National Park Service
U.S. Department of the Interior

Natural Resource Program Center

# Monitoring Western Snowy Plovers at Point Reyes National Seashore, Marin County, California

*2008 Annual Report*

Natural Resource Technical Report NPS/SFAN/NRTR—2009/180

**ON THE COVER**
Western Snowy Plover pair (*Charadrius alexandrinus nivosus)*
Photograph by: Kate Peterlein (2008)

# Monitoring Western Snowy Plovers at Point Reyes National Seashore, Marin County, California

*2008 Annual Report*

Natural Resource Technical Report NPS/SFAN/NRTR—2009/180

Catherine R. Peterlein
Point Reyes National Seashore Association
Point Reyes, CA 94956

March, 2009

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

The Natural Resource Publication series addresses natural resource topics that are of interest and applicability to a broad readership in the National Park Service and to others in the management of natural resources, including the scientific community, the public, and the NPS conservation and environmental constituencies. Manuscripts are peer-reviewed to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and is designed and published in a professional manner.

The Natural Resource Technical Reports series is used to disseminate the peer-reviewed results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service's mission. The reports provide contributors with a forum for displaying comprehensive data that are often deleted from journals because of page limitations. Current examples of such reports include the results of research that addresses natural resource management issues; natural resource inventory and monitoring activities; resource assessment reports; scientific literature reviews; and peer reviewed proceedings of technical workshops, conferences, or symposia.

Views, statements, findings, conclusions, recommendations and data in this report are solely those of the author(s) and do not necessarily reflect views and policies of the U.S. Department of the Interior, NPS. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the National Park Service.

Printed copies of reports in these series may be produced in a limited quantity and they are only available as long as the supply lasts. This report is also available from (http://www.nature.nps.gov/im/units/SFAN) and the Natural Resource Publications Management website (http://www.nature.nps.gov/publications/NRPM) on the Internet.

Please cite this publication as:

Peterlein, C.R. 2009. Monitoring Western Snowy Plovers at Point Reyes National Seashore, Marin County, California, 2008 Annual Report. Natural Resources Technical Report NPS/SFAN/NRTR – 2009/180. National Park Service, Fort Collins, Colorado.

NPS D-116, March 2009

# Contents

# Tables

# Figures

# Appendices

# Abstract

This report details the results of the 19th year of the Western Snowy Plover (*Charadrius alexandrinus nivosus*) monitoring program within Point Reyes National Seashore, Marin County, California (PRNS). The goal of the 2008 monitoring effort was to determine abundance, distribution, and breeding success of snowy plovers nesting on federal lands within PRNS. The intended audience of this report includes appropriate agencies at the county, state, and federal levels. The report provides an overview of the 2008 snowy plover monitoring program on federal lands and summarizes the results of the data collected during the field season.

In 2008, there were 147 surveys conducted between Kehoe Beach and North Beach parking lot, two from South Beach to the Lighthouse, 17 on Limantour Spit, and two on Drakes Spit to determine abundance and distribution of breeding snowy plovers. An estimated 23-24 plovers bred on Point Reyes National Seashore. Exclosures were placed around 18 of 21 nests located in 2008. Eleven of 21 nests hatched at least one egg and 30 of 55 eggs hatched. Only five of 30 chicks survived for at least 28 days after hatching for a 16.1% fledging rate. The number of fledglings per egg was 0.09 which was the lowest since 1995.

# Acknowledgements

This project is made possible by funding from the San Francisco Bay Area Network Inventory and Monitoring Program and the Point Reyes National Seashore Association. Additional support was provided by Point Reyes National Seashore.

F. Cox, D. Freid, M. Leland, J. Longstreth, T.J. Mulhern, J. Rehm, and J. Rolka helped conduct surveys, provided transportation, and/or set up symbolic fencing and exclosures. PRNS volunteer docents logged 375 hours of volunteer time and contacted 3,191 visitors on weekends and holidays throughout the 2008 plover nesting season (Stearns 2008). PRNS staff S. Allen and N. Gates provided technical supervision. PRNS ranger E. Stearns was invaluable to the ongoing outreach and education program.

# Introduction

In March 1993, the Pacific coast population of the Western Snowy Plover (*Charadrius alexandrinus*) was listed as threatened by the U.S. Fish and Wildlife Service (USFWS 2007). The population decline prompting listing was largely due to habitat degradation, predators, and recreational disturbance. In 1996 PRBO Conservation Science (PRBO) began helping the U. S. National Park Service reach the USFWS (2007) recovery goal of 64 breeding birds within Point Reyes National Seashore (PRNS) by recommending management actions and monitoring the birds' response to those actions. PRBO conducted intensive snowy plover research at PRNS for 18 years including 1977, 1986 to1989, and 1995 to 2007. In 2008, Point Reyes National Seashore took on the responsibilities of monitoring.

### Current Monitoring Objectives

The overall goals of the Western Snowy Plover Monitoring Program are to:

1. Determine trends in the estimated breeding population size, distribution, and reproductive success of snowy plovers at known breeding beaches at PORE.

2. Determine changes in relative abundance and distribution of snowy plovers at known wintering beaches at GOGA and PORE and relate to the rates of recreation or management activities.

3. Identify plover adult, egg and chick predators and determine trends in encounter rates during plover surveys (both winter and breeding).

## Study Area & Methods

Snowy plovers have historically used Point Reyes Beach, Drake's Spit and Limantour Spit for nesting within Point Reyes National Seashore. Point Reyes Beach is separated into four survey areas: 1. Kehoe Beach entrance to Abbott's Lagoon (K); 2. Abbott's Lagoon to North Beach parking lot (NP); 3. North Beach parking lot to South Beach parking lot (NB); and 4. South Beach parking lot to Lighthouse Beach (SB). Limantour Spit (L) refers to the beach area from the Limantour Beach parking lot west to the end of Limantour Spit. Although Limantour has not been used by plovers during a breeding season since 2000, it continues to be surveyed. Drake's Spit (D) refers to the beach to the West side of the mouth to Drake's Estero (Figure 1). For details on study area, see also Adams et al. (DRAFT).


