-7 | Secure and manage Point San Bruno. | 1225 | 2 | Continuous | 1 | RE Acq. | CDFG* | To be determined | | | 9 hectares (Rail only) |
| A-7 | Secure and manage Mountain View and Sunnyvale shoreline Salt ponds. | 1226 | 1 | Continous | 1 | RE* Acq. | | To be determined | | | 70 hectares |
| A-7 | Protect Novato Creek East. | 1231 | 3 | Continuous | 1 | RE | CDFG* | To be determined | | | 102 hectares |
| A-7 | Secure and manage Gallinas Creek South. | 1232 | 2 | Continuous | 1 | | DPR | To be determined | | | 59 hectares |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-7 | Secure and manage Gallinas Creek North. | 1233 | 2 | Continuous | 1 | RE<br>Acq. | <br>CDFG*<br>CCC | To be determined | | | 119 hectares |
| A-7 | Secure and manage Petaluma River mouth | 1234 | 2 | Continuous | 1 | RE<br>SE | <br>CDFG* | | To be determined | | 92 hectares<br>Estimated cost to secure $400 k |
| A-7 | Secure and manage Black John Slough | 1235 | 2 | Continuous | 1 | RE<br>Acq. | <br>CDFG* | | To be determined | | 344 hectares<br>Estimated cost to secure $1,200 k |
| A-7 | Secure and manage Petaluma Marsh North. | 1236 | 2 | Continuous | | | CDFG | | To be determined | | 412 hectares<br>Estimated cost to secure $1,300 k |
| A-7 | Secure and manage Lower and Upper Sonoma Creeks and Steamboat Slough. | 1241 | 2 | Continuous | | | CDFG | | To be determined | | 274 hectares |
| A-7 | Secure and manage Second and Third Napa Sloughs. | 1242 | 2 | Continuous | | | CDFG | | To be determined | | 103 hectares (Rail only) |
| A-7 | Secure and manage Hudeman Slough. | 1243 | 2 | Continuous | | | CDFG | | To be determined | | 157 hectares (Rail only) |
| A-7 | Secure and manage Island Number 1 and Island Number 2 | 1244 | 2 | Continuous | 1 | RE*<br>Acq. | <br>CDFG | | To be determined | | 2500 hectares |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A-7 | Secure and manage Skaggs Island | 1245 | 2 | Continuous | 1 | SE | Navy* | | To be determined | | 2312 hectares |
| A-7 | Secure and manage Coon Island-Fagan Slough. | 1246 | 2 | Continuous | | | CDFG | | To be determined | | 227 hectares |
| A-7 | Secure and manage Napa River. | 1247 | 2 | Continuous | | | CDFG | | To be determined | | 71 hectares |
| I-2 | Identify areas of essential mouse and rail habitat in the Suisun marsh. | 1251 | 2 | 2 | 1 | SE | CDFG<br>SCS* | | 1.0<br>5.0<br>5.0 | 1.0<br>5.0<br>5.0 | |
| A-7 | Secure and manage Martinez East. | 12521 | 2 | Continuous | | | CDFG | | To be determined | | 282 hectares |
| A-7 | Secure and manage Martinez West. | 12522 | 3 | Continuous | | | CDFG | | To be determined | | 42 hectares |
| A-7 | Secure and manage McAvoy | 12523 | 2 | Continuous | | SE | NAVY* | | To be determined | | 182 hectares |
| A-7 | Secure and manage Suisun Slough North. | 12524 | 2 | Continuous | | | CDFG | | To be determined | | 169 hectares |
| A-7 | Secure and manage Collinsville marsh. | 12525 | 3 | Continuous | 1 | SE | PG&E* | | To be determined | | 123 hectares |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Develop and implement a habitat management plan for essential mouse and rail habitat in the Suisun Marsh. | 1253 | 2 | Continuous | 1 | SE | | 2 | 2 | 2 | |
| | | | | | | | CDFG* | 5 | 5 | 5 | |
| | | | | | | | SCS | 3 | 3 | 3 | |
| A-7 | Identify priorities for securing essential marshes | 126 | 2 | 5 | 1 | SE* | | To be determined | | | |
| | | | | | | | CDFG | | | | |
| Reduce limiting factors | | | | | | | | | | | |
| M-3 | Enhance selected marshes on SFBNWR. | 21 | 1 | 5 | 1 | RE | | To be determined | | | To begin on salt pond areas when salt production ceases |
| M-7 | Reduce effects of industrial pollution at San Pablo and Wildcat Creeks. | 2211 | 1 | 5 | 1 | SE | | 1 | 1 | 1 | |
| | | | | | | | CDFG* | 1 | 1 | 1 | |
| | | | | | | | EBRPD | 3 | 3 | 3 | |
| M-7 | Reduce effects of industrial pollution at Point San Bruno. | 2212 | 2 | 5 | 1 | SE | | 1 | 1 | 1 | |
| | | | | | | RE | | 2 | 2 | 2 | |
| | | | | | | | CDFG* | 3 | 3 | 3 | |
| M-7 | Reduce effects of traffic noise at Hoffman Marsh. | 222 | 3 | 3 | 1 | SE | | 2 | 2 | 2 | |
| | | | | | | | Caltrans* | 3 | 3 | 3 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-7 | Reduce effects of human foot traffic at Emeryville Crescent. | 223 | 2 | 2 | 1 | SE | | 1 | 1 | 1 | |
| | | | | | | | CDFG* | 3 | 3 | 3 | |
| I-6 | Determine the causes of rail population fluctuations. | 231 | 2 | 5 | 1 | SE* | | 10 | 10 | 10 | |
| | | | | | | | CDFG | 10 | 10 | 10 | |
| I-12 | Evaluate the effects of pollutants, sedimentation, and freshwater fluctuations, on invertebrate prey of rails. | 232 | 2 | 3 | 1 | SE | | | 5 | 5 | |
| | | | | | | | CDFG* | | 10 | 10 | |
| I-14 | Identify and resolve management conflicts for rail and mouse populations in the Suisun Marsh. | 233 | 2 | 5 | 1 | SE | | 5 | 5 | 5 | |
| | | | | | | | CDFG* | 10 | 10 | 10 | |
| | | | | | | | SCS | 10 | 10 | 10 | |
| I-3 | Determine habitat preferences of the salt marsh harvest mouse and Calif.Clapper rail in tidal marshes. | 234 | 2 | 5 | 1 | SE* | | 10 | 10 | 10 | |
| | | | | | | | CDFG | 5 | 5 | 5 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I-3 | Determine habitat requirements of the salt marsh harvest mouse and California Clapper rail in brackish and non-tidal diked marshes. | 235 | 2 | 5 | 1 | SE | | 5 | 5 | 5 | |
| | | | | | | | CDFG* | 10 | 10 | 10 | |
| | | | | | | | SCS | 5 | 5 | 5 | |
| I-14 | Determine the effects of flood and mosquito control practices on the mouse and rail. | 236 | 2 | 5 | 1 | SE | | 5 | 5 | 5 | |
| | | | | | | | CDFG* | 5 | 5 | 5 | |
| Reestablish Rails at Humboldt Bay | | | | | | | | | | | |
| M-3 | Select areas for release of birds. | 31 | 2 | 2 | 1 | SE | | 3 | 3 | | |
| | | | | | | RE* | | 3 | 3 | | |
| | | | | | | | CDFG | 2 | 2 | | |
| M-3 | Prepare translocation sites. | 32 | 2 | 2 | 1 | SE | | | | | |
| | | | | | | | CDFG* | | 4 | 4 | |
| M-2 | Capture and translocate clapper rails to Humboldt Bay. | 33 | 2 | 5 | 1 | SE | | | 2 | 2 | |
| | | | | | | RE* | | | 3 | 3 | |
| | | | | | | | CDFG | | 3 | 3 | |
| M-7 | Establish a monitoring/ protection program. | 34 | 2 | 5 | 1 | SE | | | 2 | 2 | |
| | | | | | | Refuges* | | | 3 | 3 | |
| | | | | | | | CDFG | | 2 | 2 | |

