Western Snowy Plover Numbers, Nesting Success, and Avian Predator Surveys in the San Francisco Bay, 2004

Prepared by:

Cheryl M. Strong
San Francisco Bay Bird Observatory
P.O. Box 247
1290 Hope Street
Alviso, CA 95002

And
Natalie R. Wilson and Joy D. Albertson
Don Edwards San Francisco Bay National Wildlife Refuge
P.O. Box 524
Newark CA 94560

22 December 2004

NATIONAL WILDLIFE REFUGE SYSTEM

SFBBO
San Francisco Bay Bird Observatory

Table of contents

List of Figures

List of Tables

ABSTRACT

The San Francisco Bay Bird Observatory (SFBBO), the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge), the California Dept. of Fish and Game (CDFG), and Hayward Area Recreation Dept./East Bay Regional Parks District (HARD/EBRPD) monitored the Pacific coast western snowy plover (*Charadrius alexandrinus nivosus*) breeding population in the San Francisco Bay area (Recovery Unit 3) on sites located on the Refuge, the CDFG Eden Landing Ecological Reserve (Eden Landing), and HARD properties. We estimated plover numbers, nesting success, and assessed predator pressure on plovers for the 2004 breeding season.

During the 2004 breeding season window survey of the California coast in June, we counted 113 adult plovers in the Bay. This is 5.93% of the total plovers counted (1904) along the California coast, as compared to 12.84% (176/1371) in 1991, and 4.99% (72/1444) in 2003 (G. Page, unpub. data). Compared to 2003, higher mean numbers of plovers per survey were found in the Dumbarton, Eden Landing, Ravenswood and Warm Springs areas. This year, fewer birds were seen at Hayward, and no plovers detected in Alviso, Mowry, or Coyote Hills.

We found a total of 59 nests within our study area. Of the eleven nests found on the Refuge, eight (73%) were successful, one (9%) was predated, and two (18%) had an unknown fate. On the Refuge, five nests were at Warm Springs (pond A22) and six nests were at Ravenswood (pond RSF2). We found 48 plover nests at Eden Landing, of which 40 (83%) were successful, two (4%) were predated, one (2%) was abandoned and 5 (10%) had an unknown fate. All but one of the nests at Eden Landing was found on ponds B6B and B8. Nest numbers were approximately 43% lower on the Refuge than in 2001 (the last time nesting success was examined), and were approximately 19% lower on Eden Landing.

We identified five common avian predator species near snowy plover nesting areas and seven predator nests within survey area. There were direct observations of snowy plover chick, adult and nest predation by common ravens (*Corvus corax*), northern harriers (*Circus cyaneus*), and American kestrels (*Falco sparverius*).

This year was the start of the avian predator management program at the Eden Landing. One common raven nest and five adult ravens were removed from Eden Landing. Predator nest removal may be an effective tool in increasing snowy plovers in the Bay area, however more information is needed to test this hypothesis.

INTRODUCTION AND BACKGROUND

The Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) was listed as threatened on 5 March 1993 (USFWS 1993). Declines in snowy plover numbers are due to poor reproductive success, which in turn is attributed to habitat loss and degradation, and human disturbance (USFWS 1998). Twenty Pacific coast western snowy plover breeding areas remain in California. Region Three includes the San Francisco Bay, encompassing Napa, Alameda, Santa Clara and San Mateo Counties. In 1981, an estimated 22.4% of 1566 breeding California western snowy plovers nested in and around the San Francisco Bay salt ponds (Page and Stenzel 1981). More recent surveys (2003) indicate that the number of plovers breeding in San Francisco Bay make up only about five percent of plovers nesting along the Pacific coast (G. Page, unpub. data).

The Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) supports breeding snowy plover habitat. In accordance with USFWS guidance for the management of threatened and endangered species, biologists initiated an annual snowy plover monitoring program on the Refuge in 1992. This program had five goals; (1) to identify areas used by nesting, feeding and roosting plovers, (2) to estimate the number of breeding pairs, (3) to assess reproductive success, (4) to assess predation pressures on snowy plovers, and (5) to safeguard breeding sites from disturbance and predation. Because of the large number of plovers utilizing the California Dept. of Fish and Game's Eden Landing Ecological Reserve (CDFG, Eden Landing), and the Hayward Area Recreation Dept./East Bay Regional Parks District (HARD) properties, these areas were added to the monitoring program (Figure 1). The San Francisco Bay Bird Observatory began surveying the area in conjunction with the agencies in 2003.

In 1993, Refuge biologists and the U.S. Department of Agriculture Wildlife Services began a mammalian predator management program. The program was initiated due to documented snowy plover nest and chick predation, as well as severe predation on the endangered California clapper rail (*Rallus longirostris obsoletus*) and other ground nesting birds by the non-native red fox (*Vulpes vulpes;* Harding et al. 1998). Since then, trappers have removed red fox and other captured mammals including feral cats (*Felis felis)*, skunks (*Mephitis mephitis*), and raccoons (*Procyon lotor*).

During the 1993 snowy plover breeding season, biologists also constructed nest exclosures and mesh wire and post fences across levees to block mammalian predators and limit human intrusion into nesting areas. However, the use of nest exclosures was later discontinued due to nest abandonment by some plovers and the success of the trapping program.

The mammalian predator management program does appear to be successful as clapper rail numbers have increased. Snowy plover nesting success results are

not as clear, although an increase appears to have occurred in some years since 1993 (Harding et al. 1998). However, in recent years avian predation has become a primary concern for plovers throughout their breeding range.

Common ravens (*Corvus corax*) have been implicated in plover predation at a number of sites. At Point Reyes National Seashore, ravens accounted for 69% of all predation events in five seasons and they are a major predator of snowy plovers in San Diego and Humbolt counties (Liebezeit and George 2002). Northern harriers (*Circus cyaneus*) have also been identified as a key species in snowy plover predation. In 1999 through 2001, northern harriers were believed to be the main predators of plovers and the key factor in the low fledglings rates at Salinas River National Wildlife Refuge, Moss Landing Wildlife Area, and Zmudowski State Beach (USFWS 2002). Other avian predators of concern may include red-tailed hawk (*Buteo jamaicensis*), peregrine falcon (*Falco geregrinus*), American kestrel (*Falco sparverius*), white-tailed kite (*Elanus leucurus*) burrowing owl (*Athene cunicularia*), American crow (*Corvus brachyrhynchos*), and loggerhead shrike (*Lanius ludovicianus*).

Audubon Christmas bird count data from 1955 to 2002 indicates that numbers of avian predators counted per party hour from two local counts adjacent to the South Bay plover nesting habitat (Figure 1) have increased for some predator species. Both the Hayward-Fremont and Palo Alto counts show increases in red-tailed hawk, and northern harrier, steady populations of peregrine falcon in Palo Alto, and rising numbers of peregrine falcon in Hayward-Fremont, and declines in white-tailed kites and American kestrel for both areas. Common ravens have gone from rare to common in both areas (National Audubon Society 2002).

In order to better assess numbers of nesting plovers and to identify the limitations on nesting success (including predation levels) in the South Bay, the Refuge, CDFG, HARD, EBRPD, and SFBBO monitored plovers and avian predators for the second year in 2004. This report summarizes data gathered during the 2004 snowy plover monitoring program, including results from snowy plover surveys, nesting success, avian predator surveys and the avian predator management program.

STUDY AREAS

The Refuge is an urban wildlife refuge in the San Francisco Bay, California, and encompasses approximately 30,000 acres of tidal marsh, salt ponds, mud flats and associated uplands (Figure 1). We divided the Refuge into geographical areas: Dumbarton, Warm Springs, Ravenswood, Coyote Hills, Mowry, and Alviso (Figure 2). Most plover habitat on the Refuge is levees, which are named by the letter and number of the salt pond that they border, and the salt ponds themselves. Focus ponds (see below) on the Refuge included Warm Springs ponds A22, A23 and Ravenswood ponds R2, and RSF2.

Eden Landing Ecological Reserve is a California Dept. of Fish and Game managed area located approximately 5 km north of the Refuge's northern boundary (Figure 2). In 2004, all Eden Landing ponds, including Cargill ponds acquired in 2003 (formerly known as the Baumberg tract), were monitored. Focus ponds at Eden Landing were ponds B6B and B8.

Hayward Area Parks and Recreation Department owns lands just to the north of Highway 92 that include potential snowy plover nesting and foraging habitats (Figure 2). These include Franks Dump West and Olivier Brothers North ponds OBN 1-OBN 17. This area is co-managed by East Bay Regional Parks District staff.

Figure 1. Map of the plover 2004 study area in the South Bay including Refuge, Eden Landing, and Hayward lands and the two adjacent Audubon Christmas Bird Count circles located in the area (approximately 15-mile radius circles, National Audubon Society 2002).