Figure 1. Approximate locations of study sites including: Kehoe Beach entrance to Abbott's Lagoon (K); Abbott's Lagoon to North Beach parking lot (NP); North Beach parking lot to South Beach parking lot (NB); South Beach parking lot to Lighthouse Beach (SB), Limantour Spit (L), and Drake's Spit (D).

### Field Surveys

Surveys begin March 15 and continue through August and into September, if additional

broods have not yet fledged. Observers use field notebooks to record plover nest data and observations. Nest data records are transferred to nest data forms and entered in the office and summarized at the end of the season using a MS Access database.

On surveys, observers walk just below the high tide line, crossing above the line only when necessary to see the full width of the beach. Observers stop every 50 to 100 m to scan with binoculars at least 100 m ahead for plovers. When a plover(s) is located, observers approach close enough to determine age, sex, and color band combination if bands are present (from other areas). Date, location (by sub-area and pre-determined landmarks), and the time of sighting is recorded. Observers then walk around the bird(s) to prevent flushing it.

Nests are located using three methods: 1) systematically searching microhabitats in which plovers are likely to nest; 2) watching potential breeding adults from a concealed position; and 3) following plover footprints in fine sand. Once a nest is located, it is immediately exclosed with a 10-foot by 10-foot square fence unless it is determined that avian predators or high tide threaten the nest or the safety of nesting plovers. The coordinates of all nests are determined using GPS units and maps are produced at the end of each season. Nests are checked 2-4 times per week to verify if they are still active. Near the nest's projected hatching date, checks are made more frequently to determine the precise hatch day. Adults and chicks are looked for on follow up visits; once found, the number of chicks and location are recorded. The chicks are monitored until 28 days after hatching, when they were considered fledged.

If a nest is abandoned by the adult plovers or has failed to hatch in over 35 days, the plover biologist will collect the unhatched eggs. The eggs are stored in a refrigerator at PRNS with the collection information until they can be transferred to a facility, which will test for methyl mercury. See Appendix A and B for more detailed productivity monitoring protocols.

# Results

### Number of surveys

In 2008, there were 147 surveys conducted between Kehoe Beach and North Beach parking lot (K, NP), two from North Beach parking lot to the Lighthouse (NB, SB), 17 on Limantour Spit (L), and two on Drakes Spit (D) to determine abundance and distribution of breeding snowy plovers. This compares to 148 surveys between Kehoe Beach and North Beach parking lot (K, NB), two from North Beach Parking lot to the Lighthouse (NB, SB), 18 on Limantour Spit (L), and two on Drakes Spit (D) in 2007 and 152 surveys between Kehoe Beach and the North Beach (K, NP) parking lot, two between the North Beach parking lot and the Lighthouse (NB, SB), 15 on Limantour Spit (L), and two on Drakes Spit (D) in 2006.

### Number of nesting plovers and nests

In 2008, an estimated 23-24 plovers bred on Point Reyes National Seashore compared to 30-32 plovers in 2007 and 2006, 19-21 in 2005 and 34-36 in 2004 (Table 1 Figure 2). A range of birds are provided to account for potential double counting (see Adams et al. DRAFT for details). Of the 21 nests located in 2008, 11 were between the Kehoe Beach entrance and Abbott's Lagoon (K) and 10 were between Abbott's Lagoon and North Beach parking lot (NP). As in the past seven years, no nests were found on Limantour Spit (L: Table 2, Figure 3, Figure 4).

Table 1. Number of snowy plovers nesting at PRNS, 1986 to 2008. Low number represents minimum number documented.

| Year | Females | Males | Total |
|---|---|---|---|
| 1986 | 22-23 | 19-21 | 41-44 |
| 1987 | 25-26 | 25-28 | 50-54 |
| 1988 | 21-22 | 19-20 | 40-42 |
| 1989 | 18-20 | 16-17 | 34-37 |
| 1995 | 6 | 6 | 12 |
| 1996 | 5-6 | 5 | 10-11 |
| 1997 | 12 | 13 | 25 |
| 1998 | 7 | 9 | 16 |
| 1999 | 9 | 11 | 20 |
| 2000 | 17-18 | 14-19 | 31-37 |
| 2001 | 13-19 | 14-17 | 27-36 |
| 2002 | 17-19 | 17-18 | 34-37 |
| 2003 | 11-12 | 12-13 | 23-25 |
| 2004 | 17-18 | 17-18 | 34-36 |
| 2005 | 9-10 | 10-11 | 19-21 |
| 2006 | 14-15 | 16-17 | 30-32 |
| 2007 | 14-15 | 16-17 | 30-32 |
| 2008 | 11-12 | 12-13 | 23-24 |