| General Category | Plan Task | Task No. | Task Priority | Duration of Task (yrs.) | Responsible Agency FWS Region | FWS Program | Other | Fiscal Year Costs (Est.) (in $1,000's) 86 | 87 | 88 | Comments/Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| M-3 | Reestablish salt marsh harvest mouse populations in formerly occupied habitat. | 4 | 2 | 5 | 1 | SE | CDFG* | To be determined | | | |
| Public Education and Planning | | | | | | | | | | | |
| O-1 | Develop and implement a program of conservation education. | 5 | 3 | Continuous | 1 | SE | CDFG* | 1.0<br>10 | 1.0<br>10 | 1.0<br>10 | Coordinate with BCDC, EBRPD, COE, CC, and DPR |

# Appendix A

Figures 5-11. Essential Habitat Areas for the salt marsh harvest mouse and California clapper rail. Maps and descriptions of specific sites available upon request from Sacramento Endangered Species Office, 2800 Cottage Way, Sacramento, CA 95825

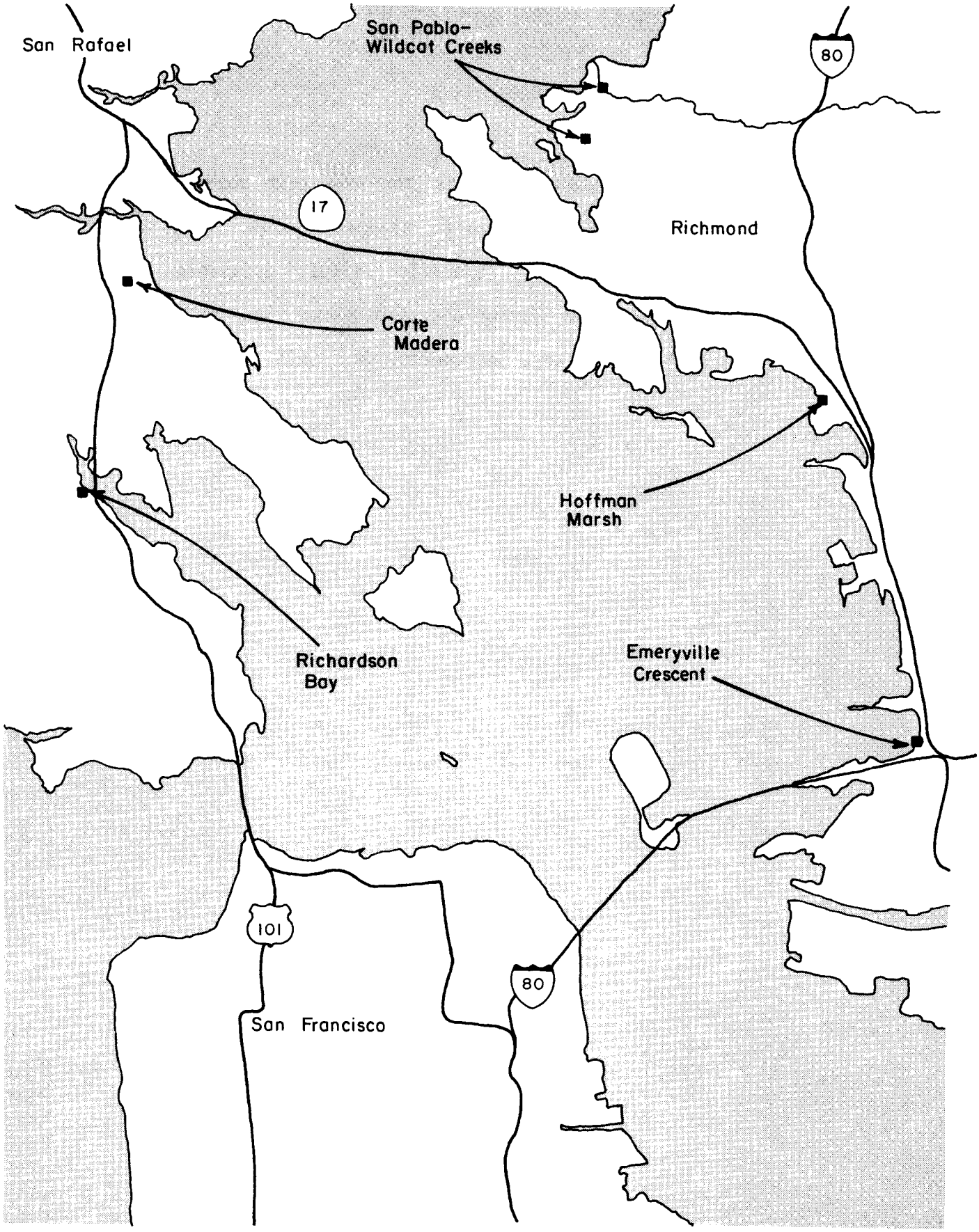


Figure 5. Essential habitat areas in Central San Francisco Bay.

