Mr. Mendel Stewart  
Project Leader  
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San Francisco Bay National Wildlife Refuge Complex  
9500 Thornton Avenue  
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Subject: Formal Intra-Service Endangered Species Consultation on Implementation of the San Francisco Estuary Invasive Spartina Project: Spartina Control Program, as detailed in the 2008 - 2010 Invasive Spartina Control Plans

Dear Mr. Stewart:

This memorandum is in response to your request for Intra-U.S. Fish and Wildlife Service (Service) section 7 consultation on the proposed Invasive Spartina Control Plans for the San Francisco Estuary: 2008 - 2010 Control Seasons (proposed action). This document represents the Service’s biological opinion on the effects of the proposed action on the federally threatened delta smelt (Hypomesus transpacificus) and its critical habitat, endangered California clapper rail (Rallus longirostris obsoletus) (clapper rail), and endangered salt marsh harvest mouse (Reithrodontomys raviventris) (harvest mouse). This biological opinion is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

We have determined the proposed action is not likely to adversely affect the endangered California sea-blite (Suaeda californica) because this species is not present at the proposed treatment sites. The endangered California least tern (Sterna antillarum bairdii) is not likely to be adversely affected by the proposed action because Spartina eradication operations would not be located near nest sites or roosting sites and eradication operations would occur in marshlands and on exposed mudflats only during extreme low tides, when these areas do not have open water habitat available for foraging California least terns. The project proposes to avoid areas where the threatened Pacific coast population of the western snowy plover (Charadrius alexandrinus nivosus) may be nesting and treatment work will not be performed within 200 feet of an active snowy plover nest during the snowy plover breeding season, March 1 through September 14, as determined through surveys. Therefore, we have determined the proposed action is not likely to adversely affect the snowy plover. In areas where the endangered soft bird’s beak (Cordylanthus mollis spp. mollis) and Suisun thistle (Cirsium hydrophilum var. hydrophilum) are present, herbicide application will be restricted to those times of the year in which seed production will not be adversely affected. Therefore, we have determined the proposed action is not likely to
adversely affect these species. Any effects are likely to be wholly beneficial by opening areas where these plants could thrive during their next growing season.

This biological opinion is a tiered document under the 2003 Programmatic Formal Intra-Service Endangered Species Consultation on the San Francisco Estuary Invasive Spartina Project (PBO) (Service file number 1-1-03-F-0216), and is based on information provided in (1) “Invasive Spartina Control Plans for the San Francisco Estuary: 2008 to 2010 Control Seasons” (CCSC 2008); (2) the Service’s biological opinion for the San Francisco Estuary Invasive Spartina Project (ISP): Spartina Control Program, as detailed in the 2005 to 2007 Invasive Spartina Control Plans (Service file number 1-1-05-F-0243); (3) the “San Francisco Estuary Invasive Spartina Project: Spartina Control Program” Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR) and Addendum (CSCC 2003, 2005); (4) miscellaneous correspondence and electronic mail concerning the proposed action between representatives of the Service and the ISP; and (5) additional information available to the Service.

Due to the programmatic nature of the PBO, the project and site specific information necessary to determine the amount and extent of incidental take of listed species associated with individual ISP activities/actions was lacking. Therefore, it was determined that the Service would: a) initiate separate intra-Service section 7 consultations for those actions/activities which may affect listed species; and b) that future biological opinions that are tiered under the PBO would estimate, evaluate, and authorize the amount and extent of incidental take associated with project specific actions.

The Site Specific Plans (SSPs) for 2008 to 2010 were developed to provide the level of detail necessary to evaluate affects on each listed species and to quantify the amount and extent of incidental take associated with site-specific and cumulative actions, as required by the PBO. The SSPs identify listed species likely to be present at each site and specify measures necessary to avoid and minimize adverse effects on listed species, in compliance with the Best Management Practices and Mitigation Measures from the PEIS/EIR, and the Conservation Measures from the PBO.

Details of the control methods and impact analysis from the PEIS/EIR, and Addendum (CSCC 2003, 2005); the Programmatic Formal Intra-Service Biological Opinion (Service file number 1-1-03-F-0216); the Formal Intra-Service Biological Opinion on implementation of the San Francisco Estuary Invasive Spartina Project: Spartina Control Program for 2004 (Service file number 1-1-04-F-0305); and the Formal Intra-Service Biological Opinion on implementation of the Invasive Spartina Control Plans for the San Francisco Estuary, 2005-2007 Control Seasons (Service file number 1-1-05-F-0243) are incorporated by reference into this biological opinion.
CONSULTATION HISTORY


June 22, 2003: The Service added three listed plants to the consultation.

August 27, 2003: The Service issued the PBO.

September 2, 2004: The San Francisco Bay National Wildlife Refuge (Service) initiated formal intra-Service consultation on the ISP’s: Spartina Control Program, 2004 SSPs as required by the PBO.

September 7, 2004: The Service issued a biological opinion for the 2004 SSPs.

September 8, 2004: A Finding of No Significant Impact was signed by the Service for the 2004 SSPs.

August 15, 2005: The Service initiated formal intra-Service consultation on the work proposed for 2005-2007 with the SSPs.


April 2008: The Service received the proposed SSPs for 2008 to 2010 and formal intra-Service consultation was initiated.

BIOLOGICAL OPINION

Description of the Proposed Action

The Service and the California State Coastal Conservancy will implement the 2008 to 2010 Invasive Spartina Control Plans (CSCC 2008) for the proposed 24 sites throughout the San Francisco Estuary (Estuary) (Figure 1 in CCSC 2008). The purpose of this program is to arrest and reverse the spread of four species of non-native, invasive perennial cordgrass (Spartina alterniflora, S. anglica, S. densiflora, and S. patens) in the tidal marshlands and intertidal mudflats of the San Francisco Bay Estuary (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties) and to prevent the further degradation and loss of the natural ecological structure and function of the Estuary. Unless control is implemented, half of the existing intertidal mudflats are likely to be replaced with dense, invasive cordgrass marsh, and much of the native diverse salt marsh vegetation replaced with nearly single species stands of invasive non-native cordgrass within several decades. Details of
the program goals and approach for the proposed 2008 to 2010 control program follow below.

Project Background

The Estuary supports the largest and most ecologically important expanses of tidal mudflats and salt marshes in the contiguous western United States. This environment naturally supports a diverse array of native plants and animals. In recent decades, populations of non-native cordgrasses were introduced to the Estuary and began to spread rapidly. Though valuable in their native settings, these introduced cordgrasses are highly aggressive in this new environment, and frequently become the dominant plant species in areas they invade. One of the non-native cordgrass species, Atlantic smooth cordgrass (S. alterniflora), established large monocultural stands throughout the Estuary, particularly in South San Francisco Bay (South Bay). Atlantic smooth cord grass and its hybrids – formed when this species crosses with the native Pacific cord grass (S. foliosa) – continue to threaten the ecological balance of the Estuary. Based on a century of international studies of comparable cordgrass invasions, without diligent control, they are likely to eventually cause the extinction of Pacific cord grass, choke tidal creeks, dominate newly restored tidal marshes, and displace thousands of acres of existing shorebird habitat. Once established in this estuary, invasive cordgrasses could rapidly spread to other estuaries along the California coast through seed dispersal on the tides. As of 2008, the SSPs address approximately 200 net acres of non-native Spartina within 23,250 acres of tidal marsh at 24 sites within the Estuary.

The Spartina Control Program (SCP) is the action arm of the ISP. The California Coastal Conservancy initiated the ISP in 2000 to stave off the invasion of non-native cord grass and its potential effects. The ISP is a regionally coordinated effort of Federal, State, and local agencies, private landowners, and other interested parties. The geographic focus of the ISP includes nearly 40,000 acres of tidal marsh and 29,000 acres of tidal flats on the shores of nine San Francisco Bay Area counties.

The current request is for a formal intra-Service section 7 consultation on the “2008 to 2010 Invasive Spartina Control Plans” to address the following elements of the ISP’s Spartina Control Program:

1. Broadening the scope of the 2008-2010 SSPs to include two new sites (White Slough/Napa River and San Pablo Bay NWR/Mare Island) in the North San Francisco Bay for a total of 24 sites;

2. Implementing a three-year control program, including the final stages of phased treatment on three of the 24 sites;

3. Incorporating ground-based treatment activities in clapper rail-occupied habitat beginning on May 1 of each year for S. densiflora-invaded sites and on June 1 of each year for sites with all other cordgrass species;
4. Incorporating *Spartina* inventory and treatment efficacy monitoring components in clapper rail-occupied habitat beginning on May 1 of each year for *S. densiflora*-invaded sites and on June 1 of each year for sites with all other cordgrass species and;

5. Expanding a revegetation component of the program, involving broadcasting a native plant seed mixture which may include *Grindelia* spp., *Sarcocornia* spp., *Distichlis* spp. or other tidal marsh plants in seven sub-areas to minimize effects to rails due to loss of habitat caused by cordgrass control activities.

The 24 Sites included in the 2008-2010 SSPs are located in all Sub-Regions of the Estuary as defined in the Baylands Ecosystem Habitat Goals (Goals Project 1999), except the South Bay which is further divided into a northern and southern section due to differences in invasive cordgrass infestation.

**Suisun Bay:** Southampton Marsh in Solano County (Site 11) is a 175-acre site. A total of 0.1 acre of *Spartina* will be controlled in this site, which is less than 0.01% of the total marsh acreage of the site and a negligible amount of the Suisun Bay Sub-Region acreage.

**North Bay:** Point Pinole Regional Shoreline (Site 10) and Two Points Complex (Site 22) in Contra Costa County, Petaluma River (Site 24) in Marin and Sonoma Counties, and North San Pablo Bay (Site 26) in Napa and Solano Counties. A total of 5.0 acres of *Spartina* will be controlled, which is less than 0.01% of the total marsh acreage of the sites and a negligible amount of the North Bay Sub-Region acreage.

**Central Bay:** Blackie’s Pasture (Site 3), Corte Madera Creek Complex (Site 4), Pickleweed Park (Site 9), and Marin Outliers (Site-23) in Marin County; Emeryville Crescent (Site 6), and Alameda/San Leandro Bay Complex (Site 17) in Alameda County; Southeast San Francisco (Site 12), Colma Creek/San Bruno Marsh Complex (Site 18), and West San Francisco Complex (Site 19) in San Mateo County. Approximately 75.0 acres of *Spartina* will be controlled, which is 5.1% of the total acreage of the sites and of the tidal marshes in the Central Bay Sub-Region.

**Northern South Bay:** Alameda Flood Control Channel (Site 1), Oro Loma Marsh (Site 7), Whale’s Tail Complex (Site 13), San Leandro/Hayward Shoreline Complex (Site 20), and Ideal Marsh (Site 21) in Alameda County; and Bair/Greco Complex (Site 2) in San Mateo County. Approximately 106.0 acres of *Spartina* will be controlled, which is less than 1.6% of the total acreage of the sites and of the tidal marshes in the north part of the South Bay.

