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BIRD OBSERVATORY

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Western Snowy Plover Numbers, Nesting Success, Fledging Success and Avian Predator Surveys in the San Francisco Bay, 2009.


M. Kern

Prepared By:
Caitlin Robinson-Nilsen, Waterbird Program Supervisor
Jill Demers, Executive Director
San Francisco Bay Bird Observatory
524 Valley Way
Milpitas, CA 95035

And

Cheryl Strong, Wildlife Biologist
Don Edwards San Francisco Bay National Wildlife Refuge
9500 Thornton Avenue
Newark, CA 94560

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ABSTRACT

The San Francisco Bay Bird Observatory (SFBBO), Don Edwards San Francisco Bay National Wildlife Refuge (Refuge), California Department of Fish and Game (CDFG), Hayward Area Recreational and Park District (HARD), and East Bay Regional Parks District (EBRPD) form the Western Snowy Plover Recovery Unit 3. The goal of this collaboration is to survey former salt ponds and other habitats for Western Snowy Plovers (*Charadrius alexandrinus nivosus*), determine nest success of Snowy Plover nests and contribute to the management of the San Francisco Bay's population of breeding Snowy Plovers. In 2009, we recorded Snowy Plover numbers, site use, nest success, fledging success, use of habitat enhancement projects, nest predators and avian predator numbers throughout the Snowy Plover breeding season.

During the 2009 breeding season window survey of the Pacific coast (24 May– 7 June) we counted 147 adult Snowy Plovers in the Bay. In 2009, we determined the fate 163 Snowy Plover nests in the South San Francisco Bay (South Bay). Ninety-six of the nests hatched (59%), 51 were depredated (31%), six were abandoned (3.6%), four were flooded (2.5%), three had unknown fates (1.8%) and two were lost at hatch (1.2%).

On Refuge property, we determined the fate of seven nests in the Alviso salt pond complex (pond A8, the Alviso impoundment and the dry pan area of New Chicago Marsh), 33 nests in the Ravenswood complex (ponds RSF2 and R1 – R5) and 21 nests in the Warm Springs complex (ponds A22 and A23). Out of these nests, 42 hatched (68.8%), 17 were depredated (27.8%), 1 was abandoned (1.6%) and 1 had an unknown fate (1.6%).

This year we determined the fate of 97 Snowy Plover nests at Eden Landing Ecological Reserve. Of the 97 nests, 53 hatched (55%), 32 were depredated (33%), 2 were lost at hatching (2%), 4 were flooded (4%), 5 were abandoned (5%) and 1 had an unknown fate (1%).

We determined the fate of five nests at Hayward Shoreline, one nest in the Old Oliver Brothers North salt ponds, which was depredated, and four nests on EBRPD's Least Tern island. Out of these four nests, one was depredated by a Killdeer (*Charadrius vociferous*), two nests were found with broken eggs and one hatched.

Throughout the South Bay, we banded 113 chicks this breeding season. From visual observations, we determined that 28 chicks survived to fledging (24.8%) as of 30 September 2009. Using only the data where all the chicks in the brood were banded (n=29), the number of chicks fledged per male was 0.62.

During avian predator surveys we counted California Gulls (*Larus californicus)* and unidentified gulls as the most numerous avian predators in all areas surveyed.

SFBBO and the Refuge began a Snowy Plover habitat enhancement study beginning the winter of 2008 at Eden Landing Ecological Reserve. Enhancements consisted of oyster shells spread by hand at densities of five to eight shells/m^2 over seven one ha plots. More Snowy Plovers nested in shell plots than in control plots, and nests in shell plots were more likely to hatch than all other nests not in shell plots. The highest nest density we recorded was six active nests in a one ha shell plot.

SFBBO, with the help of H.T. Harvey and Associates, deployed camera systems at Snowy Plover nests at Eden Landing. Camera systems were placed at 24 nests and recorded footage 24 hours a day. We recorded eight depredation events on film, including two separate events where California Gulls depredated a Snowy Plover nest and chicks. The camera systems also recorded Common Ravens (*Corvus corax*), Northern Harriers (*Circus cyaneus*) and Red-tailed Hawks (*Buteo jamaicensis*) depredating Snowy Plover nests.

The South Bay Salt Pond Restoration Project, which encompasses much of the South Bay, should continue to consider the habitat requirements of Western Snowy Plovers in the restoration planning process, including the need for large expanses of dry salt pond nesting substrate adjacent to foraging areas.

INTRODUCTION AND BACKGROUND

The Pacific coast Snowy Plover population, the Western Snowy Plover (*Charadrius alexandrinus nivosus*), breeds along or near tidal water and is behaviorally distinct from the interior population (Funk 2007). The Western Snowy Plover population has declined in response to poor reproductive success, likely due to habitat loss, habitat alteration, human disturbance, and increasing predator populations (Page et al. 1991). In response to the population decline, the U.S. Fish and Wildlife Service listed the Western Snowy Plover as a threatened species in 1993 (USFWS 1993).

Western Snowy Plover Recovery Unit 3 consists of the San Francisco Bay and includes Napa, Alameda, Santa Clara and San Mateo counties (USFWS 2007). In 1992, the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) began surveying for Snowy Plovers on Refuge lands. The Refuge developed five goals for its Snowy Plover Recovery program: 1) identify areas used by Snowy Plovers for foraging, roosting and nesting, 2) estimate Snowy Plover numbers, including breeding pairs, 3) determine nest success, 4) assess predation pressures on Snowy Plovers and 5) protect Snowy Plover breeding areas from predators and other disturbances. The Refuge joined with the California Department of Fish and Game (CDFG) in 2000 to survey Snowy Plovers on the Eden Landing Ecological Reserve property (hereafter Eden Landing). San Francisco Bay Bird Observatory (SFBBO) and the Refuge have been surveying plovers and determining nest fates since 2003.

In order to achieve the five goals put forth by the Refuge, we: 1) identified areas used by Snowy Plovers, 2) determined number of adult Snowy Plovers in the San Francisco Bay throughout the breeding season through Snowy Plover Surveys, 3) determined nest fate, success, density and chick fledging rates, 4) determined predators of Snowy Plover nests and chicks through our avian predator surveys and nest camera systems, and 5) identified areas of potential disturbances from predators, humans and construction activities. We also investigated the effect of habitat enhancements on nest success, nest density, and chick fledging rates.

The South Bay Salt Pond Restoration Project, which plans to restore over 15,000 acres of article salt pond habitat to tidal marsh and managed ponds, has set a goal of maintaining 125 breeding pairs of Western Snowy Plovers. To aid in achieving this goal, in the winter of 2008/2009 SFBBO and the Refuge initiated a habitat enhancement study on ponds currently managed for Snowy Plovers at Eden Landing. Enhancements included removing potential raptor perches that exist on the ponds and surrounding levees. In addition, using experimental plots, we added oyster shells to the pond bottoms to provide camouflage for nesting plovers and small plover chicks. We tested the effectiveness of oyster shell treatments in increasing nest success, nest density, and chick fledging rates.

This report summarizes the 2009 breeding season data, including Snowy Plover surveys, nest success, fledging success, habitat enhancement projects and avian predator surveys.

METHODS

Study Area

SFBBO and Refuge staff conducted Snowy Plover and predator surveys in the South San Francisco Bay salt ponds (Figure 1) and at one site in the North Bay salt ponds (Figure 2). The South Bay, which includes the area just north of the San Mateo Bridge (Highway 92) and extends to the extreme southern portion of the Bay, contains the majority of the Snowy Plover habitat in the Bay.

The Refuge includes approximately 30,000 acres of former salt pond habitat, tidal marsh, mudflats and upland habitat in the South San Francisco Bay. For this study, we divided the Refuge into six geographic locations: Warm Springs, Alviso, Ravenswood, Coyote Hills, Dumbarton and Mowry (Figure 3, Figure 4, Figure 5).

CDFG owns and manages Eden Landing (formally known as Baumberg), which includes approximately 5,500 acres of salt ponds, marsh and tidal habitat (Figure 6). CDFG owns and manages the Napa-Sonoma Marshes Wildlife Area, including ponds 7 and 7a, which are the only known Snowy Plover breeding ponds in the North Bay (Figure 2).

Hayward Area Recreational and Park District (HARD) owns the land directly north of Highway 92, on the east side of the San Francisco Bay, which is co-managed by East Bay Regional Parks District (EBRPD). This area includes potential Snowy Plover foraging and nesting habitat in the Oliver Brother North ponds and Frank's Dump West. EBRPD manages an island constructed for California Least Terns (*Sternula antillarum brownii*) in the adjacent area which is also used by nesting Snowy Plovers.

Snowy Plover Surveys

Snowy Plovers in the San Francisco Bay nest predominantly on dry salt ponds. To identify areas used by plovers and estimate the number of Snowy Plovers in the South Bay, we identified ponds with potential plover nesting habitat and surveyed those ponds weekly. We surveyed other ponds with less suitable habitat monthly.