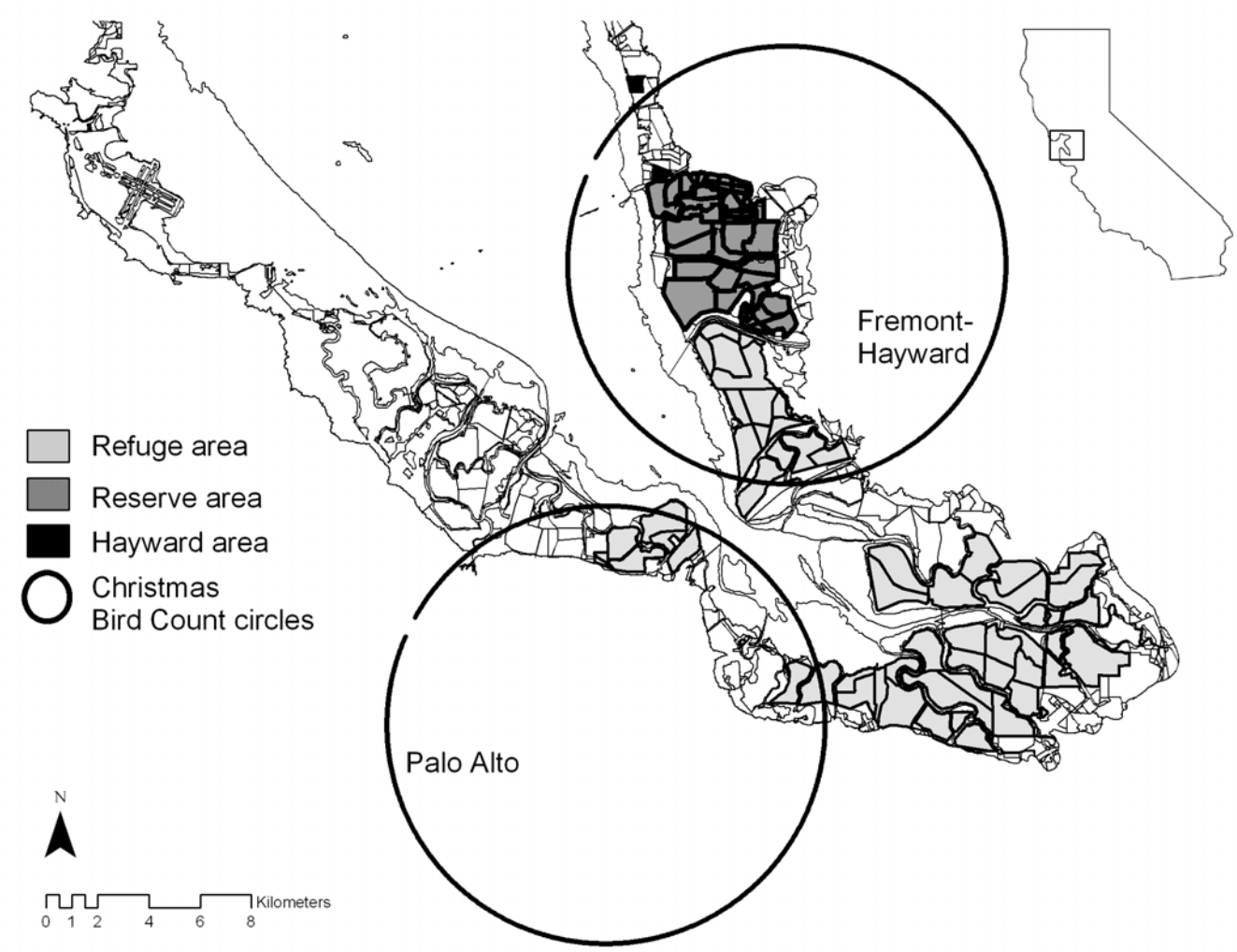
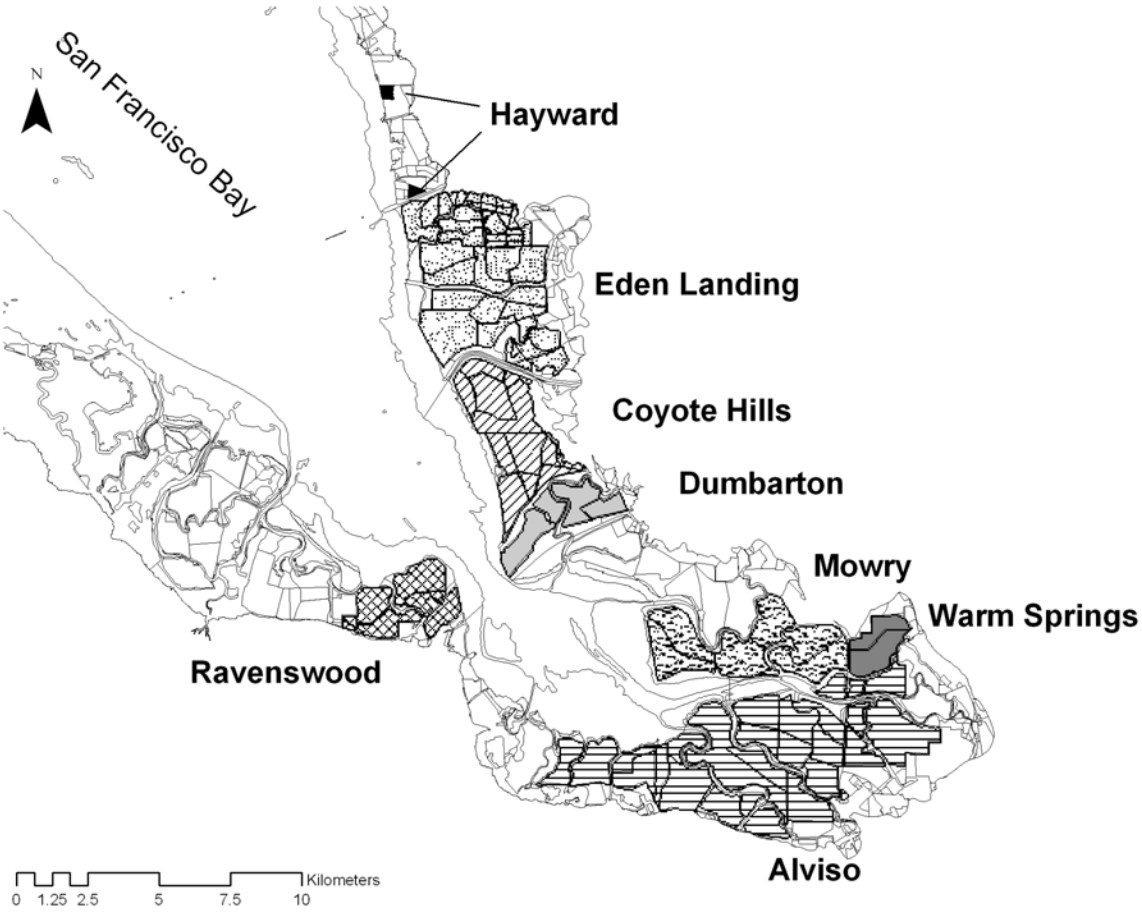


Figure 2. The Don Edwards San Francisco Bay National Wildlife Refuge snowy plover area was divided into geographical areas: Dumbarton, Warm Springs, Ravenswood, Coyote Hills, Mowry, and Alviso. Eden Landing Ecological Reserve is managed by the California Dept. of Fish and Game. The Hayward area is the Hayward Area Parks and Recreation Department lands (co-managed by East Bay Regional Parks District) just to north of Eden Landing.



METHODS

Population Monitoring

Snowy plovers are site specific, often nesting in the exact location year after year (Stenzel et al. 1994). We therefore monitored areas where we have found nesting plovers in past years. However, as water levels in the salt ponds change, plovers can also alter their nesting and foraging sites. Thus we also monitored any new areas where we found additional plover habitat. We categorized study sites into two groups: the monthly ponds and the focus ponds. SFBBO volunteers surveyed monthly ponds once a month for numbers of plovers, nests, and avian predators. This gave us an overall view of which ponds were used by plovers. The focus ponds were a subset of the monthly ponds. Refuge and SFBBO biologists and interns surveyed focus ponds weekly for numbers of plovers, nests, and avian predators, and followed all known nests to completion to determine fate. The focused ponds allowed us to sample the most densely populated ponds and closely monitor nesting success. Due to limitations in personnel and plover habitat, we focused our surveys in the southern portion of the Bay, from the area immediately north of the San Mateo Bridge to the extreme south end of the Bay. A few surveys were done in the North Bay, but no plovers were seen nesting in this area and these results are not reported here.

We monitored the sites according to the same monitoring protocol the Refuge has used since 1992 (Marriott and Schelin 2001). We drove slowly or walked along the roads and levees of the site, and scanned for plovers with binoculars and a spotting scope. Because plovers are less disturbed by passing vehicles than they are by passing pedestrians, we drove past study areas wherever possible. Upon spotting an adult snowy plover, we stopped the vehicle and followed the bird with our scopes until the plover had and settled on a nest or until ten minutes had passed, in which case we concluded that the plover was not incubating a nest. Volunteers monitored the monthly ponds and interns and biologists monitored focus ponds weekly by the same method according to this protocol.

During monthly surveys, volunteers would see a suspected nest and record detailed landmark information. Interns and biologists would then return to the potential nest, spot the bird using the directions given by the volunteers and approach the nest on foot (to the interior of the pond) to observe it. (Volunteers did not approach the nests.) On the focus ponds, staff discovered and approached nests.

Reproductive Success

Within focus ponds we followed all accessible nests to determine number of eggs laid, number of chicks hatched, and nest fate, including date of hatching, abandonment, or predation. When a nest was located in an inaccessible part of the pond (such as across a borrow ditch or remnant slough channel), we

observed it from a distance but did not enter these nests into the calculations since there was no way to determine their fate.

We assigned a number to each new nest we found using the pond number and then sequentially numbered nests (e. g. A22-1, A22-2, etc.). We used a GPS to record nest location coordinates. We recorded time, location, number of eggs/chicks in the nest, whether or not the adult was present, and predators in the area. We floated eggs in the nest to estimate age and hatching date (for example see Hays and LeCroy 1971). Floating eggs involved placing individual eggs into a small cup of distilled water, and then measuring the diameter of the egg that floated above the water line (D. George, PRBO, unpub data). We returned bi-weekly to weekly to check on the status of each nest and re-float any remaining eggs.

We used estimated hatch date to determine nest fate. We recorded nests with small shell fragments as hatched (Page et al. 1986). We checked for evidence of predation by looking for predator tracks, egg substance, or large eggshell fragments in or around the nest. If eggs disappeared from a nest two weeks before the estimated hatching date, we considered the nest to have been predated even without other evidence of predation. If there was no direct evidence for either hatching or predation, and it was near the hatching date, we recorded the nest as having an unknown fate. If eggs were present more than a week after the expected hatch date and did not see an attending adult near the nest for two weeks we considered the nest abandoned.

We used nest initiation dates to analyze peak nest initiation times. Average incubation length is 28 days, with an average of 2.5 days between eggs laid (Page et al. 1995); therefore an average nest of 3 eggs requires 33 days from initiation to hatch date. When possible we calculated initiation date from a hatch date determined by direct evidence of hatching (chicks, pipping, peeping within egg). If wet chicks were present in the nest cup, the hatch date was determined to be the observation date. If definite pipping was observed the nest was assumed to hatch the next day. If neither new chicks nor pipping was evident, we used the earliest date of the most recent egg float estimate to determine the hatch date.

We used nest success and hatching success to assess reproductive success. We evaluated nest success by determining the ratio of successful nests (nests in which at least one egg hatched) to total nests. We determined hatching success by obtaining the ratio of eggs hatched to total eggs laid.

Avian Predator Surveys

To estimate potential predator pressure on nesting plovers, we conducted avian predator surveys on all monthly ponds and weekly surveys around focus ponds. We surveyed along roads and levees with binoculars and a spotting scope at

various times of the day stopping approximately every 0.3 miles, or whenever a potential avian predator was spotted (Finck 2000). We scanned each salt pond and surrounding habitats along the route. We located known predator nests and checked them weekly to determine status.

We recorded predator attacks, predator sightings, and predator tracks. Average numbers of predators sighted per week was calculated by dividing the total number of individuals counted by the number of surveys performed. A species was considered an avian predator if it could conceivably prey on snowy plover nests, chicks, or adults. This included some species (such as gulls, herons and egrets) that have not been documented to prey on plovers but may opportunistically feed on plovers or eggs.

Our methods were not meant to survey for mammalian predators, although incidental sightings were noted.

Management Methods

We continued the mammalian predator management program with Wildlife Services. Predator management is conducted to control target mammalian predators (red fox, feral cats, skunks, and raccoons) on all Refuge property, at Eden Landing, and many adjacent public properties in the South Bay. This control is conducted for the protection of the California clapper rail, salt marsh harvest mouse (*Reithrodontomys raviventris*), and the snowy plover, as well as other ground-nesting birds. During snowy plover nesting season, a special focus is placed on protection of ponds in which snowy plovers nest, particularly at Eden Landing and Warm Springs.

In 2004 we began an avian predator management plan to remove common raven nests within the plover nesting area. By removing the nest, a raven pair could still be present to defend a territory from incoming ravens, but without the corresponding increase in food demands that chicks require (Liebezeit and George 2002). We removed one raven nest at Eden Landing but left the ravens at Warm Springs and Ravenswood unperturbed to serve as control areas.

To reduce human impacts on snowy plover nesting success, areas on the Refuge have been seasonally closed (blocked by signs and/or metal gates) to prevent pedestrians or vehicles from entering snowy plover nesting areas. These areas included: the road parallel to and south of the Dumbarton Bridge, the dirt service road that separates Highway 84 from ponds north of the highway, and Warm Springs. The Ravenswood ponds are closed to vehicles. Alviso ponds A5-A8 are completely closed to the public, while ponds A9-A17 are open to pedestrians and bicyclists.

Eden Landing reserve is closed to the public at this time of year, however considerable construction traffic was evident in the northern portion of Eden Landing due to restoration activity.

RESULTS

Plover numbers

During the 2004 breeding season window survey of the California coast in June, we counted 113 adult plovers in the Bay. This is approximately 6% of the total plovers counted along the California coast (total count: 1904).

Using the maximum number of plovers counted on any one complete survey in any one pond, we counted a maximum of 326 adult plovers (96 males, 101 females, and 203 unknown adults, Appendix 1). However, because these surveys ranged over the entire study period, they likely include substantial numbers of recounts as well as migrants moving through the area in late spring or late summer.

Weekly numbers of plovers varied by area and by pond (Figure 3, Table 1). Eden Landing had the most consistent high numbers of plovers overall (Figure 3). The most important ponds in terms of numbers of plovers were B6B, B8, R2, RSF2, A22. Some ponds had plovers only during the very early or very late part of the season (R1, B6A, B9, PP1, A23) indicating that these ponds were not used for nesting, but may be important for migrating and foraging plovers (Table 1).