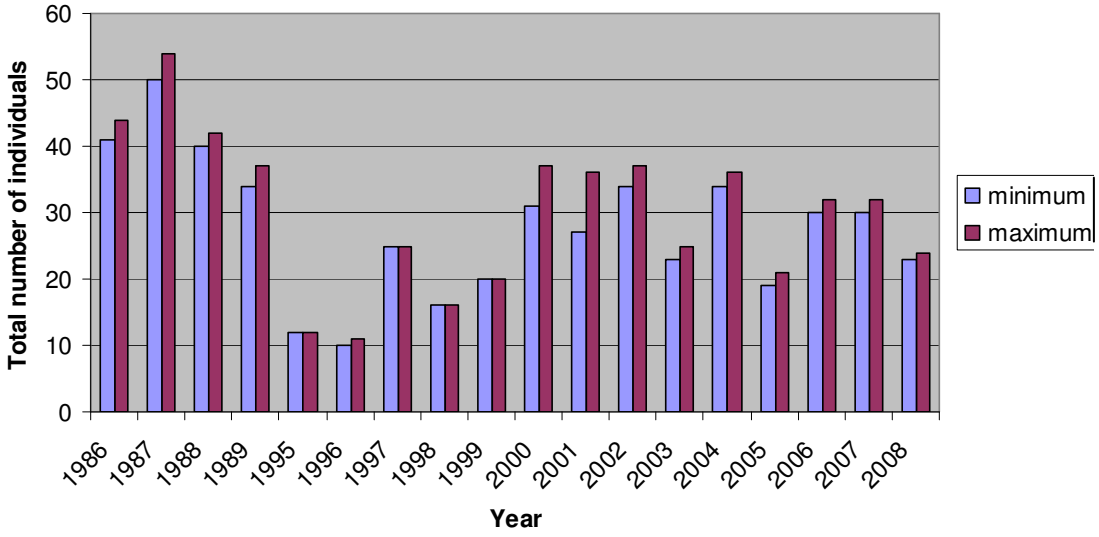
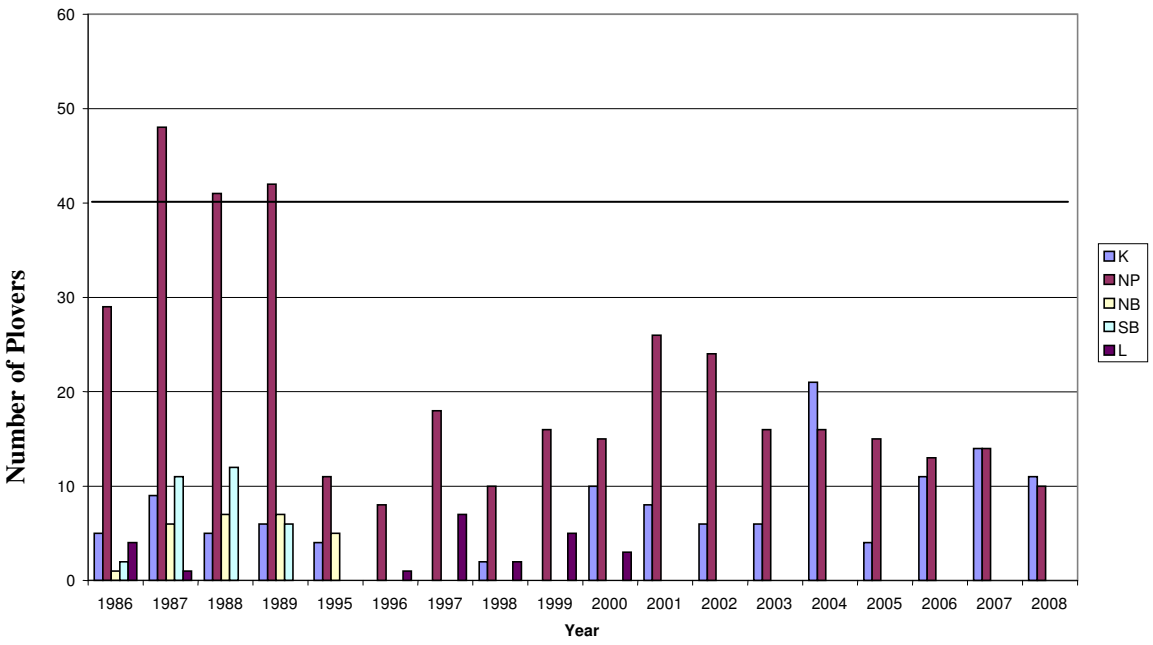



Figure 2. Nesting Western Snowy Plovers at PRNS 1986-2008.

Table 2. Number of snowy plover nests at PRNS, 1986 to 2008.

| | Number of Nests by Plot [1] | | | | | |
|---|---|---|---|---|---|---|
| Year | K | NP | NB | SB | L | Total |
| 1986 | 5 | 29 | 1 | 2 | 4 | 41 |
| 1987 | 9 | 48 | 6 | 11 | 1 | 75 |
| 1988 | 5 | 41 | 7 | 12 | 0 | 65 |
| 1989 | 6 | 42 | 7 | 6 | 0 | 61 |
| 1995 | 4 | 11 | 5 | 0 | 0 | 20 |
| 1996 | 0 | 8 | 0 | 0 | 1 | 9 |
| 1997 | 0 | 18 | 0 | 0 | 7 | 25 |
| 1998 | 2 | 10 | 0 | 0 | 2 | 14 |
| 1999 | 0 | 16 | 0 | 0 | 5 | 21 |
| 2000 | 10 | 15 | 0 | 0 | 3 | 28 |
| 2001 | 8 | 26 | 0 | 0 | 0 | 34 |
| 2002 | 6 | 24 | 0 | 0 | 0 | 30 |
| 2003 | 6 | 16 | 0 | 0 | 0 | 22 |
| 2004 | 21 | 16 | 0 | 0 | 0 | 37 |
| 2005 | 4 | 15 | 0 | 0 | 0 | 19 |
| 2006 | 11 | 13 | 0 | 0 | 0 | 24 |
| 2007 | 14 | 14 | 0 | 0 | 0 | 28 |
| 2008 | 11 | 10 | 0 | 0 | 0 | 21 |

K = Kehoe Beach to Abbott's Lagoon
NP = Abbott's Lagoon to North Beach parking lot; includes Abbott's Lagoon
NB = North Beach parking lot to South Beach parking lot
SB = South Beach parking lot to Lighthouse Beach
L = Limantour Spit




K = Kehoe Beach to Abbott's Lagoon
NP = Abbott's Lagoon to North Beach parking lot; includes Abbott's Lagoon
NB = North Beach parking lot to South Beach parking lot
SB = South Beach parking lot to Lighthouse Beach
L = Limantour Spit

Figure 3. Number of Western Snowy Plover nests at all surveyed beaches.

### *Nest success*

Exclosures were placed around 18 of the 21 nests in 2008. Overall, 11 of 21 nests hatched at least one egg and 30 of 55 eggs hatched (Tables 3 and 4). Of the 3 nests not protected by exclosures, one hatched successfully, and two were depredated by a raven which was evident by obvious raven tracks leading to the nest cup. Of the eight protected nests that failed to hatch two were inundated by a high tides, three were buried by blowing sand in strong spring wind events, and three were lost for unknown reasons. (Appendix C).

### *Fledging success*

Only five of 30 chicks survived for at least 28 days after hatching for a 16.1% fledging rate (Table 3). Of the estimated 12-13 breeding males in 2008, only five successfully fledged one or more chick compared to nine in 2007 and eight in 2006. Overall, the fledging rate was at least 0.09 fledged chicks per egg laid (Table 3).

