SAN FRANCISCO BAY
BIRD OBSERVATORY

Western Snowy Plover Studies
Agreement No. A3479F


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EXECUTIVE SUMMARY

The San Francisco Bay Bird Observatory conducted studies of Western Snowy Plovers in Santa Clara County, California in 2011. The first objective of the study was to collect and summarize current Western Snowy Plover nesting, population and distribution data in areas in which the Santa Clara Valley Water District (SCVWD) works. The second objective was to conduct a study of Western Snowy Plover nesting and behavioral responses to construction activities that are similar to potential SCVWD construction activities.

During March through August 2011, we observed an average of 12 plovers per week in the survey area. We observed the most plovers on the dry pan area of New Chicago Marsh. We located and monitored six Snowy Plover nests, all within New Chicago Marsh. Of these nests, four hatched and two were depredated. We calculated Snowy Plover nest success at 41%.

Snowy Plovers nest on dry exposed pond bottom of managed ponds and occasionally on dry salt pans in marshes. Water management plays a role in where the breeding habitat is each year. When ponds are allowed to dry, they become potential breeding habitat. This season, ponds A12 and A13 were drawn down for nesting birds. The pan area of New Chicago Marsh was also dry enough to host nesting plovers. In future years, the breeding habitat will be different, depending on the water management regimes used by land managers.

Due to the timing and location of construction activities during the 2011 breeding season, we were unable to collect data in the field. However, we used video footage from nest cameras to observe two nests in the 2010 breeding season and two nests in the 2011 breeding season in which there was construction activity within 182.8m (600 ft) of the nest and where we could see the potential construction disturbance. We also observed footage of four plover nests that were within 182.8m of a levee but were not within the construction area (control area). The average time off the nest for Snowy Plovers exposed to construction disturbance was 4:46 min compared to an average of 1:37 min off the nest for Snowy Plovers in control observations. There was an average of 5.2 disturbances per hour in the construction observations, compared to an average of 1.8 disturbances per hour in control areas. We were unable to calculate flush distance for the construction disturbance because we could not always determine where the disturbance was located, and thus calculate the distance, when the bird flushed in the video.

We recommend the SCVWD adopt the buffer distance that the South Bay Salt Pond Restoration Project uses between Snowy Plover nests and construction activities, which is 182.8 m (600 ft; USFWS 2008).

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INTRODUCTION

The Santa Clara Valley Water District's (SCVWD) Stream Maintenance Program (SMP) Biodiversity Monitoring Project is required to collect population, distribution and trend data on a variety of special status species. One of the species to be studied is the Western Snowy Plover (*Charadrius nivosus nivosus*).

The Western Snowy Plover population breeds along or near tidal water on the Pacific Coast 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 Pacific coast Western Snowy Plover population as a threatened species in 1993 (USFWS 1993).

In 2011, the SCVWD contracted the San Francisco Bay Bird Observatory to conduct Western Snowy surveys during the 2011 plover breeding season in Santa Clara County.

This study addressed two objectives:

Objective 1: Collect current Western Snowy Plover nesting, population and distribution data on District facilities and summarize that information in conjunction with ongoing monitoring on adjacent properties.

Objective 2: Conduct a study of Western Snowy Plover nesting and behavioral responses to construction activities that are similar to potential district construction activities.

This report summarizes the 2011 breeding season data for Santa Clara County, including Snowy Plover surveys, nest success, and plover response to construction surveys.

TASK 1: Habitat Surveys and Nest Monitoring

Study Area

Snowy Plovers in the San Francisco Bay nest predominantly on dry salt ponds and occasionally on dry pan areas of marshes. For this study, we surveyed ponds and marsh pan habitat in Santa Clara County, California. We conducted surveys once a week at ponds A8, A12, the Alviso impoundment area and the pan area of New Chicago Marsh in the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). Given the current water management systems, these are the only areas that provide plover breeding habitat in Santa Clara County. The ponded areas were managed under different water management regimes. Pond A8 was flooded until June, when it became muted tidal. Ponds A12 and A13 were drawn down early in the season to provide nesting habitat for birds. The Alviso impoundment and New Chicago Marsh get flooded by the winter rains, and dries throughout the Snowy Plover breeding season. The SCVWD's Pond A4 was flooded throughout the season and did not provide any plover habitat.

