



Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area

Version 2.4

Natural Resource Report NPS/SFAN/NRR—2014/896



ON THE COVER

Western Snowy Plover feeding at high tide on Crissy Field on January 27, 2005.

Photograph by: Will Elder, NPS.

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December 2014

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Merkle, B., D. Press, R. Townsend, D. Adams, and M. Koenen. 2014. Snowy plover monitoring protocol for Golden Gate National Recreation Area: Version 2.4. Natural Resource Report NPS/SFAN/NRR—2014/896. National Park Service, Fort Collins, Colorado.

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Revision History Log

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
NA	April 1995	L. Stenzel, G. Page, D. Hatch			1995 Draft
1995 Draft	February 2008	M. Koenen, R. Townsend, D. Adams, B. Merkle	More background, clarified objectives and sampling design.	To meet I&M Format	2.1
2.1	April 2010	B. Merkle, D. Adams, M. Koenen, D. Press	Finalize protocol text	To meet NRPM standards and for peer review submission	2.2
2.2	January 2011	D. Adams, D. Press, B. Merkle		Protocol edits in response to peer and administrative review.	2.3
2.3	September 2014	D. Adams, B. Merkle	Formatting into NRRv3.6	Final submittal to IRMA	2.4

Executive Summary

This document describes the National Park Service's (NPS) monitoring program for western snowy plover (*Charadrius alexandrinus nivosus*) populations that occur at Golden Gate National Recreation Area (GOGA) within the San Francisco Bay Area Network (SFAN) of parks in central California. This protocol refines the standard monitoring methodology for snowy plovers first developed by the Point Reyes Bird Observatory with park staff in 1995 (Stenzel et al. 1995). The monitoring protocol, including standard operating procedures and appendices, describes the background, monitoring objectives, sampling design, field methods, data management, annual and long-term reporting and analyses, and operational requirements to monitor snowy plovers during the non-breeding season at GOGA. There are no records of snowy plovers breeding on GOGA beaches. The annual monitoring period (July 1 – May 15) is designed to detect any potential snowy plovers nesting activity during the early breeding season (March through September).

The main purpose of the program is to monitor snowy plover population status and trends and to adaptively guide management actions.

Primary objectives for monitoring are to:

1. Determine trends in snowy plover winter season average population size at Ocean Beach and Crissy Field.
2. Determine trends in the spatial distribution of snowy plovers during the winter season at Ocean Beach and Crissy Field.

The overall management objective for the GOGA snowy plover monitoring program is to reduce human-caused disturbance to over wintering plovers. The monitoring objectives in support of that management objective are to:

3. Determine the phenology of snowy plover arrival and departure dates from Ocean Beach and Crissy Field.
4. Monitor number and distribution of people and dogs at Ocean Beach and Crissy Field.
5. Monitor compliance rates for seasonal restrictions requiring pets to be on-leash in the Snowy Plover Protection Area and Wildlife Protection Area from July 1 through May 15.
6. Monitor the rates of dogs chasing snowy plovers or other shorebirds at Ocean Beach and Crissy Field.

The Pacific coast population of the western snowy plover was listed as threatened by the U.S. Fish and Wildlife Service in 1993. It is likely that snowy plovers from both the federally threatened Pacific coast population and the non-listed population that breeds in inland areas of California and Nevada utilize GOGA beaches. Snowy plovers use Ocean Beach and the beach at Crissy Field during the non-breeding season (July through May). These beaches located in San Francisco have high visitation by people and dogs. Beach visitors, especially those with unleashed dogs, are considered

one of the main sources of disturbance to the plovers. High rates of use by dog walkers and changing pet regulations over time at Ocean Beach and Crissy Field have made gaining compliance with leash restrictions challenging. The park uses monitoring data to inform management actions to reduce disturbance to snowy plovers. GOGA snowy plover wintering sites are among the few that are accessible to a large urban population, providing the opportunity to educate urban park visitors about shorebirds and threatened and endangered species. Snowy plovers seen on Ocean Beach and Crissy Field represent about 1% of the snowy plovers recorded on the U.S. Fish and Wildlife Service window winter season counts of snowy plover seen on the U.S. Pacific coast (USFWS 2008). Also, Ocean Beach has been identified as an important beach along the outer Pacific coast for shorebirds between Point Reyes National Seashore and Half Moon Bay.

Snowy plover surveys started at Ocean Beach in 1979, and a standardized protocol was completed in 1995. Monitoring using this standardized protocol has continued since 1994. The winter season (November through February) best defines the time period for snowy plovers that consistently inhabit the GOGA beaches, though plovers move through the areas during the fall and spring migration periods. The average number of plovers observed per survey during the winter peaked in 1994-1995 at over 54 plovers. The winter season average number of plovers per survey steadily declined to under 13 in 1999. The winter population of snowy plovers increased to an average above 30 plovers per winter survey between 2002 and 2006. The 2008 season was the first year average winter season snowy plover numbers were below 20 since 2000. Snowy plover distribution on the beach has shifted over time, but snowy plovers have consistently been concentrated in two primary areas of Ocean Beach.

Snowy plovers were first observed consistently utilizing the beach at Crissy Field in February 2005, at which point efforts to monitor the population were initiated. In September 2006, GOGA began monitoring the Crissy Field plovers using the same techniques and protocol used on Ocean Beach. A small population of one to six snowy plovers has consistently been observed on this beach in the non-breeding season since 2005.

Acknowledgments

Previous versions of this protocol were written by L. Stenzel and G. Page of Point Blue Conservation Science along with D. Hatch (GOGA). Dr. K. Steinhorst of the University of Idaho provided critical assistance with data analysis and the overall sampling design. The authors thank the numerous interns and volunteers that have contributed thousands of hours assisting with the snowy plover monitoring program at GOGA.

List of Terms

Buffer Zone: The area within 15 meters (50 ft) around the flock area is the **buffer zone**.

Disturbance Agents: An entity or party of entities that approaches the target group within defined distances or that elicits an explicit response from the plovers (see below) from outside the defined distances are **disturbance agents**. These include humans, humans and dogs, or dogs within the buffer zone or flock area, raptors (falcons, hawks, etc.) within view of the plover flock, and aircraft and kites over the beach within 100 meters (330 ft) of the buffer zone.

Explicit Response: An **explicit response** disturbance is a change in plover behavior, including these sequences:

- from sitting to standing
- from sitting to standing to walking or running
- from sitting to standing to walking or running to displacing other plovers
- from sitting to standing to walking or running to displacing other plovers to flying
- from sitting to standing to walking or running to flying
- from sitting to standing to flying
- from feeding to running beyond the area in which it has been feeding
- from feeding to interacting aggressively with another plover
- from feeding to flying

Only when none of the plovers in the target group respond to a disturbance agent is a null (no) response recorded.

Non-breeding season: For the purposes of this snowy plover monitoring protocol and recreational use restrictions at GOGA beaches, the non-breeding season is July 1 through May 15.

Phenology: The scientific study of periodic biological phenomena, such as breeding and migration, and how they are influenced by seasonal and interannual variations in climatic conditions.

Sector: Ocean Beach is divided into 14 survey sectors and Crissy Field has 4 survey sectors. These sectors are delineated on maps (Figure 3) and in Appendix SOP 2A. Data are recorded by sector.

Winter season: For the purposes of this monitoring protocol, the winter season is November through February, and is a subset of what is referred to as the “non-breeding season”.

Introduction

In 1992, the National Park Service (NPS) National Inventory and Monitoring Program (I&M) developed a national policy “to better understand their dynamic nature and condition” of natural resources, to detect or predict changes that may require intervention, and to serve as reference points for more altered parts of the environment. By integrating this information into NPS planning, management and decision-making, scientific knowledge of natural resources will improve NPS stewardship of our heritage lands (NPS 1992).

The NPS I&M Program in 1998 created “networks” or groupings of parks in order to develop long-term monitoring plans for suites of parks with ecological similarities. The San Francisco Bay Area Network (SFAN) is one of eight inventory and monitoring networks in the Pacific West Region of the NPS and one of 32 across the country. The networks use common methodologies for data comparability, to reduce the level of effort, and to share resources.

Two SFAN park units, Golden Gate National Recreation Area (GOGA) and Point Reyes National Seashore (PORE), encompass resources utilized by western snowy plovers (*Charadrius alexandrinus nivosus*), a small, rare shorebird. This document describes the SFAN monitoring program for western snowy plover (snowy plover) non-breeding populations that occur on GOGA beaches. A separate SFAN snowy plover monitoring program addresses the breeding season snowy plover population on PORE beaches. The PORE monitoring protocol is in draft format and is specific to the monitoring activities and techniques relevant to the breeding season monitoring period.

Background

The western snowy plover is found along the Pacific coast from Washington to Baja California, portions of the interior western and southwestern United States, the Gulf coast of Texas, and interior portions of Mexico and is the only recognized snowy plover in the U.S. (Page et al. 1995b). The populations of snowy plovers that nest along the Pacific Coast of North America from southern Washington to Baja California were declared threatened by the U.S. Fish and Wildlife Service (USFWS) in March 1993 (USFWS 2007). The populations of snowy plovers that nest in interior California have been classified by the State of California as a bird species of special concern, but have no federal designation (Shuford et al. 2008). Both the federally threatened, Pacific coast population and the non-federally listed, interior nesting snowy plover population winter along the Pacific coast from southern Washington to Baja California (Page et al. 1986, 1995a, 1995b).

Snowy plovers inhabit Ocean Beach and the beach at Crissy Field at GOGA (Figure 1) in the non-breeding season, from July through mid-April or May (Page et al. 1986, NPS 2006a). Snowy plovers seen on Ocean Beach and Crissy Field represent about 1% of the snowy plovers recorded on the USFWS winter season counts of snowy plover seen on the U.S. Pacific coast (USFWS 2008).

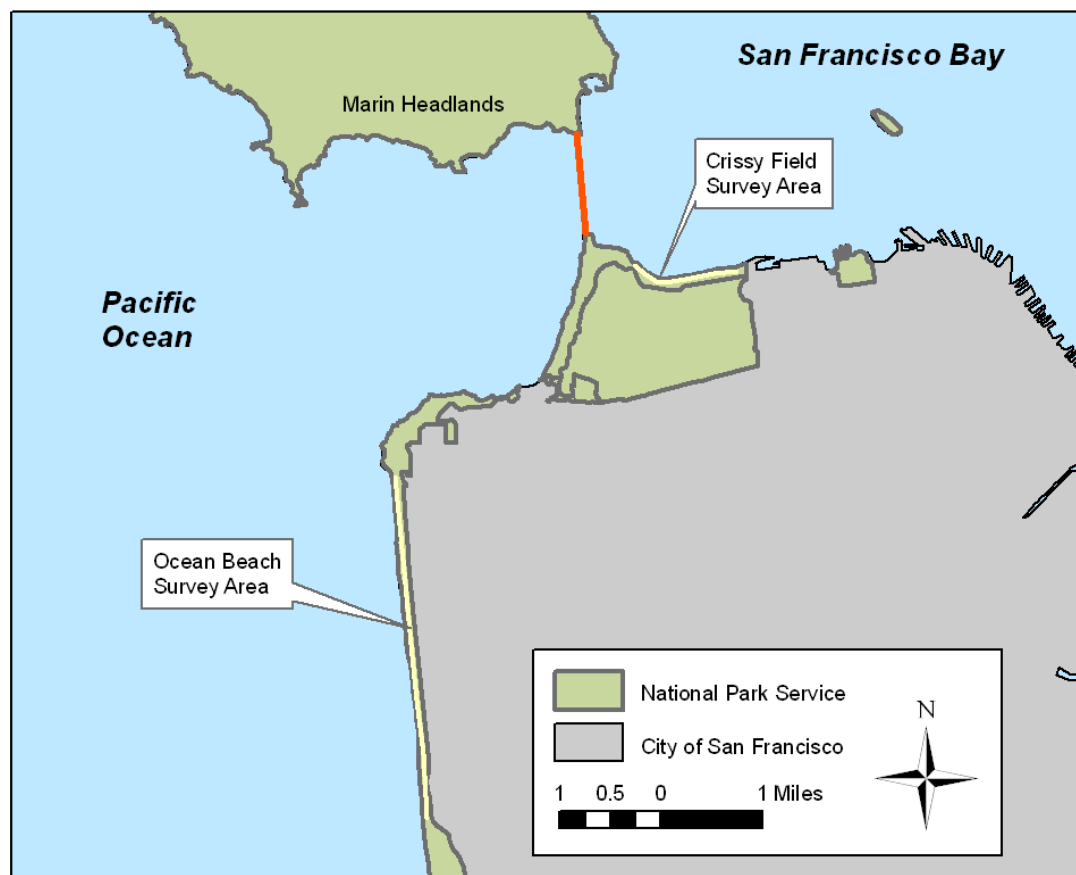


Figure 1. Ocean Beach and Crissy Field wintering areas for snowy plovers at Golden Gate National Recreation Area, San Francisco.

Ocean Beach in San Francisco is the longest stretch of dune-backed beach between Point Reyes and Half Moon Bay on the outer California coast (Figure 1), providing important habitat for migratory and non-breeding shorebirds (Stenzel et al. 1995, GOGA 1998). During 1994–2008, maximum counts of non-breeding snowy plovers at Ocean Beach have ranged from 18 to 85, with winter season averages ranging from 12 to 54 plovers observed per survey. From 1997 to 1999, approximately 100 acres of Crissy Field (Figure 1) were restored by enhancing and protecting coastal dunes, removing rubble from the beach, and construction of a 20-acre tidal marsh (Jones and Stokes Associates, Inc. 1996). A portion of the beach in the Crissy Field area was designated as a Wildlife Protection Area, largely to benefit shorebirds and birds using the nearshore waters of the San Francisco Bay. The beach at the Crissy Field Wildlife Protection Area provides important habitat along the highly modified San Francisco Bay shoreline. Snowy plovers were first observed consistently using the beach at Crissy Field in February 2005. Since then, one to six snowy plovers have typically been observed on this beach during the non-breeding season. The GOGA snowy plover populations are accessible to a large urban population, providing viewing, education and outreach, and opportunities for engagement in stewardship. There are no recent or historical nesting records for snowy plovers on GOGA beaches, although they breed on nearby beaches within about 25 miles to the north and south of GOGA, and on salt ponds in South San Francisco Bay at Don Edwards San Francisco Bay National Wildlife Refuge.

Issue Being Addressed and Rationale for Monitoring Snowy Plovers

GOGA initiated snowy plover monitoring in December 1994 due to range-wide and California population declines, NPS management policies that direct resource managers to determine population trends and enact conservation practices for federally listed species, and Endangered Species Act requirements (NPS 1991, 2007, Hatch 1996).

NPS Management Policies clearly define the NPS commitment to monitoring and the recovery of threatened and endangered species. The policies state:

“the [National Park] Service will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act. The Service will fully meet its obligations under the NPS Organic Act and the Endangered Species Act to both proactively conserve listed species and prevent detrimental effects on these species (NPS 2006b).”

In addition, under the Government Performance and Results Act of 1993, the NPS annually sets goals for maintaining populations of threatened and endangered species in stable or increasing status.

The USFWS Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (2007) provides the framework for recovering this species.

“The primary objective of this recovery plan is to remove the Pacific coast population of the western snowy plover from the *List of Endangered and Threatened Wildlife and Plants* by: (1) increasing population numbers distributed across the range of the Pacific coast population of the western snowy plover; (2) conducting intensive ongoing management for the species and its habitat and developing mechanisms to ensure management in perpetuity; and (3) monitoring western snowy plover populations and threats to determine success of recovery actions and refine management actions (USFWS 2007).”

The monitoring of snowy plover populations and site-specific threats at wintering sites is specifically identified in recovery actions 1a and 1b of the plan.

Snowy plover populations have declined over the last century (USFWS 2007). Along the California coast, breeding and wintering populations declined significantly from the late 1970's to 2000 (Page and Stenzel 1981, USFWS 2007). The reasons for decline and degree of threats vary by geographic area; however, the USFWS has identified the primary threat as habitat destruction and degradation (USFWS 2007). Habitat degradation is primarily caused by human disturbance, urban development, introduced beachgrass, and expanding predator populations. In recent years breeding numbers have increased substantially due to habitat restoration and management, though many breeding sites in southern California have been lost (USFWS 2007).

Among the factors contributing to population declines of snowy plovers are heavy human use of beaches in or near urban areas and associated disturbance to roosting plovers by people and dogs (Burger 1986, Klein 1993, USFWS 1993, Page et al. 1995b, Lafferty et al. 2006). When shorebirds are disturbed, they must spend more energy on vigilance and avoidance behaviors at the cost of

opportunities for foraging and resting (Burger 1993, Hatch 1996). High visitation by people and dogs, particularly off-leash dogs, has been noted as a major source of disturbance to snowy plovers on Ocean Beach and Crissy Field (Hatch 1996, NPS 2006a, Zlatunich 2007). Data from the snowy plover monitoring program has been used in adaptively managing these beaches to protect plovers from adverse impacts from visitors and their dogs.

Changing regulations related to dog walking on the GOGA beaches have made it difficult to gain compliance with the current, stricter regulations requiring pets to be on leash. The 1979 GOGA Pet Policy informally identified several areas of the park as suitable for recreational users with off-leash dogs under voice control, which included Ocean Beach and Crissy Field. The Pacific coast population of the western snowy plover was not listed as threatened until 1993 (USFWS 2007). As part of the conditions from a 1995 USFWS Biological Opinion for the City of San Francisco related to the movement of sand, GOGA was required to implement leash restrictions for dogs on portions of Ocean Beach to benefit snowy plovers. Enforcement of the leash regulation at Ocean Beach began in 1997. Furthermore, the 1998 Draft Snowy Plover Management Plan for Ocean Beach recommended that dogs be required to be on-leash in the Snowy Plover Protection Area at Ocean Beach from Stairwell 21 to Sloat Boulevard (GOGA 1998). From 1997 until December 2004, dogs were required to be leashed within the Ocean Beach Snowy Plover Protection Area, and dogs were prohibited within the Crissy Field Wildlife Protection Area. The environmental assessment for the Crissy Field Plan established a Waterbird Protection Area that was later formalized as the ‘Wildlife Protection Area’, which closed this area to dogs (Jones and Stokes Associates, Inc. 1996).

The rulings in *U.S. v. Barley*, allowed unleashed dogs in certain areas of the park (areas identified in the 1979 Pet Policy as appropriate for voice control that did not go through the formal rulemaking process) beginning in December 2004 (U.S. District Court of Northern California 2005). These areas included Ocean Beach and the Crissy Field Wildlife Protection Area where snowy plovers are seasonally present. In November of 2006, seasonal leash requirements were put in place at Ocean Beach and the Crissy Field Protection Areas through the NPS Compendium process for GOGA. In September 2008, a final rule was issued by the NPS, which requires dogs to be on-leash in the Snowy Plover Protection Area at Ocean Beach and the Wildlife Protection Area of Crissy Field, except for the period from May 15 to July 1, when dogs can be off-leash in those areas (36 CFR 7.97).

Loss of habitat and pressure from predators are identified as factors contributing to the population decline of plovers (USFWS 2007). In particular, coastal erosion and the spread of European beach grass (*Ammophila arenaria*), which was introduced in an attempt to stabilize dunes, adversely impacts the snowy plover population at Ocean Beach (Stenzel et al. 1995, USFWS 2007). Sea-level rise and increased storm surge associated with climate change threaten snowy plover habitat at both Ocean Beach and Crissy Field (Heberger et al. 2009). Data collected through the snowy plover monitoring program will be important for assessing potential impacts of pending proposals for erosion control measures and nourishment of Ocean Beach that are intended to protect City of San Francisco infrastructure.

History of Monitoring Snowy Plovers at GOGA

From 1979 to 1985, in an effort to determine the abundance and distribution of wintering snowy plovers across all of California, Ocean Beach was surveyed for plovers 26 times, with at least four surveys in each year (Page et al. 1986). Snowy plovers were observed on 21 of these 26 surveys, with annual maximum counts ranging from 4 to 16 plovers observed. Ocean Beach was classified as an urban shoreline with a sandy beach, backed by development, and usually receiving high recreational use (Page et al. 1986). Additionally, all the snowy plovers observed in San Francisco County through this effort were from Ocean Beach.

From 1988 to 1994, Point Reyes Bird Observatory Conservation Science (now Point Blue Conservation Science; PBCS) volunteers conducted snowy plover counts on Ocean Beach from Lincoln Street to Noriega or Sloat Boulevard as part of coordinated efforts to count plovers along the California coast (Hatch 1996). Additional data collected by an interested citizen between 1992 and 1994 was combined with the PBCS data to provide an indication of the maximum number of snowy plovers at Ocean Beach from 1988 to 1994 (Figure 2).

GOGA implemented a snowy plover monitoring program in December 1994 using a monitoring protocol developed by PBCS and NPS (Stenzel et al. 1995). Snowy plover monitoring has continued on Ocean Beach using the methods from this protocol through the present. Hatch (1996) summarized results of this monitoring using data from 1988 through the 1995 season (a survey year is considered to be the entire overwintering period during which snowy plovers are present in the park, which extends from early July through early May of the next year). In addition, based upon a study of disturbance using focal groups of snowy plovers, 19 dogs were observed deliberately chasing snowy plovers, and 15 dogs were observed to inadvertently disturb plovers or chase other shorebirds during 111 surveys totaling approximately 40 hours of direct plover observation from 1994 to 1996 (Hatch 1996). People, aircraft, bulldozers, bicycles, and kite flying were also sources of disturbance to plovers. However, it was noted that snowy plovers seemed more likely to fly when disturbed by dogs as compared to disturbances by people where the plovers tended to walk or run away (Hatch 1996). This observation is consistent with findings at other beaches (Lafferty et al. 2006).

Snowy plover population numbers on Ocean Beach have shown a great deal of variation over the years (Figure 2). Snowy plover numbers increased substantially from 1979 through 1994. Maximum snowy plover counts increased from a range of 4–16 in 1979–1985 to 38 in 1988 and up to 85 in 1994, which is the greatest number of plovers observed during monitoring on Ocean Beach. Plover numbers declined from 1994 through 1999, before increasing from 2000 through 2003. The population size has dropped since 2003, with 2008 being the first year since 1998–2000 with average winter season counts below 20 plovers (NPS unpublished data). The annual maximum count is highly positively correlated with the winter season average count ($r=0.90$, $p<0.0001$).

Snowy plovers consistently roost in two areas on Ocean Beach (Figure 3), corresponding to Sector 5 between Lincoln Way and Judah Street, and in Sectors 8 and 9 between Noriega and Rivera Streets (Hatch 1996; NPS unpublished data). Of over 13,000 tallied on counts at Ocean Beach from 1994 to 2009, only 22 have been observed outside the Snowy Plover Protection Area, Sector 4–Sector 12

(Figure 4). Thus, monitoring observations indicate that the Snowy Plover Protection Area encompasses the primary areas used by snowy plovers on Ocean Beach.

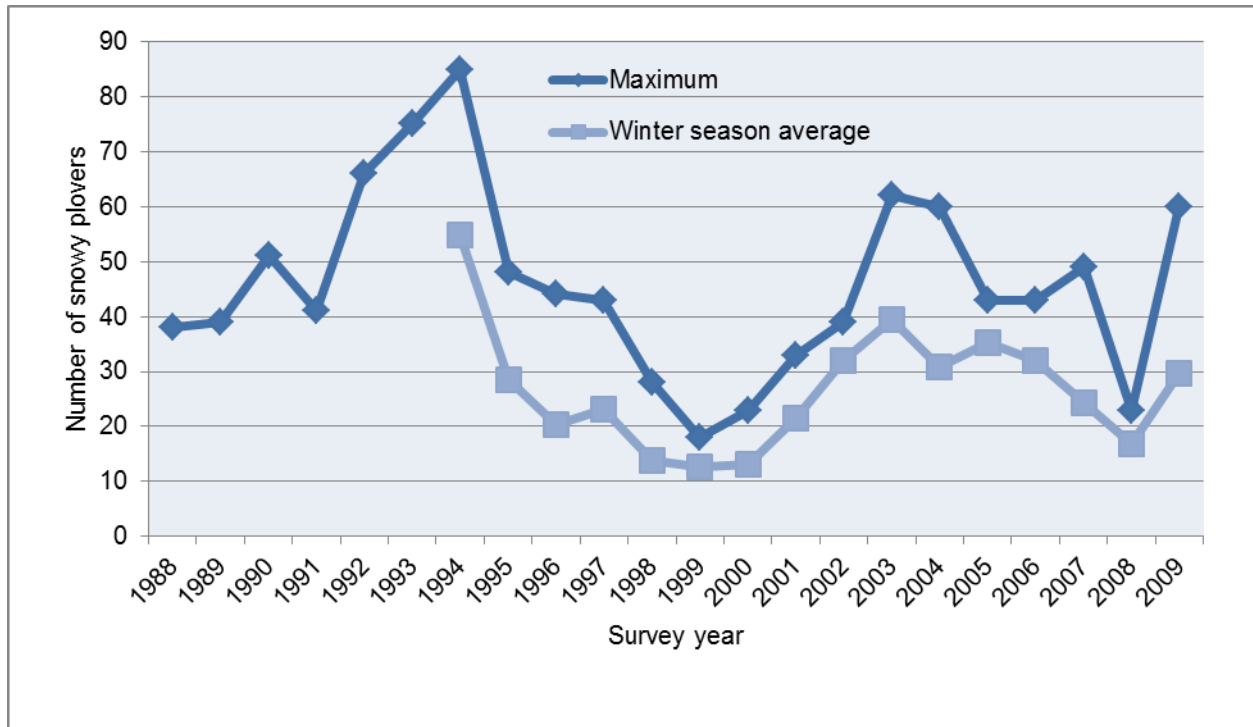


Figure 2. Maximum and winter season average number of snowy plovers on Ocean Beach from 1988 through 2007. *Source:* Hatch 1996, NPS 2006a, 2007, 2008; NPS unpublished data.

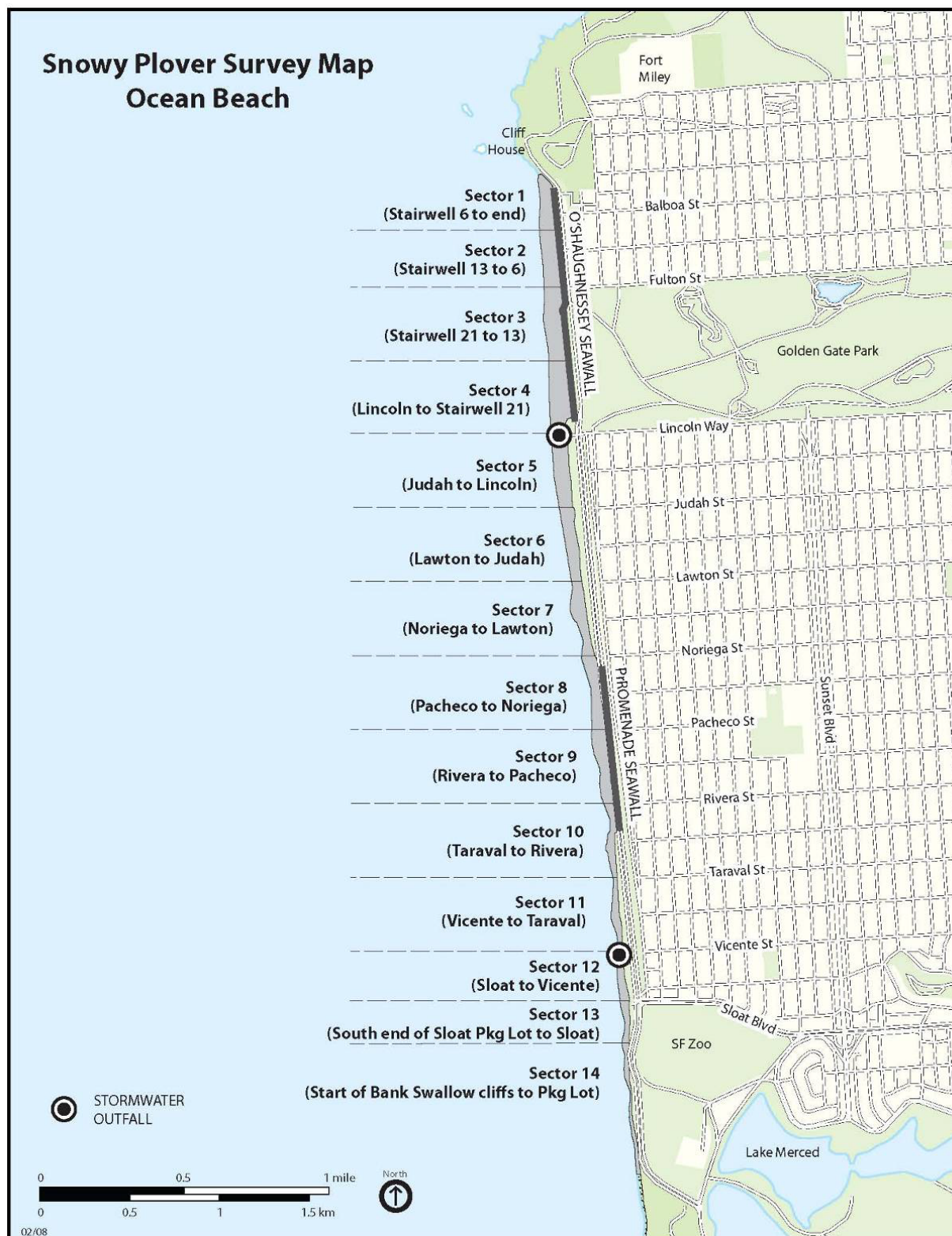


Figure 3. Snowy plover census area at Ocean Beach, San Francisco. The Snowy Plover Protection Area extends from Stairwell 21 in the north to Sloat Blvd. in the south (Sectors 4–12).