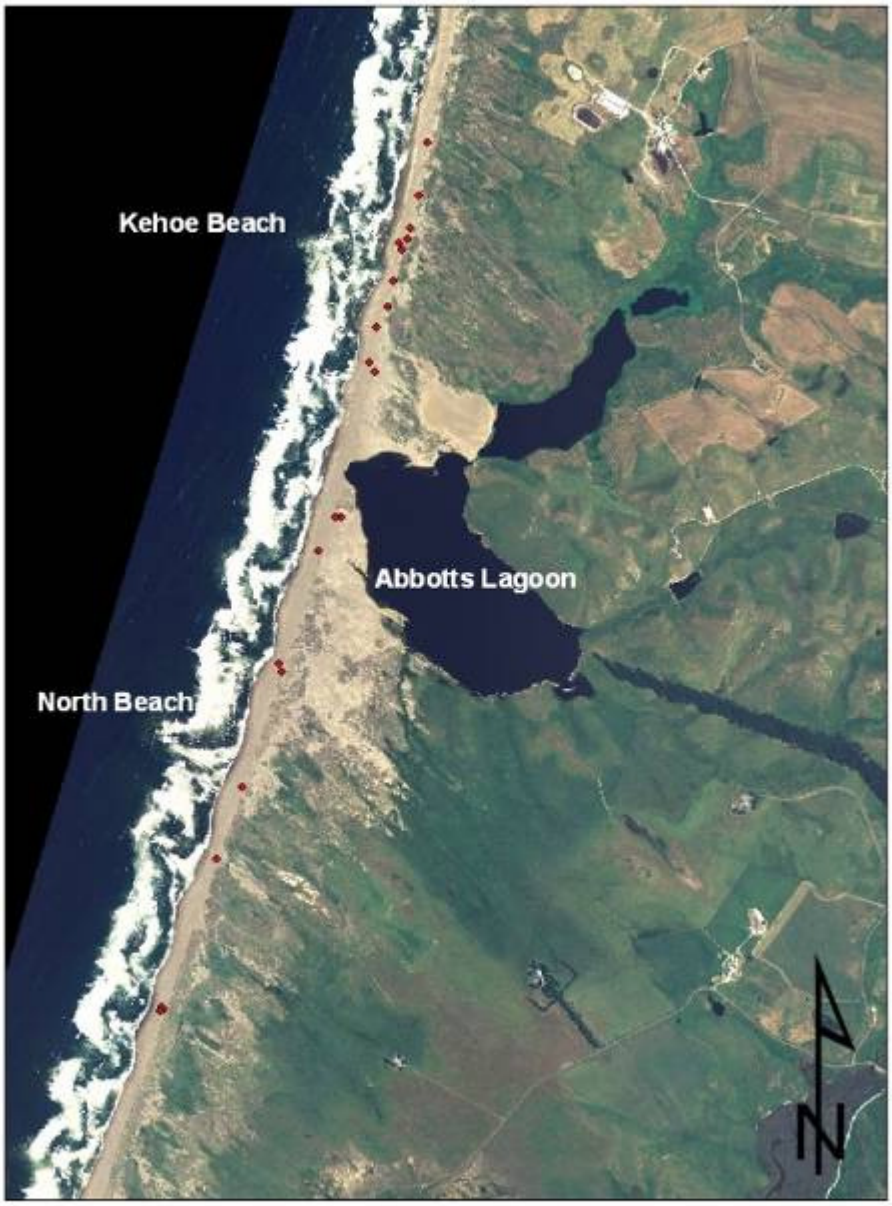



Figure 4. Locations of snowy plover nests from Kehoe Beach to Abbott's Lagoon (K) and from Abbott's Lagoon to North Beach parking lot (NP).

### *Timing of chick loss*

The time of day (night versus daytime) of chick loss was determined for 18 of the 25

chicks lost in 2008. Of the 16 chicks that failed to fledge on North Beach (NP), two were lost at night, six during the day, and eight at unknown times. On Kehoe Beach (K), four of nine losses occurred during the day, one at night, and four at unknown times. Ten of the 25 chicks lost in 2008 disappeared during a weekend; all the others were lost on weekdays. This number is the same as in 2007 and contrasts with previous years (Ruhlen et. al. 2003). In 2008, 94% of chicks that failed to fledge disappeared by the age of 10 days and 6% from age 14-17 days.

Table 3. Western Snowy Plover breeding success on Point Reyes Beach, 1986 to 2008.

| | Nests | | Eggs | | | Chicks | | |
|---|---|---|---|---|---|---|---|---|
| Year | Number | % hatched | Number | Number hatched | % of eggs that hatched | Number fledged | % of hatched eggs that fledged | fledged chicks per egg |
| 1986 | 35[1] | 31.4 | 99 | 31 | 31.3 | 8 | 25.8 | 0.08 |
| 1987 | 74 | 19.0 | 198 | 35 | 17.7 | 15 | 42.9 | 0.08 |
| 1988 | 65 | 7.7 | 161 | 11 | 6.8 | 5 | 45.5 | 0.03 |
| 1989 | 61 | 1.6 | 146 | 3 | 2.1 | 1 | 33.3 | 0.01 |
| 1995 | 20 | 10.0 | 55 | 5 | 9.1 | 4 | 80.0 | 0.07 |
| 1996 | 8 | 75.0 | 24 | 16 | 66.7 | 14 | 87.5 | 0.58 |
| 1997 | 18 | 72.2 | 44 | 33 | 75.0 | 20 | 60.6 | 0.45 |
| 1998 | 12 | 100.0 | 36 | 35 | 97.2 | 21 | 60.0 | 0.58 |
| 1999 | 16 | 87.5 | 47 | 39[2] | 83.0 | 22 | 56.4 | 0.47 |
| 2000 | 25 | 56.0 | 72[3] | 41 | 57.3 | 14 | 34.1 | 0.20 |
| 2001 | 34 | 26.5 | 86[4] | 25 | 29.1 | 10 | 40.0 | 0.12 |
| 2002 | 30 | 50.0 | 76 | 41 | 53.9 | 17 | 41.5 | 0.22 |
| 2003 | 22 | 77.2 | 63 | 43 | 68.3 | 19 | 44.2 | 0.30 |
| 2004 | 37 | 78.3 | 107 | 86 | 80.4 | 19 | 22.1 | 0.18 |
| 2005 | 19 | 63.1 | 53 | 33 | 62.3 | 17 | 51.5 | 0.32 |
| 2006 | 24 | 79.2 | 69 | 51 | 73.9 | 23 | 45.0 | 0.33 |
| 2007 | 28 | 82.1 | 83 | 64 | 77.1 | 24 | 37.5 | 0.29 |
| 2008 | 21 | 52.3 | 55 | 30 | 54.5 | 5 | 16.7 | 0.09 |

[1]37 nests were located in 1986 but only 35 were monitored for success.
[2]38-40 eggs hatched
[3]71-72 eggs laid
[4]85-87 eggs laid

### *Plover use of restored habitat*

***Nests***: Of 11 nests on Kehoe Beach (K), nine were on the beach adjacent to the Ammophila dunes and two were in the hand-treated restoration site. On North Beach (NP) two of 10 nests were located in the restoration area.

