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Washington State Snowy Plover Population Monitoring, Research, and Management: 2023 Nesting Season Research Progress Report

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Photo by **Scott F. Pearson**

Washington State Snowy Plover Population Monitoring, Research, and Management: 2023 Nesting Season Activities Final Report

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Cover photo of snowy plover at Midway Beach by Scott F. Pearson

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TABLE OF CONTENTS

OVERVIEW

During the 2023 western snowy plover (*Charadrius nivosus nivosus*) nesting season, we counted the number of adult snowy plovers at potential nesting sites in Washington and monitored breeding phenology, nest success, and fledging success at Empire Spit (previously part of Graveyard Spit). Work was conducted by Washington Department of Fish and Wildlife, US Fish and Wildlife Service, and Shoalwater Bay Indian Tribe. Management activities included restricting human access to nesting sites and restoring nesting habitat.

Thirty breeding surveys at eleven sites were conducted between 22 May and 03 July 2023 to assess site occupancy status or to count the total number of adults detected. The mean 2023 Washington breeding adult population was 63 (range: 54-68). Breeding adults were observed at Copalis Spit, Conner Creek, Midway Beach, Empire Spit, North Willapa Bay Islands, and Leadbetter Point.

A total of 49 snowy plover nests were observed on Washington beaches at Copalis Spit, Conner Creek, Midway, Empire Spit, North Willapa Bay Islands, and Leadbetter Point. Only Empire Spit was monitored closely enough to estimate nest and fledging success. Thirty-five nests were detected and monitored at Empire Spit. Eighteen (51%) of the 35 nests hatched. Predation was the primary cause of nest failures, with nine lost to raven predation, three to unknown corvids, and two to coyote predation. The average number of young fledged per adult male was 2.46 (range: 1.45-4.00). Even the low estimate (1.45) indicates a growing population at Empire Spit. While this is the first time since 2018 that we have an estimate for fledging success, it is likely not representative of the overall fledging success for all Washington sites, as Empire Spit has historically had higher nesting and fledging success compared to Washington's other primary nesting sites.

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*, *Ammophila 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 specifically, 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 (Stinson 2022).

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 federal 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).

According to the Washington State Recovery Plan (1995) for the snowy plover, the plover will be considered for down-listing to Threatened when the state supports a 4-year average of at least 25 breeding pairs that fledge at least one young per pair per year at two or more nesting areas with "secure" habitat. Delisting will be considered when the "average" population reaches 40 breeding pairs at three or more secure nesting areas. A periodic status review was completed in 2022 (Stinson 2022).

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 Indian Tribe (SBIT), and the Oregon Biodiversity Information Center (ORBIC). This coordinated effort was initiated in 2006, although Washington-specific monitoring was initiated years before.

This report serves, in part, to meet our reporting obligations under Recovery Sub-permit, WNWR-15, Amendment 15 (SPITS TE-007497-15) and for USFWS Section 6 grant number WA F22AP03263.

The primary objectives of our monitoring and management in 2023 were to:

- Conduct winter-window surveys in conjunction with the range-wide survey effort.
- Conduct breeding-window surveys in conjunction with the range-wide survey effort and two subsequent breeding adult surveys at Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Empire Spit, and Leadbetter Point.
- Conduct surveys of unoccupied breeding sites at Ocean Shores at Ocean City, Oyhut, and Long Beach.

- Estimate current population size of adult snowy plovers in Washington.
- Estimate hatching success rates and sources of nest mortality during the egg laying/incubation stage for all nest locations at Empire Spit.
- Attempt to increase nest success through habitat restoration efforts (not Section 6 funded).
- Minimize human disturbance to nesting plover to increase breeding success.
- Reduce predation impacts on plover nesting success.
- Produce a report that summarizes methodology, numbers of breeding adults, hatching success, and management actions.