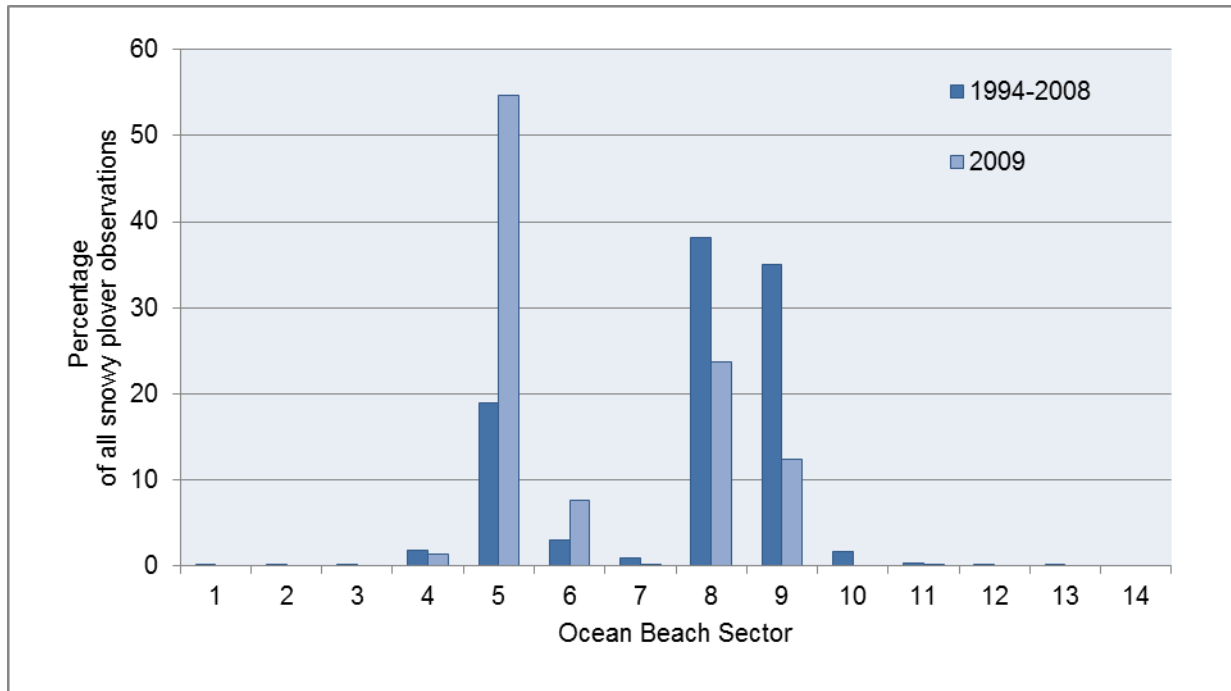


Figure 4. Percentage of snowy plovers observations 1994–2008 and in 2009 by sector on Ocean Beach. *Source:* Hatch 1996, NPS 2006a, 2007, 2008; NPS unpublished data.

Recreational use of Ocean Beach tends to be higher on weekends than on weekdays, and is related to weather, with people flocking to the beach on sunny, warm days (Hatch 1996). From 2000 to 2005, the rate of people visiting Ocean Beach remained relatively consistent, but the rate of dogs and percentage of unleashed dogs where dogs are required to be leashed both increased (NPS 2006a; Figure 5).

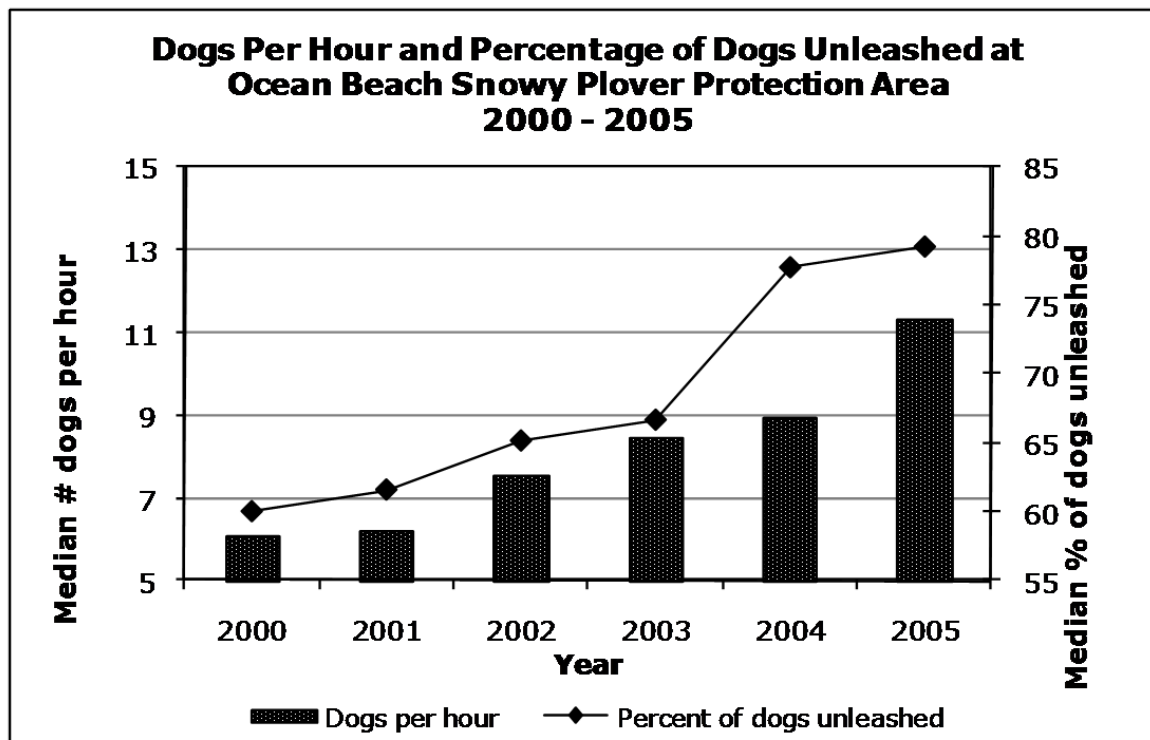


Figure 5. Median number of dogs per hour and percentage of dogs unleashed at the Ocean Beach Snowy Plover Protection Area, 2000–2005 (includes weekdays and weekends). *Source:* NPS 2006a.

Snowy plovers were first observed consistently using the Wildlife Protection Area at Crissy Field in January 2005 (NPS 2006a, Zlatunich 2006). In September 2006, the snowy plover monitoring protocol from Ocean Beach was implemented at Crissy Field. Since that time, a small population of 1-6 plovers has been observed in this area during the overwintering season. A vast majority of the plover observations have been in Sector 2 of the monitoring area (Figure 6), with a handful of observations in Sector 1 (NPS unpublished data). A large proportion of dogs in the Wildlife Protection Area are unleashed (NPS 2007).

The GOGA Snowy Plover Database was designed in the winter of 2003–2004 and is a relational Microsoft Access database used to manage the data collected in this monitoring program. The SFAN Data Manager developed the database by adopting core elements from an early version of the NPS Natural Resource Database Template (NRDT) and building in several key data tables designed by PBCS in DBASE III. The GOGA Snowy Plover Database includes data collected using consistent monitoring methods from December 1994 to the present for Ocean Beach and data for monitoring at Crissy Field from September 2006 to the present.

Other organizations have also monitored snowy plovers and reported results to GOGA. The Golden Gate Audubon Society, for example, noted and began monitoring snowy plovers at Crissy Field in 2005 and provided data to the park (Zlatunich 2006, 2007).

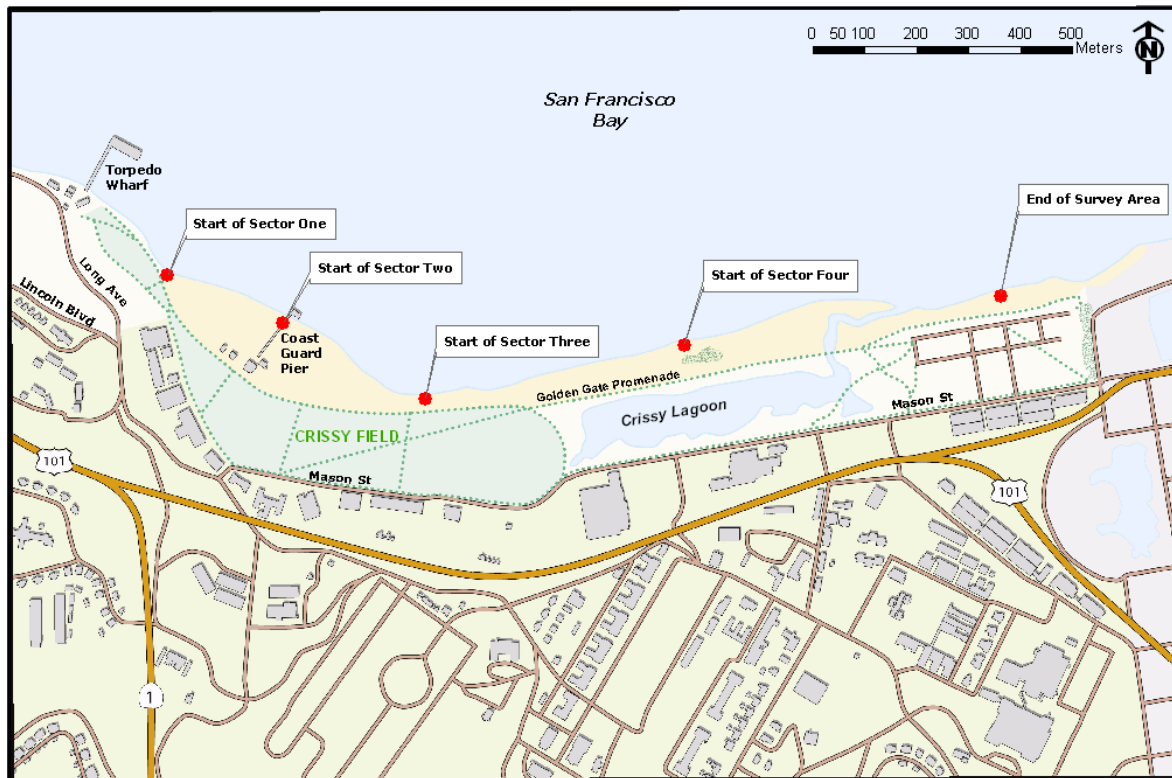


Figure 6. Snowy plover census area at Crissy Field, San Francisco.

In addition, volunteers have participated annually in the USFWS winter window survey in and the breeding window survey during each year. The specific dates for the annual survey are selected by the USFWS. Methods follow those of developed by USFWS (USFWS 2007). In 2008 and 2009, park staff and volunteers participated in the surveys and collected data on Ocean Beach and Crissy Field and other park beaches including Muir, Rodeo, Stinson, and Tennessee Valley. The one-day surveys provide the USFWS with a snapshot of the snowy plover population throughout its range. The survey results also inform GOGA of snowy plovers seen wintering or breeding on beaches that are not covered by this protocol. The range-wide data is accessible through the USFWS Office of Ecological Services in Arcata, California: <http://www.fws.gov/arcata/es/birds/WSP/plover.html>.

Monitoring Objectives

The main objectives for the GOGA snowy plover monitoring program are to determine trends in the abundance and distribution of plovers. The focus of monitoring will be on the winter season (November through February) to exclude the snowy plover breeding season and most of their migratory periods (Page et al. 1986, Page et al. 1995b). The winter season provides the best coverage of snowy plovers that are assumed to consistently use Ocean Beach and Crissy Field at GOGA. By monitoring snowy plover abundance, GOGA will be able to determine the variability and trends in annual snowy plover population size, with particular attention to long-term population (i.e., five- to ten-year) declines.

The collection of snowy plover distribution data allows examination of variability and trends in where the plovers occur on GOGA beaches. This information is important to ensure that beach

habitat protections are properly located and what actions would be most effective in reducing disturbance on the snowy plovers. The distribution data also can be related to data that is currently being collected through other research on beach morphology to better understand plover habitat selection on GOGA beaches, and to guide habitat restoration and enhancements. Plover distribution and abundance data also is useful in guiding the immediate response and determining impacts from disaster events, such as oil spills.

The specific monitoring objectives for the GOGA snowy plover monitoring program are to:

1. Determine trends in snowy plover winter season average population size at Ocean Beach and Crissy Field.
2. Determine trends in the spatial distribution of snowy plovers during the winter season at Ocean Beach and Crissy Field.

In addition to monitoring long-term population and distribution changes, GOGA is also interested in collecting data to evaluate potential effects of public beach uses on snowy plovers. For example, understanding when snowy plovers arrive and depart from Ocean Beach and Crissy Field allows GOGA management to evaluate the current seasonal public use restrictions and to inform timing of the use of heavy equipment on the beach for infrastructure maintenance.

In the urban setting of both Ocean Beach and Crissy Field, recreational use of park beaches is potentially one of the major factors affecting habitat quality for snowy plovers (Page et al. 1986, Hatch 1996, Lafferty 2001a, b, NPS 2006a). Dogs have been identified as particularly disturbing to plovers and shorebirds (Hatch 1996, Lafferty 2001a, b, NPS 2006a, 2007, USFWS 2007). Thus, it is important to collect data on beach use by people and dogs that are a potential source of disturbance to non-breeding snowy plovers. GOGA has reestablished public use restrictions that seasonally require pets to be on-leash in portions of Ocean Beach and Crissy Field. Monitoring compliance with these public use restrictions allows for the evaluation of their effectiveness. The western snowy plover is listed as a federally threatened species and is afforded protections against take and harassment under the Endangered Species Act, as well as NPS regulations prohibiting the harassment of wildlife. Tracking rates of dogs chasing snowy plovers and other shorebirds provide an indication of direct disturbance levels to these birds, as well as violations of federal regulations.

The overall management objective for the GOGA snowy plover monitoring program is to reduce human-caused disturbance to overwintering plovers. The monitoring objectives in support of that management objective are to:

1. Determine the phenology of snowy plover arrival and departure dates from Ocean Beach and Crissy Field.
2. Monitor number and distribution of people and dogs at Ocean Beach and Crissy Field.
3. Monitor compliance rates for seasonal restrictions requiring pets to be on-leash in the Snowy Plover Protection Area and Wildlife Protection Area from July 1 through May 15.

4. Monitor the rates of dogs chasing snowy plovers or other shorebirds at Ocean Beach and Crissy Field.

In addition to meeting specific objectives, regular monitoring also allows for regular observation of wildlife and interactions with recreational activities and provides opportunities for public outreach related to protecting snowy plovers.

Thresholds for Management

Significant changes in the population or distribution of plovers at GOGA warrant that the park evaluates its management activities, conduct specific research, and possibly consider new approaches to protect snowy plovers at Ocean Beach and Crissy Field. Monitoring of snowy plovers and public use of snowy plover beach habitat will enable the park to respond to these thresholds:

1. A significant declining trend in the annual average winter snowy plover population size over all years monitored.
2. A 50% decline in the annual average snowy plover winter average population size at Ocean Beach compared with any of the previous five years of monitoring.
3. Annual average winter snowy plover population size less than 15, or consecutive years with less than an average of 20 snowy plovers.
4. Consistent snowy plover use of areas outside of designated Snowy Plover Protection Area and Wildlife Protection Area.
5. Presence of snowy plovers on GOGA beaches before July 1 or after May 15.
6. Occurrence of snowy plover breeding or nesting events.
7. Observation of egregious disturbance to snowy plovers, or new and unapproved forms of recreation on beaches (e.g., kite buggies).
8. Observation of high levels of non-compliance with the current range of existing pet regulations and restrictions from July 1 to May 15 in the Snowy Plover Protection Area and Wildlife Protection Area.

Management actions would be initiated if any of the above thresholds are met or surpassed. For a decline in snowy plover winter populations greater than the proposed threshold, a likely response would be to initiate additional data analysis and/or field research to better understand factors underlying the decline. Research may also be initiated to better understand significant re-distribution of wintering snowy plovers on GOGA beaches.

Other potential management actions for surpassed thresholds may include:

- strengthening enforcement of regulations
- improving signage

- increasing uniformed park staff presence on beaches
- enhancing programs for visitor outreach and education related to snowy plover protection
- adjusting timing of park maintenance activities and/or special events
- installing fencing and restricting access to certain areas of the beach
- extending pets on-leash restrictions all year or adjusting the boundaries of the Snowy Plover and Wildlife Protection Areas
- conferencing or workshops with other regional snowy plover managers

Identifying or providing examples of specific management actions that may be employed under different scenarios is beyond the scope of this monitoring protocol. In some cases, causes of declines in the GOGA snowy plover population, such as drastic beach sand removal due to storm events, may be easy to identify. If causes of population declines can be determined, managers may be able to act accordingly in a timely manner. In other cases, however, additional, specific research may be required. Depending on the management action(s), a procedural process under the National Environmental Policy Act may be instigated, requiring significant public input. Consultation with USFWS and other regulatory agencies may also be required especially when there are any catastrophic declines in habitat or mortality events.

For more information on park management activities see:

<http://parkplanning.nps.gov/parkHome.cfm?parkID=303>

Research Questions

Monitoring data collected through this program may contribute to addressing research questions that will aid in our understanding of snowy plovers on GOGA beaches and improve the park's plover management. However, additional data outside of the scope of this monitoring effort likely will need to be collected in order to address these questions. This additional research will be contingent upon finding additional resources, including volunteers, or funding.

1. What are the effects of changing beach width and profile on the snowy plover population size and distribution?
2. What are the characteristics of preferred snowy plover habitat on Ocean Beach and Crissy Field?
3. How will rising sea levels and increased storm surge affect snowy plovers on Ocean Beach and Crissy Field?
4. How is the spread of European beach grass affecting snowy plover habitat at Ocean Beach?
5. What are all of the primary sources of disturbance to snowy plovers on Ocean Beach and Crissy Field?

6. Are there shifts in the abundance and distribution of snowy plovers on GOGA beaches in response to changing beach conditions or disturbances?
7. What are the effects of anthropogenic disturbances to the snowy plover population?

Sampling Design

Rationale for Selecting this Sampling Design over Others

The surveys conducted represent a complete count of snowy plovers utilizing Ocean Beach and Crissy Field. During the non-breeding season, snowy plovers tend to occur in flocks that may make them more observable. They are typically on the beach roosting or foraging in the wrack near the previous high tide line. Given that the GOGA snowy plover population is relatively small, typically 20–40 birds during the winter on Ocean Beach and 2–6 birds at Crissy Field, (Hatch 1996, NPS 2006a, 2007) and that the birds are utilizing an open beach with unobstructed views, a complete census can be conducted by skilled observers. There are only a few bird species on GOGA beaches that could be confused with the snowy plover, and with adequate training snowy plovers can be easily distinguished from these other species.

The census technique has been widely employed to survey snowy plovers on beaches (Page et al. 1986, 1995a, Strong and Robinson 2009). The USFWS Breeding and Winter Season Window Surveys (USFWS 2007) also use the census technique to survey for snowy plovers. Bibby and Burgess (1992) recommend direct counts for roosting and feeding flocks of fewer than approximately 200 birds in areas with good vantage points. The Gulf of the Farallones National Marine Sanctuary Beach Watch Program was established to track numbers of live and dead wildlife on central California beaches, including GOGA outer coast beaches to serve as a reference for environmental events, including oil spills. The Beach Watch program uses census techniques to count live shorebirds, including snowy plovers (Roletto et al. 2003). Lafferty (2001a, b) used census techniques in his studies of snowy plovers and other shorebirds on a beach in Santa Barbara, California. Lafferty also counted humans and dogs using the beach and sources of disturbance to shorebirds.

After an oil spill affected Ocean Beach in 2007, several snowy plovers on Ocean Beach were color-banded by PBCS oil spill researchers. Researchers engaged in intensively observing the color-banded snowy plovers as part of the response to the oil spill were often on the beach during GOGA snowy plover monitoring. A comparison of plover counts by PBCS oil spill researchers and GOGA snowy plovers surveyors showed matching counts on the five days when concurrent monitoring had occurred (C. Peterlein, PBCS Ecologist and R. Townsend, NPS Wildlife Intern, pers. comm. 2008). This indicates, at least based on this small sample size, that the plover census techniques in this protocol are effective in obtaining accurate counts of snowy plovers as verified by the intensive researcher observations. If the population grows or beach visibility decreases, additional observers or a change in the sampling design may be needed.

Having observers walk the entire beach project area is an efficient way of accurately counting plovers and meeting our suite of monitoring and management objectives. By dividing the beach into sectors, snowy plover distribution, as well as people and dog use on different areas of the beach, can be tracked. By recording the time spent in each sector, encounter rates can be calculated for people and dogs. Observers also record other potential threats and disturbance to snowy plovers by sector.

To capture the full range of recreational use, the censuses are evenly split between weekday mornings and weekend afternoons. Weekday morning surveys occur when there are typically fewer

people and dogs present. Weekend afternoon surveys, when there are typically more people and dogs on the beaches, have the potential for detecting higher levels of disturbance to snowy plovers. However, recreational use of the beaches is often determined by weather, with high numbers of people coming out to the beaches on warm, sunny days.

Site Selection

Ocean Beach and Crissy Field provide the only beach areas of GOGA that have been consistently occupied by snowy plovers (Hatch 1996, NPS 2006a, 2007). Ocean Beach (Figures 1 and 3) is located on the western edge of San Francisco, California. The shoreline at Ocean Beach has been extensively modified and is now estimated to be 550 feet seaward of the original 1800's location north of Sloat Boulevard (Moffatt and Nichols Engineers 1995). European beachgrass planted to stabilize dunes has resulted in steep, densely vegetated dunes that are not suitable as snowy plover habitat in many areas south of Lincoln Street (Stenzel et al. 1995). Small areas of Ocean Beach still have some native dune vegetation. Ocean Beach is highly dynamic with some areas accreting sand and others eroding. Storm surge can extend up over seawalls backing the beach in some areas. Beach width can range from 0–300 feet (GOGA 1998). With parking areas, adjacent high density housing, and beach access about every two blocks, the entire length of Ocean Beach is subject to fairly high visitor use levels. The Ocean Beach area surveyed includes the entire beach from the rocks below the Cliff House south to the north end of the bank swallow (*Riparia riparia*) colony near the second overlook south of the San Francisco Zoo (Figure 3).

Crissy Field (Figure 6) is located along San Francisco Bay, a few miles east of the Golden Gate Bridge. A 100-acre area of Crissy Field was restored by enhancing and protecting coastal dunes, removing rubble from the beach, and construction of a 20-acre tidal marsh (Jones and Stokes Associates, Inc. 1996). The beach at Crissy Field is backed by restored dune habitat that is actively weeded and partially fenced well above the high tide line to keep dogs out. The section of Crissy Field Beach in the Wildlife Protection Area is accreting sand. The relatively wide, flat dune-backed beach is likely what attracted snowy plovers to this area. The beach has numerous access points and receives high levels of use by people and dogs. The Crissy Field survey area begins where the beach begins just east of the Torpedo Wharf and continues to the eastern edge of the beach (Figure 6).

The two census areas are each divided into sectors based on prominent landmarks and a desire to have sectors of about the same size. Ocean Beach is divided into 14 sectors and Crissy Field is divided into 4 sectors. Plover numbers are tallied for each sector. These data will be used to analyze the changes in distributions of plovers within the larger census areas.

Additional sites may be added if new snowy plover areas become known. The Gulf of the Farallones National Marine Sanctuary's Beach Watch program includes several coastal beaches within GOGA. These beaches are surveyed twice per month by trained volunteer observers for all live and dead animals. GOGA receives annual reports from the Beach Watch program and can make special requests for data, such as observations of snowy plovers. In addition, USFWS Winter Season Window Surveys include other park beaches (USFWS 2008). Finally, given the high profile of snowy plovers and an active community of "birders" in the San Francisco Bay Area, it is very likely that new sightings will come to the attention of the NPS quickly.

Population Being Monitored

During each census, all snowy plovers observed on the beach are counted by sector according to behavior (i.e., feeding or not feeding). Observers also record the elevation zone in which the plovers are found and substrate type. Flying plovers complicate the task of obtaining an accurate count. Observers must account for flying plovers so that each individual on the beach is only counted once. The persistent presence of (and attack by) avian predators, such as common ravens (*Corvus corax*), and narrow beach width that causes plovers to be confronted repeatedly by beach users are examples of factors that may make plover especially inclined to fly when disturbed. Minimizing the time that survey requires will also decrease the chance of counting errors due to movement of birds.

In addition to counting plovers, known sources of disturbance to the plovers are also counted during a plover survey. These include people, dogs, equestrians, vehicles, and aircraft. Other shorebird species seen during a plover survey are tallied as are the number of predators (e.g., corvids, hawks, and falcons).

Sampling Frequency and Replication

The primary focus of this program is to monitor the snowy plovers that are consistently using the beach during the winter season. Data will be collected during the fall (July–October), the winter (November–February), and the pre-breeding seasons (March–May, typically). Pre-breeding season surveys continues until plovers are not observed in two consecutive surveys in different bi-weekly survey windows (e.g., no plovers observed on a Saturday survey and then no plovers observed on next Wednesday survey one and a half weeks later).

Surveys are conducted Wednesday mornings (weekday) and Saturday afternoons (weekend) every two weeks from the fall through the pre-breeding season. A minimum of 15 surveys, with at least eight weekday surveys and at least seven weekend surveys, will be conducted during the winter season at each site. The fall and pre-breeding season surveys are to meet park management objectives of determining phenology of arrival and departures, and to monitor threat from people and dogs.

Inclement Weather

Surveys will not be conducted in inclement weather (precipitation greater than a mist, high winds of >20mph or that blow sand above knee level, or visibility less than 50 m), which can reduce the ability of observers to accurately count plovers. Observers should pay attention to looming inclement weather. It is important not to stop and start surveys on the same day to avoid double counting birds. Only complete surveys are considered valid and entered into the GOGA Snowy Plover Database. A census, however, can be conducted without breaks to shorten the survey period to as little as two hours to increase a surveyor's ability to complete a census. In case a census is cancelled, it should be rescheduled for the following week on Wednesday or Saturday as a make-up, and then monitoring should return to the regular schedule.

Field Methods

Surveys are conducted Wednesday and Saturday every other week by staff and volunteers who have been trained in this protocol including snowy plover identification. This section provides a general outline of field methods. Additional background and natural history information is in Appendix A: Snowy Plover Natural History. The detailed methods are presented in Standard Operating Procedure (SOP) 1: Field Methods.

Field Season Preparations

Field staff are hired and trained in June. Training is led by the GOGA Wildlife Ecologist and includes field reconnaissance to become familiar with the study area, species identification, and behavior documentation. Highly recommended training topics include first aid, driving government vehicles, and visitor contacts. Field equipment listed in SOP 1 should be assembled and checked to make sure it is in working condition. Basic equipment includes binoculars, spotting scope with tripod, and data sheets. Previous program volunteers should be contacted to determine their interest and availability. Contact information for past volunteers is on file with the GOGA Wildlife Ecologist. New volunteers may be recruited as needed.

All new and returning participants in the monitoring program should review detailed directions for filling out the data sheets in the appendices of SOP 1: Field Methods prior to the start of the field season or participating in field surveys. The SFAN Data Manager will prepare a satellite database for each site for that year.

Field Methods

Field surveyors begin surveying for snowy plovers during the first week of July, before snowy plovers are likely to be present. Surveys continue through the end of the non-breeding season which is typically early May. Surveys are conducted through March, or when plovers are not observed in two consecutive surveys in different bi-weekly survey windows (e.g., no plovers observed on a Saturday survey and then no plovers observed on next Wednesday survey one and a half weeks later).

On weekdays, surveys start no later than 9:30 a.m. On Saturdays, surveys start no later than 1:30 p.m. If assistance is available, one car may be left at the north parking lot (Sector 1), and then another is parked in the parking lot south of Sloat St. near the Bank Swallow Cliffs and the start of sector 14 which is the beginning point of the census. Surveys will be done under a variety of tidal conditions, which may affect plover activity but not plover numbers.

Typically, censuses are conducted by two or three observers. The surveyors should consist of at least two counters in the beginning of the study or while counters are still gaining experience with surveys. The surveys are always led by the intern or Wildlife Ecologist.

The goal is to complete an accurate and complete count of the snowy plovers in each sector of beach. Surveyors record the start and end time for each sector. Observations are made by slowly walking along the beach, stopping every 50–150 m and scanning about 100–200 m ahead to look for snowy

plovers. If multiple surveyors are present, each one should be responsible for one portion of the data and data sheets. One data sheet is used to keep track of the number of snowy plovers encountered, the time and sector they were encountered in, whether they were foraging, and the beach elevation zone and the substrate they were located in. Careful notes should be taken of colored leg bands if they are present to record the unique color band combination.

As groups of plovers are encountered, maximum counts should be verified, both by each observer recounting and different observers comparing their counts. It takes approximately 5–10 minutes to census each sector, but times may vary depending on number of snowy plovers, plovers with color bands, and the degree of difficulty of making observations. Observers will have to track birds carefully to make sure they are not double counted, especially for birds that fly. When groups of plovers fly, observers record the number of plovers and direction they flew. If already counted and they fly ahead of surveyors, they will be subtracted from total counts (if they are encountered). Double counting is not usually an issue because of the low numbers of birds present in each sector. A separate data sheet is used to count potential disturbances including the number of people, dogs (counted by whether they are on-leash, off-leash within 10 feet of their owner, roaming, or chasing shorebirds or plovers), equestrians, vehicles, predators, aircraft, kite flying, or other potential sources of disturbance. On busy days, a push button hand counter may be used to assist in keeping track of large numbers of people. A third data sheet is used to count other shorebird species encountered.

It takes at least two hours to complete the Ocean Beach census and at one hour to conduct the Crissy Field census.

Field Data Collection

When recording data during field surveys, observers should emphasize the following:

- Write legibly on the data sheets. Make sure all observers write so that someone else can read what they have recorded on the data sheets.
- Use the Kestrel TM Weather Meter to collect weather data (temperature, relative humidity, and wind speed).
- Follow data collection directions from the protocol and on the data sheets to be sure that data is recorded properly, especially when tallying bird observations and disturbances.
- Sum totals and circle those total values when completed. This prevents confusion in interpreting values when entering data.
- Make sure that all fields on the data forms are completed for each sector and at the end of the survey. The NPS Monitoring Lead should confirm that data forms are complete at the end of the survey.

Data Management

This section briefly describes the data management model and procedures for the snowy plover monitoring program at GOGA. SOP 4: Data Management describes in more detail how the snowy plover monitoring protocol meets data management objectives through data entry specifications, database design, quality assurance and control measures, metadata development, data maintenance, data storage and archiving, and data distribution.

Database Design

The GOGA snowy plover monitoring program will continue to use a relational Microsoft Access database originally designed in the winter of 2003–2004. The SFAN Data Manager developed the database by adopting core elements from an early version of the Natural Resource Database Template (NRDT) and building in several key data tables designed by PBCS in DBASE III. Although the NRDT, an application developed by the NPS Natural Resource Inventory and Monitoring Program, is currently in version 3.2, there are no plans to upgrade the database to conform to current NRDT standards.

These data in the snowy plover database are simply organized around survey events on two survey areas, Ocean Beach and Crissy Field. The survey or event data is related to counts of snowy plovers, potential disturbance sources (humans, dogs, etc.), select shorebird species, common ravens, other bird species of interest (e.g., bank swallows), and banded snowy plovers encountered during the survey. These data are collected according to defined beach segments located within the survey area, each of which is described within a locations table.

A complete user interface has been developed to assist with data entry. Rather than employing a back-end, front-end database model, the forms designed for data entry are co-mingled with the data tables within one database file. Command buttons and code driven text boxes are used to navigate to forms, add data records, locate and edit data records, and print reports. Where possible, default values are set and combo boxes with fixed values are used to reduce data entry errors. Alternatively, validation rules are established where possible to limit data entry to certain values, such as beach sector values 1 through 14 for Ocean Beach.

