

Washington State Snowy Plover Population Monitoring, Research, and Management: 2011 Nesting Season Research Progress Report

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Fish and Wildlife
Wildlife Science Division



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

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OVERVIEW

During the 2011 Western Snowy Plover (*Charadrius nivosus nivosus*) nesting season, we monitored breeding phenology, nest success, fledging success and number of nesting adult plovers in Washington. Field monitoring and research was conducted by Wendy Pearson, Cyndie Sundstrom, and William Ritchie, with assistance from Marie Fernandez, Warren Michaelis, Scott Harris, Scott Pearson, and Steve Spencer. A summary of some of our 2011 activities and results:

Breeding Phenology

- Clutches were initiated between 21 April and 20 July (Figure 3). However, very early nests could have gone undetected because intensive surveys did not start until late March on Midway Beach and there was little coverage of Leadbetter until late June.
- The first chick known to fledged around 23 July and the last chick known to fledge, fledged around 9 September

Breeding Range

- Conducted 31 surveys on 12 sites to either assess occupancy or to count the number of nesting adults
- Snowy Plovers were only found nesting on Leadbetter Point and Midway Beach.

Number of Breeding Adults

- The mean 2011 Washington breeding adult population was 40 (95% Confidence interval: 20-60). All of the breeding adults observed were found on Leadbetter Point and Midway/Grayland Beach. Staff and volunteer surveyors conducted surveys.
- The Washington population is declining by approximately 4 birds per year over the past six years ($p = 0.042$), and has declined from four nesting sites to two over the past 6 years.

Nest success

- Thirty nests were discovered and monitored (fewer than in past years as a result of less effort in the spring at Leadbetter Pt.).
- The percent of nests that survived from egg laying through hatching during the 2011 nesting season was 28% (including exclosed and non-exclosed nests).
- As in past years, the primary source of nest failure was predation. Common Ravens and coyotes were the only identified nest predators. However, in many cases we could not identify the nest predator.

Fledging Success

- The average number of young fledged per adult male on the two nesting sites in Washington was 1.70 (95% Confidence interval: 0.90-2.70). Population viability analyses indicate that at least one young must fledge per adult male on average to have a stable population.

Management Actions

- *Restrictions*: Beaches were closed to fireworks at locations where State Parks and U.S. Fish and Wildlife Service are the upland land owners.
- *Nest exclosures*: Three nests were exclosed on State Park land at Midway Beach.
- *Signing*: Approximately 7.5 miles of beach was signed at Leadbetter and approximately 1 mile of Midway Beach was signed to restrict human access to the dry portion of the beach and protect nests. Access restrictions did not occur on private land.
- *Nest Predation*: Willapa National Wildlife Refuge continued conducting surveys to collect data on nest predators occurring in and adjacent to the plover and lark nesting areas at Leadbetter Point. Logistics of implementing a proposed predator management strategy were investigated

- *Restoration:* The U.S. Fish and Wildlife Service habitat restoration area (HRA) at Leadbetter Point is 121 acres, of which oyster shell has been added to approximately 62 of the 121 acres. There was no enlargement of HRA in 2011 and no aerial herbicide spray. Maintenance non-native beachgrass control included hand spraying in the south central portion of the HRA. Harrowing to redistribute shell in the north end of the shelled area of the HRA and bulldozing to remove beachgrass and widen the dune cuts in the swale adjacent to the west edge of the south HRA was conducted in February.
- No habitat restoration work was conducted on State Parks lands at Leadbetter Point or Midway Beach in 2011.

Recommendations

- Summarize, write-up and publish population monitoring results from Oregon, Washington, and northern California.
- Continue to examine the effectiveness of habitat restoration areas.
- Identify the conditions where plover populations are more likely to be self-sustaining.
- Conduct research to identify habitat features important to successful plover nesting.
- Begin implementation of a predator control plan for active snowy plover nesting locations. Continue to engage volunteers in monitoring.
- Continue to link management activities with research and monitoring.
- Continue to evaluate the effectiveness and continued use of nest exclosures on an annual basis.
- Evaluate impact and timing of clam digging on plover nesting, foraging and fledging.
- Initiate education and outreach activities.

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 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 areas supported nesting 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 (Grayland vicinity), and Graveyard Spit. However, because of the very close proximity of Graveyard Spit to Midway/Grayland Beach, this could be considered one site. During the 2009-2011 nesting seasons, only Leadbetter Point and Midway Beach (Grayland vicinity) were occupied.

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.

According to the Washington State Recovery Plan for the Snowy Plover (1995), the plover will be considered for down listing to Threatened when the state supports a 4-year average of at least 25 breeding pairs and 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 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 is coordinating its monitoring efforts with U.S. Fish and Wildlife Service, 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 2011 nesting season were:

- Conduct winter window surveys.
- Conduct breeding window surveys.
- Conduct unoccupied breeding site surveys at Copalis Beach, Connor Creek, Damon Point, and Graveyard Spit.
- Estimate hatching success rates and sources of nest mortality during the egg laying/incubation stage for all nest locations.
- Provide fledging success and adult breeding plover population size estimates 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 plovers from potential threats.
- Produce a joint report with U.S. Fish and Wildlife Service Willapa National Wildlife Refuge 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 the entire 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 plovers, Leadbetter Point, Graveyard Spit, and Midway Beach. During the 2009-2011 nesting seasons plovers nested at two sites, Leadbetter Point 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 2011. 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. 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. For definitions of terms used to describe coastal sand dune morphology in this section, we recommend referring to Wiedemann (1984).