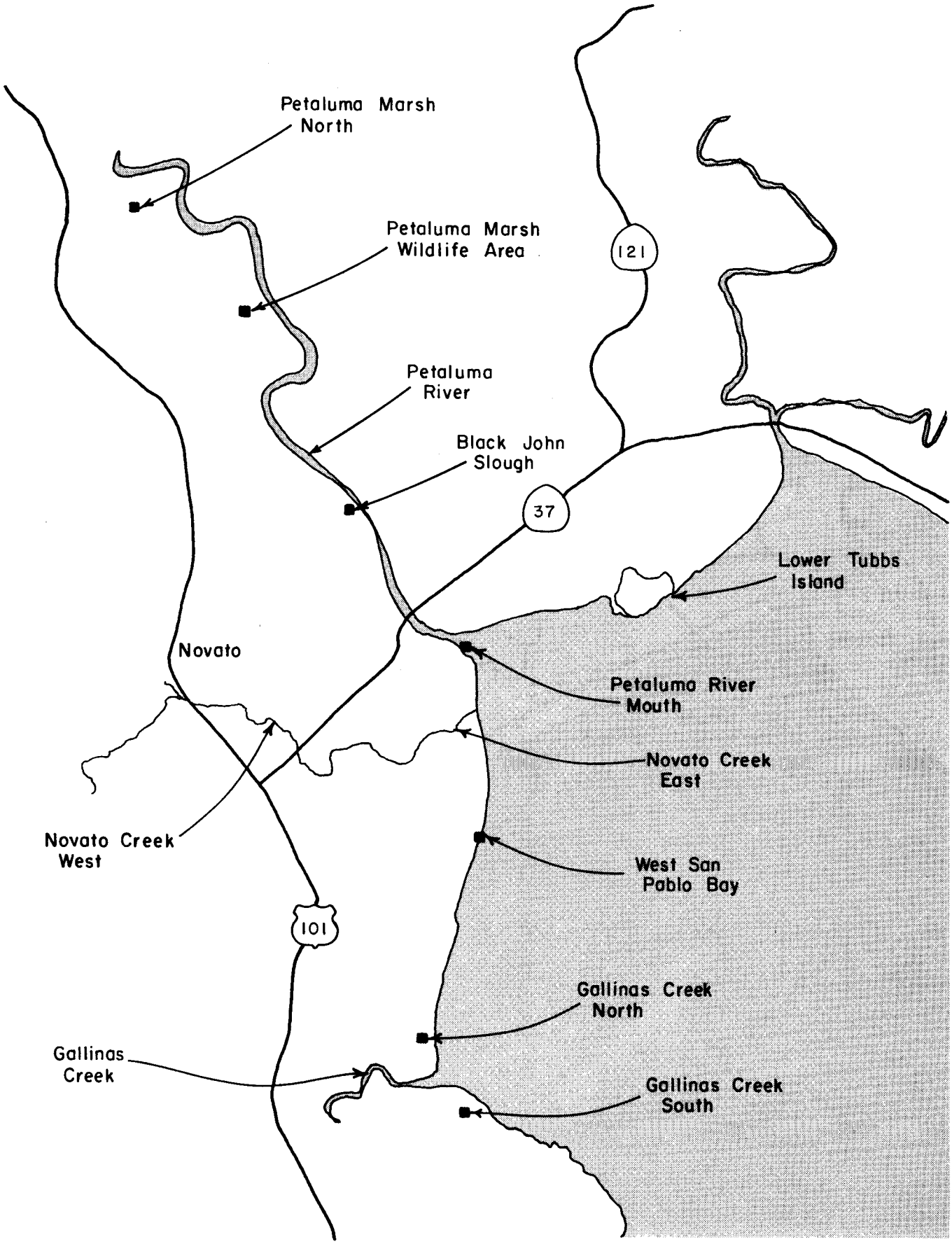


Figure 6. Essential habitat areas in western San Pablo Bay.

