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Washington State Snowy Plover Population Survey and Leadbetter Point Nesting Season Monitoring Report - 2019

Willapa National Wildlife Refuge

William Ritchie, Adam Kotaich, Cyndie Sundstrom, and Scott Pearson

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OVERVIEW

During the 2019 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. Field monitoring was conducted by William Ritchie, Adam Kotaich, Cyndie Sundstrom, and Larissa Ritzman, with assistance from Anthony Novack, Warren Michaelis, and Richard Ashley. Management activities included restricting human access to nesting sites, predator management, and restoring nesting habitat. The following is a summary of some of our 2019 activities and results:

Breeding Phenology

- Clutches at Leadbetter Point and Long Beach were initiated between 13 May and 27 June. Some early nests may have gone undiscovered because nest searching did not start until late March. Some late nesting could also have been missed since survey effort was limited after early July.
- Due to staffing limitations, we were unable to determine whether any chicks fledged.

Breeding Range

- We conducted 24 breeding surveys at 11 sites in two counties between 16 May and 27 June 2019 either to assess site occupancy status or to count the total number of adults.
- Snowy plovers were found nesting at Midway Beach, Graveyard Spit, North Willapa Bay islands, Leadbetter Point, and Long Beach.

Number of Breeding Adults

- The mean 2019 Washington breeding adult population was 93 (Range: 78-100), an increase of six birds from the previous year. Breeding adults were observed at Ocean Shores, Midway Beach, Graveyard Spit, North Willapa Bay islands, 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

- Twenty-nine nests were discovered and monitored at Graveyard Spit, Leadbetter Point, and Long Beach. No monitoring occurred at Midway Beach or on the North Willapa Bay islands.
- Three (18%) of the 17 nests that we monitored hatched while most of the remaining nests were likely lost to predation. At least one nest was abandoned attributable to human disturbance.
- 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.

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 been approximately 1.4 over the previous five years.

Management Actions

- *Nest exclosures*: No nests were exclosed in 2019.
- *Signing*: 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. Physical demarcation using signs and ropes was not installed at Graveyard Spit in 2019 due to funding limitations and access issues.

- *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 actions.
    - Long Beach: During the snowy plover breeding season, two days of razor clam digging occurred during the month of April. Portable toilets were placed on the beach at Leadbetter Point to minimize intrusions into the closed nesting areas. An additional day of recreational clam harvesting occurred in February and 35 days were open in the fall.
    - Midway Beach: Clam digging occurred on 2 days during the plover-breeding season in April compared to 15 days of overlap in 2017.
    - Graveyard Spit: tribal clam harvest was permitted in July.
- *Nest Predation:* Wildlife specialists with USDA APHIS Wildlife Services on both Leadbetter Point and Midway Beach conducted predator management in 2019. Management actions began the first week of April and continued until the end of June. 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.
- *Habitat Restoration:*
    - Seven acres of beachgrass was cleared at Leadbetter Point on the Willapa National Wildlife Refuge.
    - An additional 80 acres previously cleared was also disked to reduce resprouting beachgrass on the Willapa National Wildlife Refuge and on State Park land.
- *Outreach*:
    - Willapa NWR social media posts included information about snowy plover activities at Leadbetter Point.
    - A 60-second public service radio announcement produced by WDFW to promote plover conservation was aired on local radio stations during Earth Day weekend (April 20-21) which coincided with recreational clam digging.
    - A local public radio program produced by The Friends of Willapa NWR, Willapa Nature Notes, airs a feature story on snowy plover each spring to correspond to habitat restoration and the upcoming nesting season.
    - The Friends of Willapa NWR conducted a shorebird ambassador program focused on direct public information exchange targeted for scheduled events on Long Beach area beaches.
    - Wings over Willapa birding festival, held annually in late September, included two guided trips to Leadbetter Point to showcase snowy plover conservation efforts.

INTRODUCTION

The Pacific coastal population of the western snowy plover (*Charadrius nivosus nivosus*) is listed as Threatened under the Endangered Species Act, and is listed as Endangered by Washington State. The current Pacific coast breeding population extends from Midway Beach, Washington, to Bahia Magdalena, Baja California, Mexico. The snowy plover winters 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). In winter, snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest (U.S. Fish and Wildlife Service 2007).

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

Historically, five known areas supported nesting snowy plovers in Washington (Washington Department of Fish and Wildlife 1995). During the 2006 nesting season, there were four nesting locations: Leadbetter Point, Midway Beach (Grayland vicinity), Graveyard Spit, and Damon Point. During the 2007 and 2008 nesting season, three nesting sites were occupied, Leadbetter Point, Midway Beach, and Graveyard Spit. In nesting seasons from 2009-2019 Leadbetter Point and Midway Beach were occupied and Graveyard Spit was occupied in 2012-2019, but not in 2009-2011. Nests have been found recently on Long Beach in 2018 and 2019. 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 are maintaining 250 breeding adults for 10 years and a 5-year average productivity of at least 1.0 fledged chick per adult male (U.S. Fish and Wildlife Service 2007). The recovery plan calls for the development and implementation of mechanisms to assure long-term protection and management of breeding, wintering, and migration areas in Recovery Unit 1 (U.S. Fish and Wildlife Service 2007). This report describes progress on all of these criteria except the final one.

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

Both the federal and state recovery plans require monitoring of breeding adults and monitoring of fledging success to assess progress toward these recovery goals. Monitoring is also necessary to evaluate the impact of conservation actions on snowy plover populations such as 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. The report also serves, in part, to meet our reporting obligations under Recovery Subpermit, WNWR-15, Amendment 15 (SPITS TE-007497-15).

The primary objectives of our monitoring for the 2019-nesting season were:

- Conduct winter window surveys in conjunction with a range-wide survey effort.
- Conduct breeding window surveys in conjunction with a range-wide survey effort.
- Conduct unoccupied breeding site surveys at Copalis Spit, Connor Creek, and Damon Point/Oyhut Spit.
- 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.
- Identify potential predators, their spatial occurrence, and the efficacy of predator management activities conducted by USDA APHIS Wildlife Services at Leadbetter Point and Midway Beach.
- Attempt to increase nest success through habitat restoration efforts, restricting human activities on nesting sites, predator management, and evaluate the effectiveness of these activities.
- Produce a report that summarizes methods used, numbers of breeding adults, and hatching success (this report).

