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Washington State Snowy Plover Population Survey and Leadbetter Point Nesting Season Monitoring and Management Report - 2021

Willapa National Wildlife Refuge
Washington Department of Fish and Wildlife

William Ritchie, Cyndie Sundstrom, and Anthony Novack

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Cover photo of snowy plovers at Leadbetter Point by Russ Lewis

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OVERVIEW

During the 2021 western snowy plover (*Charadrius nivosus nivosus*) nesting season, we counted the number of nesting adult snowy plovers at potential breeding sites in Washington and, to a limited extent, monitored breeding phenology, nest success, and fledging success at Leadbetter Point. Demographic monitoring has been suspended at Midway Beach and funding limitations reduced monitoring efforts at Graveyard Spit. Surveys were conducted by Cyndie Sundstrom, William Ritchie, and Larissa Ritzman, with assistance from Anthony Novack, Warren Michaelis, Derek Stinson, Richard Ashley, and others. Management activities included restricting human access to nesting sites, predator management, and restoring nesting habitat. The following is a summary of some of our 2021 activities and results:

Breeding Phenology

- Clutches at Leadbetter Point and Long Beach were initiated between 15 May and early July. Some early nests may have gone undiscovered because nest searching did not start until early May. Some late nesting could also have been missed since survey effort was limited after late July.
- Due to staffing limitations, we were unable to effectively monitor nest success at Leadbetter Point to determine whether any chicks fledged. However, several broods of hatch year chicks were observed late in the breeding season.

Breeding Range

- We conducted 22 breeding surveys at nine sites in two counties between 16 May and 19 June 2021 either to assess site occupancy status or to count the total number of adults.
- Snowy plovers were found to be nesting at Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach.

Number of Breeding Adults

- The mean 2021 Washington breeding adult population was 97 (Range: 92-101), an increase of four birds from the 93 counted in 2019, the most recent year with a complete survey of all sites. Breeding adults were observed at Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach.
- From 2006-2009 the Washington snowy plover population declined annually and precipitously.
- From 2009-2012, the adult breeding population was stable at around 31-36 birds. Since 2013, the population has more than doubled.

Nest success

- A total of 26 nests were discovered and monitored to a limited extent at Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach.
- Two (33%) of the six nests found at Leadbetter Point/Long Beach hatched, while two additional unassigned broods were observed. Three nests failed, most likely lost to predation, and two of the nests had an undetermined fate. Nests found at both sites in Grays Harbor County and at Midway Beach failed. Information on the fate of nests at Graveyard Spit was unavailable.
- After a steady four-year decline in nest failure due to predation, avian predators have been the primary source of nest failure during the past two years. However, without intensive nest searching and monitoring at multiple sites, we do not have a full understanding of change in predation rates.

Fledging Success

- Due to staffing limitations, we were unable to determine whether any chicks fledged this season. The average number of chicks fledged per male has not been estimated since 2018.

Management Actions

- *Nest Site Protection*: In an effort to protect nests from human activities, approximately 8.0 miles of beach at Leadbetter Point and approximately 2.7 miles of publicly owned (Washington State Parks Seashore Conservation Area) beach at Midway Beach were signed to restrict human access to critical

nesting areas. Signs and symbolic fencing were also installed at Graveyard Spit, and for the first time, at Griffiths Priday State Park.

- *Clam tides*: Washington Department of Fish and Wildlife coordinated most law enforcement activities, especially during clam tides. Washington State Parks and U.S. Fish and Wildlife Service provided additional law enforcement patrols.
    - Long Beach: There was no recreational razor clam digging during the snowy plover breeding season. The 53 days approved for razor clam harvesting occurred during the last three months of 2021.
    - Midway Beach: Only fall razor clam harvesting, totaling 62 days, was authorized.
    - Graveyard Spit: There was no razor clam harvesting.
    - Copalis/Conner Creek: Tribal razor clamming occurred on five days in June. There was a total of 33 days each for tribal and non-treaty recreational clamming occurring in fall 2021.

- *Outreach*: Willapa NWR social media posts and website content included information about snowy plovers at Leadbetter Point.
- *Predator Management:* Wildlife specialists with USDA APHIS Wildlife Services conducted limited predator management at Leadbetter Point and Midway Beach in 2021. Management actions were initiated in late June and concluded in July. Predator management consisted of dispersing birds or performing targeted lethal removal of known nest and chick predators (corvids) in or adjacent to plover nesting areas. Results suggest that these actions are successful in increasing hatching and fledging rates.
- *Emergency Response:* The *FV/Terry F* was salvaged from Leadbetter Point after running aground in February.

- *Habitat Restoration:*
    - Thirty acres on the Willapa National Wildlife Refuge at Leadbetter Point were cleared of *Ammophila* beachgrass using a bulldozer and disk prior to the start of the breeding season.
    - An additional 118 acres of previously cleared beach was also disked to reduce the density of resprouting beachgrass on the Refuge.
    - Oystershell hash was applied to 50 m^2 (0.1 ac) in the southern portion of the HRA.

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 Copalis Spit, Washington, to Bahia Magdalena, Baja California, Mexico. The snowy plover winters in coastal areas from southern Washington to Central America. This coastal population nests 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, Sundstrom et al. 2021). 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, invasive beachgrass (*Ammophila arenaria* and *A. brevigulata*), 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 or chicks, adverse weather, shoreline modification, dune stabilization, and disturbance caused by 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. In nesting seasons from 2009-2021 Leadbetter Point and Midway Beach were occupied, and Graveyard Spit was occupied in 2012-2021, but not in 2009-2011. Nests have been found on Long Beach since 2018, and recently at Conner Creek and Copalis Spit. Nest searching on the north Willapa Bay islands had been sporadic until annual breeding season surveys were begun in 2016. Nests have been found on several different islands in 1995-1998, 2016, and 2019.