In general chicks and juveniles were seen in the same ponds as plover adults (Figure 4). We estimate that 134 chicks hatched from known nests, but have no information on chick survival (Table 2).

Figure 3. Sum of snowy plover adults by week and area.

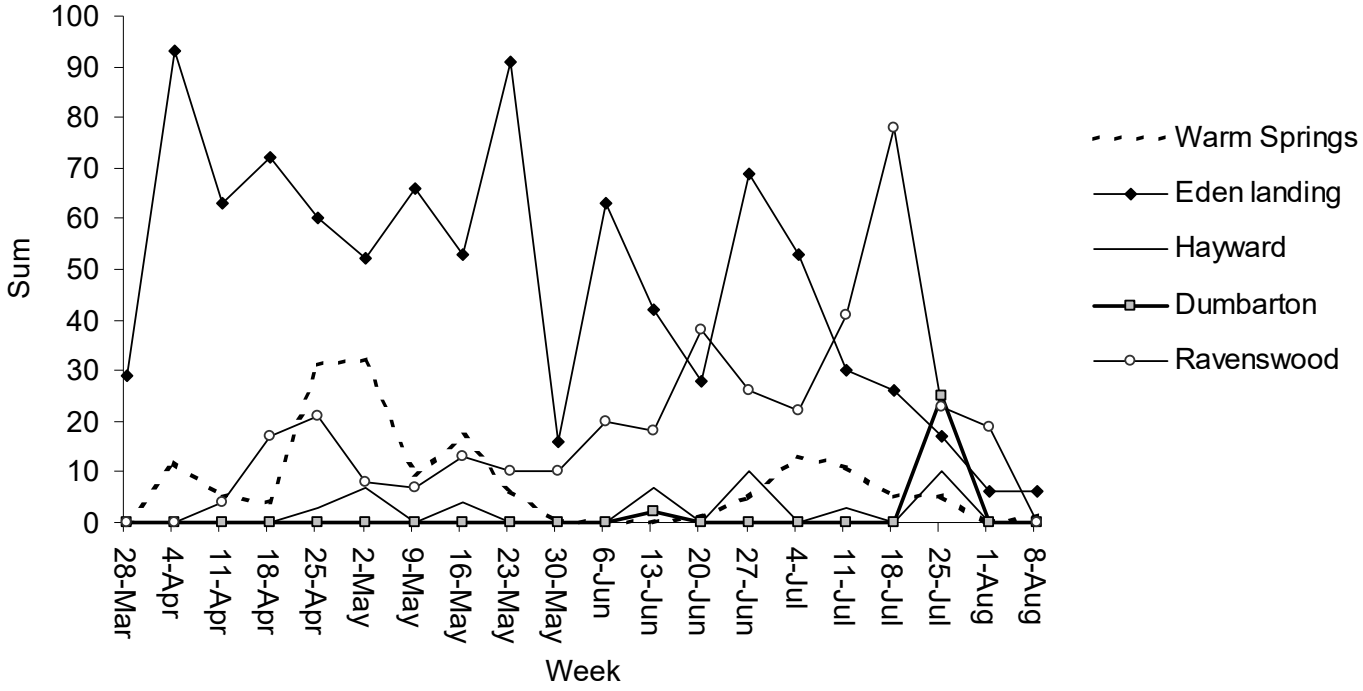


Figure 4. Mean numbers of snowy plover adults, juveniles, and chicks counted per survey in each area during the 2004 breeding season.

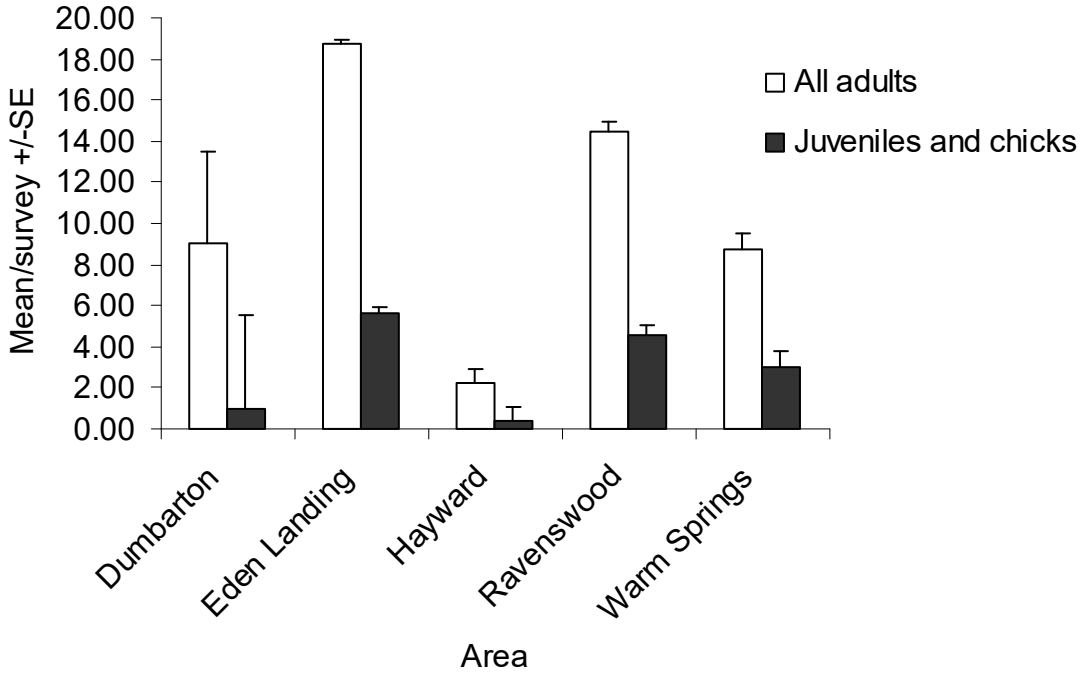


Table 1. Sum of adult plovers counted by week during the 2004 season. Week 4 starts on 21 March; week 23 starts on 1 August. See Appendix 1 for areas associated with pond numbers.

Week	A22	A23	B4B	B6A	B6B	B8	B9	B12	B13	B14	B15B	B16B	FDW	N1	OBN1	OBN2
wk4	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0
wk 5	12	0	0	0	83	0	0	7	0	0	0	3	0	0	0	0
wk 6	5	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0
wk 7	4	0	0	0	70	0	0	1	1	0	0	0	0	0	0	0
wk 8	20	11	3	19	22	0	14	0	0	2	0	0	0	0	0	0
wk 9	32	0	0	0	47	3	0	1	0	0	1	0	0	0	0	4
wk 10	9	0	0	0	64	0	0	2	0	0	0	0	0	0	0	0
wk 11	17	0	0	0	23	30	0	0	0	0	0	0	0	0	0	0
wk 12	3	3	0	4	36	46	1	1	2	1	0	0	0	0	0	0
wk 13	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0
wk 14	0	0	0	0	21	42	0	0	0	0	0	0	0	0	0	0
wk 15	0	0	0	0	6	33	0	0	0	0	0	3	0	1	0	0
wk 16	1	0	0	0	6	22	0	0	0	0	0	0	0	0	0	0
wk 17	5	0	0	0	10	59	0	0	0	0	0	0	8	0	0	0
wk 18	13	0	0	0	8	45	0	0	0	0	0	0	0	0	0	0
wk 19	11	0	0	0	6	24	0	0	0	0	0	0	0	0	1	0
wk 20	5	0	0	1	9	15	1	0	0	0	0	0	0	0	0	0
wk 21	3	2	0	0	1	16	0	0	0	0	0	0	5	0	1	0
wk 22	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
wk 23	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
mean	7.05	0.80	0.15	1.20	26.00	17.35	0.80	0.60	0.15	0.15	0.05	0.30	0.65	0.05	0.10	0.20

Week	OBN4	OBN5	OBN6	OBN8	OBN10	OBN12	OBN13	OBN14	OBN	PP1	R1	R2	RSF2	Totals
wk4	0	0	0	0	0	0	0	0	0	0	0	0	0	29
wk 5	0	0	0	0	0	0	0	0	0	0	0	0	0	105
wk 6	0	0	0	0	0	0	0	0	0	0	0	0	4	72
wk 7	0	0	0	0	0	0	0	0	0	0	9	0	8	93
wk 8	0	0	0	0	0	0	1	0	2	0	2	0	19	115
wk 9	0	0	1	0	0	0	0	2	0	0	0	0	8	99
wk 10	0	0	0	0	0	0	0	0	0	0	0	0	7	82
wk 11	3	1	0	0	0	0	0	0	0	0	0	0	13	87
wk 12	0	0	0	0	0	0	0	0	0	0	0	0	10	107
wk 13	0	0	0	0	0	0	0	0	0	0	0	0	10	26
wk 14	0	0	0	0	0	0	0	0	0	0	0	2	18	83
wk 15	0	0	0	3	0	1	0	0	3	1	0	1	17	69
wk 16	0	0	0	0	0	0	0	0	0	0	0	35	3	67
wk 17	0	0	0	0	0	0	1	0	1	0	18	0	8	110
wk 18	0	0	0	0	0	0	0	0	0	0	0	19	3	88
wk 19	0	0	0	0	1	0	1	0	0	0	0	41	0	85
wk 20	0	0	0	0	0	0	0	0	0	0	11	53	14	109
wk 21	0	0	0	0	0	1	0	0	3	25	0	0	23	80
wk 22	0	0	0	0	0	0	0	0	0	0	0	0	19	25
wk 23	0	0	0	0	0	0	0	0	0	0	0	0	0	7
mean	0.15	0.05	0.05	0.15	0.05	0.10	0.15	0.10	0.45	1.30	2.00	7.55	9.20	76.90

Table 2. Hatching success in the South Bay.

Location	Number of eggs	Number of eggs hatched	Percent eggs hatched	Total nests with known eggs
Ravenswood RSF2	17	8	47%	4
Warm Springs A22	15	15	100%	5
Eden Landing B6B	125	102	82%	40
Eden Landing B8	11	6	55%	3
Eden Landing B12	3	3	100%	1
Total South Bay	171	134	78%	53

Refuge

There was a mean of 11.89 adults seen per survey during the breeding season, all Refuge property combined. Within the Refuge, Ravenswood had an average of 14.42 adult plovers seen per survey, mostly on R2 and RSF2. An average of 8.72 adults were seen at Warm Springs each week on pond A22. Ravenswood had the highest mean number of chicks, followed by about equal numbers of chicks at Warm Springs and Dumbarton (Table 3, Figure 4). No plovers were seen in any of the other areas (Alviso, Coyote Hills, or Mowry).

A single survey indicates Ravenswood pond R2 as an important plover pond (Figure 5). This single count occurred in late July and probably included migrating plovers, rather than locally nesting plovers (Figure 3). No plovers were found nesting in this pond over the season. R1 had plovers early in the season but this pond was flooded later in the season, precluding nesting by plovers (Table 1). RSF2 had a fairly consistent number of plovers throughout the season with a maximum of 23 adults and 13 chicks counted during any one complete survey (Figure 5, Appendix 1).

Table 3. Summary statistics of plover numbers by area.