Methods

Snowy Plover Surveys

SFBBO's contract with SCVWD was approved on 6 June 2011, however in this report we incorporate data collected under another funding source to provide a more complete picture of the 2011 Snowy Plover breeding season in Santa Clara County. SFBBO has monitored Snowy Plovers since 2003, and in this report we also incorporate data collected in previous years for context and comparison.

To identify areas used by plovers and estimate the number of Snowy Plovers in Santa Clara County, we identified areas with potential plover nesting habitat and surveyed those ponds once a week. From 1 March to 31 August 2011, we surveyed the ponds by driving slowly on the levees or walking levees 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 banded Snowy Plover adults.

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). We monitored nests weekly until we determined the fate of the nest. On each visit, we recorded whether 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 predicted hatch date for all nests monitored. When there were no longer eggs in the nest, we assigned each nest a fate based on evidence seen at the nest (Mabee 1997). Nest fates included: hatched, depredated, flooded, abandoned, lost at hatch, or unknown. We defined a successful nest as a nest that hatched at least one egg.

Data Analysis

We used a logistic exposure model to estimate daily nest survival (Shaffer 2004). For this analysis, we looked at all breeding areas in the San Francisco Bay and years from our larger dataset and here we present only data for Santa Clara County. Daily nest survival was modeled as function of breeding area, year and nest initiation date and ranked candidate models using Akaike's Information Criterion (AIC; Burnham and Anderson 2002). We used model with the greatest support to produce estimates of daily nest survival. Nest survival varied significantly by initiation date, therefore we used the average initiation date to estimate daily nest survival. We estimated nest success as the product of daily nest survival over the complete life of the nest

(33 days for Snowy Plovers; Warriner et al. 1986). We calculated nest density in the ponds by dividing the number of nests in each pond by the size in hectares.

Results

Snowy Plover Surveys

From the first week in March, through the last week in August, we observed an average of 12 Snowy Plovers per week in Santa Clara County. The number increased throughout the season as the pan area of New Chicago Marsh dried out, providing additional plover habitat (Figure 4). New Chicago Marsh had the highest numbers of plover throughout the season with an average of 9.9 plovers observed per survey (Figure 5).

Reproductive Success

We found six Snowy Plover nests in Santa Clara County in 2011, all within the boundaries of New Chicago Marsh. Four of the nests hatched, and two were depredated. Using the Shaffer (2004) logistic exposure method, we calculated nest success to be 41% (Table 1). This is the lowest nest success we have calculated for Alviso since we began collecting data in 2006 (Table 1).

Nest density in New Chicago Marsh in 2011 was 0.044 nests per hectare. We did not find any nests in A5, A6, A7, A8, A10, A11, A12, A13, A14, A15, A16 or A17.

Discussion

The amount of Snowy Plover habitat available in Santa Clara County varies from year to year, depending on the water management regime within former salt ponds and diked marshes and the amount of rainfall. Any pond with dry pond bottom exposed, could potentially host nesting Snowy Plovers (Figure 3). In previous years, A8 hosted the majority of Snowy Plover nests in Santa Clara County (Robinson et al. 2006); however that area is now open to tidal action from June through December. The Refuge keeps the water level high in the pond from January through June to prevent plovers from nesting on the pond (E. Mruz, per. comm.). However, if water levels were to drop during that time period, plovers could nest in the pond again.

From 2008 through 2011, the Refuge drew down ponds A12 and A13 for nesting waterbirds and one plover nested on A12 in 2008. The Refuge will not continue this water management regime in 2012 (E. Mruz, per. comm.).

In 2012 and 2013, the water level in Refuge ponds A16 and A17 will be drawn down for construction activities related to the South Bay Salt Pond Restoration Project (E. Mruz, per. comm.). We predict that Snowy Plovers will use these ponds for nesting if they remain dry during the breeding season. During the winter of 2011, the Refuge is putting in a siphon between pond A16 and New Chicago Marsh. This will allow the Refuge to add water to the marsh year round. The new water management of New Chicago Marsh will potentially prevent the pan area of the marsh from drying out, and therefore deter the plovers from nesting in that

area. The new water management of New Chicago Marsh is likely to begin once the A16/A17 construction ends in 2013.

The number of Snowy Plovers observed in Santa Clara County increased throughout the season. This is most likely due to the additional habitat available to the plovers as pond A12 and New Chicago Marsh dried throughout the season. Near the end of July and August there were two weeks with large increases in the number of birds in Alviso. These are probably birds dispersing after the breeding season, rather than birds attempting to breed in the area.