From 3 March to 31 August 2009, SFBBO and Refuge biologists, interns and volunteers surveyed the ponds by driving slowly on the levees or walking the levee without vehicle access. We stopped approximately every 0.3 miles to scan for Snowy Plovers with spotting scopes. During each survey, we recorded the numbers and behavior of adult Snowy Plovers, identified the sex of each Snowy Plover based on plumage characteristics (Page et al. 1991), and marked its approximate location on a geo-referenced map. Also, if appropriate, we recorded the number of nests, the number of chicks in each pond, and the color-band combinations for both banded Snowy Plover adults and chicks.

In total, SFBBO and Refuge biologists and interns surveyed 16 Refuge ponds and 17 Eden Landing ponds weekly (Table 1, Table 2). SFBBO volunteers surveyed the Dumbarton, Napa-Sonoma Marshes Wildlife Area monthly and HARD ponds monthly. At the EBRPD Least Tern Island, SFBBO staff surveyed the island only when EBRPD staff informed them of nesting Snowy Plovers, as well as during the window survey period (see below). The Mowry salt pond complex was surveyed monthly as part of SFBBO's salt pond survey project (see Robinson-Nilsen et al. 2009a for methods).

At the end of May, the Snowy Plover breeding window survey was conducted as part of a West Coast-wide effort to census all Snowy Plovers during that time period. The methods for the Recovery Unit 3 (San Francisco Bay) window survey are the same as described above.

For the purposes of data analysis, we defined a survey as one complete survey of a single pond. We calculated the mean number of Snowy Plovers seen per area per survey (total number of Snowy Plovers seen over the season in an area pond or pond complex, divided by the number of surveys completed).

Reproductive Success

To determine reproductive success of Snowy Plovers, we located nests by visually searching for incubating females during weekly surveys. We then searched for the nest on foot and recorded the nest location with a GPS unit (Garmin® GPS 60). Volunteers locating nests visually during monthly surveys marked the location of the nest on a map and described nearby landmarks. Volunteers did not search for nests on foot. Later, SFBBO and Refuge staff searched for the potential nests on foot.

We monitored nests weekly until we determined the fate of the nest. On each visit, we recorded if the nest was still active (eggs present and adults incubating), and the number of eggs or chicks in the nest. We floated the eggs (Hays and LeCroy 1971) to estimate egg age. Plover nests are active for an average of 33 days, from initiation (the date the first egg was laid) to hatching (Warriner et al. 1986), and using the known egg age, we calculated the nest initiation date and hatch date for all nests monitored. When there were no longer eggs in the nest, we assigned each nest fate based on evidence seen at the nest. Nest fates included hatched (Mabee 1997), depredated, flooded, abandoned, lost at hatch, or unknown. In addition, we recorded if the nest was in an oyster shell plot (see Oyster Shell Habitat Enhancement methods below).

We defined a successful nest as a nest that hatched at least one egg. We calculated nest success rates for the South San Francisco Bay Snowy Plover population by calculating the percentage of total nests that hatched at least one egg. Additionally, we calculated nest density in the ponds by dividing the number of nests in each pond by the size in hectares.

Chick Color Banding

Beginning in 2008 and continuing in the 2009 season, SFBBO and Refuge biologists banded Snowy Plover chicks to study their movements and to estimate fledging success rates for the South Bay. To band chicks, biologists checked nests daily, starting four days before the estimated hatch date. Snowy Plover chicks are precocial, therefore, we attempted to time our arrival at nests when chicks had just hatched, but had not yet left the nest scrape. We banded each chick with a unique four-color combination, placing two bands on each lower leg of a chick. Each combination consisted of three darvic color bands and one silver U.S. Fish and Wildlife Service band wrapped in auto pin-striping tape to act as the fourth color in the combination (K. Neuman, pers. comm.).

To estimate chick fledging success and track chick movements, we surveyed areas with banded chicks every 2-3 days. We recorded if we saw the chick and marked its approximate location on a georeferenced map. We defined fledging success as a chick surviving to 31 days of age, at which point, they are considered to be flighted (Warriner et al. 1986). We calculated fledging success rates for the South Bay Snowy Plover population by calculating the percentage of chicks fledged per chicks banded. To

estimate the number of chicks fledged per male, we used the number of chicks fledged per brood when all the chicks in a brood were banded.

Oyster Shell Habitat Enhancement

To test the effect of oyster shell enhancements on breeding Snowy Plovers, we placed treatments on the ponds at Eden Landing using a randomized block design. Each block consisted of 2 plots placed on the salt pond bottom, a 1 ha oyster shell treatment plot (shells spread at five to eight shells/m^2) and a 1 ha control plot (no shells or other treatment). Due to seasonal flooding of ponds and limited access to the pond bottom when water levels were high, we spread the shells from 24 November to 9 December 2008. Drake's Bay Oyster Farm donated the oyster shells, and SFBBO staff, volunteers, and the California Conservation Corps spread the shells by hand.

We recorded when nests were located in a shell or control plot. We compared nest density in shell plots to the control plots with a one-tailed t-test, and compared nest success of the nests in the shell plots to all nests outside of the shell plots with a chi-squared test.

Avian Predator Surveys

To determine the avian predators in the area that might possibly impact Snowy Plovers, SFBBO and Refuge biologists and interns conducted weekly avian predator surveys on the same ponds surveyed weekly for plovers. Likewise, volunteers conducted monthly avian predator surveys at ponds surveyed for plovers monthly. We defined avian predators as any species that could potentially prey on a Snowy Plover nest, chick or adult and included: Common Ravens, American Crows (*Corvus brachyrhynchos*), Northern Harriers, American Kestrels (*Falco sparverius*), Peregrine Falcons (*Falco peregrines*), Merlins (*Falco columbarius*), Red-tailed Hawks, White-tailed Kites (*Elanus leucurus*), Golden Eagles (*Aquila chrysaetos*), Great Blue Herons (*Ardea herodias*), Great Egrets (*Ardea alba*), Snowy Egrets (*Egretta thula*), Loggerhead Shrikes (*Lanius ludovicianus*), and Burrowing Owls (*Athene cunicularia*).

We conducted avian predator surveys by driving slowly on levees or walking levees without vehicle access, stopping every 0.3 miles to survey for predators. We recorded the avian predator species present, number of individuals, their behavior and marked their approximate location on a map. In addition, we recorded any predator nests in the area and attempted to determine the fate of those nests by visual observation. We calculated the average number of predators present per survey in each pond complex by dividing the total number of individuals seen in each area by the number of surveys conducted for each Snowy Plover nesting location. We calculated the average number of predators by pond complex, as most predators have a larger territory than one pond (Strong et al 2004).

As in past years, the Refuge supervised and directed the predator management program and USDA Wildlife Services provided predatory removal services.

Nest Cameras

In order to determine the predators depredating Snowy Plover nests, we placed camera systems at nests to continuously record nest activities. We used security cameras placed in camouflaged ammunitions boxes, and positioned 10 to 30 m from plover nests. We used a coupled electrical and coaxial cable (up to 300 m in length) to connect the cameras to marine batteries and a DVR unit, which recorded the images collected at the nest. We stored the marine batteries and DVR units in plastic bins placed up to 300 m from the nest. The cameras were equipped with infrared to record images at night and ran continuously.

RESULTS

Snowy Plover Surveys

South Bay Overall
During the 2009 breeding season window survey of the Pacific Coast, we counted 147 plovers in the San Francisco Bay.

We consistently observed the highest numbers of Snowy Plovers in the South Bay at Eden Landing during our Snowy Plover surveys. Throughout the breeding season, we found the highest number of Snowy Plovers on pond E8A, which CDFG managed as Snowy Plover nesting and foraging habitat. We also regularly observed Snowy Plovers on Refuge ponds A22, A23, RSF2, R4 and the dry pan area in New Chicago Marsh in Alviso (Figure 7).

Refuge
We observed the most Snowy Plovers in the Warm Springs ponds and pond RSF2 throughout the season. Snowy Plovers used RSF2 in the beginning of the season then decreased their use of this pond the beginning of July as R1 started to dry out (Figure 8). We observed Snowy Plovers in pond R4 throughout the season

We did not observe any Snowy Plovers in the Dumbarton, Coyote Hills or Mowry complexes this breeding season.

Eden Landing
We observed the most Snowy Plovers throughout the season at Eden Landing with a mean of 159 birds observed per week from 9 March through 16 August (Figure 7). Pond E8A consistently had high numbers of Snowy Plovers, as did ponds E12 and E14.

During the last two weeks of August, we observed more than 400 Snowy Plovers at Eden Landing; presumably they were either migrating or wintering birds (Figure 7). At this point the Snowy Plovers move around the ponds daily, and we may have counted birds more than once throughout the surveys.

Hayward Shoreline

We observed small numbers of birds at Hayward Shoreline this season (mean of 6 birds per survey), both on the Oliver Brothers North former salt ponds and on the Least Tern Island.

Napa-Sonoma Marsh Wildlife Area

A SFBBO volunteer and Karen Taylor, a biologist with CDFG, regularly observed small numbers of plovers (mean of 15 birds per survey) using ponds 7 and 7A.

Reproductive Success

South Bay Overall

We determined the fate for 163 Snowy Plover nests in the South Bay. Out of these nests, 97 hatched, 50 were depredated, six were abandoned, four were flooded, two were lost at hatch, and two had an unknown nest fate (Table 3).