Area	Statistic	Males	Females	Unknown adults	All adults	Juveniles	Chicks	Juveniles and chicks
Dumbarton	Mean	0.33	0.33	8.33	9.00	0.00	1.00	1.00
Eden Landing	Mean	4.92	4.50	9.28	18.70	0.96	4.66	5.62
Hayward	Mean	0.15	1.80	0.25	2.20	0.35	0.00	0.35
Ravenswood	Mean	4.46	3.00	6.96	14.42	1.35	3.19	4.54
Warm Springs	Mean	2.44	1.50	4.78	8.72	0.06	3.00	3.06
Dumbarton	Standard Error	4.53	4.53	4.53	4.53	4.53	4.53	4.53
Eden Landing	Standard Error	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Hayward	Standard Error	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Ravenswood	Standard Error	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Warm Springs	Standard Error	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Dumbarton	Sum	1.00	1.00	25.00	27.00	0.00	3.00	3.00
Eden Landing	Sum	246.00	225.00	464.00	935.00	48.00	233.00	281.00
Hayward	Sum	3.00	36.00	5.00	44.00	7.00	0.00	7.00
Ravenswood	Sum	116.00	78.00	181.00	375.00	35.00	83.00	118.00
Warm Springs	Sum	44.00	27.00	86.00	157.00	1.00	54.00	55.00
Dumbarton	N	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Eden Landing	N	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Hayward	N	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Ravenswood	N	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Warm Springs	N	18.00	18.00	18.00	18.00	18.00	18.00	18.00

Eden Landing

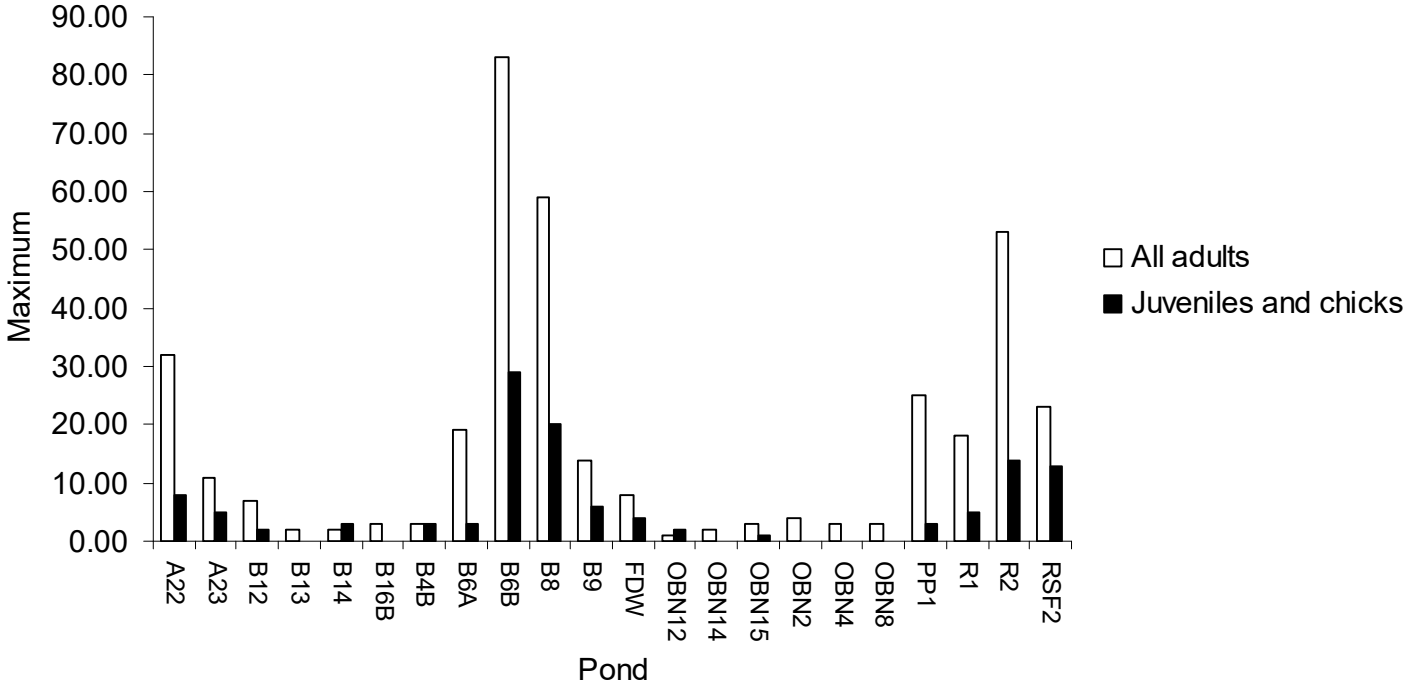
Eden Landing had the highest numbers of plovers in the South Bay with a mean of 18.70 birds per survey (Table 3, Figure 4). Plovers used at least ten ponds here. We observed the highest mean numbers in ponds B6B and B8 (Appendix 1). Sightings of chicks and juveniles followed a similar pattern within the ponds, although B8 had a higher average number of chicks and juveniles sighted than B6B (Appendix 1). There appears to have been a shift in pond use as plovers moved from B6B to B8 as B6B dried out (Table 1).

The maximum number of plovers counted during any one complete survey indicates that B6B and B8 had the highest numbers of plovers in all the areas of the South Bay that were surveyed. Pond B6A had relatively high numbers of plovers earlier in the season, but no plovers later in the season; pond B9 had high plovers during one week of surveys only (Table 1).

Hayward Shoreline

A few adults and juveniles were seen in the Hayward area but no chicks were observed (Figs. 4 and 5). This area was flooded in the early part of the season and did not dry up in time to support snowy plover nesting in 2004 (S. Junge, pers. comm.).

Figure 5. Maximum number of snowy plovers counted during any one complete survey during the breeding season. Ponds with zero or one plover removed.



Banded bird sightings

We sighted four banded plovers during the breeding season. One banded female was sighted incubating a nest on Eden Landing B6B. One banded plover was found in the Ravenswood area, and a third was found at Warm Springs pond A22. All three birds were banded as nestlings in 2003 in the Monterey area (F. Bidstrup, pers. comm.). A fourth banded plover was found in the Eden Landing area but could not be identified.

Reproductive Success

Refuge

This year we found 11 nests on the Refuge: eight (73%) were successful, one (9%) was predated and two (18%) had an unknown fate (Table 4). Of these, five were at Warm Springs on pond A22, and six were at Ravenswood on pond RSF2. A brood was sighted on PP1, but there were no confirmed nests in the Dumbarton area.

At Warm Springs all five nests hatched (100% success rate). Of the six nests at Ravenswood, three (50%) were successful, one (17%) was predated and two (33%) had an unknown fate (Table 4).

On Refuge lands, 23 eggs hatched out of 32 eggs observed (72%). All eggs at Warm Springs hatched. At Ravenswood 8 of the 17 (47%) known eggs hatched (Table 2).

Eden Landing

We found 48 nests at Eden Landing; 43 nests on B6B, four nests on B8 and one nest on B12. Of these, 40 (83%) were successful, two (4%) were predated, one (2%) was abandoned, and five (10%) had unknown fates (Table 4).

Of 139 eggs at Eden Landing, 111 hatched (80%; Table 2).

Over the season there were two separate peaks in nest initiation at Eden Landing pond B6B (Figure 6). These occurred between 14 March-28 March, and 18 April-25 April. No other ponds had a sufficient sample size to note a pattern in nest initiation.

Table 4. Nest fates in the South Bay.

Location	Hatched	Predated	Abandoned	Unknown	Total nests
Ravenswood RSF2	3	1	0	2	6
Warm Springs A22	5	0	0	0	5
Eden Landing B6B	37	1	1	4	43
Eden Landing B8	2	1	0	1	4
Eden Landing B12	1	0	0	0	1
Total South Bay	48	3	1	7	59

South Bay, Overall

Nest predation was low throughout the study area in 2004 (Table 4). Direct evidence of predation included large pieces of eggshell and yolk in the nest (nests B6B-24 and RSF2-3). Nest B8-2 had no direct evidence of predation but the eggs disappeared more than two weeks before the expected hatch date.

We compared nest predation in the raven control area (Eden Landing) to the non-raven control areas (Ravenswood and Warm Springs) over the nesting season. However, due to the small sample size of nests outside the Eden Landing area, we could see no difference in hatching success (Table 5).

Figure 6. Number of nests initiated, by week, for all weekly-monitored focus ponds.

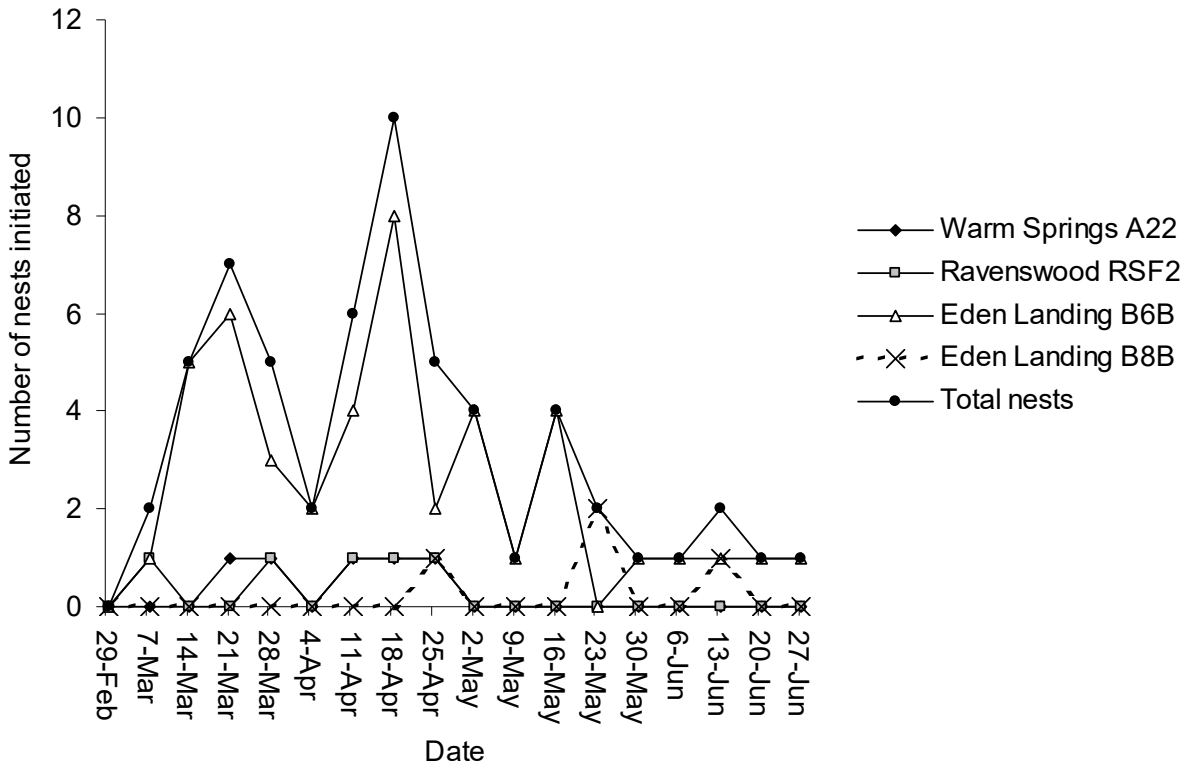


Table 5. Nest fate by common raven management.

Location	Hatched	Predated	Abandoned	Unknown	Total nests
Raven control area (Eden Landing)	40	2	1	5	48
No raven control (Ravenswood, Warm Springs)	8	1	0	2	11

Avian Predators

Refuge

At Warm Springs the most commonly sighted avian predators were gulls (*Larus* spp*.,* primarily *L. californicus*), common raven, burrowing owl, and red-tailed hawk (Table 6). Gulls were often sighted in the hundreds to thousands over the surrounding landfills and roosting on pond A23. There were two common raven nests and one red-tailed hawk nest in PG&E towers around the A22 and A23 ponds. One common raven nest and the red-tailed hawk nest were on Catellus property directly north east of pond A22, the other was on the north edge of Coyote Lagoon. The raven nest on Catellus property successfully fledged four chicks; the fate of the other raven nest was undetermined. The red-tailed hawk nest fledged three chicks.