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

METHODS

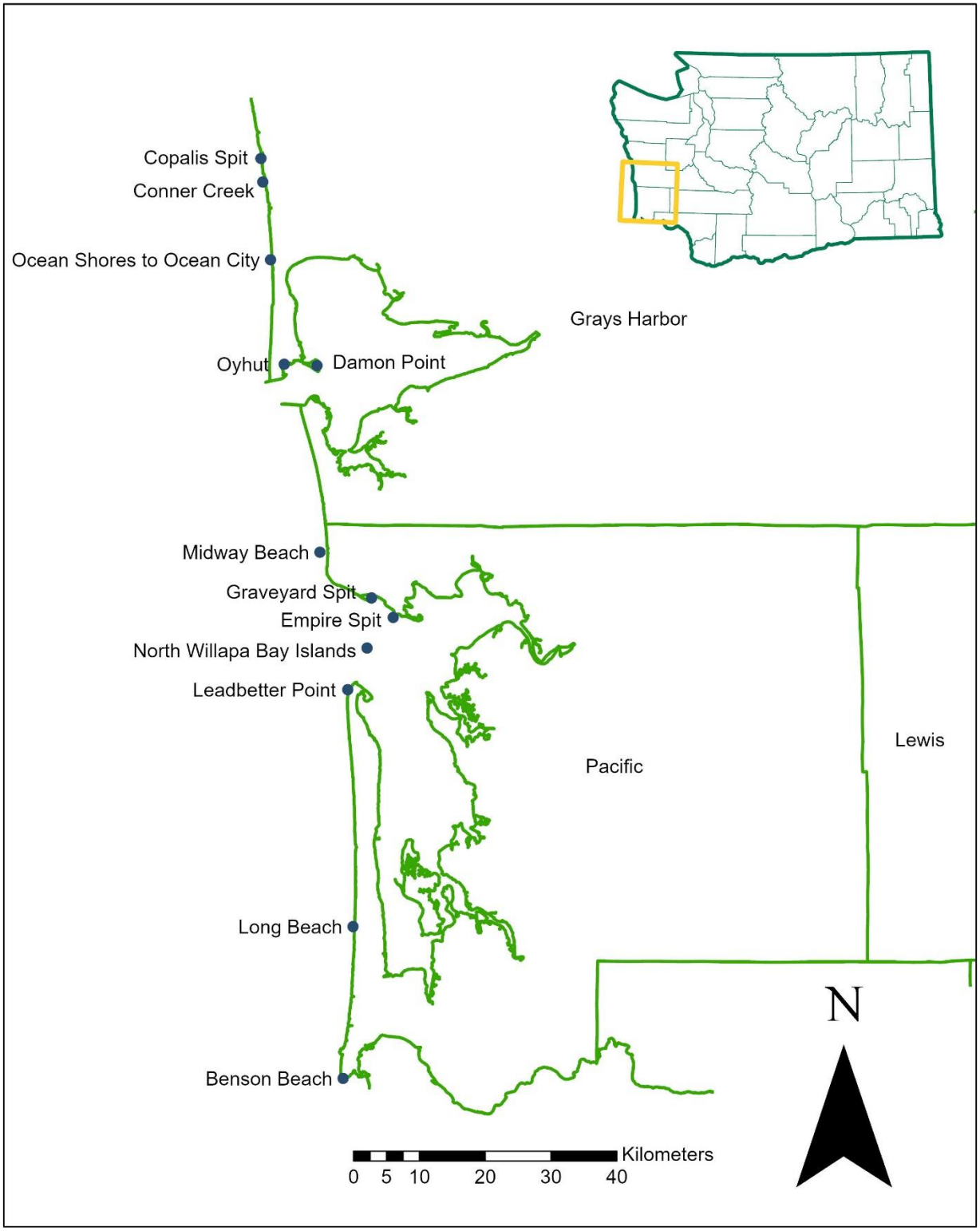
Survey and Activity Areas

Historically, Washington was home to five known breeding areas for snowy plovers: Cape Shoalwater, Leadbetter Point, Damon Point, Westport Spit, and Copalis Spit (Washington Department of Fish and Wildlife 1995). Of these five areas, Damon Point (which also included Oyhut) and Westport Spit no longer provide adequate habitat to support nesting snowy plovers. Cape Shoalwater (now broken into two nesting areas: Graveyard Spit and Empire Spit) and Leadbetter Point have remained active and important nesting areas since they were first discovered, while Copalis Spit began supporting nesting plovers again after decades without activity.

Since WDFW began monitoring snowy plovers during the breeding season, plovers have been discovered nesting at additional sites: Midway Beach, Long Beach, various sand islands in Willapa Bay, and Conner Creek (just south of Copalis Spit). The first sightings of snowy plovers at Midway Beach, now one of the primary nesting areas for Washington's population, occurred in 1994 (Washington Department of Fish and Wildlife 1995). Nests were discovered at Long Beach (south of Leadbetter Pont) in 2019 and 2021 (Ritchie et al. 2020, Ritchie et al. 2022). Nests have been discovered in recent years (2016, 2019, 2023) on two separate islands in Willapa Bay, an area where nesting plovers hadn't been observed since the 1990s (Pearson et al. 2017, Ritchie et al. 2020). Nests have been found at Conner Creek every year since 2020. Additionally, adults have been observed on the stretch of beach between Ocean Shores and Ocean City and at Benson Beach (the southern-most point of Washington's coast) during the breeding season, though no nests have been discovered to date. For approximate locations of current survey sites, see Figure 1.

Leadbetter Point and Midway Beach are dune-backed beaches and have exceptionally wide areas that are unvegetated or sparsely vegetated and are 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).

Figure 1. General locations of snowy plover survey sites. While included on the map, Damon Point has not been surveyed in the past three years.



Graveyard Spit and Empire Spit (formerly consolidated into one site: Graveyard Spit) are located on the north shore of Willapa Bay across from Leadbetter Point. The nesting habitat at these sites consist of a sparsely vegetated low-lying sand spit with hummocks and swales and unvegetated deflation plains adjacent to salt marsh communities. Since 2012, multiple projects have been completed to combat the impacts of erosion, flooding, and sea level rise to this sensitive sand spit. The most intensive effort yet was completed in November 2022 with the purpose of renourishing the northern 4,000 feet of shoreline berm and placing a dynamic revetment at the toe to make repairs to the soft shore berm. In the year following the completion of construction, the new berm created and/or enhanced approximately 50 acres of plover habitat.

Ocean Shores to Ocean City and Conner Creek are similar to other southwest Washington sandy, dune-backed beaches, but their width tends to be narrower than the more productive plover sites. Ocean Shores to Ocean City spans approximately 7 miles of shoreline between the two towns and is highly trafficked by the public. Conner Creek is located immediately to the north and spans approximately 3.3 miles from the Ocean City Beach Access (2nd Avenue) to the mouth of Conner Creek. The beach widens out near the mouth of the creek, and this is the area that provides the best habitat for nesting snowy plovers. North of the mouth of Conner Creek is Copalis Spit, which is formed and shaped by the outlet of the Copalis River and currently extends approximately 1.5 miles. This section of beach is closed to all vehicles and only accessible to the public by a walking path (~0.75 miles), making it less heavily trafficked than many of the other beaches that Washington's plovers use.

The North Willapa Islands are comprised of several small islands and ephemeral sand spits, including the Gunpowder Island Natural Area Preserve. They are characterized as mostly unvegetated wind-blown sandy accretions located in northern Willapa Bay between Leadbetter Point, Tokeland, and Stony Point, Washington. The more established islands have scattered clumps of sparse vegetation and woody debris.

Long Beach extends approximately 17 miles from Surfside (Oysterville Road Beach Approach) south to North Head near the southern end of the Long Beach Peninsula. These are moderately wide dune backed beaches with a series of adjacent north-south oriented stabilized dune ridges and swales that are extensively vegetated by nonnative *Ammophila* beachgrass and shore pine. Recreation is common along beaches here and is a primary purpose of the Seashore Conservation Area, which runs the entire length of this beach. Much of the beach-adjacent land consists of privately owned single-family homes, vacation rentals, and short-term occupancy hotels and resorts. There are two incorporated cities, both among the most populous in Pacific County, three State Parks, and seven public motor vehicle access points along this portion of beach.

Benson Beach lies along the Pacific Ocean shoreline between North Head in Cape Disappointment State Park and the Columbia River north jetty. The beach is narrow and prone to erosion, especially on the southern half, with the upland areas heavily vegetated by *Ammophila* beachgrass and shore pine. A large year-round, beach-adjacent campground is located at the north end of the beach.