Washington and Oregon comprise Recovery Unit 1 in the federal Recovery Plan for the western snowy plover (U.S. Fish and Wildlife Service 2007). The primary recovery criterion for this unit is 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 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. The Washington Department of Fish and Wildlife (WDFW) periodic status review for the snowy plover (Stinson 2016) reaffirms that the snowy plover does not currently warrant down listing. Delisting will be considered when the "average" population reaches 40 breeding pairs at three or more secure nesting areas. A draft revised state recovery plan is undergoing internal WDFW review.

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 predator management and the effectiveness of habitat restoration efforts. To provide the information needed to assess recovery progress and to assess the effectiveness of conservation actions, the U.S. Fish and Wildlife Service (USFWS) is conducting demographic monitoring at Leadbetter Point and coordinating its population monitoring efforts with Washington Department of Fish and Wildlife (WDFW), the Shoalwater Bay Tribe, and the Oregon Biodiversity Information Center (ORBIC). This coordinated effort was initiated in 2006, although state-

specific monitoring was initiated years before. During 2021 partner organizations in Washington were unable to conduct many of the monitoring requirements needed to determine the number of nests, their fates, or the estimation on reproductive success. The report also serves, in part, to meet our reporting obligations under Recovery Subpermit, WNWR-15, Amendment 15 (SPITS TE-007497-15) and for USFWS Section 6 grant number WA F19AF00830.

The primary objectives of our monitoring and management in 2021 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 occupancy breeding surveys at Ocean Shores, Damon Point/Oyhut Spit, and Benson Beach.
- Estimate snowy plover adult breeding population for Washington.
- Estimate hatching success rates and sources of nest mortality during the egg laying/incubation stage for all nest locations at Leadbetter Point.
- Reduce predator impacts to nesting snowy plovers at Leadbetter Point and Midway Beach.
- Attempt to increase nest success through habitat restoration efforts.
- Minimize human disturbance to nesting snowy plover to increase breeding success.
- Produce a report that summarizes methods used, numbers of breeding adults, hatching success, and management actions (this report).

This report summarizes progress on all these objectives, although hatching and fledging success data are limited.

METHODS

Study Areas

During the 2007 and 2008 nesting seasons, three core sites were occupied by breeding snowy plovers, Leadbetter Point, Graveyard Spit, and Midway Beach. From 2009-2011, snowy plovers nested at two sites, Leadbetter Point and Midway Beach. During the 2012-2021 breeding seasons, snowy plovers once again nested at Leadbetter Point, Midway Beach, and Graveyard Spit. During this period, snowy plover nests have also been discovered on two separate islands north of Leadbetter Point, one in 2016 and the other in 2019. Long Beach (2018) and Conner Creek/Copalis Spit (2020) have recently become occupied by snowy plovers (Table 1). The orthographic photo of nest sites in Appendix I provides a pictorial overview of the primary areas used at Leadbetter Point/Long Beach for nesting in the spring/summer of 2021.

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 or HRA).

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. In both 2012 and 2013, contractors working for the U.S. Army Corps of Engineers (USACE) deposited sand to construct a shoreline protection berm on Graveyard Spit. An emergency renourishment/dune restoration project administered by USACE began in early July 2018 and was completed in September. For definitions of terms used to describe coastal sand dune morphology in this section, see Wiedemann (1984).

The Conner Creek beach is similar to other southwest Washington sandy, dune backed beaches, but the width tends to be narrower than the beaches that lie south of Grays Harbor. The Conner Creek portion of the shoreline covers approximately 3.3 miles from the Ocean City Beach Access (2nd Avenue) to the mouth of Conner Creek. The beach at Copalis Spit is formed and shaped by the outlet of Copalis Creek and currently extends approximately 1.5 miles. The beach here tends to be wider than the other shoreline beaches north of Grays Harbor.

Table 1. **Approximate locations and land ownership/management of the 2021 snowy plover primary nesting localities in Washington.**

Site	Approximate Location	Ownership/Management
Copalis Spit	47° 07’ 16”N, 124° 10’ 59”W	Griffiths-Priday State Park
Conner Creek	47° 04’ 14”N, 124° 10’ 38”W	WA State Parks Seashore Conservation Area
Midway Beach	46° 45’ 32”N, 124° 05’ 46”W	Garyland Beach State Park, WA State Parks SCA
Graveyard Spit	46° 42’ 57”N, 124° 01’ 25”W	Shoalwater Bay Indian Reservation (trust and fee land), DNR/State Parks, Private
Leadbetter Point	46° 36’ 24”N, 124° 03’ 25”W	Leadbetter Point State Park, WA State Parks SCA, Willapa National Wildlife Refuge
Long Beach	46° 32’ 03”N, 124° 03’ 40”W	Cape Disappointment State Park, WA State Parks Seashore Conservation Area

Site Occupancy

Our goal was to determine snowy plover abundance and trends at sites that are currently occupied. We conducted surveys to assess site occupancy status at 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 relative 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. Pearson et al. (2008) 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 that recommendation, there is an 87% - 99% probability of correctly determining site occupancy. Since 2012, all Washington sites have conformed to a protocol of three attempted surveys per breeding season.

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 2021, the window survey occurred between 16 and 23 May. Connor Creek, Copalis Spit, Oyhut Spit, Ocean Shores/Ocean City, Midway Beach, Graveyard Spit, Leadbetter Point, Long Beach, and Benson Beach were surveyed (Table 2). Our primary intent during breeding window surveys was to count the adult population at occupied sites (Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach) and sites that were historically occupied (Connor Creek, Copalis Spit, Damon Point/Oyhut Spit). Due to logistical constraints, the north Willapa Bay islands were not surveyed in 2021.

Estimating breeding adult population size

In addition to the rangewide breeding window survey, we conducted two additional surveys at all occupied sites (Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach) and one additional survey at all Grays Harbor County non-occupied sites. We completed all surveys between 16 May and 19 June following the breeding window methods (USFWS 2007 Appendix J-1). These surveys are conducted 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 three surveys to derive estimates of breeding adult abundance. In the Results section, we present the average and the range of these three surveys. We rounded all estimates to the nearest whole bird.