At Ravenswood the most commonly sighted avian predators were common ravens, red-tailed hawks, white-tailed kites, and gulls (Table 6). Though no avian predator nests were found at Ravenswood, the consistent presence of a perching red-tailed hawk indicated a possible nest nearby.

In Alviso, the most commonly sighted avian predators were California gulls, snowy egrets (*Egretta thula*), black-crowned night herons (*Nycticorax nycticorax*), and great egrets (*Ardea alba*; Table 6).

The Dumbarton, Coyote Hills, and Mowry areas were only surveyed twice each during the season with many of the same predators here as well (Table 6). There was a common raven nest in a PG&E tower in Dumbarton marsh south of Highway 82.

Eden Landing

At Eden Landing the most commonly sighted avian predators were gulls, snowy egrets, red-tailed hawks, great egrets, great blue herons, common ravens and northern harriers (Table 6).

There were four avian predator nests in the Eden Landing area. A common raven nest near pond B10 was removed as part of the avian predator management program and did not fledge any chicks. A red-tailed hawk nest on pond B2B fledged two chicks. There were two northern harrier nests in the Old Alameda Creek slough channel. One northern harrier nest fledged at least two chicks and the other northern harrier nest failed (Attachment 1).

Northern harriers were often seen hunting along interior pond levees and on the ponds and commonly flushed plovers from their nests. Ravens were twice seen walking within ponds searching the ground and pecking, a documented foraging technique (Boarman and Heinrich 1999).

Hayward Shoreline

In Hayward the most commonly sighted avian predators were gulls, common raven, and northern harrier (Table 6). The common raven nest removed from Eden Landing, near pond B10, was within hunting distance of the Hayward area.

Direct Avian Predation

We observed several predation events on shorebird adults and chicks during the breeding season. On 7 May an American kestrel took a snowy plover chick on B6B. On 1 June a northern harrier was observed with a freshly killed female plover near B6B. On 4 August at pond RSF2, we saw a raven feeding on a plover nest while an adult plover performed the broken wing display in the background. Common ravens were also sighted on B6B feeding on American avocet (*Recurvirostra americana*) eggs.

Mammal predators

One grey fox (*Urocyon cinereoargenteus*) occupied a den on B6A and fox tracks were noticed on the interior levees of B6B. A long-tailed weasel (*Mustela frenata*) was seen in the Alviso area, and a fox predated a Caspian tern (*Sterna caspian*) colony in B10 at Eden Landing. The only other mammal observed was the ubiquitous California ground squirrel (*Spermophilus beecheyi*).

Table 6. Mean numbers of predators detected per survey at each of the areas.

	Species	Alviso	Coyote Hills	Dumbarton	Eden Landing	Hayward	Mowry	Ravenswood	Warm Springs	All Sites, mean
Predators of concern	Common Raven	4.50	0.00	0.00	4.12	0.21	1.50	1.00	6.56	2.24
	Northern Harrier	5.25	2.00	0.00	3.88	0.16	0.50	0.15	1.44	1.67
	Red-tailed Hawk	2.25	1.50	3.50	5.94	0.00	4.50	0.50	2.50	2.59
	Peregrine Falcon	0.25	0.00	0.00	0.24	0.00	0.00	0.00	0.22	0.09
	White-tailed Kite	0.25	2.00	0.00	0.35	0.00	1.50	0.30	1.06	0.68
Other predators	American Crow	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.28	0.07
	American Kestrel	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.06	0.26
	Black-crowned Night Heron	49.25	0.00	0.00	1.18	0.11	0.00	0.10	0.39	6.38
	Burrowing Owl	0.00	0.00	0.00	0.41	0.00	0.00	0.00	3.78	0.52
	California Gull	10267.25	0.00	0.00	0.65	9.37	0.00	0.05	0.00	1284.66
	Golden Eagle	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.06	0.01
	Great Blue Heron	13.00	0.00	1.00	5.47	0.05	0.50	0.00	0.22	2.53
	Great Egret	40.25	1.50	1.00	5.59	0.37	3.00	0.05	0.50	6.53
	Gulls-Other	1.50	0.00	23.00	23.88	1.79	304.00	0.50	0.00	44.33
	Loggerhead Shrike	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.67	0.10
	Snowy Egret	63.00	2.00	0.50	20.06	0.00	6.50	0.20	0.22	11.56
	Western Gull	0.75	0.00	0.00	0.00	0.11	0.00	0.05	0.00	0.11
	Number of surveys	4	2	2	17	19	2	20	18	84

Management Methods

Avian predator management

Predators taken within the 12-month period by Wildlife Services included: 1) Eden Landing: 1 red fox, 9 feral cats, 32 skunks; 5 adult ravens, and 1 raven nest with 4 chicks, and 2) Warm Springs: 5 feral cats, and 2 skunks. No predators were taken at Ravenswood due to access difficulties and the visibility of Wildlife Services from the highway and bike path.

PG&E personnel removed one common raven nest (with four 2-3 week old chicks) from a PG&E tower near B10 in Eden Landing on 23 April. After removal of the first nest, a new common raven nest was started in a nearby PG&E tower but never completed.

DISCUSSION

Plover numbers

During the 2004 breeding season window survey of the California coast, we counted 113 adult plovers in the Bay. This is 5.93% of the total (of 1904 plovers) counted along the California coast, as compared to 12.84% (176/1371) in 1991, and 4.99% (72/1444) in 2003 (G. Page, unpub. data).

As most adult plovers were not banded and our surveys spanned a number of days even within one area, it was difficult for us to estimate breeding snowy plover numbers within the study area. However, compared to 2003, higher mean numbers of plovers counted per survey were found in the Dumbarton, Eden Landing, Ravenswood and Warm Springs. This year, fewer plovers and no nesting pairs were seen at Hayward, and no plovers detected in Alviso, Mowry, or Coyote Hills areas. Coverage was not equal in all areas between or within years, although all areas with plover habitat were surveyed.

Reproductive success

Total nest numbers in the South San Francisco Bay fell by 24% from 78 in 2001 to 59 in 2004. Snowy plovers nested at fewer locations on the Refuge than in previous years and nest numbers declined overall. In 1995, 90 nests were found on Refuge property, 50 were found in 1998, 27 in 2000, 19 in 2001, and 11 in 2004 (Marriott and Schelin 2001). There were 48 nests in Eden Landing this year, down from 59 nests in 2001. We estimate that 134 chicks hatched from known nests in the South Bay, but without a banding program we have no information on survival rates.

Our results also indicate that plovers nested at fewer locations than in recent past years. In the past, plovers have nested on all Ravenswood ponds as well as on ponds in the Dumbarton and Coyote Hills areas, and on A8 in Alviso.

Predation levels and hatching success levels do not appear to have changed since 2001 (Figure 7). Although we cannot rule out other causes such as limitations in food resources, or wintering ground issues, the declining numbers of plovers in the South Bay may be caused by the continued presence of avian predators in and around plover nesting habitat.

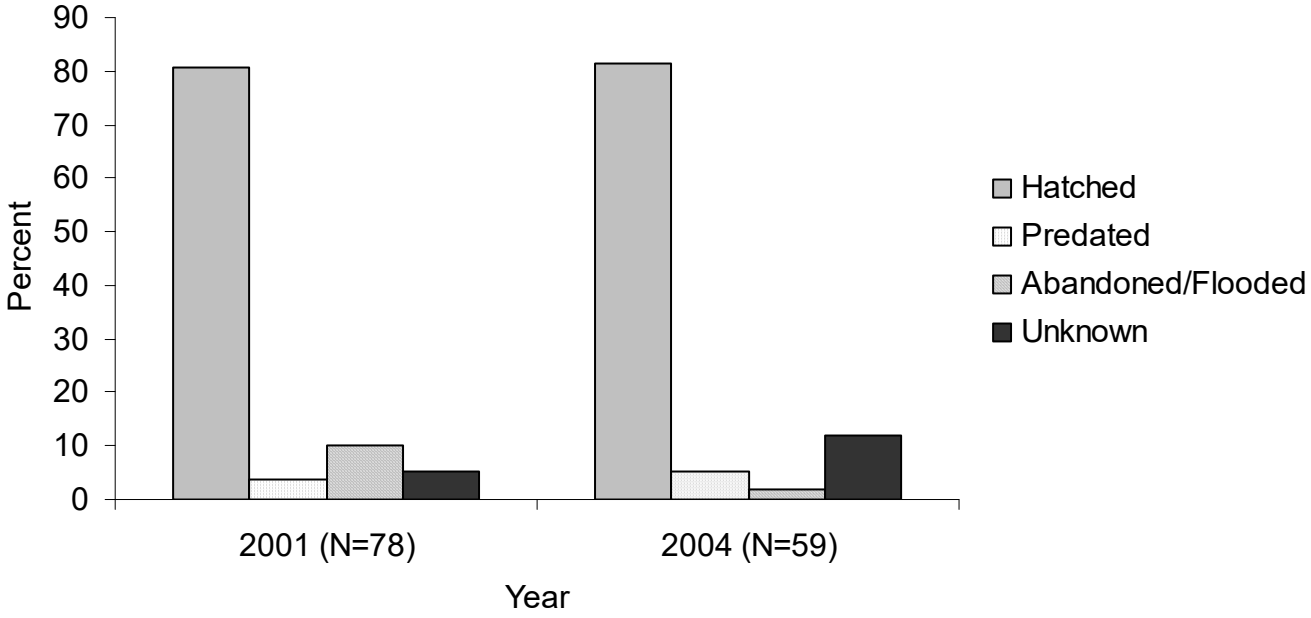
Over the past years, primary nesting sites within Eden Landing have changed in correlation to water level, vegetation, and predator changes. From 1989 to 2000, ponds at Eden Landing had consistent nesting, particularly on B16B. Up until 1996, there was also substantial nesting on some of the crystallizers (B17B, etc.), but these have become too vegetated with pickleweed (*Salicornia virginica*) to support nesting. In 2001 pond B11 dried up, providing snowy plover nesting habitat; many plovers nested there starting in mid-season. In 2001, plovers also nested on B16B and some on B12 and B6A. In 2002, when the water levels were extremely low, only a few nests were initiated in B16B and common ravens predated all of these nests. That same year, ponds B6A and B6B were mostly dry and had the majority of nesting plovers. In 2003 and part of 2004 breeding season, B16B was flooded to prevent plovers from nesting near the Eden Landing restoration activities and no plover nesting was recorded there during these two years (Cassady 1999, J. Albertson, pers. obs.).

In 2004, B6B again housed the majority of nesting plovers. As this pond dried, adults with broods and some nesting plovers moved to the adjacent pond B8. During the breeding season broods moved along the levee between B6B and B8 and as adults were leading them to better foraging habitat in B8 as B6B dried up. This is a common occurrence as pond conditions change over the season (Marriott and Schelin 2001). We began focus monitoring B8 in mid-season and thus we may have missed nests located in B8 earlier in the season.

Restoration and Snowy Plover Nesting Success

As the South Bay Salt Pond Restoration Plan continues to move forward (www.southbayrestoration.org), special consideration should be given to western snowy plover habitat requirements. Drying salt ponds with some high salinity forage areas are needed to sustain adult nesting plover and their broods. In addition, plover habitats should be spread out and allowed to vary in location from year to year in order to minimize predation levels.

Figure 7. Nest fates in the South Bay in 2001 and 2004, all areas.



Avian Predators

Between 2003 and 2004, detections of common ravens and northern harriers increased in the Alviso, Eden Landing, and Warm Springs areas. Red-tailed hawk detections also increased in Eden Landing and Warm Springs. At Ravenswood, detections of harriers increased, but detections of common ravens decreased (Figure 8).