**Southern South Bay:** Coyote Creek/Mowry Complex (Site 5) in Alameda County; Palo Alto Baylands (Site 8) and South Bay Marshes (Site 15) in Santa Clara County; and Cooley Landing Salt Pond Restoration (Site 16) in San Mateo County. Approximately 17.1 acres of *Spartina* will be controlled, which is 0.3% of the total acreage of the sites and of the tidal marshes in the south part of the South Bay.
2008-2010 Invasive Spartina Control Program: Goals and Implementation Strategy

It is the ISP’s goal to initiate treatment at all 24 sites in the Estuary with known cordgrass infestations in 2008. The SSPs include a separate plan for each of the 24 project sites. Site-specific effects and conservation measures are detailed in Attachment 2 of the 2008-1010 SSPs. Additional SSP details are outlined below.

Implementation of invasive cordgrass control at each site/sub-area will be consistent with the Invasive Spartina Project’s Integrated Vegetation Management (IVM strategy), focusing on retreatment of cordgrass treated in 2007, preventing spread of non-native cordgrass to un-infested locations, removing cordgrass from newly infested locations, and reducing spread of pollen and seed. In addition to accomplishing effective cordgrass control in the Estuary, the ISP will accomplish a number of other important objectives, including:

1. Continuing research on effectiveness of specific control methods,

2. Providing assistance to local agencies currently dealing with cordgrass control for flood control,

3. Acquiring water quality and fate and transport data for herbicides, and

4. Coordinating with and supporting other important research and monitoring efforts (e.g., clapper rail radio telemetry).

Applying the Control Program’s IVM strategy, the SCP will conduct the 2008-2010 cordgrass control according to the following approach.

The overall strategy for the 2008-2010 Spartina Control Seasons is to comprehensively treat all known infestations of non-native Spartina in the Estuary and along the outer Pacific Coast. Based on observed efficacies of treated stands over the last four years of control work, the estimated 200 net acres of non-native Spartina in 2008, would be reduced to under 75 net acres in 2009, and under 30 net acres in 2010. Only during the 2008 Control Season will some sites be ‘phased’ to minimized short-term effects to the clapper rail as a result of vegetation removal. In both 2009 and 2010, all stands will be fully treated, aiming for eradication of all stands.

The exception to comprehensive treatment will be on marshes where a dilute solution of imazapyr herbicide is used in a ‘chemical mow’ application. In this type of application, the intent is to apply a sufficient amount of herbicide to curtail further development of the plant, but not kill the plant altogether. Typically, this type of application is done early in the growing season, before the plants have begun to flower. The benefit of this method is that it significantly decreases the amount of viable seed produced by the target plants, while leaving the vegetative structure of the plants intact within the marsh. This treatment method will only be used where
high densities of clapper rail intersect with dense remnant stands of non-native *Spartina*. Chemical mow techniques will only be used during the 2008 Control Season.

Comprehensive treatment will include all methods used in the previous seasons. For herbicide-based applications, this includes broadcast and targeted aerial applications via helicopter, and ground-based treatment via boats, trucks and backpacks in all 168 sub-areas. Approximately 35 sub-areas will require the use of tracked amphibious vehicles working within the marsh to accomplish treatment. Manual control methods will include digging and covering with geotextile fabric. The majority of the treatments will involve herbicide, until such a time as the individual infestations at specific sites are small enough and localized enough to warrant manual treatments.

**Timing of Control Work**

The initiation of treatment at the sites will be timed each year according to the treatment method, presence or negative finding of clapper rail (as required through Service consultation), life history stage of the target *Spartina* stands, tidal windows, and weather conditions. In general, treatments will begin as soon as the plants have produced sufficient above-ground vegetative material to absorb and translocate applied herbicide, when the tides are low or receding, and the weather is clear and the wind is below 10 mph.

Generally, herbicide treatment of *Spartina* can be effective from June through the beginning of October of each year (an exception is with *S. densiflora*, where treatments may be more appropriate in May, and which sets seed in July.). Within that time period, the optimal treatment conditions are from June through August, when the plants are not yet in flower, tidal windows are larger and more numerous, and the weather conditions are typically excellent for treatment. By the end of August, most of the non-native *Spartina* stands are in full flower, and are less susceptible to treatments via herbicide. September and October are ‘second tier’ timing windows, which are suitable only when pre-September treatments were unable to occur. Manual treatments can be effective at any time of the year.

**Inventory Monitoring and Treatment Monitoring**

Two types of control-related monitoring will occur as part of the ISP: inventory monitoring and treatment efficacy monitoring. Monitoring methods follow guidelines established by the San Francisco Estuary Institute and the ISP (Collins *et al.* 2001), but were modified as reported by Zaremba and McGowan (2004) in “San Francisco Estuary Invasive *Spartina* Monitoring Report for 2003.”

Inventory monitoring is conducted on an Estuary-wide scale, on all 168 sub-areas, as often as once per year, to assess the current distribution and acreage of invasive cordgrass. All cordgrass infestations are mapped and described. This information allows the ISP to assess the current cordgrass invasion and to adjust control strategies, as necessary to increase effectiveness of the
program. Inventory methods are dependant upon the extent and acreage of Spartina invasion within a marsh.

Inventory monitoring must be conducted between mid-summer and late fall, when plants are at full growth, and ideally it is conducted sufficiently early in the season to provide the most up-to-date information to the Control Program. A marsh containing isolated clones is usually mapped by two observers entering the marsh and walking around the perimeter of each clone with a global positioning system (GPS) unit, recording clones as points or polygons. The infestation in a heavily infested marsh may be quantified by estimating percent cover of Spartina in the marsh. Narrow or linear marshes are usually mapped by an observer on a levee, using off-set GPS recording to record infestations.

In addition to field collected data, aerial photo interpretation has been used to interpret larger infestations. In the aerial photo interpretation method, color infrared photos are taken at 1:6000 scale at low tide during late summer or early fall, when the Spartina is at peak growth. From the photo, Spartina infested polygons within the marsh are digitized and given a cover class. In this way the Spartina acreage in a heavily infested marsh may be estimated without accessing the marsh during rail breeding season. Ground-truthing of these areas is conducted outside the rail breeding season. This method, however, has very limited utility for the 2008-2010 growing seasons. Due to the scattered, remnant patches of Spartina within large marsh areas, many stands showing sub-lethal growth stunting, aerial photo interpretation is insufficient to determine plant locations. Almost all inventory mapping in 2008 and beyond will be done via ground-based GPS surveys. The exception will be the use of helicopters to survey particularly inaccessible marsh areas.

The ISP collects plant samples for genetic analysis to confirm species identification at each of the inventory monitoring sites, and at additional sites as requested by concerned landowners or managers. Species identification is confirmed by sampling at least 3-5 plants per site. In sites dominated by difficult to identify hybrids, transects may be run for the length of the marsh, with samples taken at 10-meter intervals. Genetic monitoring employs sampling strategies and analysis described by Zaremba and McGowan (2004).

Treatment monitoring is conducted to assess efficacy of different control methods in marshes. One transect is established pre-treatment in a sub-area and monitored once each year in subsequent years post-treatment. Monitoring must be conducted in the summer, as early as June 1, or before annual cordgrass treatment occurs. The ISP will monitor 55 sub-areas for treatment efficacy in 2008-2010. Transects are normally established along the length of linear marshes such as flood control channels, and across the width of larger marshes (from high marsh to bay edge) to capture the range of marsh elevations. Thirty random points are chosen along the length of the transect. Two observers enter the marsh and sample vegetation at each point, using a ¼ meter quadrat. Vegetation characteristics recorded include relative cover of all plant species and bare ground, stem density of invasive cordgrass, and cover height. Sampling at each point takes 2 to 5 minutes. A maximum of two hours is required to complete sampling on a transect.
Revegetation Activities

Revegetation activities will be conducted in at least seven sub-areas that have previously been subject to the “phased approach” of cordgrass eradication (sub-areas 17a, 17c, 17d, 17h, 20m, 20n, 20o), as well as any other sites where native plant recruitment may accelerate vegetative recolonization of treated marshes. The basic purpose of the revegetation in treated marshes will be to minimize, to the extent feasible, short-term loss of carrying capacity for the endangered clapper rail inhabiting existing invasive cordgrass marshes proposed for eradication. Revegetation will be done both pre- and post-treatment, depending on the amount of invasive Spartina and other native cover available within a sub-area. Plantings will be targeted for the late fall or early winter of each year, when winter rains are still likely, to increase the survival rate of transplanted Grindelia, Sarcocornia, Distichlis, JAumea or other plants.

Two types of salt marsh structure at treatment sites are most suitable for habitat-compensating revegetation with high or mid-marsh species during the first growing season after cordgrass treatment: 1) pickleweed-dominated marsh plains with tidal creek beds and banks invaded cordgrass, but with channel banks devoid or deficient in gumplant or 2) accreted cordgrass-dominated fringing marsh persisting at creek banks or prograded marsh plains at upper intertidal elevation suitable for gumplant and tall form pickleweed.

Given these opportunities, we are proposing two potential strategies for re-vegetation:

1. **Plantings**: Plantings will occur on existing channel-banks, with native dominated high salt marsh species such as pickleweed and gumplant. “Transplant patches” along channels will be approximately 10 meters long. Gumplant shrubs or pickleweed plugs will be planted at intervals of 0.5 to 1.0 meters along the transects. Teams of 3 to 5 people will conduct the plantings, which are expected to take less than one hour per Transplant Patch.

2. **Broadcast seeding**: Seeds of various tidal salt marsh plant species will be collected from selected stands where there is negligible chance for contamination by non-native plants. Collected seeds are dried and winnowed to remove non-seed chaff, then packaged for dispersal. Seeds will be dispersed via hand broadcast or via helicopter using seed hoppers to introduce seed into marsh areas otherwise inaccessible to ground-based dispersal methods.

**Action Area**

The Action Area as described in the PEIS/EIR and the Service’s PBO is hereby incorporated by reference. Although two new sites were included in the North San Pablo Bay (sites 26a and 26b), they are still located within the action area as described in the PBO.
Conservation Measures

The Service proposes to implement the Conservation Measures for the harvest mouse, clapper rail, and delta smelt that are contained in the PBO and the PEIS/EIR.

Conservation Measures Specific to Ground-based Spartina Treatment

To reduce adverse effects on listed species from Spartina treatment activities, the Service proposes the following measures:

1. In areas where soft bird’s beak and Suisun thistle are present, herbicide application will be restricted to those times of the year in which seed production will not be adversely affected.

2. Crews conducting treatment activities must follow the attached “Walking in the Marsh” guidelines (Attachment A) to avoid high pickleweed cover and wrack where harvest mice are likely to nest or find cover.

3. When possible, ground-based treatment activities will occur outside of the clapper rail breeding season (September 1 – January 31).

4. If ground-based treatment must occur during the clapper rail breeding season, call counts will be conducted to determine rail locations and rail territories. Treatment may also occur if the marsh is determined to be unsuitable rail breeding habitat by a qualified biologist. If rails are present, crews must follow the attached “Walking in the Marsh” guidelines (Attachment A), to minimize disturbance to clapper rails and their nests.

5. If breeding clapper rails are determined to be present in a marsh, crews conducting ground-based treatment will be required to minimize the amount of time spent within 700 feet of an identified rail calling center.

6. If the intervening distance across a major slough channel or across a substantial physical barrier between the rail calling center and the proposed treatment area is greater than 200 feet, then control may proceed.

