Report on Nesting Snowy Plover Response to New Trail Use in the South Bay Salt Pond Restoration Project

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Introduction

Providing public access and protecting the abundance and diversity of waterbirds in the South Bay Salt Pond Restoration Project (SBSP) area are both important Project Objectives (SPBP FEIS/R 2007), but are potentially competing goals. A major focus of the Project's first phase is to develop and enhance a number of trails and add amenities, such as overlooks and interpretive displays. The SBSP Restoration Project Plan sited new trails on levees next to ponded habitat used by foraging and nesting waterbirds to avoid impacts to federally endangered tidal marsh species including the salt marsh harvest mouse (*Reithrodontymys raviventris*) and California clapper rail (*Rallus longirostris obsoletus*). Thus, the species using ponded habitat, including federally threatened western snowy plovers (*Charadrius alexandrinus nivosus*), have the greatest potential to experience negative effects of new and enhanced trails.

Each year, snowy plovers nest from approximately March through August in managed and seasonally dry ponds in the SBSP Project area. Birds nest primarily in the Eden Landing complex (Map 1), where there are currently few public access trails. In 2010, snowy plovers nested in Eden Landing ponds E11, E16B, E12/13, E14, E8A, E8, E6B, E6A, E6 and E4C. Birds also nested in other parts of the SBSP Project in 2010, including on ponds R1 through R5, SF2, A22, A23 and the pan habitat in New Chicago Marsh (Robinson-Nilsen et al. 2010).

New trails have the potential to affect nesting birds (Robinson 2007). Snowy plovers use crypsis to avoid predators (Colwell 2000). Once birds flush, their eggs and newly-hatched chicks are susceptible to predation and exposure to weather (Page and Stenzel 1981). Ruhlen, et al. (2003) found that human recreation on beaches negatively impacted snowy plover chick survival. Protection from disturbance can increase breeding success (Lafferty, et al. 2006).

Robinson (2007) collected data in the SBSP Project area on the distances at which plovers flushed when approached directly by researchers. Based on 24 approaches to single birds sitting on a nest, she found birds flushed at an average distance of 175m (SE=45m). The study conducted here assessed the response of nesting birds to tangential approach, as occurs with trail use on levees. We compared the flush rates of snowy plovers exposed to experimental trail use versus birds not disturbed by trail use, and measured the distances at which birds flushed. We also compared flush rate and distance of birds in response to researchers, whom the birds had seen before, to trail users whom the birds had not seen. We wanted to make this comparison as studies have shown that some birds recognize specific people who have disturbed them (Levey, et al. 2009).

This study addresses these questions: What is the flush rate and flush distance of nesting snowy plovers in response to new trail use around seasonally-dry ponds where birds nest? Do plovers respond differently to people who have disturbed them versus people they have not seen before? This second question provides insight into the relative impacts of management activities and public use.

Methods

Between March and August 2010, we studied the response of nesting snowy plovers to newly introduced trail use on levees that do not have public access. Trials included a trail walker or a researcher walker (a person the bird has seen before) and control observations, i.e. the behavior of birds when there are no walkers. We conducted one trial per nest and all nests were within 125 m of a levee. Before trials were conducted, all nests were located and approached one time by a San Francisco Bay Bird Observatory (SFBBO) researcher to confirm the presence of a nest, the number of eggs, and the GPS location of the nest. The GPS unit averaged the waypoints of locations, which gave us an estimated error of under 6 meters. We conducted trials on nests within 2-4 days of SFBBO's confirmation that the birds were incubating. Nest age was estimated by floating the eggs during the first visit to the nest (Hays and Lecroy 1971), and on subsequent weekly visits until the fate of the nest was determined (Mabee 1997). Nest age at the time trials were conducted ranged from 2 to 26 days. We collected data at 31 nests, 26 located in ponds in the Eden Landing Complex (Map 1), 3 in pond A22 in Alviso, and 2 in ponds in the Ravenswood Complex (Map 2). All accessible nests were tested; however, nests were not tested if they were near enough to other plover nests to be affected by responses of birds on those nests.