Table 1. Approximate locations and land ownership for the 2011 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

Breeding Window Surveys

The breeding window survey occurs annually in late May and early June along the entire U.S. Pacific coastline where Snowy Plovers nest. The specific dates for a particular year are selected by the U.S. Fish and Wildlife Service and all participants follow the methods of Elliot-Smith and Haig (2006a). In 2011, the window survey occurred the week of 23 May. We surveyed some beaches that week and some the following week due to poor weather conditions. For this survey, we surveyed Connor Creek, Copalis Spit, Damon Point, Midway/Grayland Beach, Graveyard Spit, Leadbetter Point (north of Oysterville Road) and we drove the Long Beach Peninsula south of Oysterville Road.

For the sites that were previously occupied by plovers but were thought to be unoccupied at the beginning of the 2011 field season (Damon Point, Connor Creek, Copalis Spit, and Graveyard Spit), an experienced biologist surveyed appropriate habitat on foot. We also conducted a driving survey of the Long Beach Peninsula south of Oysterville road for the breeding window survey.

Surveys attempted to determine "population" size at occupied sites and site occupancy at unoccupied sites, however, more effort was devoted to surveying occupied sites. Also, because occupied sites are generally wider with uneven surfaces and more vegetated hummocks than other localities, more observers were required to adequately cover the site. For the Leadbetter Point survey, a driving survey was conducted by 3 observers in 2 vehicles driving in tandem (one vehicle above the most recent wrack line and one vehicle below) from the Refuge property boundary south to Oysterville Road (Washington State Parks land). Three

observers walked the wider section of beach from the southern beach sign number one to the north and around the tip of the Peninsula to the second cove south on the eastern side. Two biologists most familiar with the habitat at the USFWS Leadbetter Point restoration area walked a serpentine route through the area. The three observers surveying the northern beach section walked approximately 50-75 m apart but parallel to each other. All plovers observed were communicated to other observers by 2-way radio to a single data recorder (usually the middle observer) to avoid double counting. All birds were allowed to pass between observers and every effort was made to avoid flushing plovers, which could result in double counting and unnecessary disturbance. All observers started at approximately the same time and they walked from south to north. The Midway Beach survey consisted of three observers walking parallel and approximately 50-100 m apart and again, they communicated by 2-way radios and allowed birds to pass between observers. See Elliot-Smith and Haig (2006a) for details of the survey methods used.

Table 2. Starting and ending locations, survey types and number of surveyors for each survey site in Washington. The Leadbetter counts in the figures and tables that follow include birds detected in the Habitat Restoration Area (HRA), the northern Refuge beach section (from the refuge land just south of the habitat restoration area to the tip of the Peninsula and around) and southern beach section (between Oysterville Road and just south of the Refuge 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	Vehicle/ Foot
Connor Creek	47° 04' 14", 124° 10' 24"	47° 07' 16.5", 124° 10' 59.9"	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"	3	Foot
Graveyard Spit	46° 43' 33", 124° 03' 07"	46° 42' 25", 124° 00' 36"	1 or 2	
Leadbetter - North	46° 37' 40.7", 124° 04' 17.4"	46° 38' 50.5", 124° 03' 13.6"	3	Foot
Leadbetter HRA	46° 37' 40.9", 124° 04' 07.8"	46° 38' 30.4", 124° 04' 07.2"	2	Foot
Leadbetter - South	46° 32' 54.0", 124° 03' 40.8"	46° 37' 40.7", 124° 04' 17.4"	1 or 2	Vehicle
Long Beach (S. of Oysterville Rd.	46° 32' 54.0", 124° 03' 40.8	46° 22' 03.8", 124° 03' 24.4"	1	Vehicle

Winter Window Surveys

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 U.S. Fish and Wildlife Service select the dates for any given year. All participants follow the methods of Elliot-Smith and Haig (2006b). In 2011, the window survey occurred from 9-18 January and we surveyed Connor Creek, Copalis Spit, Damon Point, Midway/Grayland Beach, and Leadbetter Point (north of Oysterville Road) but did not drive the Long Beach Peninsula south of Oysterville Road.

Adult Surveys

Site occupancy

Our goal was to determine presence/absence at sites that are currently occupied and at the sites most likely to become re-occupied where we have failed to detect plovers. 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 Graveyard Spit, Damon Point, Connor Creek and Copalis Creek to assess occupancy during the 2011 nesting season because these sites were historically occupied.

Occupancy surveys with only 1 or 2 visits

We visited two sites with suitable nesting habitat between 29 April and 20 August to informally assess occupancy and look for banded plovers (see Table 5). We also visited three islands in Willapa Bay on 20 June and one on 28 August (n = 1 visit each: Appendix I) to look for nesting plovers.

Estimating Number of Adult Plovers

All occupied sites (Leadbetter Point, Midway Beach) and recently occupied sites (Damon Point and Graveyard Spit) were surveyed four to five times between 26 April and 29 July using the methods described in Elliot-Smith and Haig (2006a). One of these surveys was also the Breeding Window Survey. We used the number of surveyors and methods described under the Breeding Window Survey above. We surveyed the entire nesting area with enough surveyors to consider these complete counts.