While common ravens were the primary avian predator of concern in 2004, we observed several direct attacks by northern harrier and American kestrel. Northern harriers prey on adult and chick plovers (USFWS 2002). The proximity of their nesting habitat (especially in slough channels in Eden Landing) to snowy plover nesting habitat is of particular concern. Northern harrier may need to be added to the avian predator management program in the future. Other future predators to watch may include red-tailed hawks, white-tailed kites, and peregrine falcons. Peregrine falcon specialize on avian prey and were often seen perching in salt ponds. While red-tailed hawks and white-tailed kites are primarily mammal predators, their numbers within the snowy plover nesting habitat indicate that they may be a predator of concern.

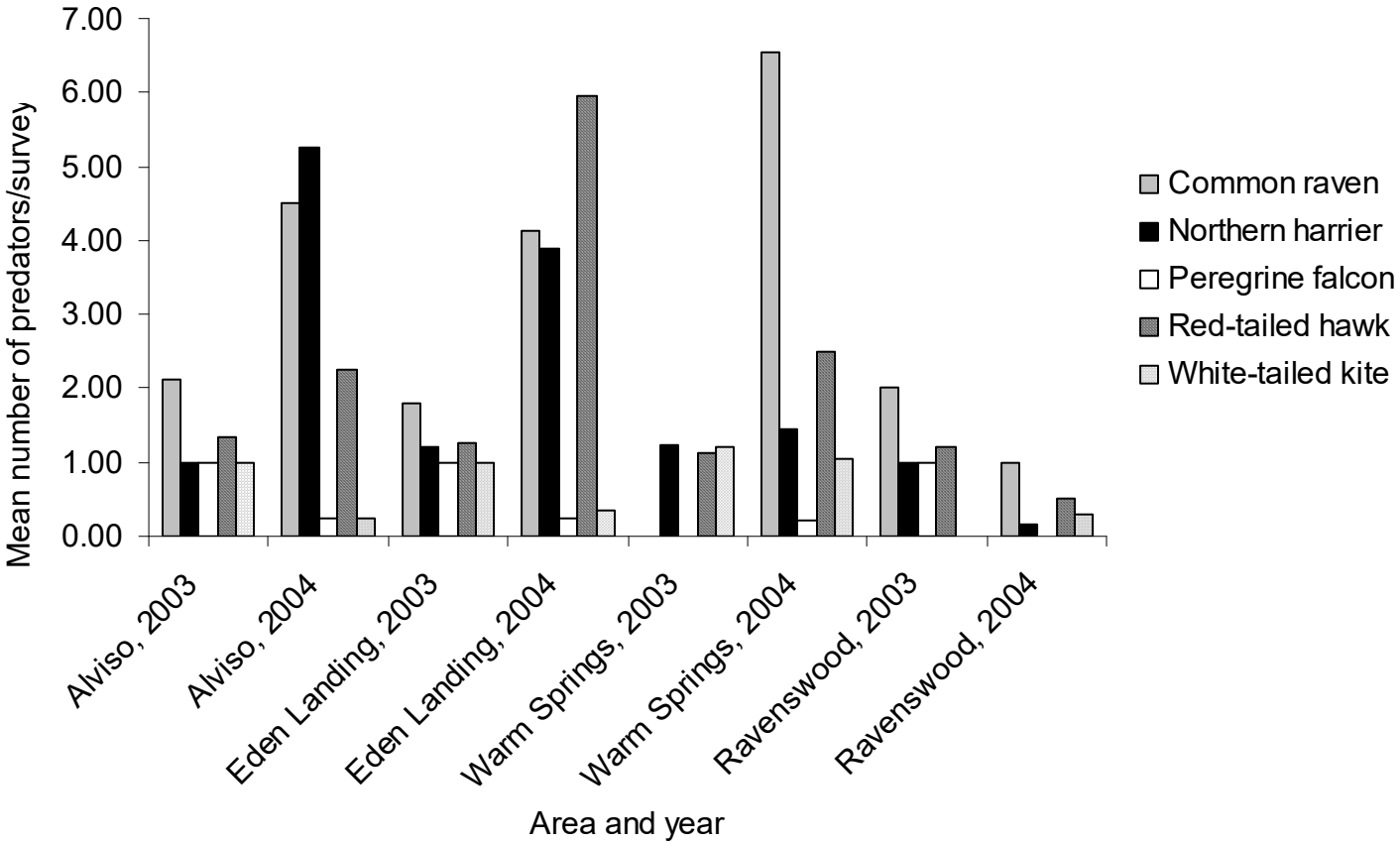
Loggerhead shrikes are documented snowy plover predators (USFWS 2004), but were only seen consistently in Warm Springs. One pair of loggerhead shrike nested successfully at the northeast corner of A22 at the office park, with two fledglings seen in the mid-summer. Because loggerhead shrike are also declining in the South Bay, limitations on nesting habitat for loggerhead shrike

adjacent to snowy plover nesting habitat should be encouraged rather than management for loggerhead shrike removal.

Several species were included in the avian predator surveys but not considered major snowy plover predators or predator species of concern. Wading birds primarily forage in slough channels, and even the great blue heron rookery (with approximately 12 nests) on pond B6B did not appear to influence plover use or nesting success.

Gulls are potential snowy plover predators due to their opportunistic feeding habits. Their nesting and roosting sites are adjacent to plover nesting sites. The largest California gull colony in the South Bay now exists adjacent to an historic snowy plover nesting area in Alviso. Since the exponential expansion of this gull colony (Strong et al 2004), no snowy plover have been known to nest in the area. The expansion of this and other gull colonies in the South Bay may require management in the near future before California gulls preclude nesting by other species, including terns, avocets, skimmers, and plovers.

Figure 8. Mean numbers of predators of concern per survey in 2003 and 2004 in areas with at least monthly surveys. Hayward eliminated due to a minimum number of predators.



Predation pressure may be correlated with nest number and density (Liebezeit and George 2002). If predators target high densities of snowy plover nests or broods then a densely packed area would provide predators with easy access to plovers. A diffuse population of plovers would present more of a challenge for predators. Management to enhance localized nesting habitat may promote predation as well as snowy plover nest numbers, leading to an overall decline in plover breeding success. Thus efforts to increase snowy plover population numbers would necessarily need to include more habitat acres distributed among a larger area and increased predator management than is currently in place.

Artificial perches and nesting structures provide roosting and nesting substrate for predators throughout the South Bay. Historical plover nesting habitat of beaches and salt flats are naturally free of prominent perches and tree-like nesting structures. On the salt ponds the main artificial nesting structures are PG&E towers. Common raven and red-tailed hawk nests were only found on these towers. Discussions with PG&E concerning tower design have been initiated and should continue in order to limit the use of towers by predators in the future. Artificial structures also provide perches from which predators survey the ponds for prey. Fence posts, old duck club structures, telephone poles, pump houses, and signs provide perches. All restoration plans in the South Bay should include the removal of as many of these structures as feasible, and no new perches should be put in place.

Road Closures and Barriers

Barriers and regulatory signs did not deter people from entering snowy plover nesting habitat. People were often seen jogging and walking on the levees around Warm Springs. At Eden Landing, bicycle tracks were observed on B6B, once within thirty feet of an active nest and bicyclists were seen riding on the levees. More law enforcement resources are required in all areas to protect plovers.

The north edge of RSF2 abuts a bike path and Highway 84. Adult plovers with broods were sighted foraging near the bike path or road (adjacent to the borrow ditch). On 4 August, a Caltrans truck passing on the bike path flushed a male with chicks from the shoulder of Highway 84 into a lane of traffic. Although no snowy plover casualties were seen, SFBBO volunteers found three dead black-necked stilt (*Himantopus mexicanus*) chicks in the same area (Attachment 2). A barrier between RSF2 and the roadways would help protect plovers from vehicles.

RECOMMENDATIONS

Research Recommendations

Monitoring and management programs and avian predator surveys should continue on a yearly basis on the Refuge, Eden Landing, and Hayward. The following research programs should be added as resources become available. We believe that at least four full time researchers and a number of interns would be needed to satisfy all of these program requirements.

a) Foraging site use studies.
b) Nesting site density studies.
c) Banding and tracking of chicks, broods, and adults.
d) Studies to determine the influence of exclosures on plover nesting success.
e) Studies to determine the influence of avian predator management, in particular predator nest removal on plover nesting success.

Management Recommendations

1. Special consideration should be given to western snowy plover habitat requirements during the South Bay Salt Pond Restoration Plan, including: 1) the availability of drying salt ponds with adjacent high salinity forage areas, 2) plover habitats should be spread out and 3) allowed to vary in location from year to year in order to minimize predation levels. All restoration plans in the South Bay should include the removal of as many predator perches as feasible, and no new perches should be put in place.

2. Monitors should work in the early morning and/or the late afternoon/early evening when lighting conditions are optimal; surveys should be done at high tide when possible to limit the number of plovers potentially foraging on bay mudflats at low tide.

3. The nest monitoring program should continue to include floating eggs to estimate age and expected hatching date.

4. Once the banding and tracking program has begun, all broods should be re-sighted daily so as not to lose track of movement.

5. Assuming no habitat changes, ponds A22, RSF2, R1, and R2 should be monitored two to four times/week as these ponds appear to support a large percentage of the Refuge population.

6. Assuming no habitat changes, ponds B6B and B8 should be monitored two to four times/week as these ponds appear to support a large percentage of the Eden Landing population.

7. The predator management plan of the Refuge should be amended to include avian predators. The avian predator control program should continue with consideration given to egg addling, nest removal, and possibly lethal removal of adults as a management method for predators. In the near future, northern harriers may need to be added to the avian predator management program.

8. Further investigation of the possible impact of red-tailed hawks, peregrine falcons, and white-tailed kites on plover success is warranted. The expansion of gull colonies in the South Bay will need to be addressed as they continue to grow and affect other nesting birds.

9. Pond access across channels around and within ponds RSF2, R1, R2, Patterson 2, Hickory/PP1, and B8 could be built in order to monitor nests. However, increased access must be mitigated by an increase in law enforcement or other limitations to public access.

10. Vehicle access should be limited on the levee between B6B and B8 during restoration construction and research activities as adults lead broods across this levee in search of foraging areas.

11. A low fence or other structure should be erected separating Highway 84 and the bike path from RSF2, as a short-term solution to preventing plovers from getting run over. As a long-term management solution, ponds farther from major roads and trails should be managed for ground-nesting birds.

12. Discussions with PG&E regarding tower design modifications should be continued to minimize use of towers by nesting predators.

13. Law enforcement resources should be made available to more stringently patrol and enforce regulations in snowy plover breeding areas.

14. As many volunteers as possible should be recruited to assist in plover surveys. This increases the visibility of the plover project and gets more people invested in wildlife issues around the Bay.

ACKNOWLEDGMENTS

We would like to thank the entire biology staff at the Refuge for providing me (NRW) the opportunity to work on such an awesome project with such an awesome staff; Heather P. Klausmeyer and Rachel J. Strickman for their diligent survey work and data entry, all the SFBBO volunteers for their time and

dedication, Emily Amaral and Todd Eggert for being snowy plover and avian predator pinch surveyors, and Joy Albertson for copious amounts of Dr. Pepper.

This project was supported by grants to C. Strong and SFBBO from Oracle and the USFWS Endangered Species Recovery Unit, and by the Don Edwards San Francisco Bay National Wildlife Refuge, and by the membership of SFBBO.

LITERATURE CITED

Boarman, W. I. and B. Heinrich. 1999. Common Raven (*Corvus corax*). The Birds of North America, No. 476. The Birds of North America, Inc., Philadelphia, PA.

Cassady, D. S. 1999. Snowy plover (*Charadrius alexandrinus*) nesting at the Baumberg Tract salt ponds, Hayward, California. California Department of Fish and Game. Yountville, California. pp. 1-4.

Finck, J. A. 2000. The Don Edwards San Francisco Bay National Wildlife Refuge avian predator survey, spring/summer 2000. USFWS. Newark, California.

Hays, H. and M. LeCroy. 1971. Field criteria for determining incubation stage in eggs of the common tern. Wilson Bulletin 83: 425-429.