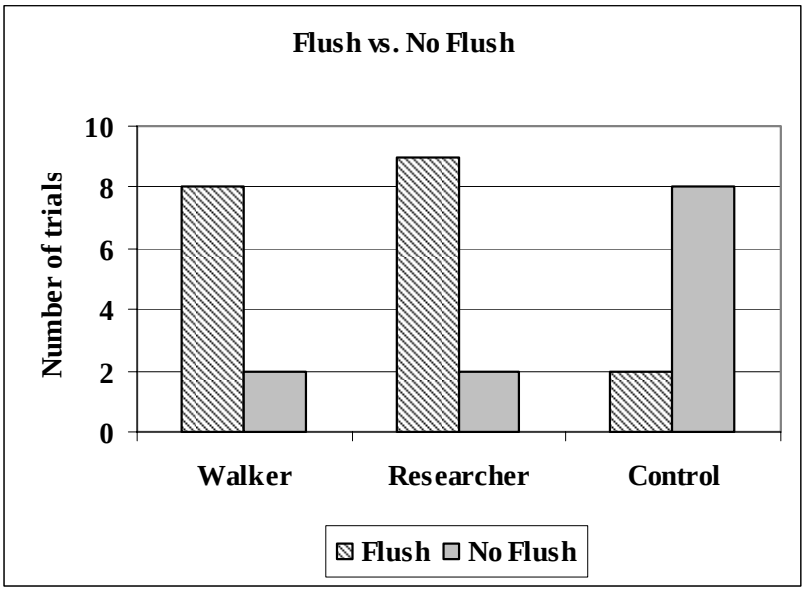
For each trial, an observer with a spotting scope, stationed on the levee at a distance far enough from the nest to avoid disturbance, watched the bird on the nest. One trail walker or researcher would begin at the scope and walk along the levee nearest to the nest. The walker carried a 2-way radio and a hand-held Garmin GPS unit with nest locations recorded in the unit. When the observer saw the bird stand up, the observer radioed the walker, who stopped and recorded her GPS location along the levee. The trial ended at this point and the walker returned to the scope. If the bird did not flush, the walker went past the bird for approximately 30m then turned around and came back. For control nests (no walkers), an observer on the scope watched the nest for 15 minutes and recorded the number of times the bird flushed from the nest. After each researcher or walker trial in which the bird stood up or moved off the nest, the observer watched the bird for up to 10 minutes to determine when the bird returned to the nest. Basic protocols for the study are found in Appendix A.

We used Chi-square analysis to assess differences in flush rates in response to trail walker, researcher and control trials. We used Pearson-Product correlations to test relationships between 1) flush distance and perpendicular distances of nests to the levee, nest to the scope and nest age and 2) the total time of trials and length of time off nests. Parameters were log transformed for correlation analysis.

Results and Discussion

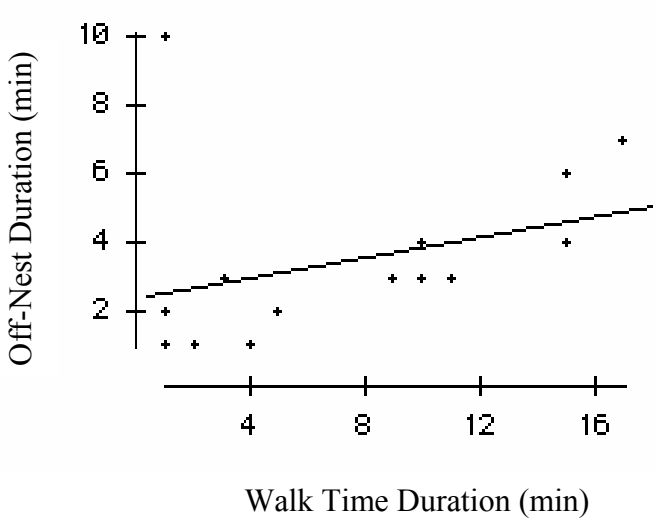
We collected data for 31 trials, composed of 10 trail walker trials, 11 researcher walker trials, and 10 control trials. We found that birds flushed off their nests 80% and 82% of the time in response to trail and researcher walkers, respectively; but in only 20% of control trials did birds flush (Figure 1). There was no difference in flush response to trail walkers versus researchers (Figure 1; $\chi 2 = 0.01$, df = 1, p=0.916). Thus, these birds did not respond differently to people who had previously disturbed them versus people they had not seen before. Because there was no difference in response to these two types of walkers, we combined trail and researcher walkers together for analysis.

