

Washington State Snowy Plover Population Monitoring, Research, and Management: 2013 Nesting Season Research Progress Report

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Fish and Wildlife
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U.S. Fish and Wildlife Service
Willapa National Wildlife Refuge

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OVERVIEW

During the 2013 Western Snowy Plover (*Charadrius nivosus nivosus*) nesting season, we monitored breeding phenology, nest success, fledging success and number of nesting adult Snowy Plovers in Washington. Field monitoring and research was conducted by Cyndie Sundstrom and William Ritchie with assistance from Brock Hoenes, Ken Scheffler, Warren Michaelis, Steve Spencer, and Larissa Pfleeger. Management activities included restricting human access to nesting sites, exclosing nests to prevent predation, predator management, and restoring nesting habitat. A summary of some of our 2013 activities and results:

Breeding Phenology

- Clutches were initiated between 12 April and 20 July (Figure 2). However, very early nests could have gone undetected because intensive surveys did not start until late March on Midway Beach and early April at Leadbetter Point.
- The first chick known to have fledged, fledged around 24 June and the last chick known to fledge, fledged around 9 September.

Breeding Range

- We conducted 20 surveys at 9 sites between 16 May and 26 July 2013 to either assess occupancy or to count the number of adults.
- Snowy Plovers were only found nesting on Leadbetter Point, Midway Beach, and Graveyard Spit.

Number of Breeding Adults

- The mean 2013 Washington breeding adult population was 43 (Range: 41-45). All of the breeding adults observed were found on Leadbetter Point, Midway Beach, and Graveyard Spit. Staff and volunteer surveyors conducted surveys.
- From 2006-2009 the Washington Snowy Plover population declined annually and precipitously. From 2009-2012, the adult breeding population has been fairly stable around 31-36 birds. There is some suggestion of an increase in 2013 relative to the recent lows but several more years of monitoring will be needed to assess whether or not trends are indeed changing.

Nest success

- Twenty-nine nests were discovered and monitored. The lower number of nests discovered in part reflects less effort focused on nest monitoring at Leadbetter Point than in past years. Based on chicks we observed on the beach, we know there were at least 6 additional nests that we did not locate. The lower number of nests may also reflect fewer re-nesting attempts due to reduced predation pressure as a result of predator management.
- The percent of nests that survived from egg laying through hatching during the 2013 nesting season was approximately 50% (includes exclosed and non-exclosed nests) which is extremely unusual. The nest success at Leadbetter Point (the site with the lowest nest success in past years) was extraordinarily high, with 79% nest success. This was the first year that predator management was implemented in Washington and it was only implemented at Leadbetter Point.
- For the first time, nest predation was not the primary source of nest failure. Common ravens were the only identified nest predator and were identified based on tracks left at the nest. However, in several cases we could not identify the nest predator.

Fledging Success

- The average number of young fledged per adult male on the three nesting sites in Washington was 1.04 (range = 0.92-1.18). Population viability analyses indicate that, on average, at least one young must fledge per adult male to have a stable population.

Management Actions

- *Restrictions:* Fireworks were prohibited on beaches where State Parks and U.S. Fish and Wildlife Service (USFWS) are the upland land owners.
- *Nest exclosures:* Two nests were exclosed on State Park land at Midway Beach and no nests were exclosed at Leadbetter Point.
- *Signing:* In an effort to protect nests, approximately 7.5 miles of beach at Leadbetter Point and approximately 1 mile of beach at Midway Beach was signed to restrict human access on the dry portions of the beach. Access restrictions on private land only occurred when permitted by the land owner.
- *Nest Predation:* The Willapa National Wildlife Refuge (Willapa NWR) continued to collect data on nest predators that occurred in and adjacent to areas where Snowy Plovers and Streaked Horned Larks nest at Leadbetter Point. Hazing and lethal removal of known nest predators (corvids) observed foraging in active Snowy Plover nesting areas was initiated in 2013 at Leadbetter Point.
- *Restoration:* The Willapa NWR habitat restoration area (HRA) at Leadbetter Point now totals more than 300 acres. This area was mostly cleared of non-native beachgrass using mechanical and chemical methods. In addition, oyster shell was spread across about 62 acres of the HRA to both attract Snowy Plover nesting and to help stabilize drifting sand. In 2013, treatments within and adjacent to the HRA included using a bulldozer and a tractor-mounted disk to remove dead and resprouting beachgrass and using a helicopter to apply herbicide to kill beachgrass.
- No habitat restoration work was conducted on State Parks lands at Leadbetter Point or Midway Beach in 2013.

INTRODUCTION

The Pacific coastal population of the Western Snowy Plover (*Charadrius nivosus nivosus*) is listed as Threatened under the Endangered Species Act, and is listed as Endangered by Washington State. The current Pacific coast breeding population extends from Midway Beach, Washington, to Bahia Magdalena, Baja California, Mexico. The Snowy Plover winters mainly in coastal areas from southern Washington to Central America. This coastal population nests primarily above the high tide line on a variety of beach and dune types including coastal beaches, sand spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and bluff-backed beaches (U.S. Fish and Wildlife Service 2007). In winter, Snowy Plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest (U.S. Fish and Wildlife Service 2007).

According to the U.S. Fish and Wildlife Service (2007), “Habitat degradation caused by human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations”. In Washington, predators eating Snowy Plover eggs, adverse weather, shoreline modification, dune stabilization, and recreational activities have been attributed to reduced nest success and have been cited as the causes of local population declines (Washington Department of Fish and Wildlife 1995).

Historically, five known areas supported nesting Snowy Plovers in Washington (Washington Department of Fish and Wildlife 1995). During the 2006 nesting season, there were four nesting locations: Leadbetter Point, Midway Beach (Grayland vicinity), Graveyard Spit, and Damon Point. During the 2007 and 2008 nesting season, three nesting sites were occupied, Leadbetter Point, Midway Beach, and Graveyard Spit. However, because of the very close proximity of Graveyard Spit to Midway Beach, this could be considered one site for analyses. During the 2009-2013 nesting seasons, Leadbetter Point and Midway Beach were occupied and Graveyard Spit was again occupied in 2012 and 2013.