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

METHODS

Study Areas

During the 2007 and 2008 nesting seasons, three sites were occupied by breeding snowy plovers, Leadbetter Point, Graveyard Spit, and Midway Beach (Table 1). From 2009-2011, snowy plovers nested at two sites, Leadbetter Point and Midway Beach. During the 2012-2018 breeding seasons, snowy plovers 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. The orthographic photos of the nest sites in Appendix I provide a pictorial overview of the primary areas used for nesting in the spring/summer of 2019. Leadbetter Point and Midway Beach are dune backed beaches and have an exceptionally wide area that is unvegetated or sparsely vegetated and is located between the mean high tide and the foredune. Snowy plovers also use the sparsely vegetated foredunes and areas behind the foredune. The snowy plover habitat at Midway Beach consists of swales, sparsely vegetated foredunes, and a large deflation plain with ephemeral dune ponds. Leadbetter Point is part of a very long sand spit or peninsula. The habitat at Leadbetter Point consists of unvegetated beach above the summer high tide line, sparsely vegetated foredunes, blowouts, and human modified habitat of sand and oyster shell landward of the foredune (habitat restoration area). Graveyard Spit is located on the north shore of Willapa Bay. The nesting habitat at this site consists of a sparsely vegetated low-lying sand spit, with hummocks and swales, and unvegetated deflation plains adjacent to salt marsh communities. 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).

Table 1. **Approximate locations and land ownership/management of the 2019 snowy plover primary nesting localities in Washington.**

Site	Approximate Location	Ownership/Management
Midway Beach	46° 45’ 32”N, 124° 05’ 46”W	South Beach State Park, Private
Leadbetter Point	46° 36’ 24”N, 124° 03’ 25”W	Leadbetter Point State Park, Willapa National Wildlife Refuge
Graveyard Spit	46° 42’ 57”N, 124° 01’ 25”W	Shoalwater Bay Indian Reservation (trust and fee land), DNR/State Parks

Site Occupancy

Our goal was to determine snowy plover abundance and trend 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 relatively close proximity to occupied sites. Wildlife species are rarely detected with perfect accuracy and non-detection does not necessarily mean that a species was absent from a site unless the probability of detecting the species (detectability) was 100%. This leads to a fundamental problem -- the measure of occupancy is confounded with the detectability of the species. Specifically, an observed “absence” occurs if either the species was present at the site but not detected, or the species was truly absent. 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 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 2019, the window survey occurred between 16 and 23 May. Connor Creek, Copalis Spit, Damon Point/Oyhut Spit, Ocean Shores/Ocean City, Midway Beach, Graveyard Spit, Leadbetter Point, Long Beach, Benson Beach, and the north Willapa Bay islands were surveyed. 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).

Estimating breeding adult population size

In addition to the rangewide breeding window survey, we conducted two additional surveys at all occupied sites (Midway Beach, Graveyard Spit, Leadbetter Point, and Long Beach) and one additional survey at all Grays Harbor County non-occupied sites. Due to logistical constraints, the north Willapa Bay islands were only surveyed once in 2019. We completed all surveys between 16 May and 27 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 & Discussion section, we present the average and the range of these three surveys. We rounded all estimates to the nearest whole bird.

Table 2. **Starting and ending locations, survey types and number of surveyors for each survey site in Washington. The Leadbetter Point counts in the figures and tables that follow include birds detected in the Habitat Restoration Area (HRA), the 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).**

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
Oyhut Spit			1	Vehicle
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 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	46° 32' 54.0", 124° 03' 40.8"	46° 37' 40.7", 124° 04' 17.4"	3	Vehicle & Foot
Long Beach[1] (S. 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] 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.

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 2019, the window survey occurred from 24-30 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.

Nest phenology and success

We visited Leadbetter Point and Graveyard Spit approximately two to several times a week from early April through 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.

Unless observed directly, we calculated clutch initiation date by backdating from known laying or hatching dates. Additionally, egg floating is often used to calculate the initiation date. 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

We did not use nest exclosures in 2019.

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 or not 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 or more chicks fledged per breeding male should increase population size at a moderate pace.

Determining the number of young fledged requires following broods from hatch date to 28 days post hatching and determining their fate. To help us identify and follow individual broods, we 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 around 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 are able to 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 hand held GPS unit. We used both a Trimble and Garmin GPS unit to document nest locations at Leadbetter Point. The Trimble unit has sub-meter accuracy with post-processing and the Garmin is accurate to within 10 m. The location of Midway Beach and Graveyard Spit nests were not recorded this year.

RESULTS

Winter Window Survey

We detected 80 adult snowy plovers at three sites during the January 2019 Winter Window Survey (Table 3).

Table 3. **Winter Window survey counts by site, sex, and year.**

Site	2012	2013	2014	2015	2016	2017	2018	2019	2019			
									Survey Date	Adult Male	Adult Female	Adult Unk.
Copalis Spit	0	0	0	0	0	0	0	0	24-Jan	0	0	0
Conner Creek	0	0	0	0	0	0	0	0	24-Jan	0	0	0
Ocean Shores/ Ocean City	-	-	-	-	-	4	10	0	24-Jan	0	0	0
Oyhut Spit	-	0	0	0	0	0	0	0	24-Jan	0	0	0
Damon Point	0	0	0	0	0	0	0	0	28-Jan	0	0	0
Midway Beach	22	24	22	22	31	22	28	58	25-Jan	6	5	47
Graveyard Spit	0	0	0	0	0	0	0	0	29-Jan	0	0	0
Leadbetter Point	12	6	45	0	28	34	12	15	29-Jan	6	6	3
Long Beach	0	0	0	0	10	6	0	7	28-Jan	1	2	4
Benson Beach	-	-	0	-	0	0	0	0	30-Jan	0	0	0
Total	34	30	67	22	69	66	50	80		13	13	54

Breeding Window Survey

We detected 98 adult snowy plovers in Washington during the 2019 breeding window survey with a slightly higher proportion of males to females (Table 4). The Leadbetter Point count was down from the previous year while the Midway Beach, Graveyard Spit, and Long Beach counts increased.