Figure 1. Number of Flushes versus No Flushes for Three Trial Types



When plovers were flushed by walkers, they returned to their nest within an average of 4 minutes of being flushed (n=15; range 1-10 min). However, plovers that flushed during control observations returned within 1 minute of being flushed (n=2). We found some evidence to indicate that the longer the duration of the walk by trail walkers, the longer the time before birds returned to their nest (Figure 2; r^2=0.403, p=0.136, n=15). These results suggest that plover nests are exposed longer and are at greater risk the longer a trail disturbance lasts. More data are needed to test this relationship and determine risks to nests.

Figure 2. Duration of Trail Walks versus Plover Time Off Nest (raw data displayed)



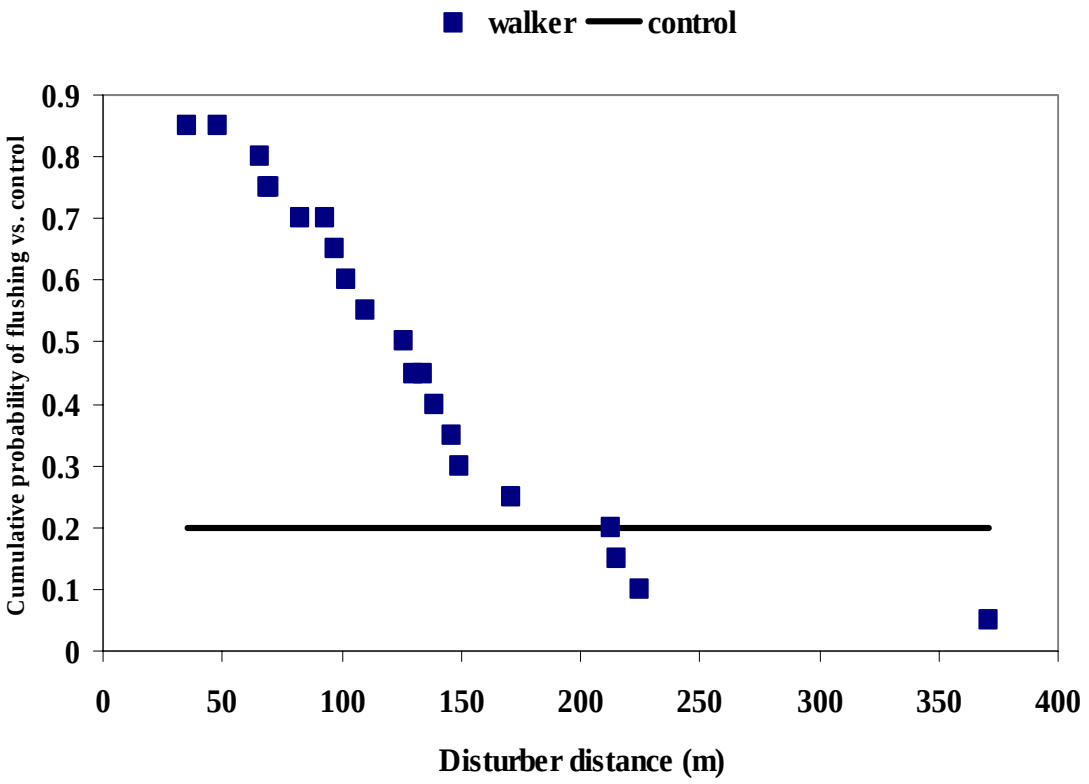
The average flush distance for birds in response to walkers (n=17) was 146m (SE 19m). While the estimated distance is less than the 175m flush distance found by Robinson (2008) for direct approach, it is not substantially less. For birds that flushed, we found no relationship

between flush distance and nest distance to the levee (r^2=0.183, p=0.482, n=17). Thus, whether a nest was relatively close or far from the levee, the birds still tended to flush at approximately 146m from the disturbance. We found no relationship between flush distance and scope distance to nest (r^2=0.084, p=0.749, n=17) or nest age (r^2=0.051, p=0.846, n=17)

In our tangential approach trials, 4 of 21 birds (19%) did not flush, but remained on their nests as walkers passed by. The average distance of walkers from these birds was 77.5m, measured as the perpendicular distance of nests from the levee; this distance was very similar to the average distance that all nests were to the levees (76.1m). But, this result is based on only 4 cases. The factors that may cause birds to flush or remain on their nest require further study.