7. If aerial treatment must occur within the clapper rail breeding season, a Service-approved biologist will be on-site to monitor aerial control activities. If any unanticipated nest abandonment is detected during control, activities will be altered to avoid further disturbance to rails.

8. Ground-based treatment requiring use of tracked amphibious vehicles in clapper rail and harvest mouse habitat (35 marshes as described in the Description of the Proposed Action in this biological opinion) will be minimized. Alternate treatment methods, both aerial
and ground-based, will be used whenever feasible.

9. When tracked amphibious vehicles are used in the marsh plain, direct treatment from the vehicle (driving around the marsh to target areas and spraying from the vehicle) will be minimized. Wherever possible, the vehicle will be centrally located and used as a base for hose-based treatment or for applicators equipped with backpacks radiating out from the vehicle.

10. Amphibious vehicles operating within target marshes will travel on unvegetated portions of the marsh whenever possible (mudflats, open areas, wrack rafts, etc.). Travel in stands of tall vegetation where visibility is limited will be minimized.

11. Pre-treatment site monitoring data will be used to inform all treatment crews operating within the marsh. GPS-mapped *Spartina* locations will be provided to treatment crews to minimize the search footprint during tracked amphibious vehicle-based treatment work.

12. Clapper rail biologists trained in rail habitat identification will inform treatment activities, either by being physically onsite during treatment work or through pre-treatment site-specific consultation.

*Conservation Measures Specific to Revegetation Activities*

In order to ensure that revegetation activities cause as little disturbance to listed species as possible, the Service proposes the following additional conservation measures:

1. A trained biologist will supervise all planting activities and access into the marsh.

2. The revegetation and ditching activities will be done outside the breeding season of the clapper rail.

3. Foot and mechanized travel though the marsh will be minimized.

4. For any ditching activities that may occur, a biologist will walk ahead of the ditching machine to ensure that rails are not present in the path of the machine.

5. All crews will follow the biologist through the marsh to the planting areas along a predetermined route.

6. The biologist will escort each crew member to their planting area and will direct crews not to wander out of their designated area.

7. When digging holes for planting, effects to existing native vegetation should be minimized.
8. Activities will not occur during extreme high tides, when the marsh plain is inundated, because protective cover for rails is limited and crew activities could prevent rails from reaching available cover.

Conservation Measures Specific to Inventory and Treatment Monitoring Activities

The following conservation measures will be implemented in order to ensure that inventory and treatment monitoring activities result in minimal disturbance to listed species:

1. Prior to beginning monitoring the prior year’s site map should be examined and a route should be determined which would minimize the amount of foot traffic in the marsh and maximize the use of existing roads, trails, and boardwalks.

2. If Inventory Monitoring will be conducted during the rail breeding season in rail occupied marshes, biologists conducting Treatment Monitoring must follow protection measures outlined in the attached “Walking in the Marsh” guidelines (Attachment A).

3. If rail nests are encountered along a transect, the observers will immediately leave the vicinity of the nest.

4. If rail adults are encountered, observers will move away from the birds if they are giving alarm calls or otherwise appear alarmed.

5. A biologist trained and familiar with clapper rails and their nests would conduct monitoring surveys.

Status of Species and Environmental Baseline

The ISP prepared a comprehensive “Site Plan Matrix” which summarizes presence/absence of listed species for each of the 24 sites covered in the 2008-2010 SSPs, effects and conservation measures for each of the 24 sites. The matrix gives the following information for each control site (and the Sub-areas of each site): site name, location, listed species present, and effects determination for each species. Many sites are further broken down into Sub-area to facilitate control planning and implementation due to differences in proposed control methods between sub-areas.

Delta Smelt

Delta smelt are small, short-lived estuarine fish that migrate between shallow freshwater stream habitats in which they spawn, and brackish reaches of the San Francisco Bay Estuary. Delta smelt also spawn at the terminal ends of tidal creeks in fresh-brackish tidal marshes. Downstream habitat is primarily limited to intertidal and subtidal habitats of Suisun Bay and its
tidal marshes, but they also occur in the northern reaches of San Pablo Bay, particularly during and after heavy freshwater flows. They may persist in tributaries of San Pablo Bay during periods of reduced salinity. Their abundance in the estuary is variable, and appears to be related to both Delta outflows and food supplied by plankton production.

Delta Smelt Critical Habitat

Critical habitat for the delta smelt is bounded and contained within the legal definition of the Sacramento-San Joaquin Delta. Delta smelt and its critical habitat occur in three of the 24 sites covered under the 2008-2010 SSPs. However, only two sites are scheduled for treatment under the 2008-2010 SSPs. These sites include Site 11 at Southampton Marsh in Contra Costa County and Site 26 (Sub-areas 26a and 26b) at the White Slough/Napa River and San Pablo Bay National Wildlife Refuge Shoreline in Solano and Napa Counties.

California Clapper Rail

The clapper rail was listed as endangered primarily as a result of habitat loss. The factors described above have contributed to the more recent population reduction, which has occurred since the mid-1980s. Although Gill (1979) may have overestimated the total clapper rail population in the mid-1970s at 4,200 to 5,900 birds, surveys conducted by the California Department of Fish and Game (CDFG) and the Service estimated that the clapper rail population approximated 1,500 birds in the mid-1980s (Harvey 1988). In 1988, the total rail population was estimated to be 700 individuals, with 400 to 500 rails in South San Francisco Bay (South Bay) (Foerster 1989). The total rail population reached an estimated all-time historical low of about 500 birds in 1991, with about 300 rails in South Bay (Service unpubl. data). In response to predator management, the South Bay rail population rebounded from this lowest population estimate to an estimated 650 to 700 individuals in 1997-98 (Service unpubl. data). Subsequently, the South Bay population declined again the following year to about 500 individuals and remained at that level through early 2002 (Service unpubl. data). However, the South Bay population declined further in 2002-2003 and is now estimated to be 400-500 individuals (Service unpubl. data), which represents the lowest estimated population level in this area since the late 1980’s and early 1990’s. A conservative estimate of the north San Francisco, San Pablo, and Suisun bay population was 195 to 282 pairs based on a synoptic survey conducted in 1992-93 (Collins et al. 1994). Since then, several population centers in San Pablo Bay have declined precipitously. The population in the White Slough tidal marshes on the west side of the Napa River declined from an estimated 16-23 pairs as recent as 2000 to an estimated 2-5 pairs in 2002, while the population in the Sonoma Creek marshes declined from 13 pairs in 1992 to 0-1 pair in 2000 (Avocet Research Associates 2003). Although recent survey data are lacking for other marshes within San Pablo Bay, these areas also may have declined. As a result of declines in areas within San Pablo and San Francisco bays, the overall population may be at its lowest recorded level reached previously during the late 1980’s and early 1990’s. Although many factors are at work, predation by native and non-native predators, in conjunction with historic habitat loss and fragmentation are the current known primary threats. With historic populations
at Humboldt Bay, Elkhorn Slough, and Morro Bay now extirpated, the Estuary represents the last stronghold and breeding population of this subspecies.

An estimated 40,191 acres of tidal marshes remained in 1988 of the 189,931 acres of tidal marsh that historically occurred in the Estuary; this represents a 79 percent reduction from historical conditions (Goals Project 1999). Furthermore, a number of factors influencing remaining tidal marshes limit their habitat values for clapper rails. Much of the east San Francisco Bay shoreline from San Leandro to Dumbarton Bridge is rapidly eroding, and many marshes along this shoreline could lose their clapper rail populations in the future, if they have not already. In addition, an estimated 600 acres of former salt marsh along Coyote Creek, Alviso Slough, and Guadalupe Slough, has been converted to fresh- and brackish-water vegetation due to freshwater discharge from wastewater facilities in the southern part of San Francisco Bay and is of lower quality for clapper rails. This conversion has at least temporarily stabilized as a result of the drought since the early 1990s.

Throughout the Estuary, the remaining clapper rail population is affected by a suite of mammalian and avian predators. At least 12 native and 3 non-native predator species are known to prey on various life stages of the clapper rail (Albertson 1995). As a result of the rapid decline and almost complete elimination of clapper rail populations in certain marshes, the San Francisco Bay National Wildlife Refuge implemented a predator management plan in 1991 (Foerster and Takekawa 1991) with an ultimate goal of increasing rail population levels and nesting success through management of red fox predation.

Mercury accumulation in eggs is perhaps the most significant contaminant problem affecting clapper rails in the Estuary, with South Bay containing the highest mercury levels. Mercury is extremely toxic to embryos and has a long biological half-life. The Service collected data from 1991 and 1992 on mercury concentrations in rail eggs in the southern portion of the estuary and found that the current accumulation of mercury in rail eggs occurs at potentially harmful levels. The percentage of non-viable eggs ranged from 24 to 38 percent (mean = 29 percent) (Service, unpubl. data).

According to 2007 rail survey data, 108 of the 168 sub-areas slated for Spartina control, are inhabited by clapper rails (Service and ISP 2007 unpubl. data). Approximately 1088 rails are present within the 108 Spartina sub-areas. The other 60 sub-areas are either uninhabited by clapper rails according to 2007 surveys or they were not surveyed.

Salt Marsh Harvest Mouse

The harvest mouse was federally listed as endangered in 1970 (35 FR 16047). Critical habitat has not been proposed or designated. A detailed account of the taxonomy, ecology, and biology of the harvest mouse is presented in the Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan (Service 1984) (Recovery Plan) and the references cited therein. The harvest mouse is a Fully Protected species under California law (See California Fish and Game Code
The harvest mouse is a rodent endemic to the salt and brackish marshes of the San Francisco Bay Estuary and adjacent tidally influenced areas. The harvest mouse closely resembles the western harvest mouse (*R. megalotis*). The harvest mouse typically weighs about 0.35 ounce, has a head and body length ranging from 2.7-2.9 inches, a tail length ranging from 2.6-3.2 inches, and a hind foot length of 0.7 inch (Fisler 1965). As stated in the recovery plan, the harvest mouse, when compared to the western harvest mouse, have darker ears, belly and back, and a slightly thicker, less pointed and unicolored tail. The harvest mouse is further distinguished taxonomically into the northern and southern subspecies, *R. raviventris halicoetes* and *R. raviventris raviventris*, respectively. Of the two subspecies, *R. r. halicoetes* more closely resembles *R. megalotis*, and can be difficult to differentiate in the field; body color and color of ventral hairs as well as the thickness and shape of the tail have been used to distinguish the two.

The harvest mouse has evolved to a life in tidal marshes. Specifically, they have evolved to depend mainly on dense pickleweed as their primary cover and food source. However, harvest mice may utilize a broader source of food and cover which includes saltgrass (*Distichlis spicata*) and other vegetation typically found in the salt and brackish marshes of this region. In natural systems, harvest mice can be found in the middle tidal marsh and upland transition zones. Upland refugia is an essential habitat component during high tide events. Harvest mice are highly dependent on cover, and open areas as small as 33 feet wide may act as barriers to movement (Shellhammer 1978, as cited in Service 1984). The harvest mouse does not burrow. It has been noted that the northern subspecies may build nests of loose grasses.

As described by Fisler (1965), male harvest mice are reproductively active from April through September, but may appear active throughout the year. Females are reproductively active from March to November, and have a mean litter size of approximately four offspring.