Even though these are complete counts, there are likely errors of both omission (birds missed that should have been counted) and commission (double counted birds). As a result, we corrected our counts for both errors of omission and commission. To estimate the number of double counts during each Midway Beach and Leadbetter survey, we determined how many times a color marked bird was double counted during a given survey. To estimate the number of birds not detected that should have been detected (omissions), we used our re-sight data of banded birds to determine the number of banded birds that were not observed during the survey but that were observed both during the two week period before the survey and the two and a half week period after the survey at that site. We used a two and a half week period post surveys because, in one instance, the closest survey in time was two and a half weeks after the survey of interest. These are the birds associated with the site that should have been detected during our survey but were not. To develop a correction factor, we used surveys in 2011 where > 25% of the birds were banded because we wanted a reasonable sample size of banded birds upon which to base our correction factor. The average proportion of double counts per survey (n = 9 surveys) was 0.079 and the average proportion of missed birds per survey was 0.35. We then used these two proportions to develop a single correction factor for any survey by subtracting the proportion of double counts from the proportion of omissions and multiplying this resulting value by 1 (= 1.27) by the number of birds detected per survey.

We derived population estimates for the nesting sites based on counts conducted during three survey windows (between 23 May and 22 June). These counts occurred when there was the least amount of immigration and emigration into and out of Washington and before post-nesting dispersal. In the Results, we present the mean of these four surveys and the 95% confidence intervals. We rounded all estimates to the nearest whole bird.

Clutch Initiation Dates

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.

Nest success

Leadbetter Point and Midway Beach were visited several times a week to search for and monitor Snowy Plover nests from late March until mid-September. However, because of hiring difficulties by USFWS, Leadbetter was not regularly surveyed for nests until late June. Searching was conducted both during adult surveys and during frequent visits to the nesting sites. Nests were located in many cases by following plover tracks to nests. Nests were also located by observing scrape building by males, locating adults incubating eggs, or by flushing incubating adults. Date and status (presence of adults and eggs) of each nest was recorded approximately every 3-5 days. Nest success was calculated using the Mayfield method (Mayfield 1961, 1975). Nest outcome was reported 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). The mini-exclosure was constructed of 2x4 inch mesh wire fencing with four sides, 4 feet long and wide and 2 feet 8 inches high. The sides were fastened together to form a square. A 'bubble' top of wire fencing was fastened to the top of the square, making the exclosure approximately 3 feet high. Under the wire bubble top we secured a taut layer of 3/4 inch polypropylene black mesh netting. This soft layer was used to keep a startled plover from flying up and hitting the wire bubble top of the exclosure, if a raptor should land above them. A door was cut in one side of the exclosure so that eggs could be accessed if necessary; doors were fastened closed with pliable, heavy gauge wire. The completed exclosure was centered over the nest creating an imprint in the sand and removed. Following the exclosure imprint, a trench, 8 inches deep, was dug and the mini-exclosure was placed in the trench. Fifteen inch stakes were placed 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 plovers free access to the nest from all sides but excludes American Crows, Common Ravens and larger mammals. Exclosures are not used 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 plovers do not feed their chicks after hatching, but lead them to suitable feeding areas. Adults warn of approaching predators 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 both 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.

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 and from successful nests, follow broods post hatching. Hatch date was estimated 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. Unlike previous years, chicks were not banded in 2011. For these unbanded chicks, we were often able to use chick plumage and size for 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 were able to track 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 when a banded adult male accompanied chicks that allowed us to accurately assign the chicks to a specific nest.

Nest Locations

Each nest was photographed and its location was recorded using a hand held GPS unit. On Leadbetter Point, the U.S. Fish and Wildlife Service used both a Trimble and Garmin GPS unit. Washington Department of Fish and Wildlife used Garmin GPS unit. 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 birds were banded in Oregon or California 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 Reyes Bird Observatory 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. Exact color combinations for a banded bird were only assigned when the birds were observed with spotting scopes and where the color combination could confidentially be determined. To help us determine if a color combination was confidentially assigned, we assigned a confidence score (0-100% confident) to each color combination recorded.

RESULTS & DISCUSSION

Breeding Window Survey

Thirty-four adult plovers were detected in Washington during the 2011 breeding window survey, which was the lowest in the past six years (Table 3).

Table 3. Breeding Window survey counts by site, sex, and age and counts of nests and broods in 2011.

Site	2006	2007	2008	2009	2010	2011	2011 Survey Dates	Adult Males	2011 Adult Females	Adult Unknown
Copalis Spit	0	0	0	0	0	0	27 May	0	0	0
Conner Creek	0	0	0	0	0	0	27 May	0	0	0
Damon Point	0	0	0	0	0	0	2 June	0	0	0
Graveyard	-	0	1	0	0	0	18 May	0	0	0
Midway Beach	25	22	12	16	18	22	23 May	8	13	1
Leadbetter Pt.	42	28	29	26	20	12	24 May	5	6	1
S. Long Beach	0	0	0	0	0	0	24 May	0	0	0
Total	67	50	42	42	38	34		13	19	2

Winter Window Survey

Twenty-two adult plovers were detected on two sites during the January 2011 Winter Window Survey (Table 4).