Although nest success was lower this year in the Santa Clara County, nest success was higher than in some other areas of the South San Francisco Bay, where nest success varied from 15% at Warm Springs, 20% at Eden Landing and 62% in Ravenswood (Robinson-Nilsen et al. 2011).

TASK 2: Monitor Responses of Western Snowy Plovers to Construction Activities and Compare with Control Nests

Study Area

We conducted the Western Snowy Plover response to construction activities portion of this study at Eden Landing Ecological Reserve (Eden Landing) in Hayward, CA. California Department of Fish and Game owns and manages Eden Landing (formally known as Baumberg), which includes approximately 5,500 acres of salt ponds, marsh and tidal habitat. These habitats are similar to the plover's habitats found in Santa Clara County, and it is assumed that the responses documented here will apply to plovers breeding in Santa Clara County. The study area is located within the project area of the South Bay Salt Pond Restoration Project. During the 2010 and 2011 Snowy Plover breeding seasons, there has been active construction on levees surrounding ponds that have Snowy Plover nesting and foraging habitat.

Methods

Construction Surveys

During the 2011 Western Snowy Plover breeding season at Eden Landing, there were no plover nests within 600 feet of a levee where (i) active construction occurring or (ii) construction vehicles were driving past on a regular basis (i.e., haul routes for the construction). Therefore, we used video footage collected by nest cameras from two nests from the 2010 breeding season and two nests from the 2011 season. These four nests (hereby construction observations) were the only nests meeting the criteria of being within 600 feet of a levee and exposed to some construction disturbance. Within the frame of videos, we could see the Snowy Plover and the type of vehicle or disturbance; therefore we could determine what type of vehicle or activity disturbed the plover. We compared the behaviors of the birds nesting with 600 feet of a levee, to behaviors of birds nesting in non-construction sites, (hereby control observations). For the control observations, we used footage collected from four nests in the 2011 breeding season.

For construction nests, we observed video in 60 min blocks during which at least one construction truck passed by the nest. For control nests, we chose random 60 min blocks. When possible, we observed the nest three times, once early in their incubation period (0-10 days), one in the mid-incubation period (11-20 days) and one late in the incubation period (21-33 days). This was not possible for every nest, as one construction nest did not experience any disturbance in the late incubation period. We watched a total of 23 hours of video. We recorded all disturbances, the type of disturbance (Table 3), the frequency and/or duration of disturbance, the response of the incubating plover to disturbance (Table 2), and the time it took a plover to return to the nest if flushed by the disturbance event. We recorded the disturbance that the plover was exposed to and classified the disturbance according to Table 3. For control trials recorded any of the above behaviors.

To determine nest fate, we monitored all nests using the field methods described in Task 1. We noted any other disturbances that might affect the plovers seen in the video, such as avian and mammalian predators or aircraft. Given that both construction activities occur at Eden Landing during the day, and the limited study budget, we did not address nocturnal disturbances.

Nest Cameras

We used security cameras placed in camouflaged ammunitions boxes positioned 10 to 30 m from plover nests. We used a coupled electrical and coaxial cable 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.

Data Analysis

We calculated the average time off the nest for Snowy Plovers in construction areas, and in control areas. We also calculated the average number of disturbances in an hour in construction areas and in control areas.

Results

Because of the small sample size of nests recorded within 600 feet of construction activities, we are unable to statistically analyze plover response to construction activities. We observed four nests in the construction area, and four nests in control areas.

When plovers flushed, the average time off the nest for Snowy Plovers exposed to construction disturbance was 4:46 minutes compared to the average time off the nest of 1:37 minutes for Snowy Plovers in control observations. There was an average of 5.2 disturbances per hour in the construction observations, compared to an average of 1.8 disturbances per hour in control areas. We observed 80 disturbance events for the construction nests and 20 disturbance events for control nests. We were unable to calculate flush distance for the construction disturbance because we could not always tell where the disturbance was located when the bird flushed in the video.

The most commonly observed disturbance types for nests in construction areas were moving pickup trucks (n=41) and moving dump trucks (n=23, Table 4). The disturbance event that caused the plover to be off the next the longest was pickup trucks passing by, along with trucks stopping in the area of the nest. The amount of time the birds stayed off the nest varied from just under a minute to 31 min.