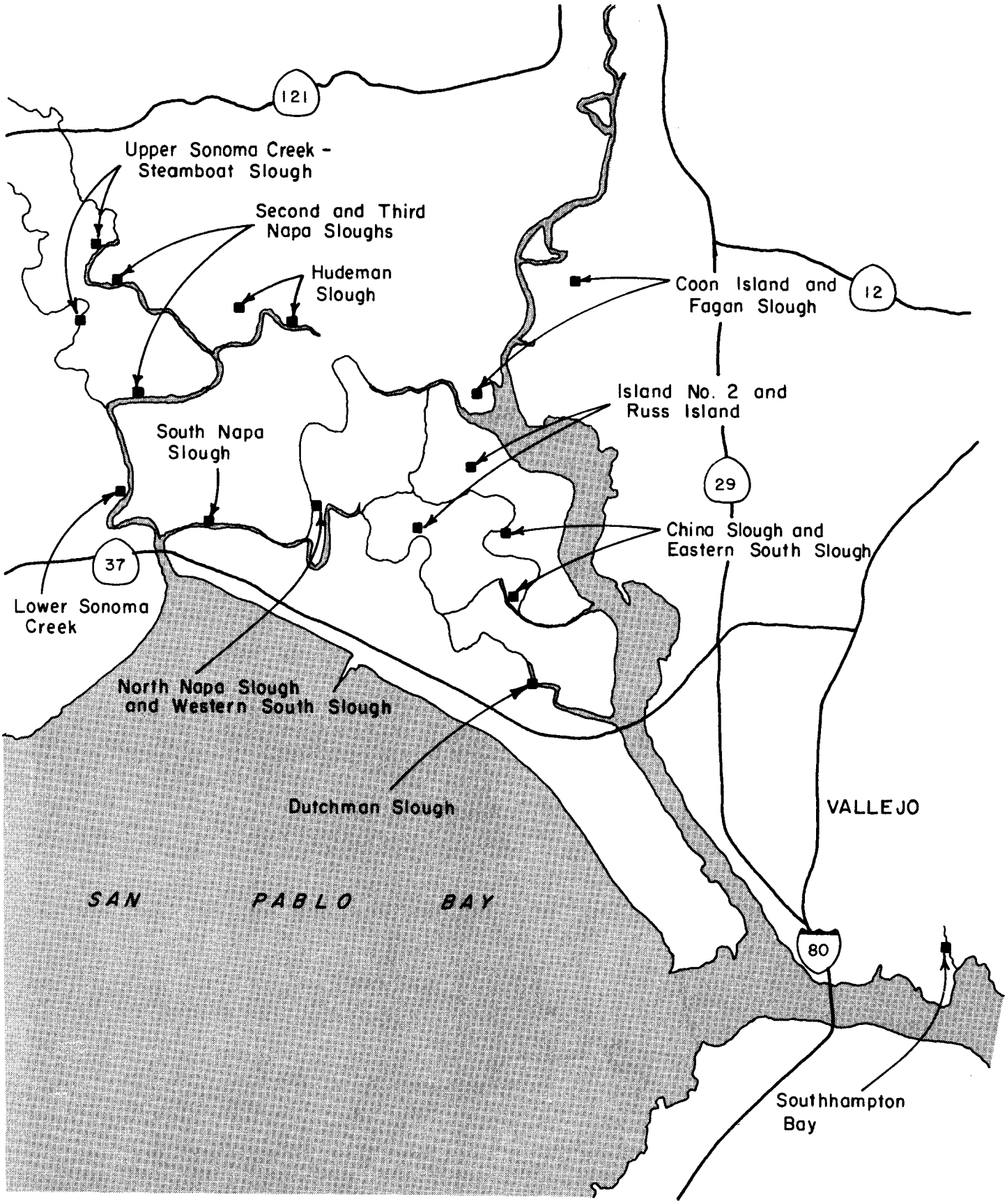


Figure 7. Essential habitat areas in eastern San Pablo Bay.

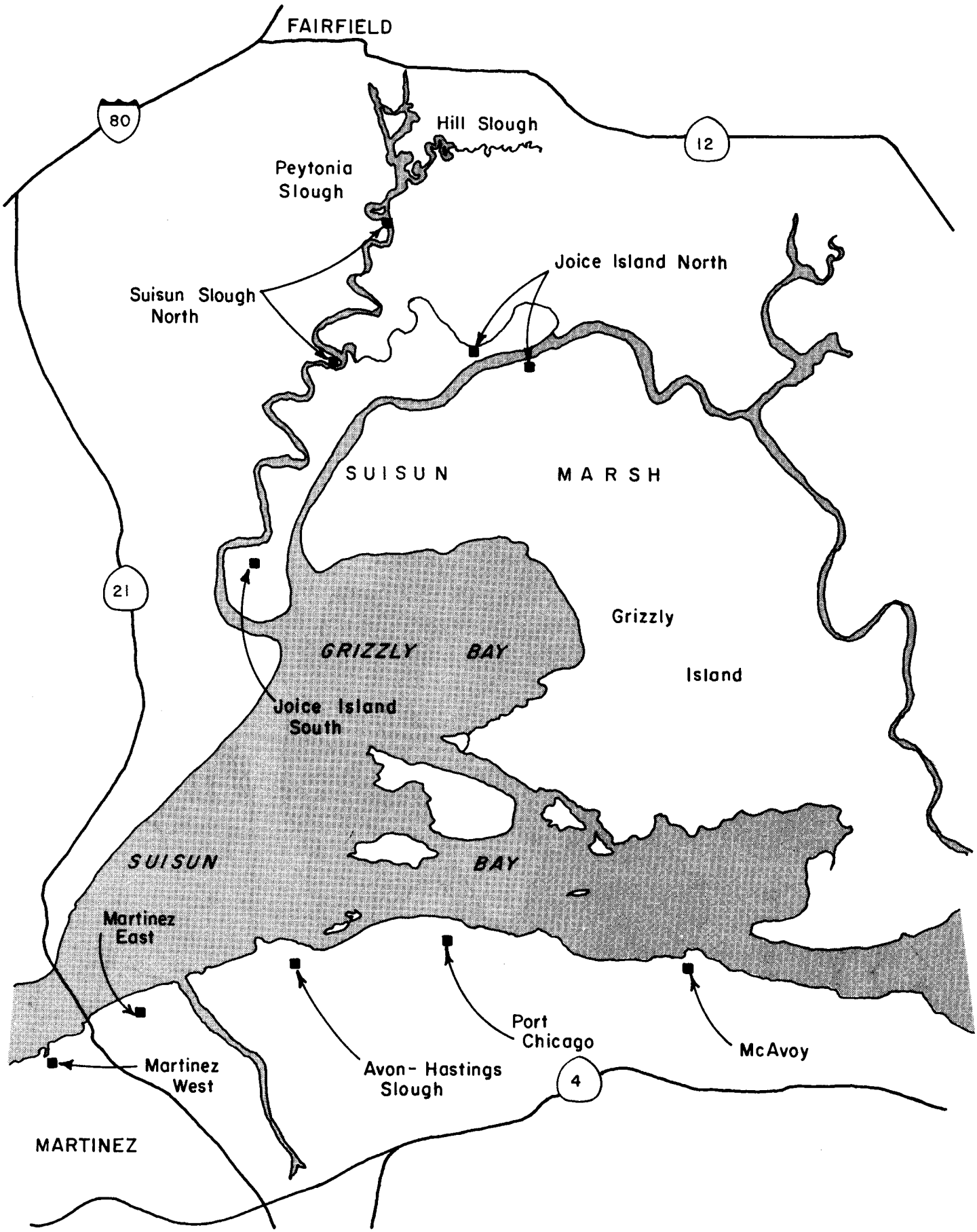


Figure 8. Essential habitat areas in Suisun Marsh west.