Winter window survey

The winter window survey occurs annually in January along the entire U.S. Pacific coastline where snowy plovers nest, have historically nested, or where there is potentially suitable habitat between nesting sites. All sites are surveyed during a specific week selected by the USFWS each year. Participants follow the methods of Elliot-Smith and Haig (2006b). In 2021, the window surveys occurred from 19-24 January. We surveyed Copalis Spit, Connor Creek, and Ocean Shores to Ocean City, Oyhut, Damon Point, Midway Beach, Graveyard Spit, Leadbetter Point, Long Beach, and Benson Beach.

Table 2. **Starting and ending locations, survey types and number of surveyors for each survey site in Washington.**

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 or 2	Foot
Connor Creek	47° 04' 14", 124° 10' 24"	47° 07' 16.5", 124° 10' 59.9"	1	Vehicle & Foot
Oyhut Spit	46° 56' 46.8", 124° 07' 57.6"	46° 56' 25.4", 124° 09' 17.2"	1	Foot
Ocean Shores to Ocean City	47° 04' 14.2", 124° 10 37.8	46° 57' 12.7", 124° 10' 31.8"	2	Vehicle
Damon Point	46° 56' 05", 124° 09' 18"	46° 56' 11", 124° 06' 18"	1	Foot
Midway Beach	46° 47' 38", 124° 05' 55"	46° 44' 07", 124° 05' 29"	5 or 6	Foot
Graveyard Spit	46° 43' 33", 124° 03' 07"	46° 42' 25", 124° 00' 36"	5 or 6	Foot
Willapa Bay Islands	Various	Various	2	Foot
Leadbetter Point[1] North	46° 37' 40.7", 124° 04' 17.4"	46° 38' 50.5", 124° 03' 13.6"	4-6	Foot
Leadbetter Point HRA	46° 37' 40.9", 124° 04' 07.8"	46° 38' 30.4", 124° 04' 07.2"	1	Foot
Leadbetter Point SCA	46° 32' 54.0", 124° 03' 40.8"	46° 37' 40.7", 124° 04' 17.4"	3	Vehicle & Foot
Long Beach[2] (So. of Oysterville Rd.	46° 32' 54.0", 124° 03' 40.8	46° 22' 03.8", 124° 03' 24.4"	1 or 2	Vehicle & Foot

[1] The Leadbetter Point counts in the figures and tables that follow include birds detected in the Habitat Restoration Area (HRA), the Willapa NWR beach section (from the Willapa NWR land south of the HRA to the tip of the Peninsula and around), and the beach section of Leadbetter Point State Park (between Oysterville Road and the Willapa NWR boundary).

[2] This area includes surveys from Oysterville Road to North Head and from North Head to the Columbia River North Jetty. It includes Long Beach and Benson Beach.

Nest Phenology and Success

We visited Leadbetter Point and Graveyard Spit approximately one to several times a week from early May through early August to locate and monitor snowy plover nests. 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, when possible.

Unless observed directly, we calculated clutch initiation date by backdating from known laying or hatching dates. Egg floating can be used to calculate the initiation date; however, no nests were floated in 2021. To backdate from 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 is calculated using the Mayfield method (Mayfield 1961, 1975). Nest outcome is 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 cause of failure.

Nest Exclosures

Nest exclosures were not installed at any nests in 2021 and they have not been used since 2010.

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 four 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 estimate 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 the population is growing, stable, or decreasing (lambda). The threshold of 1.0 young fledged per adult male 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 chicks fledged per breeding male should increase the population 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 attempt to identify hatch dates for successful nests and then follow broods post hatching. We estimate 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 check nests daily or every other day close to predicted hatching dates. 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 can assign broods to a specific nest and hatch date because a banded adult male accompanied the chicks, which allows us to assign the chicks to a specific nest.

Nest Locations

We photographed each nest and recorded its location using a handheld GPS unit. We used both a Trimble and Garmin GPS unit to document nest locations at Leadbetter Point. The Trimble GeoXT unit has sub-meter accuracy with post-processing and the Garmin is accurate to within 10 m. The location of the Midway Beach, Graveyard Spit, and Grays Harbor County nests were not recorded this year.

RESULTS

Winter Window Survey

We counted 167 adult snowy plovers at three Washington sites during the January 2021 rangewide winter window survey. This is a substantial increase in the number of overwintering snowy plovers. Ten years of nonbreeding survey count totals are reported by site in Table 3.

Breeding Window Survey

We detected 92 adult snowy plovers in Washington during the 2021 rangewide breeding window survey with a slightly higher proportion of males to females. Birds of undetermined sex (n=10) and undiscovered incubating females may account for the unbalanced sex ratio. Leadbetter Point, Graveyard Spit, and Midway Beach counts were stable from the previous full surveys while the Long Beach count declined (Table 4).

Table 3. **Washington snowy plover rangewide winter window survey adult counts by site and year.**

Site	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Survey Date
Copalis Spit	0	0	0	0	0	0	0	0	0	0	20-Jan
Conner Creek	0	0	0	0	0	0	0	0	0	0	20-Jan
Ocean Shores/ Ocean City	-	-	-	-	-	4	10	0	9	0	20-Jan
Oyhut Spit	-	0	0	0	0	0	0	0	0	0	20-Jan
Damon Point	0	0	0	0	0	0	0	0	0	ns	
Midway Beach	22	24	22	22	31	22	28	58	66	52	19-Jan
Graveyard Spit	0	0	0	0	0	0	0	0	0	0	20-Jan
Leadbetter Point	12	6	45	0	28	34	12	15	0	111	23-Jan
Long Beach	0	0	0	0	10	6	0	7	0	4	22-Jan
Benson Beach	-	-	0	ns	0	0	0	0	0	0	24-Jan
Total	34	30	67	22	69	66	50	80	75	167	

Table 4. **Washington snowy plover rangewide breeding window survey adult counts by site and year.**