Two of the three nests that we surveyed for construction disturbance hatched, and one was abandoned. All four of the nests that we observed in control areas hatched.

Discussion

When incubating birds are flushed from their nests, their eggs and newly-hatched chicks are susceptible to predation and exposure to weather (Page and Stenzel 1981). Human recreation on beaches negatively impacted snowy plover chick survival (Ruhlen, et al. 2003). Although no studies have looked at construction disturbance to Western Snowy Plovers, construction activities have the potential for disturbing nesting plovers more than recreational activities due to the large vehicles used and frequency of the disturbance events.

With our limited sample size, nesting Western Snowy Plovers appear to be disturbed off their nests more frequently in construction areas, and stay off their nests for longer periods of time than in control areas. The longer periods of time off the nest may attract predators or cause plovers to abandon nests.

While we were not able to calculate flush distances for construction disturbance from watching the videos, other studies have shown that nesting plovers are sensitive to recreational disturbance (Robinson 2008 and Trulio et al 2011). These studies took place within the South Bay Salt Pond Restoration Project area and found that plovers flushed at a distance of 175m (SE=45m) when directly approached by researchers (Robinson 2008) and 146m (SE=19m) when approached tangentially by researchers and trail users (Trulio et al 2011). Trulio et al (2011) recommended that trails be placed at least 150 meters from plover nesting areas. The Biological Opinion for the South Bay Salt Pond Project states that construction activities should not take place within 182.8 m (600 ft) of a Snowy Plover nest (USFWS 2008). Based on the amount of disturbance we observed in the videos, and the South Bay Salt Pond Restoration Project's Biological Opinion, we recommend that the SCVWD use a similar buffer distance of 182.8 m (600 ft) between their construction projects and any nesting Snowy Plovers.

ACKNOWLEDGMENTS

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LITERATURE CITED

Burnham , K.P., and D.R. Anderson. 2002. Model selection and multimoderl inference: a practical information-therotic approach, 2nd ed. Springer-Verlag, New York.

Funk, W., T.D. Mullins, and S.M. Haig. 2006, Conservation genetics of North American and Caribbean snowy plovers (*Charadrius alexandrinus*) - population genetic structure and delineation of subspecies: US Fish and Wildlife Service, p. 1-55. Catalog No: 1522.

Hays, H. and M. LeCroy. 1971. Field criteria for determining incubation stage for the common tern. Wilson Bulletin 83(4): 425-429.

Mabee, T. J. 1997. Using eggshell fragments to determine nest fate of shorebirds. Wilson Bulletin 109(2): 307-313.

Page G.W. and L.E. Stenzel. 1981. The breeding status of the snowy plover *Charadrius alexandrinus* in California, USA. Western Birds 12: 1–40.

Page, G.W., L.E. Stenzel, W.D. Shuford and C.R. Bruce. 1991. Distribution of the Snowy Plover on its western North American Breeding Grounds. Journal of Field Ornithology 62(2): 245-255.

Robinson, C., C. Strong, L. Tucci and J. Albertson. 2006. Western Snowy Plover Numbers, Nesting Success, and Avian Predator Surveys in the San Francisco Bay, 2006. Unpublished Report. San Francisco Bay Bird Observatory, Milpitas, CA.

Robinson, C. 2007. Western Snowy Plover Use of Managed Salt Ponds at Eden Landing, Hayward, CA. Master of Science Thesis. Department of Environmental Studies, San Jose State University, San Jose, CA.

Robinson-Nilsen, C., J. Demers, and C. Strong. 2011. Western Snowy Plover Numbers, Nesting Success, Fledging Success and Avian Predator Surveys in the San Francisco Bay, 2011. Unpublished Report. San Francisco Bay Bird Observatory, Milpitas, CA.

Ruhlen, T.D., S. Abbott, L. E. Stenzel, and G. W. Page. 2003. Evidence that human disturbance reduces Snowy Plover chick survival. Journal of Field Ornithology 74(3):300–304.

Shaffer, T. L., 2004. A unified approach to analyzing nest success. Auk, 121: 526–540.

Trulio, L., C. Robinson-Nilsen, J. Sokale and K. Lafferty. 2011. Report on Nesting Snowy Plover Response to New Trail Use in the South Bay Salt Pond Restoration Project. Unpublished Report.