The historic range of the species included tidal marshes within the San Francisco and San Pablo bays, east to the Collinsville-Antioch areas. Agriculture and urbanization has claimed much of the former historic tidal marshes, resulting in a 79 percent reduction in the amount of tidal marshes in these areas (Goals Project 1999). At present, the distribution of the northern subspecies occurs along Suisun and San Pablo Bays north of Point Pinole in Contra Costa County and Point Pedro in Marin County. The southern subspecies is found in marshes in Corte Madera, Richmond, and South San Francisco Bay mostly south of the San Mateo Bridge (Highway 92). The preservation and growth of existing populations of the harvest mouse is considered important to assuring the survival of this species. The Recovery Plan identifies essential habitat areas to be preserved or restored throughout the Estuary to meet the recovery objectives for this species.

Harvest mice are present or presumed present at 21 of the 24 sites. The only sites assumed to not have harvest mice present are Blackie’s Pasture (site 3), Southeast San Francisco (site 12), and Colma Creek San Bruno Marsh Complex (Site 18). These sites consist of narrow fringe
pickleweed habitat that is frequently inundated by tides, disjunct from known harvest mouse populations, and/or lacking substantial upland high tide refugia.

**Effects of the Proposed Action**

General effects of the proposed action are detailed in the PEIS/EIR and in the PBO, and are hereby incorporated by reference. Effects specifically associated with the 2008-2010 SSPs are discussed below.

**Delta Smelt**

Each SSP for 2008-2010 quantifies the amount of habitat to be treated on each site by each method and describes delta smelt use of the site. This information is summarized in the 2008-2010 Site Plan Matrix: Effects to Listed Species. Delta smelt are known to be present or suitable habitat exists near two treatment sites: the Southampton Marsh Site (Site 11), and the North San Pablo Bay Site (Sub-areas 26a and 26b). Salt-meadow cordgrass at these sites occur only in the high marsh plain, so direct and indirect effects of cordgrass eradication work would have minimal contact with delta smelt.

The effects of the proposed use of imazapyr would be similar to glyphosate as described in the PBO. Exposure risks to delta smelt would be offset by physiological inactivation of imazapyr upon contact with clay, silt, and organic matter, strong dilution effects in energetic, turbulent conditions of rising tides and wind-generated waves, and rapid resuspension of surface sediment in contact with spray. The ISP would apply herbicides with the outgoing tide, leaving a longer window of time before the tide washes off any remaining herbicide from sediment and foliage and time for some degradation of the herbicide to occur (Leson & Associates 2005).

**Delta Smelt Critical Habitat**

This biological opinion on the designated critical habitat for delta smelt does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to the designated critical habitat.

Approximately 0.5 acre of delta smelt critical habitat at the Southampton Marsh Site and 0.01 acre of suitable habitat/critical habitat at the North San Pablo Bay Site (Sub-area 26b) will be temporarily affected each year for the three years of treatment due to short-term effects to water quality during chemical control of 0.51 acre of *Spartina.*
California Clapper Rail

Effects on Individuals from Treatment Activities

The proposed action may result in the harm or harassment of individual clapper rails due to ground-based Spartina treatment using amphibious vehicles. Within the 168 Spartina-infested sites requiring ground-based treatment during the 2008-2010 Control Seasons, 35 sub-areas will require the use of tracked amphibious vehicles working within the marsh to accomplish treatment. These vehicles are used in marshes for various purposes, including materials and personnel transport, as a base for backpack or hose-based treatment strategies, or for direct treatment from the vehicle. Tracked amphibious vehicles enable access to portions of the marsh plain that are otherwise difficult to access, such as wide marsh expanses or soft mud substrates. The weight-displacing nature of the vehicle’s tracks significantly reduces the ground pressure of the vehicle on marsh vegetation, thereby minimizing long-term effect to the marsh.

It is anticipated that driving tracked amphibious vehicles through marshes inhabited by clapper rails may result in the harm or harassment of individual clapper rails during treatment activities. The 35 sub-areas targeted for treatment encompass 4,481 acres of tidal marshland. Within that area, there are 92 net acres of non-native Spartina targeted for control over the 2008-2010 Control Seasons. This net non-native Spartina acreage amounts to 2.1% of the overall marshland in the target area. Assuming that a 6-foot wide tracked amphibious vehicle would require a combined footprint on the marsh plain double the target Spartina acreage, the potential area of the 35 marshes targeted for treatment that would be affected by the use of the amphibious vehicle would be 4.2% of the marsh, or 184 acres. Summed average high population numbers from 2005-2007 yearly call count surveys on these 35 Sites show a clapper rail population of 454 rails. Thus, it can be anticipated that an estimated 20 clapper rails (4.2% of 484) may be harmed or harassed by the use of the amphibious vehicles in these marshes.

- 92 net non-native Spartina acres / 4,481 marsh acres = 2.1% of marsh.
- 2.1% x 2 (assuming double the target Spartina acreage for access) = 4.2% of marsh
- 4.2% x 4,481 marsh acres = 184 acres.
- 4.2% x 454 rail in target marshes = 20 clapper rails

However, on all sites where amphibious vehicles are proposed for use, they will be one of a number of control strategies employed, rather than the sole method. Therefore, the estimated 20 rails harmed or harassed derived above is likely to be reduced, as other ground-based treatment methods including backpacks, trucks and boats, as well as aerial helicopter applications reduce the marsh footprint of tracked amphibious vehicles.

In particular, Site 20n, Cogswell Marsh East, has both a large number of clapper rails (43 in 2007) and a large area of non-native Spartina (28.3 acres). This site will be treated in both 2008 and 2009 via aerial applications, which eliminates any effects to rails from ground-based treatment activities. As a result, the estimated 20 clapper rails above would be reduced by
approximately 8 for a total of 13 rails harmed or harassed in 2008. It is anticipated that the net acreage of Spartina in sites treated with tracked amphibious vehicles would be reduced by 70% each year due to successful Spartina control. Therefore, the level of take that would occur in 2009 would be 70% less than in 2008; and the level of take that would occur in 2010 would be 70% less than 2009.

- 92 net Spartina acres - 28.3 net Spartina acres at Sub-Area 20n = 63.7 net Spartina acres
- 63.7 net Spartina acres / 4,481 marsh acres = 1.4% of marsh
- 1.4% x 2 (assuming double the target Spartina acreage for access) = 2.8% of marsh
- 2.8% x 4,481 marsh acres = 125.5 acres.
- 2.8% x 454 rail in target marshes = 13 clapper rails in 2008

Therefore, in 2009, 4 rails (13 rails x .30) and in 2010, 1 rails (4 rails x .30) rails may be harmed or harassed due to habitat loss. As a result, up to 18 clapper rails may be harmed or harassed over the 3-year Spartina control program due to use of the tracked amphibious vehicles during treatment.

Effects on Individuals from Habitat Removal

Of the 168 sub-areas proposed for treatment 108 of them either have clapper rails present or are presumed to be habitat for this species. The ISP and the Service developed a matrix with which to analyze and quantify effects to clapper rails from habitat removal due to Spartina control. A detailed discussion of this analysis can be found in the 2005 Non-Native Spartina Control Impact Evaluation Matrix (SCIE-M) (Attachment B).

Because clapper rails can use stands of non-native Spartina for both cover and breeding, there would be a temporary loss of habitat for the rails. Typically after spraying, the dead, vegetative portion of Spartina remains on site to provide some cover over the winter months. However over the course of a year the tidal action will break about the wracks of dead Spartina leaving bare areas. Recolonization of the site by native plants such as gumplant and pickleweed will occur at the right elevations, however, there will be a temporal loss of habitat for rails until this habitat grows large enough to provide cover and nesting substrate for the rails. It is likely that the habitat will become available to clapper rails four years after treatment.

When examining the sub-areas for effects on clapper rails due to Spartina control, the ISP and Service came up with a carrying capacity for clapper rails. When possible the carrying capacity was derived from the number of birds currently using a marsh. If this was not possible a median carrying capacity was developed based off of previous scientific studies that have been done on clapper rails in the Estuary. Having these numbers provided the ability to determine if there were marshes, which after treatment would have habitat available for additional clapper rails. Sub-areas were analyzed in context with adjacent usable habitat within the larger site and between contiguous sites. If the sub-area did not provide sufficient cover for the number of rails currently occupying it, but sufficient untreated marsh habitat was available adjacent to the affected sub-
area, then it was assumed that clapper rails could move into the marsh adjacent to the affected sub-area. Therefore, this would not likely cause harassment of individual clapper rails since adjacent marsh with available habitat was present. Consistent with the 2005 SCIE-M analysis, before a take is assumed for any of the sub-areas analyzed, the sub-area is further scrutinized to see how it fits into any adjacent habitats suitable as refugia for clapper rail subject to take at a given sub-area. Thus, a take would not be generated unless the post-treatment carrying capacity of geographically contiguous sites resulted in a carrying capacity insufficient to maintain current population levels on the site.

As was described in the 2005 Non-Native *Spartina* Control Impact Evaluation Matrix (SCIE-M) (Attachment B), 18 sub-areas had a negative change in carrying capacity (denoted by a (−) symbol), that indicated a potential reduction in available habitat. Therefore, clapper rails inhabiting these 18 sub-areas would be subject to harassment when the sub-areas carrying capacity was lowered. These areas were considered in context with geographically contiguous sub-areas that had a positive change in carrying capacity (sub-areas that would support more clapper rails than are currently present). In other words, rails occupying the 18 sub-areas with a negative change in carrying capacity could move into adjacent sub-areas with a positive carrying capacity, however clapper rails would still experience harassment. According to the Service and ISP (Unpubl. data 2007), rail carrying capacities have not changed or have increased for most sub-areas. However, several of the 18 sub-areas may remain negative (even if by less than 1 bird). Therefore, to be conservative, the Service assumes that the 18 sub-areas will remain negative and could potentially result in a total of 15 clapper rails (5 each year for three years) that could be harassed by *Spartina* control activities.

Three of the 24 proposed sites identified a possible take of clapper rails due to habitat loss and lack of surrounding refugia for the birds. They are Site 17, San Leandro Bay Complex, Site 18, Colma Creek Complex, and Site 20, Sub-areas m-o, Cogswell Marsh. The common factor at all of these sites is high density of clapper rails and larger acreages of non-native *Spartina*. For Sites 17 and 20, the loss of cover for the clapper rails would be a temporary loss of habitat, until native vegetation such as gumplant and pickleweed can revegetate the site. The ISP and Service propose to ameliorate the temporary loss of cover at Sites 17 and 20 by doing some revegetation at both sites. Additionally, the amount of *Spartina* that needs to be removed is considerably less than in previous years compared to the total acreage of the marsh. Therefore, the change in clapper rail carrying capacity has been calculated for all three sites. Table 1 summarizes the effects of treating the three sites over a three-year period using the 2005 SCIE-M analysis described in Attachment B.
Table 1: Changes in clapper rail carrying capacity at sites showing a net loss of carrying capacity over three years of *Spartina* treatment

<table>
<thead>
<tr>
<th>Site</th>
<th>Total Marsh Area (acres)</th>
<th>Net acres of <em>Spartina</em> to be treated</th>
<th>Rails present*</th>
<th>Rail carrying capacity loss**</th>
<th>Approx. # rails harmed due to habitat loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 – San Leandro Bay</td>
<td>456</td>
<td>48</td>
<td>237</td>
<td>-9.91</td>
<td>10</td>
</tr>
<tr>
<td>18 – Colma Creek Complex</td>
<td>131</td>
<td>13</td>
<td>46</td>
<td>-1.82</td>
<td>2</td>
</tr>
<tr>
<td>20 - Cogswell Marsh (sub-areas m-o)</td>
<td>202</td>
<td>29</td>
<td>78</td>
<td>-4.48</td>
<td>4-5</td>
</tr>
</tbody>
</table>

* 2007 average count for rails
** Carrying capacity loss over three years of *Spartina* control

While treatment will take place in the first year (2008), actual effects to the clapper rails would be delayed. During the first year after treatment dead *Spartina* is still available to clapper rails for cover and nesting. As previously indicated in 2004-2005, sites treated in the first year had the same number or higher numbers of clapper rails in the previous year when the ISP and Service were doing call counts the following spring. Over the course of the year the tides come in and remove most to all of the dead *Spartina*, leaving a loss of cover in year 2. It has been estimated that with seedling plantings of pickleweed and gumplant occurring the same year as treatment cover that habitat could be used again by clapper rails in year 3. With planting there would be a 1 to 2 year loss of available habitat for clapper rails. However, even with this loss, as Table 1 shows, no more than 15 clapper rails in sites 17 and 20 would be harmed over the two years due to temporary loss of cover and nesting habitat.