Site Surveys

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 between early to mid-May and the end of the first week of July to determine if it is being used as a nesting site. With three to four visits, there is an 96% - 99% probability of accurately

determining site occupancy. If that is not feasible, two visits would yield a detection probability of 89% and one visit a detection probability of 67%.

We conducted occupancy surveys at historically occupied sites where we previously failed to detect snowy plovers, as these sites may become re-occupied due to suitable habitat and proximity to occupied sites. We endeavored to conduct at least two occupancy surveys of unoccupied sites to ensure a detection probability of 89% or more.

Adult Population Surveys

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 2023, the window surveys occurred from 26 January to 2 February. Sites surveyed include Copalis Spit, Connor Creek, Ocean Shores to Ocean City, Oyhut, Midway Beach, Graveyard Spit, Empire Spit, Leadbetter Point, Long Beach, and Benson Beach.

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 and at unoccupied beaches with potential nesting habitat. 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 2023, the window survey occurred from 20 to 27 May. Connor Creek, Copalis Spit, Ocean Shores to Ocean City, Oyhut, Midway Beach, Graveyard Spit, Empire Spit, North Willapa Bay Islands, Leadbetter Point, Long Beach, and Benson Beach were surveyed. The primary intent during breeding window surveys is to count the adult population at recently occupied sites and historically (though not recently) occupied sites that would still provide suitable habitat for snowy plovers.

Breeding adult surveys and estimating breeding adult population

In addition to the rangewide breeding window survey, two additional surveys were conducted at recently occupied sites (Copalis Spit, Conner Creek, Midway Beach, Empire Spit, Graveyard Spit, Leadbetter Point, and Long Beach). All surveys were completed between 22 May and 03 July 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. Breeding window survey and two additional surveys are used to estimate observed breeding adult abundance. In the Results section, the average and the range of these three surveys are presented. All estimates are rounded to the nearest whole bird. Table 1 provides sites, survey types, survey effort, and dates.

Table 1. Snowy plover sites surveyed during the 2023 breeding season. All sites had a breeding window survey, which was the first survey of the season.

Site	Type of Survey(s) Conducted	# Surveys	# Surveyors	Survey Dates
Copalis Spit	Breeding Adult	3	1	5/24, 6/5, 6/22
Connor Creek	Breeding Adult	3	1	5/24, 6/5, 6/22
Ocean Shores/ Ocean City	Occupancy	3	1	5/24, 6/5, 6/22
Oyhut	Occupancy	1	1	5/25, 6/8
Midway Beach	Breeding Adult	3	5-6	5/23, 6/6, 6/23
Graveyard Spit	Breeding Adult	3	1-2	5/23, 6/8, 6/26
Empire Spit	Breeding Adult	3	5	5/23, 6/8, 6/26
North Willipa Bay Islands	Occupancy	1	1	5/24, 7/3
Leadbetter Point	Breeding Adult	3	2-6	5/22, 6/7, 7/3
Long Beach	Breeding Adult	3	1	5/25, 6/5, 6/23
Benson Beach	Occupancy	2	1	5/23, 6/27

Nest Phenology and Success

WDFW and USFWS biologists did not actively look for nests in 2023. Any nests located were found opportunistically during breeding adult surveys. Nest locations were marked with a GPS and checked by staff, time permitting, or during the next breeding adult survey.

Shoalwater Bay Tribe (SBIT) biologists conducted active nest searching and monitoring at Empire Spit. Staff visited beaches 3-7 times per week from late March to early September (when the last brood fledged) to locate and monitor snowy plover nests and broods. In many cases, nests were located by following snowy plover tracks, observing scrape building by males, locating adults incubating eggs, or flushing incubating adults. Date and status were recorded.

Unless observed directly, biologists calculated clutch initiation date by backdating from known laying or hatching dates. Additionally, egg floating was used to backdate the initiation date. Biologists 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 outcomes were recorded as the number of successful (hatched) 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 undetermined causes of failure.

Oregon continues their nest monitoring efforts, and their results are included in the *Progress on Recovery Objectives* section.

Fledging Success

Snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. Chicks fledge (i.e., are capable of sustained flight) at 28 to 33 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 to determine 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). Population modeling by Nur et al. (1999) 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.

Determining the number of chicks fledged requires following broods from hatch date to 28 days post hatching and determining their fate. Due to the great effort needed to estimate fledging success, Washington did not produce estimates between 2019 and 2022. With the addition of a full-time dedicated plover biologist, Shoalwater Bay Tribe (SBIT) was able to resume comprehensive monitoring efforts for the 2023 season at Empire Spit and Graveyard Spit. These were the only two sites in Washington where such monitoring efforts were possible.

To identify and follow individual broods, SBIT biologists attempted to identify hatch dates for successful nests, which they checked daily or every other day around predicted hatching dates. In cases where a banded adult male accompanies the chicks, biologists are able to assign broods to a specific nest and hatch date and to easily follow that brood through time to fledging. When the adult is unbanded, biologists can use chick plumage and size to estimate chick ages. For some nests, biologists can determine the outcome of the brood because no other chicks of a similar age were along a particular stretch of beach.

To estimate the number of young fledged per male, SBIT biologists divided the number of young fledged by the number of breeding adult males (an estimate that is derived from the breeding adult surveys).

RESULTS

Adult Population Surveys

Winter Window Survey

We counted 99 adult snowy plovers at four Washington sites during the January 2023 winter window survey: Conner Creek, Ocean Shores to Ocean City, Midway Beach, and Leadbetter Point. This is the same number we observed in 2022 (Cent et al. 2023) and is one of the highest counts we have observed for a Washington winter window survey. The highest count was observed in 2021 with 167 birds. This number was unprecedented, and we do not know the reason(s) for the surge in Washington's wintering plovers in that year. Ten years of nonbreeding survey count totals are reported by site in Table 2.

Breeding Window Survey

We detected 54 adult snowy plovers at six sites in Washington during the 2023 rangewide breeding window survey, with 31 males, 20 females, and 3 unknowns. Plovers were observed at Copalis Spit, Conner Creek, Midway Beach, Empire Spit, North Willapa Bay Islands, and Leadbetter Point (Table 3).