Refuge

In 2009, SFBBO determined the fate for 61 Snowy Plover nests on Refuge property (Table 3). In the Alviso complex, we determined the fate for five nests in the dry pan areas of New Chicago Marsh, one nest in the Alviso Marina Impoundment and one nest on the road on the east side of A8. Four of these nests hatched (57%), two were depredated (28%) and one had an unknown fate (14%).

We determined the fate for 33 nests in the Ravenswood complex. Of these, 27 hatched (82%) and six were depredated (18%). Pond RSF2 had the most nests (n=23; Table 3). We determined the fate for 21 nests in the Warm Springs area on the Refuge. Pond A23 had the most nests (n=17). Fifty-two percent of the nests hatched (11), 43% were depredated (9) and 5% were abandoned (1; Table 3).

Eden Landing

We determined the fate for 97 Snowy Plover nests at Eden Landing (Table 3). Of these, 53 hatched (55%), 32 were depredated (33%), five were abandoned (5%), four were flooded (4%), two nests were lost at hatch (2%) and one nest had an unknown fate (1%). Pond E16B had the most nests (n=24), followed by pond E8A (n=19) and E8 (n=14; Table 3).

Hayward Shoreline

This year, there were four Snowy Plover nests on the Least Tern Island (Table 3). One Snowy Plover nest was depredated by a Killdeer (Riensche et al. in prep). The fate of two of the nests was unknown. One nest hatched, but the chicks had been depredated by the following day when biologists arrived to band them.

SFBBO also determined the fate for one nest on the Oliver Brothers North salt ponds,. This nest was depredated by an unknown predator. Two chicks, presumably from the same brood, were later seen on the ponds from an unknown nest.

Napa-Sonoma Marsh Wildlife Area

In 2009, DFG biologists found and determined the fate for 12 Snowy Plover nests on the levee separating ponds 7 and 7a in the Napa-Sonoma Marsh Wildlife Area. Ten of these nests hatched, one nest was depredated and one had an unknown fate (K. Taylor, personal communication;
Table 3).

Nest Density and Breeding Chronology

The pond with the highest nest density was E16B, with 0.73 nests per hectare (Table 4 and Table 5).

The peak Snowy Plover nest initiation week in the South Bay was 7 June 2009 with 18 nests initiated (Figure 9). There was also a small peak in nest initiation during the week of 15 May. The number of active nests per week stayed fairly constant throughout the season, with the number of active nests ranging from 30 to 45 for the time between 12 April and 12 July (Figure 9).

Chick Fledging Success

In 2009, SFBBO biologists banded 113 Snowy Plover chicks. We determined that 28 chicks fledged (24.8% fledging rate). Using only the data where all the chicks in the brood were banded (n=29), the number of chicks fledged per male was 0.62.The fledge rate in 2009 was 25.7% at Eden Landing (n=68), 100% at Warm Springs (n=5), and 13.2% at Ravenswood (n=39; Table 6).

The number of chicks fledged varied by pond and ranged from 0% on pond E11 (n=2) to 100% on pond A23 (n=5) and R5 (n=3; Table 6).

Habitat Enhancement Project: Oyster Shell Plots

We spread seven 1-ha size shell plots prior to the 2009 breeding season. Three plots were on E16B, two plots on E8, one on E6B and one on E6A.

Twenty-four of the 97 nests that we monitored weekly the Eden Landing complex were in shell plots. More Snowy Plovers nested in shell plots (n=24) than control plots (n=0; *t*=4.08, df=6, *P*=0.015). Two of the E16B shell plots were used heavily in the beginning of the season, and we recorded the highest known Snowy Plover nest density in the San Francisco Bay in one of those shell plot (6 nests/ha). The third shell plot hosted two nests.

No plovers nested in the control plots, therefore, we compared nest success in shell plots to all other nests at Eden Landing. Nest success rate in the shell plots was 66%, whereas the nest success rate at Eden Landing outside of the shell plots was 50%. Nests in the shell plots hatched at higher than expected rates compared to all other areas at Eden Landing (χ^2 =4.98, df=1, *P*=0.026). Eight percent of the shell plot nests were depredated compared to 44% of nests at Eden Landing outside of the shell plots.

The fledging rate of banded chicks from shell plots (25% in E16B and 23.1% in E8) was nearly identical to the overall South Bay fledging rate of 24.8% (Table 7).

Avian Predators

Refuge

The most commonly observed avian predators in all areas of the Refuge were California Gulls and unidentified gulls (presumably mostly California Gulls at this time of year and location; Table 8). Other frequently observed predators in Alviso included Great Egrets and Snowy Egrets, which were observed foraging in ponds A5 and A7, and Common Ravens in A8 and A12. We also observed Northern Harriers and Red-tailed Hawks hunting the Dumbarton ponds. In the Ravenswood complex, we observed groups of Common Ravens and American Crows foraging on pond RSF2 throughout the season. At one point we saw a group of 26 crows foraging on the pond bottom. We usually observed the crows west of the PG&E towers running through the pond. Another predator that we observed on RSF2 throughout the season was a Red-tailed Hawk, which was perched on the PG&E towers. We observed very high numbers of Common Ravens at Warm Springs (Table 8).

Eden Landing

The most commonly observed avian predators at Eden Landings were California Gulls and unidentified gulls (Table 8). We also observed many Snowy Egrets and Great Egrets feeding in the sloughs and in pond E9.

At the beginning of the season, we regularly observed a pair of Red-tailed Hawks perched in the PG&E towers in ponds E16B and E15B. We also observed different Red-tailed Hawks along Old Alameda Creek, perched on the old power poles. We frequently saw Northern Harriers hunting along Old Alameda Creek and hunting ponds E8, E8A, E8X and E14. Late in the season, we started seeing more harriers hunting along Mt. Eden Creek and E12 and E14.

Great Blue Herons nested again this season on the old hunting blind in E6B, referred to as the "heron house." In 2007 and 2008, herons also nested on the old hunting blinds in E9 and E14 (Schacter et al 2008). This year we observed them constructing nests on the blinds in E9, however, they abandoned their nesting attempt for unknown reasons.

Hayward Shoreline

California Gulls were the most commonly observed avian predator at Hayward Shoreline (Table 8). A volunteer also observed unidentified gulls and American Crows at the ponds.

Napa-Sonoma Marsh Wildlife Area

Great Egrets were the most commonly observed avian predator at the Napa-Sonoma Marsh Wildlife Area (Table 8). A volunteer also observed Common Ravens and Great Blue Herons.

Nest Cameras

We recorded footage at 24 nests throughout the season, and filmed eight depredation events. We recorded two Red-tailed Hawks, a Common Raven, a California Gull and two Northern Harriers depredating Snowy Plover nests. We also recorded a California Gull depredating newly hatched Snowy Plover chicks and a Northern Harrier depredating newly hatched California Least Tern chicks.
This footage can be viewed at:
http://vimeo.com/4186219

Observed Depredation Events

One of field assistant working on the project observed a Northern Harrier depredate a Snowy Plover nest on pond E8A on 12 June 2009.

Mammalian Predators

We did not observe any direct evidence of mammals depredating Snowy Plover nests or chicks; however we did see skunks, raccoons, opossums, grey foxes and feral cats around nesting ponds. The feral cat feeding station is still operating outside the Veasy Street gate to Eden Landing where cat food is deposited regularly.

DISCUSSION

Snowy Plover Surveys

It is difficult to estimate the exact number of breeding Snowy Plovers in the San Francisco Bay because the majority of the Bay's adult Snowy Plovers are not color

banded and surveys of areas take several days to complete. A rough estimate of the number of breeding Snowy Plovers is 147 birds, based on a complete survey done during the breeding window survey conducted the last week in May. Eden Landing continues to host the majority of the Bay's Snowy Plovers, though numbers increased this season at pond RSF2 and the Warm Springs ponds.

Reproductive Success

We found more Snowy Plover nests in 2009 (n=163) than in previous years (118 nests in 2008 and 89 in 2007). This increase may be due to increased survey efforts due to a larger staff, rather than an actual increase in the number of nests.

Nest success in the South Bay increased for the second year in a row to 59%. Although it was not as high as nest success in 2004 and 2005, it is an improvement from 2007 and 2008, when less than 50% of the nests hatched. The increase in nest success may be due to the habitat enhancement project or to more focused predator management activities from the data collected by the nest cameras.

In 2009, more plovers nested on Refuge ponds than in previous years. We found 17 nests on A23, compared to 4 nests in 2008. On pond A23, all known nests initiated before 15 May (7 nests) were depredated, whereas all known nests initiated after May 15 hatched (10 nests). The Warm Springs salt ponds are located between the Newby Island Landfill and the Tri-Cities Landfill; large numbers of gulls fly between the landfills during the day, and we recorded large numbers of gulls roosting on pond A23 during the non-breeding season. The drop in number of Snowy Plover depredated nests at A23 after May 15 may be due to the wintering gulls leaving the area, or a change in foraging behavior by the local California Gull breeding population. During the breeding season, approximately 12,482 adult California Gulls bred on Mowry ponds M1/M2 and M4/M5 (SFBBO, unpublished data), which is adjacent to the Warm Springs ponds.