U.S. Fish and Wildlife Service. 1993. Endangered and threatened wildlife and plants; determination of threatened status for the Pacific coast population on the western snowy plover; final rule. Federal Register 58 (42): 12864-12874.

U.S. Fish and Wildlife Service. 2008. Formal Endangered Species Consultation on the Proposed South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California. 81420-08- F-0621.

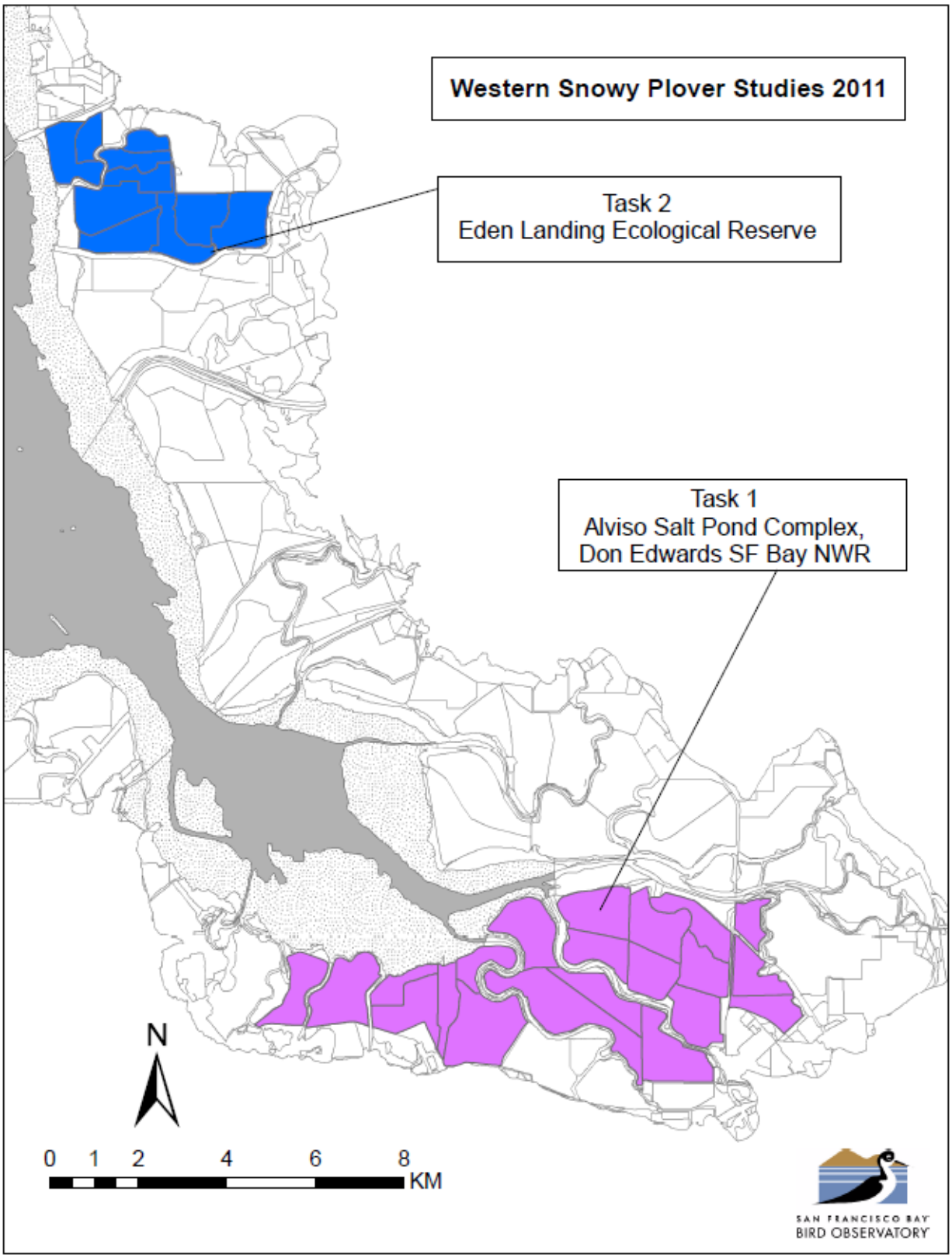

Figure 1. Map of Western Snowy Plover Study areas in South San Francisco Bay, California, 2011.

Figure 2. Map of Western Snowy Plover nest locations in Santa Clara County, South San Francisco Bay, California, 2011.