According to the federal Recovery Plan for the Western Snowy Plover, Washington and Oregon compose Recovery Unit 1 (U.S. Fish and Wildlife Service 2007). The primary recovery criterion for this unit are maintaining 250 breeding adults for 10 years and a 5-year average productivity of at least 1.0 fledged chick per adult male (U.S. Fish and Wildlife Service 2007). The recovery plan calls for the development and implementation of mechanisms to assure long-term protection and management of breeding, wintering, and migration areas in Recovery Unit 1 (U.S. Fish and Wildlife Service 2007). This report describes progress on all of these criteria except the final one.

According to the Washington State Recovery Plan for the Snowy Plover (1995), the Snowy Plover will be considered for down listing to Threatened when the state supports a 4-year average of at least 25 breeding pairs that fledge at least one young per pair per year at two or more nesting areas with “secure” habitat. Delisting will be considered when the “average” population reaches 40 breeding pairs at three or more secure nesting areas.

Both the federal and state recovery plans require monitoring of breeding adults and monitoring of fledging success to assess progress toward these recovery goals. Monitoring is also necessary to evaluate the impact of conservation actions on Snowy Plover populations such as the use of wire nest enclosures to exclude potential predators and the effectiveness of habitat restoration efforts. To provide the information needed to assess recovery progress and to assess the effectiveness of conservation actions, Washington Department of Fish and Wildlife (WDFW) is coordinating its monitoring efforts with U.S. Fish and Wildlife Service (USFWS), and Oregon Department of Fish and Wildlife. This coordinated effort was initiated in 2006 although state-specific monitoring was initiated years before.

The primary objectives of our monitoring for the 2013 nesting season were:

- Conduct winter window surveys in conjunction with a range-wide survey effort.
- Conduct breeding window surveys in conjunction with a range-wide survey effort.
- Conduct unoccupied breeding site surveys at Copalis Spit, Connor Creek, and Damon Point.
- Estimate hatching success rates and sources of nest mortality during the egg laying/incubation stage for all nest locations.
- Estimate fledging success and adult breeding Snowy Plover population size for Washington.
- Attempt to increase nest success through habitat restoration efforts, the use of nest exclosures and by restricting human activities on nesting sites, and evaluate the effectiveness of these activities.
- Provide information to land management agencies during the field season to help them protect nesting Snowy Plovers from potential threats.
- Produce a joint report with USFWS Willapa National Wildlife Refuge (Willapa NWR) that summarizes methods used, numbers of breeding adults, and hatching success (this report).
- Coordinate monitoring efforts with Oregon Department of Fish and Wildlife to produce consistent monitoring metrics for Recovery Unit 1 (Oregon and Washington). However, specific methods may differ between states.

This report summarizes the progress on all of these objectives.

METHODS

Study Areas

During the 2007 and 2008 nesting seasons, three sites were occupied by breeding Snowy Plovers, Leadbetter Point, Graveyard Spit, and Midway Beach (Table 1). During the 2009-2011 nesting seasons, Snowy Plovers nested at two sites, Leadbetter Point and Midway Beach. During the 2012 and 2013 field seasons, Snowy Plovers nested at Leadbetter Point, Graveyard Spit, and Midway Beach. The orthographic photos of the nest sites in Appendix I provide a pictorial overview of the primary areas used for nesting in the spring/summer of 2013. Leadbetter Point and Midway Beach are dune backed beaches and have an exceptionally wide area that is unvegetated or sparsely vegetated and is located between the mean high tide and the foredune. Snowy Plovers also use the sparsely vegetated foredunes and areas behind the foredune. The Snowy Plover habitat at Midway Beach consists of swales, sparsely vegetated foredunes, and a large deflation plain with ephemeral dune ponds. Leadbetter Point is part of a very long sand spit or peninsula. The habitat at Leadbetter Point consists of unvegetated beach above the summer high tide line, sparsely vegetated foredunes, blowouts, and human modified habitat of sand and oyster shell landward of the foredune (habitat restoration area). Graveyard Spit is located on the north shore of Willapa Bay. The nesting habitat at this site consists of a sparsely vegetated low lying sand spit, with hummocks and swales, and unvegetated deflation plains adjacent to salt marsh communities. Sand was deposited on Graveyard in both 2012 and 2013 by contractors working from the U.S. Army Corps of Engineers. For definitions of terms used to describe coastal sand dune morphology in this section, see Wiedemann (1984).

Table 1. Approximate locations and land ownership for the 2013 Snowy Plover nesting localities in Washington.

Site	Approximate Location	Ownership/Management
Midway Beach	46° 45' 32", 124° 05' 46"	South Beach State Park, Private
Leadbetter Point	46° 36' 24", 124° 03' 25"	Leadbetter State Park, Willapa National Wildlife Refuge
Graveyard Spit	46° 42' 57", 124° 01' 25"	Shoalwater Bay Indian Reservation

Site Occupancy

Our goal was to determine Snowy Plover presence/absence at sites that are currently occupied and at the sites where we have failed to detect Snowy Plovers in the recent past, but are most likely to become re-occupied due to suitable habitat and relatively close proximity to occupied sites. Wildlife species are rarely detected with perfect accuracy and non-detection does not necessarily mean that a species was absent from a site unless the probability of detecting the species (detectability) was 100%. This leads to a fundamental problem -- the measure of occupancy is confounded with the detectability of the species. Specifically, an observed "absence" occurs if either the species was present at the site but not detected, or the species was truly absent. In Pearson et al. (2008), we recommended three to four visits to a site to determine if it is being used as a nesting site and that those visits occur between early to mid-May and the end of the first week of July. Following this recommendation, there is an 87% - 99% probability of correctly determining site occupancy. We conducted repeated visits to Damon Point, Connor Creek, and Copalis Spit to assess occupancy during the 2013 nesting season because these sites were historically occupied.

Adult Population Surveys

Breeding window survey

The breeding window survey occurs annually in late May along the entire U.S. Pacific coastline where Snowy Plovers are known to nest. The specific dates for a particular year are selected by the USFWS and all participants follow the methods of Elliot-Smith and Haig (2006a). In 2013, the window survey occurred the week of 20 May. We surveyed Connor Creek, Copalis Spit, Damon Point, Midway Beach, Graveyard Spit, and Leadbetter Point. Our primary intent during breeding window surveys was to determine “population size” at occupied sites (Midway Beach, Leadbetter Point, Graveyard Spit) and site occupancy at unoccupied sites (Connor Creek, Copalis Spit, Damon Point).