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

Site	2006 -	2007 -	2008 -	2009 -	2010 -	Survey Dates	Adult Males	Adult Females	Adult Unkn
	2007	2008	2009	2010	2011				
Copalis Spit	0	0	0	0	0	9 January	0	0	0
Conner Creek	0	0	0	0	0	9 January	0	0	0
Damon Point	0	0	0	0	0	18 January	0	0	0
Graveyard	0	-	-	0	-	-	0	0	0
Midway Beach	21	15	10	12	13	10 January	1	2	10
Leadbetter Pt.	17	14	9	23	9	11 January	3	2	4
S. Long Beach	-	-	-	-	0	11 January	0	0	0
Total	38	29	19	35	22		4	4	14

Adult Surveys

As indicated in Table 5, we conducted 30 surveys at 12 sites between 26 April and 29 August 2011.

Table 5. Snowy Plover survey dates, number of surveys and surveyors and type of survey by site during the 2011 nesting season

Site	Type of Survey	# Surveys	# Surveyors	Walking or Driving	Survey Dates
Midway	Breeding Adult/Window	5	3-4	Foot	4/26, 5/10, 5/23, 6/08, 6/21
Leadbetter	Breeding Adult/Window	4	5	Foot/Drive ²	5/24, 6/09, 6/22, 7/07
Graveyard	Occupancy/Window	5	1	Foot	5/18, 6/16, 7/01, 7/18, 8/17
Damon Pt.	Occupancy/Window	4	2	Foot	5/03, 6/02, 6/28, 7/29
Connor Creek	Occupancy/Window	3	1-2	Foot/Drive ¹	4/29, 5/27, 6/28
Copalis Creek	Occupancy/Window	3	1-2	Foot/Drive ¹	4/29, 5/27, 6/28
Ocean Shores/N. Jetty	Opportunistic	1	1	Drive	4/29
Westport S. Jetty to Bonge Ave.	Opportunistic	1	1	Foot	8/04
Gunpowder Shoal, Willapa Bay	Opportunistic	1	3	Foot	8/29
Snag Island/Ellen Sands, Willapa Bay	Opportunistic	1	4	Foot	6/20
Unnamed Island, Willapa Bay	Opportunistic	1	4	Foot	6/20
Gunpowder 1 (just NE of Gunpowder Shoal	Opportunistic	1	3	Toot	6/20

¹Half area surveyed by foot and half area driving

² Post 1 south to Oysterville Rd driving surveys with 2 vehicles with 3-4 observers

Our goal was to determine plover presence-absence at Damon Point, Connor and Copalis Creeks and Graveyard Spit and we surveyed these sites at least three times this season. At Midway Beach and Leadbetter our goal was to estimate the number of breeding adults and we surveyed Leadbetter Pt. four times and Midway/Grayland Beach five times during the nesting season. We also conducted opportunistic surveys to the islands in Willapa Bay, the Ocean Shores area, and south of the Westport jetty (Table 5; Appendix I).

Site occupancy

Because Damon Point, Graveyard Spit, and Copalis and Connor Creeks were historically occupied by nesting birds, we conducted at least three surveys of each site during the 2011 nesting season and found all of these sites to be unoccupied. According to Pearson et al. (2006), there is a 67% probability of correctly determining site occupancy with one visit, an 89% probability with two visits, a 96% probability with three visits, and a 99% probability with four visits. Because sites are colonized and go extinct within a season as demonstrated by Damon Point in the past, it is important to spread out visits between early to mid-May and the end of the first week of July – the period of greatest nesting activity.

Opportunistic Surveys

No plovers were observed during opportunistic surveys (Table 5; Appendix I).

Estimating Number of Adult Plovers

We examined the average resights of banded male and female plovers per day during the 2011 nesting season to determine if there are differences in detectability (average resights per day) between the sexes (Figure 1). This result, and nearly identical results in 2006 – 2010, indicates that there is no need to adjust counts for differences in detectability between males and females.

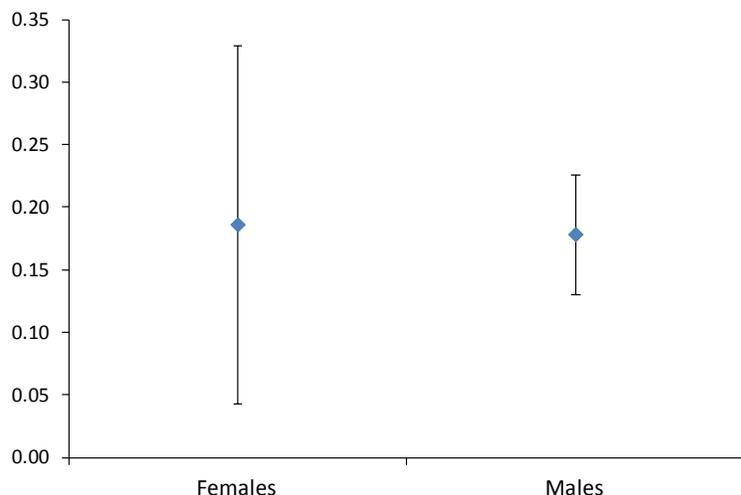


Figure 1. Average number of re-sights per banded adult female (n = 24) and male (n = 8) Snowy Plovers per day (± SD) during the 2011 nesting season.