Table 4. **Breeding Window survey counts by site, sex, and age and counts of nests and broods between 2012 and 2019.**

Site	2012	2013	2014	2015	2016	2017	2018	2019	2019			
									Survey Date	Adult Male	Adult Female	Adult Unk.
Copalis Spit	0	0	0	0	1	0	0	0	16-May	0	0	0
Conner Creek	0	0	0	0	0	0	0	0	16-May	0	0	0
Ocean Shores/ Ocean City	-	-	-	-	-	-	3	0	16-May	0	0	0
Oyhut Spit	-	0	0	0	0	0	0	0	24-Jan	0	0	0
Damon Point	0	0	0	0	0	0	0	0	16-May	0	0	0
Midway Beach	11	24	9	20	39	35	23	28	22-May	15	13	0
Graveyard Spit	0	1	6	3	18	17	28	32	21-May	16	16	0
No. Willapa Bay Islands	-	-	0	0	3	0	0	-	-	-	-	-
Leadbetter Point	15	20	28	41	45	32	27	19	23-May	9	8	2
Long Beach	0	0	0	0	0	0	0	19	21-May	11	8	0
Benson Beach	-	-	0	-	0	0	0	0	19-May	0	0	0
Total	26	45	43	64	106	84	81	98		51	45	2

Breeding Adult Surveys

As indicated in Table 5, we conducted 24 surveys at 11 sites between 16 May and 27 June 2019. Note that the north Willapa Bay islands survey includes all islands with exposed sand at mean high tide.

Site occupancy

We conducted occupancy surveys at seven sites 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 2019-nesting season.**

Site	Type of Survey	# Surveys	# Surveyors	Walking or Driving	Survey Dates
Copalis Spit	Occupancy/Window	2	1-2	foot	5/16 & 6/21
Connor Creek	Occupancy/Window	2	1	foot/drive	5/16 & 6/06
Ocean Shores/ Ocean City	Occupancy/Window	2	2	drive	5/16 & 6/06
Oyhut	Occupancy/Window	2	1	foot	5/17 & 6/06
Damon Point	Occupancy/Window	2	1	foot	5/16 & 6/07

Midway Beach	Breeding Adult/Window	3	6-7	foot	5/22, 6/04, 6/19
Graveyard Spit	Breeding Adult/Window	3	6	foot	5/21, 6/05, 6/17
North Willapa Bay islands	Occupancy/Window	1	2	foot	6/27
Leadbetter Point	Breeding Adult/Window	3	7-8	foot	5/23, 6/03, 6/18
Long Beach (Oysterville to No. Head)	Breeding Adult/Window	3	2	foot/drive	5/21, 6/05, 6/20
Benson Beach	Occupancy/Window	1	1	foot	5/19

Estimating Number of Adult Snowy Plovers

We used the mean from the three surveys conducted in 2019 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. However, the population appears to have stabilized since 2015. Counts at Graveyard have increased dramatically since 2012 while there has been a decline in the number of birds at Leadbetter Point.

Table 6. **Mean counts (range) of the breeding adults at nesting sites in Washington and the total population estimate for the State, 2006-2019.**

Year	Midway Beach	Graveyard Spit	Leadbetter Point	Long Beach	N. Willapa Bay Is.	Total
2006	21 (14-28)	2 (0-5)	35 (26-45)	ns	ns	59 (48-70)[1]
2007	18 (14-21)	2 (0-4)	25 (20-30)	ns	ns	44 (36-53)
2008	14 (10-19)	1 (0-2)	32 (23-40)	ns	ns	47 (33-60)
2009	15 (13-17)	0	17 (10-24)	ns	ns	31 (23-39)
2010	14 (11-18)	0	21 (17-26)	ns	ns	36 (33-38)
2011	19 (8-30)	0	12 (6-19)	ns	ns	31 (15-47)
2012	14 (5-23)	2 (0-3)	18 (6-29)	ns	ns	33 (15-52)
2013	20 (16-24)	4 (1-6)	20 (19-20)	ns	ns	43 (41-45)
2014	11 (9-13)	7 (6-8)	24 (21-28)	ns	ns	41 (40-43)
2015	24 (19-33)	8 (3-11)	43 (34-54)	ns	ns	77 (65-98)
2016	37 (33-40)	21 (18-25)	33 (25-32)	2 (0-2)	3	93 (85-103)
2017	36 (35-36)	21 (18-24)	21 (14-32)	13 (0-13)	0	78 (70-86)
2018	31 (23-40)	35 (28-42)	21 (13-29)	1 (0-1)	0	87 (80-91)
2019	33 (28-39)	31 (30-32)	16 (7-21)	11 (7-19)	1	93 (78-100)[2]

[1] 2006 total includes 1 adult (range 0-2) encountered at Damon Point
[2] 2019 total includes 1 adult (range 0-1) encountered at Ocean Shores