Table 2. Washington snowy plover rangewide winter window survey adult counts by site and year. "ns" indicates no survey was conducted that year. Prior to 2023, Empire Spit was surveyed as a part of Graveyard Spit.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023 Survey Information			
Site											Survey Date	Adult Males	Adult Females	Adult Unk
Copalis Spit	0	0	0	0	0	0	0	0	0	0	28-Jan	0	0	0
Conner Creek	0	0	0	0	0	0	0	0	18	18	28-Jan	0	0	18
Ocean Shores/ Ocean City	ns	ns	ns	4	10	0	9	0	0	8	28-Jan	1	0	7
Oyhut	0	0	0	0	0	0	0	0	ns	0	30-Jan	0	0	0
Damon Point	0	0	0	0	0	0	0	ns	ns	ns	-	-	-	-
Midway Beach	22	22	31	22	28	58	66	52	41	55	26-Jan	6	2	47
Empire Spit	-	-	-	-	-	-	-	-	-	0	26-Jan	0	0	0
Graveyard Spit	0	0	0	0	0	0	0	0	1	0	23-Jan	0	0	0
Leadbetter Point	45	0	28	34	12	15	0	111	39	18	29-Jan	4	5	9
Long Beach	0	0	10	6	0	7	0	4	0	0	30-Jan	0	0	0
Benson Beach	0	ns	0	0	0	0	0	0	0	0	28-Jan	0	0	0
Total	**67**	**22**	**69**	**66**	**50**	**80**	**75**	**167**	**99**	**99**		**11**	**7**	**81**

Table 3. Washington snowy plover rangewide breeding window survey adult counts by site and year. "ns" indicates no survey was conducted that year.

											2023 Survey Information			
											Survey	Adults		
Site	2014	2015	2016	2017	2018	2019	2020[1]	2021	2022	2023	Date	Male	Female	Unk
Copalis Spit	0	0	1	0	0	0	4	5	2	5	24-May	3	1	1
Conner Creek	0	0	0	0	0	0	4	2	5	2	24-May	1	1	0
Ocean Shores to Ocean City	-	-	-	-	3	0	2	0	0	0	24-May	0	0	0
Oyhut	0	0	0	0	0	0	0	0	0	0	25-May	0	0	0
Damon Point	0	0	0	0	0	0	0	ns	0	ns	-	-	-	-
Midway Beach	9	20	39	35	23	28	37	29	20	10	23-May	8	1	1
Graveyard & Empire Spit	6	3	18	17	28	32	ns	35	22	21	23-May	10	10	1
No. Willapa Bay Islands	0	0	3	0	0	ns	ns	ns	1	1	24-May	0	1	0
Leadbetter Point	28	41	45	32	27	19	ns	17	8	15	22-May	9	6	0
Long Beach	0	0	0	0	0	19	ns	4	0	0	25-May	0	0	0
Benson Beach	0	ns	0	0	0	0	ns	0	0	0	23-May	0	0	0
Total	**43**	**64**	**106**	**84**	**81**	**98**	**47**	**92**	**58**	**54**		**31**	**20**	**3**

[1] 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 1, we conducted 30 total surveys at 11 sites between 22 May and 03 July 2023. WDFW staff visited Damon Point prior to the start of surveys to assess the habitat and concluded that the site continues to provide unsuitable nesting habitat for snowy plovers.

Site occupancy

Occupancy surveys were conducted at three sites: Ocean Shores to Ocean City, Oyhut, and Benson Beach. Oyhut and Benson Beach were surveyed twice, and Ocean Shores to Ocean City was surveyed three times. No plovers were observed during these surveys, and we can continue to presume that they are unoccupied by snowy plovers.

Estimating Number of Adult Snowy Plovers

We visited eight sites to estimate breeding abundance: Copalis Spit, Conner Creek, Midway Beach, Graveyard Spit, Empire Spit, North Willapa Bay Islands, Leadbetter Point, and Long Beach. Seven of these sites were surveyed three times. Due to the logistics of surveying North Willapa Bay Islands by boat, USFWS staff were only able to survey the islands twice.

Surveyors did not detect snowy plovers at Graveyard Spit or Long Beach during breeding adult surveys. Adult plovers were observed at Midway Beach, Copalis Spit, Conner Creek, Empire Spit, Leadbetter Point, and North Willapa Bay Islands (Table 4). The 2023 mean count of observed adults across all Washington sites was 63 (range: 54-68). This is a very similar to the 2022 mean count of 64, and we continue to see a depressed population compared to 2016 to 2021 (Figure 2, Table 4). For the second year in a row, counts at Midway Beach were the lowest since 2014. Copalis Spit and Conner Creek, which likely share birds due to their close proximity, appear to be maintaining a small breeding population of 6-8 birds (combined) since 2020. Counts at Leadbetter Point and Empire Spit don't seem to have changed meaningfully. It should be noted, however, that the third visit to Leadbetter Point may have yielded an underestimate of the breeding adult population due to decreased survey effort—only two people were available to survey. As this site needs 6+ surveyors to adequately cover the breeding area, the number of plovers observed (5) were likely undercounted on the beach that day.

Figure 2. Breeding adult snowy plover counts from 2006 to 2023. The circles represent the average count from that year's abundance surveys. Leadbetter Point was not surveyed in 2020. Without data from Leadbetter, we were unable to estimate an average for 2020.