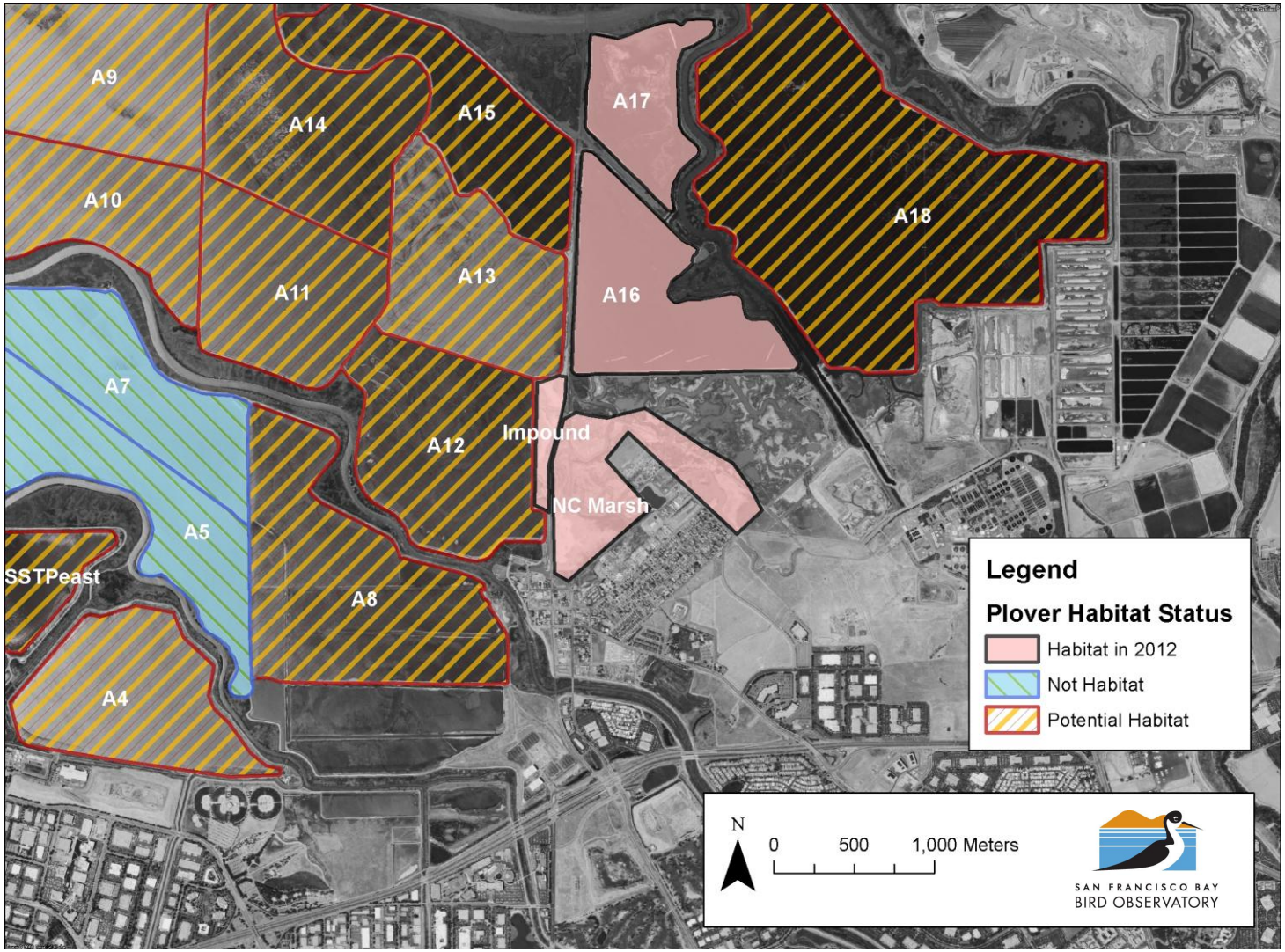

Figure 3. Map of Western Snowy Plover habitat status in Santa Clara County, CA. Map shows habitat area for 2012, areas that could potentially support plovers if the water levels were lowered and areas that are not considered habitat or potential habitat.