The sex specific resight information and our previous information on immigration and emigration (e.g., Pearson et al. 2010) indicates that 1) populations are not closed and likely vary slightly week to week; 2) that populations are less dynamic between late April and the first week of July and are likely composed primarily of local breeders during this period; 3) and there are no sex biases in our counts associated with differences in detectability between males and females. We conducted repeated counts of adult birds during the 2006 season for a longer window of time and our results also indicated that adult numbers declined after the first week in July suggesting that some birds are dispersing from these sites after either failing to breed or females dispersing after leaving their mate with the final clutch or brood of the season and that counts increase through early April suggesting that birds are still arriving on the nesting grounds (Pearson et al. 2007). This pattern also suggests that surveys of breeding adult birds should be conducted between late April and before the second week in July when populations are more stable and largely composed of local breeders.

Table 6. Adjusted counts (95% CI) of the breeding adults at four nesting sites in Washington and the total population estimate for the State in 2006-2011.

	Damon	Midway	Graveyard	Leadbetter	Total
2006 Adjusted Counts	1 (-1-3)	23 (15-30)	2(-1-6)	39 (28-49)	65 (53-77)
2007 Adjusted Counts	0	19 (16-23)	2(-1-5)	27 (22-33)	48 (39-58)
2008 Adjusted Counts	0	16 (11-22)	1 (0-2)	36 (26-47)	54 (38-69)
2009 Adjusted Counts	0	16 (14-19)	0	19 (11-27)	35 (26-44)
2010 Adjusted Counts	0	17 (13-21)	0	25 (20-31)	43 (39-46)
2011 Adjusted Counts	0	24 (10-38)	0	16 (8-24)	40 (20-60)

Repeated counts help us understand the variability associated with estimates. We used three surveys from pre-determined weeks (23 May and 22 June) to estimate the breeding adult population (Figure 2, Table 6). Adult population counts are declining for the 2006-2011 period (Table 6, Figure 2).

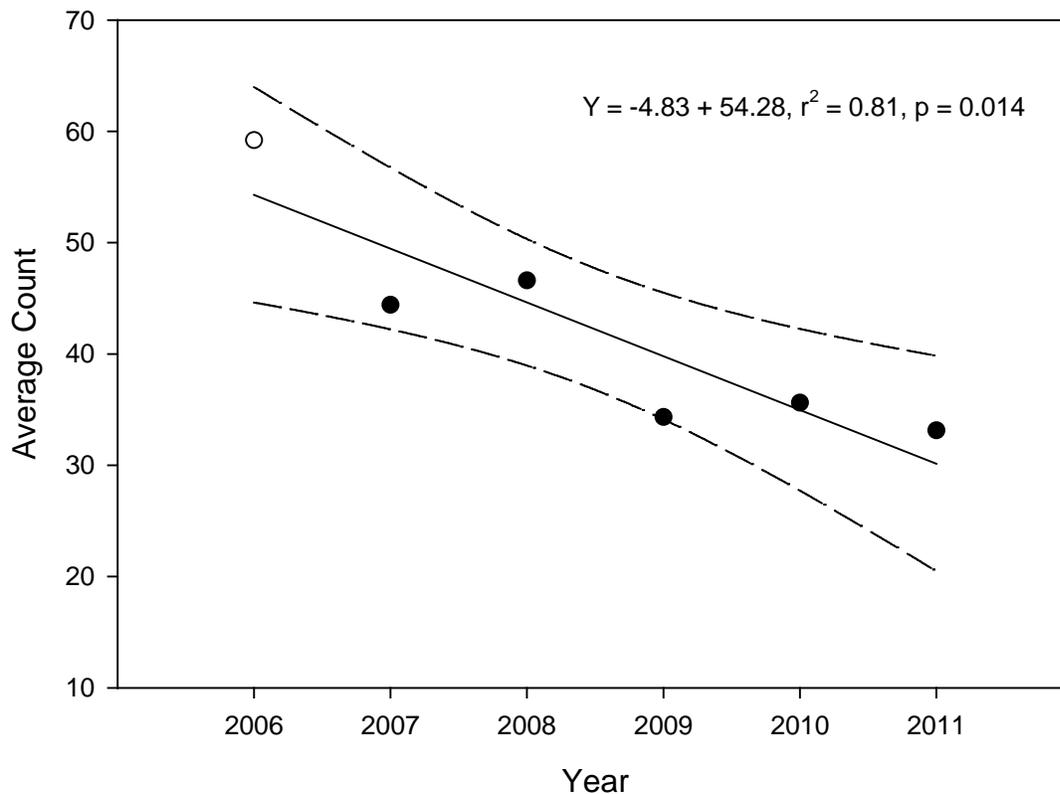


Figure 2. Washington adult plover population trend (95% CI) from 2006 – 2011 using unadjusted counts. The trend is almost identical for adjusted counts ($Y = -4.32$ birds per year + 59.02 , $r^2 = 0.68$, $p = 0.042$).

Clutch Initiation Dates and Breeding Phenology

Clutches were initiated between 21 April and 20 July (Figure 3). However, very early nests could have gone undetected because intensive surveys did not start until late March on Midway Beach and there was little coverage of Leadbetter until late June. The first chick known to fledged around 23 July and the last chick known to fledge, fledged around 9 September (Figure 5B).

Scrape building and territory defense occurs prior to egg laying, consequently the active nesting season occurred between late-March and mid-September in 2011. In Figure 3, we present the number of clutches initiated and number of chicks fledged in ten-day intervals at all sites combined. Clutch initiation was fairly evenly spread out between mid-April and mid-July. Overall, both nest initiation and fledging occurred much later this past nesting season than recent years. Looking at all years combined, the nesting season starts in late March and continues through mid-September.