We plotted the cumulative percent of birds flushing from a nest as a function of the distance between the nest and the disturbance (Figure 3). This assumes that shorter distances between the disturbance and nest are more likely to disturb birds, but it also allows for variation in sensitivity to birds. Because birds flushed from the nest 20% of the time in the absence of disturbance, we compare this background rate (solid line) with the cumulative plot. Figure 3 suggests that birds will flush at background rates (20%) if the disturber is approximately 200m or further from a nest. The probability of disturbance rises steeply if the distance is less than 150m. At closer disturbance distances, birds are less likely to stay on their nest than if the disturbance was at a greater distance.

Figure 3. Cumulative percent of birds flushing plotted against distance of a disturber at the time of the disturbance (points) compared to the background probability of flushing in the absence of a disturber (line).



Management Considerations:

- Trail walkers resulted in birds flushing off nests at rates 4 times greater than the background rate of flushing.
- Locating new trails at least 150m from plover nesting habitat should reduce disturbance to background levels.
- Existing trails during the breeding season may bring people close enough to nests to increase disturbance rates (per walker) to unacceptable levels. For instance, trails within 150 m of nests may cause rates of response higher than background rates.
- Bird response to existing trails may differ from their response to new trails.

Study Suggestions:

- Quantifying nesting plover response to existing trails would be useful, as snowy plovers can become habituated to human trail use, where use is relatively constant and non-threatening.
- Determining the source of background disturbances would be useful in understanding the relative impact of humans compared to other sources of disturbance and could indicate additional means of reducing disturbance rates.
- Research on the consequences of disturbance on nest success would help verify the assumption that disturbance rates (which are easy to measure) are a good proxy for threats to nesting success.
- Strengthening the analysis comparing time duration of trail walks and plover time off-nest would be valuable.
- Study of factors that promote birds to remain on nests versus move in response to disturbance could be useful.