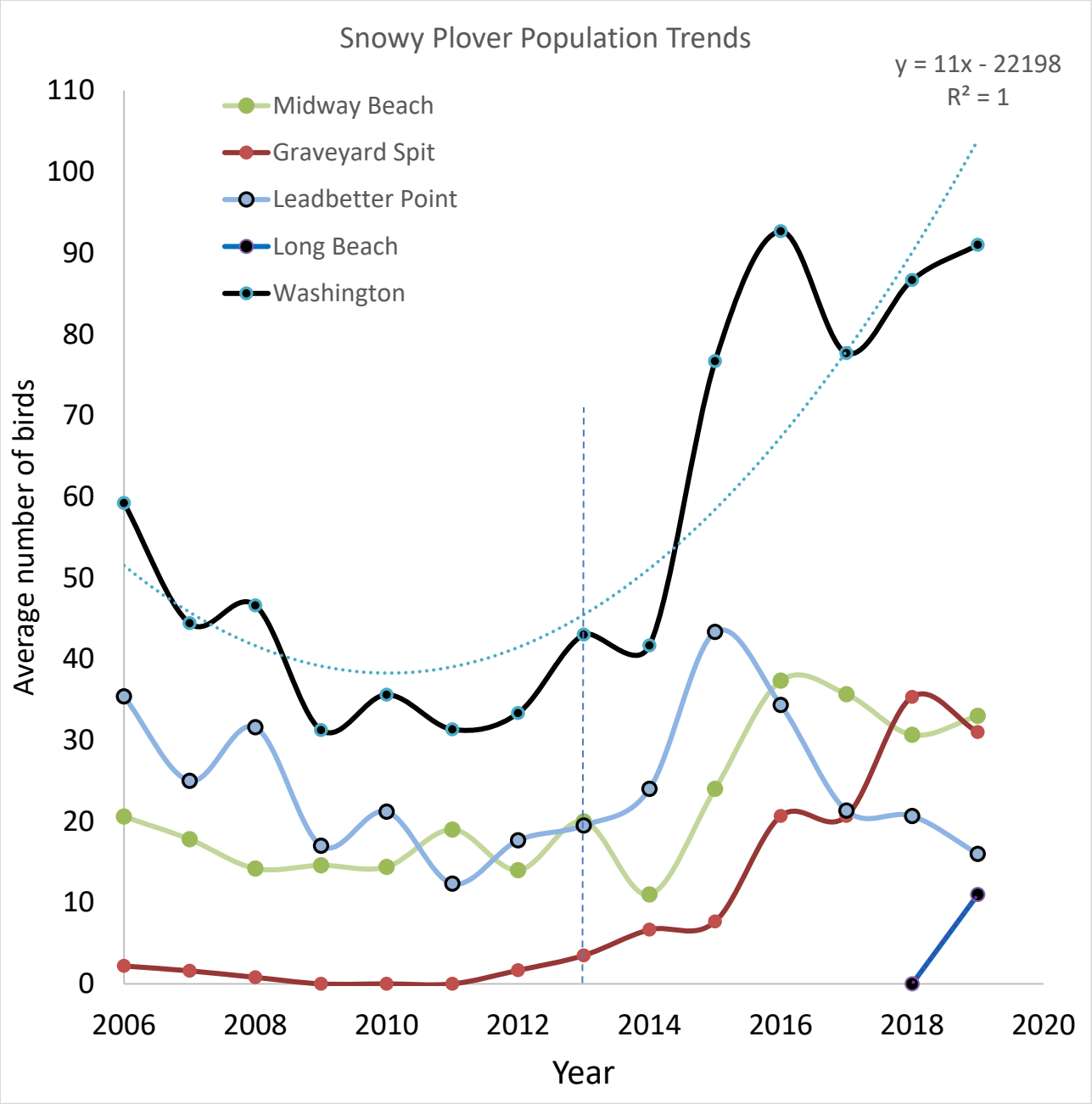


Figure 1. **Breeding adult snowy plover population trend; all Washington sites (2006 – 2019). The circles represent the average count (from three counts) and the dotted curved line represents the quadratic relationship for the overall Washington estimate. The 2019 Washington total includes one adult at Ocean Shores and one at Willapa Bay islands. Blue vertical line indicates when predator management was initiated at Leadbetter Point. Predator management began at Midway Beach in 2014.**

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 each nesting site, this information cannot be calculated. Using the previous ten years of data, most clutch initiations begin in mid-April through mid-August while the last known fledged chicks occurs by mid-

September. For pervious clutch initiation and breeding phenology, patterns see Pearson et al. (2019). Limited data were available for 2019 and only seven nests on the Long Beach Peninsula had exposure days. Those clutches initiated between May 14 and about June 27 with a peak occurring in late May 2019. We were unable to determine if any chicks fledged in 2019.

Nest Success

We located 29 nests and determined that at least two other nests went undiscovered based on either broods unaccounted for on the beach or nests found post-failure. Ten nest were located at Leadbetter Point, Graveyard Spit had 11 nests, there were seven nests discovered in the Long Beach area, and one nest was found on Gunpowder Sands Island (Table 7). Several nests were encountered during adult breeding surveys at Midway Beach but no documentation or monitoring was conducted. Of the 17 monitored nests at Leadbetter Point and Long Beach, only seven persisted enough days to determine exposure required for the Mayfield assessment, and one of those nests had an undetermined outcome. For a map of nest locations, see Appendix I. Three of the six nests with known fate that we monitored hatched. Only one nest failure could be attributed to raven predation but the two unknown nest failures may have been caused by corvids (Table 8). Since predator management was initiated, predation has been quite low until last year.

Using the Mayfield approach for assessing nest success at Leadbetter Point/Long Beach, nest survivorship in 2018 was 25% and 36% in 2019, although both years had extremely small sample sizes. Exclosures have not been placed around any nests to exclude predators since 2010 and predator management began in 2013.

Nest success was low in both 2018 and 2019 for the first time since predator management began. Since 2018 nest success statewide appears to be trending downward (Figure 2).

Table 7. **Nest outcomes by snowy plover nesting locality in 2019. Outcomes include successful (hatched), failed, or unknown outcome. Nests without exposure days (failed shortly after discovery or found after success or failure) were excluded from the Outcome portion of this table.**

			Outcome		
Site	# Nests Located	Nests w/ Exposure Days	Hatch	Fail	Unknown
Midway Beach	ns	ns	-	-	-
Graveyard Spit	11	0	-	-	-
No. Willapa Bay Is.	1	0	-	-	-
Leadbetter Point	10	4	1	3	0
Long Beach	7	3	2	0	1
Totals	29	7	3	3	1

Table 8. **Sources of snowy plover nest failure in 2019 for nests that failed to hatch. Sources of failure include predators (common raven or unknown predator) eating eggs. At least one nest without exposure days was abandoned and attributable to human disturbance. Nests without exposure days (failed shortly after discovery or found after success or failure) were excluded from this table.**

	Nest Failures								
	Predator					Other Sources			
Site	Crow	Raven	Corvid	Coyote	Unknown	Human	Tidal	Abandon	Unknown
Midway	-	-	-	-	-	-	-	-	-
Graveyard	0	0	0	0	0	0	0	0	0
Leadbetter	0	1	0	0	2	0	0	0	0
Long Beach	0	0	0	0	0	0	0	0	0
Totals	0	1	0	0	2	0	0	0	0