Annual Data Work Flow

Rather than enter snowy plover monitoring data directly into the master database, satellite databases are created at the beginning of each monitoring season that parallel the structure of the master database. The SFAN Data Manager prepares the database for the field staff.

At the end of each season, the field staff is responsible for proofing the data entry records in the satellite database against field notes and paper data sheets completed during the surveys. When complete, the satellite databases are sent or provided to the SFAN Data Manager for additional review and certification. A subset of randomly selected records (10%) is reviewed after initial verification by the SFAN Data Manager. If significant errors are found, the entire data set should be verified again by the project field staff.

Once verification procedures are complete, additional validation procedures are implemented by the Data Manager. Validation procedures include identifying outliers and logic errors and reviewing the database and data records for completeness and consistency. The Data Manager works with the Project Lead and the field staff to complete any final edits or additions to the seasonal dataset. Once certified, the Data Manager imports the satellite data into the master database, appends the data to the appropriate tables, and archives the satellite database within the natural resources directory on the GOGA server.

Quality Assurance and Quality Control

The success of the snowy plover monitoring program is dependent on the quality of the data it collects, manages, and disseminates. Analyses performed to detect ecological trends or patterns require data that are recorded properly and have acceptable precision, accuracy, and minimal bias. Poor-quality data can limit detection of subtle changes in ecosystem patterns and processes, can lead to incorrect interpretations and conclusions, and can greatly compromise the credibility of the program managing it.

Quality assurance (QA) can be defined as an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the consumer. Quality control (QC) is a system of technical activities that measure the attributes and performance of a process, item, or service relative to defined standards (Palmer 2003). While QA procedures maintain quality throughout all stages of data development, QC procedures monitor or evaluate the resulting data products.

To ensure that the snowy plover monitoring program produces and maintains data of the highest possible quality, QA/QC procedures are implemented to identify and minimize errors at each project stage associated with the data life cycle. SOP 4: Data Management outlines specific QA/QC guidelines and procedures to be followed during data entry, data collection, data verification, and data validation.

Version Control Guidelines and Database History

Version control guidelines for the snowy plover monitoring database will follow those presented in the SFAN Data Management Plan (Press 2005). Prior to any major changes to the database design, a back-up copy of the database should be made. Once the database design changes are complete, the database should be assigned the next incremental version number. The final copy of the previous database version should be archived with the version closing date incorporated into the database title. Version numbers should increase incrementally by hundredths (e.g., version 1_01, version 1_02, etc.) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2_0, 3_0, 4_0, etc.). Significant database re-design may require approval by the Project Lead, review by other data management staff, and revisions to the Data Management SOP. The database version number should be included in the file title of the database, for example, Master_SNPL_v2_00.

The Data Manager maintains a history log of the snowy plover monitoring database in a Microsoft Word document titled Master_SNPL_info. All design modifications to the databases are tracked

within the history log and are referenced to changes in database version numbers. Design modifications include changes to the table structure, user interface, or underlying macros and Visual Basic Code. Major changes to the data are also noted in this document, such as when a new set of annual data are uploaded. It is especially important to note edits to the data that will result in changes to final data summaries previously published in annual reports or other media. This will prove invaluable to data users attempting to understand discrepancies in data between years.

Metadata Procedures

The NPS Geographic Information Systems (GIS) Committee requires all NPS GIS data layers be described with the NPS Metadata Profile, which combines the Federal Geographic Data Committee (FGDC) standard, elements of the ESRI metadata profile, the Biological Data Profile, and NPS-specific elements. Although no standard has been applied to natural resource databases and spreadsheets, SFAN will complete the NPS Metadata Profile to the greatest extent possible to document the master snowy plover monitoring database. Because the annual datasets are uploaded into the master databases without alteration, SFAN will not create separate metadata records for each satellite database.

Complete metadata records for the snowy plover monitoring database will be generated in compliance with current NPS standards by the SFAN Data Manager. Because the location data for this project is stored as UTM coordinates within the MS Access databases, there are no spatial data products associated with this protocol that require metadata records.

When completed, metadata records, but not the data, will be posted to the NPS Natural Resource Information Portal ([NRInfo](#)) for public discovery and consumption. Contact information within the metadata records will direct interested parties to the SFAN Data Manager for further inquiries. Master database metadata records posted to NRInfo will be updated annually after the annual data has been uploaded or following database revision to a new version whole number (i.e., v1_3 to v2_0, but not v2_0 to v2_1).

Data Distribution

For the snowy plover monitoring program to inform park management and to share its information with other organizations and the general public, guidance documents, reports, and data must be easily discoverable and obtainable. The main mechanism for distribution of the snowy plover monitoring documents and data will be the Internet. The monitoring protocol, accompanying SOPs, and all annual reports will be made available for download at the SFAN website:

<http://science.nature.nps.gov/im/units/sfan/>. NRInfo records will be created for all of the snowy plover monitoring documents, including the protocol, annual reports, and any resulting publications.

Although the monitoring database will not be posted for public download, as previously mentioned, metadata records for the master databases will be maintained at NRInfo. The metadata records will direct interested parties to the SFAN Data Manager.

Analysis and Reporting

This section summarizes the reports produced by the SFAN I&M Program. Details are provided in SOP 5: Data Analysis and Reporting.

Reporting Schedule and Formats

Reporting results is a critical component of long-term monitoring and ensures that information generated through the program is integrated into NPS planning, management, and decision making. Details for analytical methods and reporting requirements are presented in SOP 5: Data Analysis and Reporting. A summary of reports that will be developed is provided in table 1.

Annual Reports

The annual reporting on the snowy plover monitoring program is completed following the non-breeding season activities (March–May). The report follows the template of the NPS Natural Resource Technical Report Series (NRTR). Updated information on this series is available online: <http://www.nature.nps.gov/publications/nrpm>.

The document includes general sections including abstract, introduction, study area, methods, results, and discussion. The annual report summarizes the monitoring data collected for the season, as well as putting it into context with data collected since the program was initiated, in relation to the monitoring objectives.

Results presented in the annual report address both snowy plover population monitoring objectives:

Monitoring Objective 1: Determine trends in snowy plover winter season average population size at Ocean Beach and Crissy Field by recording:

- number of snowy plovers encountered on each survey
- average number of snowy plover per survey by month
- annual maximum, median, and winter season average and median number of snowy plovers

Monitoring Objective 2: Determine trends in the spatial distribution of snowy plovers during the winter season at Ocean Beach and Crissy Field by calculating:

- percentage of snowy plover observations by sector
- winter season average number of snowy plovers per survey by sector, and across sectors

In addition, the annual report will present results to address four monitoring objectives that are in direct support of the overall management objective of reducing human-caused disturbance to winter season snowy plovers:

Monitoring Objective 3: Determine the phenology of snowy plover arrival and departure dates from Ocean Beach and Crissy Field by recording:

- annual arrival (first date plovers observed) and departure dates (last date plovers observed) as well as dates of first and last surveys

- average number of snowy plovers per survey by month

Monitoring Objective 4: Monitor number and distribution of people and dogs at Ocean Beach and Crissy Field by calculating:

- median values of number of people per hour and unleashed dogs per hour in Snowy Plover Protection Areas by sector

Management Objective 5: Monitor compliance rates for seasonal restrictions requiring pets to be on leash on portions of Ocean Beach and Crissy Field from July 1 through May 15 by calculating:

- percentage of dogs unleashed in the Snowy Plover Protection Areas

Management Objective 6: Monitor the rates of dogs chasing snowy plovers or other shorebirds at Ocean Beach and Crissy Field by calculating:

- average number of dogs chasing shorebirds and snowy plovers

The discussion section of the report may highlight management issues and possible recommendations from monitoring activities. Format follows the national guidelines established for the Natural Resource Technical Report series by the Natural Resource Publications Manual (<http://nature.nps.gov/publications/nrpm>). These annual reports will also be distributed to the SFAN parks, and can be used to report on park management goals. Portions may be included in the SFAN Annual Administrative Report and Workplan. For examples of annual reports see the 2006 report, “Snowy plovers during the non-breeding season at Golden Gate National Recreation Area” (Townsend et al. 2008). For more details including sample tables and figures presented in the annual report see SOP 5: Data Analysis and Reporting.

Table 1. Summary of reporting and communication products.

Communication Product	Lead	Audience	Schedule	Summary
Annual Report	Intern /GOGA Wildlife Ecologist	Park Resource Managers, Outside Agencies (i.e., USFWS), Interested Public	Annually	<ul style="list-style-type: none"> • Summarize data and document monitoring activities • Describe current condition of the resources • Document changes in the monitoring protocol • Provide management recommendations as appropriate • Increase communication within the park and network, and with regional partners
Analysis and Synthesis Report	GOGA Wildlife Ecologist	Park Resource Managers	5 years	<ul style="list-style-type: none"> • Determine trends as stated in the monitoring objectives • Provide context, interpret data for the park within a multi-park, regional, or national context • Recommend changes to management practices
Program and Protocol Reviews	Network Program Manager/ GOGA Wildlife Ecologist	Program Lead, I&M Technical Steering Committee,	5 years	<ul style="list-style-type: none"> • Periodic formal reviews of operations and results • Review of protocol design and product to determine if changes are needed • Part of the quality assurance and peer review process
Resource Briefing	Intern /GOGA Wildlife Ecologist	Program Managers, Superintendents, Frontline Interpretation Staff	Annually (upon completion of annual report)	Two-page summary that lists monitoring objectives and questions, discusses annual results, and provides a regional context
Web Site Intranet	Data Manager	Park Staff	Annually or as needed	Post all completed reports
Web Site Internet	Data Manager	Park Staff, General Public	Annually or as needed	Post all Resource Briefings
Park Presentations	Intern /GOGA Wildlife Ecologist	Park Staff	Annually	Provide a presentation to park staff during senior staff, all employee, or division meetings
Monthly E-Mail Update	Intern	Volunteers, Park Staff	Monthly	Monthly update sent to park staff to increase awareness of resource status. Highlights most recent survey findings.
Monthly Natural Resources and Science Updates	Intern	Park Staff, Network	Monthly	This one-page monthly e-mail provides park staff with a short update on monitoring programs. Text should be no more than one paragraph.
Photos	Intern	For all reports and publication	Continuous	High-quality photo are needed to support all communication products. For digital photos that means 300 pixels per inch resolution in a plain or compressed TIF format. Field staff should make every effort to document ongoing work, special incidents, site visits for communication purposes.

Long-term Trend Reports

A long-term trend report will be developed every 5 years to summarize long-term changes in population abundance and to present statistical analyses of trends. The winter plover analyses will also show long-term changes in the distribution of non-breeding snowy plovers. The comprehensive data report will also interpret data within a context of the park ecosystem and address management concerns. See SOP 5: Data Analysis and Reporting for details and example trend figures from previous data.

Abundance: abundance of snowy plovers will be evaluated by analyzing tabular and graphical representations of the data. The Mann-Kendall test will be used to detect trends in winter season average snowy plover counts. This test measures the correlation of two rankings (year and average number of snowy plovers). While trends can be rejected or not rejected, failing to reject does not prove that there was no trend. Tests can be run using a variety of statistical software.

In addition, we will analyze each survey sector separately for a simple repeated measures design that is equivalent to a randomized block design where blocks are equal to locations and years equal to treatment. Page's test is used for multiple comparisons between ordered correlated variables. In this case, Page's test will reveal if there is a trend (upward or downward) over years among sectors.

Distribution: trends in snowy plover distribution will be analyzed through visual interpretation of the data. In addition, Mann-Kendall or Page's test can be run on individual or groups of sectors. The average number of snowy plovers counted in the four most commonly used sectors (5, 6, 8, and 9) from 1995 to 2009 show a lot of variability in the distribution (Figure 7).

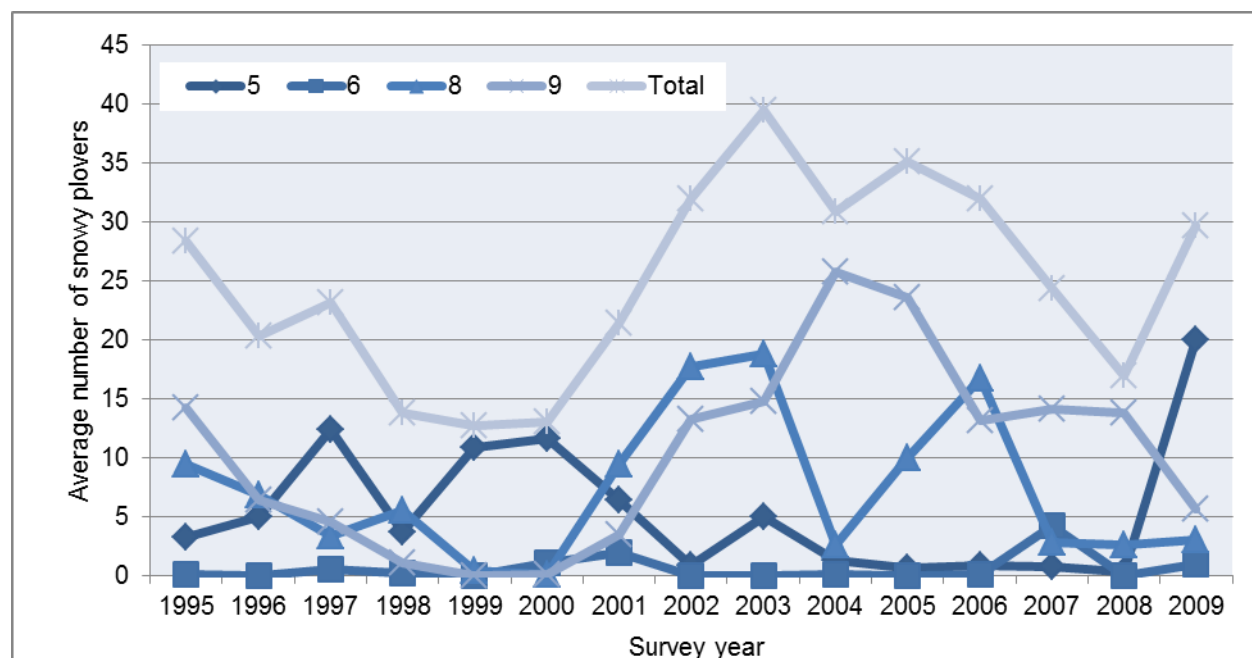


Figure 7. Average number of snowy plovers observed for Sectors 5, 6, 8, 9, and across all sectors of Ocean Beach during the winter season, 1995–2009. *Source:* Hatch 1996, NPS 2006a, 2007, 2008, NPS unpublished data.

Phenology: changes in phenology will be of interest to evaluate influences of climate change. Significant arrival or departure date changes may require adjustments of management activities such as beach closures. To determine if there are trends in snowy plover arrival or departure dates, Mann-Kendall and Page's tests as described above will be used to evaluate Julian date of arrival (or departure) over years.

Disturbance: to determine if there are long-term trends over years in the number of people, dogs, compliance with leash restrictions, or dogs chasing shorebirds or plovers, Mann-Kendall and Page's tests will be used. Tests can be for overall parameter values across sectors, for groups of sectors, or for individual sectors.

Future exploratory analyses could include a variety of correlations with other data sets (e.g., temperature, precipitation, beach conditions, food availability, predator levels) as they become available.

Monthly Natural Resources and Science Updates

Shorter updates on plover progress are created monthly during the snowy plover overwintering season by the Intern and shared with all park staff through a GOGA park update that comes out weekly. These will be distributed to docents and other park staff via electronic mail or may be published in the monthly Natural Resources and Science Update (electronic and hardcopy), internet or intranet, and through other media.

Operational Requirements

This program is directed by the GOGA Wildlife Ecologist with assistance from an intern who leads most of the field surveys with assistance from long-term volunteers.

The intern is responsible for conducting field work, data entry, and communicating results to some degree. The position is seasonal (June–May) and will have a flexible schedule due to the need for travel time and long hours in the field. The duty station will be at Fort Cronkhite in the Marin Headlands, Sausalito, California. The park provides office space and administrative support. The intern is directly supervised by the GOGA Wildlife Ecologist (GS-12). The supervisor provides training and consistency in implementing the protocol.

Government vehicles are available through a check-out system at the GOGA Natural Resource Offices at Marin Headlands. If government vehicles are not available on a survey day, keep track of the mileage when using a personally-owned vehicle and request reimbursement using the SF-1164 form “Claim for Reimbursement for Expenditures” as directed by the GOGA Wildlife Ecologist. Using two vehicles for Ocean Beach surveys is preferred to minimize the time needed to complete a full survey.

The data management aspect of the monitoring effort is the shared responsibility of the intern, GOGA Wildlife Ecologist and SFAN Data Manager. Typically, the intern is responsible for data collection, data entry, data verification and validation, and works with the GOGA Wildlife Ecologist to complete data summary, analysis and reporting. The SFAN Data Manager works with the intern to make sure data is entered correctly and verified, and conducts several queries to check for data entry errors. The GOGA Wildlife Ecologist is ultimately responsible for adequate QA/QC procedures built into the database management system and appropriate data handling procedures followed by the intern.

The snowy plover monitoring program has a long-tradition of volunteer involvement. For each survey, 1–2 volunteers may participate in making observations and collecting data. In 2007 there were three volunteers. Two volunteers assisted with weekday surveys and one volunteer worked on Saturday. Historically, the volunteer turnover has been low. When new volunteers start the program, they are trained by the intern, the GOGA Wildlife Ecologist and other, experienced volunteers. Training includes field identification, methods for conducting surveys and filling out data sheets appropriately. Once adequately trained, volunteers are scheduled by the intern. It should be noted that volunteers are always in the field with trained staff and do not conduct censuses independently.

Roles and Responsibilities

Tasks for the GOGA Snowy Plover Intern

The snowy plover monitoring program takes up about half of an annual intern’s time (four days/two-week period), and this position is typically shared with other GOGA Natural Resource program needs. Snowy plover monitoring tasks include two full days in the field every other week. Field day activities include conducting surveys, sign installation and maintenance, and outreach. The other half

of the intern's time (two days/two-week period) is spent on doing data entry, analysis and reporting, communicating results, and coordinating work with volunteers.

- Be well-versed in all aspects of the snowy plover monitoring protocol and implement monitoring
- Coordinate logistics for field work
- Coordinate field assistance for protocol implementation and provide training to field assistants such as volunteers
- Conduct outreach related to snowy plovers as appropriate
- Maintain equipment in good working order and keep maintenance records
- Collect field data and implement field QA/QC measures
- Complete data entry, verification, and validation and consult with SFAN Data Managers
- Working with the park staff, perform basic statistical analyses on data; present and interpret results in annual reports
- Coordinate with GOGA Wildlife Ecologist regarding staff and training needs, data analysis and data interpretation
- Coordinate with GOGA Wildlife Ecologist on budget, vehicle, and equipment needs
- Complete annual report and other communication products

Broad Tasks for GOGA Wildlife Ecologist

- Responsible for program oversight and leadership
- Plan and manage program budget
- Provide technical assistance and supervision for the intern
- Provide or coordinate training for the intern
- Conduct annual QA/QC field checks
- Review Job Hazard Analysis (JHA) and other safety issues with intern
- Present issues to the SFAN I&M Program Manager for consultation with the Technical Advisory Committee
- Review and provide comments on annual report
- Initiate and complete analysis and synthesis report
- Communicate with division, park, and outside agencies about program and results, including management recommendations from monitoring program

Tasks for SFAN Data Manager

- Provide assistance to the intern regarding data management, archiving, reporting
- Assist with QA/QC
- Assist with GIS needs
- Assist with compilation of metadata for past and current monitoring programs
- Provide technical assistance or review of reports as appropriate

In addition, broad programmatic oversight related to the overall I&M program and review are provided by the SFAN I&M Program Manager. These responsibilities are not presented in the project budget below (Table 2).

Broad Tasks for SFAN I&M Program Manager

- Provide guidance on data management, data analysis and reporting
- Review technical reports
- Coordinate peer review of analysis and synthesis report with GOGA Wildlife Ecologist

Volunteer Requirements

Volunteers conducting surveys must be able to walk several miles of beach and maintain a level of attentiveness throughout the survey. All volunteers must be able locate snowy plovers and to distinguish them from other, similar species. Volunteers making disturbance observations must be able to watch all human and dog-plover interactions and record all the pertinent data concerning each interaction. Volunteers must commit to regularly participate in surveys throughout the year.

Budget

Personnel expenses for field work are based on using 0.5 of a full-time intern for one year. The majority of the long-term funding is provided by GOGA. In-kind services are provided by I&M staff for report reviews and assistance with GIS, database management, data summary, and data analysis. A projected budget is provided in table 2. Amounts are based on expenses from previous years.

Table 2. Estimated annual budget for GOGA snowy plover monitoring.

Description		Cost	GOGA Support	SFAN Support*
Annual expenses	GOGA Intern, half-time (1/2 field, 1/2 data)	\$4,500	\$4,500	
	SFAN data manager (GS-11, 1–2 pp)	\$5,000		\$5,000
	GOGA wildlife ecologist (GS-12, 2 pp)	\$10,000	\$10,000	
	Vehicle	\$1,000	\$1,000	
	Equipment and Supplies	\$500	\$500	
	Travel	\$500	\$500	
	Total cost in years with annual reports	\$21,500		
Every 5 th year expenses	GOGA intern 1 month	\$750	\$750	
	SFAN data manager (GS-11, 1–2 pp)			\$5,000
	GOGA wildlife ecologist (GS-12, 1 pp)	\$5,000	\$5,000	
	Statistical support (1 PP)	\$5,500	\$5,500	
	Additional cost in years with long-term reports (every 5 years)	\$16,250		

* The SFAN I&M contribution is an in-kind contribution of assistance from the SFAN data manager.

Additional periodic costs may be incurred if new equipment (e.g., spotting scopes and binoculars) are needed that are not covered by annual funding. Data management, data summaries, and short-term data analysis are accomplished cooperatively by the intern, SFAN Data Manager, and the GOGA Wildlife Ecologist. Every five years, long-term trend analyses will be developed by park and network staff or through cooperative agreements with partnering agencies such as PBCS or the California Cooperative Ecosystems Study Unit (CESU). These reports will incur additional costs.

Annual Workload and Field Schedule

Ideally the intern starts at the beginning of the field season (June) and finishes the report the following year in May or June. In recent years, however, GOGA has worked with AmeriCorps whose volunteers work October through August. Data collection and management are done concurrently throughout the field season. Report writing, photograph updates, and database verification can be completed at the end of the season. Table 3 summarizes the annual schedule of activities.

Table 3. Summary of annual schedule of snowy plover monitoring activities.

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Advertise for intern												
Intern begins												
Prepare for field season												
Field surveys												
Data verification/reporting												

Note: A more detailed timeline of field operations is available in SOP 1: Field Methods.

Facility and Equipment Needs

The nature of snowy plover surveys does not require special facilities beyond normal office space and equipment storage. GOGA will supply the computer equipment for data entry and report writing.

Permit Procedures

All data collected through this monitoring program are field observations collected along publicly accessible beaches. The methods are considered non-invasive and are no different than activities that might be conducted by any park visitor. Park or USFWS research permits are, therefore, not needed by this monitoring program.

Revising and Archiving the Protocol

Over time, revisions to both the Protocol Narrative and to specific SOPs are expected. Careful documentation of changes to the protocol is essential for maintaining consistency in methods, data collection, and for appropriate treatment of the data during data summary and analysis. Each document has a separate version number. The steps for changing the protocol (Protocol Narrative, SOPs, or Appendix) are outlined in SOP 3: Revising the Protocol. The narrative and each SOP or Appendix contains a Revision History Log that should be filled out each time a revision is made. The log is a record of what changes were made and why, and tracks the version numbers. The new version of the SOP, Appendix, and/or Protocol Narrative should then be archived in the SFAN Protocol Library on the GOGA I&M Server.

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Appendix A. Snowy Plover Natural History

Version 1.3

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
Draft 1995	Oct. 2007	M. Koenen	Adapted to formatting standards for the NPS I&M Program	To meet NPS guidelines	1.0
1.0	Dec. 2009	B. Merkle	Revisions for consistency with program and completeness.	Development and review for protocol submission.	1.1
1.1	Mar. 2010	D. Adams	Formatting for peer review		1.2
1.2	January 2011	D. Adams	Changed to an appendix from an SOP, shorebird id photos added.	In response to peer review comments.	1.3
1.3	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		1.4

Overview

This appendix provides background information for identifying snowy plovers in the field at Golden Gate National Recreation Area (GOGA) and describing a variety of behaviors. A more comprehensive natural history is found in the Recovery Plan for the Pacific Coast Population of the western snowy plover (USFWS 2007). Most of the information in this appendix is taken and revised from the original monitoring protocol for snowy plovers on Ocean Beach (Stenzel et al. 1995).

Field Identification of the Snowy Plover

Snowy plovers (*Charadrius alexandrinus*) are distinguished from other small shorebirds that use Ocean Beach and Crissy Field by their pale gray or brown backs, white breasts and under parts, plump profiles, large eyes, and slender black bills (Figure APP A.1). Observers should look for the white breasts of roosting plovers as they scan the beach with binoculars, realizing that some white patches are pieces of debris. Snowy plovers have dark gray to black legs. Snowy plovers have a shorter, less pointed bill than other sandpipers. Dark markings across the forehead, on the cheek below and behind the eye, and on either side of the throat that are prominent during the breeding season are very faint or absent in basic plumage during the non-breeding season.

Sometimes early and late in the non-breeding season, or during migration, snowy plovers in breeding plumage are observed. If these birds are observed late in the season, or are exhibiting breeding behavior, these observations should be noted and documented through photographs and relayed to the GOGA Wildlife Ecologist because breeding records do not exist for either Ocean Beach or Crissy Field.

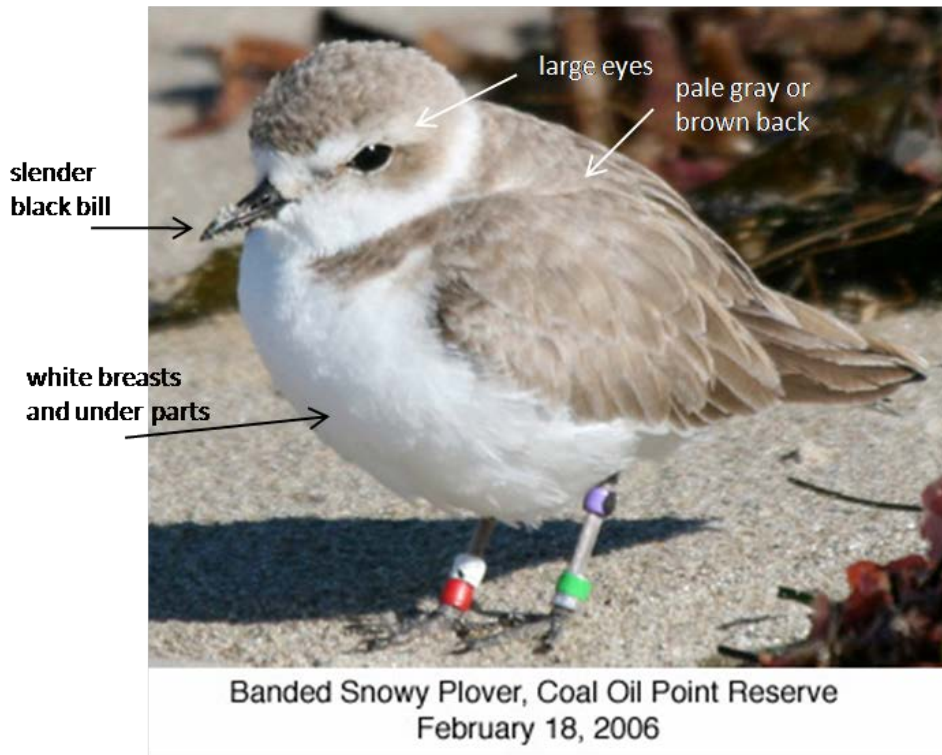


Figure APP A.1. Snowy plover in winter plumage with identifying features. *Photo by:* Callie Bowdish.

Observers must be able to distinguish snowy plovers from the larger killdeer (*Charadrius vociferous*), semipalmated plover (*Charadrius semipalmatus*), sanderling (*Calidris alba*), dunlin (*Calidris alpina*), and smaller western sandpiper (*Calidris mauri*), and should become very familiar with these species (Figure APP A.2). Sanderlings are the most common overwintering shorebird on GOGA beaches and also the species that is most likely to be confused with snowy plovers, so extra attention should be given to distinguishing plovers from sanderlings. Other common shorebird species on these beaches include willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), and whimbrel (*Numenius phaeopus*).

Gender

Snowy plover gender cannot be differentiated in non-breeding plumage, and thus the genders of snowy plovers are not identified as part of this monitoring program. During the breeding season, a rufous crown may be noted on breeding males, but is generally not seen not on females (Page et al. 2009).

Adult versus Juveniles

Fledged juveniles have buffy edges on their upper parts. They can be distinguished from adults until approximately July through October, depending on when in the nesting season they hatched. After this period, molt and feather wear makes fledged juveniles indistinguishable from adults. Snowy plovers are not aged as part of this program.



Figure APP A.2. Useful characteristics for field identification of similar shorebirds found on Ocean Beach and Crissy Field, San Francisco, California. Unless noted, photos by Will Elder, NPS.

Snowy Plover Behavior

Feeding Behavior

Snowy plovers usually feed at low tide, on water-saturated sand below the current high tide line. Plovers also may be found feeding on flies in kelp, on beetles or flies on marine mammal carcasses, on insects in dry sand at the base of vegetation, or in other beach microhabitats. When actively foraging, snowy plovers often behave like American robins (*Turdus migratorius*); snowy plovers will pause then run a short distance to peck at the ground using the run-stop-peck method of feeding. Sanderlings are most frequently observed foraging at the water's edge running back and forth with incoming and outgoing waves, often as a group with synchronous movement. Plovers are more likely to be found near the wrack line, alone, though are infrequently observed foraging at the water's edge, so observers must confirm identifications.

Roosting Behavior

Snowy plovers typically spend much of the day resting above the current high tide line, often sitting in depressions, such as foot prints, or behind wave-cast debris, such as kelp or surf grass. These habits endow plovers with good camouflage while roosting. Non-breeding snowy plovers tend to be in flocks, which makes them more likely to be detected by observers. Single plovers and small groups are observed though, and sometimes these are on days when disturbances or weather may have separated larger groups. Smaller numbers of snowy plovers, up to a total of six birds, have been observed at Crissy Field, but with birds showing similar flocking behavior as on Ocean Beach. Plovers are typically found roosting only with other plovers, but can be found with other species, especially small numbers of sanderlings and semipalmated plovers. As noted above, sanderlings are most commonly observed at the water's edge, but more rarely are found roosting in groups around the old high tide line.