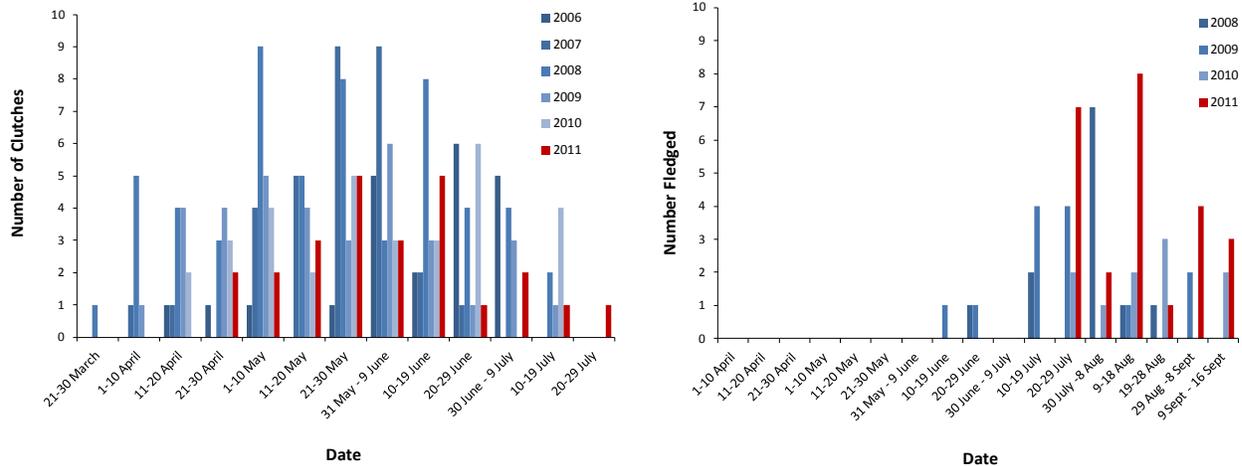


Figure 3. Number of Snowy Plover clutches initiated in 2006-2011 (A) and number of chicks fledged in 2008-2011 (B). Results are presented in 10-day intervals for all Washington nesting sites combined.

Nest success

We located and monitored the outcome of 30 plover nests in 2011. We know that there were at least two additional nests that we did not discover at Leadbetter because two adult males were discovered with a chick but their nests were never located. Undiscovered nests and one nest with no exposure days are not included in nest success analyses because of potential bias associated with including them. Of the 29 discovered nests with exposure days, 10 were located at Leadbetter and 19 at Midway Beach (Table 7). For a map of nest locations see Appendix I. Thirteen of these nests hatched. For nests that failed to hatch, predation was the primary source of nest failure (56%). Common Ravens (*Corvus corax*) and coyotes were the only identified nest predators (Table 8). Unlike previous years, drifting sand was not a significant source of nest failure (Table 8). Two nests were abandoned and three failed for unknown reasons.

Table 7. Nest outcomes by Snowy Plover nesting locality in 2011. Outcomes include successful (hatched), failed or unknown outcome.

Site	# Nests	Outcome		
		Hatch	Fail	Unknown
Midway	19	8	11	0
Leadbetter	10	5	5	2
Exclosed ¹	3	3	0	0
Not exclosed	26	10	16	2
Totals	29	13	16	2

¹The three exclosures were used at Midway

We used the Mayfield method to estimate nest survival probability. The Mayfield method accounts for potential biases associated with the date of nest discovery and the resulting number of days that a nest is exposed to predators by calculating a probability of survival associated with the number of exposure days (number of days observed). In Tables 9 and 10, we report Mayfield nest success estimates for the 2011 nesting season and compare to the previous nesting seasons. The probability of nest survivorship was 26% at Midway and 33% at Leadbetter. Only three nests were exclosed and all were located at Midway Beach.

Table 8. Sources of Snowy Plover nest failure in 2011. 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	0	2	6	0	0	1	1
Leadbetter	0	0	0	0	0	0	0	1	2
Exclosed	0	0	0	0	0	0	0	0	0
Not exclosed	0	1	0	2	6	0	0	2	3
Totals	0	1	0	2	6	0	0	2	3

Table 9. Mayfield estimates of Snowy Plover nest survival and of daily nest survival probability by site and by exclosed and unexclosed nests in 2011.

Site	Daily Survival Probability	Nest Survival
Midway	0.959	0.261
Leadbetter	0.966	0.325
Washington total (including exclosures)	0.961	0.281

Table 10. Mayfield estimates of nest survival by site from 2006 - 2011. Most nests (79-93%) were exclosed at Leadbetter in 2007- 2010 but none were exclosed in 2011, and 33%, 39%, 0%, 6%, and 16% were exclosed Midway in 2007-2011 respectively.