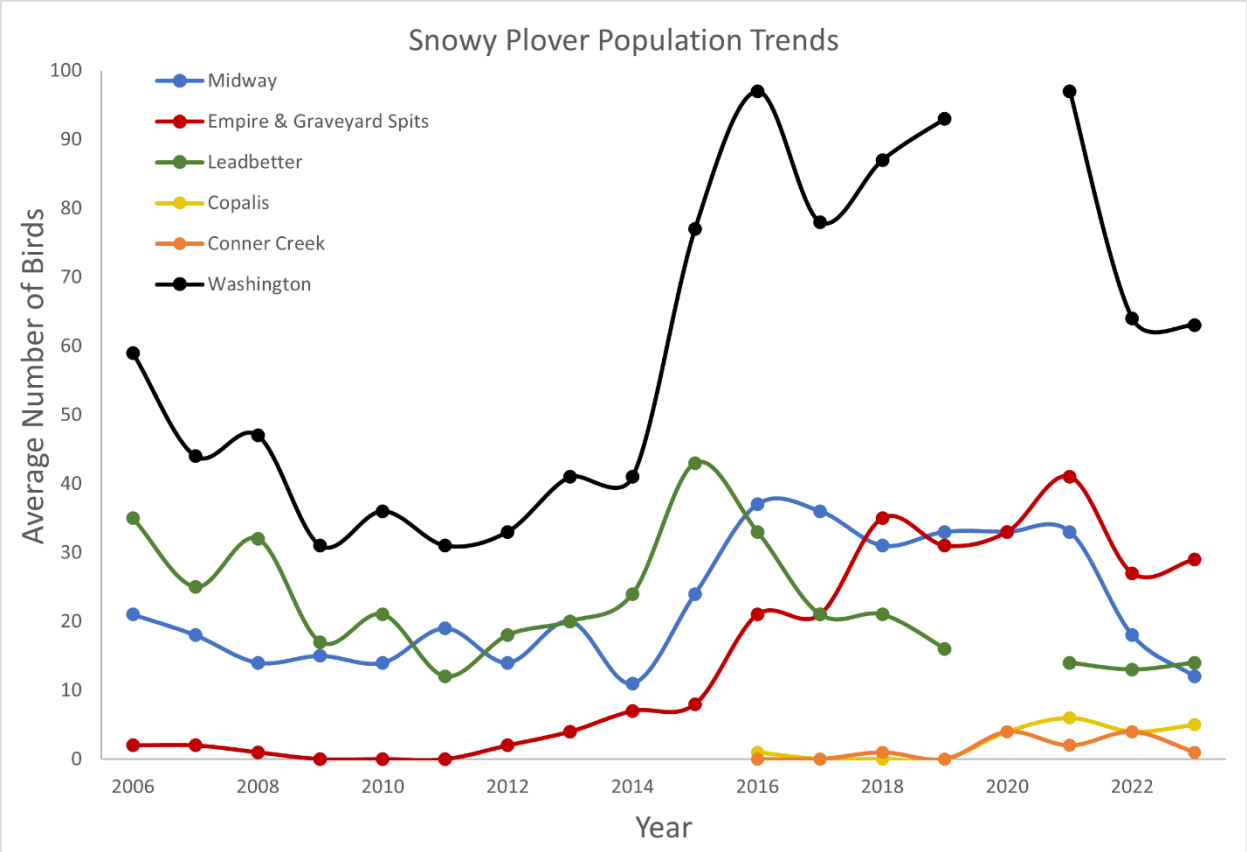


Table 4. Mean counts (range) of the breeding adults at nesting sites in Washington and the total population estimate for the State, 2006-2023. Plovers haven't been observed during a survey at Oyhut or Benson Beach since prior to 2006. "ns" indicates no survey was conducted.

Year	Copalis Spit	Connor Creek	Ocean Shores/ Ocean City	Damon Point	Midway Beach	Graveyard Spit[1]	Empire Spit[1]	No. Willapa Bay Is.	Leadbetter Point	Long Beach	Total
2006	ns	ns	ns	2 (0-2)	21 (14-28)	2 (0-5)	-	ns	35 (26-45)	ns	59 (48-70)
2007	ns	ns	ns	0	18 (14-21)	2 (0-4)	-	ns	25 (20-30)	ns	44 (36-53)
2008	ns	ns	ns	0	14 (10-19)	1 (0-2)	-	ns	32 (23-40)	ns	47 (33-60)
2009	ns	ns	ns	0	15 (13-17)	0	-	ns	17 (10-24)	ns	31 (23-39)
2010	ns	ns	ns	0	14 (11-18)	0	-	ns	21 (17-26)	ns	36 (33-38)
2011	ns	ns	ns	0	19 (8-30)	0	-	ns	12 (6-19)	ns	31 (15-47)
2012	ns	ns	ns	0	14 (5-23)	2 (0-3)	-	ns	18 (6-29)	ns	33 (15-52)
2013	ns	ns	ns	0	20 (16-24)	4 (1-6)	-	ns	20 (19-20)	ns	43 (41-45)
2014	ns	ns	ns	0	11 (9-13)	7 (6-8)	-	ns	24 (21-28)	ns	41 (40-43)
2015	ns	ns	ns	0	24 (19-33)	8 (3-11)	-	ns	43 (34-54)	ns	77 (65-98)
2016	1	0	0	0	37 (33-40)	21 (18-25)	-	3	33 (25-32)	2 (0-2)	97 (85-103)
2017	0	0	0	0	36 (35-36)	21 (18-24)	-	0	21 (14-32)	0	78 (70-86)
2018	0	1 (1-2)	1 (0-3)	0	31 (23-40)	35 (28-42)	-	0	21 (13-29)	1 (0-1)	87 (80-91)
2019	0	0	1 (0-1)	0	33 (28-39)	31 (30-32)	-	1	16 (7-21)	11 (7-19)	93 (78-100)
2020	4 (2-6)	4 (3-4)	2	0	33 (29-37)	33 (30-35)	-	ns	ns	ns	65 (47-76)[2]
2021	6 (5-7)	2 (2-3)	0	ns	33 (29-36)	41 (35-44)		ns	14 (12-17)	1 (0-4)	97 (92-100)
2022	1 (0-2)	4 (3-5)	0	0	18 (15-20)	27 (22-36)	-	1	13 (8-21)	0	64 (58-69)
2023	5	2 (0-4)	0	ns	12 (10-14)	0	29 (21-42)	1	14 (5-22)[3]	0	68 (54-76)

[1] From 2006-2022, Empire Spit was surveyed as part of Graveyard Spit. In 2023, the two were separated into two distinct nesting areas.
[2] Incomplete survey effort due to SARS CoV-2 pandemic restrictions.
[3] Third visit to Leadbetter Point had reduced survey effort (2 surveyors) likely leading to an underestimated count.

Clutch Initiation Dates

Clutch initiations and breeding phenology are typically calculated based on when the first and last nest is known to have been initiated and when the last hatched chick has fledged. The consistent monitoring that is needed to calculate this information only occurred at Empire Spit. Clutches were initiated between 01 April and 10 July in 2023.