Disturbance Behavior

If disturbed, roosting plovers may stand and, when further disturbed, walk, run, or fly away. When agitated, they also may "bump" one another from resting places. Potential agents of disturbance include people, dogs, and birds of prey.

Annual Cycle

Breeding Season

The breeding season is about six months long (mid-March through mid-September). Females and males have different roles in rearing the young. Most females and many males make second breeding attempts. Based on the known histories of banded individuals, about 40% of females and 16% of males studied on Monterey Bay moved from their regular breeding areas to locations at least 50 km away for additional nesting attempts (Stenzel et al. 1994).

Snowy plovers nest in open, unvegetated or sparsely vegetated, habitat that may have a sparse to moderate scattering of debris such as driftwood. The Pacific coast population of snowy plovers nests along the coast between central Washington and southern Baja California, including three or four of the Channel Islands off the southern California coast. Locally, the closest breeding locations are Point Reyes National Seashore and the San Francisco Bay National Wildlife Refuge. To the south, Pacifica State Beach and the mouth of Pilarcitos Creek on Half Moon Bay have also been used by

nesting plovers. In the absence of disturbance, Ocean Beach or Crissy Field may provide nesting habitat, but nests have never been documented in these areas. High numbers of potential nest predators, including common ravens, would make nesting in these areas difficult.

The inland population of snowy plovers nests at inland locations around the margins of saline lakes mostly in California, Oregon, Nevada, and Utah, and evaporation ponds in the California Central Valley. More rarely they have been found nesting around the unvegetated margins of freshwater lakes. Although researchers have recorded a few cases of coastal-born plovers nesting at inland locations, inland-born plovers have not been documented nesting along the coast.

Non-breeding Season

Most snowy plovers in western North America winter along the coast, although small numbers of snowy plovers regularly winter in the San Joaquin Valley around evaporation ponds and around the Salton Sea. In the winter they use both beaches on which they nest as well as other beaches that are unsuitable for nesting. The non-breeding season for Ocean Beach and Crissy Field begins when the earliest birds arrive or are moving through (early July), until the departure of the latest bird in mid-May.

Page et al. (1995) found that snowy plovers exhibit strong site fidelity to wintering areas. Approximately 60% of males, females, and immatures from Lake Abert, Oregon, that were located on their coastal California or Baja California wintering areas were present for 2 consecutive years, and about 30% for at least three years (Page et al. 1995).

Conservation Concerns

Predators

Common predators on Ocean Beach and Crissy Field include common ravens and domestic dogs (NPS 2006). Coyotes (*Canis latrans*), striped skunks (*Mephitis mephitis*), ground squirrels (*Spermophilus beecheyi*), and raccoons (*Procyon lotor*), as well as non-native red fox (*Vulpes vulpes*) and domestic cats (*Felis catus*), are other potential mammalian predators. Merlins (*Falco columbarius*), peregrine falcons (*Falco peregrines*), and northern harriers (*Circus cyaneus*) are rare visitors and could prey on free-flying plover adults.

Human Disturbance

Recreational activities such as walking, jogging, kite flying, dogs, horseback riding, grooming of beaches, vehicle use, are sources of disturbance on beaches (USFWS 2007). Additional sources of disturbance at Ocean Beach and Crissy Field are events drawing large numbers of people, aircraft, and fireworks. These disturbances may displace plovers from preferred roosting or foraging areas and cause them to expend energy in flushing or running away.

Habitat Alteration

Loss of nesting and wintering habitat is one of the major threats to snowy plovers (USFWS 2007). This includes building of beach-front developments, shoreline stabilization and also introduced species such as European beach grass (*Ammophila arenaria*) used to stabilize dunes. Along Ocean Beach, European beach grass is spreading and has created steep dunes over a large portion of the site. Iceplant (*Carpobrotus edulis*) also is well established and known to encroach further onto beaches.

Climate Change

Rising sea-level and increased storm surge associated with climate change threaten snowy plover habitat at both Ocean Beach and Crissy Field. Currently at Ocean Beach, some portions of the beach are under water at higher tides, especially in the middle and southern ends of the Snowy Plover Protection Area. These areas include sections of beach that have been preferred roosting areas for snowy plovers in the past. During storms, waves often wash over the entire beach onto seawalls or into the dunes backing the beach. Long-term projections of future sea-level rise indicate that most of the beach areas at Ocean Beach and Crissy Field are expected to be lost. At Ocean Beach, roads and buildings directly in the back of the beach allow no room for the beach to migrate inland. In addition, climate change impacts on breeding plovers may reduce populations that attempt to overwinter at GOGA.

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SOP 1. Snowy Plover Monitoring Field Methods

Version 2.3

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
Draft 1995	Oct. 2007	M. Koenen ,	Adapted to formatting standards for the NPS I&M Program	To meet NPS guidelines	1.0
1.0	Oct. 2008	R. Townsend, M. Koenen	Filled in gaps.		1.1
1.1	Dec. 2009	B. Merkle	Development of protocol and consistency with program.	Revise protocol for peer review.	2.0
2.0	April 2010	D. Adams	Formatting	Peer review	2.1
2.1	Jan. 2011	D. Adams	Formatting, changed from SOP 2.0 to SOP 1.0, improved graphics, typos corrected	Rearranged SOPs and appendices following CESU peer review	2.2
2.2	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		2.3

Overview

The purpose of this standard operating procedure is to describe the census methods utilized in the field to count snowy plovers and document their location on Ocean Beach and Crissy Field. The timeline in Table SOP 1.1 provides an overview of activities throughout the year.

Table SOP 1.1. Annual schedule of snowy plover monitoring activities.

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Advertise for intern												
Intern begins												
Prepare equipment												
Contact volunteers												
Make sure signs are set up on Ocean Beach												
Field surveys												
Bi-monthly e-mail updates												
Data validation												
Annual reports												
Update resource briefing												

Field Season Preparation

Equipment Preparation

The intern or Wildlife Ecologist is responsible for gathering necessary equipment at the beginning of each field season (Table SOP 1.2). This equipment is stored in the wildlife storage room in Bldg.

1063, Fort Cronkhite, Sausalito, CA. Snowy plover monitoring equipment is typically stored in a large gray plastic cargo box that should be brought out in the field for surveys. Equipment should be checked for functionality and purchases for new equipment coordinated with the Project Lead. Government vehicles are available through a check-out system at the Natural Resource Offices at Marin Headlands. Using two vehicles for Ocean Beach surveys is preferred to minimize the time needed to complete a full survey.

Volunteer Assistance

Volunteers have played an important role in the monitoring program since its inception serving to increase safety, confirm counts, segregate data collection tasks, and to increase efficiency of the surveys. Volunteers must be able to identify snowy plovers accurately in the field and should be familiar with the monitoring protocol, and especially with field methods in this SOP. Volunteers are expected to regularly participate in surveys, ideally working over multiple years. New volunteers will be trained and returning volunteers will receive seasonal refreshers on safety and field methods. The project intern may contact past volunteers to inquire about availability. Contact information for past volunteers is on file with the GOGA Wildlife Ecologist. New volunteers may be recruited as needed. Volunteer waivers (VIP Form 10-85) will have to be signed by volunteers and Project Leads before commencing work.

Table SOP 1.2. Equipment list for snowy plover monitoring at GOGA.

Equipment	Description
Necessary equipment	Binoculars (8x40)—enough pairs for all observers. Clipboard, data forms and extras, instructions and code sheet for forms, and sector maps. Pens and Pencils, and extras Wrist watch Pocket weather meter Cell phone with emergency contact information or park radio Field guide
Recommended equipment	Spotting scope (optional but useful where beach is wide) Warm, layered clothes, including rain shell Hat, gloves Sun protection (sunscreen, sun hat, and sunglasses) Water and snacks, first aid kit Copy of the monitoring protocol

Training and Evaluating Observers

New observers will work with experienced observers before they will be allowed to collect data independently. The NPS Wildlife Ecologist will verify that new NPS interns are familiar with the monitoring protocol and field identification and data collection before allowing them to lead the snowy plover surveys. This typically involves conducting several surveys together, and gradually having the intern take on more of the data collection while verifying counts and the data that is recorded. In addition, sometimes overlap of program intern allows for new interns to participate in surveys with the interns that had led the surveys for the past season. While surveyors are still

inexperienced, they should be paired with more experienced observers. Observers should count groups of plovers independently, compare numbers, and recount until both are able to find all the birds. More experienced observers can provide tips on locating plovers and identifying other shorebirds. This is a good way for new surveyors to learn to make accurate counts of plover flocks and to learn a search image for snowy plovers on the census areas. Plovers that are feeding are easier to count because their movement makes them more conspicuous. Trainers will also work with new observers on counting and classifying visitors and dogs, common ravens, and other shorebirds.

After accompanying an experienced observer on at least three surveys, new observers should fill out an entire data sheet independently. Periodically during the survey and at the completion of the survey, the new observer's data sheets will be reviewed for accuracy. If the trainer confirms that the new volunteer is consistently accurate in 90% or more of the form fields and counts, the volunteer may continue filling out the data sheets independently; otherwise the intern will continue to focus on clarifying areas of uncertainty until the volunteer is comfortable and competent with field data collection.

Field Methods

Seasonal Timing of Surveys

Signs are in place on the beach at entrances to the Snowy Plover Protection Area at Ocean Beach and the Wildlife Protection Area at Crissy Field, indicating seasonal pet on leash restrictions from July 1 through May 15 (Figure SOP 1.1). Field surveyors begin surveying for snowy plovers during the first week of July, before the snowy plovers are likely to be present. Surveys continue through the end of the non-breeding season which is typically early May. Surveys are conducted through at least March, or when plovers are not observed in two consecutive surveys in different bi-weekly survey windows (e.g., no plovers observed on a Saturday survey and then no plovers observed on next Wednesday survey one and a half weeks later).

Survey Area

The census area at Ocean Beach encompasses the beach extending to the rocks below the Cliff House south to the north end of the bank swallow colony south of the second overlook parking lot and west of the San Francisco Zoo, where the Coastal Trail exits on to the beach at the north end of Fort Funston (Appendix SOP 1A). At Crissy Field, surveys cover the beach from where it starts east of the Torpedo Wharf east to the developed area where the beach ends to the east of the Crissy Marsh inlet (Appendix SOP 1A).

Data are collected for each sector identified in the maps. Sectors are typically identified by prominent landmarks, including streets and sand ladders to the beach, numbered stairwells on a seawall, piers, etc. Observers must not assume that there are no plovers in areas where they have not been observed before. No data is different than no plovers. If new snowy plover observations are reported through casual observations by volunteers, staff, or the public, additional areas may be added to the census area. Areas to be added to the surveys would need to support consistent populations of snowy plovers, not just single sightings of one or a few birds that remain for short periods of time as occurs rarely at other GOGA beaches.



Figure SOP 1.1. Signs alerting beach visitors to the presence of the Snowy Plover Protection Area are placed at entrances to Ocean Beach. The signs have a map illustrating the borders of the protection area and remind visitors to keep dogs on leashes and to avoid disturbance of the plovers and other wildlife.

Survey Methods

A census is conducted by one or more surveyors by walking on the beach starting south of Sloat Boulevard and walking north to the Cliff House at Ocean Beach. At Crissy Field, the survey begins on the beach from east of the Torpedo Wharf to where the beach ends east of the Crissy Marsh inlet. At Ocean Beach, surveyors may want to leave a vehicle at the north parking lot for the beach before the survey and shuttle a second vehicle to the second overlook parking lot, catch a bus or ride a bike to Sloat Boulevard to avoid having to walk back to the starting point after the census. For Crissy Field, it is fairly easy to walk the entire beach and then walk back.

Typically, censuses are conducted by two or three observers. The surveyors should consist of at least two counters in the beginning of the study or while counters are still gaining experience with surveys. The surveys are always led by the intern or Wildlife Ecologist. With more experience and expertise, one person can cover the census areas (note that this option is restricted to one of the NPS staff). New volunteers should accompany experienced counters while they are learning techniques.

At Ocean Beach, the survey group will meet at the south end of the survey area, and at Crissy Field the group will meet on the beach just east of the Torpedo Wharf. The NPS lead should make sure everyone has the required equipment and clothing for weather conditions, as well as reminding everyone about safe work practices before starting the survey. Observers should fill out the headers of data sheets and collect weather information using the Kestrel™ Weather Meter immediately before the survey.

Observers record the time of the start of the survey, and the start time for each subsequent sector count. The amount of time spent in each sector is recorded so that encounter rates can be calculated. Each census area is broken into sectors based on landmarks, with Ocean Beach divided into 14 sectors and Crissy Field divided into four sectors (Appendix SOP 1A). For Ocean Beach only, the survey is broken into southern (sectors 8–14) and northern (sectors 1–7) halves, with separate data sheets for each half, and observers taking a second set of weather data before the starting the northern half of the beach.

At Ocean Beach the survey group starts at the south end of Sector 14 and walks north on the beach to Sector 1, and at Crissy Field the group starts at Sector 1 east of the Torpedo Wharf and walks east to the end of Sector 4. At Ocean Beach, the south end of the beach may be impassable at higher tides. In this situation, observers should conduct the survey from the roadway above the beach, which affords views of each sector; sectors which are covered in this manner should be noted on the data sheet. Surveyors should return to the beach where it can be safely accessed. Surveyors count and record data on snowy plovers, people, dogs, and other potential sources of disturbance, and shorebirds, ravens, and raptors for each sector.

Observers should stop every 160–500 feet (50–150 m) to scan the entire beach in front of them for 325–650 feet (100–200 m) for plovers. The nature of the beach habitat (amount of kelp, surf grass, other debris, foot prints, etc.) and type of optics (binoculars and/or spotting scope) will determine how far ahead surveyors will be able to search effectively for plovers. Unless the plovers are feeding, they will probably be sitting in or above the current high tide line in footprints or amid beach wrack. They can be surprisingly difficult to see because they are cryptic when roosting.

Surveyors should count the number of birds in a flock from where they were first seen and then walk around to obtain counts from other vantage points until all birds have been documented. Observers should attempt to verify the maximum count of plovers, by recounting and checking with other observers. Surveyors should be cautious to not flush birds since this will complicate counting. Be particularly careful of disturbance when approaching roosting birds closer than 50 feet (15 m).

Surveyors count all plovers encountered on the beach. The number and direction of flying groups of plovers is recorded, with birds flying from behind to in-front of observers subtracted from census totals as they should have already been counted and birds flying from in-front to behind the observers retained in the total count. Each individual or group of snowy plovers should be recorded on a separate row on the data sheet indicating the sector number, time, number of snowy plovers in the group, and whether they are foraging or not, location on the beach, and beach substrate conditions. Banded plovers will be noted (see below). Where the beach is narrow enough to be well-viewed from a central position on the slope, observers should walk along the beach at an elevation that allows viewing the entire width of the beach. In areas of wider beach two observers can walk the upper and lower beach simultaneously; single observers will have to weave between the upper and lower beach.

Recording Snowy Plover Data

Data collected include the number, activity, and location of plovers in each sector (see data sheets in Appendix SOP 1B).

Recording Disturbance Data

Tracking actual and potential sources of disturbance to snowy plovers (and other shorebirds) is a management objective for the program. Collecting disturbance data is best done by a surveyor who is not also counting plovers so they can focus on disturbance data only. The surveyors work together to collect the disturbance event data (e.g., when shorebirds are chased by dogs).

Observers record the following data, by sector, the number of:

- people
- dogs, tallied by whether dogs are:
 - on-leash,
 - off-leash within 10 feet of their owner,
 - roaming (where dogs are observed more than 10 feet from their owner),
 - chasing shorebirds,
 - chasing plovers (the number of plovers that were disturbed also is recorded)

Other potential disturbance sources are recorded, by sector, including the number of:

- equestrians
- vehicles
- ravens and raptors, including their behavior (perched, flying, attacking birds, or attacking plovers)
- aircraft, helicopters, and kites flying within 1,000 feet of the beach (see Data Sheet Appendix SOP 1B).

Observed disturbances to plovers are recorded, by sector, including the number of:

- plovers disturbed
- the agent of disturbance

Dogs are only counted once in the category of greatest potential for disturbance it exhibits (e.g., if a dog is counted as leashed and its owner removes the leash, the dog's status is changed to unleashed).

Recording Shorebird Data

The park is also interested in identifying other shorebird species that are using Ocean Beach and Crissy Field. This data can be easily collected during snowy plover surveys. Shorebirds on the beach are counted in each sector. To avoid double-counting shorebirds that fly by observers, observers use similar methods as previously described for snowy plovers. A separate data sheet is used (see Appendix SOP 1B) to track shorebirds species other than snowy plovers. The most common shorebirds observed on census areas include: sanderlings, willets, marbled godwits, Heermann's gulls, western gulls, and ring-billed gulls.

Monitoring Schedule

Snowy plover censuses are conducted from July to mid-May. At the beginning of the monitoring season, the intern will develop a monitoring schedule for the season. Counts are conducted on Wednesday mornings and Saturday afternoons, every other week (total of four surveys per month). The Wednesday surveys are designed to capture potentially lower levels of recreational use of the beach and plovers in a less disturbed state, and the Saturday counts the potential for observing the highest levels of recreational use, though on nice weather days large numbers of people typically use the beach regardless of the day of the week.

The Wednesday morning survey should end by noon. The Saturday surveys should start after noon and be completed by at least two hours prior to sunset. This schedule will result in counts being done under a variety of tidal conditions and most likely result in variability in the activity of the plovers rather than their numbers. During surveys on high-use days when disturbance rates are higher, plovers may use areas or elevations zones of the beach not typically observed under lower disturbance conditions.

Missed surveys will be made up on the same day and time the following week, returning to the regular schedule. The goal is to conduct surveys over the entire seasonal period with no significant gaps. To maintain some degree of independence among the censuses, there should be at least two days between surveys of the same kind (i.e., do not skip one weekend and conduct surveys on Saturday and Sunday both days of the following weekend).

Time Required

The Ocean Beach survey should take the survey group from two to three hours to complete, but total time will depend on the logistics used by counters to return to vehicles or public transportation. The Crissy Field survey typically takes one and one half hours to complete.

Special Circumstances

Inclement Weather

The survey group will not begin a survey in adverse weather conditions. Adverse conditions include winds that blow sand above knee level, precipitation greater than a mist, or visibility less than 160 feet (50 m). It may not be possible to obtain reliable field data under adverse weather conditions, and snowy plovers may be more difficult to detect. Blowing sand impedes visibility and moisture limits effectiveness of (and may damage) optical equipment. If adverse conditions arise during survey, surveyors should attempt to wait until these conditions clear. If these conditions do not clear, the surveyors will have to judge whether or not they can obtain a reasonable survey by continuing. With experience, surveyors will be able to obtain accurate results under more adverse conditions, although it may be necessary to spend more time moving between the upper and lower beach to ensure that all areas are covered. Surveys that are aborted before completion should be clearly marked on the data sheet, as they do not constitute a complete census of the beach. Data collected from incomplete surveys are not used in analysis or reporting. See Monitoring Schedule section above for making up an aborted survey.

Reading Bands

Color-banded plovers from other monitoring sites can occur at both Ocean Beach and Crissy Field. Snowy plovers have occasionally been banded at Ocean Beach and Crissy Field to track individual plovers in relation to oil spill incidents. Most recently, color banding of snowy plovers occurred at both Ocean Beach and Crissy Field following the Cosco Busan oil spill in November 2007.

Observations of color-banded snowy plovers are recorded on the data sheets (and should be reported to Lynne Stenzel at Point Blue Conservation Science (lstenzel@pointblue.org)). Reading color bands accurately on snowy plovers can be difficult, and observers should not spend undo time or risk disturbing roosting plovers to deliberately read color bands.

Colored bands are recorded first for the bird's left leg, then right leg. Legs may have more than one band and bands may have more than one color. Record colors from top to bottom for each leg. If there are three colors on a band, the top and bottom color will be the same with a thin contrasting strip in the center. Colors on a single band should be separated by a slash (/); a colon (:) separates the left leg color code from the right. Potential colors include Aqua (light blue), Blue (royal blue), Green, black, brown, N, Lime (celery color), Orange, Pink, Red, Silver, Violet, White, Yellow, Dark (color undistinguishable). For example, a bird with a single band on the left leg, a yellow leg band with a thin red strip around the center of the band, and two bands on the right leg, a white band over a green band, would be recorded as Y/R/Y:WG. In some shorebirds, there also may be a flag on one of the bands, but flags have not been used with snowy plovers. See Appendix SOP 1C for an illustration of leg band colors and examples.

Injured Wildlife

Occasionally, surveyors may find injured wildlife during the fieldwork. Injured wildlife that has been noted on previous beach surveys includes gulls with broken wings or fishhooks in their bills, diseased western grebes (*Aechmophorus occidentalis*), willets, brown pelicans (*Pelecanus occidentalis*) and stranded pinnipeds. If there is a bird that is injured due to direct human causes, such as an embedded fishhook, is in a highly visible location, or is at risk from dogs, the surveyors are advised to call GOGA park dispatch at 415-561-5505. Stranded pinnipeds are reported to the Marine Mammal Center rescue line (415-289-SEAL). Wildlife carcasses identified to species or taxa are recorded when they are in the microhabitat being used by plovers, and otherwise can be recorded in the comments on the plover data sheet by sector. The surveyors in the Gulf of the Farallones National Marine Sanctuary Beach Watch program count and mark dead wildlife on Ocean Beach during bi-weekly (once every two weeks) surveys.

Field Season Closeout

Equipment

At the end of the field season, equipment should be inspected. If new equipment is needed before the next field season, purchases should be coordinated with the Project Lead. All equipment should be stored in the wildlife storage room in Building 1063 and labeled as the snowy plover equipment. Typically, most of the equipment is stored in a large gray plastic cargo box.

Data Archiving

Data sheets should be reviewed and organized chronologically in a folder for the year. Once all data has been entered into the database and quality assurance completed, these folders will become part of the NPS archives at GOGA.

Appendix SOP 1A. Ocean Beach and Crissy Field census areas.

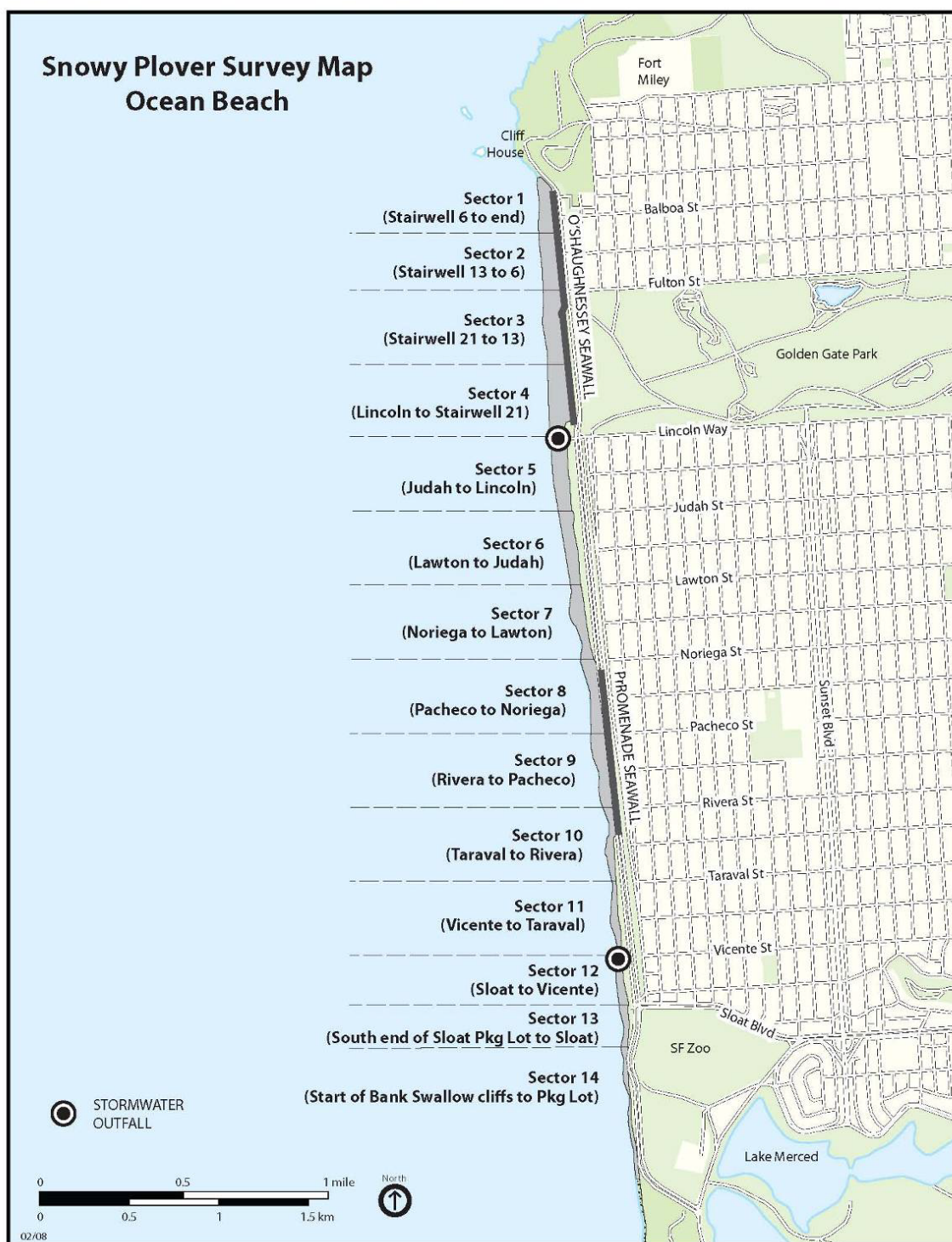


Figure SOP 1A.1. Snowy plover census area at Ocean Beach, San Francisco. The Snowy Plover Protection Area extends from Stairwell 21 in the north to Sloat Blvd. in the south (Sectors 4–12).

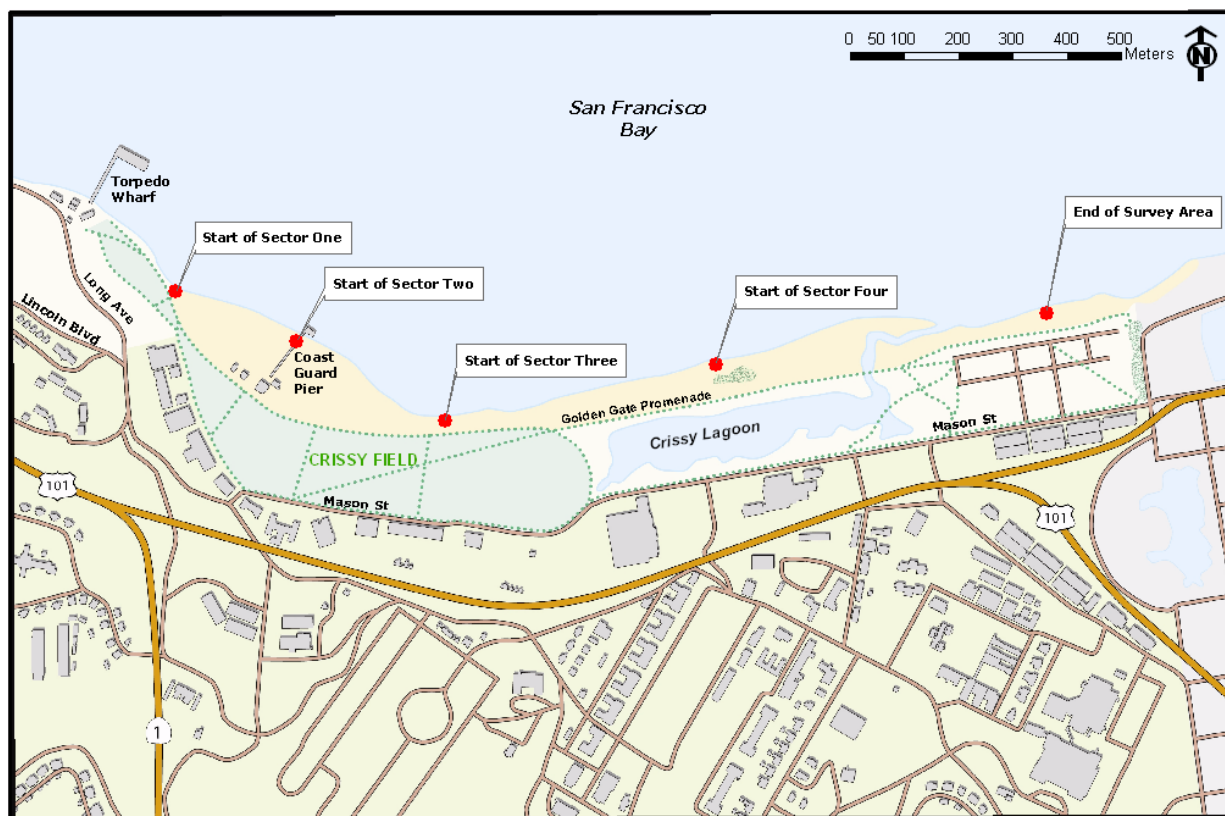


Figure SOP 1A.2. Snowy plover census area at Crissy Field, San Francisco.

Appendix SOP 1B. Data sheets and instructions.