***Chicks*:** Very few male plovers were observed raising chicks in the restoration areas in 2008. Of the nine chicks that were raised in restoration areas, five were in the hand removal area on Kehoe Beach (K) and four were in the mechanical restoration area on North Beach (NP). There were no chicks that fledged within restoration areas in 2008.

Table 4. Western Snowy Plover breeding success on Limantour Spit, 1986 to 2008.

| | Nests | | Eggs | | | Chicks | | |
|---|---|---|---|---|---|---|---|---|
| Year | Number | % Hatched | Number | Number Hatched | % Hatched | Number Fledged | % Fledged | Fledged Per Egg |
| 1986 | 4 | 0.0 | 12 | 0 | 0.0 | - | - | 0.00 |
| 1987 | 1 | 0.0 | 3 | 0 | 0.0 | - | - | 0.00 |
| 1988 | 0 | - | - | - | - | - | - | - |
| 1989 | 0 | - | - | - | - | - | - | - |
| 1995 | 0 | - | - | - | - | - | - | - |
| 1996 | 1 | 100.0 | 3 | 3 | 100.0 | 1 | 33.3 | 0.33 |
| 1997 | 7 | 42.9 | 18 | 8 | 44.4 | 5 | 62.5 | 0.28 |
| 1998 | 2 | 50.0 | 6 | 2 | 33.3 | 2 | 100.0 | 0.33 |
| 1999 | 5 | 40.0 | 14 | 5 | 35.7 | 2 | 40.0 | 0.14 |
| 2000 | 3 | 0.0 | 9 | 0 | 0.0 | 0 | 0.0 | 0.00 |
| 2001 | 0 | - | - | - | - | - | - | - |
| 2002 | 0 | - | - | - | - | - | - | - |
| 2003 | 0 | - | - | - | - | - | - | - |
| 2004 | 0 | - | - | - | - | - | - | - |
| 2005 | 0 | - | - | - | - | - | - | - |
| 2006 | 0 | - | - | - | - | - | - | - |
| 2007 | 0 | - | - | - | - | - | - | - |
| 2008 | 0 | - | - | - | - | - | - | - |

### *Raven occurrence*

Common Ravens (*Corvus corax*) have been a constant presence on Point Reyes Beaches and 2008 was no exception although numbers of ravens was lower than in the past three years. On Kehoe Beach (K), ravens were detected on 74.4% of surveys averaging 7.74 birds per survey and on North Beach they were detected on 73.7% of surveys with a 2.77 bird per survey average. This compares to a 91% of surveys and an average of 10.19 birds per survey in 2007, 89% and an average 11 birds per survey in 2006, and an 85% detection rate and 7.3 birds per survey in 2005. On North Beach (NP), ravens were detected on 73.7% of surveys averaging 2.77 birds per survey. In comparison, ravens were detected on 97% of surveys and averaged 3.2 birds per survey in 2007,63% and an average of 3.0 birds per survey in 2006 and an average of 1.0 ravens on 27% of the surveys in 2005 (Table 5, Figure 5).

Table 5. Occurrence of Common Ravens on surveys 2002-2008.

| Year | No. of Surveys | Total Survey Hours | Surveys with Ravens | Total Raven Sightings | % Surveys with Ravens | Average Ravens per Survey | Average Ravens per Survey per Hour |
|---|---|---|---|---|---|---|---|
| | Kehoe (K) | | | | | | |
| 2002 | 47 | 120.16 | 39 | 470 | 83 | 10.00 | 3.91 |
| 2003 | 41 | 128.14 | 22 | 300 | 53.7 | 7.32 | 2.34 |
| 2004 | 72 | 291.97 | 66 | 1062 | 91.7 | 14.75 | 3.64 |
| 2005 | 40 | 95.4 | 34 | 291 | 85 | 7.28 | 3.05 |
| 2006 | 76 | 210.75 | 68 | 836 | 89.4 | 11.00 | 3.97 |
| 2007 | 78 | 312 | 71 | 795 | 91 | 10.19 | 2.55 |
| 2008 | 86 | 344 | 64 | 666 | 74.4 | 7.74 | 1.94 |
| Average | 62.8 | 214.6 | 52 | 631.4 | 81.1 | 10.05 | 2.94 |
| | North Beach (NP) | | | | | | |
| 2002 | 57 | 172.36 | 31 | 141 | 54.4 | 2.47 | 0.82 |
| 2003 | 72 | 230.99 | 20 | 108 | 27.8 | 1.50 | 0.47 |
| 2004 | 62 | 149.66 | 25 | 158 | 40.3 | 2.55 | 1.06 |
| 2005 | 68 | 120.8 | 18 | 65 | 26.5 | 0.96 | 0.54 |
| 2006 | 76 | 204.25 | 48 | 230 | 63.2 | 3.03 | 1.13 |
| 2007 | 70 | 350 | 68 | 228 | 97.1 | 3.26 | 0.65 |
| 2008 | 61 | 305 | 45 | 169 | 73.7 | 2.77 | 0.55 |
| Average | 66.5 | 219 | 36.4 | 157 | 54.7 | 2.36 | 0.72 |