Site	2012	2013	2014	2015	2016	2017	2018	2019	2020*	2021 Count Total	2021 Survey Date	2021 Adult Male	2021 Adult Female	2021 Adult Unk.
Copalis Spit	0	0	0	0	1	0	0	0	4	5	20-May	3	2	0
Conner Creek	0	0	0	0	0	0	0	0	4	2	20-May	2	0	0
Ocean Shores/ Ocean City	-	-	-	-	-	-	3	0	2	0	20-May	0	0	0
Oyhut Spit	-	0	0	0	0	0	0	0	0	0	21-May	0	0	0
Damon Point	0	0	0	0	0	0	0	0	0	ns	-	-	-	-
Midway Beach	11	24	9	20	39	35	23	28	37	29	18-May	19	10	0
Graveyard Spit	0	1	6	3	18	17	28	32	ns	35	19-May	12	13	10
No. Willapa Bay Islands	-	-	0	0	3	0	0	ns	ns	ns	-	-	-	-
Leadbetter Point	15	20	28	41	45	32	27	19	ns	17	17-May	9	8	0
Long Beach	0	0	0	0	0	0	0	19	ns	4	18-May	2	2	0
Benson Beach	-	-	0	ns	0	0	0	0	ns	0	16-May	0	0	0
Total	26	45	43	64	106	84	81	98	47	92		47	35	10

* Breeding population total for 2020 is considered a minimum count since several primary breeding sites were not surveyed due to coronavirus pandemic restrictions.

Breeding Adult Surveys

As indicated in Table 5, we conducted 22 total surveys at 8 sites between 16 May and 19 June 2021. Breeding adult surveys comprising three survey visits each took place at six sites. Two sites were not surveyed, Damon Point and North Willapa Bay islands.

Site occupancy

We conducted occupancy surveys at three sites, Ocean Shores, Oyhut, and Benson Beach, to assess snowy plover presence/absence on suitable and/or historically occupied sites (Table 5).

Table 5. **Snowy plover survey dates, number of surveys and surveyors and type of survey by site during the 2021-nesting season.**

Site	Type of Survey	# Surveys	# Surveyors	Walking or Driving	Survey Dates
Copalis Spit	Breeding Adult/Window	3	1	foot	5/20, 6/01, 6/18
Connor Creek	Breeding Adult/Window	3	1-2	foot/drive	5/20, 6/02, 6/15
Ocean Shores/ Ocean City	Occupancy/Window	2	2	drive	5/20 & 6/15
Oyhut	Occupancy/Window	1	1	foot	5/21
Damon Point	Occupancy/Window	0	-	foot	
Midway Beach	Breeding Adult/Window	3	5	foot	5/18, 6/01, 6/17
Graveyard Spit	Breeding Adult/Window	3	5	foot	5/19, 6/04, 6/16
North Willapa Bay islands	Occupancy/Window	0	-	foot	
Leadbetter Point	Breeding Adult/Window	3	6-8	foot/drive	5/17, 6/03, 6/14
Long Beach (Oysterville to No. Head)	Breeding Adult/Window	3	1	drive	5/18, 6/05, 6/19
Benson Beach	Occupancy/Window	1	1	foot	5/16

Estimating Number of Adult Snowy Plovers

We used the mean from three surveys conducted at each breeding site in 2021 to estimate trends in the breeding adult population (Figure 1, Table 6). Adult population counts declined precipitously from 2006 to 2011, then began increasing. The total population estimate has increased steadily since 2011. Counts at Midway Beach have remained relatively stable since 2015 while counts at Graveyard Spit have increased dramatically since 2012. There has been a decline in the number of birds at Leadbetter Point since 2017. The number of snowy plovers breeding at Midway Beach during the previous four-years has shown a modest increase of six percent. The Graveyard Spit breeding population has increased seventeen percent during the same four-year period. Leadbetter Point is the only core breeding site than has exhibited a decreasing number of breeding plovers, with a loss of thirty-three percent over four years. This rate of loss may be influenced somewhat by reduced survey effort in recent years and dispersal of plovers to adjacent areas.

Table 6. **Mean counts (range) of the breeding adults at nesting sites in Washington and the total population estimate for Washington State, 2006-2021.**

Year	Midway Beach	Graveyard Spit	Leadbetter Point	Long Beach	No. Willapa Bay Is.	Ocean Shores/ Ocean City	Connor Creek	Copalis Spit	Total
2006	21 (14-28)	2 (0-5)	35 (26-45)	ns	ns	ns	ns	ns	59 (48-70)[1]
2007	18 (14-21)	2 (0-4)	25 (20-30)	ns	ns	ns	ns	ns	44 (36-53)
2008	14 (10-19)	1 (0-2)	32 (23-40)	ns	ns	ns	ns	ns	47 (33-60)
2009	15 (13-17)	0	17 (10-24)	ns	ns	ns	ns	ns	31 (23-39)
2010	14 (11-18)	0	21 (17-26)	ns	ns	ns	ns	ns	36 (33-38)
2011	19 (8-30)	0	12 (6-19)	ns	ns	ns	ns	ns	31 (15-47)
2012	14 (5-23)	2 (0-3)	18 (6-29)	ns	ns	ns	ns	ns	33 (15-52)
2013	20 (16-24)	4 (1-6)	20 (19-20)	ns	ns	ns	ns	ns	43 (41-45)
2014	11 (9-13)	7 (6-8)	24 (21-28)	ns	ns	ns	ns	ns	41 (40-43)
2015	24 (19-33)	8 (3-11)	43 (34-54)	ns	ns	ns	ns	ns	77 (65-98)
2016	37 (33-40)	21 (18-25)	33 (25-32)	2 (0-2)	3	0	0	1	97 (85-103)
2017	36 (35-36)	21 (18-24)	21 (14-32)	0	0	0	0	0	78 (70-86)
2018	31 (23-40)	35 (28-42)	21 (13-29)	1 (0-1)	0	1 (0-3)	1 (1-2)	0	87 (80-91)
2019	33 (28-39)	31 (30-32)	16 (7-21)	11 (7-19)	1	1 (0-1)	0	0	93 (78-100)
2020	33 (29-37)	33 (30-35)	ns	ns	ns	2	4 (3-4)	4 (2-6)	65 (47-76)[2]
2021	33 (29-36)	41 (35-44)	14 (12-17)	1 (0-4)	ns	0	2 (2-3)	6 (5-7)	97 (92-101)

