

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

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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 affects 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.

Note: USFWS BO concluded on September 7, 2005 that no significant reduction of carrying capacity would occur at Site 20, 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 model¹. Table 1 summarizes the estimated change 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

Site	Initial estimated rail carrying capacity	Change per treatment year			
		2005	2006	2007	2008
17. San Leandro Bay	125.0	+6.22	-7.23	-7.72	+2.09
19. Colma Creek Complex	82.0	-8.12	-16.89	-12.71	-3.80
20. Cogswell Marsh (sub-areas m-o)	85.0	+9.15	-2.62	+16.78	+16.78
Total	292.0	-8.12	-26.74	-20.42	-3.8

IV. Detailed Analysis

A) Treatment 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 2 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
 $= 36\%$ 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

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.

Table 2. Estimated efficacies of various *Spartina* treatment methods

<i>Method</i>	<i>Efficacy*</i>	
<i>Non-chemical control methods</i>		
Cover with fabric	95%	
Manual digging	95%	
Mechanical Excavation	95%	
<i>Chemical control methods</i>		
	<i>Glyphosate</i>	<i>Imazapyr</i>
Conventional spray truck	60%	80%
Backpack sprayer	50%	75%
Amphibious tracked vehicle	60%	80%
Boat with spray tank/hose	60%	80%
Aerial (Helicopter)	30%	80%
* "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.		

B) Post-Treatment Habitat Values

The “vegetation removal” estimates (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 “devegetated” 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

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*-

rent 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:

<u>Pre-treatment carrying capacity:</u>	540.8 ac. marsh site ÷ 3.4 ac. per rail = 159.1 rails
<u>Post-treatment habitat:</u>	540.8 ac. site - 21.6 ac. of habitat removed = 519.2 acres
<u>Post-treatment carrying capacity:</u>	519.2 ac. post-treatment habitat ÷ 3.4 ac. per rail = 152.7 rails
<u>Change in carrying capacity:</u>	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 resulted 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 3: Net area of non-native *Spartina* to be treated per site, per year, under the phased treatment approach

Site	Treatment Year						
	2005			2006			
	Acres of <i>Spartina</i> within Site	Acres of <i>Spartina</i> Treated	% of <i>Spartina</i> Treated	Acres of <i>Spartina</i> within Site	Acres of <i>Spartina</i> Treated	% of <i>Spartina</i> Treated	
17 San Leandro Bay	88.5	36.3	41.0%	89.9	66.5	74.0%	
18 Colma Creek Complex	56.0	26.5	47.3%	52.3	41.8	79.9%	
20 (m-o) Cogswell Marsh	144.4	75.0	51.9%	114.6	114.6	100.0%	
Site	Treatment Year						
	2007			2008			2009
	Acres of <i>Spartina</i> within Site	Acres of <i>Spartina</i> Treated	% of <i>Spartina</i> Treated	Acres of <i>Spartina</i> within Site	Acres of <i>Spartina</i> Treated	% of <i>Spartina</i> Treated	Remaining <i>Spartina</i>
17 San Leandro Bay	54.4	50.4	93.0%	21.4	21.4	100.0%	6.5
18 Colma Creek Complex	28.3	28.3	100.0%	8.5	8.5	100.0%	2.6
20 (m-o) Cogswell Marsh	34.4	34.4	100.0%	10.3	10.3	100.0%	3.1

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 (LaRiviere 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 LaRiviere 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 LaRiviere 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.

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