Nest Success

WDFW, USFWS, and SBIT staff located 49 nests at six survey locations in Washington: Copalis Spit, Conner Creek, Empire Spit, Midway Beach, North Willapa Bay Islands, and Leadbetter Point (Table 5). One nest was located at Conner Creek, which failed for unknown reasons. Three nests were discovered at Copalis Spit. One nest, which was located in a highly trafficked part of the beach, was abandoned early in the season. The other two had unknown fates. Seven nests were discovered at Midway Beach, all of which had unknown fates. During the third breeding adult survey, 3 chicks were observed with two unbanded adult males.

One nest was discovered in the habitat restoration area (HRA) at Leadbetter Point, which failed due to raven predation. Two nests were found while conducting adult surveys on the North Willapa Bay Islands. Both were discovered on Refuge Island, an unofficial name used by USFWS. The first failed for undetermined reasons (possibly buried by sand), and the second had an unknown fate. An unbanded female was observed with both nests, and the timing is such that it could have been the same female renesting after a failed attempt.

Thirty-five nests were discovered at Empire Spit with 18 nests successfully hatching. Of the 17 failed nests, one nest failure was attributed to human and/or human-dog causes, two nests were abandoned, and 14 failed due to predation. Of the predation failures, nine were attributed to ravens, three to unknown corvids, and two to coyote(s).

Table 5. Nest outcomes by snowy plover nesting locality in 2023. Outcomes include hatched, failed, or unknown.

		Nest Outcome		
Site	# Nests Located	Hatch	Fail	Unknown
Copalis Spit	3	0	1	2
Conner Creek	1	0	1	0
Midway Beach	7	0	0	7
Empire Spit	35	18	17	0
North Willapa Islands	2	0	1	1
Leadbetter Point	1	0	1	0
Totals	49	18	21	10

Table 6. Sources of snowy plover nest failure in 2023 for nests that failed to hatch. Sources of failure included predators eating eggs, disturbance from human activities, and abandonment.

		Nest Failures							
		Predator					Other		
Site	# Failed Nests	Crow	Raven	Corvid	Coyote	Unknown	Human	Abandon	Unknown
Copalis Spit	1	0	0	0	0	0	0	**1**	0
Conner Creek	1	0	0	0	0	0	0	0	**1**
Midway Beach	0	0	0	0	0	0	0	0	0
Empire Spit	17	0	**9**	**3**	**2**	0	**1**	**2**	0
North Willapa Islands	1	0	0	0	0	0	0	0	**1**
Leadbetter Point	1	0	**1**	0	0	0	0	0	0
Totals	21	0	**10**	**3**	**2**	0	**1**	**3**	**2**

Fledging Success

Fledging success is defined as the number of chicks fledged per adult male. Due to limited monitoring, we were only able to calculate fledging success at a single breeding site. Using direct observations of fledglings, SBIT staff estimated between 29 and 40 chicks (mean: 34.5) fledged at Empire Spit in 2023. The first chick fledged around 30 June and the last chick around 06 September.

During the three breeding adult surveys, staff counted 10, 12, and 20 males (mean: 14) at Empire Spit. Using the mean of these two estimates (34.5 chicks fledged and 14 males) and the extremes of each (high male count and low fledge estimate; low male count and high fledge estimate), we estimated that 2.46 (1.45-4.00) chicks fledged/male. Even the most conservative estimate of fledging successes exceeds the 1.1 chicks per male needed to have an increasing population.

Nest Locations

Active nest searching occurred at Empire Spit, and nests were discovered along the entire length of the spit. Nests were located both landward and seaward of the berm in open sand and sparsely vegetated areas. Nesting activity at Midway was primarily concentrated at the north and south end of the site. For the first time, we saw significant activity south of Warrenton Cannery Road, where we observed three nesting pairs and their nests. At Copalis Spit, nesting activity (scrapes and nests) was observed along the entire length of the spit. The only nest discovered at Conner Creek was at the northern end of the site near the mouth of the creek. Leadbetter Point's only nest was located in the habitat restoration area (HRA). The two nests found on the North Willapa Bay Islands were both located on the same island—Refuge Island.

Predator Management

Midway Beach was the only site where predator management occurred in 2023. Between 9 May and 24 August, USDA removed two common ravens and four American crows, and they dispersed at least 46 crows and three ravens.

Habitat Restoration and Vegetation Sampling

At Leadbetter Point, 10 acres on Willapa National Wildlife Refuge were disked and bulldozed to treat nonnative *Ammophila* beachgrass prior to the start of the breeding season. An additional 200 acres (on Refuge and State Park lands) that had been previously cleared of beachgrass was treated with herbicide

and disked to reduce the density of resprouting beachgrass. Oystershell hash was spread over approximately 32 acres of disked ground within the Refuge's habitat restoration area (HRA).

Habitat restoration work began on Empire Spit at two focus areas: the inner dunal pond (situated in the heart of the plover nesting area) and the newly constructed berm. Restoration work around the point comprised of the hand removal of native and non-native plants—primarily Scotch broom, gorse, alders, cattail, and willows. Dense stands of scotch broom and alder trees provided roosting, nesting, and perching areas for predators. Habitat restoration of the new berm at Empire Spit began in mid-August after the last plover brood moved to the outer beach and was completed in October. SBIT staff hand removed all non-native vegetation and collected trash that was inner mixed with the dredge spoils that were used to create the 2022 berm.

At Copalis Spit, nine acres of *Ammophila* beachgrass was treated with herbicide. This is part of a larger restoration project (by State Parks) that aims to remove nonnative beachgrass at the north end of Copalis Spit to expand available nesting habitat for snowy plovers. 2023 was the first year that work was completed on this project.

PROGRESS ON RECOVERY OBJECTIVES

Federal Recovery Objectives

Objective 1: 250 breeding adults in Recovery Unit 1

The 2023 Washington nesting population was 63 (range = 54-68), while the Oregon nesting population reached 475 (Lauten et al. 2023) for a total of 538 (range = 529-543) nesting adult snowy plovers in Recovery Unit 1 (Table 8). While breeding adult numbers have exceeded the Recovery Unit objectives since 2013, 2023's numbers are the lowest since 2015.

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

2015	2016	2017	2018	2019	2020	2021	2022	2023
526 (514-547)	622 (614-632)	546 (538-554)	589 (582-591)	595 (580-602)	532 (514-543)	623 (616-628)	572 (566-577)	538 (529-543)

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

The average number of chicks fledged per adult male in Oregon was 0.79 in 2023, which gives the state an average of 0.72 chicks fledged per adult male over the past five years (Table 9). This estimate (and fledging rates in Table 9) does not include data from Washington, as we did not produce productivity estimates from 2019 to 2022.