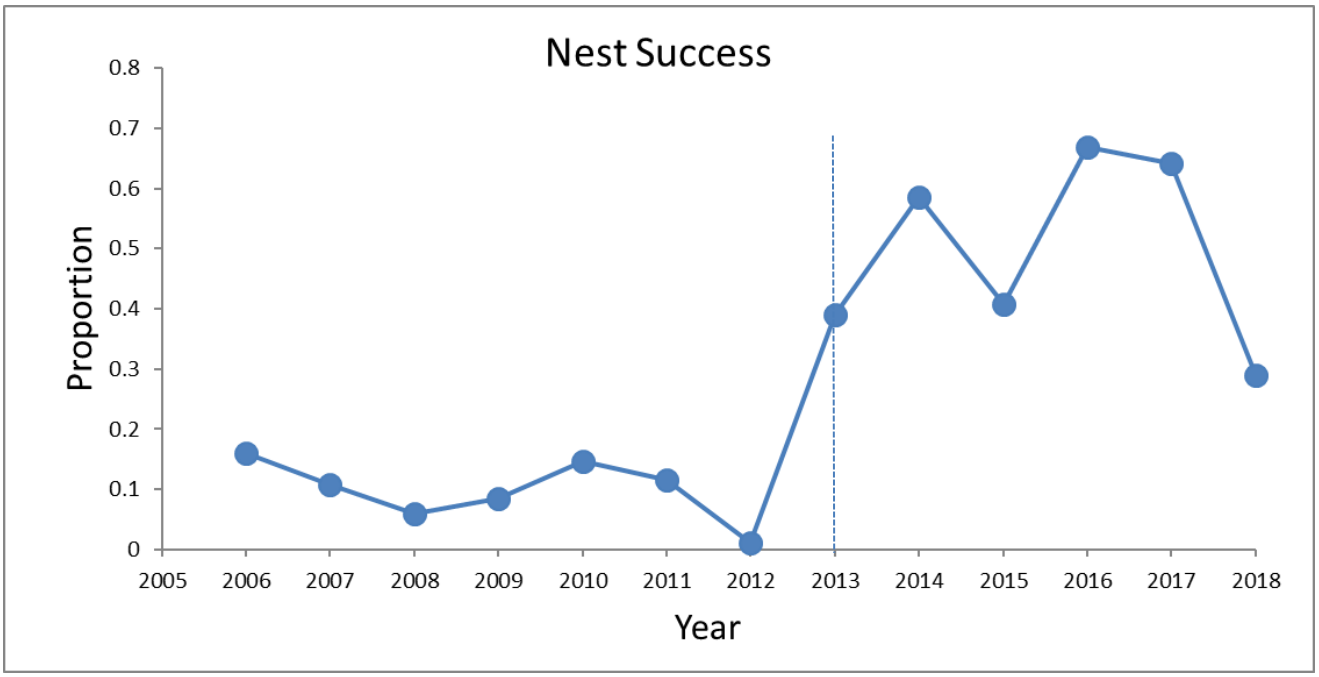


Figure 2. **Mayfield nest success of unexclosed nests by year (2006-2018). Note that predator management was initiated in 2013-2014.**