[1] 2006 total includes 1 adult (range 0-2) encountered at Damon Point
[2] incomplete survey effort due to SARS CoV-2 pandemic restrictions
ns - indicates no survey conducted

Clutch Initiation Dates and Breeding Phenology

Clutch initiations and breeding phenology are typically calculated based on when the first and last nest is known to have begun and when the last hatched chick has fledged. Without consistent monitoring at any nesting site, this information cannot be calculated. On the Long Beach peninsula, the earliest nest found was on 15 May. Using the previous ten years of data, most clutch initiations begin in mid-April through mid-August while the last known fledged chicks occur by mid-September. For previous clutch initiation and breeding phenology patterns see Pearson et al. (2019).

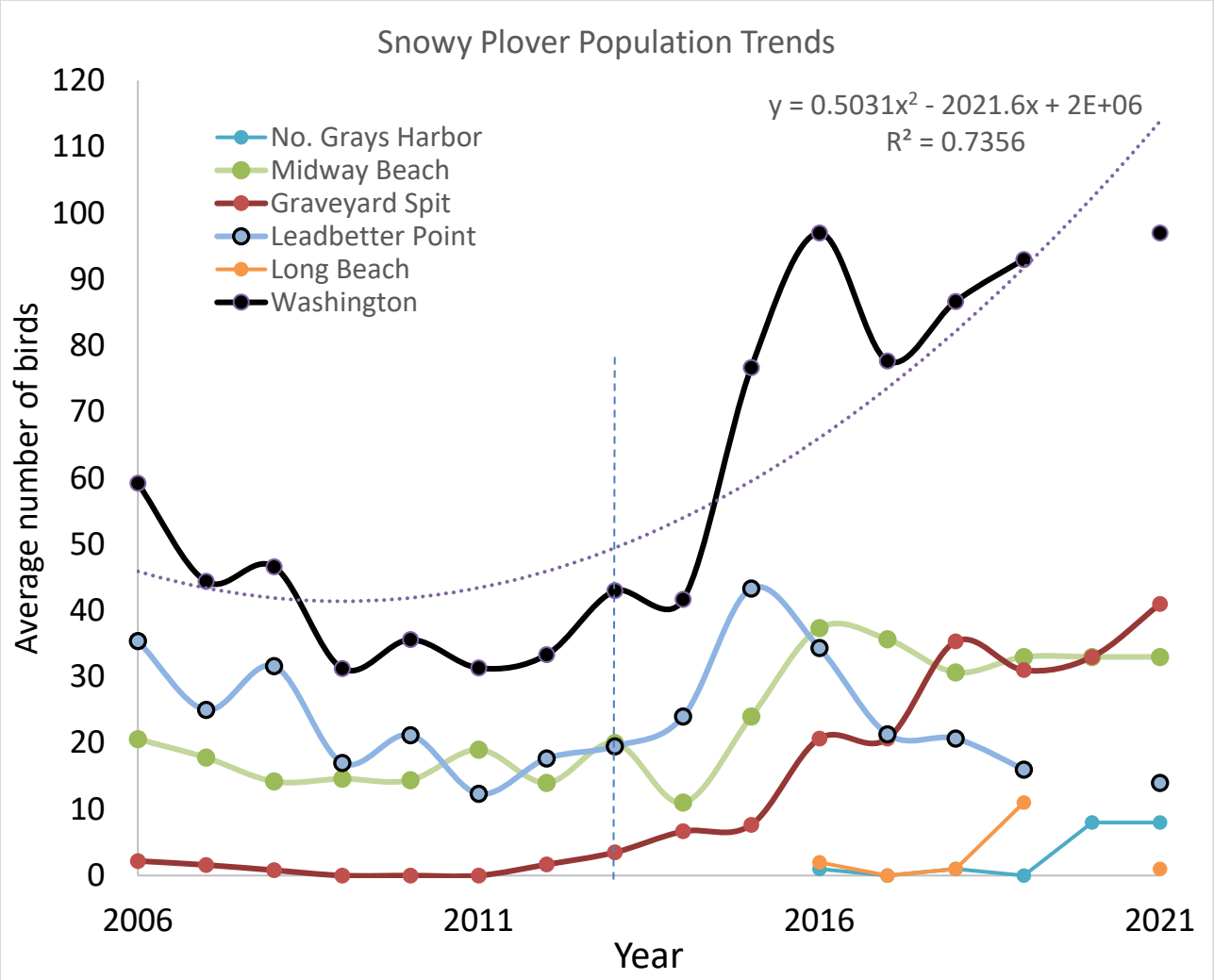

Figure 1. **Breeding adult snowy plover population trends; all Washington sites (2006 – 2021). The circles represent the average count (from three surveys per site per year) and the dotted curved line represents the quadratic relationship for the overall Washington population estimate. North Grays Harbor includes Conner Creek and Copalis Spit. The 2016 Washington total includes three adults at Willapa Bay islands and the 2019 total includes one adult at Ocean Shores and one at Willapa Bay islands. The 2020 survey was incomplete due to SARS CoV-2 pandemic restrictions. The blue vertical line indicates when predator management was initiated at Leadbetter Point. Predator management began at Midway Beach in 2014.**

Nest Success

We located 26 nests and determined that at least two other nests went undiscovered based on broods unaccounted for on the beach. Limited data were available for 2021 but five nests were located at Leadbetter Point, sixteen nests were located at Graveyard Spit, two nests were discovered at Midway Beach, and one nest each was found at Copalis Spit, Conner Creek, and Long Beach (Table 7). Several nests were encountered during adult breeding surveys, but limited documentation or monitoring was conducted. For a map of nest locations at Leadbetter Point and Long Beach see Appendix I.