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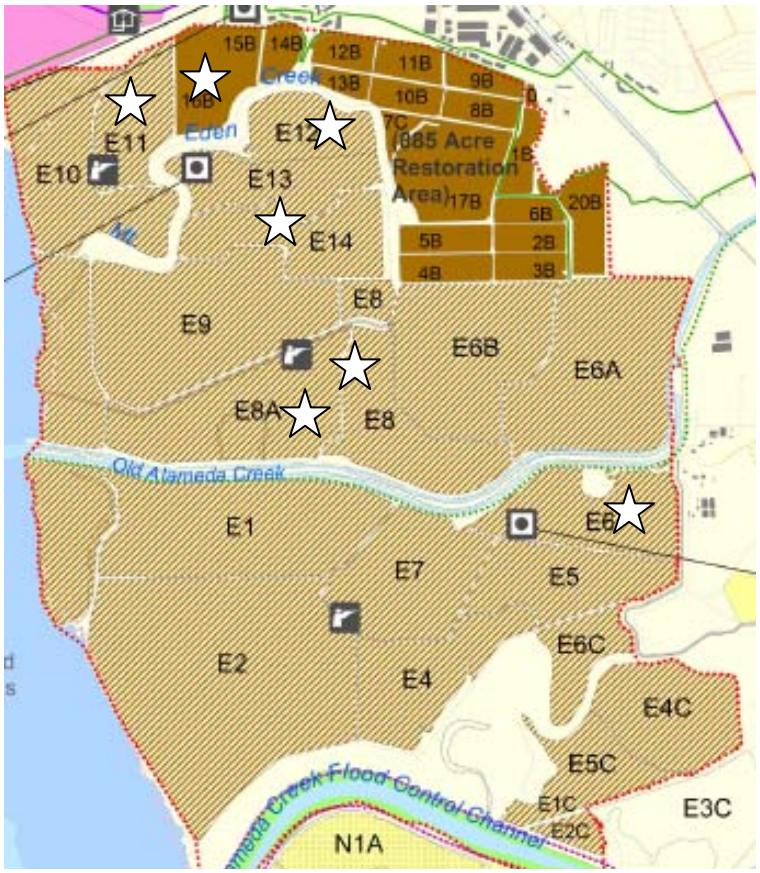
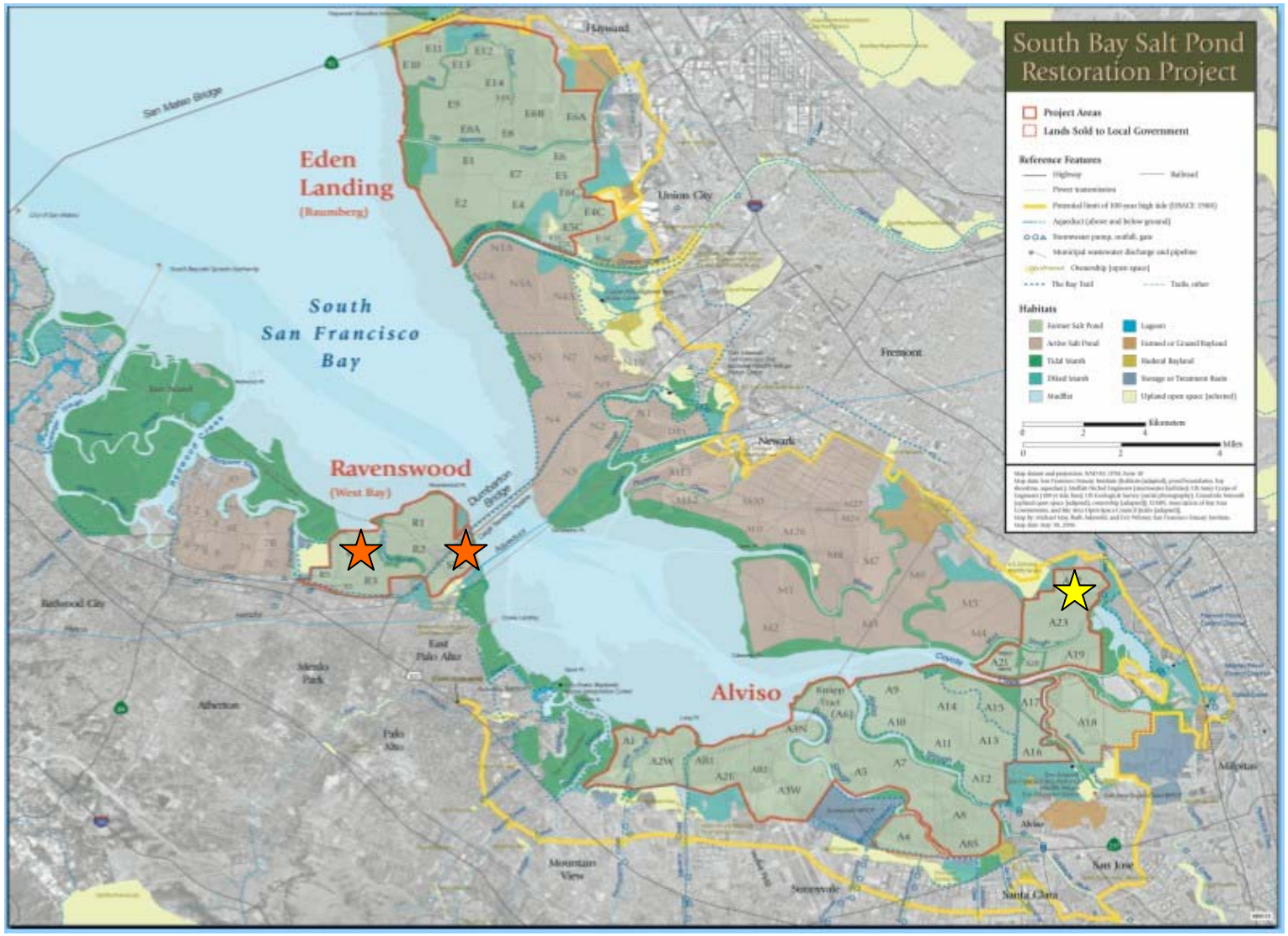


Map 1. Study sites in Eden Landing—Ponds E6, E8, E8A, E11, E12, E14, and E16B.



Map 2. Three study sites outside Eden Landing—SF2 and R4 (orange stars) in Ravenswood and A22 (yellow star) in Alviso.