Harding, E. K., Doak, D. F., Albertson, J. D., and J. E. Takekawa. 1998. Predator management in San Francisco Bay wetlands: past trends and future strategies. Final report. U.S. Fish and Wildlife Service, Division of Ecological Services, Sacramento, California.

Liebezeit, J. R. and George, T. L. 2002. A summary of predation by corvids on threatened and endangered species in California and management recommendations to reduce corvid predation. Calif. Dept. of Fish and Game, Species Conservation and Recovery Program Rpt. 2002-02, Sacramento CA 103 pp.

Marriott, M. A. and C. Schelin. 2001. Pacific coast western snowy plover monitoring program at the Don Edwards San Francisco Bay National Wildlife Refuge, the Eden Landing Ecological Reserve and selected Cargill Salt Division properties, 2001. USFWS. Newark, California. pp. 1-31.

National Audubon Society. 2002. The Christmas Bird Count Historical Results [Online]. Available http://www.audubon.org/bird/cbc. 15 November 2004.

Page, G. W. and L. E. Stenzel. 1981. The breeding status of the snowy plover in California. Western Birds 12(1):1-40.

Page, G. W., F. C. Bidstrup, R. J. Ramer and L. E. Stenzel. 1986. Distribution of wintering snowy plovers in California and adjacent states. Western Birds 17(4):145-170.

Page, G. W., J. S. Warriner, J. C. Warriner and P. W. C. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). The Birds of North America, No. 154. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washinton, D. C.

Stenzel, L. E., J. C. Warriner, J. S. Warriner, K. S. Wilson, F. C. Bidstrup and G. W. Page. 1994. Long-distance breeding dispersal of snowy plovers in western North America. Journal of Animal Ecology 63:887-902.
USFWS. 1993. Endangered and threatened wildlife and plants; determination of federal status for the Pacific coast population of the western snowy plover; final rule. Federal Register 58(42):12864-12874.
USFWS. 1998. Western snowy plover (*Charadrius alexandrinus nivosus*) Pacific coast population draft recovery plan. Region 1, USFWS, Portland, Oregon.
USFWS. 2002. Salinas River National Wildlife Refuge Comprehensive Conservation Plan. Region 2, USFWS, Portland, Oregon.

Attachment 1. Memo regarding northern harriers nesting in Old Alameda Creek.

July 28, 2004

Memorandum

To: File

From: Biology Intern, Don Edwards San Francisco Bay NWR

Re: NOHA nest activity on Old Alameda Creek in Baumberg

There were two NOHA nests in Old Alameda Creek near the 29 tide gates. NOHAs were frequently seen hunting along levees and in ponds that were used by SNPLs as nest habitat. On 6/1/2004 a harrier was seen near 29 tide gates with a SNPL in it's talons. The harriers nesting in Old Alameda Creek hunted SNPLs on B6B, B8 and surrounding ponds.

Below are brief notes on the monitoring of the NOHA nests.

NOHA nest south of 29 tide gates on Old Alameda Creek.
05/26/04, Joy Albertson, Natalie R. Wilson
Located and GPSed nest. GPS file name is SNPLNEST24MAY. It contained 2 chicks, only a couple days old, small with dry yellow down. The nest also contained a dead chick; there was no apparent cause of death.
06/10/04, Natalie R. Wilson, Heather P. Klausmeyer, Rachel J. Strickman
Rechecked nest. There were no chicks in nest. There was no blood or feathers or down in nest.

NOHA nest north of 29 tide gates on Old Alameda Creek.
06/08/04, Natalie R. Wilson, Heather P. Kausmeyer
Located nest. GPSed a point ~10 meters south of nest to minimize disturbance to birds. GPS file name is NOHA. One immature NOHA flew from the nest site and low over the bulrush to a spot ~30 meters north of nest. Another immature NOHA was in the nest and was greatly agitated by my presence.
06/15/04, Natalie R. Wilson, Rachel J. Strickman
A NOHA fledgling was seen flying low near nest site.

Natalie R. Wilson

Attachment 2. Memo regarding plovers on road and bike path at Ravenswood.

August 4, 2004

Memorandum

To: File

From: Biology Intern, Don Edwards San Francisco Bay NWR

Re: SNPL on RSF2 near road and bike path

RSF2 is on the west side of the bay just south of highway 84 as it crosses the Dumbarton Bridge. A bike path follows the entire northwest edge of the pond. The bike path is separated from the road by a gravel divider about 3 meters wide. Along the northwest edge of RSF2, about 400 meters from the bay, an access road branches off from 84 and runs towards the bay between the rising Dumbarton bridge and the bike path. There is a parking area along this road next to the Dumbarton bridge. The road then turns under the bridge and provides access to Ravenswood West.

The Dumbarton Bridge and highway 84 is a major east-west road that is constantly busy. The bike path along this road is also very popular and I see at least two bicyclists on the path every hour I am at RSF2 and often there are walkers. The access road is used by highway patrol fairly often and Caltrans uses the bike path as access to its utilities.

The heavy traffic in this area is a concern because RSF2 is a prime breeding site for SNPL. This year there have been many adult and chick sightings on the bike path and along the road. SNPLs are most often sighted along a 300m stretch near the water gauge and survey marker pair near the end of access road, at a site about 200m southwest of the PGE boardwalk and at the northwest corner of the pond, illustrated on the attached map. Land bridges span the dredge channel in these areas and we assume that SNPLs use these land bridges as access to the bike path. I have seen 12 different SNPLs near the bike path or road. For a period of six weeks there was a plover sighted near the bike path or road at least once a week. Of the plover sightings, seven times it was an adult with chicks, four times it was an adult male and once it was a juvenile. The plovers forage along the gravel and also on the asphalt of the road and bike path. On 8/4/04, a Caltrans truck passing on the bike path flushed a male with chicks from the gravel and shoulder of 84 into a lane of traffic.

It is mostly the chicks on the bike path and road that is of concern. Motorist and bicyclists would not see the chicks and may unknowingly run over them, especially the younger chicks that freeze on the spot when alarmed. There have been three sightings of one week old chicks near the road.

Possible solutions include erecting chick fence or hazing birds off the pond. Chick fence should surround the entire northwest and west sides of the pond, the sides that border a road. If only erected in spots it is possible that a chick could get around the fence by swimming or crossing land as the pond dries then getting trapped near the road. The pond cannot be flooded to prevent SNPL nesting because of lead clean-up. After the

Below is a summary of the SNPL sightings near the road on RSF2.
Date, time – number sex/age, number and age of chicks if present, place where sighted, observers
8/4, 0905 – 1 male with 3 2-week chicks, gravel between bike path and road and 84, NRW HPK
7/26, 1045 – 1 male, bike path, NRW HPK
7/26, 1107 – 1 male, bike path, NRW HPK
7/26, 1144 – 1 juvenile, road near stop sign, NRW HPK
6/23, 1055 – 1 male with 1 2-week chick, gravel between bike path and road, NRW HPK
6/17, 1116 – 1 male with 3 1-week chicks, gravel between bike path and road, NRW RJS HPK
6/9, 1034 – 1 male with 2 1-week chicks, shoulder of 84, NRW
6/2, 1150 – 1 male with 1 1-week chick, bike path, NRW HPK
6/2, 1153 – 1 male, bike path, NRW HPK
5/27, 1242 – 1 unknown with 1 chick (unknown age), edge of bike path, NRW TE
5/21, 1030 – 1 male, bike path, NRW EA
5/21, 1104 – 1 male with 1 4-week chick, gravel between bike path and road, NRW EA

Observers are Natalie R. Wilson (NRW), Heather P. Klausmeyer (HPK), Rachel J. Strickman (RJS), Emily Amaral (EA), and Todd Eggert (TE).

Natalie R. Wilson

Appendix 1. Summary statistics of plover numbers by pond for the 2004 nesting season.

Area	Pond	Statistic	Male	Female	Unknown adults	All adults	Juveniles	Chicks	All juveniles and chicks
Warm Springs	A22	Maximum	9.00	7.00	22.00	32.00	1.00	8.00	8.00
Warm Springs	A23		2.00	0.00	11.00	11.00	0.00	5.00	5.00
Eden Landing	B12		2.00	1.00	6.00	7.00	0.00	2.00	2.00
Eden Landing	B13		1.00	1.00	0.00	2.00	0.00	0.00	0.00
Eden Landing	B14		1.00	1.00	0.00	2.00	0.00	3.00	3.00
Eden Landing	B15B		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Eden Landing	B16B		2.00	1.00	3.00	3.00	0.00	0.00	0.00
Eden Landing	B4B		2.00	0.00	1.00	3.00	0.00	3.00	3.00
Eden Landing	B6A		6.00	8.00	5.00	19.00	3.00	0.00	3.00
Eden Landing	B6B		29.00	23.00	59.00	83.00	5.00	29.00	29.00
Eden Landing	B8		21.00	12.00	41.00	59.00	6.00	15.00	20.00
Eden Landing	B9		7.00	6.00	1.00	14.00	3.00	6.00	6.00
Hayward	FDW		1.00	8.00	3.00	8.00	4.00	0.00	4.00
Dumbarton	N1		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN1		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN10		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN12		0.00	1.00	0.00	1.00	2.00	0.00	2.00
Hayward	OBN13		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN14		1.00	1.00	0.00	2.00	0.00	0.00	0.00
Hayward	OBN15		1.00	3.00	0.00	3.00	1.00	0.00	1.00
Hayward	OBN2		0.00	4.00	0.00	4.00	0.00	0.00	0.00
Hayward	OBN4		0.00	1.00	2.00	3.00	0.00	0.00	0.00
Hayward	OBN5		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN6		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN8		0.00	3.00	0.00	3.00	0.00	0.00	0.00
Dumbarton	PP1		1.00	0.00	24.00	25.00	0.00	3.00	3.00
Ravenswood	R1		4.00	4.00	16.00	18.00	5.00	0.00	5.00
Ravenswood	R2		17.00	12.00	35.00	53.00	14.00	2.00	14.00
Ravenswood	RSF2		10.00	9.00	15.00	23.00	5.00	13.00	13.00
Warm Springs	A22	Mean	2.73	1.80	4.87	9.40	0.07	3.20	3.27
Warm Springs	A23		1.00	0.00	4.33	5.33	0.00	2.00	2.00
Eden Landing	B12		0.80	0.20	1.40	2.40	0.00	1.00	1.00
Eden Landing	B13		1.00	0.50	0.00	1.50	0.00	0.00	0.00
Eden Landing	B14		0.50	1.00	0.00	1.50	0.00	1.50	1.50
Eden Landing	B15B		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Eden Landing	B16B		1.00	0.50	1.50	3.00	0.00	0.00	0.00
Eden Landing	B4B		2.00	0.00	1.00	3.00	0.00	3.00	3.00
Eden Landing	B6A		2.33	3.67	2.00	8.00	1.00	0.00	1.00
Eden Landing	B6B		6.00	7.78	15.11	28.89	0.89	6.78	7.67
Eden Landing	B8		8.69	4.62	13.38	26.69	2.00	7.23	9.23
Eden Landing	B9		2.33	2.67	0.33	5.33	1.00	2.00	3.00
Hayward	FDW		0.50	4.50	1.50	6.50	2.00	0.00	2.00
Dumbarton	N1		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN1		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN10		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN12		0.00	1.00	0.00	1.00	1.00	0.00	1.00
Hayward	OBN13		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN14		1.00	1.00	0.00	2.00	0.00	0.00	0.00
Hayward	OBN15		0.25	2.00	0.00	2.25	0.25	0.00	0.25
Hayward	OBN2		0.00	4.00	0.00	4.00	0.00	0.00	0.00
Hayward	OBN4		0.00	1.00	2.00	3.00	0.00	0.00	0.00

App 1. continued.