Site	Nest Survival					
	2006	2007	2008	2009	2010	2011
Midway and Graveyard	0.23	0.28	0.25	0.15	0.20	0.26
Leadbetter	0.26	0.51	0.54	0.43	0.83	0.33
Washington Total (including exclosures)	0.25	0.37	0.36	0.30	0.46	0.28

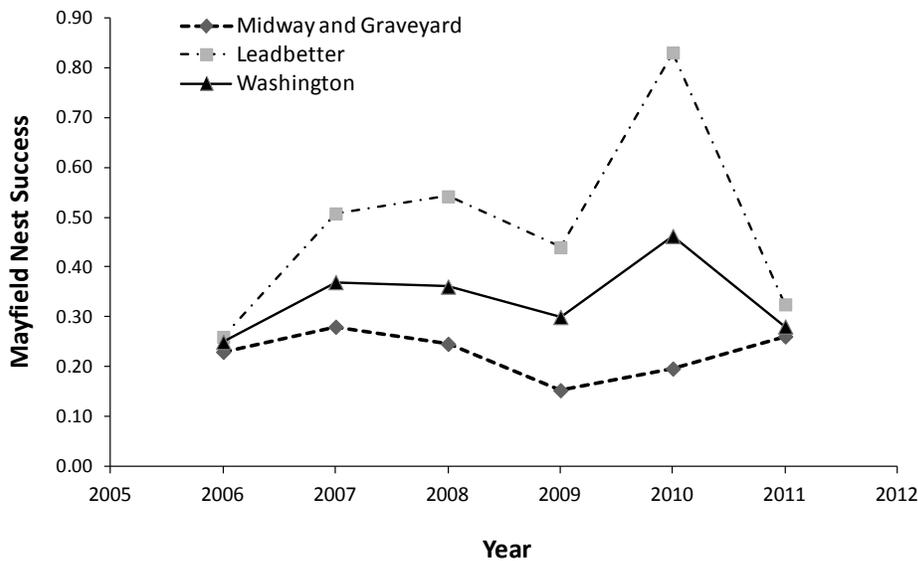


Figure 4. Mayfield estimates of nest survival by site and for coastal Washington. Note that most nests (79-93%) were exclosed at Leadbetter in 2007- 2010 but no nests were exclosed at that site in 2011. For Midway Beach, 33%, 39%, 0%, 6%, and 16% were exclosed Midway in 2007, 2008, 2009, 2010 and 2011 respectively.

Fledging Success

The U.S. Fish and Wildlife Service 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.

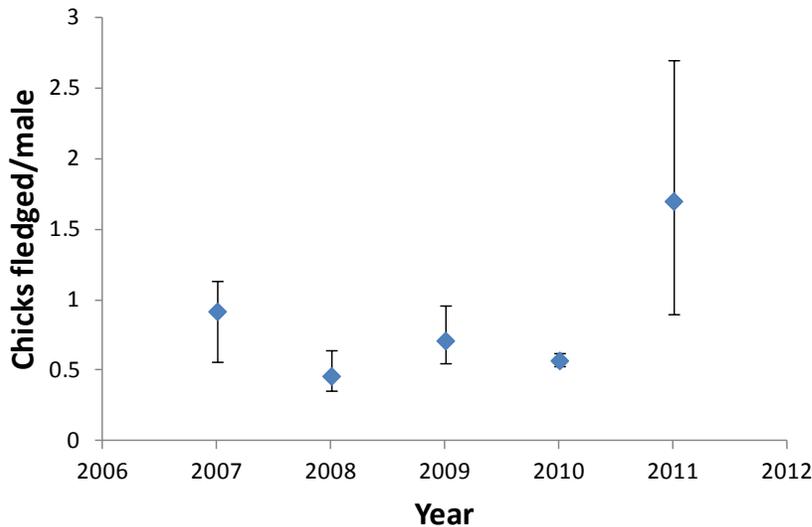


Figure 5. Number of Snowy Plover chicks fledged per adult male from 2007-2011 for all Washington nesting sites combined. Population modeling indicates that one chick fledged per male is needed on average to maintain a stable population.

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 23 and 25 chicks fledged in 2011. We used the proportion of males from our breeding adult surveys (using known sex birds) to determine the number breeding males in Washington. Because there was no difference in the sightability of males and females (Figure 2), this result should be unbiased. Using our estimate of breeding males and number of young actually thought to have fledged, we estimate that the number of young fledged per adult male in 2011 was 1.70 (95% CI = 0.90-2.70). This is the first year that the point estimate exceeded 1.0.

Nest Locations

2011 nest locations are presented by nesting site in Appendix I. At Midway Beach, birds nested in Grayland Beach State Park and the beach immediately to the south. On Leadbetter Point plovers nested on the tip of the Peninsula on the outer beach and in the habitat restoration area on the Willapa National Wildlife Refuge.

PROGRESS ON RECOVERY OBJECTIVES

Federal Recovery Objectives:

Objective 1: 250 breeding adults in Recovery Unit 1.

The 2011 Washington nesting population was 40 (95% CI = 20-60) and the 2011 Oregon nesting population was 168 (Lauten et al. 2011) for a total of 208 (range = 188-228) nesting adult plovers in Recovery Unit 1.

Table 11. Estimated number of breeding adults in Recovery Unit 1 by year.

2007	2008	2009	2010	2011
210 (201-220)	183 (167-198)	184.5 (175-194)	217 (213-220)	208 (188-228)

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

We combined the Oregon and Washington estimates of the number of breeding adult males (n = 116-134) and the number of young fledged (n = 191-193) to derive this combined Unit 1 fledging success per male. The number of chicks fledged per male in Unit 1 was 1.59 (1.43-1.66) in 2011.