Only two nests, found in early June on the Long Beach Peninsula, persisted enough days to determine exposure required for the Mayfield assessment. One of the six nests monitored with a known fate hatched,

and one failure was attributed to crow predation (Table 7). Nest exclosures have not been placed around nests at Leadbetter Point to exclude predators since 2010 and predator management began in 2013.

Table 7. **Nest outcomes by snowy plover nesting locality in 2021. Outcomes include successful (hatched), failed, or unknown outcome. Nests without exposure days (failed shortly after discovery or found after success or failure) cannot be used to calculate nest success. Two additional unassigned broods from nests that were not located were observed at Leadbetter Point.**

			Outcome		
Site	# Nests Located	Nests w/ Exposure Days	Hatch	Fail	Unknown
Copalis Spit	1	-	0	1	0
Conner Creek	1	-	0	1	0
Midway Beach	2	-	0	2	0
Graveyard Spit	16	-	-	-	16
Leadbetter Point	5	2	1	2	2
Long Beach	1	-	0	1	0
Totals	26	2	1	7	18

Fledging Success

Fledging success is defined as the number of chicks fledged per adult male. However, we were unable to determine if any chicks fledged at any sites. Consequently, we lack data to calculate fledging success (chicks fledged/male) again in 2021.

Nest Locations

At Midway Beach, snowy plovers nested in Grayland Beach State Park and on the beach immediately south of the Park to Warrenton-Cannery Road. At Graveyard Spit, nests were along the entire length of the spit. On the Long Beach Peninsula birds nested at Leadbetter Point and south of Oysterville Road. Snowy plovers also nested at both Copalis Spit and Conner Creek. The 2021 Leadbetter Point and Long Beach nest locations are presented in Appendix I.

Predator Management

Predator management began at Leadbetter Point in 2013 and at Midway/Grayland Beach in 2014. Predator management was coordinated by wildlife specialists with USDA APHIS Wildlife Services (WS) from about mid-June to July 2021. WS activities were focused on conducting targeted dispersal or lethal removal of those predator species (crows and ravens) responsible for nest predation events. One raven was dispersed at Leadbetter Point and none were lethally removed. At Midway Beach, one raven was removed, five were dispersed, and 22 crows were dispersed.

Quantification of Take (Leadbetter Point only)

• *Population Surveys*

Snowy plover population surveys were conducted once in early January (rangewide non-breeding survey) and three times from late May to mid-June (rangewide breeding survey and two additional Washington-specific breeding surveys). These surveys are conducted on foot or by vehicle utilizing from one to six surveyors (Table 2). Surveys within the posted snowy plover nesting areas are conducted strictly on foot. Vehicles used during driving surveys are operated on the wet, hard-packed lower portions of the beach.

• *Nest Inspection/Monitoring*

Nests are visited upon discovery, to assess status, and for monitoring demographic parameters (e.g., egg floating to determine nest initiation/hatch dates and banding chicks). Once a nest is discovered, most observations to assess its status are done from a distant vantage point, thus avoiding the need to approach the nest. Visit times to nests in 2021 averaged three minutes (0-10 minutes) and typically occurred only 2-4 times while the nest was occupied. A thorough visual area search for potential predators is always undertaken prior to approaching any active nest. Care is taken to minimize leaving tracks that lead directly to a nest. All surveyor's tracks within 10-20 meters are swept away while departing the area.

• *Chick Banding*

There were no chicks banded in 2021.

• *Egg Floating*

Egg floating is performed to determine clutch initiation and predict egg hatch dates for data analysis. Egg floating can be detrimental to the eggs so experienced individuals conduct it only when necessary. Nests found containing more than one egg, and that have adequate exposures days, may be floated. No eggs were floated in 2021.

• *Rehabilitation and Salvage*

No birds were rehabilitated or salvaged in 2021. No biological samples were collected for genetic analysis.

• *Habitat Restoration and Vegetation Sampling*

Ten weeks of habitat restoration occurred at Leadbetter Point in 2021. Habitat work took place on Refuge lands between 12 January and 25 March. Areas scheduled for habitat restoration are searched several times during the preceding 2-3 weeks and inspected every one to two weeks during operations to minimize potential impacts. All major work occurs well outside of the breeding seasons of most resident wildlife.

PROGRESS ON RECOVERY OBJECTIVES

Federal Recovery Objectives:

Objective 1: 250 breeding adults in Recovery Unit 1

The 2021 Washington nesting population was 97 (range = 92-101) while the Oregon nesting population reached 524 (Lauten et al. 2021) for a total of 621 (range = 616-626) nesting adult snowy plovers in Recovery Unit 1 (Table 8). Breeding adult numbers have exceeded the Recovery Unit objectives since 2013. The ten-year average population in Recovery Unit 1 is 491 adult plovers, which may well have been double the recovery objective if not for the reduced survey effort in 2020.

Table 8. **Estimated number of breeding adult snowy plovers in Recovery Unit 1 by year.**

2015	2016	2017	2018	2019	2020	2021
526 (514-547)	622 (614-632)	546 (538-554)	589 (582-591)	595 (580-602)	532 (514-543)	621 (616-626)

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

In 2016, Oregon went to a sampling strategy to estimate fledging success. To account for this strategy, we used the total number of males from the sampled sites and the total number of chicks fledged from the

sample sites when estimating fledging success for the recovery unit (rather than averages per site because of sample size differences between sites). The average number of chicks fledged per adult male in Recovery Unit 1 was 1.16 in 2021 and averaged 1.06 over the past five years (Table 9). Population modeling by Nur et al. (1999) indicates that productivity of 1.2 or more chicks fledged per breeding male should increase population size at a moderate pace. Note that the fledging success values since 2019 are derived solely from the Oregon portion of the population.