The *Spartina* covered area at Site 18 is not likely to revegetate with native species (except years from now when the native *Spartina* is restored to the Estuary) because non-native *Spartina* has invaded mudflats where the low elevations would not support the gumplant and pickleweed. The *Spartina* control program may cause harm of as many as 2 clapper rails due to permanent loss of cover and nesting habitat (Table 1). Removal of non-native *Spartina* would open up additional areas for clapper rails to forage in after the dead *Spartina* has been removed by the tides.

The remaining 147 sub-areas, which support or are capable of supporting clapper rails are considered large enough and have lower densities of rails providing adequate cover and nesting habitat for the number (or greater) of clapper rails currently inhabiting these areas. Therefore, the clapper rails located in these sub-areas are not likely to be adversely affected by the *Spartina* control activities.

Because in the short term clapper rails can successfully use tall stands of *Spartina* for cover and nesting, *Spartina* control can have a negative effect to clapper rails. However, long-term effects of non-native *Spartina* infestations have negative effects to clapper rails by choking out tidal sloughs and channels where they prefer to feed. With small channels choked off, drainage would change in the marshes potentially causing some marshes to become waterlogged and supporting
stunted, sparse, short-form cordgrass, which is not suitable for clapper rail cover or nesting habitat (Baye 2005). Survival of clapper rails in the Estuary would be threatened, and the distribution of the species would be radically altered, if the Service and ISP are unsuccessful.

Disturbance Effects Associated with Spartina Eradication Operations

Ground-based treatment - backpack spraying and truck or boat-mounted spraying. The ground based spraying is used to treat smaller areas. Because spraying would be done during the clapper rail breeding season, the crew spraying each area would be required to follow the guidelines outlined in the “Walking in the Marsh” document (Attachment A). Although these guidelines would minimize if not eliminate the likelihood of stepping on nests, there would still be disturbance associated with crews potentially walking near nests and clapper rail individuals in the area. All of the 108 sub-areas inhabited by clapper rails will require backpack spraying and truck or boat-mounted spraying. It will be difficult to quantify how many rails could be disturbed, therefore, the Service will assume that all of the rails occupying the Spartina control sites could be affected. Therefore, up to 1088 clapper rails (Service and ISP, 2007 unpubl. data) inhabiting the 108 sub-areas (21,042 acres of marsh) may be subject to harassment.

Aerial-based treatment - application of herbicides by helicopter. Application by helicopter will occur in both the clapper rail breeding and non-breeding season. The disturbance created by helicopters will be temporary, consisting of either a single flight over the marsh for broadcast spraying, or brief hovering over a portion of marsh for spray ball application. Clapper rails in parts of the Estuary may be accustomed to frequent aircraft overflights because many small airports are located adjacent to the bay and have flight paths over marshes. Although aerial-based treatment will likely result in a small amount of disturbance to rails within the Spartina treatment sites, there is low likelihood of nest abandonment due to aerial application. It is difficult to quantify how many rails could be disturbed by aerial application, therefore, up to 1088 clapper rails inhabiting the 108 sub-areas (21,042 acres of marsh) may be subject to harassment.

Disturbance Effects Associated with Revegetation Activities

Revegetation activities will be conducted in at least seven sub-areas that have previously been subject to the “phased approach” of cordgrass eradication (sub-areas 17a, 17c, 17d, 17h, 20m, 20n, 20o), as well as any other sites where native plant recruitment may accelerate vegetative recolonization of treated marshes. Plantings will be targeted for the late fall or early winter of each year (after July 15th), when winter rains are still likely, and most clapper rails have completed nesting (Harvey 1998, Foerster et al. 1990). Therefore, revegetation activities would not have an effect on breeding clapper rails. However, people working in the marsh may disturb adult clapper rails. Human-related disturbance of clapper rails in the winter, particularly during high tide and storm events, may increase the bird’s vulnerability to predators. To minimize this effect, the project has proposed to not enter the marshes during high tides or during storm events. This should provide the rails access to larger amounts of habitat for refuge if disturbed
by the revegetation efforts. Planting at each planting area is expected to be brief (one hour) and only 10 to 20 planting areas would be planted in a sub-area. It is expected that harassment to clapper rails would be minimal.

*Disturbance Effects Associated with Inventory Monitoring and Treatment Monitoring*

Two types of control-related monitoring will occur as part of the ISP: inventory monitoring and treatment efficacy monitoring. Almost all inventory mapping in 2008 and beyond will be done via ground-based GPS surveys. The exception will be the use of helicopters to survey particularly inaccessible marsh areas. Treatment monitoring is conducted to assess efficacy of different control methods in marshes. Monitoring must be conducted in the summer, as early as May 1, or before annual cordgrass treatment occurs. The ISP will monitor all sub-areas for treatment efficacy in 2008-2010. Because monitoring transects would occur in clapper rail habitat during part of the breeding season, these activities could result in the harassment of breeding/nesting clapper rails. Clapper rails vary in their sensitivity to human disturbance, both individually and between marshes. Clapper rail nests have been documented within three meters of trails in Elsie Roemer and Cogswell marshes and within 20 meters of a busy street near White Slough. While there have been documented occurrences of clapper rails abandoning their territory due to human disturbance, these cases occur when there is repeated, over the course of several days, and long duration, many hours per day, disturbance by humans. In the case of the inventory monitoring, human disturbance would consist of two people both trained in clapper rail adult, nest, and young ID entering the marsh to spend 2 to 5 minutes per quadrat to collect data. Each transect would be completed in 2 hours or less. Clapper rails disturbed by monitoring activities could be subjected to predation if they increase their movements within the marshes or disperse to other nearby or distant tidal wetlands. If nesting clapper rails are determined to be present near a randomly selected data point, the data point would be relocated to avoid nests or clapper rails. Treatment monitoring would result in harassment of clapper rails during the nesting season.

*Salt Marsh Harvest Mouse*

Harvest mice are present or presumed present at 21 of the 24 proposed sites, therefore, harvest mice may be affected by control activities at these sites as detailed in the PEIS/EIR and the PBO. Because harvest mice do not generally inhabit cordgrass stands, direct effects of eradication on harvest mice would be minimal. The only potential adverse effects to harvest mice associated with the invasive cordgrass control detailed in the SSPs could occur from temporary disturbance of marsh vegetation (habitat degradation) from tracked amphibious vehicles while accessing infested marsh areas. As was calculated in the 2005-2007 SSPs, implementation of all SSPs was estimated to cause temporary disturbance of 3.63 acres in 2005, 1.70 acres in 2006, and 1.03 in 2007, of salt marsh harvest mouse habitat; with a cumulative acreage of 6.36 acres of harvest mouse habitat being affected. For the 2008-2010 SSPs, the marsh affected by the tracked amphibious vehicles is estimated to be less; however, to be conservative, the Service will assume that the same amount of habitat would be affected. Therefore, all harvest mice occupying a total
of 6.36 acres of habitat over three years may be harmed or harassed as a result of tracked amphibious vehicle use for spray control.

Although the eradication of non-native cordgrass is not specifically identified in the Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan (Service 1984), successful eradication of non-native cordgrass is likely to substantially benefit the harvest mouse and to assist with its recovery within the Estuary. Planting pickleweed at portions of Sites 17 and 20 would benefit harvest mice in those marshes by increasing the amount of available cover for this species in areas where there is little to no pickleweed.

**Cumulative Effects**

Cumulative effects include the effects of future State, Tribal, local or private actions affecting listed species and their critical habitat that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Cumulative effects are identical to those detailed in the PEIS/EIR and in the PBO, and are hereby incorporated by reference. Numerous activities continue to eliminate habitats of clapper rails, harvest mice, and delta smelt. Habitat loss and degradation affecting these species continues as a result of urbanization, freshwater urban run-off, and contaminant inputs. These species are also affected by increased predation associated with human development, and disturbance of breeding and foraging behavior.

Cumulative projects with which the proposed action would be evaluated in combination include related non-Federal projects such as construction projects proposed by local, regional, or state agencies in and around the proposed action area. These include other projects proposed by CDFG within the proposed action area (e.g., CDFG’s Eden Landing Ecological Reserve project); city and county development projects (e.g., new or expanded residential, commercial, or industrial development projects); local agency infrastructural projects (e.g., water or wastewater facilities improvements/construction, and flood protection projects); Pacific Gas and Electric (PG&E) projects (e.g., transmission line/facilities construction and/or improvements); traffic signalization and roadway construction/improvement projects of local municipalities or Caltrans; and recreation-related projects proposed by local municipalities, Association of Bay Area Governments (ABAG), park districts, or other non-governmental agencies.

A number of reasonably foreseeable projects will involve tidal restoration and are expected to result in a net enhancement or increase of habitat for tidal marsh species such as the clapper rail and harvest mouse, without having the potential for net adverse effects on these listed species. Although some projects (e.g., utility, road, or development projects) may result in adverse effects to the listed species discussed in this biological opinion, it is expected that those impacts will have to be mitigated to satisfy CEQA, NEPA, and/or section 7 consultation requirements.

In addition, the global average temperature has risen by approximately 0.6 degrees Centigrade
during the 20th Century (IFPC 2001, 2007; Adger et al. 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IFPC 2001, 2007; Adger et al. 2007), and that it is "very likely" that it is largely due to man made emissions of carbon dioxide and other greenhouse gases (Adger et al. 2007). Ongoing climate change (Anonymous 2007; Inkley et al. 2004; Adger et al. 2007; Kanter 2007) likely imperils the clapper rail, harvest mouse, and delta smelt and the resources necessary for their survival, since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of the California clapper rail, salt marsh harvest mouse, and delta smelt, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service’s biological opinion that the proposed action is not likely to jeopardize the continued existence of these species and is not likely to destroy or adversely modify critical habitat for delta smelt. No critical habitat has been proposed or designated for the clapper rail and salt marsh harvest mouse, therefore none will be destroyed or adversely modified.