Appendix A. **Protocols for the Snowy Plover Response to Trail Use Study**

Methods for the Snowy Plover Study are as follows:

1) We will study the response of nesting plovers to both trail walkers and SFBBO researchers and will compare to bird activity at control nests, with no walkers.

2) The study will occur during the 2010 nesting season, which begins in mid-March and ends in late August. The study period will not extend beyond March 15 to September 30, 2010.

3) We will study plover nests in any part of the SBSP Project area. Nests must be within 100m of a levee where there is no formal trail, and at nests where cameras are not set up (SFFBBO has cameras at some nests to record nest fate). Nests must be approximately 100m from other nesting birds, either plovers or other species.

4) Because nests are hard to see, all nests will be visited initially by an SFBBO researcher in advance of our research trial to determine whether birds are actually sitting on a nest and to collect GPS location information if it is a nest. They will place a flag on the levee directly across from the nest to help us find the nest later.

5) We will collect bird responses to three types of trials types: 1) nests approached by 1 researcher, 2) nests approached by 1 trail user, and 3) nests not approached by anyone (control). Approaches will all be tangential and on the levee. Before these trials, all nests will have been handled once by a researcher (point 4 above).

6) Before conducting each trial, we will survey the area for predators; no trials will be conducted when predators are close enough to threaten a nest.

7) The timing of the observations will be:
i) SFBBO researchers find and visit nest to confirm that it is a nest and to GPS the location.
ii) We will conduct the walker disturbance and control trials 2-3 days later to give us the best chance possible to test nests before they fail or disappear.
iii) The researcher disturbance will also be 2-3 days after the nest location is confirmed and the same researcher that collected the GPS data will be the walker in the researcher trial.

8) Our goal is to observe responses at 30 nests, 10 nests for each trial type. In 2009, SFBBO found 163 plover nests in the area, so we expect a minimum of 30 nests that meet our criteria is a reasonable goal. While we expect 10 nests per trial type, we will collect data on as many nests as possible to maximize sample size and stabilize the variance. We will collect data on all nests feasible as soon as they are found in an attempt to collect adequate data in one year. Data will be collected only once at each nest.

9) If multiple nests are found together near a particular levee, we will collect data on the nest closest to the beginning of the trail walk. Other nests may be affected by the response of birds nearby and thus would not be independent observations. Nests near others that establish after we conduct a trial or that are far enough away from the nest that was exposed to a trial may be independent and acceptable for data collection. Exact criteria for testing additional nests in an area will be developed based on field data.

10) An SFBBO researcher will be the nest observer using an SFBBO scope (60X) at a distance of 100-150m for all three trial types to ensure a seasoned plover researcher is watching the birds and to ensure inter-observer reliability.

11) Walkers will carry a walkie-talkie and a hand-held Garmin GPS unit with nest locations recorded in the program. This equipment will be provided by SFBBO. Caitlin Robinson-Nilsen collected some data on the distance at which plovers are not disturbed by walkers, and the walkers for this study will begin their walk at that distance. When the observer (with the scope) sees the bird stand up, she/he will inform the walker who will stop and record her GPS location along the levee. The program will calculate the distance from the bird to the walker. The trial ends at that point. For the control nests (no walkers of any sort), the observer will watch the nest for a specified period of time and record the number of times the bird stood up.

12) After each researcher or walker trial in which the bird stands up or moves off the nest, the observer will continue watching the bird for 10 minutes to determine if the bird returns to the nest in that period of time.

10) We will pilot test methods and data sheets in March 2010, before plover nesting begins.

11) We will work with Cheryl Strong, at USFWS, to be sure volunteers are covered under SFBBO's 10(a)1(a) permit.

12) We will always conduct a predator survey before starting trial and record results under comments. Trials will not be conducted if a predator is near enough to threaten a nest.

13) Bird head turns are not considered a disturbance response in this study. Bird responses include:

1 – stand up
2 – walk away from nest
3 – run away from nest
4 – fly
5 – alarm call

14) The control observer will watch the nesting bird for 15 minutes at a distance far enough away to avoid disturbing the bird. Whenever a bird exhibits one of the behaviors listed above, she will record the time and the behavior. If the bird leaves the nest, the observer will record the time when the bird returns to the nest, if that occurs within the 15 minute observation period.