Table 9. **Estimated number of chicks fledged per breeding adult male in Recovery Unit 1 by year.**

	2014	2015	2016	2017	2018	2019	2020	2021
Chicks fledged/male	1.71 (1.68-1.74)	1.55 (1.49-1.57)	0.66	0.90	1.03	1.08[3]	1.11[3]	1.16[3]

[3] The number of chicks fledged per male since 2019 represents fledging success only in Oregon, as data for Washington are not available.

Washington State Recovery Objectives (currently being revised):

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

We counted between 46-52 pairs of adult snowy plovers (mean = 49.5) in Washington during the 2021 nesting season. The mean number of males sampled was 50 (range 47-53), so if we assume that all males counted were paired with a female, that aligns with the mean number of breeding pairs of snowy plovers in 2021 (Table 10). This recovery objective has been attained with a current four-year average for breeding pairs in Washington of 43. This average includes 2020 which is likely an under estimation of breeding pairs due to reduced survey effort on account of COVID-19 restrictions. During each of the seven most recent years we have had an annual statewide average of at least 25 breeding pairs.

Table 10. **Estimated number of paired breeding males in Washington (2015-2021).**

	2014	2015	2016	2017	2018	2019	2020	2021
Breeding males	23-27	35-55	43-57	28-51	34-37	36-62	--	47-53

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

Table 11 presents the average number of young fledged per adult male in Washington until 2018, the most recent year with complete data. Data on the average number of chicks fledged in 2021 are not available, so progress towards this objective cannot be determined. Snowy plovers currently nest at Long Beach, Leadbetter Point (primarily on the Refuge), Graveyard Spit, Midway Beach, Conner Creek, and Copalis Spit.

Table 11. **Estimated number of chicks fledged per adult male in Washington (2013-2018).**

	2013	2014	2015	2016	2017	2018
Fledge rate	1.04 (0.92-1.18)	1.88 (1.67-2.13)	1.74 (1.24-2.2)	0.96 (0.74-1.21)	1.70 (1.55-1.83)	0.76 (0.65-0.93)

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

None of the current breeding areas have reached this objective population threshold. Without clear agreement on what constitutes a "secure nesting area" it cannot be determined when this objective has been achieved.

2021 MANAGEMENT ACTIONS

Several management actions in 2021 involved minimizing 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 decline 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

- *Nest Site Protection* – In an effort to protect nests from human activities suitable habitat is closed to public entry during the breeding season.
    - Approximately 8.0 miles of public beach at Leadbetter Point were demarcated with signs and PVC posts to restrict human access onto the upper, dry sand portions of the beach, in an attempt to protect nesting birds. To protect nests at Midway Beach, an estimated 2.7 miles were posted and signed to restrict human access on the upper portions of the beach. The Shoalwater Bay Tribe posted approximately 15 acres of beach used by nesting snowy plovers at Graveyard Spit. Signs and symbolic fencing were also installed for the first time at Griffiths-Priday State Park. The area protected encompasses approximately 27 acres.
    - Symbolic fencing, totaling over 1,500 feet in length, was placed along three hiking trails that access the beach on the Long Beach Peninsula (one private access, one State Park access, one National Wildlife Refuge access) during a 26-week period.
    - WDFW personnel posted and roped a 2,500-foot long horse trail from private property through the Seashore Conservation Area to the high tide wrack line to direct equestrian traffic between the outer beach and a private horse bed & breakfast business.
- *Clam Tides* – Recreational razor clam digs occurred at both Long Beach, which includes Leadbetter Point, and Twin Harbors, which includes Midway Beach, and Conner Creek/Copalis.
    - There was no recreational razor clam digging on Long Beach during the snowy plover breeding season. The 53 days approved for razor clam harvesting occurred during the last three months of 2021.
    - There was no recreational clam digging during the snowy plover breeding season at Midway Beach in 2021. Only fall razor clam harvesting, totaling 62 days, was authorized
    - Tribal razor clam harvest was approved for five days in June at Conner Creek/Copalis. A total of 33 days each for tribal and non-treaty recreational clamming occurred in fall 2021.
- *Law Enforcement* – Washington Department of Fish and Wildlife coordinated law enforcement activities with State Park rangers and U.S. Fish and Wildlife law enforcement officers.
    - Additional law enforcement effort was directed to plover nesting beaches during high traffic events such as the July 4 holiday and locally organized events.
    - Refuge law enforcement patrols were conducted periodically during the nesting season.
- *Outreach* –
    - Willapa NWR social media posts and website content included information about snowy plover at Leadbetter Point.

- Trailside shorebird interpretive signs are installed at locations around the Long Beach Peninsula and Willapa Bay.

- *Predator Management* –
  - Wildlife specialists with USDA APHIS Wildlife Services at Leadbetter Point and Midway Beach conducted limited late season predator management in 2021. Management actions occurred from late June to July. Predator management consisted of dispersing birds or performing targeted lethal removal of known nest and chick predators (corvids) in or adjacent to the plover nesting areas. Results typically suggest that this activity is successful in increasing nest hatching rates and fledging rates.
- *Vehicle and Recreation Restrictions* –
  - Coastal beaches at Willapa NWR and Leadbetter Point State Park are closed to vehicle traffic year round. However, driving is allowed on the wet sand portions of these beaches during spring and winter recreational razor clam harvests. Driving is restricted in the Seashore Conservation Area from Oysterville Road to Leadbetter Point State Park from 15 April to the day following Labor Day in September.
  - The Midway Beach area is open to vehicle traffic year-round except during and preceding the July 4 holiday. There are vehicle beach access points at Cranberry Beach Road to the north and Warrenton-Cannery Road to the south.
  - Motor vehicles are prohibited on Conner Creek beaches between 15 April and the day after Labor Day, except during authorized razor clam dig hours.
  - Overnight camping and fires are prohibited on the Refuge and the State Park at Leadbetter Point. Fireworks are prohibited at Midway Beach during and preceding the July 4 holiday and always prohibited at Leadbetter Point. Campfires on State Park managed beaches are not permitted in driftwood or within 100 feet of the dunes.
  - Dogs are not permitted within snowy plover nesting areas or anywhere on Refuge lands.