Pond A8 was flooded this year to exclude Snowy Plovers from nesting there due to planned construction on this pond. However, this lack of habitat likely caused a Snowy Plover pair to nest on the road adjacent to pond A8. Snowy Plovers have breed in A8 in past years; we monitored two nests in 2007 and 11 nests in 2006 (Robinson et al. 2006; Robinson et al. 2007). Additionally, in 2008, we monitored a plover nest on an island in pond A12, which had water levels lowered to provide shorebird nesting habitat. Snowy Plovers did not use A12 in 2009, even though water levels were lowered in March 2009. This may have been too late in the season to lower water levels for Snowy Plovers and instead plovers nested on the dry pan area of adjacent New Chicago Marsh.

The Ravenswood ponds R1, R2 and R3, where the majority of the Ravenswood Snowy Plovers nested in 2007 and 2008, were flooded during the winter of 2008-2009 to kill invasive vegetation growing on R3. These ponds were still flooding at the beginning of

breeding season, and, in response, large numbers of plovers nested on RSF2. We also found a nest on R5. Once R1 dried in June, the plover use of RSF2 decreased, and we began to observe plovers nesting on R1. (For more on pond RSF2, please see the Restoration and Snowy Plover Nesting section below.)

At Eden Landing, Snowy Plovers nested on 13 ponds, with the majority of the nests on ponds E16B, E8A, E8 and E12. E16B was dry at the beginning of the breeding season and contained three shell plots, which likely increased the attractiveness of the pond to nesting Snowy Plovers before other ponds dried out. Although 11 of these nests hatched, we rarely observed chicks on this pond, and a male with a chick from E16B was seen crossing Mount Eden Creek to get to E12. This suggests that with the steep drop to the borrow ditch, E16B may not provide foraging habitat and chicks must go elsewhere to forage. Mount Eden Creek is tidal, and crossing this wetland may be dangerous for plover chicks. In the future, water levels should be kept higher or interior channels should be added to E16B to increase the amount of foraging habitat in this pond.

Ponds E8, E6B and E6A were not drained until later in the season. Consequently, these ponds were not regularly used by plovers until the end of the breeding season, when flocks of over 150 Snowy Plovers were observed roosting and foraging on these ponds. Pond E12 dried out in May, although we found two Snowy Plover nests in the dry "salt works" area of this pond in April. These nests were very close to the levee, and one was depredated by a Common Raven, which was recorded with our nest cameras.

At EBRPD's Least Tern Island this season, two of the four Snowy Plover nests located there failed for unknown reasons, although it is a possibility that they were stepped on by other nesting birds on the island, such as American Avocets (*Recurvirostra Americana*), Black-necked Stilts (*Himantopus mexicanus*), Canada Geese (*Branta canadensis*) or roosting Marbled Godwits (*Limosa fedoa*). Additionally, biologists observed Killdeer removing a Snowy Plover egg from another nest and piercing it with its bill (Reinsche et al, in prep). The other nest appeared to have hatched, however, all three chicks had been depredated by an unknown predator by the time biologists came to band the chicks the following day.

There were 12 Snowy Plover nests this season at the Napa-Sonoma Marsh Wildlife Area. This is the first year that the number of nests and the nest fates were documented for the North Bay ponds.

Chick Fledging

The 2009 South Bay fledging rate of 24.8% was lower than last year's fledging rate of 28.9%. These fledging rates in the South Bay are lower than those reported by PRBO Conservation Science in the Monterey Bay from 1997 through 2007 (G. Page, personal communication). However, with only two years of data we cannot state if this low fledging rate is typical of the South Bay.

At pond RSF2, we banded 36 Snowy Plover chicks, but confirmed that only two chicks survived to fledging. We consistently saw flocks of American Crows as well as Common Ravens walking and scavenging on the pond bottom. These birds roosted in the trees in adjacent business parks and the PG&E substation near pond R2. We also regularly observed Red-tailed Hawks and a Peregrine Falcon in the PG&E towers running through the western side of the pond.

We banded five chicks at pond A23 at Warm Springs from three separate clutches. All of the five chicks that were banded also fledged. This was surprising due to the large numbers of gulls and ravens seen at Warm Springs, the high rates of predation on Snowy Plover chicks in other areas (Robinson et al. 2008), and predation rates on other shorebird chicks in the South Bay (Ackerman et al. 2006). This may be due to the fact that pond A23 has gypsum deposited on the pond bottom and provides lots of cover for chicks, or that the predators were not foraging on the ponds during June, July and August. In addition, the Newby Island landfill has been practicing gull abatement techniques which are reducing gull use of this landfill.

The chicks banded in pond E12 had the highest fledgling success rate at Eden Landing, as in 2008. The E12 chicks may have also benefited from hatching later in the season when there are additional predator food sources in the ponds in July and August because of the returning migratory shorebirds.

Habitat Enhancement Project: Oyster Shell Plots

Snowy Plovers used the oyster shells plots for nesting more than the control plots. However, the amount each plot was used varied, most likely based on location of plot within the pond. One of the E16B plots and the E6A plot were directly under a PG&E tower where Red-tail Hawks were often seen perched and these plots were not used heavily for nesting. The E16B plot under the power tower only had two nests in it and we never observed a Snowy Plover in the E6A shell plot. The E6A plot is also located between a levee and the PG&E towers and it may not be open enough for Snowy Plovers. Snowy Plovers have not used this pond in recent years.

Three of the plots were flooded throughout the 2008/2009 winter and did not dry out until the middle of the Snowy Plover breeding season. These plots were on the south side of E8, E6B and E6A. The shells had small amounts of sediment deposited on them but still looked white against the darker pond bottom substrate. We found one nest each in both the E6B and E8 south shell plots. We later found more scrapes in both plots, but we were not able to determine if they were ever active nests.

The percentage of depredated nests within the shell plots (8%) was much lower than the rest of the nests at Eden Landing (44%). The oyster shells may have provided the camouflage needed to conceal the nests and adults from predators. In the fall of 2009,

SFBBO will continue to spread shells on eight additional 1-ha plots in order to further test the effectiveness of shells in reducing nest predation, increasing nest density, and increasing chick fledging rates.

The highest nest density ever recorded in the South San Francisco Bay was within one of the shell plots on E16B. This has important implications as the amount of available nesting habitat on salt ponds is reduced by the South Bay Salt Pond Restoration Project. Snowy Plovers nesting density will need to increase the Snowy Plover breeding population on a smaller habitat footprint. The nest density achieved in the oyster shell plots illustrates that the higher nest densities needed to reach the recovery goal of 500 breeding birds in the San Francisco Bay may be possible in the future.

Avian Predators

From the data collected by the cameras, observation of a direct predation event, and the data collected during avian predator surveys, Northern Harriers continue to be a predator of concern. As well as documenting predation of plover nests and chicks, we frequently observed Northern Harriers hunting ponds with Snowy Plover nests. Additionally, nest camera recorded one instance of a Northern Harrier depredating California Least Tern chicks, an endangered species. The restoration of marsh habitat in the future will increase the potential Northern Harrier nesting habitat in the South Bay. An increase of the local Northern Harrier population may result in higher predation pressure on salt pond nesting waterbirds.

California Gulls also continue to be a predator of concern. This year we captured the first direct evidence that California Gulls directly impact Snowy Plovers. California Gulls are opportunistic feeders and are documented depredating other shorebird eggs and chicks in the South Bay (Ackerman et al. 2006). Three of the largest colonies (Alviso A6 colony, Mowry M4/M5 colony and the Coyote Hills colony) are close to Snowy Plover nesting areas. This year we saw more gulls using the ponds at Eden Landing for foraging and roosting. This year, the largest colony on pond A6 hosted approximately 24,190 breeding adults (Robinson-Nilsen et al. 2009b), a decrease from 2008 (26,366 breeding adults; Schacter et al. 2008). Construction on pond A6, will begin during the winter of 2009/2010, reducing the amount of breeding habitat available to California Gulls. Presumably, California Gulls will move elsewhere in the Bay to breed. If California Gulls begin to breeding on or closer to Snowy Plover nesting ponds, gulls may further impact plovers by depredating nests and chicks or encroachment on nesting habitat.

The other avian predators we filmed depredating Snowy Plover nests were Common Ravens and Red-tailed Hawks. Both these species are known to nest in the PG&E towers which run through the Snowy Plover nesting ponds at Eden Landing, Warm Springs and Ravenswood. We frequently observed both Red-tailed Hawks and Common Ravens perched in the towers within nesting ponds at all three complexes. These species should be discouraged from nesting in the towers, preferably before Snowy Plover nesting

season starts. The Refuge will continue to coordinate the removal of these nests from towers with PG&E annually.

Restoration and Snowy Plover Nesting

The majority of the South Bay's Snowy Plover nesting habitat is located within the South Bay Salt Pond Restoration Project (the Project) area. The Project aims to restore large areas of former salt ponds to a mix of wetland habitats including managing former salt ponds as managed wildlife ponds. Some of the ponds that will remain managed wildlife ponds, such as RSF2, E12/13 and A16, will have islands constructed on them to provide waterbird nesting, roosting and shallow-water foraging habitat. The Project has agreed to support 125 breeding pairs of Snowy Plovers within the Project area. Here, we make recommendations to reduce conflicts between restoration constructions activities and nesting plovers, manage habitats to help reach the Project's goal of 125 breeding Snowy Plover pairs, and reduce receational disturbance that may result as the Project oepns more areas to public use.