Estimating breeding adult population size

In addition to the breeding window survey, we conducted one additional survey at all occupied sites (Leadbetter Point, Midway Beach, and Graveyard Spit) and at one historically occupied site (Damon Point). We completed all surveys between 22 May and 1 July following the breeding window methods (USFWS 2007 Appendix J-1). We conducted these surveys at a time of year when there was the least amount of immigration and emigration into and out of the Washington breeding sites. We used these two surveys to derive estimates of breeding adult abundance. In the Results, we present the average of these two surveys and the range. We rounded all estimates to the nearest whole bird.

Table 2. Starting and ending locations, survey types and number of surveyors for each survey site in Washington. The Leadbetter Point counts in the figures and tables that follow include birds detected in the Habitat Restoration Area (HRA), the northern Willapa NWR beach section (from the Willapa NWR land just south of the HRA to the tip of the Peninsula and around) and the southern Willapa NWR beach section (between Oysterville Road and just south of the Willapa NWR boundary).

Site	Starting Point	Ending Point	Number of Surveyors	Survey Type
Copalis Spit	47°07'16.5", 124° 10' 59.9"	47° 08' 15.6", 124° 10' 58.4"	1	Foot
Connor Creek	47° 04' 14", 124° 10' 24"	47° 07' 16.5", 124° 10' 59.9"	1	Vehicle/ Foot
Ocean City	47° 04' 14.2", 124° 10' 37.8"	46° 57' 12.7", 124° 10' 31.8"	1	Vehicle/ Foot
Damon Point	46° 56' 05", 124° 09' 18"	46° 56' 11", 124° 06' 18"	1 or 2	Foot
Midway Beach	46° 47' 38", 124° 05' 55"	46° 44' 07", 124° 05' 29"	4 or 5	Foot
Graveyard Spit	46° 43' 33", 124° 03' 07"	46° 42' 25", 124° 00' 36"	1 to 4	
Leadbetter Point North	46° 37' 40.7", 124° 04' 17.4"	46° 38' 50.5", 124° 03' 13.6"	3	Foot
Leadbetter Point HRA	46° 37' 40.9", 124° 04' 07.8"	46° 38' 30.4", 124° 04' 07.2"	2	Foot
Leadbetter Point South	46° 32' 54.0", 124° 03' 40.8"	46° 37' 40.7", 124° 04' 17.4"	1 or 2	Vehicle
Long Beach ¹ (S. of Oysterville Rd.	46° 32' 54.0", 124° 03' 40.8"	46° 22' 03.8", 124° 03' 24.4"	1	Vehicle

¹This area includes surveys from Oysterville Road to North Head and from North Head to the Columbia River North Jetty

Additional breeding season Graveyard Spit surveys

As part of a monitoring effort associated with a sand deposition project administered by the U.S. Army Corps of Engineers, we conducted surveys on the site at least weekly starting on 23 April and continued to conduct surveys until the last chicks fledged from the site on 20 August. We located nests and monitored nest outcome using the methods described below.

Winter window survey

The winter window survey occurs annually in January along the entire U.S. Pacific coastline where Snowy Plovers nest or historically nested. All sites are surveyed during a specific week and the USFWS selects the dates for any given year. All participants follow the methods of Elliot-Smith and Haig (2006b). In 2013, the window survey occurred from 17-22 January and we surveyed Connor Creek, Copalis Spit, Damon Point, Midway Beach, Graveyard Spit and Leadbetter Point (north of Oysterville Road).

Nest phenology and success

We visited Midway Beach and Graveyard Spit approximately two to several times a week from early April until mid-September to search for and monitor Snowy Plover nests. The effort on Leadbetter Point was much reduced compared to previous years and as a result, many nests may have gone undiscovered and some fledging may not have been documented. In many cases, we located nests by following Snowy Plover tracks to nests. We also located nests by observing scrape building by males, by locating adults incubating eggs, or by flushing incubating adults. We recorded date and status (presence of adults and eggs) of each nest approximately every 3-5 days.

Unless observed directly, we calculated clutch initiation date by backdating from known laying or hatching dates. Backdating using hatch dates requires information on the time intervals associated with the egg laying and incubation stages. We used the following time intervals from California and reported in Page et al. (1995) to calculate clutch initiation dates: egg laying = 2.5 days between laying egg 1 and 2 and 2.3 days between laying eggs 2 and 3, incubation = 27 days or 32 days from the first egg laid until hatching. We calculated nest success using the Mayfield method (Mayfield 1961, 1975). We reported nest outcome as the number of successful nests, nests that failed, nests lost to predation, nests abandoned, nests covered by drifting sand, nests lost to human activities (vehicles, walking, horseback riding, etc.) or unknown sources of failure.

Nest Exclosures

We used the mini-exclosure design provided by plover biologists Dave Lauten and Kathy Castelein of Oregon (Lauten et al. 2003) to exclude larger avian and mammalian predators from nests. Exclosures were cuboid in shape (sides were 4 feet long and wide and 2 feet 8 inches high) with a 'bubble top' making them approximately 3 feet high. Sides were constructed from 2x4 inch mesh wire. Under the wire bubble top we secured a taut layer of 3/4 inch polypropylene black mesh netting. We used this soft layer to keep a startled Snowy Plover from flying up and hitting the wire bubble top. We cut a door in one side of the exclosure so we could access eggs, if necessary; we fastened doors closed with pliable, heavy gauge wire or zip ties. We centered the completed exclosure over the nest creating an imprint in the sand and then removed it. Following the exclosure imprint, we dug an eight inch deep trench and then placed the mini-exclosure in the trench. We placed 15 inch stakes on each corner of the exclosure to help hold it in place prior to filling in the trench. The 2 x 4 inch mesh allows adult Snowy Plovers free access to the nest from all sides but excludes American Crows (*Corvus brachyrhynchos*), Common Ravens (*Corvus corax*) and larger mammals. We did not use exclosures in the early nesting season to reduce the risk of adult predation from migrating raptors.