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

	2007	2008	2009	2010	2011
Chicks fledged per adult male	1.43 (1.37-1.50)	0.92 (0.85-1.01)	1.25 (1.18-1.32)	0.85-0.87	1.59 (1.43-1.66)

Washington State Recovery Objectives:

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

The mean 2011 Washington breeding adult population was 40 (95% Confidence interval: 20-60) and approximately 55% of these birds are females and 45% are males. If all females are paired, these estimates indicate that there are approximately 22 pairs (95% CI = 11-33 pairs) in Washington in 2011. The average number of pairs for the past four years was .

Table 13. Estimated number of breeding pairs in Washington (2006-2011).

	2006	2007	2008	2009	2010	2011
Breeding Pairs	32	24	27	17-18	21-22	22

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 was 2011 was 1.70 (95% CI = 0.90-2.70), 0.57 (95% CI: 0.53-0.62) in 2010, 0.71 (95% CI = 0.55-0.96) in 2009, 0.46 (95% CI = 0.36-0.64) in 2008, and 0.91 (95% CI = 0.77 - 1.13) in 2007. The average fledging rate for the past five years is 0.87. Currently plovers are nesting on two primary sites – one on a National Wildlife Refuge and the other on private 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”.

2011 MANAGEMENT ACTIONS

A number of the management actions that occurred in 2011 involved minimizing some human activities near active Snowy Plover nesting sites during the nesting season. Human related disturbance negatively affect hatching success of Snowy Plovers (Warriner et al. 1986, Schulz and Stock 1991) and Snowy Plover chick survival by as much as 72% (Ruhlen et. al. 2003). Disturbances to wintering Snowy Plovers is 16 times higher at a public beach than at a protected beach and 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 plovers were actively nesting on Grayland and South Beach State Parks and on National Wildlife Refuge and State Park lands on Leadbetter Point. Private lands at Midway/Grayland Beach were not closed to human activities. Approximately 7.5 miles of beach nesting habitat was closed at Leadbetter by State Parks and U.S. Fish and Wildlife Service and slightly under a mile of beach was closed to foot traffic at Midway/Grayland Beach by State Parks and Washington Department of Fish and Wildlife. The lower beach, adjacent to the ocean, remained open to the public. There are two dog restriction signs at trail junctions and trailheads on Leadbetter Refuge lands and there is a “Share the Beach” sign posted at Grayland Beach State Park and on the Refuge trails at Leadbetter Point.
- Symbolic fencing was put at Long Beach access trails at Leadbetter by U.S. Fish and Wildlife Service staff to direct people toward the wet sand and away from plover nesting habitat. Symbolic fencing was used on State Park land at Midway/Grayland Beach at 5 specific 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 and if nests are discovered adjacent to this trail, we recommend managers considering closing or re-routing this trail.
- On the Long Beach Peninsula, the beach is closed to vehicle traffic north of Oysterville Road to the southern Leadbetter State Park boundary from April 15 to the day after Labor Day. Coastal beaches at Willapa National Wildlife Refuge 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/Grayland beach area is open to vehicle traffic and there are vehicle access points at Cranberry Beach Road, Midway Beach Road and Warrenton-Cannery Road. The Midway Beach Road access cuts through the center of the highest use area for plover nesting on this beach but has been closed since 2009. As a result, there was much less disturbance to 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 plover nests.
- Washington Department of Fish and Wildlife biologists put nest exclosures around 3 nests on the Midway Beach.
- In 2011 WDFW, State Parks, and U.S. Fish and Wildlife Service coordinated enforcement activities during clam tides which reduced the amount of associated human activity in active nesting areas.

Restoration

- The U.S. Fish and Wildlife Service habitat restoration area (HRA) at Leadbetter Point is 121 acres, of which oyster shell has been added to approximately 62 of the 121 acres. There was no

enlargement of HRA in 2011 and no aerial herbicide spray due to a problem with the helicopter contractor. Maintenance included hand spraying in the south central portion of the HRA. Harrowing to redistribute shell in the north end of the shelled area of the HRA and bulldozing to remove beachgrass and widen the dune cuts in the swale adjacent to the west edge of the south HRA was completed in February.

- No habitat restoration work was conducted on State Parks lands at Leadbetter Point or Midway Beach in 2011.

FUTURE RESEARCH & MONITORING CONSIDERATIONS

- Summarize, write-up and publish population monitoring results from Oregon, Washington, and northern California.
- Continue to examine the effectiveness of habitat restoration areas.
- Identify the conditions where plover populations are more likely to be self-sustaining.
- Conduct research to identify habitat features important to successful plover nesting.
- Begin implementing a predator control program for current active nesting locations on Willapa NWR.
- Continue to engage volunteers in monitoring.
- Continue to link management activities with research and monitoring.
- Continue to evaluate the effectiveness and continued use of nest exclosures on an annual basis.
- Initiate education and outreach activities.

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APPENDIX I

Blue circles represent locations of Snowy Plover nests in 2011 at Leadbetter Point, U.S. Fish and Wildlife Service Refuge lands. Locations for two nests were not recorded. All of the orthographic photos are from 2011.



Blue circles represent locations of Snowy Plover nests in 2011 at Midway Beach. All of the orthographic photos are from 2011.



Islands in Willapa Bay surveyed by U.S. Fish and Wildlife and Washington Department of Fish and Wildlife Biologists during the 2011 nesting season. No plovers were detected.