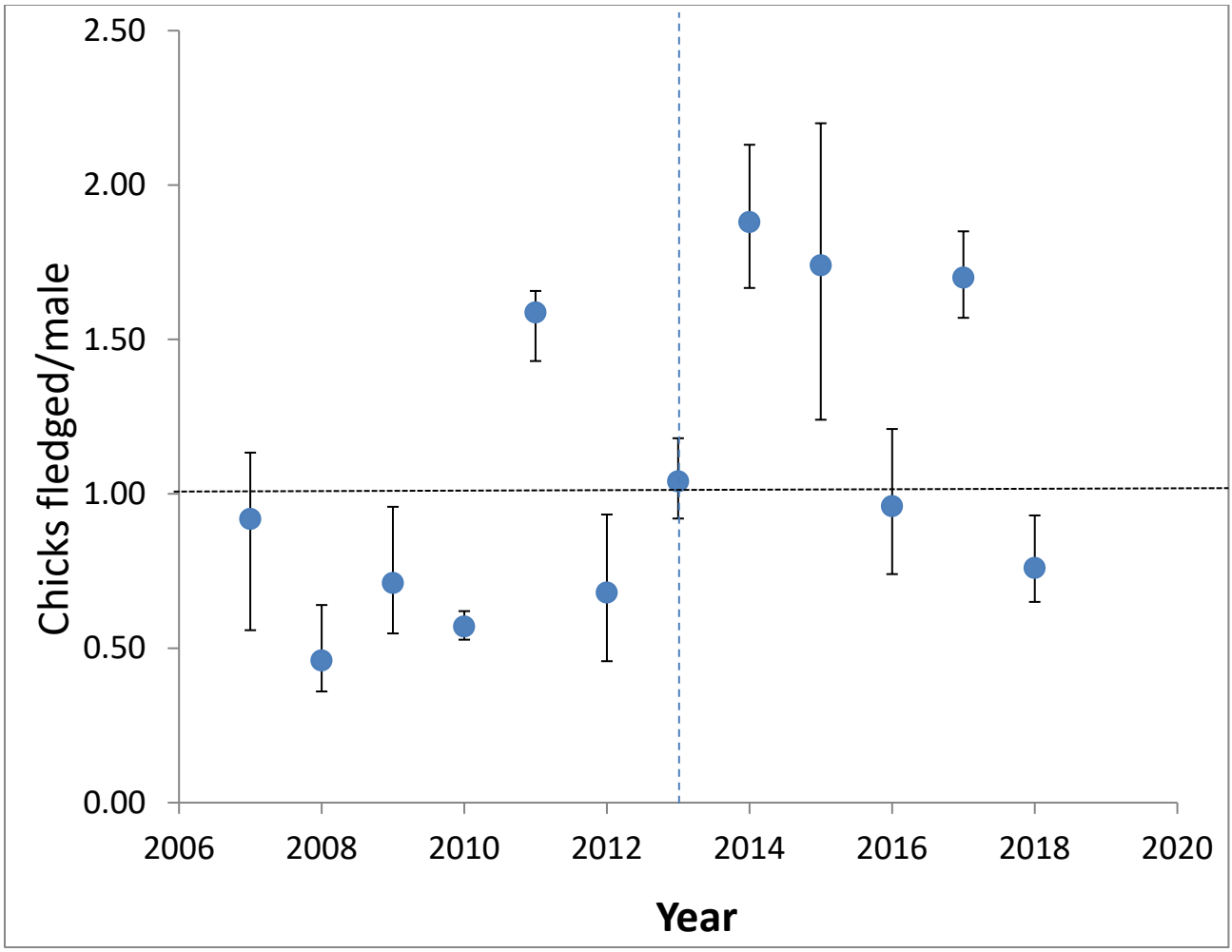


Figure 3. **Number of snowy plover chicks fledged per adult male 2007-2018 for all Washington nesting sites combined. Statewide data are not available for 2019. Population modeling indicates that one chick fledged per adult male is needed on average to maintain a stable population (black dashed line). Note that predator management was initiated in 2013 at Leadbetter Point (blue dashed line) and 2014 at Midway Beach.**

Fledging Success

Fledging success is defined as the number of chicks fledged per adult male. Figure 3 depicts the snowy plover fledging success at all Washington sites combined from 2007 to 2018. During our repeated counts at occupied sites in 2019, 42-52 males were counted during the three adult surveys. However, we were unable to determine if any chicks fledged at any sites. Consequently, we lack data to calculate fledging success (chicks fledged/male) in 2019.

Nest Locations

At Midway Beach, snowy plovers nested in Grayland Beach State Park and on the beach immediately south of Grayland Beach State 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 at locations from south of Oysterville Road to south of Klipsan Beach. One nest was also discovered north of Leadbetter Point on Gunpowder Sands Island. The 2019 Leadbetter Point and Long Beach nest locations are presented in Appendix I.

Predator Management

Predator management occurred on Midway/Grayland Beach and Leadbetter Point in 2019. Wildlife specialists with USDA APHIS Wildlife Services (WS) and refuge staff who worked primarily during the active plover nesting season (April-July) in 2019 conducted predator management and monitoring of predator activities. WS activities were focused on removing those predator species (crows and ravens) primarily responsible for most of the nest predation events observed during the past seven years (Table 10). Communication between plover biologists and wildlife specialists at Leadbetter Point helped focus management activities on locations and individual predators that were apparently causing the most plover depredations. Management activities included observing predator activities at plover nesting sites, then conducting targeted dispersal or lethal removal as appropriate (Figures 4 and 5). There were no negative impacts to plovers evident from WS activities. Predator observations made by refuge staff (n=144) occurred between 26 March and 05 July 2019. These observations occurred on standardized driving transects along the outer beach and opportunistically during walking surveys and nest search activities (Figure 5A).

Table 10. **Number of avian predators dispersed or killed by year (2013- 2019). Note that most of the predator management activities focused on dispersing corvids.**

	Leadbetter Point				Midway Beach				Graveyard Spit
	American Crow		Common Raven		American Crow		Common Raven		Northern Harrier
Year	Dispersed	Removed	Dispersed	Removed	Dispersed	Removed	Dispersed	Removed	Removed
2013	60	32	13	18	-	-	-	-	-
2014	63	30	16	11	248	25	11	13	-
2015	33	11	15	8	16	2	2	8	-
2016	35	9	11	4	33	2	8	4	-
2017	38	11	11	7	56	12	6	3	-
2018	3	1	17	5	19	8	9	6	1
2019	42	9	9	6	22	7	2	6	-