Fledging Success

Snowy Plover chicks are precocial, leaving the nest within hours after hatching to search for food. They are not capable of sustained flight until approximately 4 weeks after hatching. Adult Snowy Plovers do not feed their chicks after hatching, but lead them to suitable feeding areas. They also "brood" their young for several days after hatching. Adults warn of approaching predators or other perceived threats and use distraction displays to lure predators and people away from chicks. Chicks fledge (i.e., are capable of sustained flight)

at 28 to 33 days (mean equals 31 days) post hatching (Warriner et al. 1986). The Recovery Plan considers chicks fledged at 28 days post hatching (U.S. Fish and Wildlife Service 2007). According to the Recovery Plan, the productivity information most useful for determining recovery is the annual number of young fledged per adult male. Because males are responsible for post-hatching parental care (Warriner et al. 1986) and because male population trends and survivorship can be estimated with greater certainty than for females, they are used in determining this metric of reproductive success (U.S. Fish and Wildlife Service 2007). We estimated the number of young fledged per adult male for all active nesting sites combined by using the estimates of the number of breeding adult males from the adult surveys described above and by estimating the number of young fledged.

The USFWS uses the number of young fledged per adult male to determine whether or not the population is growing, stable, or decreasing. This threshold of 1.0 is based on the population viability analysis conducted by Nur et al. (1999). Their population modeling indicates that productivity of at least 1.0 chick fledged per breeding male per year should result in a stable population and productivity of 1.2 or more chicks fledged per breeding male should increase population size at a moderate pace.

Determining the number of young fledged requires following broods from hatch date to 28 days post hatching and determining their fate. To help us identify and follow individual broods, we attempted to identify hatch dates for successful nests and then follow broods post hatching. We estimated hatch date by floating eggs following Hays and LeRoy (1971) or by counting forward from known egg laying dates. Regardless of the method used to estimate hatch dates, we checked nests daily or every other day around predicted hatching dates. We banded some chicks on the hatch date and followed them until fledging or until we were no longer able to locate them. For unbanded chicks, we used chick plumage and the size of chicks observed within a couple of days of hatching to narrow down the assignment of hatch date to plus or minus one day. For some nests, we determined the outcome of the brood because no other chicks were of similar age along a particular stretch of beach. In other cases, we were able to assign broods to a specific nest and hatch date because a banded adult male accompanied the chicks, which allowed us to accurately assign the chicks to a specific nest.

Nest Locations

We photographed each nest and recorded its location using a hand held GPS unit or Trimble. We used both a Trimble and Garmin GPS unit to document nest locations at Leadbetter Point and only a Garmin GPS unit at Midway Beach. The Trimble Unit has approximately 1 m accuracy with post-processing and the Garmin has approximately 15 m accuracy.

Reading Color Bands

A number of Washington's breeding Snowy Plovers were banded in Oregon or California as adults and young of the year or were banded as young of the year in Washington. Most birds have two color bands on each lower leg and each color combination should be unique. Gary Page with Point Blue Conservation Science currently coordinates color banding for the Pacific coast and assigns unique color combinations to each state. Color bands are read top down from the belly to the foot of the bird. Colors on the birds' left leg are read first, and then the colors on the right leg are read. For example, if a bird has red band on top of an aqua band on the left leg and a white band over a red band on the right, its combination would be red, aqua: white, red or RA:WR. We assigned exact color combinations for a banded bird only when the birds were observed with spotting scopes and when we could confidently determine the color combination. To help us determine if a color combination was confidently assigned, we assigned a confidence score (0-100% confident) to each color combination recorded.

RESULTS & DISCUSSION

Breeding Window Survey

We detected 45 adult Snowy Plovers in Washington during the 2013 breeding window survey (Table 3).

Table 3. Breeding Window survey counts by site, sex, and age and counts of nests and broods between 2008 and 2013.

Site	2008	2009	2010	2011	2012	2013	2013 Survey Dates	2013 Adult Males	2013 Adult Females	2013 Adult Unknown
Copalis Spit	0	0	0	0	0	0	24 May	0	0	0
Conner Creek	0	0	0	0	0	0	24 May	0	0	0
Damon Point	0	0	0	0	0	0	16 May	0	0	0
Graveyard	1	0	0	0	0	1	22 May	1	0	0
Midway Beach	12	16	18	22	11	24	23 May	12	12	0
Leadbetter Pt.	29	26	20	12	15	20	24 May	11	9	0
S. Long Beach	0	0	0	0	0	-	-	0	0	0
Total	42	42	38	34	26	45		24	21	0

Winter Window Survey

We detected 28 adult Snowy Plovers on two sites during the January 2013 Winter Window Survey (Table 4).

Table 4. Winter Window survey counts by site, sex, and year.

Site	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013	2012 - 2013 Survey Dates	2012 - 2013 Adult Males	2012 - 2013 Adult Females	2012 - 2013 Adult Unk.
Copalis Spit	0	0	0	0	0	22 January	0	0	0
Conner Creek	0	0	0	0	0	22 January	0	0	0
Damon Point	0	0	0	0	0	22 January	0	0	0
Graveyard	-	0	-	-	0	18 January	0	0	0
Midway Beach	10	12	13	22	24	18 January	4	10	10
Leadbetter Pt.	9	23	9	12	6	17 January	1	3	0
S. Long Beach	-	-	0	0	-	11 January	-	-	-
Total	19	35	22	34	28		5	13	10

Adult Surveys

As indicated in Table 5, we conducted 20 surveys at 9 sites between 16 May and 1 July 2013.

Site occupancy

We conducted nine occupancy surveys at three sites plus five opportunistic surveys at three additional sites to assess Snowy Plover presence/absence on suitable and/or historically occupied sites (Table 5). We had no Snowy Plover detections during these surveys.