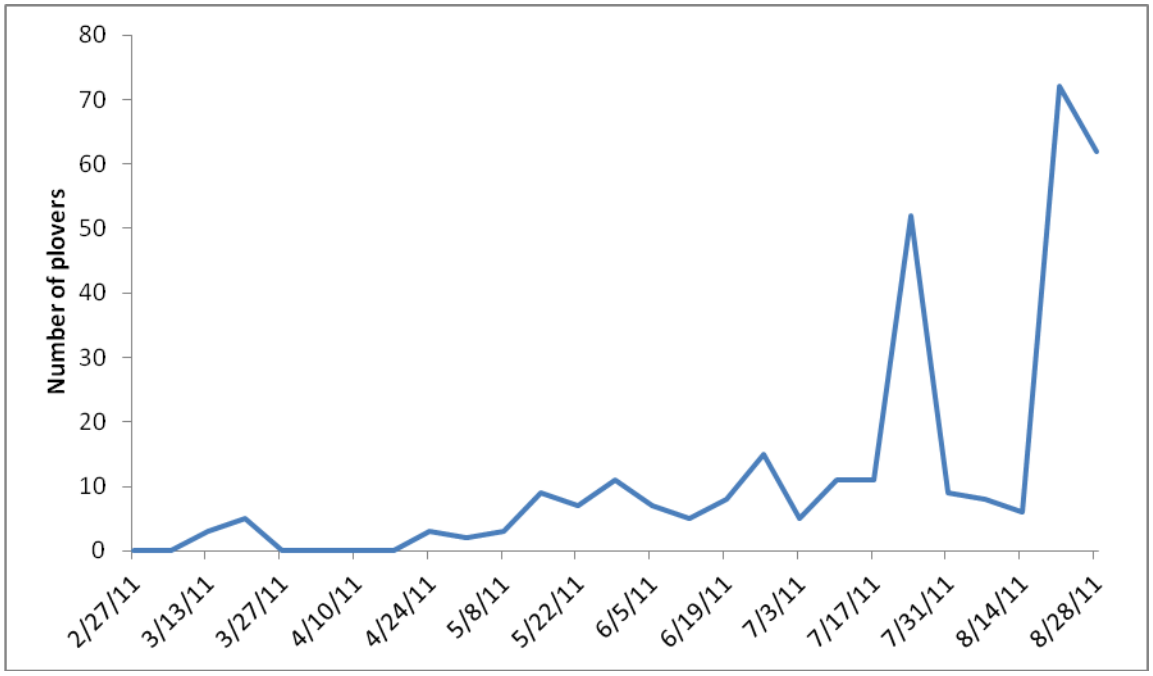

Figure 4. Weekly counts of adult Snowy Plovers in Santa Clara County, California, 2011.