Snowy Plover Census Data Sheet

Location (Circle): Ocean Beach ---- Crissy Field

DATE (mo/da/yr) _____ DAY OF WEEK _____ OBSERVER(S) _____ PHONE _____

NORTH OR SOUTH HALF OF BEACH (circle one) _____ TIME: _____ TO _____

WIND: Average _____ (mph) Max _____ (mph) TEMP _____ (F) rH _____ (rel. humidity) CLOUDCOVER ____/8

OTHER WEATHER NOTES (visibility, precip., changes): _____

TIDE: (circle) HI-SLACK FALL LO-SLACK RISE HT AT START: _____

SNOWY PLOVER GROUPS ON THE GROUND:

TIME	SECTOR	SNPL #	ACT	ZN	MICRO	NOTES (substrate relief, color bands—keep tally of number of plovers you were able to check for bands)

ACTivity=NOT FEEDING OR FEEDING

ZN=zone: 1=BELOW CHTL, 2=IN CHTL, 3=BETWEEN CHTL AND OHTL, 4=IN OHTL,
5=ABOVE OHTL (CHTL=CURRENT HIGH TIDE LINE, OHTL=OLD HIGH TIDE LINE)

NOTES: **CODES FOR MICROHABITAT DESCRIPTION:** SUBSTRATE CHARACTERISTICS: sand=S, coarse sand, shell, pebble, rock=R, seaweed or kelp=K, washed up debris or trash from beach visitors=T, vegetation or sand at the base of vegetation=V, carcasses=C (specify) // **SUBSTRATE RELIEF:** smooth to gently undulating=E, with human/dog foot prints=P, with horse prints=H, with vehicle tracks=A

CODES FOR BAND COLORS: Aqua (light blue), Blue (royal blue), Green, black K, Lime (celery color), Orange, Pink, Red, Silver, Violet, White, Yellow, brown N, Dark (color undistinguishable)

Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area: Version 2.4

FLYING SNOWY PLOVER GROUPS:

TIME	SECTOR	SNPL #	DIR	NOTES (indicate if included above)

(FLIGHT) DIRection: north=N, south=S

TOTAL SNOWY PLOVERS FOR THIS HALF OF BEACH: ____ (OR CHECK HERE IF NONE SEEN ____)

☐ CHECK BOX IF THIS WAS AN **INCOMPLETE** SURVEY

Snowy Plover Disturbance Data Sheet

Location (Circle): Ocean Beach _____ Crissy Field _____

DATE (mo/da/yr) _____ DAY OF WEEK _____ OBSERVER(S) _____ PHONE _____

NORTH OR SOUTH HALF OF BEACH (circle one)

HUMANS AND DOGS

TIME	SCT	NOP	L	U	R	C	P	NO	HR	VH	OTHER NOTES

SCT=sector

NOP=number of people (no surfers); circle total in each sector

NUMBER OF DOGS: **L**=leashed, **U**=unleashed, staying within 10 feet of owner, **R**=roaming, **C**=chasing birds other than SnPls, **P**=chasing SnPls

NO=number of SnPls disturbed (if this is filled in, use single line to indicate agent of deliberate or inadvertant disturbance)

HR=number of horses **VH**=number of vehicles

NOTES: including owners reaction to chasing dogs (e.g., unaware, indifferent, encouraging), types of vehicles (including rangers, heavy equipment)

COMMON RAVEN/RAPTOR ACTIVITY DIRECTLY OVER/ON BEACH:

TIME	SECTOR	SPECIES	NUMBER	ACT	NOTES

(RAPTOR) ACTivity: perched=**P**, perched & appears to be hunting=**H**, flying in area, not actively hunting=**F**, flying north, not actively hunting=**N**, flying south, not actively hunting=**S**, stooping on or otherwise attacking birds=**B**, stooping on or otherwise attacking snowy plovers=**A**

RECORD HERE AIRCRAFT, HELICOPTERS, OR KITEFLYING WITHIN 1000 FEET OF BEACH:

(what, how many, where):

Shorebird/Snowy Plover Leg-Band Combination Data Sheet

Location (Circle): Ocean Beach ---- Crissy Field

DATE (mo/da/yr) _____ DAY OF WEEK _____ OBSERVER(S) _____ PHONE _____

NORTH OR SOUTH HALF OF BEACH (circle one)

SHOREBIRD COUNTS

TIME	SECTOR	WILL	SAND	MAGO	HEER	WEGU	RBGU	OTHER (Note species and number)

COLOR-BANDED SNOWY PLOVERS:

TOTAL # SNOWY PLOVERS	TOTAL # SNOWY PLOVERS CHECKED FOR BANDS	NUMBER OF BANDED PLOVERS	NOTES

SNOWY PLOVER BAND COMBINATIONS

TIME	SECTOR	COLOR BANDS LEFT LEG	COLOR BANDS RIGHT LEG	NOTES

CODES FOR BAND COLORS: Aqua (light blue), Blue (royal blue), Green, black, Lime (celery color), Orange, Pink, Red, Silver, Violet, White, Yellow, brown, Dark (color undistinguishable)

Instructions for Completing the Survey Forms for Snowy Plovers, People, Dogs, Aircraft, and Raptors



Forms and Tables

There are four different data tables on this two-page form that must be filled out for each survey. Fill out the top of each page and enter data into each of the four tables, which record:

- Observations of snowy plover groups on the ground
- Observations of flying snowy plover groups
- Observations of humans, dogs, horses, and vehicles
- Observations of avian predators

(Additional lines at the bottom of human/dog/raptor page for aircraft flying over beach.)

Filling Out the Top of the Form

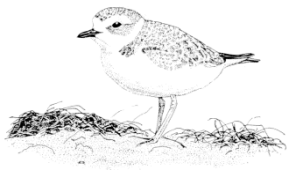
- Be sure to circle the beach surveyed, and always fill in the **DATE**, **OBSERVER(S)** name(s), **PHONE** (number of the observer that should be called in case there are questions), **HALF OF THE BEACH** covered (circle one), **TIMES** (beginning and ending), **WIND**, **TEMPERATURE**, **RELATIVE HUMIDITY**, **CLOUD COVER**, and other weather notes.
- Record **WIND** on the following Beaufort scale, code with **negative sign if coming off the land** (out of the east). Use weather meter (Kestrel brand) if available and record Beaufort scale:

Beaufort Scale	MPH	Description
0	<1	CALM: smoke rises vertically; leaves do not stir
1	1–3	LIGHT AIR: smoke drifts; wind vanes do not respond
2	4–6	LIGHT BREEZE: wind is felt on face; leaves rustle; light flags not extended; wind vanes respond
3	7–10	GENTLE BREEZE: light flags extended; leaves in constant motion
4	11–16	MODERATE BREEZE: most flags extend fully; small branches move; dust and loose paper may be raised
5	17–21	FRESH BREEZE: small trees in leaf sway; tops of tall trees in noticeable motion
6	22–27	STRONG BREEZE: large branches in motion; whistling heard in wires
7	28–33	MODERATE GALE: whole trees in motion; inconvenience felt when walking against wind
8	34–40	GALE; twigs broken off trees; generally impeded progress on foot; field work probably not possible in these winds

- Other weather notes should include exceptionally cold or hot ambient temperature, low dense fog that moves in during survey, precipitation, and any other weather condition which might limit visibility or affect plover behavior.
- **TIDAL INFORMATION** is obtained from the appropriate NOAA Tides and Currents website. These data are currently available for Ocean Beach ([StationId: 9414275](#)) and Crissy Field ([StationId: 9414290](#)).

From the NOAA web sites determine the tide height at the start of the survey by clicking on the tide graph at the beginning time for the survey. This value is entered as the Height at Start. Then determine if the tide is rising, falling, or slack by clicking on the tide graph at the beginning and end time of survey. Look to see if the chart shows the tide rising, falling, or slack. This value is entered as the Tide Flow. The Tide Type (low, medium, or high) is autogenerated by the database. A Medium tide is defined as >2.5 and ≤ 4.0 feet at the start on a falling tide or >1.5 and ≤ 2.5 feet on a rising tide; Lows fall below and Highs above the defined mediums. For slack tides, a Medium tide is defined as >1.5 and ≤ 4.0 feet at the start; Lows fall below and Highs above the defined mediums for slack tides.

- Fill in "page ____ of ____" so we know that all the data are present.



Filling in the Survey Tables

Ocean Beach sectors (**SEC**) are numbered 1–14. Surveys of the north half of Ocean Beach start from sector 7 at Noriega Street to sector 1 near the Cliff House ($1.8 \pm$ miles). Surveys of the south half of Ocean Beach go from sector 8 at Noriega Street to sector 14 at the bank swallow colony ($1.9 \pm$ miles). Sectors 13–14 are often impassable at high tide or when the beach is narrow during the winter. At Crissy Field, survey starts at Sector 1 east of the Torpedo Wharf and continues east to the end of Sector 4.

Counts of Snowy Plovers on the Ground

Use at least one line for each sector of beach and record the time (under **TIME**) you begin the sector. Under **SNPL#** record each distinct group on a separate line. For example, if in a single sector you see feeding plovers below the current high tide line and sitting plovers both in the current high tide line and between the current and old high tide line, you will require three lines to record the data for that sector. Record "0" if you see no plovers. The time you finish the last beach sector will be recorded on the top of the form under "**TIME ____ TO ____**".

At the bottom of the page, total the number of plovers you counted (do not count flying birds that have otherwise been counted) or check if you did not encounter any plovers. This ensures that you check to make sure that your data makes sense before you hand it in. It also provides a double check for the person doing data entry, and indicates when a lack of data is not a mistake.

If the beach becomes impassable or if the survey is aborted for any other reason, note the time and location and write the reason in the notes column.

Codes for **ACT**ivity, **ZONE**, and flight **DIR**ection are given under the tables on the survey form. If you see another activity, write a description of the activity in **NOTES**.

Color Bands

Although you should not spend undo time or risk disturbing roosting plovers to deliberately read color bands, you should survey and report them under **NOTES**. Potential colors include red, dark (royal) blue, light blue, bright green, light pale green, yellow, white, orange, pink, purple, and black.

Bands are read as the bird's left leg followed by the bird's right leg, top colors before bottom colors. Separate the colors on the left and right leg with a colon. Two or three colors on a single band are separated by slashes. For example, a bird that has single bands on each leg, yellow on the left leg band with a thin red strip around the center of the band and white on the right leg band, would be Y/R/Y:W. A bird with two bands on each leg, a white band over a green band on the left and a yellow band over a red band on the right, would be WG:YR. A bird that has single bands on each leg, yellow on the left leg band and pink over blue on a single band on the right leg, would be Y:P/B. Also note that sunlight can fade color bands making them more difficult to read.

Microhabitat

You should indicate characteristics of the microhabitat being used by the plovers under **NOTES**; microhabitat codes are given under the table. Microhabitat description should include **substrate characteristics** (sand=**S**; coarse sand, shell, pebble, rock=**R**; seaweed or kelp=**K**, washed up debris or trash from beach visitors=**T**; vegetation or sand at the base of vegetation=**V**; carcasses=**C** (specify)) and **substrate relief** (smooth to gently undulating=**E**; with human/dog footprints=**P**; with horse prints=**H**; with vehicle prints=**A**).

Counts of Flying Snowy Plover Groups

Note all flying plovers **except** those that fly from behind you, where you have already counted them, to in front of you where they are still visible. If plovers fly from behind you to ahead of you, note them here so you will remember not to count them again if they land ahead and you encounter them again.

Plovers flying in the direction observers are walking will be subtracted from, while those flying in the opposite direction will be added to the total for the entire beach. If you record a group of birds flying first one direction and then the same number flying the opposite direction, you can line out your first entry and enter the time of the opposite flight to the left of the line.

TIME is the time you first observe the group of flying plovers.

Observation of Humans, Dogs, Horses, and Vehicles

Give the time that you begin each sector. On the last line of your form, write the time you finish your last sector. These times should correspond to those on the accompanying plover survey. Use a hand-held tally to count people, especially on weekends. Don't forget to zero the counter at the start of each sector.



Codes

NOP=number of people. Do not include surfers in your count of people unless they are walking on the beach (they sometimes leave their dogs on the beach while they are in the water). Do not count any group of people or dogs or any horses or vehicles more than once. Record their beach sector only the first time they are encountered.

Codes for dog counts: **DL** (leashed dog), **DU** (unleashed dog staying within 10 feet of owner), **DR** (dog roaming), **DC** (dog chasing birds), **DP** (dogs chasing plovers) are given under the tables. **NO**=number of plovers **disturbed** by people or dogs (see next point for entering cases in which **NO**>0. **HR**=number of horses. **VH**=number of vehicles.

Provide human and dog totals for each beach sector. Enter on separate line any cases in which there is any entry under **DC** or **DP** or if humans or non-chasing dogs disturb plovers, and indicate the number of plovers disturbed under **NO** (so we can tell what it was that disturbed each group of plovers). Otherwise, **NOP**, **DL**, **DU**, **DR**, **DC**, **DP**, **HR**, and **VH** may be combined for each sector. Also, if people are particularly numerous, use more than one line for each beach sector. Counters may use tick marks or other means to tally individuals, but write in and circle the grand total for each sector. If no people are observed in a sector, write 0 (zero) under **NOP**. Blanks under the dog categories are taken to mean zero.

What to include under **NOTES**:

- details about any plover disturbances you observe
- horses (elevation on beach)
- vehicles (type, number, elevation on beach)
- notable activities of people (for example, throwing stones at birds, kite flying)
- type (plane, helicopter or other, specified), altitude, direction, and time of aircraft
- traffic over beach

Observations of Raptors (Avian Predators)

Possible raptors include peregrine falcon (species code PEFA), merlin (MERL), American kestrel (AMKE), Cooper's hawk (COHA), sharp-shinned hawk (SSHA), red-tailed hawk (RTHA), red-shouldered hawk (RSHA), and northern harrier (NOHA). You should also record observations of any other species of hawk, falcon, or owl. In addition, record sightings of common ravens (CORA) which plovers might perceive as threats.

ACTivities are shown below table. Raptor activities include perched=**P**; perched and appears to be hunting=**H**; flying north, not actively hunting=**N**; flying south, not actively hunting=**S**, stooping on or otherwise attacking birds=**B**; stooping on or otherwise attacking snowy plovers=**A**. If you observe another activity, write a description of the activity in **NOTES**.

Observations of Aircraft, Helicopters, and Kites

Record only those aircraft within 1,000 feet of the beach and kites flying over the beach. Record the type, the number observed, and location on the line provided at the bottom of the form.

Other Notes

Avoid crowding the front of the forms with additional information as it complicates data entry. If you want to make other field notes, such as narrative descriptions, categories of human activity (which would be useful; e.g., fishing, walking, surfing, etc.), numbers of other species of birds, etc., use the blank back of the form or a separate sheet of paper.

Important Reminders about Snowy Plover Censuses



1. The **absence** of plovers, dogs, or people when you are conducting a survey **is also data**. Record data for **each sector**, whether or not you find plovers, dogs, or people. Be sure to record the time that you begin each sector. If you do not cover a sector due to weather or extreme erosion that has removed the sand from the beach, clearly state that for the sector so that we can differentiate absence of plovers from your inability to complete sectors.

2. Someone will be transcribing your field notes into computer data files. So....

- Please write legibly in dark ink.
- Keep the front of your form neat. If you make an observation that does not fit onto the form, write it out on the back of the data sheet or attach an additional sheet of paper. Please mention your addition in the notes column of the data form.
- Clearly indicate the total number of plovers (or dogs or people) for each sector by neatly **circling the total**. This is particularly important if you tally your results in the field as you go. This will help the data-entry person differentiate between, for example, 2 tic marks that total 2 and the number 11.

3. Do not record the same individuals (plovers, people, or dogs) more than once. So, for example, if people are moving ahead of you while you survey, record them only in the first sector in which you see them.

4. Record snowy plover band combinations carefully. Read the field instructions on band reading and recording color combinations. All bands should be on the lower leg segment in snowy plovers, but some shorebirds have bands on the upper leg. Upper leg bands are reported the same way as lower leg bands. Record the bird's left leg color first, right leg color second. Record top colors before bottom colors. If there is more than one color on the band, separate colors with a slash (/).

For example: You are face to face with a color banded snowy plover, so you read the right color (the bird's left leg) first, then the left color (on the bird's right leg). On the bird's left leg, there is a light blue band over a dark blue band. On bird's right leg is a red band over a light blue band. Checking the color band reminder sheet to obtain the codes for the different colors, you will record this bird's bands as: AB:RA

Another example: You are looking at the back of a bird that has one band on each leg. Therefore, the left color (true green) is the color on the bird's left leg. The band on the right leg is a light (celery-colored/lime) green on the top and bottom, with a thin strip of red around the center. You will record this as: G:L/R/L

5. Remember that the way plover and dog activities are recorded is different. **For plovers record the behavior in which you first observe plovers engaged**. For example, if you first see them roosting but as you pass them they stand up and start feeding, they should be recorded as roosting. **For dogs**, we are documenting the extent to which they affect snowy plovers. Therefore, you **record the most extreme behavior observed**. If you first observe a dog walking along side its owner, but later it

breaks into a run to chase birds, you should record the dogs as chasing. Remember that a dog may not be near any birds while it is under observation and so even the most persistent bird-chaser may not be recorded as such by us. Feel free to add notes (if extensive, they should go on the back of the page) if you observe more detailed behavior on dogs or people. (For example, you may record a dog as roaming but add in the notes that it passed a flock of feeding birds without chasing. If an owner calls back a chasing dog or encourages a dog to chase birds, that should also be noted.)

6. The best data will be obtained if the plover censuser and the human/dog censuser work as a team. The person that records humans and dogs will usually be more busy writing than the person that is recording plovers. It is easy to miss disturbance events or interactions between humans or dogs and plovers. Therefore, it is helpful if the plover censusers alert the human/dog censusers when they see a disturbance or interaction.

7. Be sure that the survey coordinator checks your data sheet with you before you leave for the day. Please return any borrowed equipment at the end of each survey.

Appendix SOP 1C. Leg bands.

This appendix describes the snowy plover leg band combinations used in the region. It is useful to have the band color list in the field until a surveyor becomes familiar with the different colors and can read bands with certainty.

Color-banded plovers from other monitoring sites can occur at both Ocean Beach and Crissy Field. Color banding of snowy plovers occurred at both Ocean Beach and Crissy Field following the Cosco Buisan oil spill in November 2007. Observations of color-banded snowy plovers are recorded on the data sheets (and should be reported to Lynne Stenzel at Point Blue Conservation Science (lstenzel@pointblue.org). Reading color bands accurately on snowy plovers can be difficult, and observers should not spend undo time or risk disturbing roosting plovers to deliberately read color bands.



Figure APP SOP 1C.1. Leg band colors used in Northern California for western snowy plovers. Not shown in this list, Brown (N) is also used on coastal plover populations and is usually a tan color rather than a dark brown.



Figure APP SOP 1C.2. Example of the band locations on a banded bird.

In figure APP SOP 1C.3, the bird has a yellow band (Y) above a red band (R) on its left leg and a blue band (B) above an aqua band (A) on its right leg. This combination should be recorded as YR:BA. Some plovers marked in Monterey Bay have a color band on the upper left leg, which make them more difficult to see. The data is recorded the same way, but observers should note that it is an upper leg band.

Literature Cited

U.S. Fish and Wildlife Service (USFWS). 2007. Recovery Plan for the Pacific Coast Population of the western snowy plover (*Charadrius alexandrinus nivosus*). In 2 volumes. Sacramento, California.

There are different color combinations and both solid and striped color bands. Options include:

- (1) a bird with a single band on each leg, yellow on the left leg band with a thin red strip around the center of the band and white on the right leg band, would be recorded Y/R/Y:W;
- (2) a bird with two bands on each leg, a white over a green band on the left and a yellow over a red band on the right, would be recorded WG:YR;
- (3) a single band on each leg, yellow on the left leg and pink over blue on a single band on the right leg, would be recorded Y:P/B.

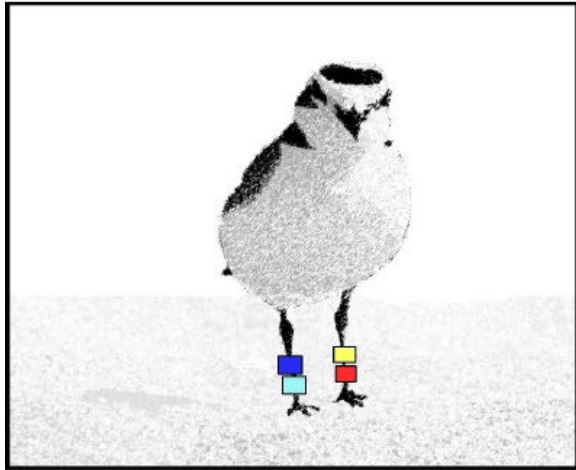


Figure APP SOP 1C.3. Example of a banded snowy plover (YR:BA). *Source:* USFWS 2007.

SOP 2. Field Safety

Version 1.1

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
	Jan. 2011	D. Adams, M. Koenen	Adapted from PORE Protocol	Greater emphasis on safety procedures	1.0
1.0	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		1.1

Overview

This SOP provides safety information related to monitoring snowy plovers at GOGA. Safety during all aspects of program implementation is a primary concern. To this end, program leads will review the Job Hazard Analysis (JHA; Appendix A) with new and continuing plover surveyors. The JHA analyzes the duties, tasks, and potential hazards that are associated with the activities and addresses the hazards through safe work behaviors and procedures. Risks inherent in the program, safe work practices, and contact information for emergencies are emphasized. Also see SFAN Field Safety SOP maintained on the network drive: X:\Shared\Standard Operating Procedures\SFAN Field SOPs\Standard Operating Procedures.

General Safety Considerations

Summer temperatures are often mild (60–80°F), but when conducting fieldwork along the coastal environment, it is important to dress appropriately for a range of weather conditions. Because sharp and potentially injurious debris may be partially or totally buried in the sand, observers should wear sturdy footwear. Since surveys can last longer than anticipated, field personnel are encouraged to take extra food and drinking water into the field.

Though permitted in national parks, guns may not be carried by staff, interns, or volunteers during surveys. In case of emergency contact either 911 or the GOGA Ranger Dispatch Office: (415) 561-5656.

Field Hazards

During surveys, observers should always be aware and stay out of the surf. Large waves occur irregularly and can wash much farther onto the shore than then the waves immediately before them. Any wave may carry heavy logs or objects that could knock over a person.

Biting or stinging invertebrates (wasps, spiders, ticks) may be encountered. The bites or stings from these animals can be painful, but usually not fatal. If bitten or stung and painful swelling or an allergic reaction occurs, seek medical attention immediately. Check your clothing and exposed skins

frequently when in the field for ticks and upon returning from the field, do a more thorough body search for ticks.

Poison oak is found in primarily in the forest, but before doing any fieldwork personnel should become familiar with the dangers associated with exposure to this native plant. If exposure occurs wash thoroughly with soap and rinse with plenty of water upon returning from the field and then apply Tecnu® ointment. If a strong reaction occurs, contact your supervisor and seek medical attention.

Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area: Version 2.4

Golden Gate National Recreation Area Job Hazard Analysis	Project Title: Western Snowy Plover Monitoring	Analysis by: Rachel Townsend Date: 10/30/08
Division: Natural Resources	Title of person who does job: Bio-Technician-Wildlife, Intern, Volunteers	Reviewed by: Bill Merkle, GOGA Wildlife Ecologist
Location: Golden Gate NRA	Supervisor: Bill Merkle	Approved by:
Personal Protective Equipment: Long-sleeved shirt, thick pants, good walking shoes, hat, sunglasses and sunscreen		Permits: none needed.
Training and/or certifications: None required; first aid and CPR encouraged.		
A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Identify steps and sequence of work activities	Task: Identify hazards in each basic step. Site: Identify site hazards that could affect workers	Determine specific controls and safe behaviors for each hazard.
Office Work- Computer use for email and data entry	Muscle and eye strain, repetitive stress injury	Proper posture and use of ergonomic furniture Take breaks every hour
Travel to Field Locations in Vehicle	Driving hazards such as accident	Use defensive driving techniques Expect oncoming traffic on one-lane roads in park Be alert for foggy conditions Obey traffic laws and wear seatbelt at all times Do not drive when fatigued, be familiar with route or prepare for unknown route Do not talk on cell phone while driving Do not put hot drinks on your lap Be familiar with the vehicle and its operation Check gauges, tires, wipers, fluids and replace when necessary Check vehicle has spare tires, jumper cable and jack with all parts.
Hiking to work areas in the parking lot, on the beach and visitor walkway	Getting lost or confused as a group Losing a crew member	Have map and compass and other navigational aids and know how to use them. Travel together Make sure both members of the team are aware of location

Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area: Version 2.4

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Identify steps and sequence of work activities	Task: Identify hazards in each basic step. Site: Identify site hazards that could affect workers	Determine specific controls and safe behaviors for each hazard.
		<p>Arrange meeting places and times—all crewmembers must wear a watch.</p> <p>Have a travel plan for each day and make sure it is understood by all crewmembers</p> <p>Stay in communication via radio or stay in sight</p> <p>Carry cell phone to call dispatch if necessary</p> <p>If injured, stay put and call dispatch.</p> <p>Carry a light source and extra batteries.</p> <p>In the event of a lightning storm, if near a vehicle, get entirely inside. If in the out of doors try to do the following: separate the group, get off ridge tops and away from trees or telephone/electric poles, get as low as possible and if possible lie on conductive material.</p> <p>If it is windy enough to forcefully blow sand and debris, try to get off the beach and away from hazard trees or lines.</p> <p>Be aware of ocean conditions, particularly in narrow sections of beach. During extreme high surf, certain sectors of beach may need to be surveyed from above or survey may be aborted altogether.</p> <p>Wear proper equipment and bring extra layers of clothing.</p> <p>Recognize the signs of hypothermia in yourself and others</p> <p>Carry and eat high-calorie foods, stay well-hydrated</p> <p>Have hat, sunscreen and sunglasses</p> <p>Recognize the signs of dehydration</p> <p>Take rest stops when needed (15 min per every 2 hours) and stay hydrated</p> <p>Pay attention to footing— plan ahead for the route to avoid steep, unstable terrain</p> <p>Use appropriate footwear, boots and socks.</p> <p>Prevent blisters and have blister treatments (moleskin, tape etc.) accessible.</p>
	Lightning storms	
	Wind storms	
	Large and/or sneaker waves	
	Exposure to cold, wet conditions	
	Exposure to heat and sun Overexertion and dehydration	
	Injuries due to hiking (aches, sprains and blisters)	
	Injuries due to falling (lacerations, broken bones, head injuries)	

Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area: Version 2.4

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Identify steps and sequence of work activities	Task: Identify hazards in each basic step. Site: Identify site hazards that could affect workers	Determine specific controls and safe behaviors for each hazard.
Working in the outdoors	Injuries due to carrying a heavy pack	<p>Pay particular attention to walking in areas where a lot of debris has washed up, there is unstable terrain, and in foggy conditions.</p> <p>Have first aid kit, stabilize injured person, treat for shock and know how to initiate rescue via radio</p> <p>Reduce pack weights when possible</p> <p>Pay attention to how you put your pack on (avoid twisting motions—get help or place pack on surface or against tree)</p> <p>Make sure your pack is properly fitted and balanced</p>
	Exposure to allergy causing plants and insects	Alert crew members to possible problems with allergens. Be alert for toxic plants and alert to common bee and wasp nesting habitat and activity—especially the person in front.
	Exposure to toxic plants	<p>Carry Benadryl, epi-pen or other anti-histamine</p> <p>Do not eat any fungi or plant unless you are 100% sure it is edible.</p> <p>Wear proper attire (long sleeved shirts and long pants) to avoid exposure to the sun, wind and fog.</p> <p>Do not drink any water unless it has been filtered, boiled or treated in some fashion</p>
	Improper nutrition due to inappropriate food choices	Wash hands when possible and carry hand cleaner Bring a variety of healthy, nutritious food that will give you good energy during travel and work. Do not rely on sugar snacks.
	Strange or aggressive human interactions	Terminate contact with visitor and leave the area, contact dispatch
	Aggressive or confrontational behavior from canines	Remain calm and do not run. Place pack in-between yourself and the dog, back up slowly while avoiding eye contact, contact dispatch
	Injuries due to dog bites	Cover face and ears with arms and curl up. Lie still and try not to scream. If a dog bites, try not to pull back. Seek immediate medical attention. If the dog's owner is known or present, find out if the dog's rabies vaccination is current. Report the bite to the dispatch and local animal control office.

SOP 3. Revising the Protocol

Version 1.4

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
	Oct. 2008	M. Koenen		Created	1.0
1.0	Dec. 2009	B. Merkle	Minor edits to text	Review for protocol submission	1.11
1.11	April 2010	D. Adams	Formatting	For protocol peer review	1.2
1.2	January 2011	D. Adams	Formatting; added NRPC notification to procedures	Response to peer review comments	1.3
1.3	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		1.4

Scope and Application

This standard operating procedure (SOP) explains how to make changes to the Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area narrative and accompanying SOPs and appendix, and tracking these changes. Each SOP or appendix, however, has its own revision history log to track changes. Observers asked to edit the protocol narrative, SOPs, or appendix need to follow this outlined procedure in order to eliminate confusion in how data is collected and analyzed. All observers should be familiar with this SOP in order to identify and use the most current methodologies.

This SOP also contains a table (Table SOP 3.1) listing the most current version of the protocol narrative and each of the SOP's. This will provide a single reference for ensuring that the most current documents are being used.

Also included in the appendixes are comments from protocol reviewer, responses to those comments, and approvals.

Protocol Revision Procedures

1. Every attempt was made to incorporate the most appropriate and current methodologies for collecting and analyzing data. However, all protocols require revision as new and different information and techniques become available. Necessary revisions should be made in a timely manner and appropriate reviews undertaken.
2. All revisions to the protocol require review for clarity and technical soundness. Small changes or additions to existing methods will be reviewed in-house by the SFAN program staff. However, if a complete change in methods is sought, an outside review is required. Regional and National Park Service (NPS) staff with familiarity in avian research and data

analysis may also be utilized as reviewers. Also, experts in avian research and statistical methodologies outside of the NPS will be utilized in the review process.

3. Document revisions and protocol versioning are recorded in the Revision History Log that accompanies the protocol narrative and each SOP. Changes should be logged only within the protocol narrative or SOP that is being revised. Version numbers increase incrementally by hundredths (e.g., version 1.01, version 1.02 ... etc.) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 ...). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.
4. Inform the Data Manager about changes to the protocol narrative or SOP so the new version number can be incorporated in the metadata of the project database. The database may have to be edited by the Data Manager to accompany changes in the protocol narrative and SOPs.
5. Post new versions on the internet and forward copies to all individuals with a previous version of the affected protocol narrative or SOP.
6. Inform Natural Resource Program Center so that the link to the protocol in the online series listing can be updated.

Table SOP 3.1. Current versions and dates for the Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area and accompanying SOPs and appendix.

Document Name	Current Version	Version Date
Snowy Plover Monitoring Protocol for Golden Gate National Recreation Area	2.4	October 2014
Appendix A.: Natural History	1.4	October 2014
SOP 1: Field Methods	2.3	October 2014
SOP 2: Field Safety	1.1	October 2014
SOP 3: Revising the Protocol	1.4	October 2014
SOP 4: Data Management	1.7	October 2014
SOP 5: Data Analysis, and Reporting	2.3	October 2014

Protocol Review

Reviewer Comments

An additional appendix will contain the Pacific West Region Protocol Review Checklist generated by the formal peer review process and the consolidated comments and responses from formal peer review.

SOP 4. Data Management

Version 1.7

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
		M. Koenen	Adapted to formatting standards for the NPS I&M Program	To meet NPS guidelines	1.0
1.0					1.1
1.1	Dec. 2008	D. Press	Completed Data Management section of SOP, including database description, data work flow, metadata, data archival, data distribution, QA/QC, and version control.	To meet NPS guidelines	1.2
1.2	Dec. 2008	M. Koenen	Split SOP 4 into two SOPs. SOP 4 (this document) covers data management and SOP 5 covers data analysis and reporting.	Easier to review and implement shorter, more focused SOPs.	1.3
1.3	Dec. 2009	B. Merkle	Reviewed and edited for protocol submission.	Some minor edits to make consistent with monitoring program and adding scanning of data sheets.	1.4
1.4	April 2010	D. Adams	Formatting	To meet NPS guidelines	1.5
1.5	January 2011	D. Adams	Typos and formatting	Response to peer review comments	1.6
1.6	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		1.7

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Data Management Overview

Two critical long-term goals of the San Francisco Bay Area Network (SFAN) Inventory and Monitoring Program (I&M) are to:

- integrate natural resource inventory and monitoring information into National Park Service (NPS) planning, management, and decision making
- share NPS accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives

For the snowy plover monitoring program at Golden Gate National Recreation Area (GOGA) to meet I&M Program goals, a detailed management plan is needed to ensure data quality, interpretability, security, longevity and availability.