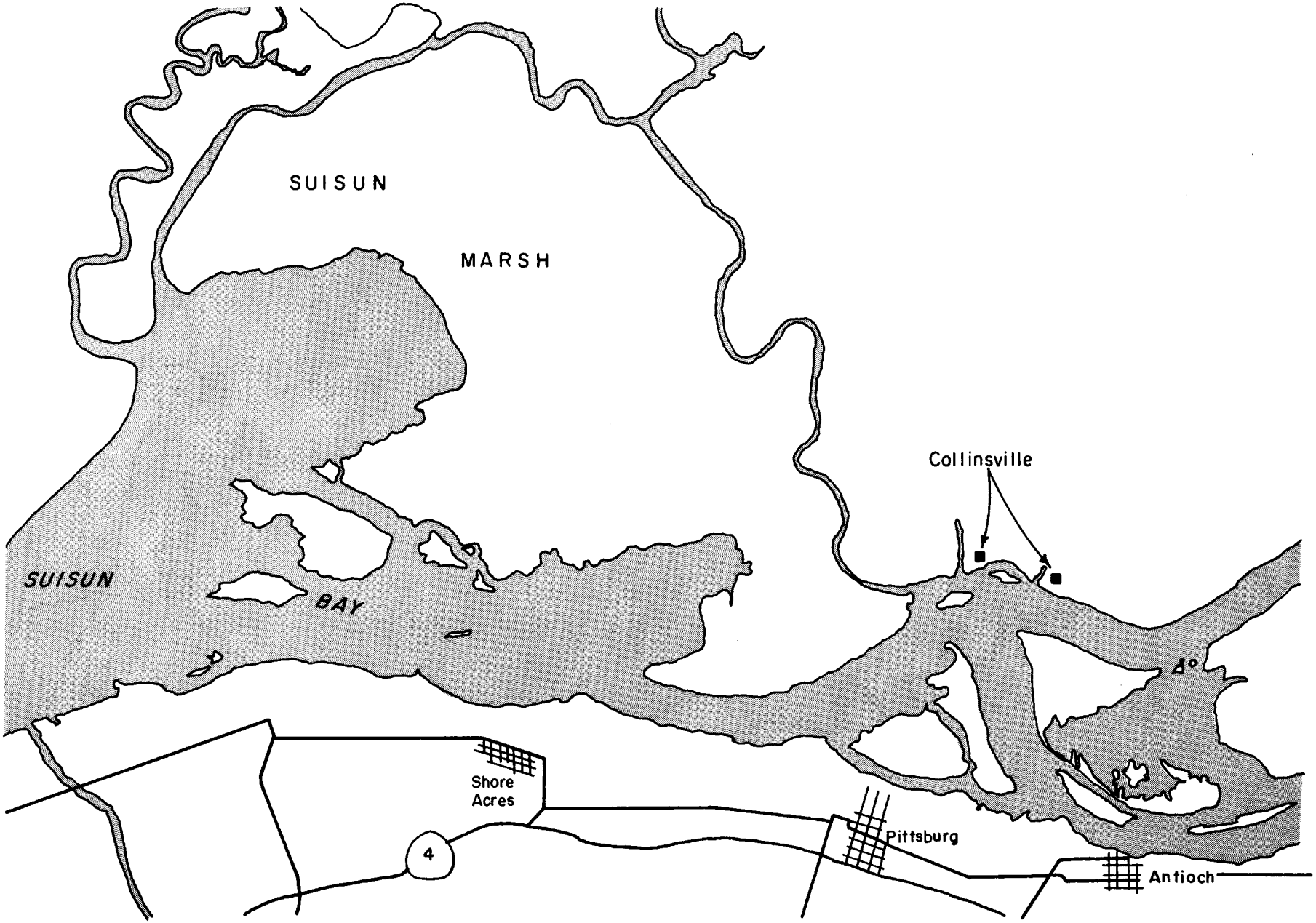


Figure 9. Essential habitat areas in Suisun Marsh east.

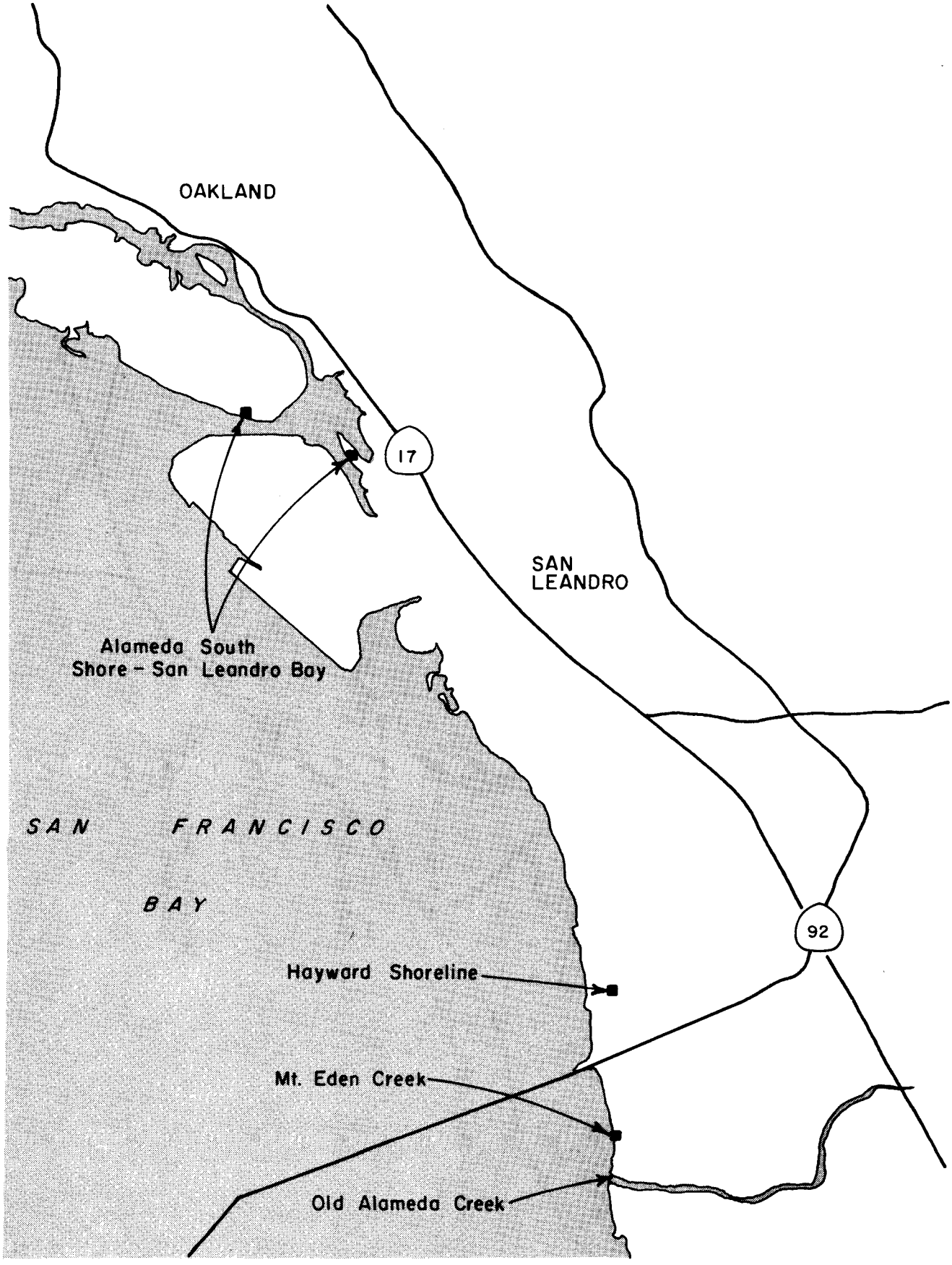


Figure 10. Essential habitat areas in western South San Francisco Bay.