In 2009, the Project's Phase 1 construction activities began on some of the ponds used by Snowy Plovers for nesting. We observed several negative effects on breeding Snowy Plovers, and recommend in the future the Project works carefully to maintain enough nesting habitat to support the existing population of Snowy Plovers during construction activities. We strongly suggest that managers provide nesting habitat in nearby or adjacent areas to ponds drained for construction to avoid plovers nesting in contrsuction areas. For instance, pond A8 in Alviso was flooded to keep Snowy Plovers from nesting there during construction on the outer levees. The flooding was successful in keeping Snowy Plovers from nesting in the pond (where they have nested in past), however, nesting habitat was also limited in nearby areas, such as A12. As a result, one pair of Snowy Plovers nested on the access road surrounding pond A8, which put the nest in danger and compromised manager's access to the area. Additionally, construction in pond A8 was delayed until after the plover breeding season (fall 2009); thus flooding of the pond and the loss of plover nesting habitat was unnecessary. In the future, if current Snowy Plover nesting ponds are to be flooded to exclude plovers, managers should drain other nearby ponds before plover breeding season in order to provide nesting habitat.

We suggest that construction activities on Snowy Plover nesting ponds start before the breeding season and actions be taken before the nesting season starts to deter Snowy Plovers from nesting on ponds where heavy equipment will be operating. For example, in the Ravenswood pond RSF2, construction began in March 2009 at the same time as Snowy Plovers were copulating and constructing nests on the pond. Historically, only small numbers of Snowy Plovers used this pond, however, in 2009, ponds R1 (which had 17 nests in 2008), R2 and R3 were flooded to kill invasive vegetation. This left very little suitable habitat available for Snowy Plovers in Ravenswood. As a result, we observed large numbers of Snowy Plovers using RSF2 for both foraging and nesting, despite the

ongoing construction. SFBBO and Refuge biologists worked carefully with the construction crews so as not to crush known Snowy Plover nests or chicks with heavy equipment or step on them while walking through the ponds. We believe that starting construction prior to the start of breeding season, when plovers prospect for suitable nest sites, in conjunction with providing nearby nesting habitat, may have limited the number of Snowy Plover nesting in this pond.

The largest impact that the Project will have on South Bay Snowy Plovers is the reduction of nesting and foraging habitats, as salt ponds are opened to tidal action. We recommend converting ponds to tidal action slowly, and studying the impacts to breeding Snowy Plovers. Many of the first ponds to be opening to tidal action or converted to ponds with islands have historically hosted large numbers of Snowy Plovers (A8, E12/E13 and E8A), and losing these nesting ponds may negatively affect the number of Snowy Plovers nesting in the Bay. Snowy Plovers in the San Francisco Bay prefer to nest in dry salt ponds or on large, open salt panne areas located near foraging habitat. While four Snowy Plovers nested on EBRPD's Least Tern Island this season, and one nest was found on an island in A12 in 2008, it is unknown how many pairs the created islands in ponds A16, RSF2 and E12/13 will support. Therefore, dry salt panne habitat may need to be actively managed and maintained in the future as primary nesting habitat in order to reach the Project's goal of 125 breeding Snowy Plover pairs.

Another goal of the Project is to increase the public access to certain areas. Currently, most Snowy Plover nesting areas are closed to the public; however, we routinely see trespassers in the closed area at the Warm Springs and at Eden Landing. For example, in 2009, trespassers on ATVs drove through ponds that had active Snowy Plover nests. Research has shown that the Snowy Plovers in the South Bay are very sensitive to recreational disturbance (Robinson 2008); therefore, public access may need to be limited or prohibited on trails adjacent to Snowy Plover nesting ponds during the breeding season (March-August). Additionally, fencing or barriers that limit pedestrians from entering sensitive nesting areas and reduce human disturbance may need to be installed.

In conclusion, we recommend that the Project carefully plan construction activities so they do not negatively impact breeding Snowy Plovers. We recommend providing alternative breeding habitat when construction activities impact Snowy Plover nesting ponds. We also recommend beginning construction activities before Snowy Plover breeding season begins, and discouraging plovers for using ponds where construction activities are taking place. As more areas are opened to tidal action or converted to ponds with islands, the Project will need to take great care in maintaining enough Snowy Plover nesting habitat to maintain and increase the number of nesting Snowy Plovers in the South Bay. In addition, as areas are opened to the public, managers will need to take numerous steps to reducing recreational impacts to nesting Snowy Plovers. The Project will impact Snowy Plovers in multiple ways and managers and researchers

should continue to study and monitor the plovers South Bay to reduce the negative impacts in the future.

RECOMMENDATIONS

Research Recommendations

Future research involving Snowy Plovers and their nesting areas within the salt ponds should include projects that address the following topics:

1. Continue to band and track Snowy Plover chicks, and begin to band adults, to examine how plovers use the habitats throughout the breeding season. Additionally, banding provides data on Snowy Plover adult survival rates, better population estimates, and chicks fledging success rates. This is vital information to reach the recovery goal of 500 birds in Recovery Unit 3, with 250 birds to be supported in the South Bay Salt Pond Restoration Project area.
2. Impacts of California Gulls on nesting Snowy Plovers.
3. Potential impacts of disturbance from trail use at Eden Landing and RSF2
4. Research on the effectiveness of the avian predator management on increasing Snowy Plover nest success.
5. Further studies on Northern Harrier territory size and habitat use.
6. Plover foraging habitat use (borrow ditches, open channel, muted tidal, shallow pools, dry substrate) and invertebrate availability within the salt ponds.
7. Experimental designs to determine whether Snowy Plovers in the Bay will nest on islands constructed as part of the South Bay Salt Pond Restoration Project.

Recommendations for the Snowy Plover Recovery Project

1. The Western Snowy Plover monitoring program should continue into the future. Monitoring the South Bay population is important to ensure that the Snowy Plover population does not decrease as nesting habitat is reduced due to habitat conversion to tidal marsh and construction activities occur.
2. Plover chicks and adults should be banded and re-sighted every day to determine chick and adult survival, fledging rates and movements. Banding chicks will be required to assess the progress toward the recovery goal of 1.0 chick fledged per male.
3. SFBBO, along with CDFG and the Refuge should develop a Snowy Plover outreach program in areas adjacent to Snowy Plover breeding habitats. Some of these areas will be open to the public within the next few years and actions should be taken now to educate the public on Snowy Plover conservation issues.
4. SFBBO, along with CDFG and the Refuge, should design interpretive panels to be placed in areas open to the public to educate people on Snowy Plover habitat needs and conservation issues, such as the panel ebing designed for pond RSF2.

Management Recommendations

1. Management should continue to meet Snowy Plover habitat requirements by: a) providing areas of drying salt ponds with nearby high salinity foraging habitat, b) manage ponds in several areas around the South Bay for Snowy Plovers to reduce the potential impacts from predation, flooding, or disease, c) varying the locations of Snowy Plover ponds should vary from year to year to reduce predation rates.
2. The predator management program should continue in 2010 in the South Bay. This should include removing mammalian and avian predators and predator nests. Avian predator management should be considered on Refuge lands.
3. Pond E6A and A22 should be flooded to kill off vegetation that is growing on the pond bottoms which may discourage Snowy Plovers from using these ponds.
4. Pond E11 has fissures throughout the mid section of the pond. Some of these cracks are over half a meter deep and could be a hazard for Snowy Plover chicks. The pond should be flooded to prevent Snowy Plover nesting.
5. If the Ravenswood ponds are to support more Snowy Plovers in the future, the ponds should be drained before the breeding season begins, to expose the panne habitat for nests and the water level in the borrow ditches should be higher in order to keep water and the interior channels. This will create better foraging habitat and hopefully increase the numbers of Snowy Plovers using the complex.
6. Managers and biologists should continue to work with PG&E to remove predator nests from the towers. Tower design modifications should be researched to discourage ravens and Red-tailed Hawks from nesting in the towers near Snowy Plover habitat. In addition, trees should be removed from the PG&E substation near pond R2 to discourage roosting by American Crows.
7. The feral cat feeding station by the Eden Landing Veasy Street gate should be removed. This encourages feral cats near Eden Landing as well as other predators including raccoons, skunks and rats. So far, no local agency has been identified as having jurisdiction over the Veasy Street feeding station.
8. More effort should be put into enforcement of regulations and area closures of Snowy Plover breeding habitat to minimize disturbance from humans. This will become progressively more important as additional areas are open to the public as part of the Project.