This SOP describes how the monitoring protocol meets these data management objectives through database design, quality assurance and control measures, metadata development, data maintenance, data storage, and data archiving. Procedures for data handling and quality assurance/quality control for all monitoring protocols implemented by the SFAN monitoring program are described in the program's Data Management Plan (Press 2005) and in the National I&M Program's Data Management Plan (NPS 2008).

Database Design

SFAN will continue to use a relational Microsoft Access database for the GOGA snowy plover monitoring program originally designed in the winter of 2003–2004. The SFAN Data Manager developed the database by adopting core elements from an early version of the Natural Resource Database Template (NRDT) and building in several key data tables designed by Point Blue Conservation Science (PBCS) in DBASE III. Data for the 1994 to 2003 field seasons was entered into DBASE and subsequently imported into the new Microsoft Access database by the SFAN Data Manager. Data entry of new field data into the Microsoft Access database began during the 2004 season. Although the NRDT, an application developed by the National I&M Program, is currently in version 3.2, there are no plans to upgrade the database to conform to current NRDT standards.

The data in the snowy plover database are organized around survey events at Ocean Beach and Crissy Field. The survey or event data is related to counts of snowy plovers, potential disturbance sources (humans, dogs, etc.), select shorebird species, common ravens, other bird species of interest, and banded snowy plovers encountered during the survey. This data is collected according to defined beach segments located within the survey area, each of which is described within a locations table.

The last significant modification to the database occurred in April 2007 with the addition of shorebird count data, more efficient reporting of banded snowy plovers, and reorganization of the data entry form. The database is currently in version 2.00. Table relationships are displayed in Figure SOP 4.1 and a complete data dictionary is included as Appendix SOP 4A.

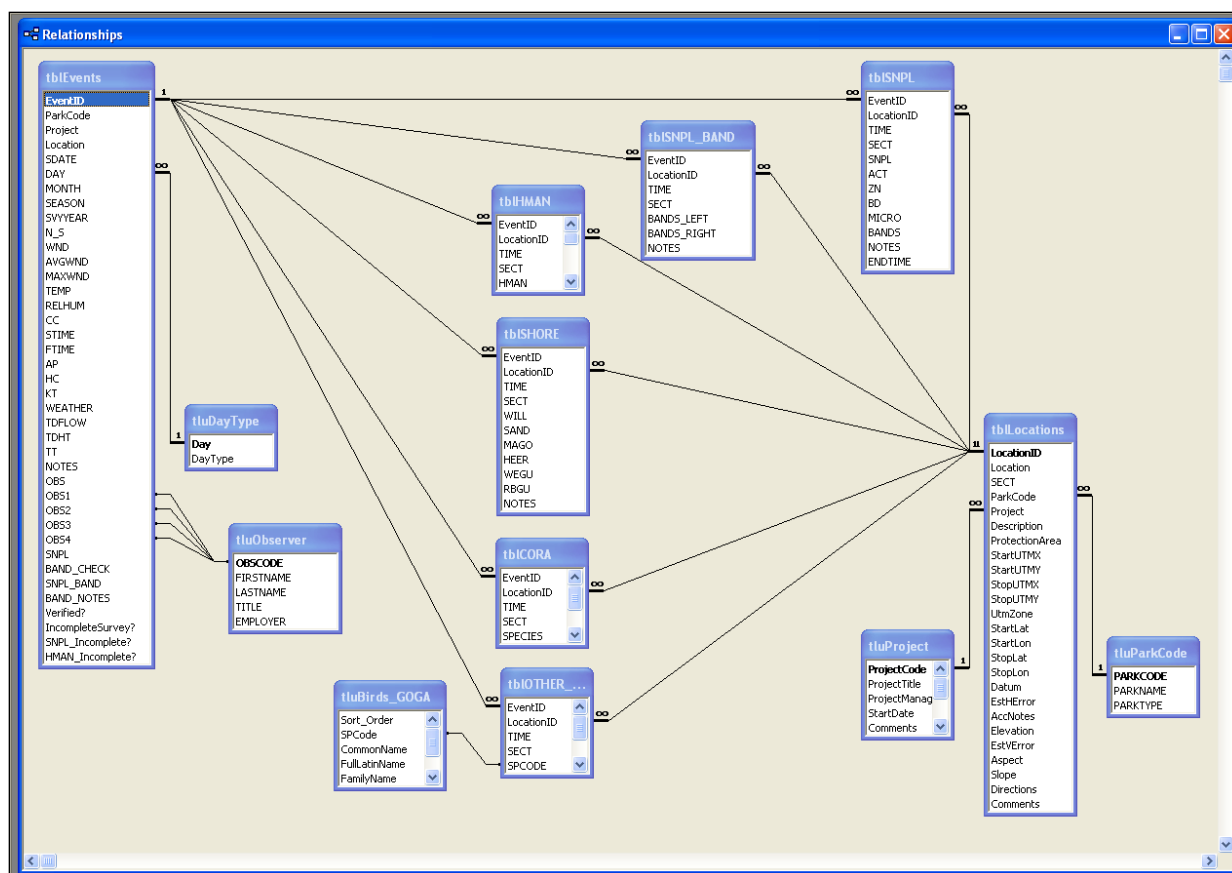


Figure SOP 4.1. Table relationships within the GOGA snowy plover monitoring database.

Table Structure

The primary snowy plover (abbreviated as SNPL in the database structure and on data sheets) monitoring events table, *tblEvents*, stores all survey specific details, including the date, weather conditions, tide level, and observer code. For Ocean Beach surveys, each record in the events table represents either the north or south half of the beach, as it is collected, and is designated in the [N_S] field. Event records for Crissy Field represent the entire survey area.

The events table is linked to all six related sub-tables by one-to-many relationships via an EventID Globally Unique Identifier (GUID; Figure SOP 4.1). The sub-tables represent the data collected in each beach sector, of which there are 14 on Ocean Beach and 4 at Crissy Field. Each sub-table has fields for the beach sector number and the start time for that beach sector. The sub-tables include:

Snowy plover data table (*tblSNPL*). Counts of snowy plovers per beach sector, entered according to activity such as feeding or not feeding, as well as beach elevation zone and microhabitat.

Banded snowy plover data table (*tblSNPL_BAND*). Band combinations of banded snowy plovers encountered within the beach sectors, if applicable.

Human and dog data table (*tblHMAN*). Counts of humans and dogs per beach sector. Dogs are split into categories, such as leashed, unleashed, roaming, chasing birds, and chasing plovers.

Common raven data table (tblCORA). Counts of common ravens per beach sector, entered according to raven activity such as flying or perched.

Shorebird data table (tblSHORE). Counts of six common shorebird species per beach sector. Six species are willet, sanderling, marbled godwit, Heermann's gull, western gull, ring-billed gull.

Other bird data table (tblOTHER_BIRD). Counts of other bird species of interest encountered within the beach sectors, if applicable.

The locations table (tblLocations) in the database provides a geographic reference for each of the beach sectors at Ocean Beach and Crissy Field. The beach sector LocationID, such as OB1 (Ocean Beach, Sector 1), in each of the data tables links to a master location record in the locations table (Figure SOP 4.1). The location table records document the start and end point UTM coordinates of each beach sector and provide detailed geographic descriptions of the beach sectors.

The database employs two key look-up tables to assist with both data entry and data organization. The observer look-up table provides the full name, organization, and title for each of the project observers, and is linked to each of the four observer fields in the events table by the observer code field (Figure SOP 4.1). The bird look-up table, developed from the certified NPSpecies bird list for GOGA, provides the common name, scientific name, family, order, and ITIS Taxonomic Serial Number for the park's birds. Species documented in the other bird data table are noted with a species code, which links to a master bird record in the look-up table (Figure SOP 4.1). The species code values are adopted from the Institute for Bird Populations acronym list, developed from the American Ornithologists' Union Checklist as modified through the 47th Supplement (AOU 2006).

User Interface

A complete user interface has been developed to assist with data entry. Rather than employing a back-end, front-end database model, the forms designed for data entry are co-mingled with the data tables within one database file. Command buttons and code driven text boxes are used to navigate to forms, add data records, locate and edit data records, and print reports. Where possible, default values are set and combo boxes with fixed values are used to reduce data entry errors. For example, all fields that identify project observers are set as combo boxes which link to the observer look-up table. Alternatively, validation rules are established where possible to limit data entry to certain values, such as beach sector values 1 through 14 for Ocean Beach. Key features of the user interface are described below.

frmStartUp

This startup form is the entry point for the application, and therefore the first thing users will usually see when opening the application (Figure SOP 4.2).

Command buttons direct the user to either the data entry or report generating features of the database. To learn more about the database, the user may click the hyperlink in blue below the command buttons to open a descriptive Microsoft Word document (see Version Control Guidelines and Database History).

frmSurvey

This is the core data entry form for the database (Figure SOP 4.3), within which are embedded several sub-forms. The control source for the form is the events table (tblEvents). All of the survey specific data, such as the date, observers, and weather conditions, are entered into the header portion of the form. Macros are used to generate some values in the events table following data entry of certain fields. After entering the survey date, for example, the survey year, month, and season values are automatically populated in the events table.

frmSubPlover

Located within the “SNOWY PLOVERS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the counts of snowy plovers per beach sector. The control source is the snowy plover data table (tblSNPL). A beach sector may be represented more than once per survey if snowy plovers are observed in different activities within that sector (Figure SOP 4.3).

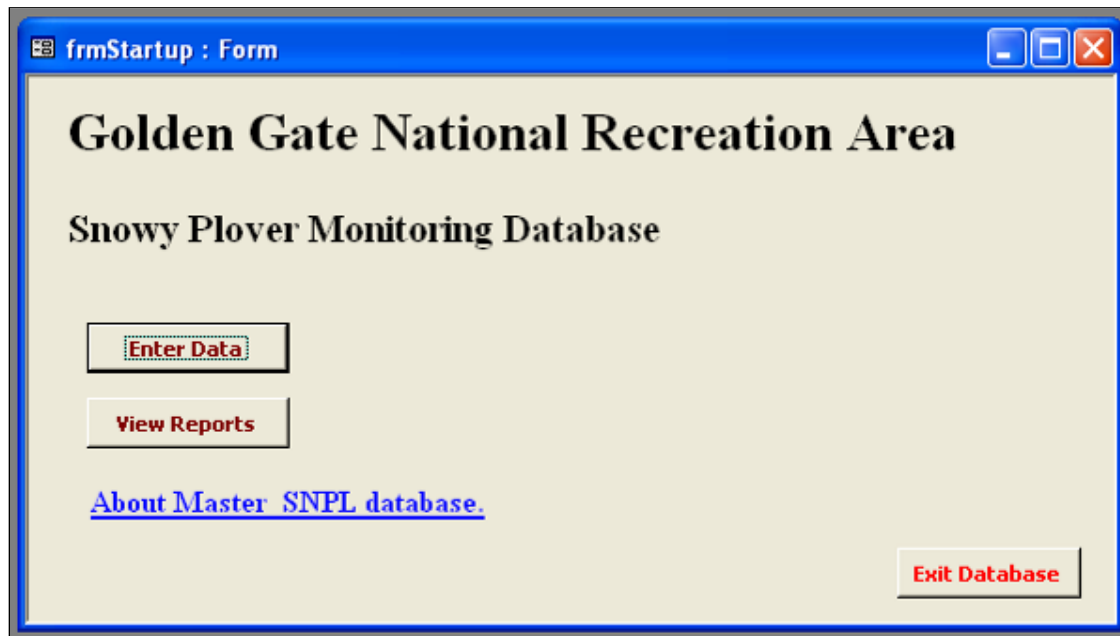


Figure SOP 4.2. Startup database screen for the snowy plover monitoring database.

frmSurvey : Form

Ocean Beach Survey For Snowy Plovers

Record Selectors: First, Prev, Next, Last, New

Find Record (enter date): Go!

EVENT ID: {05F6107B-1952-4AFA-A265-1272A1288D8B}

DATE (mo/da/yr): 03/15/2008 OBSERVER(S): Rto SB START TIME: 13:15 FINISH TIME: 14:35

NORTH/SOUTH HALF OF BEACH: s DAY: Saturday

AVG WIND: 11.7 MAX WIND: 20.7 TEMP: 53.2 rH: 75.9 CLOUD COVER: 3

WEATHER NOTES: nice day but very windy, not many people on beach

OTHER NOTES:

TIDE: s TIDE HEIGHT: -0.2 HELICOPTER: 0 AIRPLANE: 0 KITE: 1

SNOWY PLOVERS | SHOREBIRDS | OTHER BIRDS | SNPL BANDS | HUMANS / DOGS | RAVENS

SNOWY PLOVER GROUPS ON THE GROUND

	TIME	SECT	SNPL	ACT	ZN	MICRO	NOTES
▶	13:15	14	0				
	13:27	13	0				
	13:33	12	0				
	13:38	11	0				
	13:42	10	0				
	13:52	9	14	n	4	s, t	
	14:27	8	0				
*			0				

Record: 1 of 7

☐ INCOMPLETE SURVEY? ☒ VERIFIED?

Close Form

Figure SOP 4.3. Primary snowy plover monitoring data entry form, with the snowy plover sub-form displayed in the first data entry tab.

frmSubShore

Located within the “SHOREBIRDS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the counts of six common shorebirds observed per beach sector (Figure SOP 4.4). The control source is the shorebirds data table (tblShore).

frmSubOtherBird

Located within the “OTHER BIRDS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the counts of other bird species of interest encountered within the beach sectors, if applicable (Figure SOP 4.5). The control source is the other bird data table (tblOtherBird).

frmSubPloverBands

Located within the “SNPL BANDS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the band combinations of banded snowy plovers encountered within the beach sectors, if applicable. The control source is the banded snowy plover data table (tblSNPL_BAND). The four data entry fields under the “COLOR-BANDED SNOWY PLOVERS” heading (Figure SOP 4.6) are stored in the events table.

frmSubHuman

Located within the “HUMANS / DOGS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the counts of humans and dogs per beach sector (Figure SOP 4.7). The control source is the human and dog data table (tblHMAN).

frmCORA

Located within the “RAVENS” tab on the data entry form (Figure SOP 4.3), this sub-form is where the user enters the counts of common ravens per beach sector. The control source is the common raven data table (tblCORA). A beach sector may be represented more than once per survey if ravens are observed in different activities within that sector (Figure SOP 4.8).

SNOWY PLOVERS		SHOREBIRDS		OTHER BIRDS		SNPL BANDS		HUMANS / DOGS		RAVENS	
SHOREBIRD COUNTS											
	TIME	SECT	WILL	SAND	MAGO	HEER	WEGU	RBGU	NOTES		
▶	13:15	14	0	43	0	0	2	0			
	13:27	13	0	0	0	0	17	0			
	13:33	12	0	0	0	0	1	0			
	13:38	11	0	0	0	0	1	0			
	13:42	10	3	0	21	0	9	2			
	13:52	9	0	4	0	0	65	5			
	14:27	8	0	0	2	0	6	0			
*			0	0	0	0	0	0			
Record: 1 of 7											

Figure SOP 4.4. Sub-form for data entry of common shorebirds observed during plover surveys.

SNOWY PLOVERS		SHOREBIRDS		OTHER BIRDS		SNPL BANDS		HUMANS / DOGS		RAVENS	
OTHER BIRDS											
	TIME	SECT	SPECIES	NUMBER	ACT	NOTES					
	13:33	12	WHIM	1	f						
▶	13:42	10	WHIM	1	f						
*											
Record: 1 2 of 2											

Figure SOP 4.5. Sub-form for data entry of other birds observed during plover surveys.

SNOWY PLOVERS		SHOREBIRDS		OTHER BIRDS		SNPL BANDS		HUMANS / DOGS		RAVENS	
COLOR-BANDED SNOWY PLOVERS											
TOTAL # SNOWY PLOVERS		TOTAL # SNOWY PLOVERS CHECKED FOR BANDS		NUMBER OF BANDED PLOVERS		NOTES					
14		12		7							
SNOWY PLOVER BAND COMBINATIONS											
	TIME	SECT	BANDS_LEFT	BANDS_RIGHT	NOTES						
▶	13:52	9	p?	yg							
	13:52	9	p?	by							
	13:52	9	lw	aw							
	13:52	9	ob	oy							
	13:52	9	ob	ow							
	13:52	9	ba	oy							
	13:52	9	ro	og							
*											
Record: 1 of 7											

Figure SOP 4.6. Sub-form for data entry of snowy plover band combinations observed during surveys.

SNOWY PLOVERS SHOREBIRDS OTHER BIRDS SNPL BANDS HUMANS / DOGS RAVENS												
HUMANS AND DOGS ON OCEAN BEACH												
	TIME	SECT	HMAN	DL	DJ	DR	DC	DP	NO	HR	VH	NOTES
▶	13:15	14	9	0	1	0	0	0	0	0	1	atv flushed sanderlings
	13:27	13	3	0	0	0	1	0	0	0	0	
	13:33	12	8	2	0	0	0	0	0	0	0	
	13:38	11	10	1	0	0	0	0	0	0	0	
	13:42	10	4	0	0	0	1	0	0	0	0	
	13:52	9	10	0	1	0	0	0	0	0	0	
	14:27	8	5	0	0	1	0	0	0	0	0	
*			0	0	0	0	0	0	0	0	0	

Record: 1 of 7

Figure SOP 4.7. Sub-form for data entry of human and dog data collected during plover surveys.

SNOWY PLOVERS SHOREBIRDS OTHER BIRDS SNPL BANDS HUMANS / DOGS RAVENS						
RAVENS						
	TIME	SECT	SPECIES	NUMBER	ACT	NOTES
▶	13:42	10	CORA	2	p	
	13:52	9	CORA	4	p, a	swooped down at plovers
	14:27	8	CORA	3	f, p, a	2 of same ravens swooped down on plovers, flushed
*			CORA			

Record: 1 of 3

Figure SOP 4.8. Sub-form for data entry of common ravens observed during plover monitoring.

frmSelectReports

The database report switchboard allows the user to generate standardized reports that summarize the monitoring data for each survey year in which it has been collected. The reports adopted were originally designed by PBCS for their DBASE application and are defined in the Annual Data Work Flow section below. The command buttons associated with each report operate macros which run a series of queries to produce each report (Figure SOP 4.9).

Figure SOP 4.9. Report switchboard for the GOGA snowy plover monitoring database.

Ocean Beach and Crissy Field Databases

Snowy plover monitoring began at Crissy Field in September 2006, two years after a new snowy plover monitoring database was designed for surveys occurring at Ocean Beach. A separate database, following the exact same database design, was implemented for Crissy Field. The monitoring project continues to employ two separate snowy plover monitoring databases, one for Ocean Beach and one for Crissy Field. The databases are titled Master_SNPL and SNPL_Crissy_Master, respectively. Data management, data handling procedures, and the annual data work flow are the same for both databases.

Annual Data Work Flow

Rather than enter snowy plover monitoring data directly into the master database, satellite databases are created at the beginning of each monitoring season that parallel the structure of the master database. The SFAN Data Manager prepares the database and provides it to the field staff based at GOGA. The satellite data tables are blank in each of the databases, but tblLocations and the look-up tables are populated and ready for use. The SFAN Data Manager confirms all default values, such as field season, prior to distribution. The database is provided in MS Access XP format.

Satellite databases should be backed up regularly during the course of the season. CDs are a good option for back-ups. Databases can also be regularly copied to an archive on the network, to a hard drive, or both. File names of back-up databases should include the date of the back-up, such as: SNPL_Satellite_2008_050108_BackUp.

At the end of each season, the field staff is responsible for proofing the data entry records in the satellite database against field notes and paper data sheets completed during the surveys. When complete, the satellite databases are sent to the SFAN Data Manager for additional review and certification. The Data Manager works with the Project Lead and the field staff to complete final edits or additions to the seasonal dataset. A subset of randomly selected records (10%) is reviewed after initial verification by the SFAN Data Manager. If significant errors are found, the entire data set should be verified again by the project field staff. See Data Verification and Validation Procedures for more information. If data collection issues in a consistent component of the monitoring are leading to problems, then this can be emphasized in the training and refresher prior to the start of the next monitoring season.

One critical task of the Data Manager is completion of the ENDTIME field in the snowy plover table (tblSNPL) and the human and dog table (tblHMAN). The ENDTIME field is the time at which the observer completes surveying a beach sector. The field is not populated during data entry because it is quicker for the Data Manager to auto-populate values for ENDTIME based on the start time for the next beach sector surveyed.

The Data Manager is also responsible for ensuring that incomplete surveys, which at times occur because of poor weather conditions, are correctly noted within the database. When the data is entered, the user should check the [INCOMPLETE SURVEY?] box on the data entry form (Figure SOP 4.3) for any surveys in which not all beach sectors are completed. For incomplete surveys, two associated fields in the events table should be noted by the Data Manager, indicating the completeness of the snowy plover and human/dog data. This design resulted from surveys in which one data component was complete while the other was not and the desire to use as much data within the database as possible. For Ocean Beach surveys, where survey records are split into two halves of the beach, the Data Manager must ensure that the same incomplete survey specifications are set for the other corresponding survey record. For example, if a plover count on the north half of the beach is completed on a given day, but the count in the southern half is incomplete, both event records must be noted as having incomplete snowy plover data. Since most of the snowy plover data analyses use total counts for the entire beach, this measure ensures that only surveys with equal effort are included in the analyses.

Once certified, the Data Manager imports the satellite data into the master database, appends the data to the appropriate tables, and archives the satellite database within the I&M directory. The Data Manager alerts the monitoring staff at GOGA when the master database upload is complete.

After certification and upload of the data, the Data Manager customarily produces a series of data summaries at the request of the Project Manager in preparation for the annual report. The data summaries are based on or build upon reporting techniques originally designed by Point Blue Conservation Science for use with their DBASE data management system. SFAN has therefore adopted the naming conventions of both the reports and fields from PBCS, which are documented in the Word document titled *reportsSNPL* located at:

Inpgogamahe1\Natural Resources\Natural_&_Social_Sciences(N)\N14-Animal_and_Plant_Life_(Observations_&_Studies)\N1419_Birds\Snowy_Plover\Databases\Master_Dbase

Annual data summaries produced by the Data Manager and forwarded to the Project Manager are outlined in Table SOP 4.1.

Table SOP 4.1. Annual snowy plover monitoring data summaries.

Type	Title	Description
Table	ANNSUM_ALL	Summary of survey statistics for all years.
Table	MEDIAN	Human and dog summaries by year and plover protection area for all years. Reported as median values.
Table	PPA_MANDOG	Human and dog summaries by survey date and plover protection area for all years.
Table	SEASON_MEDIAN	Human and dog summaries by year, season, and plover protection area for all years. Reported as median values.
Table	SECTA_ALL	Occurrence of plovers by sector for complete and incomplete surveys. All seasons for all years.
Table	SECTF_ALL	Occurrence of plovers by sector for complete and incomplete surveys. Fall season for all years.
Table	SECTS_ALL	Occurrence of plovers by sector for complete and incomplete surveys. Spring season for all years.
Table	SECTW_ALL	Occurrence of plovers by sector for complete and incomplete surveys. Winter season for all years.
Table	SPBYDATE_ALL	Summary occurrence data for plovers. One record for each survey.
Query	MANDOG1	Human and dog summary statistics for all years. Both a north and south half beach record for each survey. Ocean Beach only.
Query	MANDOG2	Human and dog summary statistics for all years. One record per survey.
Query	MANDOG_byppa	Human and dog summary statistics by survey date and plover protection area for all years.
Query	MANDOG_bysector	Human and dog summary statistics by survey date and beach sector for all years.
Query	Shore_YearRate	Shorebird encounter rate. Criteria may be set to report by year, season, month, and sector.
Query	Surveys_SNPLSUM	Sum of snowy plover counts for each survey.
Query	Surveys_SNPLSUM_FLDATES	Sum of SNPL counts for each survey, between first and last dates that SNPLs are observed on the beach.

Quality Assurance and Quality Control

The success of the snowy plover monitoring program is dependent on the quality of the data it collects, manages, and disseminates. Analyses performed to detect ecological trends or patterns require data that are recorded properly and have acceptable precision, accuracy, and minimal bias. Poor-quality data can limit detection of subtle changes in ecosystem patterns and processes, can lead to incorrect interpretations and conclusions, and can greatly compromise the credibility of the program managing it.

Quality assurance (QA) can be defined as an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the consumer. Quality control (QC) is a system of technical activities that measure the attributes and performance of a process, item, or service relative to defined standards (Palmer 2003). While QA procedures maintain quality throughout all stages of data development, QC procedures monitor or evaluate the resulting data products.

To ensure that the snowy plover monitoring program produces and maintains data of the highest possible quality, QA/QC procedures are implemented to identify and minimize errors at each project stage associated with the data life cycle.

Data Collection

Attention to detail during the data collection phase is crucial to overall data quality. Unlike a typographical error that occurs during data entry, an incorrect observation in the field is not easily corrected. The snowy plover monitoring program adopts the following guidelines regarding data collection that affect data quality:

- Field crews will receive proper training in data collection and recording.
- Field equipment will be regularly maintained and calibrated.
- Data will be recorded on pre-formatted, project-specific data sheets that reflect the overall design of the project and are designed to minimize the amount of writing necessary to effectively record observations.
- The format of field data sheets will be reflected in the computer data entry interface to help ensure all relevant information is recorded and subsequent data entry errors are minimized.
- Field forms will be reviewed for completion and errors each day in the field. The NPS lead, intern, or Wildlife Ecologist, is responsible for checking all data sheets at the end of each survey.

Storage of Data Sheets

Data sheets should be scanned into digital pdf files upon returning to the office. Files should be named by site (OB North, OB South, or CF) and date of survey (e.g., OB_SOUTH_Data_12_09_09.pdf, OB_NORTH_Data_12_09_09.pdf, CF_Data_12_09_09.pdf). These files should be saved on the GOGA network on the Marin Headlands server in the folder:

Inpgogamahe1\Natural_&_Social_Sciences(N)\N14Animal_and_Plant_Life_(Observations_&_Studies)\N1419_Birds\Snowy_Plover\Completed_Datasheets\2009

Each year a new subfolder within the same path should be set up for that season of monitoring. Hard copies of data sheets should then be filed and stored with the intern or Wildlife Ecologist for data entry and verification purposes.

Data Entry

Data entry is the process whereby the raw data collected in the field are transferred from paper field forms and notes into the project databases. The snowy plover field staff performs all data entry into seasonal satellite databases. The goal of data entry is to transcribe field observations into a computer database with 100% accuracy, although errors are unavoidable. Several QA/QC practices help to reduce errors during the data entry phase:

- Data will be entered as soon as reasonably possible after collection
- Data entry will be completed by someone familiar with data collection.
- The Project Lead or SFAN Data Manager must ensure that data entry staff is familiar with the database software, database structure, and any standard codes in the databases. At a minimum, data entry technicians should know how to open a data entry form, create a new record, edit an existing record, and exit the database properly. They must also learn how to correct mistakes made while typing.
- Data will be entered into pre-designed database forms that resemble field sheets to the greatest extent possible. Data entry forms maximize error control wherever possible, include the use of default values, limiting data entry domains to values in drop-down menus, and auto-generating certain codes.
- Data will be entered, one logical "set" at a time. Paper forms are initialed and dated when completed to avoid confusion about what has been entered and what has not.

Data Verification

Following data entry, subsequent data verification is conducted to ensure that the raw data on the paper data sheets matches the entered data. The snowy plover field staff verifies all data in the seasonal satellite databases before forwarding on to the SFAN Data Manager. The following steps occur during the data verification phase:

- Data verification is carried out by staff thoroughly familiar with data collection and entry
- A visual review after data entry is performed with one person reading aloud from the original data sheets while a second person checks the corresponding entered data in the database.
- Errors in the data are immediately corrected once discovered.
- When complete, a verification record is added to the data history table in the database and the paper data sheet is initialed and dated.
- All records (100%) are verified against the original source data.

- A subset of randomly selected records (10%) is reviewed after initial verification by the SFAN Data Manager. If significant errors are found, the entire data set should be verified again by the project field staff.

Data Validation

Data verification checks that the digitized data match the source data, while *data validation* checks that the data make sense. Although data entry and verification can be handled by personnel who are less familiar with the data, validation requires in-depth knowledge about the data. The SFAN Data Manager performs all data validation procedures on the seasonal satellite databases before integrating the data into the master databases. The Data Manager consults with the Project Lead, the field staff, or directly reviews the data sheets to correct any errors that are discovered.

During the data validation phase, the Data Manager checks all the satellite databases for the following and makes corrections as needed:

- Verification records for all survey data records.
- Erroneously generated records with no actual data.
- Orphaned records within the sub-tables (i.e., no link back to tblEvents).
- Data outliers (applies to both numerical and date/time values).
- Logic errors (i.e., start time is after the end time, human/dog data reported more than once for a beach sector per survey).
- Correct values for fields with fixed domains (beach sector, snowy plover activity, etc.).
- Complete data entry for all required fields.

Version Control Guidelines and Database History

Version control guidelines for the snowy plover monitoring database will follow those presented in the SFAN Data Management Plan (Press 2005). Prior to any major changes to the database design, a back-up copy of the database should be made. Once the database design changes are complete, the database should be assigned the next incremental version number. The final copy of the previous database version should be archived with the version closing date incorporated into the database title. Version numbers should increase incrementally by hundredths (e.g., version 1_01, version 1_02, etc.) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2_0, 3_0, 4_0 ...). With proper controls and communication, versioning ensures that only the most current database version is used for queries and analyses. Significant database re-design may require approval by the Project Lead, review by other data management staff, and revisions to this data management SOP. The database version number should be included in the file title of the database, for example, Master_SNPL_v2_00.

The Data Manager maintains a history log of the snowy plover monitoring databases in a Microsoft Word document titled *Master_SNPL_info* located at:

Inpgogamahe1\Natural Resources\Natural_&_Social_Sciences(N)\N14-Animal_and_Plant_Life_(Observations_&_Studies)\N1419_Birds\Snowy_Plover\Databases\Master_Dbse

Both the Ocean Beach and Crissy Field databases are documented in the database history log. All design modifications to the databases are logged in more detail within the history logs and are referenced to changes in database version numbers. Design modifications include changes to the table structure, user interface, or underlying macros and Visual Basic Code. Major changes to the data are also noted in this document, such as when a new set of annual data is uploaded. It is especially important to note edits to the data that will result in changes to final data summaries previously published in annual reports or other media. This will prove invaluable to data users attempting to understand differences in data between years.