Table 5. Snowy Plover survey dates, number of surveys and surveyors and type of survey by site during the 2013 nesting season

Site	Type of Survey	# Surveys	# Surveyors	Walking or Driving	Survey Dates
Midway	Breeding Adult/Window	2	4-5	Foot	5/23,6/13
Leadbetter	Breeding Adult/Window	2	5	Foot/Drive ¹	5/24, 6/17
Graveyard	Breeding Adult/Window	2	3	Foot	5/22, 6/11
Damon Pt.	Occupancy/Window	3	2	Foot	5/16,6/05,7/01
Connor Creek	Occupancy/Window	3	1	Foot/Drive	5/16,6/31,7/01
Copalis Spit	Occupancy/Window	3	1	Foot	5/31,7/01
Ocean Shores/N. Jetty	Opportunistic	1	1	Drive	5/16
S. Long Beach	Opportunistic	2	1	Drive	6/28,7/26
Benson Beach	Opportunistic	2	1	Foot	6/10,7/26

Estimating Number of Adult Snowy Plovers

We used the annual mean from the two surveys from pre-determined weeks (20 May and 10 June) to estimate trends in the breeding adult population (Figure 1, Table 6). Adult population counts were declining precipitously through 2012 but with a higher average count in 2013, the decline is no longer significant at the $p = 0.05$ level, but is still significant at the $p = 0.10$ level (Table 6, Figure 1).

Table 6. Mean counts (95% CI or in 2013 we present the range) of the breeding adults at four nesting sites in Washington and the total population estimate for the State, 2006-2013.

Year	Damon	Midway	Graveyard	Leadbetter	Total
2006	1 (0-2)	21 (14-28)	2 (-1-5)	35 (26-45)	59 (48-70)
2007	0	18 (14-21)	2 (-1-4)	25 (20-30)	44 (36-53)
2008	0	14 (10-19)	1 (0-2)	32 (23-40)	47 (33-60)
2009	0	15 (13-17)	0	17 (10-24)	31 (23-39)
2010	0	14 (11-18)	0	21 (17-26)	36 (33-38)
2011	0	19 (8-30)	0	12 (6-19)	31 (15-47)
2012	0	14 (5-23)	2 (0-3)	18 (6-29)	33 (15-52)
2013 ¹	0	20 (16-24)	4 (1-6)	20 (19-20)	43 (41-45)

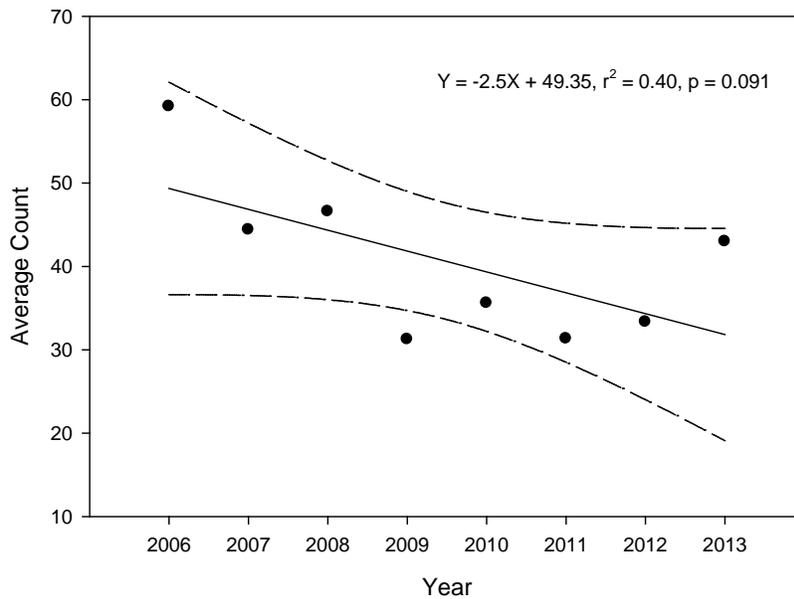


Figure 1. Breeding adult Snowy Plover population trend (95% CI) of average yearly counts for all Washington sites (2006 – 2013).

Clutch Initiation Dates and Breeding Phenology

The active nesting season occurred between late-March and early-September in 2013. Clutches were initiated between 12 April and 20 July (Figure 2A). However, very early nests could have gone undetected because we did not initiate intensive surveys until early April at Midway Beach and mid-April at Leadbetter Point. The first chick fledged around 24 June and the last chick fledged around 28 August (Figure 2B). Overall, this was a typical year for fledge and clutch initiation dates.

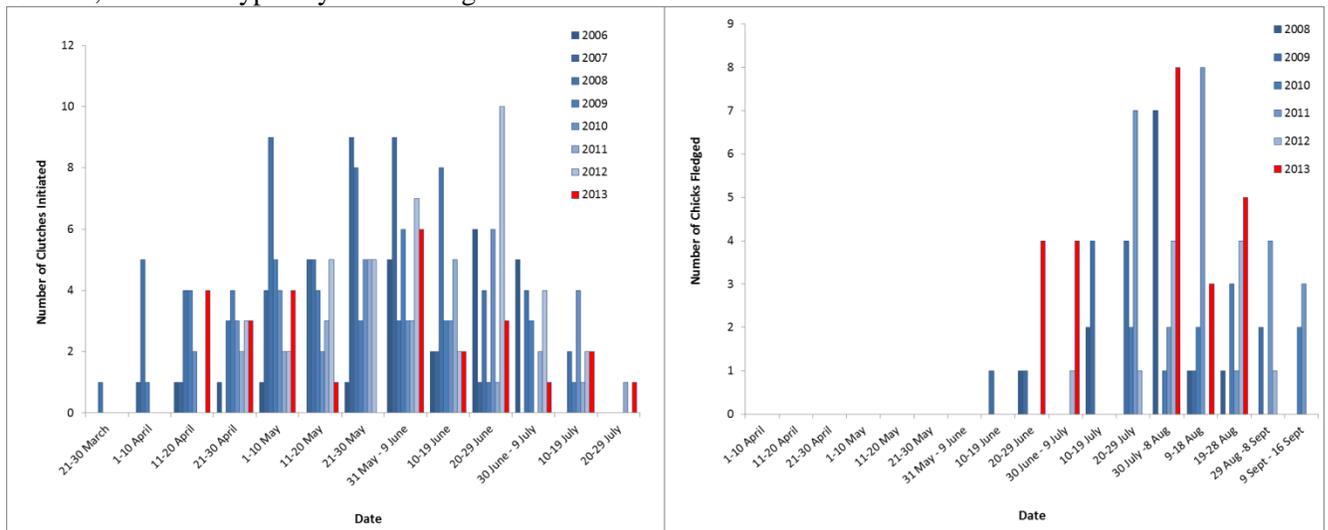


Figure 2. Number of Snowy Plover clutches initiated by date, 2006-2013 (A) and number of chicks fledged by date, 2008-2013 (B). Results are presented in 10-day intervals for all Washington nesting sites combined.