We base this conclusion on the following: (1) a limited amount of tidal marsh habitat and upland/transitional habitat for California clapper rails and salt marsh harvest mice would be permanently lost or temporarily affected; (2) a limited amount of habitat for delta smelt will be temporarily affected; (3) several conservation measures would be implemented to minimize adverse effects to these species from implementing the Spartina control program; and (3) more than 200 net acres of Spartina will be eradicated in 2008-2010, which would allow restoration of intertidal mudflats and native, diverse salt marsh vegetation that support these species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act, and Federal regulation pursuant to section 4(d) of the Act, prohibits the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as actions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency
action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The incidental take statement accompanying this biological opinion exempts take of California clapper rails, delta smelt, and salt marsh harvest mice carried out in accordance with the reasonable and prudent measures and terms and conditions from the prohibitions contained in section 9 of the Act. It does not address the restrictions or requirements of other applicable laws.

The measures described below are non-discretionary, and must be implemented by the Service so that they become binding conditions of any grant or permit issued to the ISP, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Service (1) fails to require the ISP to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Conservation measures proposed and described above in the Description of the Proposed Action section will reduce, but do not eliminate, the potential for incidental taking of California clapper rails and salt marsh harvest mice. The Service anticipates incidental take of individual salt marsh harvest mice will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, and the difficulty of finding killed or injured small mammals. The level of take of individual salt marsh harvest mice can be anticipated by the amount of available habitat lost from the proposed action. The Service expects that incidental take of the California clapper rail will be difficult to detect because of the reclusive nature of this species. The Service considers the number of salt marsh harvest mice and California clapper rails subject to harassment from noise and vibrations to be difficult to estimate. The Service, therefore, anticipates the following levels of take as a result of implementation of the proposed action.

Incidental take of California clapper rails and salt marsh harvest mice is expected in the form of:

1. Up to eighteen (18) clapper rails may be harmed or harassed due to use of tracked amphibious vehicles over the 3 years of Spartina control.
2. Up to fifteen (15) clapper rails would be harassed due to temporary loss of habitat over the 3 years of Spartina control.
3. Up to fifteen (15) clapper rails in sites 17 and 20 would be harmed due to temporary loss of cover and nesting habitat over the 3 years of Spartina control.
4. Up to two (2) clapper rails in site 18 would be harmed due to permanent loss of cover and nesting habitat over the 3 years of Spartina control.
5. Up to 1088 clapper rails inhabiting the 108 sub-areas (21,042 acres of marsh) will be
harassed each year for 3 years due to ground-based control, inventory and treatment monitoring, and revegetation; and all rails inhabiting the *Spartina* control action area will be subject to harassment due to aerial application of herbicide and aerial treatment monitoring.

6. All salt marsh harvest mice occupying a total of 6.36 acres of habitat for this species may be harmed or harassed as a result of tracked amphibious vehicle use over the 3 years of *Spartina* control.

7. All delta smelt will be subject to harm associated with the temporary loss of 1.53 acres of suitable delta smelt habitat at Southampton Marsh and North San Pablo Bay over the 3 years of *Spartina* control.

**Effect of Take**

In this biological opinion, the Service determined that the level of anticipated take is not likely to jeopardize the continued existence of the California clapper rail, salt marsh harvest mouse, and delta smelt, or result in destruction or adverse modification of critical habitat for the delta smelt. Critical habitat has not been proposed or designated for the clapper rail or the salt marsh harvest mouse, therefore, none will be affected.

**Reasonable and Prudent Measure**

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize the effects of take on the California clapper rail, salt marsh harvest mouse, and delta smelt:

1. Avoid, minimize, and offset the effects of the proposed action on California clapper rails, salt marsh harvest mice, and delta smelt.

**Term and Condition**

To be exempt from the prohibitions of section 9 of the Act, the Service must ensure compliance with the following term and condition, which implements the reasonable and prudent measure described above. This term and condition is nondiscretionary.

The following term and condition implements the reasonable and prudent measure:

1. Implement the conservation measures as described in the ISP's; *Spartina* Control Program, 2008 - 2010 SSPs.

**Reporting Requirements**

The Service must be notified within 24 hours of the finding of any injured or dead salt marsh
harvest mice, California clapper rails, and/or delta smelt, or any unanticipated damage to their habitats associated with the proposed action. Injured salt marsh harvest mice and/or California clapper rails shall be cared by a licensed veterinarian or other qualified person, such as the Service-approved biologist for the proposed action. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead animals should be sealed in a zip lock bag containing a piece of paper indicating the location, date and time when it was found, and the name of the person who found it; and the bag should be frozen in a freezer in a secure location. The Service contact persons are Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program) at the Sacramento Fish and Wildlife Office at 916/414-6600 and Resident Agent-in-Charge Scott Heard of the Service’s Law Enforcement Division at telephone 916/414-6660.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act directs Federal agencies to utilize their authorities to further the purpose of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and databases.

For the Service to be kept informed of actions that minimize or avoid adverse effects, or benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations. We propose the following conservation recommendations:

1. Assist the Service in implementing recovery actions identified within most current recovery plans for the California clapper rail and salt marsh harvest mouse.

2. Encourage or require the use of appropriate California native species in revegetation and habitat enhancement efforts associated with projects authorized by the Service.

3. Encourage participation of other prospective permittees to limit and reverse the spread on non-native Spartina within the San Francisco Bay Estuary.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation for the ISP for control years 2008-2010. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not
considered in this opinion; (3) the agency action is subsequently modified in a manner that
causes an effect to listed species or critical habitat that was not considered in this opinion; or (4)
a new species or critical habitat is designated that may be affected by the proposed action. In
instances where the amount or extent of incidental take is exceeded, any operations causing such
take must cease pending re-initiation.

If you have any questions regarding this biological opinion on the proposed *Spartina* Control
Program, as detailed in the 2008 - 2010 Invasive *Spartina* Control Plans, please contact Melisa
Helton at (510) 792-0717 (ext. 228) or Ryan Olah at (916) 414-6625.

Sincerely,

[Signature]

Cay C. Goude
Acting Field Supervisor

Attachments

cc:
Scott Wilson, John Krause, & Suzanne DeLeon, California Department of Fish and Game,
Yountville, California
LITERATURE CITED


CSCC. 2005b. Addendum to the Final Programmatic EIR for the San Francisco Estuary Invasive Spartina Project: Spartina Control Program. CSCC, Oakland, California.


Attachment A
Walking in the Marsh: Methods to Increase Safety and Reduce Impacts to Wildlife/Plants
Project Leader

Attachment B
2005 Non-Native Spartina Control Impact Evaluation Matrix (SCIE-M)
ATTACHMENT A

Walking in the Marsh: 
Methods to Increase Safety and Reduce Impacts to Wildlife/Plants

I Safety

A) Before heading out into the marsh check the tides: tides can affect your ability to move through the marsh. Be aware of how long you plant to be in the marsh, what channels you may have to cross, and how the tides will change while you are in the field.

B) Plan your route through the marsh: use existing aerial imagery and maps to identify channels and sloughs that may impede access. When available, use high points such as boardwalks or levees to scope out a route. Scoping a route can be especially important in scenarios where visibility across the marsh is low (e.g., South Bay, Suisun). It may be necessary to flag stations and/or access corridors through the marsh prior to surveys. If more than one person is accessing the marsh, travel together along major access routes to avoid the development of multiple paths. At the end of the sampling period, persons furthest out should walk out first, meeting up with others along the major access route ... this minimizes the potential of people getting lost and ensures that anyone who is injured will be found in a timely manner (before everyone else has left the marsh). The goal should be to plan a safe route into and out of the marsh while minimizing travel and pathways.

C) Channels and sloughs: Avoid jumping channels in locations where you cannot see through vegetation on the opposite bank. Thick vegetation (e.g., pickleweed, gumplant) can obscure the edge of the bank. Considerations before jumping: depth of water/channel, steepness of the channel edges, tide levels. If you are not confident that you can make the jump and the edges have high dense vegetation that you cannot see through ... DO NOT JUMP.

D) Getting stuck in the mud: If you are sinking into mud, try to keep moving to avoid getting stuck further. If a leg gets stuck, try to twist your leg to break the suction while leaning your weight on your other leg or knee. Use whatever material you have available (e.g., clipboard, backpack) for leverage (e.g., lean on those items).

E) Other: Besides general items such as water and food, it’s a good idea to bring a flashlight and a phone (+GPS) in cases of an emergency. Let someone know what marsh area you will be in and when you plan to complete work for the day. Designate an end time and final meeting place when more than one person is out in the marsh at the same time.
II Avoiding Impacts to Wildlife and Plants

A) Movement through the Marsh. While walking through the marsh, keep noise to a minimum. Avoid using multiple pathways through the marsh. Use trails if they exist. Plan and map your route to minimize environmental impacts and decrease running into hazards/barriers such as large channels. When looking for a suitable place to jump a channel, do not walk along the edge of the channel/slough because these areas provide nesting habitat for many species including the endangered California clapper rail. To find an alternate jump site, walk parallel to the channel at a distance where vegetation is lower in height and where visibility of the ground surface is greater. At all times, observe the environment you are walking through to avoid disturbance. Choose channel jump sites where vegetation is lower or you can clearly discern what you are jumping onto. In general, avoid walking adjacent and parallel to channels/sloughs.

B) Avoiding nests and nest substrates. Tidal marsh species have nests that are well concealed and therefore easy to disturb when walking through the marsh. To avoid stepping on a nest, do not walk through thick vegetation or areas where you cannot see through to the ground. Avoid walking on vegetation whenever possible since plants serve as nesting substrate for many species in the marsh. In general, be aware of the area you are walking through. See Table 1 for next characteristics of common tidal marsh birds.

C) Bird behavior. If a bird vocalizes or flushes within close range of where you are standing or walking (e.g., < 10 m), it is possible that a nest or young are nearby. When these circumstances arise, stop whatever you are doing and leave the immediate area (be sure to watch where and what you are walking on). Choose an alternate route through the marsh, identify the new route and location of the sighting/occurrence on a map, and record coordinates of the location if possible. Be sure to pass this information on to others that may use the same route or are conducting surveys in the same area. Be very observant of where you walk as you leave the area. There exists the possibility that you could step on a nest of young, both of which can be concealed by vegetation or cryptic. When alarmed, individuals may freeze in place (especially juveniles).

D) Tidal lagoons/ponds. Avoid walking along tidal lagoons and ponds in marsh interiors that support foraging, roosting, or nesting shorebirds and waterfowl. Be observant of the distance at which birds flush or become alarmed.

E) Tides. Avoid conducting surveys during high tides as much as possible. These are periods when many wildlife species are at greatest risk (e.g., predation). If your surveys require a high tide, be aware of the increased risk you may cause for wildlife and take all precautions to reduce that risk (e.g., avoiding areas where sensitive species are known to occur).
ATTACHMENT B

Non-Native *Spartina* Control Impact Evaluation Matrix (SCIE-M)

Estimating the impact of *Spartina* control on the California clapper rail carrying capacity of San Francisco Bay tidal marshes

May 2005

E.K. Grijalva, Invasive *Spartina* Project
J.D. Albertson, US Fish & Wildlife Service, Don Edwards San Francisco Bay NWR

I. Introduction

Staff from the Invasive *Spartina* Project (ISP) and the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) have developed the *Spartina* Control Impact Evaluation Matrix (SCIE-M) to quantify temporary impacts to marshland habitat that will occur as a result of non-native *Spartina* Control through four years of anticipated treatment activities – 2005-2008, and to assess whether these impacts will affect California clapper rail (clapper rail) populations. This document summarizes the results of this analysis for the purposes of assessing and quantifying potential effects to clapper rail populations in the Bay due to temporary habitat loss, both on a site-specific and a regional basis. Affects are quantified in terms of clapper rail carrying capacity of marshes, as detailed below.