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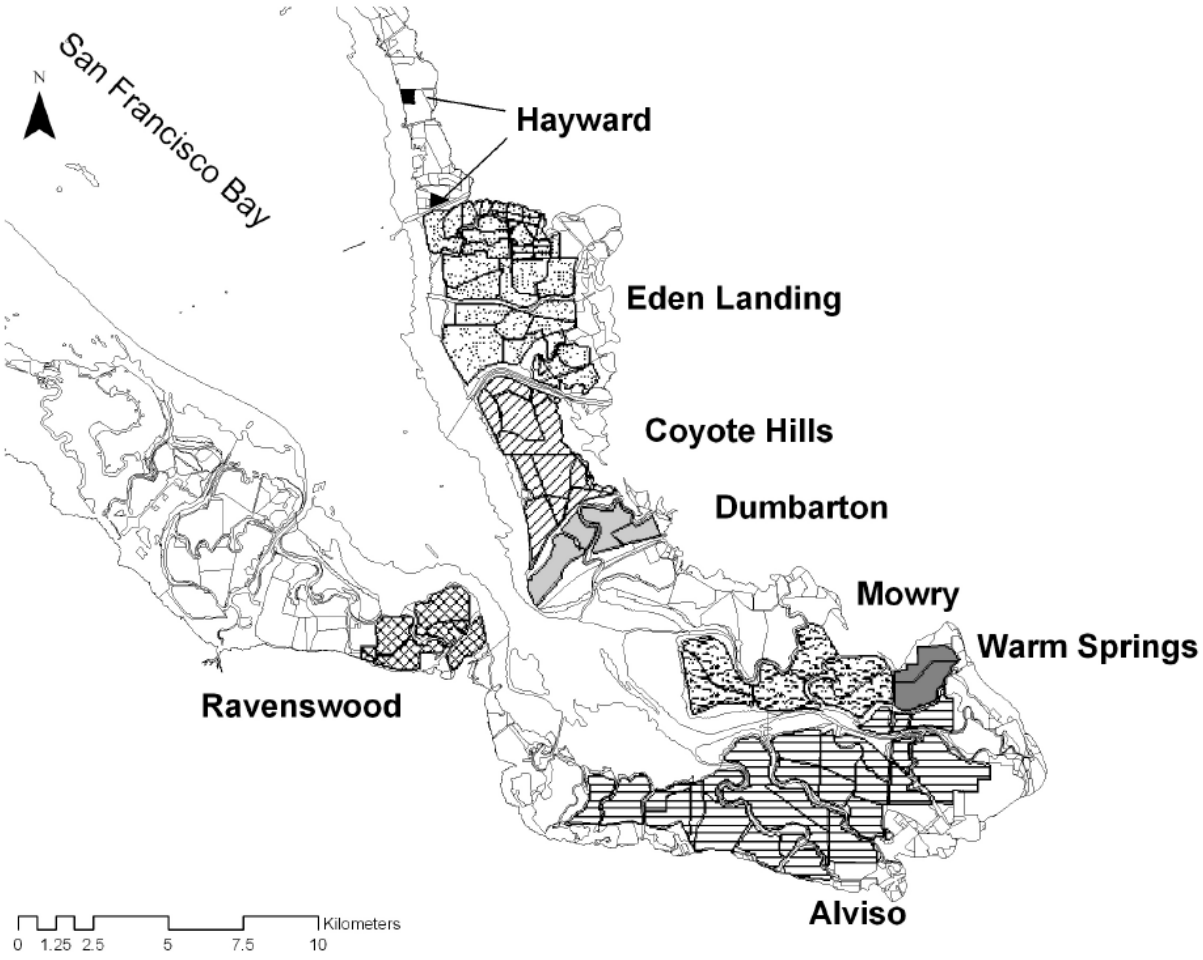

Figure 1. The Don Edwards San Francisco Bay National Wildlife Refuge, CDFG's Eden Landing, and Hayward Area Recreation District lands in the South San Francisco Bay.

Figure 2. Salt ponds located in the CDFG's Napa-Sonoma Marsh Wildlife Area, near Napa, San Pablo Bay.

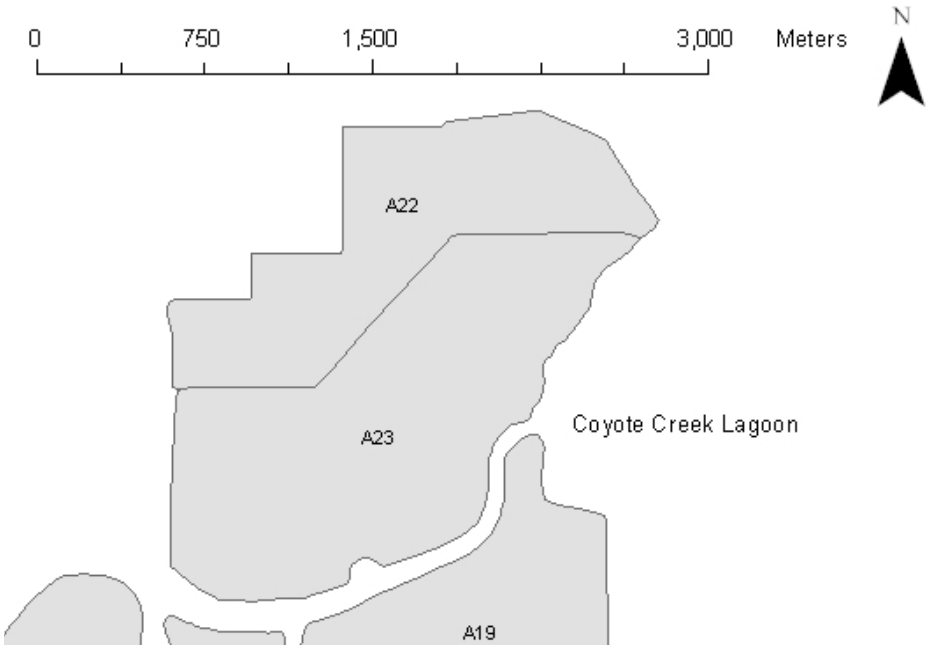

Figure 3. Salt ponds located in the Refuge's Warm Springs area, near Fremont, South San Francisco Bay.

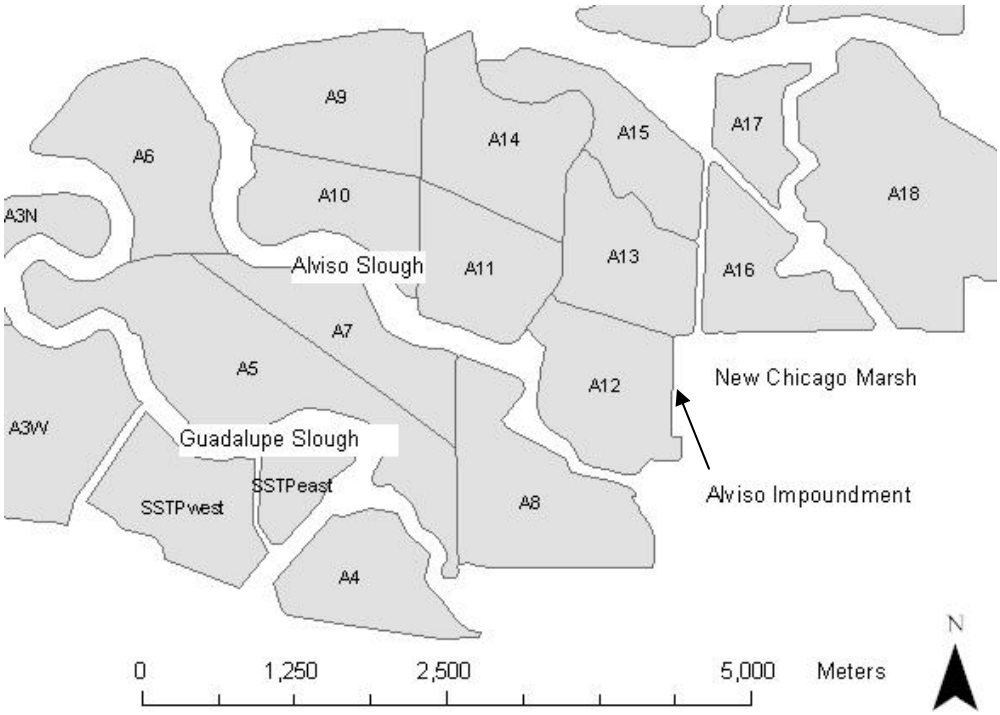

Figure 4. Salt ponds in the Refuge's Alviso complex, at the southern end of the South San Francisco Bay**.**

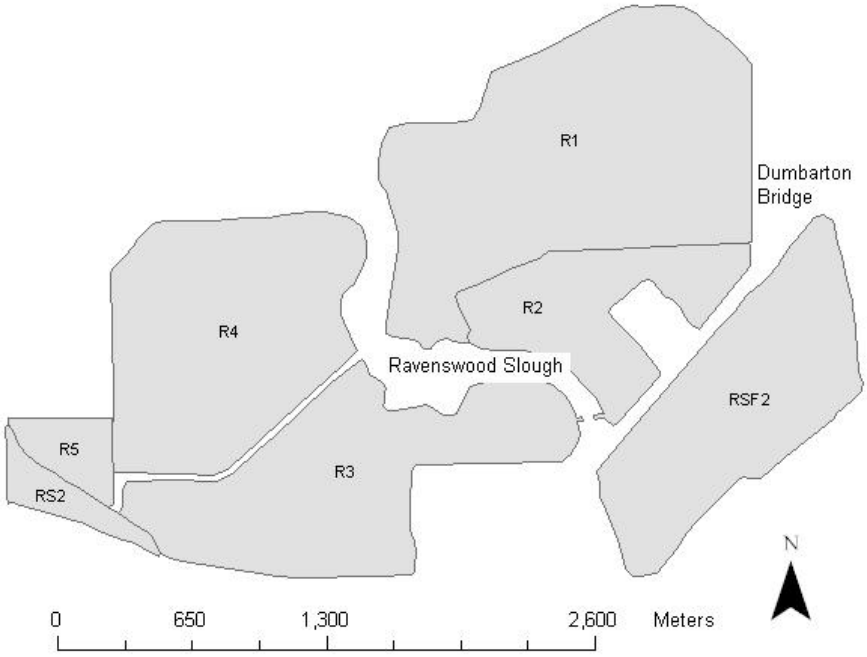

Figure 5. Salt ponds in the Refuge's Ravenswood complex, at the west end of the Dumbarton Bridge, South San Francisco Bay.