Nest success

We located and monitored the outcome of 28 Snowy Plover nests in 2013. Of these 28 nests, 16 were found at Midway Beach, 3 at Graveyard Spit, and 9 at Leadbetter Point (Table 7). For a map of nest locations see Appendix I. The reduced number of nests discovered at Leadbetter Point is likely in part due to a considerable reduction in effort and late start at that site in 2013. It also could be attributed to the increased nest success, which results in fewer re-nesting attempts after failures. Seventeen (61%) of the 28 nests that we monitored hatched. For the first time, predation was not the primary source of nest failure and was surpassed by other sources (Table 8). Corvids were the only documented predators and only one nest was apparently depredated at Leadbetter Point.

Table 7. Nest outcomes by Snowy Plover nesting locality in 2013. Outcomes include successful (hatched), failed, or unknown outcome.

Site	# Nests	Outcome		
		Hatch	Fail	Unknown
Midway	16	6	10	0
Graveyard	3	3	0	0
Leadbetter	9	8	1	0
Exclosed ¹	2	2	0	0
Not exclosed	17	7	10	0
Totals	28	17	11	0

¹Two exclosures were used at Midway Beach and no exclosures were used at Leadbetter Point.

Table 8. Sources of Snowy Plover nest failure in 2013 for nests that failed to hatch. Sources of failure include predators (American/Northwest Crows, Common Ravens, unknown Corvid, or Unknown predator) eating eggs, or other sources of failure including Human activities, drifting Sand covering the nest, Abandoned nests and Unknown sources of failure.

Site	Failures								
	Predator					Other Sources			
	Crow	Raven	Corvid	Coyote	Unknown	Human	Sand	Abandon	Unknown
Midway	0	1	1	0	2	1	1	3	1
Leadbetter	0	0	1	0	0	0	0	0	0
Graveyard	0	0	0	0	0	0	0	0	0
Exclosed	0	0	0	0	0	0	0	0	0
Not exclosed	0	1	2	0	2	0	1	3	1
Totals	0	1	2	0	2	1	1	3	1

In Tables 9 and 10, we report Mayfield nest success estimates for the 2013 nesting season and compare these results to the previous nesting seasons. The probability of nest survivorship was 35% at Midway Beach and 79% at Leadbetter Point.

Table 9. Mayfield estimates of Snowy Plover nest survival and of daily nest survival probability by site and by exclosed and unexclosed nests in 2013.

Site	Daily Survival	
	Probability	Nest Survival
Midway & Graveyard	0.968	0.349
Leadbetter	0.993	0.787
Washington exclosed	1.000	1.000
Washington unexclosed	0.971	0.390
Washington total (including exclosures)	0.975	0.447

Table 10. Mayfield estimates of nest survival by site from 2007 – 2013. We also include the percent of nests exclosed by site and year because of the large influence of exclosures on nest success.

Site	Nest Survival						
	2007	2008	2009	2010	2011	2012	2013
Midway and Graveyard	0.28	0.25	0.15	0.20	0.26	0.26	0.35
% Exclosed	0.39	0	0.06	0.16	0.29	0.15	0.10
Leadbetter	0.51	0.54	0.43	0.83	0.33	0.17	0.79
% Exclosed	0.86	0.97	0.78	0.88	0	0.40	0
Washington Total (including exclosures)	0.37	0.36	0.30	0.46	0.28	0.21	0.45

For unexclosed nests at Leadbetter Point, nest success is usually about 20% when nest success is optimal (late in the nesting season) and below 20% during the rest of the season (Pearson et al. in review). This year’s result of nearly 80% nest success at Leadbetter Point without using exclosures is truly remarkable and might be attributed to the initiation of active predator management at this site.

Fledging Success

Deriving this metric for Washington requires an estimate of both the number of breeding adult males and the number of chicks fledged. Using direct observations of fledglings on the beach, we estimated between 22 and 26 chicks fledged in 2013. During our repeated counts to occupied sites, we counted 22 males during one survey and 24 during another. Using the mean of these two estimates and the extremes of each (e.g., high male count and low fledge estimate), we estimated that 1.04 (possible range = 0.92-1.18) chicks fledged/male (Figure 3).

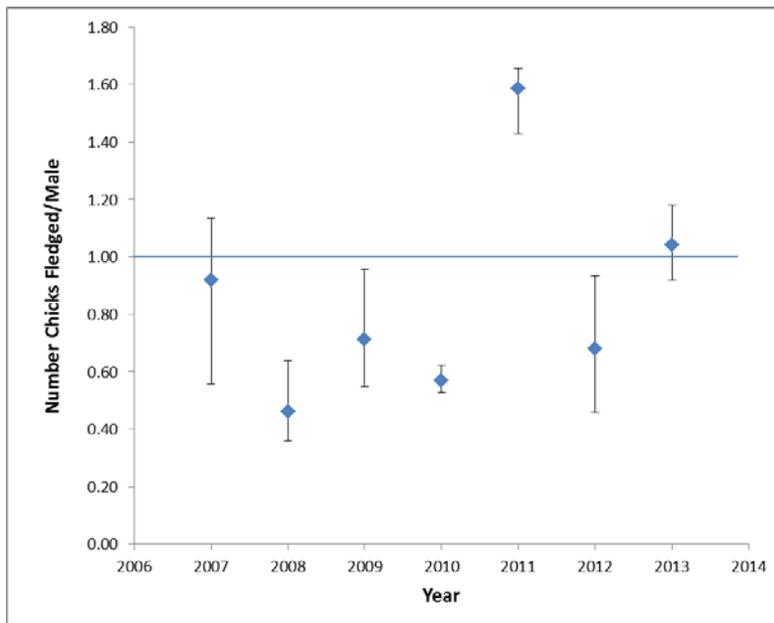


Figure 3. Number of Snowy Plover chicks fledged per adult male from 2007-2013 for all Washington nesting sites combined. Population modeling indicates that one chick fledged per adult male is needed on average to maintain a stable population – the point estimate was above 1.0 in 2011 and 2013.