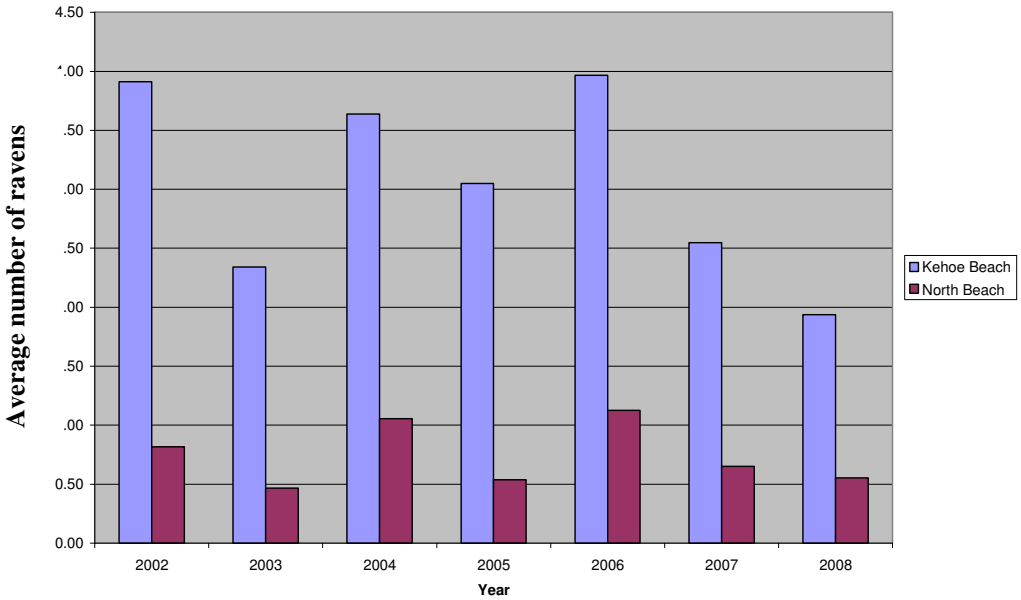



Figure 5. Average number of ravens per survey hour 2002-2008

# Discussion

## Number of nesting plovers

The estimate of 24 nesting snowy plovers on Point Reyes National Seashore in 2008 compares with a mean of 27.25 (SE = 2.6 %) individuals from 1996-2007, the prior period during which exclosures have been employed to protect nests from predators. The estimated number of nesting plovers in 2008 was lower than 2007 and 2006 when 32 nested (Table 1).

Table 6. Potential causes of Western Snowy Plover nest loss on Point Reyes Beach.

| | Total | Nests Ex- | Predator | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Nests | closed | Rav. | Rap. | Avi. | Fox | Coy. | Bob. | Mam. | Unk. | Abd. | Env. | Inf. |
| 1996 | 8 | 7 | 1 | | | | | | | | 1* | | |
| 1997 | 18 | 13 | 3 | | | | | | | 2 | | | |
| 1998 | 12 | 12 | | | | | | | | | | | |
| 1999 | 16 | 16 | | | | | | 1* | | 1* | | 1* | |
| 2000 | 25 | 25 | | | | | | | | 1* | 5* | 1* | 4* |
| 2001 | 34 | 16 | 11 | 1* | | | 2 | | | 2 | 8* | 1 | |
| 2002 | 30 | 20 | 5 | | 1* | 1 | | | 2 | | 3* | 2, 1* | |
| 2003 | 22 | 22 | | | | | | | | | 2* | 3* | |
| 2004 | 37 | 32 | | | | 1 | | | | | 1, 1* | 5* | |
| 2005 | 19 | 16 | | | | 2, 1* | | | | | 2* | 2 | |
| 2006 | 24 | 23 | | | | 1* | | | | | 2* | | 2* |
| 2007 | 28 | 22 | 1 | | | | | | | 3 | | 1* | |
| 2008 | 21 | 18 | 2 | | | | | | | 3 | | 5* | |

* Nests that were protected by exclosures.
Predators are raven (Rav.), raptor (Rap.), avian (Avi.), coyote (Coy.), bobcat (Bob.), unidentified mammal (Mam.), and unidentified predator (Unk.). Other causes of nest loss are abandonment (Abd.), environmental (Env., includes wind and tide), and infertile eggs (Inf.).

## Nest hatching rate

The 52.3% clutch hatching rate in 2008 compares with a mean of 70.59% (SE = 5.5%) from 1996-2007. In 2008, two nests were lost to ravens which have been responsible for most of the predator losses in prior years. Abandonment has been a recurring cause of nest loss since 2000 but no nests were abandoned in either 2007 or 2008. Weather, which has been responsible for some nest loss every year since 1999, was responsible for five losses in 2008 (Table 6).

## Chick fledging rate

In 2008, the 16.1% snowy plover chick fledging rate at Point Reyes was lower than the 48.3% (SE = 4.8%) average of the previous 12 years. The fledge rate in 2008 was the lowest chick fledging rate at Point Reyes in all the 18 years plovers have been monitored (Table 3).

## Timing of chick loss

As during the past five years most chicks were lost in the first third of the fledging period. In 2008, 94% of chick loss occurred when chicks were 1-10 days old and 6%

when they were between 11-17 days. This compares with 91% of chick loss when chicks were 1-10 days old and 9% when they were between 11-17 days old in 2007, a 93% loss rate when chicks were 1-10 days old in 2006, 81% in 2005 and 75% in 2004. By comparison 93.3% were lost during the first 9 days in 2003. Of the 6 years, 2004 is the only one in which chicks older than 18 days disappeared.

### Use of restored dune habitat

Snowy plovers were documented using restored dune habitat for the sixth consecutive year. In 2008, four nests were initiated in restored areas, 2 in the hand treated area north of Abbott's Lagoon and two in the mechanically treated area to the south of the lagoon. This is the same number of nests initiated in restored areas in 2007 and 2006. No males were able to fledge chicks from these areas in 2008; there were nine chicks that were lost there.

### Raven Occurrence

Although the number of ravens on surveys was lower than in the past three years they still had a pronounced presence on both Kehoe Beach (K) and North Beach (NP). There were 86 surveys conducted on Kehoe Beach in 2008 and ravens were present on 64 of those surveys. On North Beach (NP), where ravens have historically had lower numbers comparatively, they were detected on 45 of the 61 surveys. There were two confirmed nest losses to ravens in 2008, both occurring on Kehoe Beach (K); neither nest was able to be exclosed.