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

	2015	2016[1]	2017	2018	2019	2020	2021	2022	2023
Chicks fledged/male	1.51	0.60	0.90	1.03	1.07	0.79	0.62	0.35	0.79

[1] In 2016, Oregon changed their methodology for estimating fledging success, moving to a sampling strategy.

Washington State Recovery Objectives

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

We estimated there were 63 (range = 54-68) adult nesting snowy plovers in Washington during the 2023 nesting season and approximately 31-34 of these birds were males. Assuming all of these males were paired, we estimate there were 31-34 breeding pairs in Washington (Table 10). As each of the last 4 years has exceeded 25 breeding pairs, we are clearly meeting this recovery objective.

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

	2015	2016	2017	2018	2019	2020[1]	2021	2022	2023
Breeding males	35-55	43-57	28-51	34-37	36-62	-	47-53	28-32	31-34

[1]We do not have an estimate for 2020 due to reduced survey effort on account of COVID-19 restrictions.

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. There are no estimates since 2018, since brood monitoring across all three of Washington's primary nesting areas has not occurred since then. While nest and brood monitoring resumed in 2023 at Empire Spit, it has historically had higher fledging success than the two other primary nesting sites in Washington (Midway Beach and Leadbetter Point; Amburgey et al. 2023), and its 2023 estimate of fledging success cannot be assumed to be indicative of Washington's fledging success across all sites.

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 definition on what constitutes a "secure nesting area", we cannot determine when this objective has been achieved.

2023 MANAGEMENT ACTIONS

Management actions that occurred in 2023 involved minimizing human activities near active snowy plover nesting sites during the nesting season, habitat restoration, and predator management. Human activity can lead to direct and indirect mortalities of eggs, chicks, and adults. Pedestrians and vehicles may crush eggs or chicks and push adults off nests, exposing their eggs to extreme temperatures, blowing sand, and predators (US. Fish and Wildlife Service 2007, Stinson 2022). Heavily trafficked sections of a beach may discourage use of otherwise-suitable nesting habitat (U.S. Fish and Wildlife Service 2007). Restricting access to dry sand portions of the beach where nesting occurs during the breeding season can help reduce the impacts of human disturbance on nesting activity.

Many predators, notably corvids in Washington, have increased in numbers along the coast, attracted by trash, offal from fish and shellfish harvests, and other waste left by human beachgoers. Removing or dispersing corvids near plover nesting areas can mitigate the impacts of artificially augmented predator populations and increase plover nesting and fledging success (U.S. Fish and Wildlife Service 2007, Stinson 2022).

Encroachment of invasive beach grasses (*Ammophila arenaria, Ammophila brevigulata,* and their hybrid) and other invasive vegetation has been one of the main drivers of snowy plover habitat degradation. *Ammophila* spp. outcompete native beach grasses, changing the geomorphology of Washington's beaches (U.S. Fish and Wildlife Service 2007, Stinson 2022). Removal of invasive vegetation through mechanical and chemical methods can restore or enhance nesting areas, though regular management is necessary to maintain restored beaches.

Nest Site Protection

In an effort to protect nests from human activities, suitable habitat is closed to public entry during the breeding season. Sites that are not listed below did not have any nest site protection.

- Copalis Spit
    - Approximately 0.5 miles of upper beach were signed to prohibit public access along the north end of the Copalis Spit, the primary nesting area of plovers at this site.
- Conner Creek
    - Signs were installed at the north end of Conner Creek to restrict human access on the upper portions of the beach where plovers nest. The protected area encompassed approximately 27 acres of nesting habitat.
- Midway Beach
    - An estimated 2.7 miles were posted and signed to prohibit public access on the upper portions of the beach.
- Empire Spit
    - 1.9 miles of beach was signed to prohibit public access to approximately 230 acres of plover habitat.
- Leadbetter Point
    - Approximately 8.0 miles of public beach were demarcated with signs on PVC posts to restrict human access onto the upper, dry sand portions of the beach where plovers nest.
    - During a 26-week period, symbolic fencing, totaling over 1,500 feet in length, was placed along three hiking trails that access the beach to prohibit public access.

Vehicle and Recreation Restrictions

- Copalis Spit
    - Fireworks are prohibited year-round.
- Conner Creek
    - From 2nd Avenue to Heath Road, motor vehicles are prohibited between 15 April and the day after Labor Day, except during authorized razor clam dig hours.
    - North of Heath Road, the beach is closed to vehicle traffic year-round, except authorized vehicles and Tribal members on tribal clam dig days.
    - Fireworks are prohibited year-round on sections of the beach where State Parks is the upland landowner.
- Midway Beach:

  - Fireworks are prohibited year-round on sections of the beach where State Parks is the upland landowner.

- Leadbetter Point:
  - Coastal beaches are closed to vehicle traffic year-round except during recreational clam harvests. Driving is allowed on the wet sand portions of these beaches during spring and winter recreational razor clam harvests. Diving is restricted in the Seashore Conservation Area from Oysterville Road to Leadbetter Point State Park from 15 April to the day following Labor Day.
  - Dogs are not permitted on Refuge lands.
  - Overnight camping and fires are prohibited on the Refuge and the State Park at Leadbetter Point. Campfires on State Park managed beaches are not permitted in driftwood or within 100 feet of the dunes.
  - Fireworks are prohibited at Leadbetter Point all year round.

Predator Management

- Predator management occurred only at Midway Beach in 2023.
- Between May 9 and August 24, USDA removed two common ravens and four American crows. They dispersed at least 46 crows and three ravens.