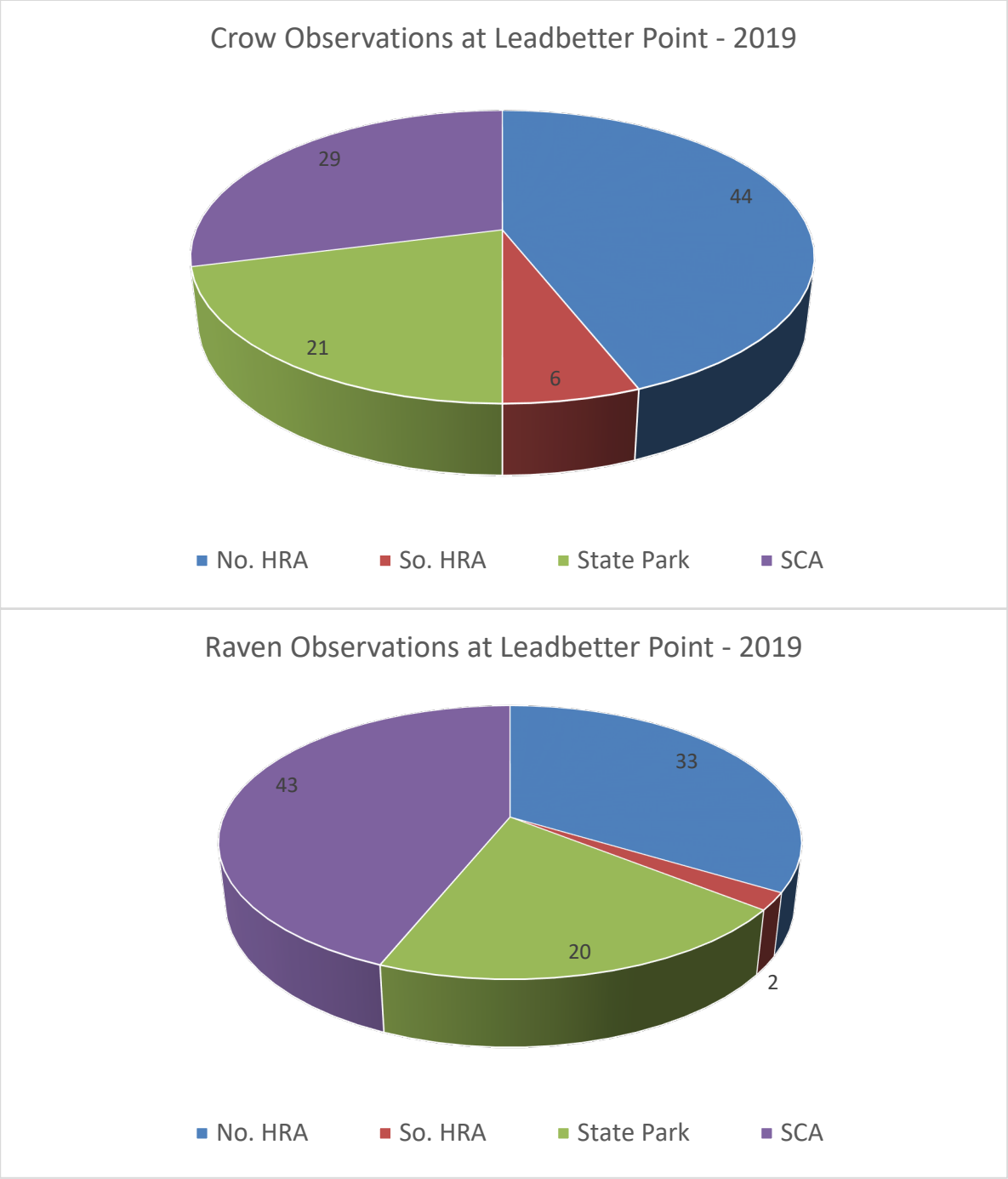
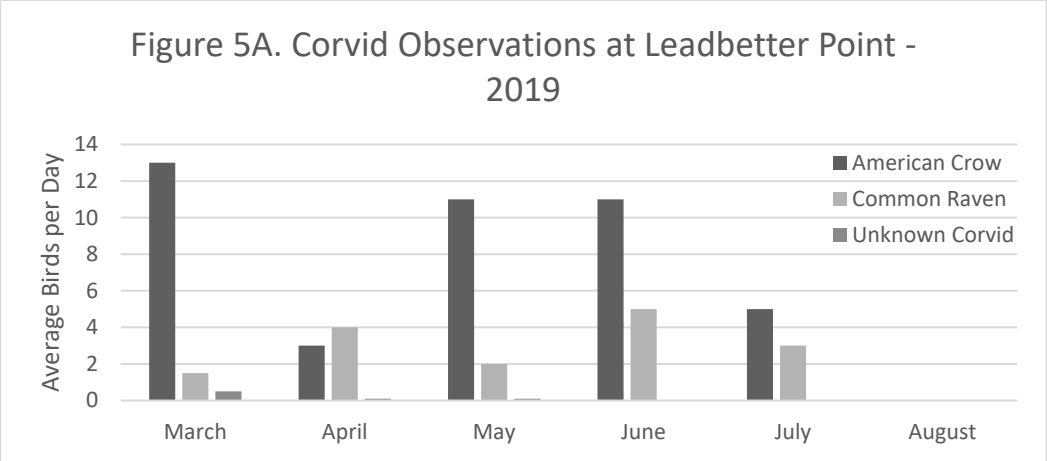
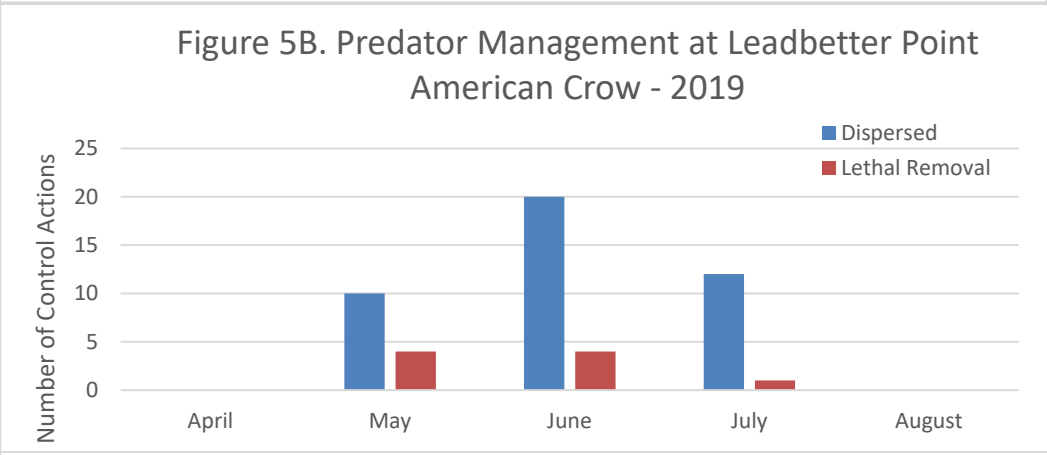


Figure 4. **The number of corvids observed by location (n=144) at Leadbetter Point during the 2019 snowy plover breeding season. Predator observations occurred between 26 March and 05 July 2019 in the North Habitat Restoration Area (HRA), South HRA, Leadbetter Point State Park, and Seashore Conservation Area (SCA).**





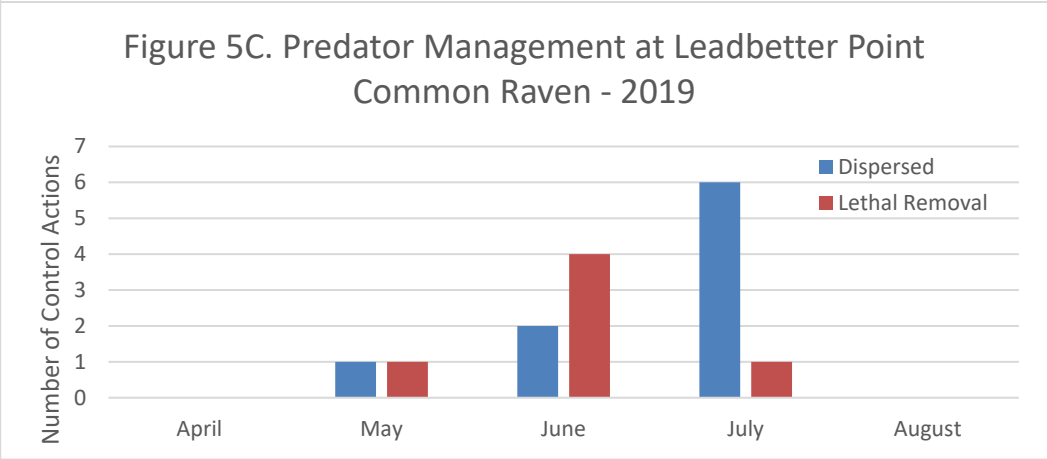


Figure 5. **Average number of corvids observed per survey day (n=30) at Leadbetter Point during the 2019 snowy plover breeding season (A), Number of crows dispersed and lethally removed at Leadbetter Point in 2019 (B), and Number of ravens dispersed and lethally removed at Leadbetter Point in 2019 (C). Note that predator survey effort was reduced in March and July and no predator surveys or predator management actions were conducted in August.**

Quantification of Take (Leadbetter Point only)

• *Chick Banding*

There were no chicks banded in 2019.