Nest Locations

2013 nest locations are presented by nesting site in Appendix I. At Midway Beach/Graveyard Spit, Snowy Plovers nested in Grayland Beach State Park and on the beach immediately south of Grayland Beach State Park and on the outer beach of Graveyard Spit. At Leadbetter Point, Snowy Plovers nested on the tip of the Peninsula on the outer beach and in the Willapa NWR habitat restoration area.

PROGRESS ON RECOVERY OBJECTIVES

Federal Recovery Objectives:

Objective 1: 250 breeding adults in Recovery Unit 1.

The 2013 Washington nesting population was 43 (range = 41-45) and the 2013 Oregon nesting population was 190-191 (Lauten et al. 2013) for a total of 234 (range = 231-236) nesting adult Snowy Plovers in Recovery Unit 1.

Table 11. Estimated number of breeding adult Snowy Plovers in Recovery Unit 1 by year.

2008	2009	2010	2011	2012	2013
183 (167-198)	184.5 (175-194)	217 (213-220)	208 (188-228)	268 (246-290)	234 (231-236)

Objective 2: A 5-year average productivity of at least 1.0 fledged chick per adult male

We combined the Oregon and Washington estimates of the number of breeding adult males and the number of young fledged to derive the fledgling rate per adult male for Recovery Unit 1. The number of chicks fledged per adult male in Recovery Unit 1 was 1.04 (1.02-1.07) in 2013. The average number of young fledged per adult male for the past five years was 1.17.

Table 12. Estimated number of chicks fledged per breeding adult male in Recovery Unit 1 by year.

	2008	2009	2010	2011	2012	2013
Chicks fledged per adult male	0.92 (0.85-1.01)	1.25 (1.18-1.32)	0.85-0.87	1.59 (1.43-1.66)	1.12 (1.08-1.16)	1.04 (1.02-1.07)

Washington State Recovery Objectives:

Downlisting objective 1: A 4-year average of at least 25 breeding pairs

We estimated there were 43 (range = 41-45) adult nesting Snowy Plovers in Washington during the 2013 nesting season, and approximately 22-24 of these birds were males. Assuming all of these males paired, we estimate there were 22-24 breeding pairs in Washington. Following the 2013 season, the 4-year average number of breeding pairs in Washington is approximately 21.

Table 13. Estimated number of breeding pairs in Washington (2008-2012).

	2008	2009	2010	2011	2012	2013
Breeding Pairs	27	17-18	21-22	22	19	22-24

Downlisting objective 2: Fledge at least one young per pair per year, at two or more nesting areas with secure habitat.

The average number of young fledged per adult male in Washington in 2013 was 1.04 (possible range = 0.92-1.18), 0.68 (range = 0.46-0.94) in 2012, 1.59 (range = 1.43-1.66) in 2011, 0.57 (range = 0.53-0.62) in 2010, 0.71 (range = 0.55-0.96) in 2009, 0.46 (range = 0.36-0.64) in 2008, and 0.91 (range = 0.77 - 1.13) in 2007. The average Washington fledging rate for the past five years was 0.92. Currently, Snowy Plovers are nesting

on two primary sites – one on a National Wildlife Refuge and the other on private, tribal and Washington State Park lands.

Delisting objective 1: The average population reaches 40 breeding pairs at three or more secure nesting areas.

See Downlisting Objective 1. Recommend defining the term “secure” and determining the number of sites considered “secure”.

2013 MANAGEMENT ACTIONS

A number of the management actions that occurred in 2013 involved minimizing some human activities near active Snowy Plover nesting sites during the nesting season. Human related disturbance negatively affects hatching success of Snowy Plovers (Warriner et al. 1986, Schulz and Stock 1993) and Snowy Plover chick survival by as much as 72% (Ruhlen et. al. 2003). Disturbances to wintering Snowy Plovers are 16 times higher at a public beach than at a protected beach. Humans, dogs, American Crows and other birds are the main sources of disturbance (Lafferty 2001). In addition, Snowy Plover feeding rates declined in response to disturbance (Lafferty 2001). Human disturbance negatively affects hatching rates and chick survival for various plover species (Flemming et al. 1988, Buick and Paton 1989, Dowling and Weston 1999).

Management

- The nesting areas above the wet sand were closed to all human activities where Snowy Plovers were actively nesting on Midway Beach (Grayland and South Beach State Parks) and on National Wildlife Refuge and State Park lands at Leadbetter Point. With the land owner’s permission, approximately 975 feet of private land at Midway/Grayland Beach was posted as a plover nesting area. Approximately 7.5 miles of nesting habitat was closed at Leadbetter Point and approximately 1.33 miles of beach was closed to foot traffic at Midway Beach. The lower beach, adjacent to the ocean, remained open to the public. There are two dog restriction signs at trail junctions and trailheads on Willapa NWR lands at Leadbetter Point and there is a “Share the Beach” sign posted at Grayland Beach State Park at Midway Beach and on Willapa NWR trails at Leadbetter Point.
- Symbolic fencing was installed by Willapa NWR staff at established beach access trails at Leadbetter Point to direct people toward the wet sand and away from Snowy Plover nesting habitat. Symbolic fencing was used on State Park land at Midway Beach at 5 high-intrusion locations along the posted sign line. Rope was used more as a reinforcement alert to the public not to enter the closed area. This method was very successful in greatly reducing the number of human intrusions into the posted nesting area. We recommend that this selective symbolic fencing method be used in subsequent years. It is also recommended that symbolic fencing be added to trailhead #5 at Grayland Beach State Park if the posted nesting area expands to the north. If nests are discovered adjacent to trail #5, we recommend managers consider closing or re-routing this trail.
- At Leadbetter Point, the beach is closed to vehicle traffic north of Oysterville Road from 15 April to the day after Labor Day. Coastal beaches at Willapa NWR and Leadbetter State Park are closed to vehicle traffic year round. However, driving is allowed on the wet sand portions of the beach in these areas during razor clam harvest openings. All of the Midway Beach area is open to vehicle traffic and there are vehicle access points at Cranberry Beach Road and Warrenton-Cannery Road. The Midway Beach Road access cuts through the center of the highest use area for Snowy Plover nesting, but has been closed since 2009. As a result, there was much less disturbance to Snowy Plovers in this area again this season. Birds now nest on the old roadway and, as a result, opening this gate during the nesting season could result in the loss of Snowy Plover nests.
- In response to a request to reopen Midway Beach Road to foot traffic by Pacific County Commissioner Lisa Ayers and local residents, Washington State Parks coordinated a volunteer group

of citizens to create a beach access trail on July 20th. This was a narrow roped corridor intended to provide residents with beach access while, at the same time, limiting human disturbance of plover nesting. State Parks placed “foot trailhead” signs at each end of the trail. Although the intent was to create a straight east-west trail, plover nesting activity in the intended path route required re-routing. If the foot trail is to be reinstalled in subsequent years by volunteers, we recommend that the roped path should be installed no later than April 15th.