II. Summary of Methods

Potential habitat impacts were determined through the analysis of existing site conditions, proposed treatment regimes, proposed treatment methods, efficacies associated with each treatment method, and post-treatment habitat values of successfully treated *Spartina* stands. The potential temporary impact to the clapper rail carrying capacity of treated marshes was determined based on the pre- and post-treatment habitat values for treated marshes, current and historic clapper rail populations in treated marshes, and estimated habitat acreage requirements for breeding clapper rails based on home range core-use area size as determined through radio-telemetry (Albertson 1995). Section IV (below) provides a detailed analysis of methods used to determine efficacy, post-treatment habitat values, and impacts to clapper rail carrying capacity.

III. Results

Twenty-two sites containing 132 sub-areas are slated for *Spartina* control over the four years (2005-2008) analyzed in the SCIE-M. According to 2005 survey data, 45 of these sub-areas are uninhabited by clapper rail. Of the remaining 87 sub-areas, post-treatment carrying capacity on treated marshes exceeds the pre-treatment population numbers for the marsh on all but 21 sub-areas. This means that post-treatment acreage within these sub-areas has been determined to be more than sufficient to support the current rail populations there. When the remaining 21 sub-areas were analyzed in context with adjacent usable habitat within the site and between contiguous sites, only the following three sites showed a net loss of carrying capacity following treatment:

1) Site 17: San Leandro Bay Complex, Alameda County,
2) Site 19: Colma Creek Complex, San Mateo County, and,
3) Site 20 (Sub-Areas m-o): Cogswell Marsh.
As with each of the sites (and sub-areas) addressed in the SCIE-M, these three sites were analyzed over the entire four-year scope of the model\(^1\). Table 1 summarizes the estimated reduction in clapper rail carrying capacity at each of these sites each year over that four-year period.

Table 1: Changes in clapper rail carrying capacity at sites showing net loss of carrying capacity over four years of Spartina treatment

<table>
<thead>
<tr>
<th>Site</th>
<th>Initial estimated rail carrying capacity</th>
<th>Change per treatment year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2005</td>
</tr>
<tr>
<td>17. San Leandro Bay</td>
<td>125.0</td>
<td>+6.22</td>
</tr>
<tr>
<td>19. Colma Creek Complex</td>
<td>82.0</td>
<td>-8.12</td>
</tr>
<tr>
<td>(sub-areas m-o)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>292.0</strong></td>
<td>-8.12</td>
</tr>
</tbody>
</table>

Over the four-year scope of the SCIE-M analysis, the majority of the estimated decrease in clapper rail carrying capacity will occur during years two and three of treatment activities. Treatment in the last season of control will result in a loss of carrying capacity on only one of the three sites. Only in the second year of treatment (2006) will all three sites identified above show a net decrease in carrying capacity. In the first and fourth years (2005 and 2008 respectively), only Site 19 will show a net decrease in carrying capacity. Change in carrying capacity is only summed across sites where there are decreases in carrying capacity on individual sites. In other words, a carrying capacity figure that shows a net positive amount of carrying capacity remaining following treatment, has not been used to buffer negative carrying capacity numbers from other disparate locations.

IV. Detailed Analysis

A) Efficacy

The ISP and Refuge staffs have assigned each planned Spartina treatment method a specific efficacy (removal success) based on observations from local and Willapa Bay, WA Spartina treatment work. Each estimated efficacy represents the higher end of the range of efficacies possible with each treatment. This more conservative approach therefore attempts to identify the maximum possible impact to vegetative cover in treated areas. It is likely that actual on the ground efficacies will be less than those estimated given the variables of leaf-surface silt deposition, tidal windows, growth stage, weather, and other factors which may inhibit maximum translocation of applied herbicides. Table 3 shows the estimated efficacies of various Spartina treatment methods.

Individual sites slated for Spartina treatment were then evaluated for the appropriateness of any or all of the above treatment methods. The acres treated by each treatment method on a site were then multiplied against the efficacy of that method, and the resulting values of each method added together to arrive at the overall adjusted treatment acreage. For example:

The Bair & Greco Islands Complex, Sub-Area 2c - B2 North Quadrant has 540.8 total marsh acres, with 45 net acres of non-native Spartina to be treated. Treatment on this site involves the use of backpack sprayers (1 acre), boats with spray equipment (9 acres), and aerial treatment via helicopter (35) acres. With this information, the amount of vegetation that would be effectively removed by each herbicide can be calculated as follows:

For glyphosate: \(1(0.50) + 9(0.60) + 35(0.30) = 16.4\) ac. of vegetation effectively removed

\(^1\) The SCIE-M incorporates estimated expansion rates of the non-native Spartina on each site (50% increase of untreated or surviving plants per year), as well as phasing of treatment methods over four years. Phasing of treatments aims to minimize impacts to clapper rail in any given season, while achieving a level of Spartina control sufficient to keep the infestation from expanding within or between sites. See Section IV D.
= 36% of treated *Spartina*
= 3% of the site’s total marsh area

For imazapyr: \(1(0.75) + 9(0.80) + 35(0.80) = 36.0\) ac. of vegetation effectively removed
= 80% of treated *Spartina*
= 7% of the site’s total marsh area

**B) Post-Treatment Habitat Values**

The “vegetation removal” estimates above (16.4 ac. for glyphosate and 36.0 ac. for imazapyr), considered the efficacy of the treatment method, but they do not reflect what habitat value the “dev egetated” area might still provide. Observations of treated *Spartina* infestations in San Francisco Bay, including sites in the Don Edwards San Francisco Bay National Wildlife Refuge, indicate that considerable habitat value is maintained post-treatment in successfully treated stands of non-native *Spartina*. In fact, studies show an average of 56 - 82% relative cover of standing dead *Spartina* and native vegetation in the year following the first treatment (USFWS unpubl. data, Zaremba 2001), and, as will be described further below, these areas continued to provide habitat for breeding clapper rails and other species. Following treatment, the aboveground, standing wrack of non-native *Spartina* typically remains until mid-winter on exposed sites and longer in more sheltered sites. On sites of higher elevation, once the standing *Spartina* wrack begins to diminish, seedling recruitment under the dying *Spartina* canopy typically begins, with annual and perennial pickleweeds (*Salicornia europaea* and *S. virginica* respectively), gumplant (*Grindelia stricta*), and other native marsh plants dominating. Following treatment on lower sites, open mudflats are restored, enhancing foraging grounds. In the absence of continued invasion pressure from adjacent untreated stands of non-native *Spartina*, treated marshland areas begin natural, native successional patterns soon after the treated *Spartina* thins and is eventually removed.

Because of these phenomena, the estimates of vegetation removal described in the previous section should not be used alone to evaluate the impact to habitat caused by removal of non-native *Spartina*. The area of *Spartina* removed does not equal the amount of habitat that is removed from use by marshland animal species on the site. Treatment of non-native *Spartina* infested areas is not analogous to paving a parking lot, where the post-project habitat value approaches zero. Rather, a non-native-dominated marsh assemblage is transitioned to a native-dominated marsh assemblage, beginning almost immediately following treatment and continuing over several growing seasons
Table 2. Estimated efficacies of various Spartina treatment methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Efficacy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-chemical control methods</td>
<td></td>
</tr>
<tr>
<td>Cover with fabric</td>
<td>95%</td>
</tr>
<tr>
<td>Manual digging</td>
<td>95%</td>
</tr>
<tr>
<td>Mechanical Excavation</td>
<td>95%</td>
</tr>
<tr>
<td>Chemical control methods</td>
<td></td>
</tr>
<tr>
<td>Conventional spray truck</td>
<td>60%</td>
</tr>
<tr>
<td>Backpack sprayer</td>
<td>50%</td>
</tr>
<tr>
<td>Amphibious tracked vehicle</td>
<td>60%</td>
</tr>
<tr>
<td>Boat with spray tank/hose</td>
<td>60%</td>
</tr>
<tr>
<td>Aerial (Helicopter)</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glyphosate</th>
<th>Imazapyr</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>80%</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* "60% efficacy" means that 60% of the target vegetation is killed and 40% is expected to be unaffected or will re-grow the following year.

To accommodate this occurrence, a “post-treatment habitat value” was factored into the impact estimation model used in the SCIE-M. Based on past observations by ISP and Refuge staffs, the post-treatment habitat value for treated marshes estimated across function (foraging, shelter, breeding, etc.) and across time (1st, 2nd & 3rd year post-treatment), was determined to be 40% of pre-treatment levels. For the purposes of the SCIE-M, the pre-treatment habitat value of the non-native Spartina-infested marsh was assumed to be 100%, rather than some reduced or elevated amount. To incorporate post-treatment habitat value into the model, the acreage of “vegetation effectively removed” calculated in the previous section was reduced by 40% to provide an estimate of “habitat value effectively removed.” Continuing the example started above, the adjusted “removed habitat” values are calculated as follows:

For glyphosate:

\[
\text{16.4 acres x 0.60 = 9.84 ac. of vegetated habitat removed} \\
= 1.8\% \text{ of the site’s total marsh area}
\]

For Imazapyr:

\[
\text{36.0 acres x 0.60 = 21.6 acres of vegetation to be removed} \\
= 4\% \text{ of the site’s total marsh area}
\]

C) Carrying capacity and quantifying potential impacts to California clapper rail

The net acreages of “vegetated habitat removed” (calculated above) were then considered in conjunction with the known populations of clapper rail in these marshes and calculated core-use and homerange areas to estimate the potential exposure of rail to temporary habitat loss. For the purposes of this analysis, affects to rails were defined in terms of potential loss of clapper rail carrying capacity of marshes. The population data used for this analysis came from recent surveys, and from the ISP-coordinated Bay-wide clapper rail survey conducted in January-March 2005 (including new data by East Bay Regional Parks District, California Department of Fish and Game, Point Reyes Bird Observatory, Avocet Research, ISP, and Refuge).

1) Homerange and Core-use areas

Albertson (1995) estimated that a California clapper rail pair requires approximately 3.44 acres (1.39 hectares) of core-use habitat for successful breeding based on radio telemetry studies. This number represents the average size of the overall core-use area of a rail territory throughout the 11-month study period in Mowry Marsh, the marsh with the largest determined core-use area in this
study. A core-use area is the highly defended portion of a homerase that is nearly exclusive to a rail pair. There is little overlap between core-use areas of adjacent rail pairs within a marsh. Core-use areas are defined as the area of a minimum convex polygon (MCP) containing 50% of the rail relocations in a telemetry study (Anderson 1982, White and Garrott 1990, Albertson 1995). In contrast, the homerase, which contains 95% of the rail relocations, has been found to overlap considerably between adjacent individuals (Zemtal et al. 1989, Albertson 1995). Overall core-use area is defined as the minimum convex polygon area that includes 50% of the rail relocations throughout a year. Albertson (1995) also determined core-use area sizes for different seasons of the year.