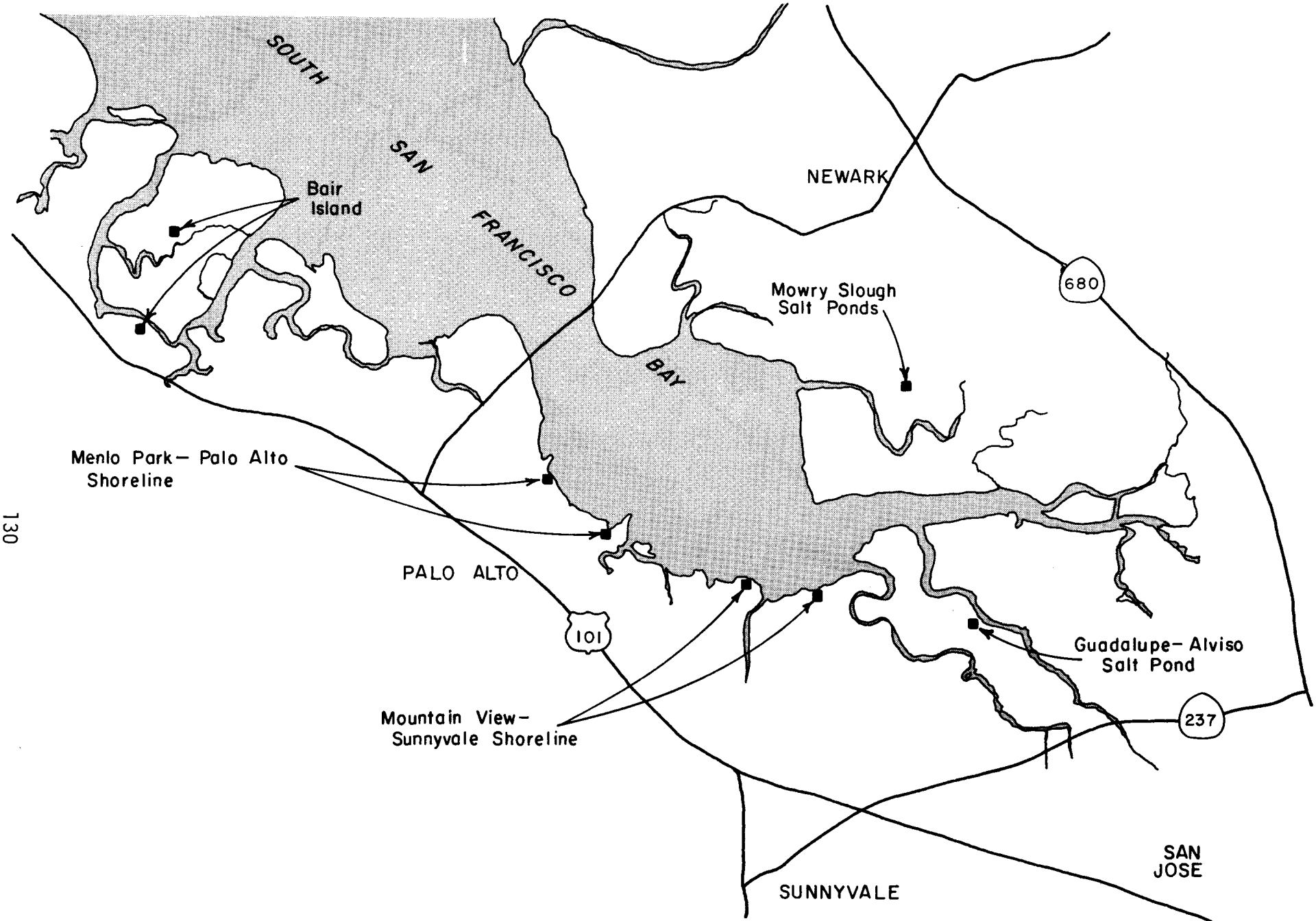


Figure 11. Essential habitat areas in South San Francisco Bay.

# Appendix B

## Marsh Management Guidelines

The characteristics of preferred habitat for salt marsh harvest mice are as follows: (1) Each area should have 100 percent cover. (2) Vegetation should have a depth of 30-50 cm at summer maximum. (3) A high percentage of pickleweed should be present. Areas conducive to denser populations of harvest mice range from 100 percent pickleweed down to 50 percent pickleweed with a variety of other halophytes, especially fat hen and alkali heath. Scirpus and Typha species do not reduce the quality of such habitat so long as they are not present in pure stands. (4) There should be no areas, or very few and small areas, of salt grass, brass buttons, alkali bulrush, other Scirpus species or Typha. Upland grasses are valuable as an upland edge but should not be dominant within the marsh. Such a situation is conducive to western rather than salt marsh harvest mice. (5) There should be no barriers of open ground or water dissecting the vegetation. Salt marsh harvest mice are extremely dependent on cover and open belts divide potentially large populations into smaller ones and decrease their chances of survival. (6) Each marsh area should be large. Connections between parts of a marsh supporting mice should be at least 20 m wide with 100 percent cover of optimum vegetation and have no barriers of open ground or water across them. A considerable portion of each marsh should be habitable throughout the year. The nature of the soil surface and the management practices should result

in at least 40 percent of the marsh being useable by salt marsh harvest mice in the winter (i.e., receiving little, if any, flooding). A majority of the marsh (80 percent or more) should be of optimum habitat in the summer. Each marsh should have a large edge of halophytes and possibly an adjoining and possibly interdigitating band of upland grasses. (7) The area should receive minimal disruptive manipulation and only that needed to provide and maintain mouse habitat. Freshwater flushing should be absent or minimized. Plowing, mowing and/or burning should not be allowed.