- *Emergency Response* – Refuge staff assisted Federal and State officials and private salvage contractors in February to quickly remove the grounded *FV/Terry F* and locate and collect debris from ¾ mile of shoreline near the northern tip of Leadbetter Point.

Habitat Restoration

Leadbetter Point

- Pre-breeding –
  - Thirty acres of invasive *Ammophila* beachgrass was removed using bulldozers and disks on the Refuge.
  - An additional 118 acres previously cleared on the Refuge was disked to reduce resprouting beachgrass.
  - Oystershell hash was applied to 50 m^2 (0.1 ac) of ground in the southern portion of the HRA.

DISCUSSION

The Recovery Unit (RU1) western snowy plover population continues to grow, and emigration is enhancing the Washington population. Prospecting young birds are showing up at beaches on the north Oregon and south Washington coasts that have not seen nesting plovers for decades. Individual snowy plovers have recently been observed as far north as the northwestern Olympic Peninsula and Vancouver Island, British Columbia. This is to be expected as the number of adults increase.

Although overall, federal Recovery Unit goals have been met and the Washington adult population is continuing to trend upward, the productivity in Washington may be showing early signs for concern. Emigration from the south could help explain an increasing Washington population while productivity lags behind Oregon. However, a clear signal for the cause of reduced nest success is not evident. Nest predation, and possibly changes in ocean productivity, likely have some effect on recent nest success. Changing weather patterns that allow beach sand to dry and then be blown by the ever-present coastal winds, as well as, rising sea levels, may also be impacting outer beach nests. Nest predation alone does not seem to be the sole factor affecting nest success since predator numbers do not appear to be rising dramatically. In addition, the population of streaked horned larks nesting in similar areas at Leadbetter Point appears to be stable and is not exhibiting a decline in reproductive success that would be expected if predation was high, although a more thorough examination of the current situation is warranted. The level of potential human disturbance has not been quantified, but recreational use of beaches appears to have increased in recent years. It should also be noted that the lack of nesting and fledging success data from all Washington nesting sites impair our ability to understand statewide reproductive rates.

As capacity allows, tracking of potential nest predator numbers and locations and monitoring of snowy plover nests will increase to better understand nest success on refuge lands. Habitat quality is another important factor that can influence productivity. The recent discovery of a potentially more aggressive *Ammophila arenaria* x *A. brevigulata* hybrid (Mostow et al. 2021) may lead to more persistent vegetative changes that could be detrimental to plovers and other native beach dwellers. Further investigation of how *Ammophila* hybridization may be impacting the beach habitat is warranted. A vegetation sampling plan and wrack monitoring assessment may help inform refuge management to improve the quality and quantity of suitable habitat and quantify food availability.

Discussion amongst a larger group of managers is needed to address what, if anything should be done regarding monitoring and protection of plover nests at new and historic locations. It may be advisable for managers to conduct a landscape-scale assessment of potential suitable habitats and identify critical beaches that can serve as core sites and long-term population source locations. We recommend defining what constitutes a “secure nesting area” and determine the number and location of sites considered “secure” to sustain a viable population in Washington.

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APPENDIX I

Long Beach Peninsula Snowy Plover Nest Locations

Green circles indicate approximate locations of western snowy plover nests on the Long Beach Peninsula, Washington in 2021. The yellow polygon depicts federally designated critical habitat.

Leadbetter Point

APPENDIX II

Banded Snowy Plovers Observed on the Long Beach Peninsula in 2021

Band combinations are expressed from top down and left to right, where forward slashes (/) distinguish different colors on one band and single letters indicate separate color bands. A colon (:) differentiates between left and right leg bands. Letters used to identify colors are: A = aqua, B = blue, G = green, K = black, L = lime, N = brown, O = orange, R = red, S = silver, V = violet, W = white, X = no band, and Y = yellow. The sex of the bird, phenology when observed, whether the bird was associated with a known nest, whether the bird had been observed in a recent previous year, and the origin location and year the band was applied are reported.

Band	Sex	Phenology	2021 Nest	Previous Year	Origin
A/W:B	unk		--	no	
B:B	male	breeding	LBN001	no	
B/W:O	male		--	no	
B/V:Y	female		--	no	
G/A:K	unk	non-breeding	--	yes	OR-SB-17
G/O:K	male		--	no	OR
L/G:K	female		--	no	OR
O/A:V	female	breeding	--	no	OR
O/B:Y	female	resident	--	no	
O/B/O:Y	female		--	no	
O/G:B	male	breeding	--	no	
O/G:R	male		--	yes	OR-NO-18
O/W:K	female		--	yes	OR-TS-17
R/B:Y	female	resident	--	no	
R/B/R:Y	unk		--	no	
R/V:K	female		--	no	
RV:BW	male	non-breeding	--	yes	WA-GY-17
R/W/R:Y	female		--	no	
R/Y:B	unk		--	no	
R/Y/R:B	unk		--	no	
S:K	male		--	no	OR
V/R/V:O	unk		--	no	OR
V/W/V:Y	unk		--	no	OR
W/B:O	unk		--	no	
W/B:Y	female		--	no	
X:S	female	breeding	--	yes	OR-multi
Y:G	unk		--	no	
Y/B:K	female		--	no	OR
Y/B:Y	female	breeding	--	no	
Y/G:V	female	breeding	--	no	OR
Y/O:G	unk		--	no	
Y/O:R	unk		--	no	

Band	Sex	Phenology	2021 Nest	Previous Year	Origin
Y/O:Y	female		--	no	
Y/B/Y:Y	female	breeding	--	no	
Y/R/Y:Y	female	non-breeding	--	yes	OR-SN-13
Y/W/Y:Y	unk		--	no	