To be conservative in our impacts assessment, we assume a core-use area size of 3.4 acres per rail (not per pair), which is twice the size of the largest estimated overall core-use area in Albertson (1995). This equates to a rail population density of 0.29 rails/acre (0.73 rails/hectare), which is considered a medium rail density for a marsh. Our approach allows for some differences in core-use area movements between males and females of a pair and accounts for portions of treated marshes where habitat may be less than optimal. The analysis allows for 6.8 acres of exclusive marsh habitat per rail pair (2.75 hectares), which is nearly the same size as some seasonal homerases (95% MCP) in the Albertson study, and more than sufficient core area acreage to support a rail pair. Realistically, there is probably at least a 50% overlap between male and female core areas, which would result in a 5.1-acre core area for the pair (or 2.55 acres/bird).

2) Carrying Capacity

Using the core-use area estimate of 3.4 acres per rail, the existing clapper rail carrying capacity in targeted marshes was estimated by dividing the total marsh acreage by 3.4. The results of that calculation were used as the carrying capacity for the marsh unless the observed carrying capacity (i.e. the current rail population) in the marsh exceeded this number, in which case we used the current rail population number as the carrying capacity value in our calculations. Post-treatment carrying capacities were estimated using the same criteria, then compared to pre-treatment carrying capacity levels to determine potential impacts to clapper rail. It is important to note that the use of the current rail population number as the carrying capacity value creates the assumption that the carrying capacity has been reached in that marsh and that any habitat loss will cause rail impacts. This, in fact, may not be true in all marshes. So, in summary, negative carrying capacity values represent maximum rail impacts that could be reached if the carrying capacity in a marsh has already been reached and that carrying capacity will be reduced as a result of habitat loss from Spartina control activities.

However, if carrying capacity has not actually been reached in a marsh, then the calculated lost carrying capacity may not represent actual lost carrying capacity, because some (or all) of the rails in the lost acreage may be able to be absorbed into the remaining habitat on site. For this reason, an assessment of the validity of all negative carrying capacity values will be done on a site-by-site basis, looking at both historic rail numbers in those marshes and/or comparing known clapper rail breeding densities in similar marshes around the San Francisco Bay. As a result of such an assessment, it may be determined that fewer rails will be impacted in certain marshes.

Note: When rail density in a sub-area marsh was determined to be equal to or less than 0.04 rails/acre, the sub-area carrying capacity values were not included in our summed carrying capacity values for the site or Bay-wide. Such a low rail density in a sub-area strongly indicates very low habitat value for rails and it cannot be assumed that 3.4 acres of this habitat would support a rail. When the 0.04 rails/acre density is converted to terms of carrying capacity, this would mean that each rail would need 25 acres of core-use habitat. In reality, rails using low value marshes do not use all areas of the marsh, but instead use the wider, higher portions, leaving much of the marsh uninhabited. Since rails are not likely to use much of the marsh acreage within these sub-areas, carrying capacity values would be artificially inflated and would give a much larger estimate for suitable breeding habitat than actually exists. For this reason, we excluded these very low rail density marshes from our analysis.
To be conservative, the SCIE-M assumed that imazapyr would be the preferred treatment method, as it has greater efficacy than glyphosate and would therefore have greater potential to impact the marsh habitat values and clapper rail carrying capacity.

Continuing the example started above for the 540.8-acre north quadrant of Baer Island, and using the most recent survey data for the site (10 clapper rails present) the change in clapper carrying capacity would be calculated as follows:

- Pre-treatment carrying capacity: 540.8 ac. marsh site / 3.4 ac. per rail = 159.1 rails
- Post-treatment habitat: 540.8 ac. site - 21.6 ac. of habitat removed = 519.2 acres
- Post-treatment carrying capacity: 519.2 ac. post-treatment habitat / 3.4 ac. per rail = 152.7 rails
- Change in carrying capacity: 159.1 pre-treatment capacity - 152.7 post-treatment capacity = -6.4 rails

In this example, since the pre-treatment population was 10 clapper rails, a post-treatment carrying capacity of 124.9 rails shows that ample habitat remains for the birds following treatment. In other cases where the post-treatment carrying capacity becomes less than is necessary for existing rail populations, a 'take' may be indicated. Before a take is assumed for any of the sub-areas analyzed however, the sub-area is further scrutinized to see how it fits into any adjacent habitats suitable as refugia for clapper rail subject to take at a given sub-area. Thus, a take would not be generated unless the post-treatment carrying capacity of geographically contiguous sites results in a carrying capacity insufficient to maintain current population levels on the site (also see the note above for discussion of actual lost carrying capacity in areas where negative carrying capacity is calculated).

D) Phased Treatment Approach

As mentioned above in the Results section, three main areas are called out as having a net decrease in CC during at least one of the control seasons covered in this analysis. Impacts on these sites do not assume a single season treatment of all non-native Spartina present. Rather, these numbers are derived from a phased treatment approach on each of the sites. Spartina treatment on any site must proceed rapidly enough to outpace the estimated expansion rate of the non-native Spartina in each of these marshes, while minimizing the impacts to rails. Table 3 details the percent of non-native Spartina treated in each year under the phased approach and the total Spartina acres on the site as calculated via efficacy of the previous years’ treatment, treated acreage, and expansion rate of the infestation:

<table>
<thead>
<tr>
<th>Site</th>
<th>Treatment Year 2005</th>
<th>Treatment Year 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres of Spartina within Site</td>
<td>Acres of Spartina Treated</td>
</tr>
<tr>
<td>17 San Leandro Bay</td>
<td>88.5</td>
<td>36.3</td>
</tr>
<tr>
<td>18 Colma Creek Complex</td>
<td>56.0</td>
<td>25.5</td>
</tr>
<tr>
<td>20 (m-o) Cogswell Marsh</td>
<td>144.4</td>
<td>75.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site</th>
<th>Treatment Year 2007</th>
<th>Treatment Year 2008</th>
<th>Treatment Year 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Spartina Project 2005 SCIE-M Page 6 of 8 May 2005*
<table>
<thead>
<tr>
<th></th>
<th>Acres of Spartina within Site</th>
<th>Acres of Spartina Treated</th>
<th>% of Spartina Treated</th>
<th>Acres of Spartina within Site</th>
<th>Acres of Spartina Treated</th>
<th>% of Spartina Treated</th>
<th>Remaining Spartina</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 San Leandro Bay</td>
<td>54.4</td>
<td>50.4</td>
<td>93.0%</td>
<td>21.4</td>
<td>21.4</td>
<td>100.0%</td>
<td>6.5</td>
</tr>
<tr>
<td>18 Colma Creek Complex</td>
<td>28.3</td>
<td>28.3</td>
<td>100.0%</td>
<td>8.5</td>
<td>8.5</td>
<td>100.0%</td>
<td>2.6</td>
</tr>
<tr>
<td>20 (m-o) Cogswell Marsh</td>
<td>34.4</td>
<td>34.4</td>
<td>100.0%</td>
<td>10.3</td>
<td>10.3</td>
<td>100.0%</td>
<td>3.1</td>
</tr>
</tbody>
</table>

The results of Table 1 and Table 3 indicate that as the amount of Spartina on each site decreases each year as a result of treatment, so too does the potential impact to clapper rail habitat. Each individual year’s Spartina acreage estimates are estimates of both untreated and surviving Spartina within the marsh multiplied by the estimated expansion rate. These plants may be growing within dead stands of the previous year’s Spartina infestation (resprouts), or in newly establishing clones adjacent to treated areas.

V. Update on rail populations in 2004 treated marshes

In 2004, Spartina control was conducted in a number of marshes in South San Francisco Bay. Comparisons of 2004 and 2005 rail populations from breeding season call counts conducted in 2004 treated marshes shows no reduction in rail numbers, even though some rail impacts were predicted and quantified using the 2004 method of impacts analysis. In fact, preliminary rail numbers for treated sites show increased rail numbers between 2004 and 2005: Site 1 (Alameda Flood Control Channel) increased from 33 to 43 rails, Site 13a-c (Old Alameda Creek) increased from 18 to 24 rails, and Site 5d (LaRiviére Marsh) increased from 12 to 18 rails. Although vegetation surveys have not been conducted in these treated marshes yet, substantial standing vegetation is visible in the marshes, consisting of both standing dead Spartina and native species. In addition, rail call counts show that distribution of rails within these marshes has not changed substantially between 2004 and 2005.

VI. Discussion of SCIE-M method of rail impact analysis

We used the 2004 rail population numbers and compared the impacts calculated with both the 2004 impacts analysis and the 2005 SCIE-M analysis. We then looked at the 2005 rail population data to see if how well results of each analysis compared to the actual number of rails counted.

For example, in Old Alameda Creek Island (Subarea 13b), where 16 acres of cordgrass were treated (20% of the marsh), the 2004 model predicted an impact to 2.24 rails. In comparison, using the 2005 SCIE-M method of impacts analysis for assessing this 2004 data, no rail carrying capacity reduction is predicted since the estimated carrying capacity of the marsh exceeds the current population by 10. In fact, data show that rail numbers in this subarea remained stable at 14 rails between 2004 and 2005. In this case, the SCIE-M model gives the accurate result.

In LaRiviére Marsh (Subarea 5d), where 25 acres of cordgrass were treated (25% of the marsh), the 2004 model predicted an impact to 1.8 rails. In comparison, the 2005 SCIE-M model predicts that a value of 10 rail carrying capacity units will still remain. Data show that rail numbers actually increased in LaRiviére from 12 rails in 2004 to 18 rails in 2005. Again, the SCIE-M model gives a more accurate result.

In comparing the results of the two models, we must remember that the 2004 impacts analysis is a simple model, which quantifies impacts using density of rails in a marsh multiplied by the number of acres of treated Spartina. The model assumes that rails are evenly spread throughout the marsh, utilizing the entirety of the marsh. While this method of analysis gives a rough quantification of impacts, it probably greatly overestimates impacts in most low to mid-density marshes because rails
actually utilize defined homeranges within a larger area, and do not expand homerange sizes indefinitely to “fill” unused spaces in the marsh. In fact, most rail activity, including nesting and calling, occurs in the core home range of about 3.4 acres, with additional areas of the homerange (95% MCP) used for foraging. The core homerange is the only part of the homerange that is highly defended and exclusive of other rail pairs. The remainder of the homerange may be shared between adjacent rail pairs. Extent of overlap of this undefended portion of the homerange between adjacent pairs is higher in higher density rail marshes.

In comparison, the 2005 SCIE-M model incorporates post-treatment habitat values and information about rail core home range size, which was lacking from the 2004 impacts analysis. It also takes into account rate of Spartina spread for untreated acreages within sites, and provides a mechanism for phasing treatment in a way that minimizes rail impacts each control year and cumulatively, while still reaching Spartina Control Program control objectives with four years of treatment.

As a result of these comparisons, the Spartina Control Program is proposing to use the SCIE-M method of rail impact analysis in 2005 because we believe it provides a more accurate quantification of potential habitat loss-related impacts to rails than the rail impact analysis conducted in the Biological Assessment for the 2004 Spartina Control Program.

LITERATURE CITED