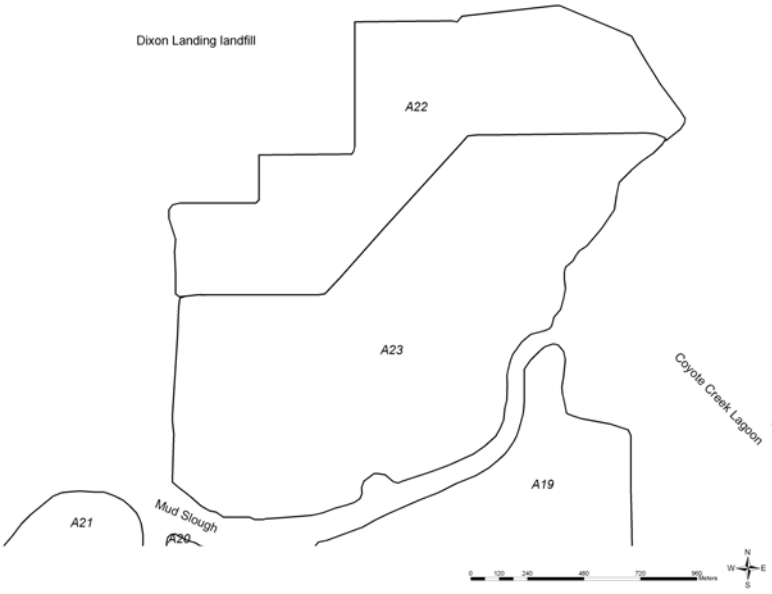
Area	Pond	Statistic	Male	Female	Unknown adults	All adults	Juveniles	Chicks	All juveniles and chicks
Hayward	OBN5	Mean	0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN6		0.00	1.00	0.00	1.00	0.00	0.00	0.00
Hayward	OBN8		0.00	3.00	0.00	3.00	0.00	0.00	0.00
Dumbarton	PP1		0.50	0.00	12.50	13.00	0.00	1.50	1.50
Ravenswood	R1		2.00	1.50	6.50	10.00	1.25	0.00	1.25
Ravenswood	R2		6.83	3.17	15.17	25.17	3.00	0.83	3.83
Ravenswood	RSF2		4.19	3.31	4.00	11.50	0.75	4.88	5.63
Warm Springs	A22	Number of surveys	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Warm Springs	A23		3.00	3.00	3.00	3.00	3.00	3.00	3.00
Eden Landing	B12		5.00	5.00	5.00	5.00	5.00	5.00	5.00
Eden Landing	B13		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Eden Landing	B14		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Eden Landing	B15B		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Eden Landing	B16B		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Eden Landing	B4B		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Eden Landing	B6A		3.00	3.00	3.00	3.00	3.00	3.00	3.00
Eden Landing	B6B		18.00	18.00	18.00	18.00	18.00	18.00	18.00
Eden Landing	B8		13.00	13.00	13.00	13.00	13.00	13.00	13.00
Eden Landing	B9		3.00	3.00	3.00	3.00	3.00	3.00	3.00
Hayward	FDW		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Dumbarton	N1		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN1		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Hayward	OBN10		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN12		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Hayward	OBN13		3.00	3.00	3.00	3.00	3.00	3.00	3.00
Hayward	OBN14		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN15		4.00	4.00	4.00	4.00	4.00	4.00	4.00
Hayward	OBN2		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN4		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN5		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN6		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hayward	OBN8		1.00	1.00	1.00	1.00	1.00	1.00	1.00
Dumbarton	PP1		2.00	2.00	2.00	2.00	2.00	2.00	2.00
Ravenswood	R1		4.00	4.00	4.00	4.00	4.00	4.00	4.00
Ravenswood	R2		6.00	6.00	6.00	6.00	6.00	6.00	6.00
Ravenswood	RSF2		16.00	16.00	16.00	16.00	16.00	16.00	16.00
Warm Springs	A22	Standard Error	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Warm Springs	A23		0.91	0.91	0.91	0.91	0.91	0.91	0.91
Eden Landing	B12		0.55	0.55	0.55	0.55	0.55	0.55	0.55
Eden Landing	B13		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Eden Landing	B14		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Eden Landing	B15B		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Eden Landing	B16B		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Eden Landing	B4B		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Eden Landing	B6A		0.91	0.91	0.91	0.91	0.91	0.91	0.91
Eden Landing	B6B		0.15	0.15	0.15	0.15	0.15	0.15	0.15
Eden Landing	B8		0.21	0.21	0.21	0.21	0.21	0.21	0.21
Eden Landing	B9		0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hayward	FDW		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Dumbarton	N1		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN1		1.37	1.37	1.37	1.37	1.37	1.37	1.37

App 1. continued.

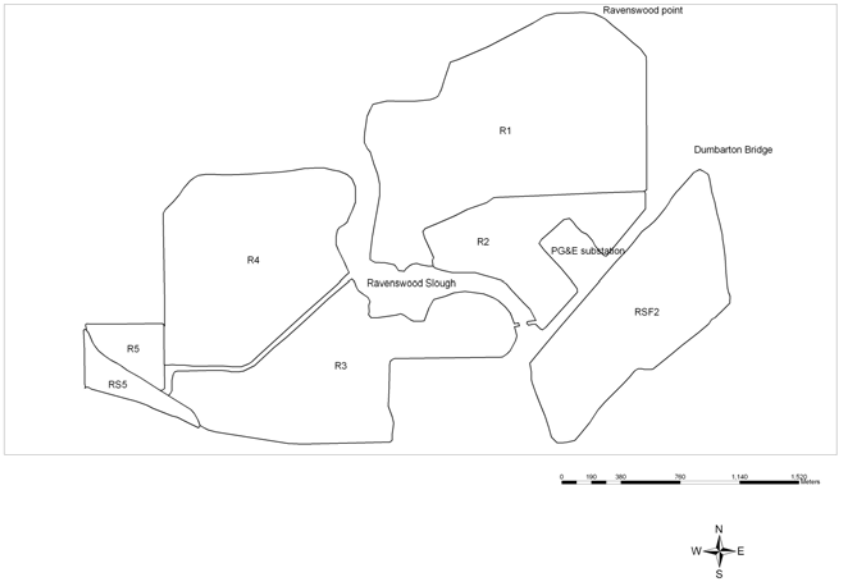
Area	Pond	Statistic	Male	Female	Unknown adults	All adults	Juveniles	Chicks	All juveniles and chicks
Hayward	OBN10	Standard Error	2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN12		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Hayward	OBN13		0.91	0.91	0.91	0.91	0.91	0.91	0.91
Hayward	OBN14		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN15		0.68	0.68	0.68	0.68	0.68	0.68	0.68
Hayward	OBN2		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN4		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN5		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN6		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Hayward	OBN8		2.74	2.74	2.74	2.74	2.74	2.74	2.74
Dumbarton	PP1		1.37	1.37	1.37	1.37	1.37	1.37	1.37
Ravenswood	R1		0.68	0.68	0.68	0.68	0.68	0.68	0.68
Ravenswood	R2		0.46	0.46	0.46	0.46	0.46	0.46	0.46
Ravenswood	RSF2		0.17	0.17	0.17	0.17	0.17	0.17	0.17

Appendix 2. Maps of salt ponds surveyed during the 2004 breeding season.

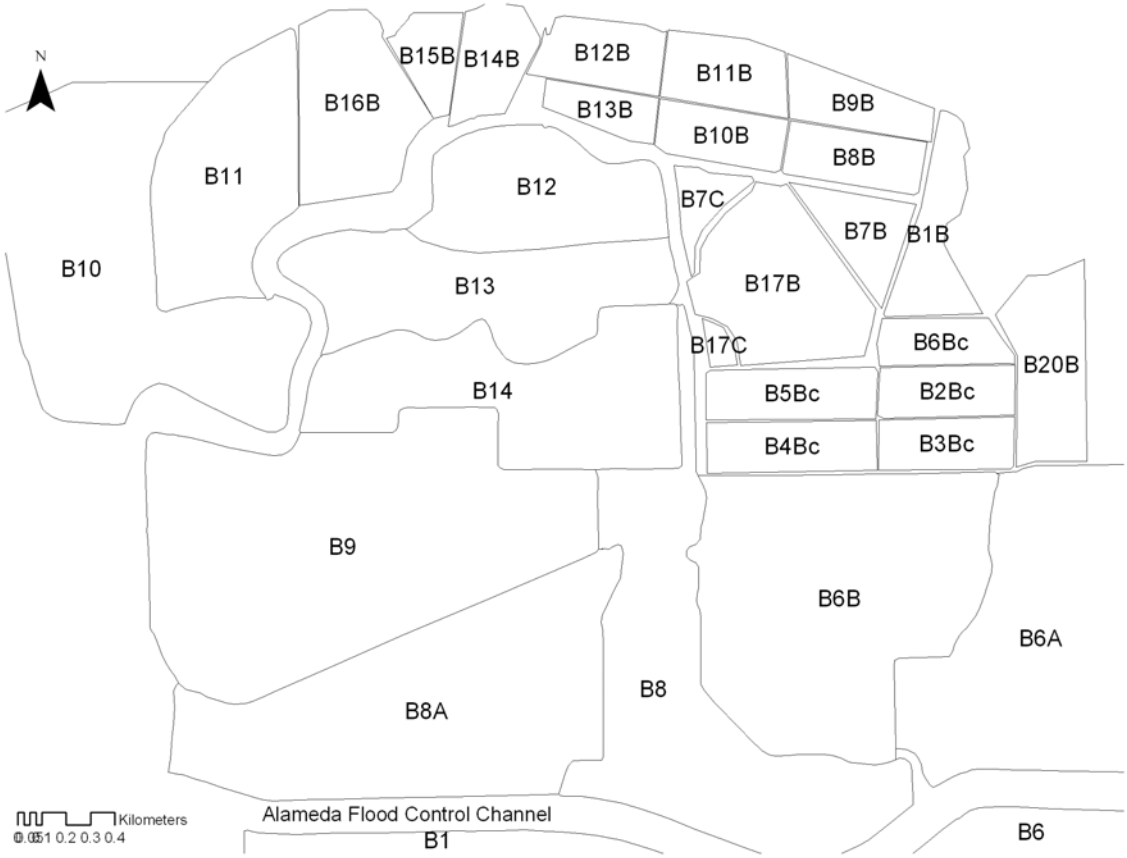
Refuge- Warm Springs



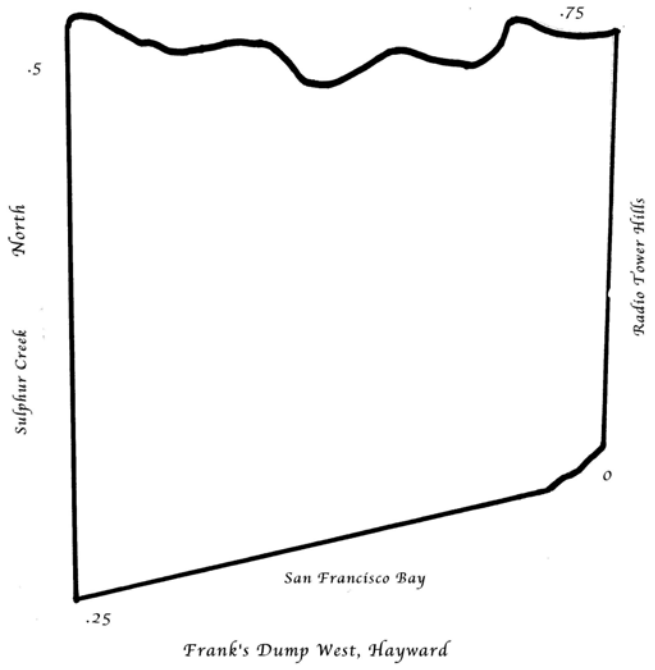
Refuge-Ravenswood



CDFG-Eden Landing



Hayward- FDW



Hayward- OBN