Habitat Restoration

- Copalis Spit
  - Nine acres of *Ammophila* beachgrass was treated with herbicide on the northern tip.
- Empire Spit/Graveyard
  - From February to mid-April, SBIT staff removed Scotch broom, gorse, and other nonnative vegetation and alder trees from around the pond on Empire Spit.
  - From mid-August to the October, all non-native vegetation was hand-pulled, and trash was removed on the newly constructed berm (project completed in November 2022) at Empire Spit.
  - In October, 18 small pink sand verbena plants were transplanted from the old berm to the new berm.
- Leadbetter Point:
  - Ten acres were disked and bulldozed to treat *Ammophila* beachgrass prior to the start of the breeding season.
  - An additional 200 acres on Refuge and State Park lands that had previously been cleared was treated with herbicide and disked to reduce the density of resprouting beachgrass.
  - Oystershell hash was spread over ~32 acres of disked ground within the Refuge's habitat restoration area (HRA).
- No habitat restoration was conducted with Section 6 funds.

Clam Tides

- Washington Department of Fish and Wildlife coordinated most law enforcement activities, especially during clam tides.

- Washington State Parks and US Fish and Wildlife Service provided additional law enforcement patrols.
- Fourteen days in April and 11 days in May were open to recreational clamming at Midway Beach and the Long Beach Peninsula (Leadbetter Point, Long Beach, and Benson Beach) in 2023.
- Six days in both April and May were open to recreation clamming from Ocean Shores north to Copalis Spit.
- No WDFW-managed recreational clamming occurred between 15 May and 29 September.

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.
- Refuge law enforcement patrols were conducted periodically during the nesting season.
- WDFW staff patrolled nesting areas during holidays and clam digging tides

Outreach

- Willapa NWR social media posts and website content included information about snowy the plover at Leadbetter Point.
- Trailside shorebird interpretive signs were installed at locations around the Long Beach Peninsula and Willapa Bay.
- WDFW paid for public service announcements (PSAs) leading up to Earth Day with information on how to avoid disturbing nesting snowy plovers while recreating on Washington beaches. These PSAs coincided with dates and times when large numbers of recreational clam diggers were expected to be located on beaches where nesting plovers are found. Approximately 20,000 recreational clam diggers visited the beach during this timeframe. Post-harvest interviews of 138 clam diggers revealed that about 9% of those clam diggers heard the PSA.

DISCUSSION

We continued to see low numbers of breeding adult plovers in 2023 compared to the preceding years from 2015-2021. This reduction in the adult plover population has primarily been observed at Midway Beach and Leadbetter Point, whereas the numbers at Copalis Spit/Conner Creek and Graveyard Spit/Empire Spit remain fairly stable. Additionally, although survey effort and monitoring has been reduced, nest success at Leadbetter Point appears to be lagging. There are several possible explanations for these perceived trends, all of which warrant further investigation.

At Leadbetter Point, recent changes to the geomorphology of the beach have resulted in decreased elevation, a narrowing of the southern refuge beach (the southern portion of Leadbetter Point), and substantial accretion at the northern tip. These changes may be influencing the quantity and location of suitable nesting and foraging habitats by reducing the amount of nesting area on the outer beach on the south end and the amount of intertidal foraging area to the north. The impact these changes may be having on the south end beach could be exaggerated by more frequent wave run-up due to sea level rise. Increased vegetative cover in older portions of the habitat restoration area (HRA) at Leadbetter Point may be impacting nest selection and productivity. The spread of beachgrass and scotch broom has reduced the quantity and quality of nesting habitat available for plovers. To address this concern, the Refuge, in partnership with Washington State Parks, began accelerating the amount of beachgrass removal in 2019. The result is a substantial reduction in *Ammophila* cover on the southern portion of the Refuge and in the

State Park HRA. As outer beach conditions change and potentially become less desirable to nesting plovers, it is important that the HRA provides functional nesting habitat.

Similar changes to beach geomorphology and habitat quality have occurred at Midway Beach. Significant erosion to the outer and upper beach and the expansion of invasive beachgrasses has degraded a large area that was once quality nesting habitat.

Another explanation for lower breeding survey counts could be that plovers that previously nested at Midway Beach and Leadbetter Point could be prospecting and nesting at different or new locations. Recently enhanced nesting conditions like the sand nourishment project at Empire Spit or newly formed islands in north Willapa Bay may provide more attractive nesting habitat than what Midway Beach and Leadbetter Point currently offer. Recent documentation of snowy plover activity as far north as the northwestern Olympic Peninsula and Vancouver Island, British Columbia indicates that plovers could be breeding further north, outside of our current survey area. A wider distribution of breeding plovers may, in part, explain the reduction in the density of birds nesting at Midway Beach and Leadbetter Point. In 2024, we hope to expand breeding adult surveys further north to tackle this question.

While we have an estimate of fledging success at Empire Spit, we cannot assume a similar estimate at other Washington sites. When Midway Beach, Empire Spit, and Leadbetter Point were all closely monitored (prior to 2018), fledging success at Empire Spit was consistently higher than at the other sites (Amburgey et al. 2023). We suspect that the overall Washington estimate, if we had one, would be considerably lower than what was observed at Empire Spit. In 2024, Washington State Parks, Washington Department of Fish and Wildlife, and Shoalwater Bay Indian Tribe plan to band chicks at Griffiths-Priday State Park (Copalis Spit and Conner Creek), Midway Beach, Graveyard Spit, and Empire Spit. With a greater proportion of banded birds on the landscape and expanded nest and brood monitoring, we hope to learn more about nesting and fledgling success across Washington's sites, overwinter survival, and plover movements. This may help us narrow down what factors are leading to a reduction in Washington's breeding adult snowy plover population.

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APPENDIX

Starting and ending locations of Washington's snowy plover surveys.

Site	Starting Point	Ending Point
Copalis Spit	47.12125, -124.183306	47.137667, -124.182889
Connor Creek	47.070500, -124.177296	47.12125, -124.183306
Ocean Shores to Ocean City	46.965668, -124.175174	47.070611, -124.177167
Oyhut	46.946333, -124.132667	46.940389, -124.154778
Damon Point	46.947458, -124.129992	46.939395, -124.106865
Midway Beach	46.793751, -124.103754	46.745019, -124.093880
Graveyard Spit	46.727794, -124.044786	46.723772, -124.031169
Empire Spit	46.722478, -124.029036	46.704367, -123.987911
Willipa Bay Islands	46.659108, -124.033663	46.675329, -123.963650
Leadbetter Point	46.627972, -124.0715	46.647361, -124.053778
Long Beach	46.548333, -124.061333	46.367722, -124.056778
Benson Beach	46.271541 -124.074397	46.296730° -124.0759635°