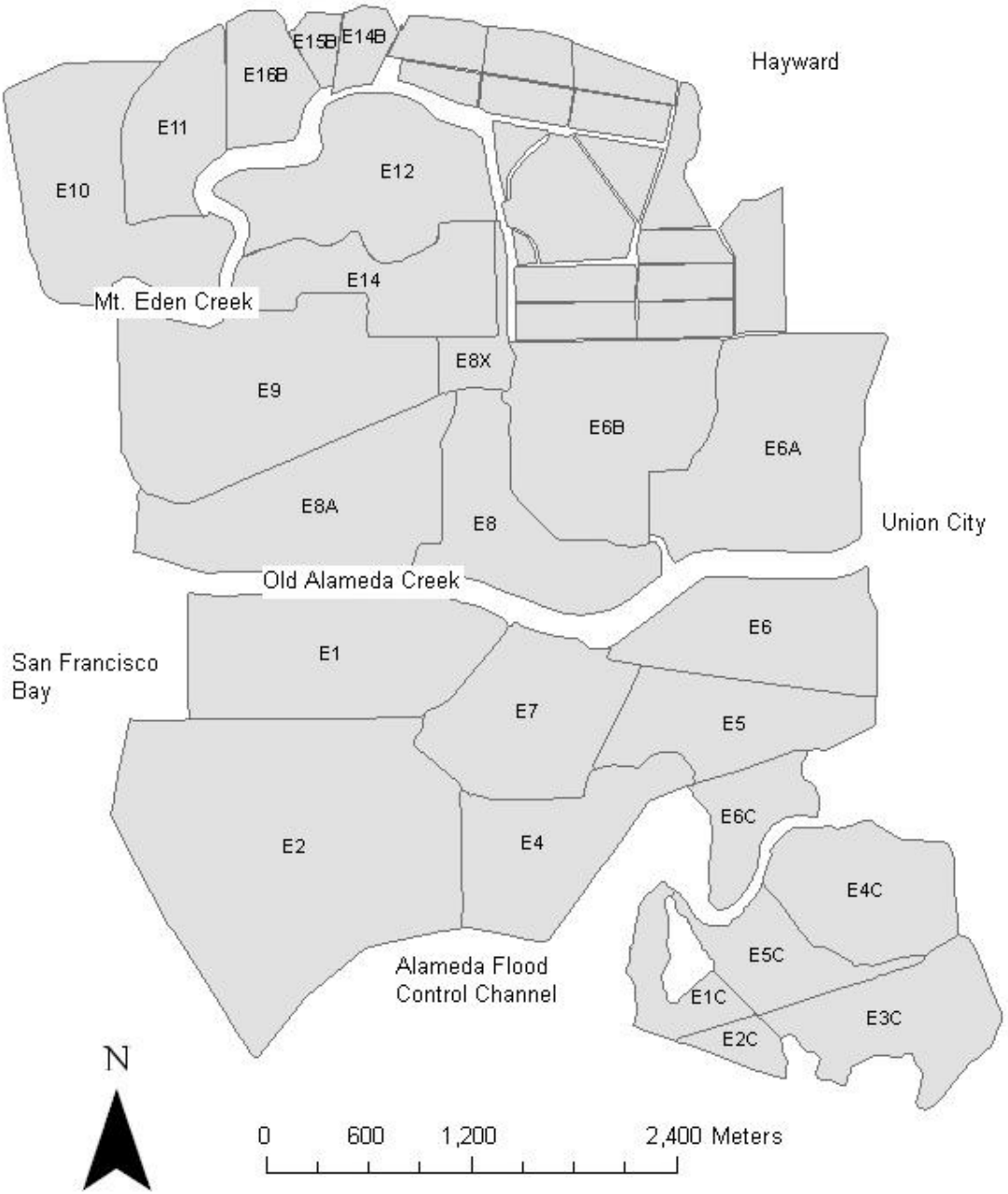

Figure 6. Salt ponds in the CDFG's Eden Landing Ecological Reserve Complex, near Hayward, South San Francisco Bay.

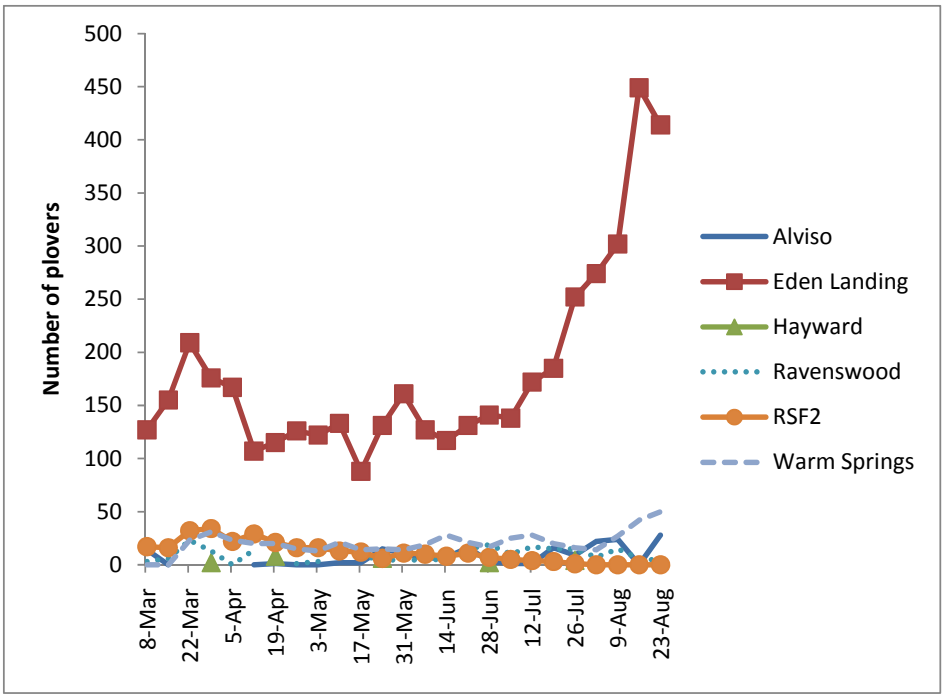

Figure 7. Weekly counts of adult Snowy Plovers by week and area, South San Francisco Bay, CA, 2009

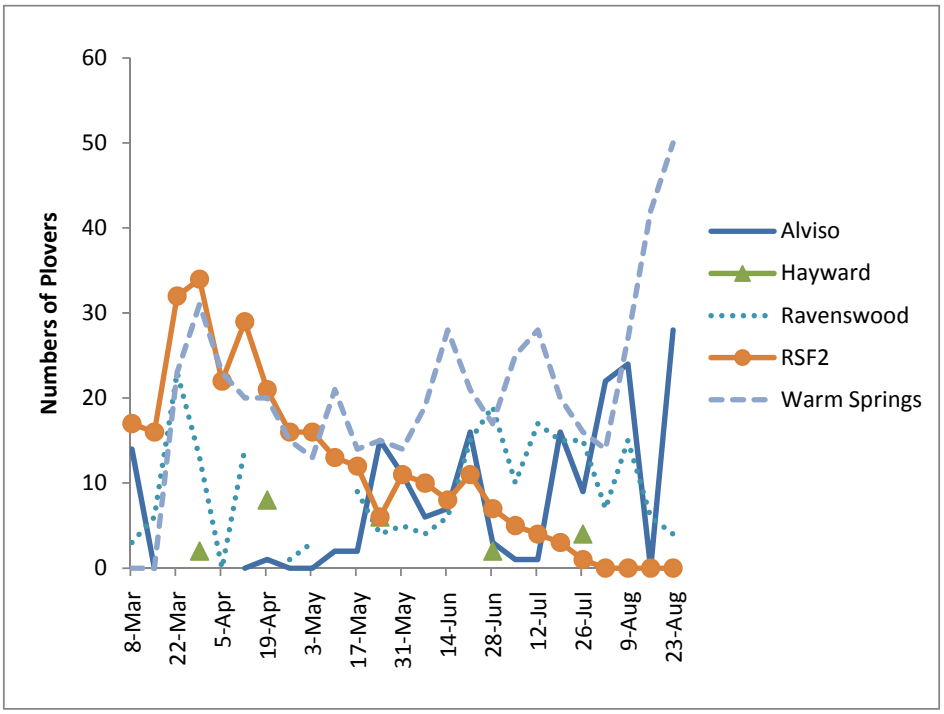

Figure 8. Weekly count of adult Snowy Plovers by week and area, South San Francisco Bay, CA, 2009, excluding Eden Landing.