The database history may also be used each year to summarize anything that was unique or changed about the year's methodology and is therefore reflected in the annual dataset. Notes on techniques for collection and review of data are also very helpful.

Metadata Procedures

The NPS GIS Committee requires all NPS GIS data layers be described with the NPS Metadata Profile, which combines the Federal Geographic Data Committee (FGDC) standard, elements of the ESRI™ metadata profile, the Biological Data Profile, and NPS-specific elements. Although no standard has been applied to natural resource databases and spreadsheets, SFAN will complete the NPS Metadata Profile to the greatest extent possible to document the master snowy plover monitoring database. Because the annual datasets are uploaded into the master databases without alteration, SFAN will not create separate metadata records for each satellite database.

Complete metadata records for the snowy plover monitoring database will be generated in compliance with current NPS standards by the SFAN Data Manager. Because the location data for this project is stored as UTM coordinates within the MS Access databases, there are no spatial data products associated with this protocol that require metadata records.

The metadata records for the snowy plover monitoring database will initially be developed in Dataset Catalog v3.0, an MS Access metadata development and catalog tool developed by the National I&M Program. Dataset Catalog is currently the preferred tool to begin metadata records for MS Access databases because of its ability to harvest entity and attribute information from this database format.

The metadata records will be exported from Dataset Catalog as XML files and completed in NPS Metadata Tools and Editor Program v1.1 (NPS MTE), thus allowing for all NPS-specific elements in the metadata records to be completed. When completed, metadata records, but not the data, will be posted to the NRInfo Portal (nrinfo.nps.gov) for public discovery and consumption. Contact information within the metadata records will direct interested parties to the SFAN Data Manager for further inquiries. Master database metadata records posted to NRInfo will be updated annually after the annual data has been uploaded or following database revision to a new version whole number (e.g., v1_3 to v2_0, but not v2_0 to v2_1).

Data Storage and Archival Procedures

All master data files for the snowy plover monitoring project are housed at GOGA on the Marin Headlands server. The SFAN I&M Program office and the GOGA Natural Resources staff, which

directs the snowy plover monitoring program, are all located in the Marin Headlands. The master database, currently in version 2_00, resides at:

Inpgogamahe1\Natural Resources\Natural_&_Social_Sciences(N)\N14-Animal_and_Plant_Life_(Observations_&_Studies)\N1419_Birds\Snowy_Plover\Databases\Master_Dbse

Inpgogamahe1\Natural Resources must always be mapped as the X drive. The following folders reside within the above “Snowy_Plover” directory:

Master_BackUps

Back-up copies of the active master databases should be stored here. File names of back-up databases should include the date of the back-up, such as Master_SNPL_050108_BackUp.

SNPL_Data_Archive

When the master database is converted to a new version number, the final previous database version should be archived here. Final seasonal satellite databases and all legacy DBASE data files are also stored in this archive directory.

At the end of each field season, once the data has been certified by the Data Manager, copies of the field data sheets are made and delivered to the Project Lead. The original data sheets are then sent to the GOGA Park Archives and Records Center in the Presidio, San Francisco.

Data Distribution

In order for the snowy plover monitoring program to inform park management and to share its information with other organizations and the general public, guidance documents, reports, and data must be easily discoverable and obtainable. The main mechanism for distribution of the snowy plover monitoring documents and data will be the Internet. The snowy plover monitoring protocol, accompanying SOP's, appendices, and all annual reports will be made available for download at the SFAN website (<http://science.nature.nps.gov/im/units/sfan/>). NRInfo records will be created for all of the snowy plover monitoring documents, including the protocol, annual reports, and any resulting publications. The public version of NRInfo is in development by the National I&M program.

Although the snowy plover monitoring database will not be posted for public download, as previously mentioned, metadata records for the master databases will be maintained at [NRInfo](#). The metadata records will direct interested parties to the SFAN Data Manager for further inquiries.

All documents produced by the snowy plover monitoring program will be published in either the Natural Resource Report Series (NRR) or the Natural Resource Technical Report (NRTR) Series following guidance from the NPS Natural Resource Program Center in Fort Collins, CO. The Natural Resource Publications Management home page hosts a list of all documents published (<http://www.nature.nps.gov/publications/NRPM/>).

Literature Cited

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- Press, D. T. 2005. Data management plan for the San Francisco Area Network Inventory and Monitoring Program. National Park Service Unpublished Report, San Francisco, California.

Appendix SOP 4A. GOGA Western snowy plover data dictionary.

Data Dictionary for: GOGA Western Snowy Plover Monitoring Database, SFAN I&M Program

TABLE NAME:	tblEvents		
FILENAME:	MASTER_SNPL_v2_00.mdb		
DESCRIPTION:	Core survey event data table.		
FORMAT:	Microsoft Access		
NO. OF FIELDS:	38		
FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
ParkCode	dbText	50	4-character Park Code
Project	dbText	10	Code for component of program (Weather, Birds, Fish, Veg Plots, etc.)
Location	dbText	50	Beach name of survey.
SDATE	dbDate	8	Date of sampling event.
DAY	dbText	50	Day of week
MONTH	dbDouble	8	Month in which sampling event occurred (numbered 1-12). Automatically-populated.
SEASON	dbText	50	Season in which sampling event occurred (fall, winter, or spring). Automatically-populated.
SVYYEAR	dbDouble	8	Survey year in which sampling event occurred. Automatically-populated.
N_S	dbText	255	North or south beach zone ("n" or "s").
WND	dbDouble	8	Wind level on beaufort scale, negative-valued if easterly.
AVGWND	dbDouble	8	Average wind speed (mph).
MAXWND	dbDouble	8	Maximum wind speed (mph).
TEMP	dbDouble	8	Air temperature (degrees F).
RELHUM	dbDouble	8	Relative humidity (%).
CC	dbDouble	8	Cloud cover (1-8 to indicate x/8 coverage by clouds).
STIME	dbDate	8	Survey start time.
FTIME	dbDate	8	Survey finish time.
AP	dbDouble	8	Number of aircraft during survey.
HC	dbDouble	8	Number of helicopters during survey.
KT	dbDouble	8	Number of kites during survey.
WEATHER	dbText	255	Additional weather notes.
TDFLOW	dbText	255	Tide flow ('hs' if high-slack water; 'ls' if low-slack; 's' if slack; 'f' if falling; 'r' if rising).
TDHT	dbDouble	8	Tide height at start time.
TT	dbText	255	Tide type (low, med, or hi). Automatically-populated.
NOTES	dbText	255	Short additional notes or reference to longer notes in notes.
OBS1	dbText	50	Observer's identification code (initials).
OBS2	dbText	50	Observer's identification code (initials).

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OBS3	dbText	50	Observer's identification code (initials).
OBS4	dbText	50	Observer's identification code (initials).
SNPL	dbDouble	8	Total number of snowy plovers observed.
BAND_CHECK	dbDouble	8	Total number of snowy plovers checked for bands.
SNPL_BAND	dbDouble	8	Total number of banded snowy plovers.
BAND_NOTES	dbText	250	Short additional notes regarding SNPL color bands.
Verified?	dbBoolean	1	Data verified against paper data sheet?
IncompleteSurvey?	dbBoolean	1	Was this an incomplete survey?
SNPL_Incomplete?	dbBoolean	1	Is the SNPL data incomplete?
HMAN_Incomplete?	dbBoolean	1	Is the HMAN data incomplete?

TABLE NAME: **tbISNPL**

FILENAME: MASTER_SNPL_v2_00.mdb

DESCRIPTION: Snowy plover data sub-table.

FORMAT: Microsoft Access

NO. OF FIELDS: 12

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).
SNPL	dbDouble	8	Number of snowy plovers in sector engaged in coded activity and occurring in coded beach elevation zone.
ACT	dbText	1	Code for snowy plover activity ('f' for feeding, 'n' for not feeding, 'u' for unknown, '0' if there are no plovers).
ZN	dbText	1	Beach elevation zone (1-5 or 0 for unknown or if there are no plovers).
BD	dbDouble	8	Number of banded plovers.
MICRO	dbText	25	Microhabitat notes (sand=S; coarse sand, shell, pebble, rock=R; seaweed or kelp=K; washed up debris or trash from beach visitors=T; vegetation or sand at the base of vegetation=V; carcasses=C).
BANDS	dbText	20	List of band combinations of all plovers enumerated in field [BD].
NOTES	dbText	250	Short additional notes or reference to longer notes.
ENDTIME	dbDate	8	Time observer completes covering sector.

TABLE NAME: **tbISNPL_BAND**

FILENAME: MASTER_SNPL_v2_00.mdb

DESCRIPTION: Snowy plover band data sub-table.

FORMAT: Microsoft Access

NO. OF FIELDS: 7

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FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).
BANDS_LEFT	dbText	20	List of color bands on left leg.
BANDS_RIGHT	dbText	20	List of color bands on right leg.
NOTES	dbText	250	Short additional notes or reference to longer notes.

TABLE NAME: **tbIHMAN**

FILENAME: MASTER_SNPL_v2_00.mdb
 DESCRIPTION: Human and dog data sub-table.
 FORMAT: Microsoft Access
 NO. OF FIELDS: 16

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).
HMAN	dbDouble	8	Number of people counted in beach sector.
DL	dbDouble	8	Number of leashed dogs.
DU	dbDouble	8	Number of unleashed dogs remaining within 10 feet of owner.
DR	dbDouble	8	Number of unleashed, roaming dogs.
DC	dbDouble	8	Number of unleashed dogs chasing birds, owner unaware of chasing.
DP	dbDouble	8	Number of unleashed dogs chasing plovers, owner unaware of chasing.
NO	dbDouble	8	Number of plovers disturbed, intentionally and accidentally.
HR	dbDouble	8	Number of horses in sector.
VH	dbDouble	8	Number of vehicles in sector.
DD	dbBoolean	1	Set to true to indicate when there are additional details about plover disturbance in the file details.dbf.
NOTES	dbText	250	Short additional notes or reference to notes.dbf for longer notes regarding people, dogs, horses, or vehicles not fitting into previous variables.
ENDTIME	dbDate	8	Time observer completes covering sector.

TABLE NAME: **tbISHORE**

FILENAME: MASTER_SNPL_v2_00.mdb
 DESCRIPTION: Shorebird data sub-table.
 FORMAT: Microsoft Access
 NO. OF FIELDS: 11

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FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).
WILL	dbDouble	8	Number of willets observed.
SAND	dbDouble	8	Number of sanderlings observed.
MAGO	dbDouble	8	Number of marbled godwits observed.
HEER	dbDouble	8	Number of heerman's gulls observed.
WEGU	dbDouble	8	Number of western gulls observed.
RBGU	dbDouble	8	Number of ring-billed gulls observed.
NOTES	dbText	250	Note additional species observed and number.

TABLE NAME: tbIOTHER_BIRD
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Other bird data sub-table.
FORMAT: Microsoft Access
NO. OF FIELDS: 8

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).
SPCODE	dbText	50	Species code of bird observed.
NUMS	dbDouble	8	Number of birds in sector engaged in coded activity.
ACT	dbText	250	Code for species activity (perched=P, perched/ hunting=H, flying in area=F, flying north=N, flying south=S, stooping on / attacking birds=B, stooping / attacking Snowy Plovers=A).
NOTES	dbText	250	Short additional notes or reference to longer notes.

TABLE NAME: tbICORA
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Common raven data sub-table.
FORMAT: Microsoft Access
NO. OF FIELDS: 8

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbGUID	16	Unique identifier for the sampling event. Automatically-populated.
LocationID	dbText	50	Location ID code
TIME	dbDate	8	Time observer starts covering sector.
SECT	dbDouble	8	Beach sector in which sampling event occurred (1-14).

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SPECIES	dbText	50	Species observed. Set to CORA = common raven.
NUMS	dbDouble	8	Number of common ravens in sector engaged in coded activity.
ACT	dbText	250	Code for species activity (perched=P, perched/ hunting=H, flying in area=F, flying north=N, flying south=S, stooping on / attacking birds=B, stooping / attacking Snowy Plovers=A).
NOTES	dbText	250	Short additional notes or reference to longer notes.

TABLE NAME: **tblLocations**

FILENAME: MASTER_SNPL_v2_00.mdb

DESCRIPTION: Core locations table. Provides spatial data and descriptions of beach sectors.

FORMAT: Microsoft Access

NO. OF FIELDS: 25

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
LocationID	dbText	50	Location ID code
Location	dbText	50	Beach name.
SECT	dbDouble	8	Beach section number.
ParkCode	dbText	50	4-character Park Code
Project	dbText	10	Code for component of program (Weather, Birds, Fish, Veg Plots, etc.)
Description	dbText	255	Description of this location (<256 characters)
ProtectionArea	dbText	50	Is beach section in the plover protection area?
StartUTMX	dbDouble	8	UTM X (easting) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StartUTMY	dbDouble	8	UTM Y (northing) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StopUTMX	dbDouble	8	UTM X coordinate (easting) of ending point of line or polygon (double precision to15 significant digits)
StopUTMY	dbDouble	8	UTM Y coordinate (northing) of ending point of line or polygon (double precision to15 significant digits)
UtmZone	dbText	4	UTM zone
StartLat	dbDouble	8	Latitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StartLon	dbDouble	8	Longitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)
StopLat	dbDouble	8	Latitude in decimal degrees for the ending point of a line or polygon (double precision to 15 significant digits)
StopLon	dbDouble	8	Longitude in decimal degrees for the ending point of a line or polygon (double precision to 15 significant digits)
Datum	dbText	5	Datum of mapping ellipsoid

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EstHError	dbSingle	4	Estimated horizontal accuracy error--see users guide for complete details and examples
AccNotes	dbMemo	0	Comments about how positional (horizontal) accuracy was estimated
Elevation	dbSingle	4	Elevation in meters
EstVError	dbSingle	4	Estimated vertical accuracy error in meters
Aspect	dbText	5	Aspect (N, S, E, W)
Slope	dbLong	4	Slope in degrees
Directions	dbMemo	0	Directions to access site
Comments	dbText	255	Additional location comments.

TABLE NAME: **tluBirds_GOGA**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of Golden Gate NRA bird species.
FORMAT: Microsoft Access
NO. OF FIELDS: 7

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Sort_Order	dbDouble	8	Species sort order - based on phylogeny.
SPCode	dbText	255	Four-letter species code, based on common name.
CommonName	dbText	255	Common, vernacular name of species.
FullLatinName	dbText	157	Scientific name of species.
FamilyName	dbText	157	Family name of species.
OrderName	dbText	157	Order grouping of species.
TSN	dbLong	4	ITIS Taxonomic Serial Number.

TABLE NAME: **tluDayType**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of day types - weekday or weekend.
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Day	dbText	50	Day of week.
DayType	dbText	50	Weekday or weekend.

TABLE NAME: **tluMonth**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of month names and numbers.
FORMAT: Microsoft Access
NO. OF FIELDS: 3

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
MonthNumber	dbDouble	8	Number of month.
MonthName	dbText	50	Name of month.

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OrderBy dbDouble 8 Sort order of months.

TABLE NAME: **tluObserver**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of observer initials and details.
FORMAT: Microsoft Access
NO. OF FIELDS: 5

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
OBSCODE	dbText	50	Initials of observer.
FIRSTNAME	dbText	50	First name of observer.
LASTNAME	dbText	50	Last name of observer.
TITLE	dbText	50	Position title of observer.
EMPLOYER	dbText	50	Employer of observer.

TABLE NAME: **tluParkCode**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of SFAN I&M park codes.
FORMAT: Microsoft Access
NO. OF FIELDS: 3

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
PARKCODE	dbText	255	4-character park code.
PARKNAME	dbText	255	Park name.
PARKTYPE	dbText	255	Park type (National Park, National Monument, etc.).

TABLE NAME: **tluProject**
FILENAME: MASTER_SNPL_v2_00.mdb
DESCRIPTION: Look-up table of project history and description.
FORMAT: Microsoft Access
NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
ProjectCode	dbText	10	Code for the monitoring project (up to 10 characters).
ProjectTitle	dbText	255	Full project title.
ProjectManager	dbText	50	Individual in charge of monitoring project.
StartDate	dbDate	8	When monitoring project was initiated.
Comments	dbText	255	Comments on the project.
DatabaseName	dbText	250	Name of the data warehouse.
Format	dbText	250	Type of database.
DatabasePath	dbText	250	Directory path of database.
DataTypes	dbText	250	Indicates types of data stored in the database.

SOP 5. Data Analysis and Reporting

Version 2.3

Revision History Log:

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
		M. Koenen	Adapted to formatting standards for the NPS I&M Program. Added analyses.	To meet NPS guidelines	1.0
1.0	Dec. 2009	B. Merkle	Development and consistency with monitoring program.	Preparation for protocol review submittal	2.0
2.0	April 2010	M. Koenen, B. Merkle, D. Adams	Finalizing analysis methods, formatting	Peer review	2.1
2.1	January 2011	D. Adams, B. Merkle, D. Press	Updated and improved figures, typos corrected, formatting	Response to peer review comments	2.2
2.2	Oct. 2014	D. Adams	Updated formatting to NRR v3.6		2.3

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Data Analysis and Reporting Overview

The following section describes how data will be analyzed and presented in annual and long-term reports. Although the focus of annual reports is to summarize monitoring efforts and data collected during the previous season, the graphs and tables will show running tallies from other years. Long-term reports will provide additional interpretation and statistical analysis of parameter trends over the entire range of dates for the monitoring program. In general, for annual reporting, trends are evaluated by analyzing graphical or tabular representations of the data.

Annual Reports

Annual reporting for this project began in 2008. Prior to that, trend reports were completed every few years. However, annual reports ensure that information about the snowy plover winter season is documented and distributed to staff and other agencies. The annual report provides a concise summary of the field season and is written according to the San Francisco Bay Area Network (SFAN) Data Management Plan (Press 2005).

The annual report includes an abstract, introduction, study area and methods, results, and discussion including conclusions. The results section includes information on monitoring efforts, annual snowy plover arrival and departure dates and a summary of census numbers, and a synopsis of the disturbance monitoring data collected. Recommendations on topics including management, research, and changes in the protocol (changing monitoring intervals and timing, moving/adding sites, etc.) are included in the discussion section. The recommendation section is an excellent place to identify and emphasize the need for additional protective measures for snowy plovers (e.g., locations for additional or improved signage, working with different user groups, restricting activities, etc.). The annual report enables readers to determine if the monitoring goals of the project are being met and provides an administrative and scientific record of monitoring activities. Additionally, the report provides enough information for resource managers to visually interpret trends in snowy plover abundance and distribution.

Annual Data Summaries

In annual reports, the data are summarized for each monitoring objective. Some tables and figures cover multiple objectives. For monitoring objectives, the analysis of snowy plover population numbers focuses on the winter season data versus using all three seasons. The winter season from November through February best defines the time period when snowy plovers consistently inhabit Ocean Beach and Crissy Field during the non-breeding season. Analysis of only winter season population numbers removes the fall and spring migration periods when some of the snowy plovers observed are moving through the Golden Gate National Recreation Area (GOGA) survey areas.

Monitoring objectives 3–6 relate to the collection of important data to inform resource management decisions to protect plovers. Since these monitoring objectives relate to tracking snowy plovers that are using park beaches throughout the non-breeding season, some analysis and reporting also covers the entire monitoring period.

Monitoring Objective 1

Determine trends in snowy plover winter season average population size among years at Ocean Beach and Crissy Field by recording:

- number of snowy plovers encountered on each survey on Ocean Beach and Crissy Field for the entire monitoring season (Figure SOP 5.1)
- average snowy plover count by month for survey year in comparison with average over all other survey years for Ocean Beach and Crissy Field (Figure SOP 5.2)
- annual maximum, median, and winter season average and median number of snowy plovers on Ocean Beach and on Crissy Field (Tables SOP 5.1, Figure SOP 5.3)

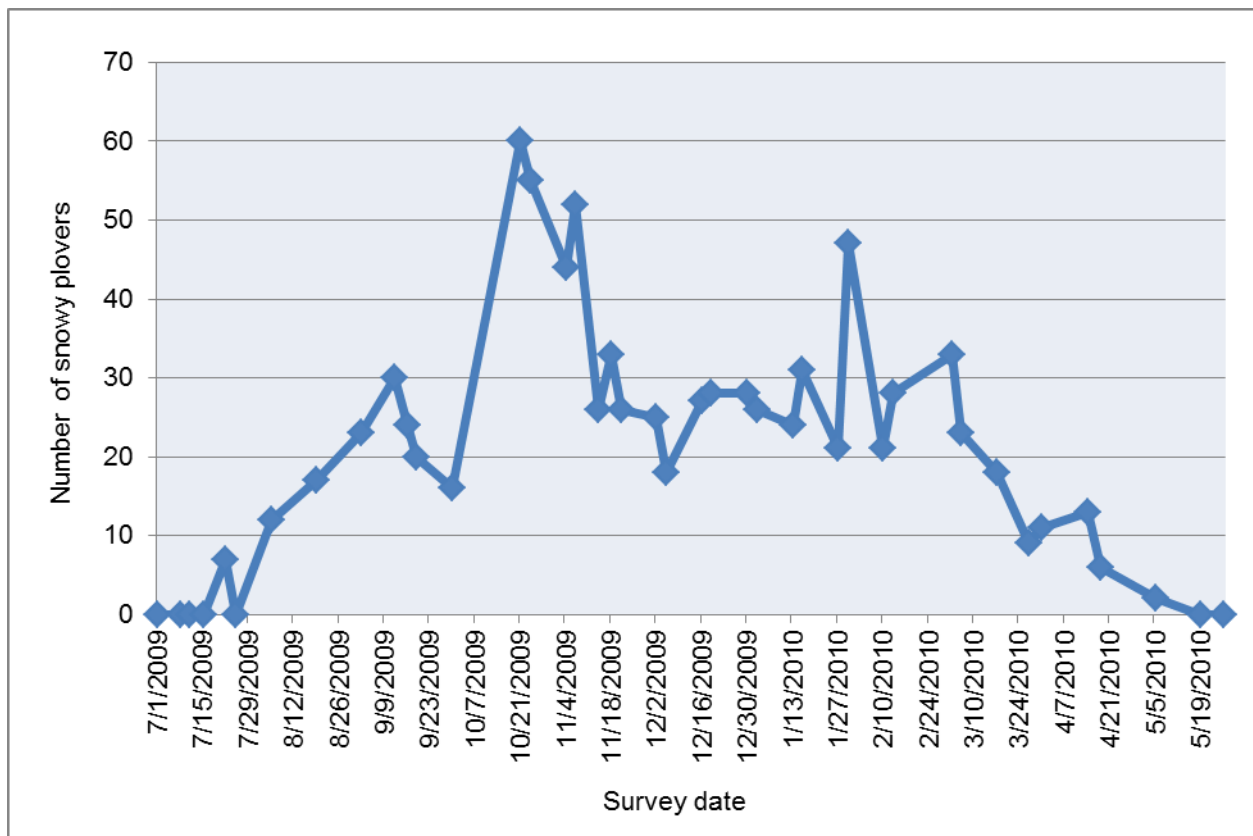


Figure SOP 5.1. Number of snowy plovers observed on each survey during the 2009 survey year at Ocean Beach, Golden Gate National Recreation Area. *Source:* NPS unpublished data.

The 2009 survey year results generally showed a typical pattern of snowy plover use of Ocean Beach (Figure SOP 5.1). Snowy plovers tend to be first observed in early to mid-July, but in 2009 snowy plovers were first seen on 7/22/2009. The number of snowy plovers increases, and tends to peak in about October, when some plovers have settled on Ocean Beach but other plovers are still migrating through. The winter season, November until February, shows the most consistent numbers but with some variation among counts. Starting in late February or March the plover numbers decline as birds begin leaving for breeding areas. Snowy plovers tend to be gone from Ocean Beach by mid-May.

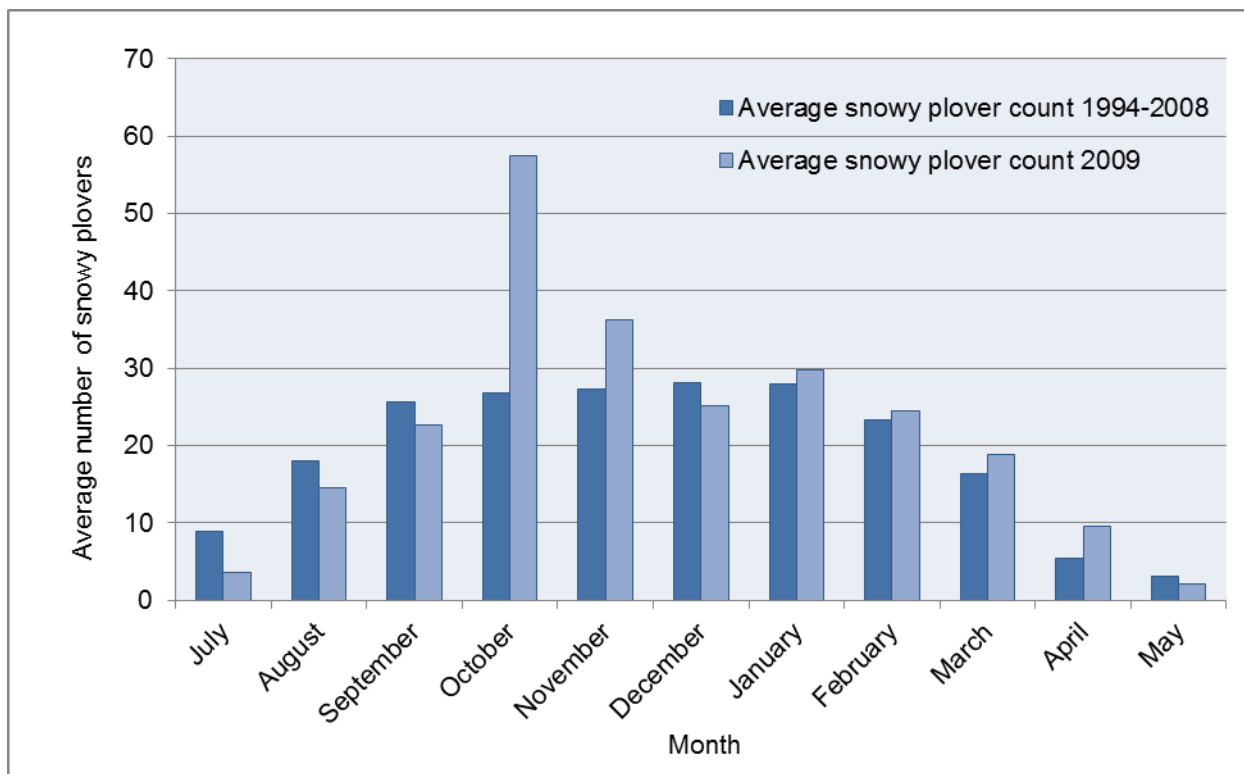


Figure SOP 5.2. Monthly average number of snowy plovers observed per survey at Ocean Beach for the survey years 1994–2006 combined in comparison with 2007 survey year. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data. Note that only surveys with snowy plovers between the first and last date of plover detections were included.

In comparison to the monthly average from 1994 through 2009 survey years, the 2009 survey year was very close to the average or exceeded the 1994–2008 average in terms of the numbers of plovers observed in most months (Figure SOP 5.2). The October 2009 average snowy plover count was more than twice the 1994–2008 October average plover count.

The average number of snowy plovers observed per survey during the winter peaked in 1994–1995 at over 54 plovers (Table SOP 5.1, Figure SOP 5.3). The winter season average snowy plovers per survey steadily declined to under 13 in 1999. The winter population of snowy plovers increased to an average above 30 birds per winter survey in 2002–2006. The 2008 season was the first year that the average winter season snowy plover population size was below 20 since 2000, but the population size returned to previous levels in 2009.

Table SOP 5.1. Maximum and median number of snowy plovers counted at Ocean Beach (1994–2009) and Crissy Field (2006–2009). *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

Beach Location	Survey Year	Maximum number	Median Number (1 July–15 May)	Winter Mean (Nov–Feb)	Winter Median (Nov–Feb)
Ocean Beach	1994	85	*	54.7	59.0
Ocean Beach	1995	48	22.0	28.4	27.5
Ocean Beach	1996	44	19.0	20.3	21.0
Ocean Beach	1997	43	20.5	23.1	24.0
Ocean Beach	1998	28	14.0	13.9	13.0
Ocean Beach	1999	18	14.0	12.7	15.0
Ocean Beach	2000	23	13.5	13.1	14.5
Ocean Beach	2001	33	21.5	21.4	22.0
Ocean Beach	2002	39	26.0	32.0	34.0
Ocean Beach	2003	62	32.0	39.5	36.0
Ocean Beach	2004	60	28.0	30.9	33.0
Ocean Beach	2005	43	33.0	35.2	35.0
Ocean Beach	2006	43	28.5	32.0	33.0
Ocean Beach	2007	49	16.0	24.4	26.0
Ocean Beach	2008	23	15.5	16.9	16.5
Ocean Beach	2009	60	24.0	29.7	27.0
Crissy Field	2006	6	-	2.3	3.0
Crissy Field	2007	4	-	2.4	3.0
Crissy Field	2008	5	-	2.6	3.0
Crissy Field	2009	5	-	1.9	2.0

* Counts in 1994 did not start until December 8, so median value is not reported.