The following guidelines should be applied to all units of marsh given protection under this plan.

(1) Marshes should have an upper zone of peripheral halophytes where possible, provided, if necessary, by grading and planting of native plant species typical of that zone. Dredge spoils should not be deposited in the upper marsh zone unless approved as part of an improvement plan for that zone. Islands of higher elevations, and hence upper zone marsh vegetation, should be created within marshes where possible.

(2) Human impact on the upper zone of the marshes and adjacent upland vegetation should be minimized. Land filling, discing, grazing, and/or burning should be discouraged in upper marsh and adjacent upland vegetation. Placement of trails and roads should avoid upper marsh vegetation and minimize access to the marsh. Boardwalks should

be provided when access to marshes is intended and should be of a height sufficient to allow vegetation to thrive beneath them.

(3) Whenever possible, there should be a buffer zone of upland vegetation adjacent to the upper edge of each tidal marsh. Some of this buffer zone should exist between roads bordering the marsh and the upper zone of marsh vegetation.

(4) Restored tidal marshes should be large enough to allow tidal channels to develop and thus provide foraging habitat for rails. Narrow, strip marshes are not desireable except to connect adjacent larger parcels as corridors for rail and mouse movements.

(5) Restored tidal salt marshes should support the three zones of habitat typical of pristine bay marshes, including an upper zone of peripheral halophytes, a middle zone of dense pickleweed and a lower zone of cordgrass. Brackish tidal marshes should have high species diversity (plant and animal). Both types of marshes should have a wide, relatively undisturbed band of upland vegetation adjacent to their upper zone.

# Appendix C

## List of essential areas administered by State or local agencies or private organizations

The following 18 areas administered by Federal, State or local agencies or private organizations should be managed according to the guidelines in Appendix B.

| Areas Administered by DFG | Task # |
|---|---|
| San Pablo Bay State Wildlife Area (62 ha) | 11311 |
| Petaluma Marsh Wildlife Area (812 ha) | 11312 |
| Corte Madera Ecological Reserve (220 ha) | 11313 |
| Coon Island Ecological Reserve (101 ha) | 11314 |
| Fagan Marsh Ecological Ecological Reserve (134 ha) | 11315 |
| Point Edith Marsh (166 ha) | 11316 |
| Bair Island (Part) (400 ha) | 11332 |
| Elkhorn Slough Estuarine Sanctuary (323 ha) | 11331 |
| Subtotal 2,052 ha | |
| **Areas Administered by DPR** | |
| China Camp State Park (45 ha) | 1121 |
| Benecia State Recreation Area (68 ha) | 1122 |
| Subtotal 113 ha | |
| **Lands Under U.S. Navy Jurisdiction** | |
| Avon-Hastings Slough (338 ha) | 1141 |
| Port Chicago (Concord Naval Weapons Station) (111 ha) | 1142 |
| Subtotal 449 ha | |
| **Areas Under Other Jurisdictions** | |
| Alameda South Shore-San Leandro Bay (East Bay Regional Park District - EBRPD) (27 ha) | 1151 |
| Hayward Shoreline (EBRPD) (189 ha) | 1152 |
| Mountain View-Sunnyvale Shoreline (Cities of (San Jose, Sunnyvale, Mountain View and Palo Alto) (113 ha) | 1161 |
| Menlo Park-Palo Alto Shoreline (City of Palo Alto) (145 ha) | 1162 |
| San Leandro-Hayward Shoreline (Cities of San Leandro and Hayward) (240 ha) | 1163 |
| Elkhorn Slough Preserve (Nature Conservancy) (80 ha) | 117 |
| Subtotal 794 ha | |
| **Federal Refuges** | |
| San Francisco Bay National Wildlife Refuge 1,130 ha | 1111 |
| San Pablo Bay National Wildlife Refuge 1,130 ha | 1112 |
| Total 5,668 ha | |

Appendix D. Ownership and Estimated Acreage of Essential Habitat Areas[1]

| Essental Habitat | Government Lands | | Private Holdings | | Recovery Plan Task(s) | Total hectares | Comments |
|---|---|---|---|---|---|---|---|
| | Occupied habitat (ha) | Potential habitat (ha) | Occupied habitat (ha) | Potential habitat (ha) | | | |
| Richardson Bay | ? | ? | ? | ? | 1211 | 36 | Mouse habitat uncertain, current and potential rail habitat ownerships undetermined. |
| Corte Madera | 220 (R)* | | | 72 | 11313, 1211, 4 | 292 | 220 acre in CDFG ownership. |
| San Rafael Bayfront | | | 60(M)** | | 1211 | 60 | |
| Gallinas Creek South/ China Camp State Park | 45 | | 20 | | 1121, 1232 | 65 | 45 hectares in State Park ownership. |
| Gallinas Creek North | 16 | | 177 | | 1233 | 193 | 16 hectares in McInnis County Park. |
| San Pablo Bay State Wildlife area | 62 | | | | 11311 | 62 | CDFG ownership. |
| Novato Creek | | | 102 | | 1231 | 102 | All private. |
| Black John Slough | | | ? | 344 | 1235 | 344+ | All private. |
| Petaluma Marsh Wildlife Area | 812 | | | | 11312 | 812 | CDFG ownership. |
| Petaluma Marsh North | | | 412 | | 1236 | 412 | All private. |

Appendix D Ownership and Estimated Acreage of Essential Habitat Areas

| Essental Marsh | Government Lands | | Private Holdings | | Recovery Plan Task(s) | Total hectares | Comments |
|---|---|---|---|---|---|---|---|
| | Occupied habitat (ha) | Potential habitat (ha) | Occupied habitat (ha) | Potential habitat (ha) | | | |
| Petaluma River Mouth | 24 | | 92 | | 1234 | 116 | 24 hectares owned by CDFG. |
| Lower and Upper Sonoma Creeks-Steamboat Slough | | | 274 | | 1241 | 274 | All private. |
| Second and Third Napa Sloughs | | | 103(R) | | 1242 | 103 | All private. |
| Hudeman Slough | | | 157 | | 1243 | 157 | All private. |
| Island Number 1 and 2 | | | 425 | 2075 | 1244 | 2500 | All private. |
| Skaggs Island | 462 | 1850 | | | 1245 | 2312 | U.S. Navy. |
| Coon Island-Fagan Marsh | 235 | | 225 | | 1246, 11314, 11315 | 460 | 235 hectares owned by CDFG at Fagan Marsh and Coon Island. |
| Napa River | | | 514 | | 1247 | 514 | All private. |
| Benecia State Recreation Area | 68(R) | | | | 1122 | 68 | All in State Parks ownership. |
| Suisun Marsh | ? | ? | ? | ? | 132, 125 | ? | State and Private holdings. |
| Collinsville | | | 132(M) | | 1225 | 132 | Pacific Gas and Electric Co. land. |