- A US Army Corps of Engineers (USACE) dune restoration project Graveyard Spit (Shoalwater Bay Indian Reservation) was initiated in 2012 and completed in late November 2013. The project is intended to reduce shoreline erosion from flooding and coastal storms. The portion of the project that was completed in 2012 created new potential plover nesting habitat. In an effort to reduce the probability of plovers nesting within the main construction zone during the 2013 nesting season, USACE, USFWS, WDFW, and Shoalwater Bay Tribal authorities agreed on a plan to place construction fencing in the newly created suitable nesting habitat as a nesting deterrent. Snowy plovers did not nest in the construction zone, but several scrapes were located within the construction zone. Construction within the active nesting area was postponed until all chicks had fledged. Biologists from WDFW and Shoalwater Bay Tribe monitored the nesting birds, chicks, and fledglings while coordinating with the USACE contractor to minimize disturbance to the birds. All nests were successful and all chicks fledged from this site in 2013.
- The majority of snowy plover monitoring for Graveyard Spit will be turned over to tribal biologists in the 2014 season.
- Just prior to the 2013 breeding season an Integrated Predator Damage Management Program was initiated at Willapa NWR to minimize losses of Western Snowy Plovers to predation. The primary objectives were to 1) continue to assess and refine efforts to determine predator species responsible for nest, chick and adult predation on all nesting sites; and 2) reduce predation pressure on nesting sites when necessary to protect Snowy Plovers. The high nest success at Leadbetter in 2013 was truly unusual and may be attributed to the initiation of active predator management, but further study is needed. The only observed or suspected nest predators were common ravens and crows (American and/or Northwestern crows). Predator control actions occurred throughout the plover nesting season. However, most crow control actions were conducted early in the plover nesting season, and raven control actions peaked in July. A summary of the 2013 predator management results:
 - Total Nest Predator Control Hours (Apr - Aug) = 202
 - Number of Predator Hazing Incidents (Crow/Raven) = 60/13
 - Number of Lethal Removals (Crow/Raven) = 34/18
- Since 2012 WDFW, State Parks, and USFWS have coordinated enforcement activities during clam tides which reduced the amount of associated human activity in active nesting areas. In addition, USFWS and WDFW provided funding for two portable toilets that were placed on Willapa NWR beaches during the busiest razor clam weekend days during that occurred during the Snowy Plover nesting season. These toilets were successful in reducing the number of human intrusions into the posted nesting area. The Willapa NWR received favorable public response to this action.
- Willapa NWR distributed an outreach brochure informing the public about Snowy Plover conservation and habitat restoration actions at Leadbetter Point. “Share The Beach” brochures were requested and delivered to an equestrian bed and breakfast/camping business located south of Midway Beach Road for distribution to guests.
- Anthropogenic debris and trash was collected from Snowy Plover nesting beaches at Leadbetter Point after Snowy Plovers had finished nesting and chicks had fledged.
- WDFW biologists put nest exclosures around 2 nests at Midway Beach.

Restoration

- The HRA at Leadbetter Point has increased in size annually since Willapa NWR began work in 2001. By 2008 a total of 121 acres had been cleared of beachgrass, of which oyster shell has been

added to approximately 62 of the 121 acres. The HRA now totals more than 300 acres. Between 4 February and 15 March 2013, Willapa NWR staff used a bulldozer and a tractor-mounted disk to remove dead beachgrass in areas surrounding the south end of the HRA that were sprayed with herbicide in 2012. This has created an estimated 10 acres of additional habitat along the eastern edge of the existing HRA. They also disked resprouting beachgrass in the unshelled portions of the northern HRA and in the swale to the west of the HRA.

- On 22 October, 2013 Willapa NWR used a helicopter to apply the herbicide Imazapyr, with Modified Seed Oil as a surfactant. This was substantially later than previous years due to the federal government shutdown. Fortunately, the weather was unseasonably warm and dry which kept the grass actively growing, while providing a favorable weather window that allowed for herbicide treatment much later than could be done during more normal years. The Willapa NWR treated approximately 110 acres of heavily vegetated beachgrass. The sprayed areas were within and adjacent to the west edge of the south end of the HRA and along the east edge of the northern portions of the HRA. They also sprayed beachgrass to the south and east of the South Swale area cleared in 2012. Lastly, Willapa NWR treated an additional 20 acres along the dunes on the northern end of Leadbetter Point State Park. Aerial application is cost effective and results in a more uniform application in rugged, choppy terrain.
- No habitat restoration work was conducted on State Park lands at Leadbetter Point or Midway Beach in 2013.

RESEARCH PROGRESS

- In collaboration with The Oregon Biodiversity Information Center and Steve Dinsmore, we completed a manuscript that will be submitted to a journal for peer-review. The manuscript examines chick survival in Oregon and Washington for the 28 days post-hatching – the period of time needed to reach full independence. This information may play a critical role in evaluating the effectiveness of predator management – does chick survival improve with predator management?
- We also submitted a manuscript to a journal for peer-review that assesses the influence of habitat characteristics, proximity of other Snowy Plover nests and nest exclosures on nest survival in Washington State. Results of this work will be available on our web site in the near future.

ACKNOWLEDGMENTS

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APPENDIX I

Blue circles represent locations of Snowy Plover nests at Leadbetter Point, Willapa NWR in 2013. Orthographic imagery is from 2013.



Blue circles represent locations of Snowy Plover nests at Midway Beach and Graveyard Spit in 2013. Orthographic imagery is from 2013.