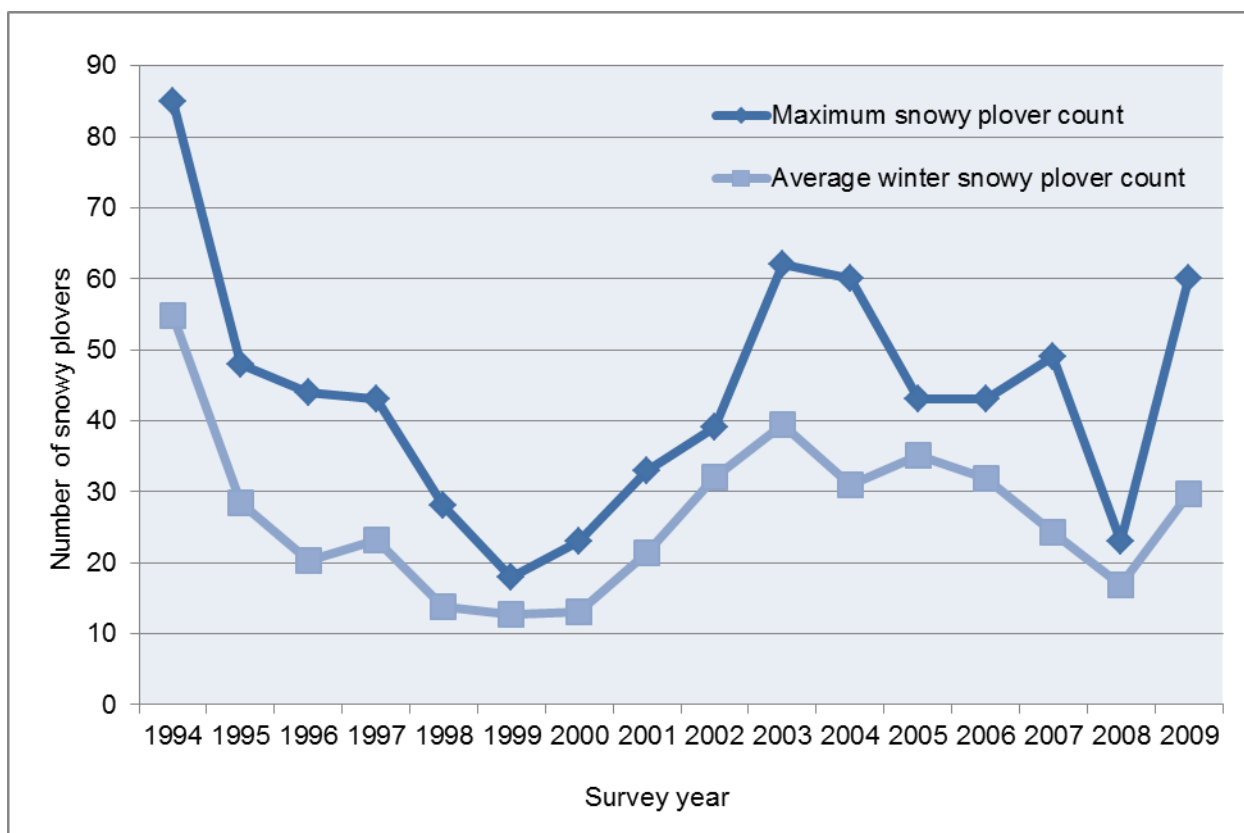


Figure SOP 5.3. Annual maximum and winter season average number of snowy plovers per survey for Ocean Beach, 1994–2009. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

Monitoring Objective 2

Determine trends in the spatial distribution of snowy plovers during the winter season at Ocean Beach and Crissy Field by calculating:

- percentage of snowy plover observations by sector for most recent survey year in comparison with all other years combined (Figure SOP 5.4)
- winter season average number of snowy plovers per survey by sector, and across sectors (Figure SOP 5.5)

Most snowy plover observations have occurred in sectors eight and nine on Ocean Beach. A higher percentage of the snowy plovers observed in 2008 occurred in sectors eight and nine in comparison with pooled data from 1994 to 2007 (Figure SOP 5.4). The percentage of plover use of sectors eight and nine was lower in 2009 as compared to the percentages in 2008 and the 1994–2007 combined.

Snowy plovers appear to use sectors eight and nine on Ocean Beach (Figures SOP 5.4 and SOP 5.5), but there is variation in the number of snowy plovers per winter survey in sectors five, six, eight, and nine with no single sector serving as an index for total population.

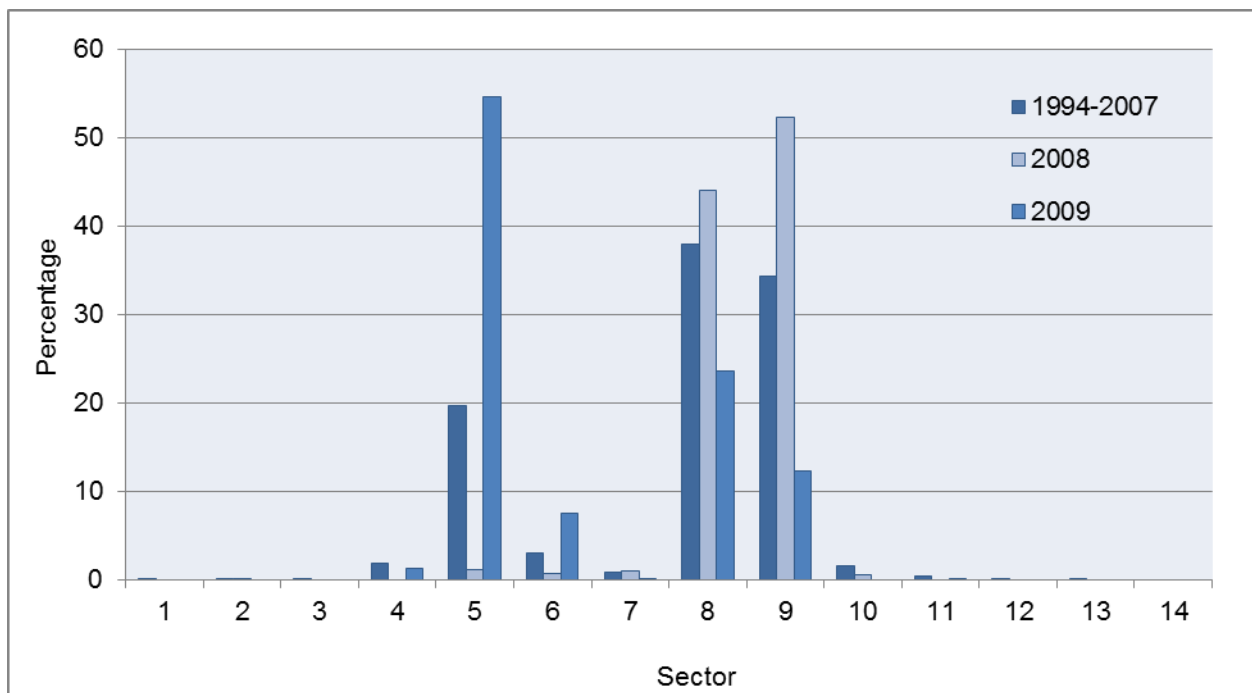


Figure SOP 5.4. Percentage of snowy plovers observed on Ocean Beach for survey years 1994–2007 combined in comparison with survey years 2008 and 2009. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

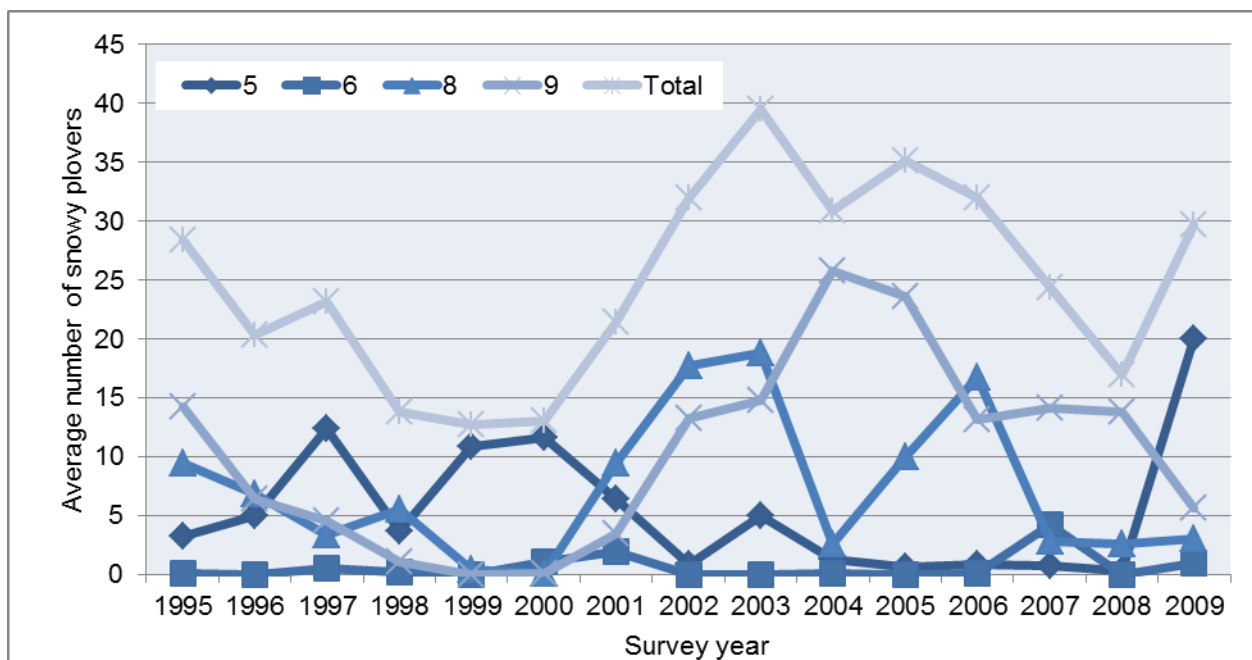


Figure SOP 5.5. Average number of snowy plovers observed for the four most commonly used sectors (Sectors 5, 6, 8, and 9) of Ocean Beach, and across all sectors, during the winter season, 1995–2009. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

Monitoring Objective 3

Determine the phenology of snowy plover arrival and departure dates from Ocean Beach and Crissy Field by recording:

- annual arrival (first date plovers observed) and departure dates (last date plovers observed) from Ocean Beach and Crissy Field (Table SOP 5.2)
- average number of snowy plovers per survey by month for most recent survey year in comparison with monthly average counts over rest of monitoring period (Figure SOP 5.2)

Understanding patterns of when snowy plovers arrive and depart from Ocean Beach and Crissy Field allows park managers to evaluate the current seasonal public use restrictions, as well as informing when heavy equipment can access the beach for maintenance of infrastructure. Changes in plover arrival or departure dates also would change the annual monitoring timeline. Determining changes in the period of time within a non-breeding season that snowy plovers use Ocean Beach and Crissy Field could also indicate habitat or disturbance issues. Long-term changes in wildlife phenology are also of biological interest related to habitat alterations due to climate change.

Table SOP 5.2. First and last dates snowy plovers were observed at Ocean Beach and snowy plover numbers seen on those dates, 1994–2009 survey years. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

Survey Year	Date of First Complete Survey	First Date Plovers Observed	# of Plovers	Date of Last Complete Survey	Last Date Plovers Observed	# of Plovers
1994	12/08/1994	12/08/1994	69	5/13/1995	5/13/1995	2
1995	7/19/1995	7/19/1995	17	4/27/1996	4/20/1996	2
1996	7/10/1996	7/10/1996	4	5/14/1997	4/30/1997	2
1997	7/03/1997	7/09/1997	3	5/20/1998	5/13/1998	2
1998	7/11/1998	7/11/1998	1	4/28/1999	3/31/1999	7
1999	7/21/1999	7/21/1999	4	5/10/2000	4/26/2000	3
2000	7/05/2000	7/09/2000	2	4/11/2001	4/11/2001	9
2001	7/12/2001	7/25/2001	11	4/06/2001	3/30/2002	12
2002	7/24/2002	7/24/2002	8	5/21/2003	5/07/2003	2
2003	7/30/2003	7/30/2003	10	5/15/2004	4/28/2004	4
2004	7/28/2004	7/28/2004	16	5/25/2005	4/30/2005	4
2005	8/10/2005	8/10/2005	20	4/19/2006	4/19/2006	6
2006	7/12/2006	7/26/2006	13	5/12/2007	4/25/2007	2
2007	7/7/2007	7/21/2007	9	5/14/2008	5/6/2008	1
2008	7/2/2008	7/9/2008	1	5/20/2009	4/29/2009	2
2009	7/01/2009	7/22/2009	7	5/26/2010	5/5/2010	2

Snowy plovers tend to arrive at Ocean Beach in July (Table SOP 5.2). The earliest arrival date of July 9 occurred in both 1997 and 2000. The latest date plovers have been observed on Ocean Beach is May 13 in both 1994 and 1997. There do not appear to be any strong trends in plover arrival or departure dates from Ocean Beach.

Monitoring Objective 4

Monitor number and distribution of people and dogs at Ocean Beach and Crissy Field by calculating:

- median values of number of people per hour and unleashed dogs per hour in Snowy Plover Protection Areas (Figure SOP 5.6)

Annual reports will also provide information relating to the management objective of minimizing disturbance to wintering snowy plovers. For analysis of rates for people and dogs, median values are used to remove the effects of a few extreme visitation days. These analyses focus on the Snowy Plover Protection Area and Wildlife Protection Area.

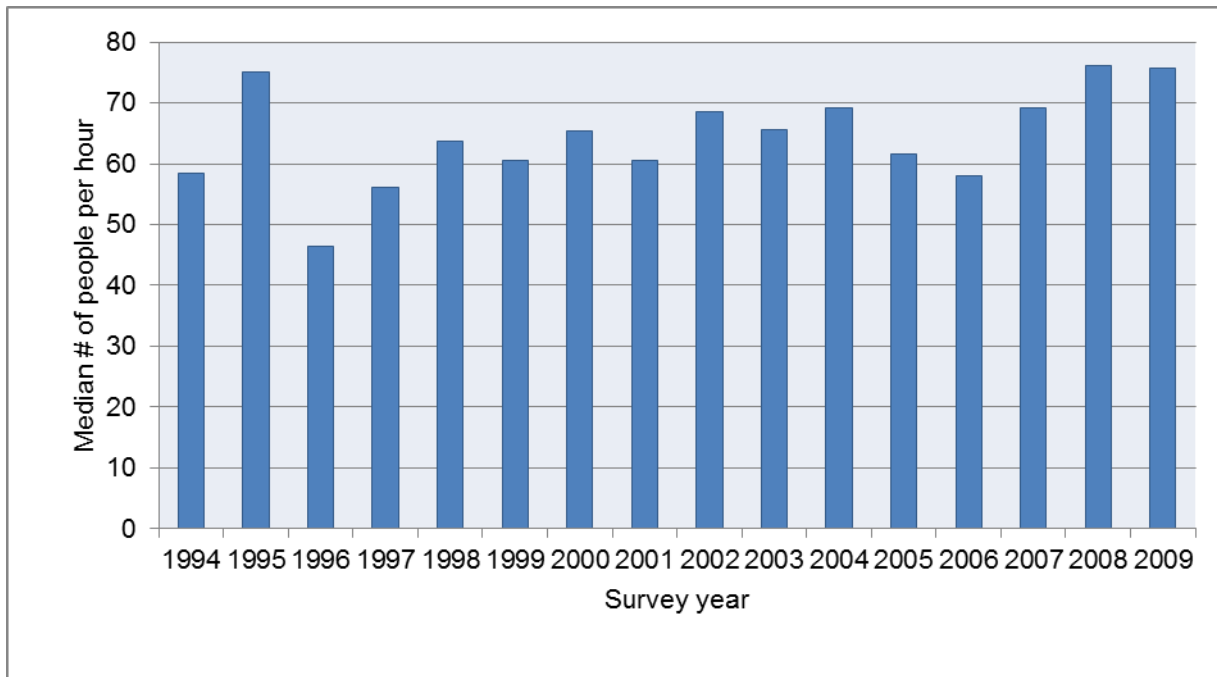


Figure SOP 5.6. The annual median number of people per hour in the Snowy Plover Protection Area at Ocean Beach (sectors 4–12) from 1994 to 2009 survey years. *Source:* Hatch 1996, NPS 2006, 2007, 2008, unpublished data.

There is no apparent trend in the overall number of people using the Snowy Plover Protection Area at Ocean Beach between 1994 and 2009 (Figure SOP 5.6). An analysis of visitation trends by sector has not been completed but would likely be done for a long-term trend report.

Monitoring Objective 5

Monitor compliance rates for seasonal restrictions requiring pets to be on leash in the Snowy Plover Protection Area and Wildlife Protection Area from July 1 through May 15 by calculating:

- percentage of dogs unleashed in the Snowy Plover Protection Areas at Ocean Beach and Crissy Field (Figure SOP 5.7)

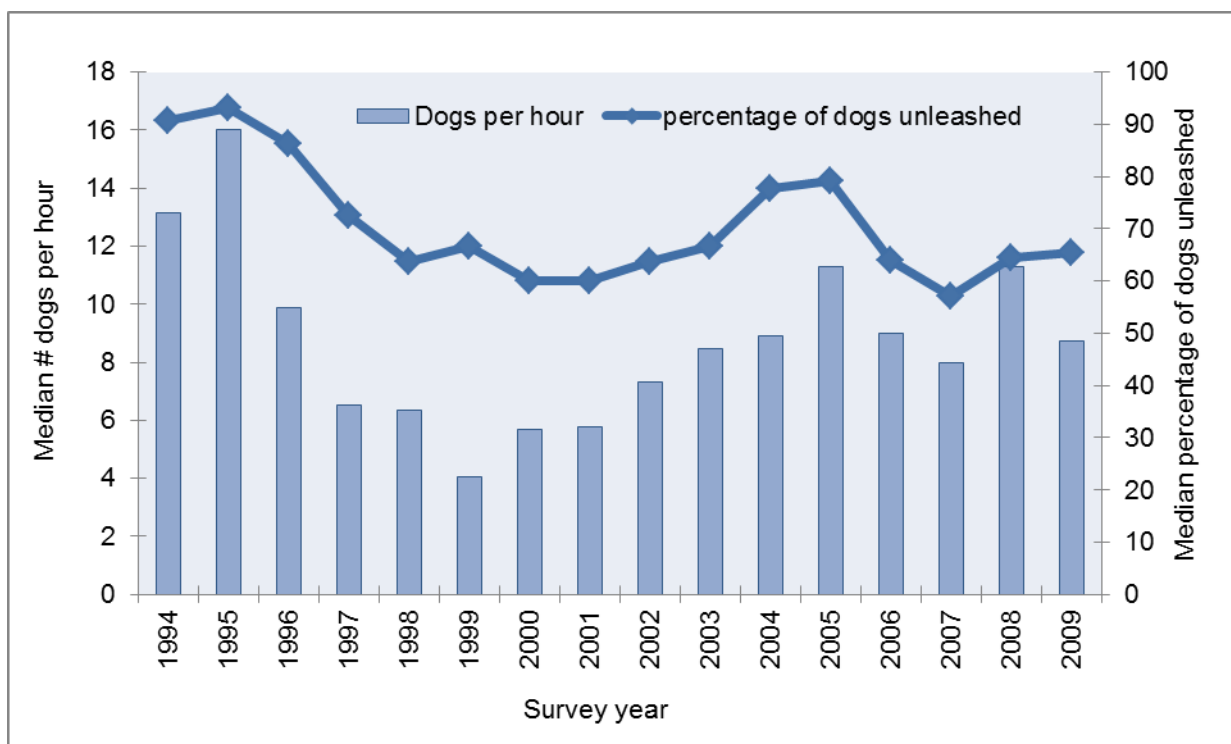


Figure SOP 5.7. The median number of dogs per hour and the median percentage of unleashed dogs in the Snowy Plover Protection Area at Ocean Beach from 1994 to 2009. *Source:* Hatch 1996, NPS 2006, 2007, 2008, NPS unpublished data.

From 1995 to 1999, there was a decline in the median number of dogs; median numbers increased from 2000 to 2005 then decreased in 2006 and 2007 survey years before increasing again in 2008 (Figure SOP 5.7). The percentage of off-leash dogs follows a similar pattern. These patterns may be due to enforcement of pets on leash regulations that started during the 1996 survey year. The increases from 2000 to 2004 may have been due to the park providing advance notice of proposed rulemaking in relation to dogs and the ensuing public controversy, with reduced enforcement of leash regulations. In December of 2004, a judge's ruling rescinded the leash regulations which was likely related to the increase in percentage of dogs unleashed in 2004 and 2005 survey years. GOGA issued new leash requirements during the 2006 survey year.

Monitoring Objective 6

Monitor the rates of dogs chasing snowy plovers or other shorebirds at Ocean Beach and Crissy Field by calculating:

- average number of dogs chasing shorebirds and snowy plovers (Figure SOP 5.8)

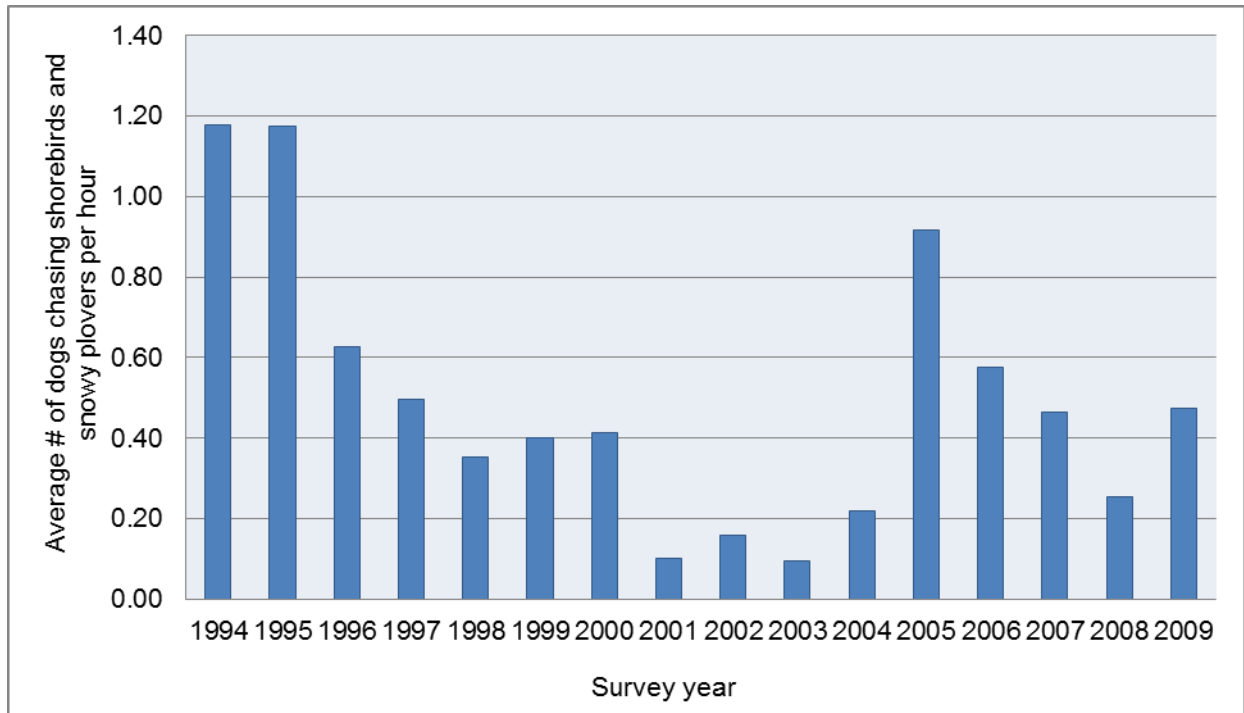


Figure SOP 5.8. Average number of dogs chasing shorebirds and snowy plovers in the Snowy Plover Protection Area at Ocean Beach from 1994 to 2009. *Source:* NPS 2006, 2007, 2008, NPS unpublished data.

From 1995 through 2004, survey results showed a decreasing trend of dogs chasing shorebirds (Figure SOP 5.8). There is a sharp increase in the number of chasing events observed by observers after the judge's ruling allowed off-leash dogs again in December 2004, indicated by the large increase from 2004 to 2005.

Annual Report Format

Format follows the national guidelines established for the Natural Resource Technical Report series by the Natural Resource Publications Manual (<http://nature.nps.gov/publications/NRPM>).

Annual Report Distribution

These annual reports will be distributed to the GOGA Chief of Natural Resources, SFAN I&M Staff, and Point Reyes National Seashore Wildlife Biologist. Electronic copies will be archived on the SFAN Intranet page and the SFAN I&M Archive on the network drive.

Long-term Trends and Synthesis Reports

A comprehensive data analysis and synthesis will be written every five years to summarize general trends of parameters measured through the snowy plover monitoring program within the context of the park ecosystem. Having a periodic, in-depth analysis report allows for more thorough data analysis and review of the protocol and SOP's and may allow for greater opportunity for adaptive management. The synthesis report summarizes data collected over multiple years and over the extent of the monitoring program as presented above and will provide additional interpretation of results including evaluating trends, making multi-year comparisons, and framing the results in the broader

regional context of snowy plover monitoring and conservation. Previous examples of these reports were completed by Hatch (1996) and NPS 2006 and 2007, which are located on the SFAN network drive. Future reports, however, will include more statistical analysis among years to detect trends.

The focus of the trend reports will be to evaluate population abundance and distribution trends of snowy plovers on Ocean Beach and Crissy Field, including the relationship between population and distribution trends and potential causes of disturbance (temperature, precipitation, storm events, beach profile changes, recreational use levels). A model (e.g., general linear model) will be developed to examine the relative importance of various factors including regional population trends, regional breeding success, adult and juvenile survivorship, weather and climate, beach width and profile, habitat measures, as well as potential causes of disturbance including aircraft, vehicles, watercraft, horses, people, and dogs in explaining changes in snowy plover population levels and distribution on the beach. This model will help tease out the relative importance of breeding season effects, environmental factors, and anthropogenic disturbance on the snowy plovers that overwinter at Ocean Beach and Crissy Field.

Dr. Kirk Steinhorst, University of Idaho, provided technical assistance on monitoring program design and trend analysis for this program. Data from the 1994 survey year have been excluded from trend analysis, as monitoring did not begin until midway through the season in December of 1994. Methods for long-term trend analysis are presented below. New, more robust statistical techniques may be added as they are developed in the future.

Abundance and Distribution Trends

Abundance of snowy plovers will be evaluated by analyzing tabular and graphical representations of the data (see Tables SOP 5.1 and SOP 5.2, and Figures SOP 5.3 and SOP 5.5).

The Mann-Kendall test will be used to detect trends in winter season average snowy plover counts. This test measures the trend of a variable (average number of snowy plovers) against time (year) or correlations between any set of paired observations if one variable is not time. While trends can be rejected or not rejected, failing to reject does not prove that there was no trend. Tests can be run using a variety of statistical software.

The Mann-Kendall test for winter season average number of snowy plovers from 1995 to 2007 showed no significant trend over time ($p=0.14$; University of Idaho, K. Steinhorst, Professor, pers. comm., 2009). In addition, we can analyze each sector separately for a simple repeated measures design that is equivalent to a randomized block design where blocks are equal to locations and years equal to treatment. Page's test is used for multiple comparisons between ordered correlated variables. In this case, Page's test will reveal if there is a trend over years among sectors. Page's test was run for sectors five, eight, and nine, where the most plovers have been observed, indicating no significant trend over time ($z=0.75$, $p=0.23$; University of Idaho, K. Steinhorst, Professor, pers. comm., 2009).

Trends in snowy plover distribution will be analyzed through visual interpretation of the data (See Figures SOP 5.4 and SOP 5.5). In addition, Mann-Kendall or Page's test can be run on individual or groups of sectors. Mann-Kendall correlations run on snowy plover average winter counts (1995–

2007) for individual sectors provided some evidence for a declining trend in sector five ($\tau = -0.41$, $p = 0.05$), and an increasing trend for sectors nine ($\tau = 0.46$, $p < 0.03$) and ten ($\tau = 0.38$, $p = 0.08$; University of Idaho, K. Steinhorst, Professor, pers. comm., 2009).

In addition, future exploratory analyses could include correlations with other data sets (e.g., temperature, precipitation, beach conditions, food availability) as they become available and would consider regional trends using USFWS winter window survey data or other winter season snowy plover monitoring data. This section will be updated with new analyses as they are made.

Changes in Phenology

Changes in phenology as presented in table SOP 5.3 will be of interest to evaluate influences of climate change. Significant arrival or departure date changes may require adjustments of management activities such as beach closures. To determine if there are trends in snowy plover arrival or departure dates, Mann-Kendall and Page's tests as described above will be used to evaluate Julian date of arrival and departure over years.

Trends in Disturbance

To determine if there are long-term trends over years in the number of people, dogs, compliance with leash restrictions, or dogs chasing shorebirds or plovers, Mann-Kendall and Page's tests will be used. Tests can be for overall parameter values across sectors, for groups of sectors, or for individual sectors.

Outreach Activities

Given that the relationship between snowy plover preservation and off-leash dogs is controversial and inspires public debate, it is critical to inform park staff about snowy plovers including their population trends and issues encountered on the beach.

Monthly GOGA E-Mail Updates

Once a month during the monitoring season, the intern should send an update on snowy plover monitoring to GOGA staff including the beach safety patrol, law enforcement, interpreters, and managers. The email also would be forwarded to volunteers supporting the monitoring program and will be posted to the SFAN intranet site. This email provides the following data updates:

1. Overview: A brief summary of monthly activities that include interesting observations. These may include a description of snowy plover numbers, list of unusual bird sightings, unique encounters with the public.
2. Table with running monthly average and high counts of snowy plovers.
3. Bar graph showing snowy plover numbers compared to monthly average numbers for previous years.
4. Photos.

The monthly update must include the following disclaimer:

The National Park Service shall not be held liable for improper or incorrect use of the data described and/or contained herein. These data and related graphics (if available) are not legal

documents and are not intended to be used as such. The information contained in these data is dynamic and may change over time. The National Park Service gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. For more information: http://science.nature.nps.gov/im/units/sfan/data_liability.cfm.

Monthly I&M Update

The SFAN I&M Program produces a monthly email update covering natural resource events and activities at GOGA, Pinnacles National Monument, and Point Reyes National Seashore. Project Leads are encouraged to submit a short paragraph on I&M activities every few months to update staff throughout the network parks. The snowy plover project will submit paragraphs for inclusion in these updates at least twice a year.

Resource Briefing

The resource briefing for the GOGA snowy plover monitoring program should be updated annually or at least every two years. The briefing is a two-page summary in a standard template that is used to inform park staff and the public about the monitoring program and the status of snowy plovers on GOGA beaches. The briefing summarizes key findings, especially population trends and conservation issues. Photographs and an illustrative figure are used to engage readers. Examples of briefings, including the snowy plover briefing are posted to the SFAN website: <http://science.nature.nps.gov/im/units/sfan/index.cfm>.

Public Access to Reports and Data

Public access to snowy plover reports is available through the SFAN website (noted above) in the form of a resource briefing and annual reports. NRInfo (<http://nrinfo.nps.gov>) records will be created for all of the snowy plover monitoring documents, including the protocol, annual reports, and any resulting publications. When completed, metadata records, but not the data, will be posted to the NPS NRInfo for public discovery and consumption. Contact information within the metadata records will direct interested parties to the SFAN Data Manager for inquiries. Master database metadata records posted to NRInfo will be updated annually after the annual data has been uploaded or following database revision to a new version whole number (i.e., v1_3 to v2_0, but not v2_0 to v2_1).

Literature Cited

Hatch, D. A. 1996. Western snowy plover wintering population and interaction with human activity on Ocean Beach, San Francisco, Golden Gate National Recreation Area, 1988 through 1996. Golden Gate National Recreation Area Unpublished Report, San Francisco, California.

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National Park Service (NPS). 2008. Addendum: 2007 Plover monitoring season update, status report: Western snowy plovers and recent changes in human and dog use within the Snowy Plover Management Area at Ocean Beach and the Wildlife Protection Area at Crissy Field. Golden Gate National Recreation Area Unpublished Report, San Francisco, California.

Press, D. T. 2005. Data management plan for the San Francisco Bay Area Network Inventory and Monitoring Program. National Park Service Unpublished Report, San Francisco, California.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 641/127559, December 2014

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