### Vandalism

Vandalism was less of a problem in 2008 than in 2007 and 2006. There were only two incidents where signs were vandalized compared to 19 in 2007 and 24 in 2006. This may be attributed to the fact that a permanent "no dogs" sign was placed at the Kehoe Trailhead and at the North Beach parking lot. These new signs are metal with posts buried in the sand very deeply making it hard to knock over. Previous signs were laminated on wooden posts, and easily removed and vandalized.

There was, however, a higher incidence of visitors entering fenced areas particularly near the AT&T site and at Abbott's Lagoon. On several occasions during surveys it was discovered that people had entered closed areas and fires had been built. Although biologists, park employees, and docents were present on the beaches during busy weekend times, human footprints (sometimes accompanied by dog tracks) were still seen inside symbolic fencing and leading up to exclosures.

# Research Activities and Recommendations

### Continue current monitoring

It is recommended that PRNS continue monitoring the breeding population of snowy plovers at Point Reyes. The Recovery Plan (USFWS 2007) sets a goal of 50 adult birds on Point Reyes Beach (K, NP, NB, and SB), ten on Limantour Spit (L), and four on Drakes Spit (D; 32 pairs). The plan also recommends that to sustain the population, reproductive success should be one fledged chick per male. Continued monitoring will help to determine if these population goals are being met. Monitoring data should be further analyzed to determine trends in raven observations; it is possible there could be seasonal trends across the plover breeding season that correlate with nearby agricultural activities. Research on methods to prevent nest losses due to abandonment and environmental factors is also desired.

### Education and Outreach

The educational and informational visitor contacts on weekends and holidays by park employees and volunteer docents appears to be effective in increasing understanding and compliance of habitat closures. The continued presence of park employees and docents in breeding areas especially during the weekends and holidays is recommended.

# Management Activities and Recommendations

### Habitat Restoration

Because plovers have readily used the restoration areas for nesting and chick rearing, it is recommended that habitat restoration in the areas around and to the south of Abbott's Lagoon be continued and expanded. Newly restored dune areas have proven to be critical to the success of plovers at PRNS. The 2004 to 2007 breeding seasons indicate that the removal of beach grass has a positive effect on the raising of plover chicks. Although there was not as much success in restored areas in 2008, plovers still attempted to use those areas and chick loss was high in all areas during the 2008 breeding season.

### Predator Management

To attain a sustainable plover population without employing the management efforts of recent years requires predator management. Recommendations include:

- completion of the Point Reyes Predator Management Plan
- implementation of agricultural operation best management practices (covering feeding troughs, minimizing silage harvesting in fields adjacent to plover breeding areas)

### Visitor Education

Human presence on beaches continues to be problematic during critical breeding periods. This is particularly true when nests are incubating and chicks are between 1 and 15 days old. Symbolic fence trespass, driftwood sculptures, illegal dog walking, illegal camping and campfires, and beach activities along symbolic fence lines can be detrimental to this tenuous population. With such small breeding numbers and so few chicks born each year, every case where chicks or eggs are lost due to human activities should be examined and analyzed to improve the stewardship of this population. The Point Reyes Plover Docent Program continues to be a champion for breeding plovers. In addition to continuing the program, the park should consider extending the docent season to include the month prior to nesting and the month of September until all chicks are fledged. This year, for the first time, the Plover Docent Coordinator participated in numerous field monitoring days which proved valuable to the program, not only providing additional monitoring support but, more importantly, providing a uniformed park presence on beaches during the week.

## Literature Cited

Adams, D., M. Koenen, D. Press, and K. Peterlein. DRAFT. Snowy Plover Monitoring Plan, Point Reyes National Seashore. Version 2.0. NPS/SFAN/NRR – DRAFT. National Park Service, Fort Collins, Colorado.

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

Stearns, E. 2008. Snowy plover docent program: final report. Unpublished report. Point Reyes National Seashore, Point Reyes, California.

U.S. Fish and Wildlife Service (USFWS). 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). Sacramento, California.

# Appendix A. Criteria for determining snowy plover brood fate

**Determining hatch date**

- Make notes of when bird activity first started.
- When was the first egg laid?
- When was the clutch complete (usually 3-5 days)?
- Nests should be checked daily at 25 days past known clutch completion.
- If exact clutch completion date cannot be determined, nest checks should be made more frequently at 20 days past estimated completion. Your field notebook should provide good clues to bird activity around the nest site making it possible to closely estimate hatch dates.

**Determining if a clutch has hatched (also see Hatched in clutch fate section)**

- Eggs gone close to estimated hatch date with no signs of predation.
- Flattened scrape and pip fragments located in scrape.
- Tapping or cracks observed in eggs on recent visit to nest.
- Indication of presence of newly hatched brood in immediate vicinity (direct observation, broody behavior exhibited by nearby adult).

**Monitoring broods**

- Once a nest has hatched, chicks should be checked daily to determine timing of any loss that may occur.
- Approach the area where the brood was last seen slowly and cautiously.
- Are there adults present? And if so, are they displaying broody behavior (flying, vocalizing or feigning injury)?
- Can you easily see the chicks? Often, chicks are within a few meters of the adult.
- If a brood is located immediately, count the number of chicks present, location, and behavior. Record this information in your field notebook. Leave the area quickly, particularly if the tending adult is agitated.
- If the brood is not immediately located, move away to a concealed position and wait for the birds to resume undisturbed behavior. Again, count the number of chicks present, location, and behavior in your notebook.
- Once the brood is located and counted, leave the area. Any additional notes should be written well away from the site.
- If additional data collection is required (disturbance study or better aging) do so from a concealed area where your presence is not a factor and the birds are not disturbed further.

**Determining the timing of chick loss**

- First, determine what information is needed. For example, is it important to know the exact time of loss? Or, does general knowledge of loss suffice for your study area?
- When needing to determine the difference between weekday and weekend loss, all broods should be checked on Friday afternoon and again on Monday morning. If

chicks are present on Friday but not on Monday morning, this is considered a weekend loss and should be recorded in your field notebook and data sheets as such.

- When trying to determine whether chick loss occurs in the day, at night, or at dusk or dawn, checks must be made within each of those time periods. For example, if chicks are present at 7 pm and at again at 9pm, but not present at 5 am, the loss event would be recorded as occurring at night (take into consideration changing hours of sunrise and sunset).
- Determining the timing of chick loss events can be time consuming and somewhat difficult. Remember that most brood checks cause some disturbance to the birds and should only be done at a minimum frequency required to answer your research questions.