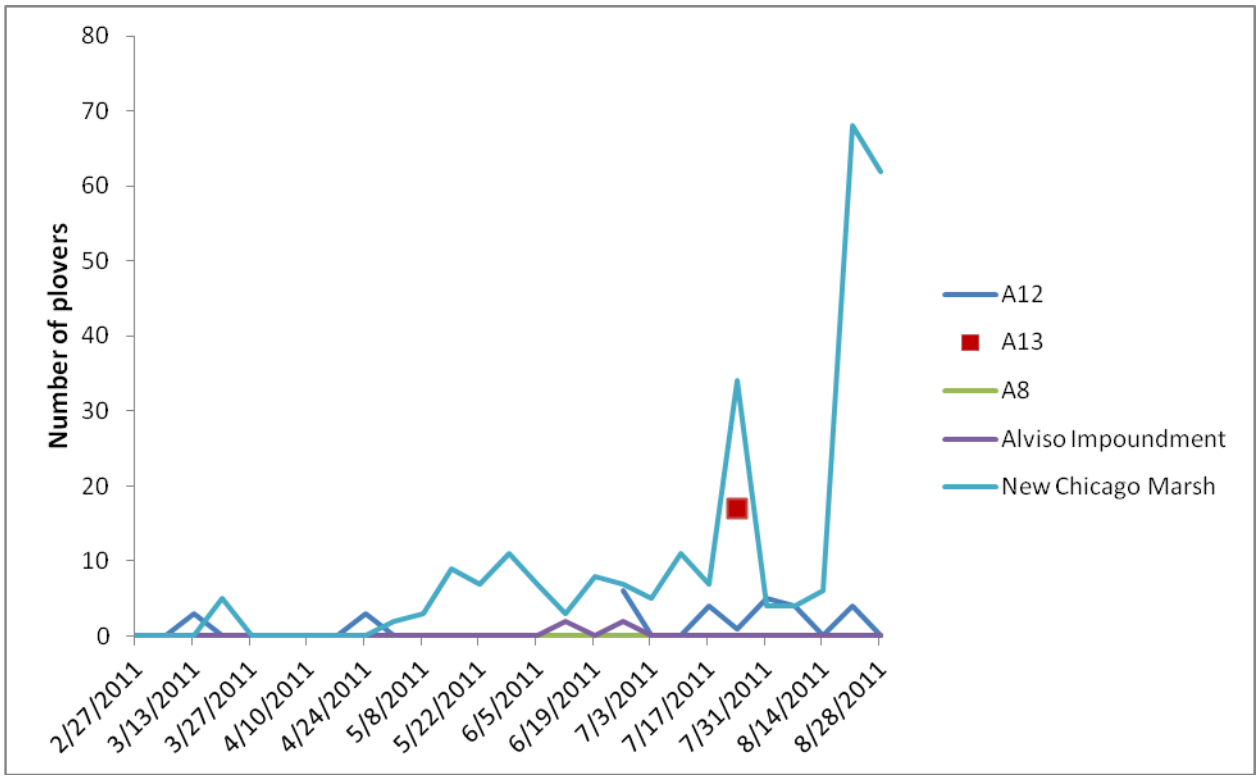

Figure 5. Weekly counts of adult Snowy Plovers in each pond or marsh, Santa Clara County, California, 2011.

Table 1. Summary of nest data for Snowy Plovers in Santa Clara County, California, 2006-2011. Mean initiation dates is given by day of the year and the calendar date. Sample size is the number of nests used in the nest success analysis.

Year	Nests Initiated	Mean Initiation Date	Nest Success	Confidence Limits Lower 95%	Confidence Limits Upper 95%	Sample size
2006	11	11-May	53%	0.15	0.81	11
2007	2	2-Apr	51%	0.11	1.00	2
2008	6	13-May	48%	0.09	0.81	6
2009	7	13-Jun	46%	0.06	0.81	7
2010	2	3-May				1
2011	6	25-May	41%	0.03	0.81	6

Table 2. Western Snowy Plover response types and codes used during the Western Snowy Plover response to construction activities study, San Francisco Bay CA, 2011.

Code	Plover response:
1	Stand up, stay at nest
2	Stand up, walk away from nest
3	Stand up, run away from nest
4	Fly away from nest
5	Alarm call
6	No response; bird stayed on nest and performed typical nesting behaviors
7	Bird already off nest

Table 3. Disturbance types and codes used during the Western Snowy Plover response to construction activities study, San Francisco Bay ,CA, 2011.

Code	Disturbance type
1	Moving pick-up truck
2	Moving dump truck or other large machinery
3	Stopped vehicle (person stays inside)
4	Stopped vehicle (person gets out of vehicle)
5	Person on foot walking by
6	Person on foot stopped and working (i.e. surveying etc)
7	Machinery stopped and working
8	Other (recorded note)
9	Unknown - could not see in video

Table 4. Disturbance type recorded, the number of incidences of each disturbance type, number of times birds reacted and the average time off nest when birds flushed in construction and control areas, San Francisco Bay, CA , 2011.

	Instances of disturbances recorded		Number of times the birds reacted		Average time off nest when flushed	
Disturbance Type	**Construction Areas**	**Control Areas**	**Construction Areas**	**Control Areas**	**Construction Areas**	**Control Areas**
Moving pick-up truck	41	3	6	1	0:06:33	0:00:28
Moving dump truck or other large machinery	24	0	1	0	0:04:37	0:00:00
Stopped vehicle (person stays inside)	5	0	0	0	0:00:00	0:00:00
Stopped vehicle (person gets out of vehicle)	4	0	1	0	0:04:06	0:00:00
Person on foot walking by	0	0	0	0	0:00:00	0:00:00
Person on foot stopped and working (i.e. surveying etc)	0	0	0	0	0:00:00	0:00:00
Machinery stopped and working	1	0	0	0	0:00:00	0:00:00
Other (recorded note)	1	0	1	0	0:03:17	0:00:00
Unknown - could not see in video	4	17	4	17	0:02:41	0:01:53
No disturbances during survey	1	4	NA	NA	0:00:00	0:00:00