Appendix D Ownership and Estimated Acreage of Essential Habitat Areas

| Essental Marsh | Government Lands | | Private Holdings | | Recovery Plan Task(s) | Total hectares | Comments |
|---|---|---|---|---|---|---|---|
| | Occupied habitat (ha) | Potential habitat (ha) | Occupied habitat (ha) | Potential habitat (ha) | | | |
| McAvoy | | | 182(M) | | 12523 | 182 | All private. |
| Port Chicago | 111(M) | | | | 1142 | 111 | U.S. Navy. |
| Avon-Hastings and Point Edith Marshes | 504(M) | | | | 11316, 1141 | 504 | 166 hectares CDFG owned marsh at Point Edith; 338 hectares U.S. Navy land. |
| Martinez East | 150(M) | | | | 12521 | 150 | State of California ownership. |
| Martinez West | | | 42(M) | | 12522 | 42 | All private. |
| San Pablo and Wildcat Creeks | | | 202 | | 1212 | 202 | All private. |
| Hoffman Marsh | | 14 | | | 1213 | 14 | Caltrans property. Status of species uncertain. |
| Emeryville Crescent | 51 | | | | 1214 | 51 | Ownership uncertain. |
| Alameda South Shore-San Leandro Bay | 27(R) | | | | 1161 | 27 | Administered or owned by East Bay Regional Parks. |
| Hayward Shoreline | 11(M) | 178 | | | 1152 | 189 | Administered or owned by East Bay Regional Park District. |

Appendix D Ownership and Estimated Acreage of Essential Habitat Areas

| Essental Marsh | Government Lands | | Private Holdings | | Recovery Plan Task(s) | Total hectares | Comments |
|---|---|---|---|---|---|---|---|
| | Occupied habitat (ha) | Potential habitat (ha) | Occupied habitat (ha) | Potential habitat (ha) | | | |
| San Leandro-Hayward Shoreline | 15(M) | 225 | | | 1163 | 240 | Cities of San Leandro and Hayward. |
| Mt. Eden-Old Alameda Creek | ? | ? | ? | ? | 1221 | 2800 | Some private lands Alameda Flood Control District. |
| Mowry Slough | | | | 1050 | 1222 | 1050 | Privately owned salt ponds. |
| Guadalupe-Alviso Salt Ponds | | 150 | | 460 | 1223 | 610 | 150 hectares owned by SFBNWR |
| Mountain View-Sunnyvale Shoreline | 43 | 70 | | | 1226 | 113 | City owned lands. |
| Menlo Park-Palo Alto shoreline | 145 | | | | 1162 | 145 | City owned lands. |
| Bair Island | 559 | | | 741 | 11332, 1111, 1224 | 1300 | 159 hectares SFBNWR, 400 hectares CDFG, some ownerships undetermined. |
| Point San Bruno | | | 9 | | 1225 | 9 | All private. |

Appendix D Ownership and Estimated Acreage of Essential Habitat Areas

| Essental Marsh | Government Lands | | Private Holdings | | | Recovery Plan Task(s) | | Total hectares | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | Occupied habitat (ha) | Potential habitat (ha) | Occupied habitat (ha) | Potential habitat (ha) | | | | | |
| Elkhorn Slough | 323(R) | | 80(R) | | | 11331, 117 | | 403 | 80 hectares owned by Nature Conservancy, 323 hectares owned by CDFG. |
| Total | 3883 | 2487 | 3208 | 4742 | (Subtotal) | 14320 ha | Grand Total | 17156 | 2836 hectares undetermined ownership. |

*(R) = rail habitat only
**(M) = mouse habitat only

1 This does not include estimates of occupied and potential habitat for these species on the San Francisco Bay and San Pablo Bay National Wildlife Refuges. Present estimates of tidal marsh for these two refuges is about 1130 hectares each.

# Appendix E

Agencies Requested to Provide Comments During Agency Review -

Director
CA Dept. of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

Association of Bay Area Governments
Hotel Clairemont
Berkeley, CA 94705

California Dept. of Transportation
Division of Transportation & Planning
1120 "N" Street
P.O. Box 1499
Sacramento, CA 95807

California Dept. of Water Resources
Central District
P.O. Box 388
Sacramento, CA 95802

Regional Director
U.S. Bureau of Reclamation
Federal Office Building
2800 Cottage Way
Sacramento, CA 95825

State of California Coastal Conservancy
1212 Broadway, Room 514
Oakland, CA 94612

Pacific Gas & Electric
Environmental Review Section
345 Mission Street
San Francisco, CA 94106

San Mateo County Planning Department
County Government Center
Redwood City, CA 97063

City of Mountain View
540 Castro Street
P.O. Box 10
Mountain View, CA 94042

The Nature Conservancy
California Field Office
156 2nd Street
San Francisco, CA 94105

San Francisco Bay Conservation and Development Commission
30 Van Ness
San Francisco, CA 94102

Natural Resource Management Branch
Department of the Navy
Naval Facilities Engineering Command
P.O. Box 727 - Code 243
San Bruno, CA 94066

East Bay Regional Park District
11500 Skyline Blvd.
Oakland, CA 94619

District Engineer
Army Corps of Engineers
211 Main Street
San Francisco, CA 94105

California Dept. of Parks and Recreation
P.O. Box 2390
Sacramento, CA 95811

Marin County Planning Department
Civic Center
San Rafael, CA 94903

City of San Jose
Planning Department
801 N. First Street
City Hall
San Jose, CA 95112

City of Corte Madera
Planning Department
P.O. Box 159
Corte Madera, CA 94925

Redwood City Planning Department
P.O. Box 391
Redwood City, CA 94064

City of Palo Alto
Planning Department
250 Hamilton Avenue
P.O. Box 10250
Palo Alto, CA 94393