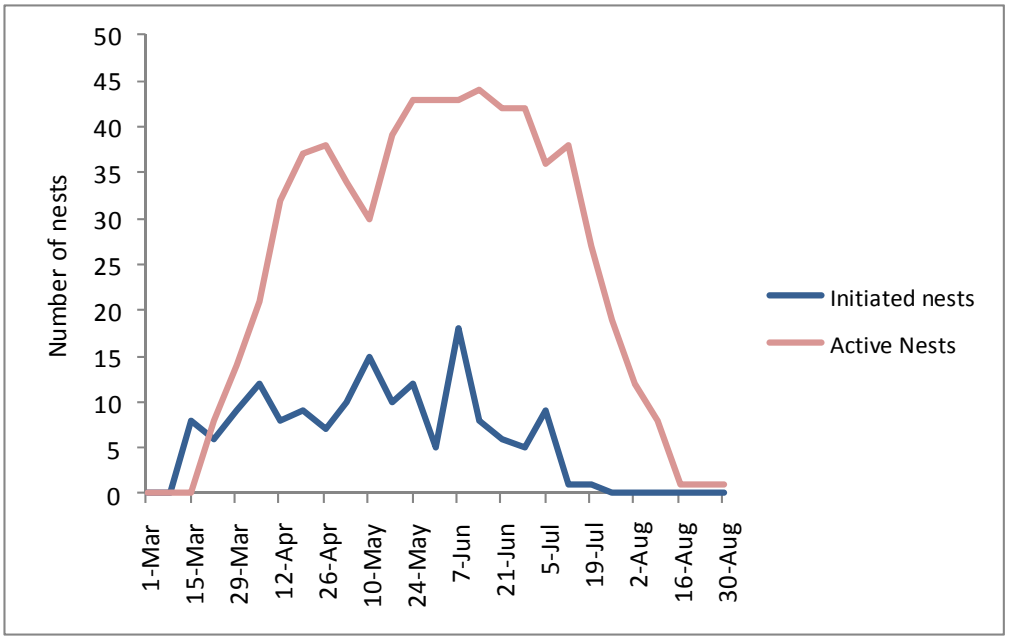

Figure 9. The weekly number of initiated and active Snowy Plover nests in the South San Francisco Bay, CA, 2009.

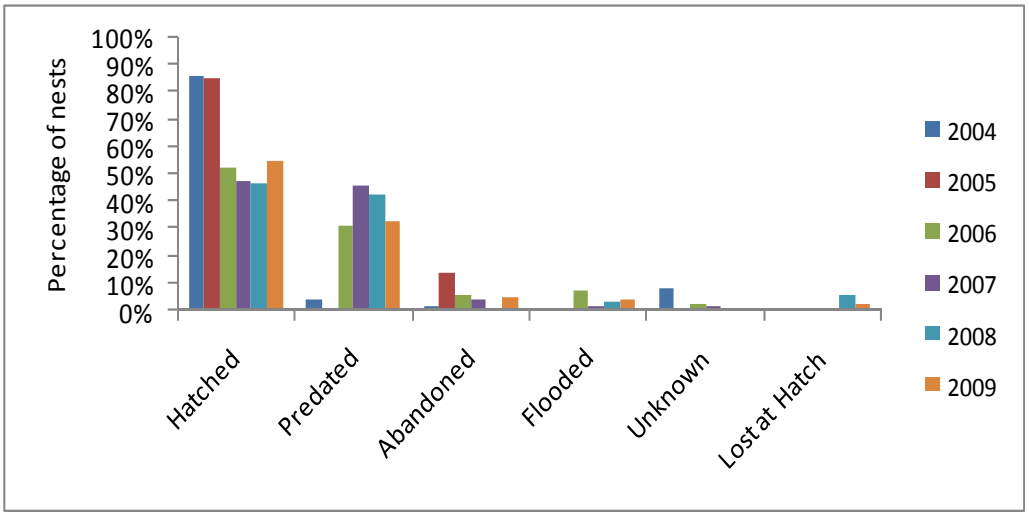

Figure 10. Annual Snowy Plover nest fates in the South San Francisco Bay, CA, 2004-2009.

Table 1. Ponds surveyed within the Don Edwards San Francisco Bay National Wildlife Refuge, South San Francisco Bay, CA, 2009.

Location	Ponds
Alviso	A5, A6, A7, A8, A12, A13, Impoundment, New Chicago Marsh
Dumbarton	N1, N2, N3, PP1
Ravenswood	R1, R2, R3, R4, R5, RSF2
Warm Springs	A22, A23

Table 2. Ponds surveyed on California Department of Fish and Game property, San Francisco Bay, CA, 2009.

Location	Ponds
Eden Landing Ecological Reserve	E6, E8, E8A, E8X, E11, E12, E14, E15B, E16B, E1C, E2C, E3C, E4C, E5C
Napa-Sonoma Marsh	7, 7a

Table 3. Snowy Plover nest fates by pond in the South San Francisco Bay and the Napa-Sonoma Marsh Wildlife Area, CA, 2009.

Location	Hatched	Predated	Abandoned	Flooded	Unknown	Lost at Hatch	Total nests
Alviso							
A8		1					1
Impoundment					1		1
New Chicago Marsh	4	1					5
Eden Landing							
E6B	2						2
E8	10	5			1	1	17
E8A	11	4	1	3			19
E8X	0	1					1
E12	10	4					14
E14	3	6					9
E16B	11	8	4			1	24
E11	4	2					6
E6	1						1
E1C	1						1
E3C				1			1
E4C		1					1
E5C		1					1
Ravenswood							
R1	4						4
R3	2						2
R4	2						2
R5	2						2
RSF2	17	6	0	0	0	0	23
Warm Springs							
A22	1	2	1	0	0	0	4
A23	10	7					17
Hayward Shoreline							
Hayward	1	1	0	0	2	0	4
OBN-14	0	1	0	0	0	0	1
Total South Bay	**96**	**51**	**6**	**4**	**4**	**2**	**163**
Napa-Sonoma Marsh	10	1			1		12
RU3 Total	**106**	**52**	**6**	**4**	**5**	**2**	**175**

Table 4. Snowy Plover nest densities (nest/acre) by pond on Refuge property in the South San Francisco Bay, CA, 2009.

Pond	R1	R3	R4	R5	RSF2	A22	A23
Nests per ha	0.022	0.018	0.02	0.1538	0.235	0.037	0.093

Table 5. Snowy Plover nest densities (nests/acre) by pond at Eden Landing in the South San Francisco Bay, CA, 2009.

Pond	E6	E6B	E8	E8A	E8X	E11	E12
Nests per ha	0.0141	0.03	0.23	0.18	0.08	0.13	0.15
	E14	E16B	E1C	E3C	E4C	E5C	
	0.1429	0.73	0.01	0.02	0.01	0.02	

Table 6. Number of chicks banded, chicks fledged and percent fledged per pond in the South San Francisco Bay, CA, 2009.

	Chicks Banded	Chicks Fledged	Percent Fledged
Eden Landing			
E8A	18	2	11.1%
E11	2	0	0.0%
E12	10	7	70.0%
E16B	19	4	21.1%
E8	17	4	23.5%
E1C	3	1	33.3%
Ravenswood			
RSF2	36	2	5.6%
R5	3	3	100.0%
Warm Springs			
A23	5	5	100.0%
All Areas	**113**	**28**	**24.8%**

Table 7. Number of chicks banded, chicks fledged and percent fledged in the shell plots per pond at Eden Landing in the South San Francisco Bay, CA, 2009.

	Chicks Banded in Shell Plots	Chicks Fledged in Shell Plots	Percent Fledged
E16B	16	4	25.0%
E8	13	3	23.1%

Table 8. The mean numbers of predators per survey in each area of the San Francisco Bay, CA, 2009. We did not include the Alviso California Gull colony in our estimates.

		Alviso	Dumbarton	Eden Landing	Hayward	Napa	Ravenswood	Warm Springs
Predators of Concern	Northern Harrier	0.60	0.2	0.51			0.20	0.10
	Common Raven	2.76		0.19		0.8	1.05	10.60
	Peregrine Falcon	0.24		0.11			0.18	0.07
	American Crow			0.09	0.20		0.67	0.07
	White-tailed Kite	0.08		0.03			0.08	0.07
	American Kestrel			0.05				0.33
	Red-tailed Hawk	0.60	0.2	0.71			0.38	0.43
	California Gull	124.24	55	20.10	40.40		14.77	156.97
	Unidentified Gull	792.64	2.8	95.96	6.00		43.83	201.67
Other Predators	Ring-Billed Gull	0.32						
	Western Gull	0.04						0.03
	Black-Crowned Night Heron	4.60		1.01			0.02	
	Great Blue Heron	4.08		1.96		0.4	0.25	
	Snowy Egret	15.76		13.43			2.62	0.13
	Great Egret	13.28		7.10		1.4	0.33	0.27
	Loggerhead Shrike							0.03
	Golden Eagle							0.13
	Number of Surveys	25	5	91	5	5	60	30