# Appendix B. Criteria and evidence for determining fate of snowy plover clutches.

**HATCHED:**

- Eggs gone within days of estimated hatch date, predator tracks not evident in substrate.
- Flattened scrape and pip fragments located in scrape.
- Tapping or cracks observed in eggs on recent visit to nest.
- Indication of presence of newly hatched brood in immediate vicinity (direct observation, broody behavior exhibited by nearby adult).

**NOT HATCHED:**

**Depredated - Unknown Predator:**

- Direct evidence that eggs were destroyed, including:
  - substrate cemented together by egg contents, or
  - eggshell fragments intact but damaged eggs found well before estimated hatch date.
- Eggs gone well before estimated hatch date, no predator tracks to nest, but wind or tide would not have destroyed nest. Evidence may include:
  - scrape intact or still discernible, or
  - substrate stable or level enough such that wind would not cause clutch to be buried or eggs to roll out of scrape, or
  - substrate too firm for imprint of predator tracks.
- Unidentified potential predator tracks directly to and at nest site (if potential predator tracks are observed leading towards nest site but gait is unchanging directly past nest site, that predator is not associated with clutch loss).

**Depredated - Identified Predator:**

- Identified predator tracks directly to the nest site.
- Timing of lain predator tracks coincides with nest loss, as indicated by substrate conditions.

**Tide:**

- Tide had washed over original nest location.
- Eggs gone well before estimated hatch date and substrate is smoothed from water washing over it.
- Eggs gone close to estimated hatch date, but no indication of a newly hatched brood in the vicinity.
- Eggs located near original nest location but no indication eggs being incubated.
- Eggs located near original nest location, eggs being incubated by adults well past estimated hatch date.

**Non-viable Eggs:**

- Intact eggs of full clutch remain well after estimated hatch date along with evidence that there is consistent adult activity at nest location. Adult activity can be determined by presence of adult on nest, egg position changing from survey to survey. Nests should be monitored until adult activity ceases.

**Abandoned:**

- Intact eggs of clutch remain but evidence of adult activity at nest ceased well before the estimated hatching date. No evidence nest was washed over by tides or ever buried by wind blown sand or other debris.

**Wind:**

- Eggs not being incubated and one of the following:
  - intact eggs located outside of scrape, eggs not being incubated, and no indication that any other species may have moved eggs, or
  - eggs in scrape and covered by wind-blown sand or other debris.

*Note: Distinction between the above three categories (non-viable eggs, abandoned, and wind) can be difficult and may require additional information.

**Trampled:**

- Eggs found destroyed (not depredated) and tracks of a larger species directly through nest location.

**Destroyed – Human:**

- Human footprints directly next to or on the nest location and:
  - one or more eggs missing from the clutch, or
  - evidence that eggs were destroyed including shell fragments or contents.
- Human footprints near nest with evidence that something was dragged over, dropped or placed on nest.

**Failed Unknown:**

- Eggs gone well before estimated hatch date, but absence of clear evidence of depredation, wind loss, tide, or trampling.

**Unknown:**

- Eggs gone close to estimated hatch date but evidence of hatch would have been obscured by weather conditions or other factors.

# Appendix C. Fate of snowy plover nests at Point Reyes National Seashore in 2008.

| Nest & Location[1] | Date Found | Exc. Yes/No | Female ID | Male ID | Eggs Laid | Eggs Hatched | Clutch Fate | Current Status |
|---|---|---|---|---|---|---|---|---|
| NP01 | 4/07/08 | YES | U | bo:ov | 3 | 3 | HATCH | FLEDGE 0 |
| NP02 | 4/10/08 | YES | U | U | 3 | 3 | HATCH | FLEDGE 0 |
| NP03 | 4/14/08 | YES | U | U | 2 | 0 | FAIL | WIND |
| NP04 | 4/16/08 | YES | U | U | 3 | 0 | FAIL | UNKNOWN |
| NP05 | 5/17/08 | YES | U | U | 3 | 3 | HATCH | FLEDGE 0 |
| NP06 | 6/14/08 | YES | U | yo:wv | 3 | 3 | HATCH | FLEDGE 0 |
| NP07 | 6/18/08 | YES | wo:bo | U | 3 | 2 | HATCH | FLEDGE 0 |
| NP08 | 6/24/08 | YES | U | U | 3 | 0 | FAIL | TIDE |
| NP09 | 7/5/08 | YES | U | bo:ov | 2 | 0 | FAIL | TIDE |
| NP10 | 7/5/08 | YES | U | U | 3 | 2 | HATCH | FLEDGE 0 |
| K01 | 4/04/08 | YES | U | U | 1 | 0 | FAIL | WIND |
| K02 | 4/04/08 | YES | U | U | 2 | 0 | FAIL | WIND |
| K03 | 4/20/08 | YES | U | U | 1 | 0 | FAIL | UNKNOWN |
| K04 | 4/22/08 | NO | U | U | 3 | 0 | FAIL | RAVEN |
| K05 | 5/13/08 | NO | U | U | 3 | 3 | HATCH | FLEDGE 0 |
| K06 | 5/16/08 | YES | U | U | 3 | 3 | HATCH | FLEDGE 1 |
| K07 | 5/30/08 | YES | U | U | 3 | 3 | HATCH | FLEDGE 1 |
| K08 | 6/3/08 | NO | U | U | 3 | 0 | FAIL | RAVEN |
| K09 | 6/4/08 | YES | U | U | 3 | 0 | FAIL | UNKNOWN |
| K10 | 6/28/08 | YES | U | U | 2 | 2 | HATCH | FLEDGE 0 |
| K11 | 7/17/08 | YES | U | U | 3 | 3 | HATCH | FLEDGE 3 |

[1]K = Kehoe Beach to Abbott's Lagoon; NP = Abbott's Lagoon to North Beach parking lot (including shore of the lagoon). Exc. is exclosure. ID refers to leg band combinations w=white, o=orange; b=blue; v=violet; y=yellow (see Adams et al. Draft for details).

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 D-116, March 2009

**National Park Service**
**U.S. Department of the Interior**

**Natural Resource Program Center**


**Natural Resource Program Center**
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

**EXPERIENCE YOUR AMERICA** ™