• *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 2019.

• *Nest Inspection*

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 observation to assess its status is done from a distant vantage point, thus avoiding the need to approach the nest. Visit times to nests in 2019 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.

• *Rehabilitation and Salvage*

No birds were rehabilitated or salvaged in 2019. Three eggs from one abandoned nest were collected to determine viability and then destroyed. No biological samples were collected for genetic analysis.

• *Habitat Restoration and Vegetation Sampling*

Four weeks of habitat restoration and two days of herbicide application occurred at Leadbetter Point in 2019. Habitat work took place on Refuge and State Park lands between 19 February and 14 March. Aerial herbicide application was conducted in the HRA on 1 October. An additional herbicide treatment to control Scot's broom and gorse on the bayside of the refuge, which is not suitable for larks or plovers, was conducted on 1 May. Areas scheduled for habitat restoration are searched several times during the preceding 2-3 weeks to minimize potential impacts and 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 2019 Washington nesting population was 93 (range = 78-100) and the 2019 Oregon nesting population was 502 (Lauten et al. 2019) for a total of 595 (range = 580-602) nesting adult snowy plovers in Recovery Unit 1. Recovery Unit objectives for breeding adults have been exceeded since 2013. The ten-year average population in Recovery Unit 1 is 320 adult plovers.

Table 11. **Estimated number of breeding adult snowy plovers in Recovery Unit 1 by year.**

2013	2014	2015	2016	2017	2018	2019
234 (231-236)	379 (378-381)	526 (514-547)	622 (614-632)	546 (538-554)	589 (582-591)	595 (580-602)

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 1.02 over the past 5 years. 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 2019 value is derived solely from the Oregon portion of the population.

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

	2013	2014	2015	2016	2017	2018	2019
Chicks fledged/male	1.04 (1.02-1.07)	1.71 (1.68-1.74)	1.55 (1.49-1.57)	0.66	0.90	1.03	1.08[3]

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

Washington State Recovery Objectives:

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

We counted 39-50 pairs of adult snowy plovers (average 44) in Washington during the 2019 nesting season, while 36 to 62 of these birds were males. Thus, there was a mean of 44, or 46 if we assume that all males counted were paired, breeding snowy plover pairs in Washington. During each of the five most recent years, we have met the objective statewide average of at least 25 breeding pairs (Table 13).

Table 13. **Estimated number of paired breeding males in Washington (2013-2019).**

	2013	2014	2015	2016	2017	2018	2019
Breeding males	22-24	23-27	35-55	43-57	28-51	34-37	36-62

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

The average number of young fledged per adult male in Washington in 2018, the most recent year with complete data, was 0.76 (range = 0.65-0.93). Data on the average number of chicks fledged in 2019 are not available, but no chicks were known to have fledged. Anecdotal information from nests known to have hatched and the extremely low incidents of brood observations suggest that fledging success was likely below 1.0 this year. This would be the third year of the past four years where the number of chicks fledged was below the 1.0 threshold in Washington (Figure 3 and Table 14). However, the average number of chicks fledged per male was approximately 1.35 between 2013 and 2018. Snowy plovers currently nest at Leadbetter Point (primarily on the Refuge), Long Beach, Graveyard Spit, and Midway Beach. The first site is part of the Willapa National Wildlife Refuge while the others are on private, tribal, and Washington State Park lands.

Table 14. **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.

See Downlisting Objective 1. The 4-year average for breeding pairs in Washington is currently 44. However, only three of the past five years have been greater than 40, and only one those years has had a fledging success rate of 1.0 chick fledged per breeding pair. One individual site has reached 40 pairs once during the past 13 years, Leadbetter Point. We recommend defining the term "secure" and determining the number of sites considered "secure".

2019 MANAGEMENT ACTIONS

A number of the management actions that occurred in 2019 involved minimizing some human activities near active snowy plover nesting sites during the nesting season. Human related disturbance negatively affects hatching success of snowy plovers (Warriner et al. 1986, Schulz and Stock 1993) and snowy plover chick survival by as much as 72% (Ruhlen et. al. 2003). Disturbances to wintering snowy plovers are 16 times higher at a public beach than at a protected beach. Humans, dogs, American crows and other birds are the main sources of disturbance (Lafferty 2001). In addition, snowy plover feeding rates declined in response to disturbance (Lafferty 2001). Human disturbance negatively affects hatching rates and chick survival for various plover species (Flemming et al. 1988, Buick and Paton 1989, Dowling and Weston 1999).

Management

- *Nest Site Protection* – In an effort to protect nests from human activities suitable habitat is closed to public entry during the breeding season. Physical demarcation using signs and ropes was not installed at Graveyard Spit in 2019 due to funding limitations and access issues.
    - 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, thus protecting nesting birds. In an effort 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 total length of protected nesting habitat is approximately double the length signed in 2018 due to expanded efforts by WA State Parks to provide protection to nesting birds.
    - Symbolic fencing, totaling over 1,500 feet in length, was placed along three hiking trails that access the beach on the Long Beach Peninsula (1 private access, 1 State Park access, 1 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.
    - There were 38 recreational razor clam days at Long Beach in 2019. Two clam harvest days occurred during the plover breeding season, one before nesting, and 35 post-breeding. There were no clam harvest days in May. Portable toilets were placed on the beach for the two April dates.
    - Clam digging occurred on two days during the plover breeding season in April at Midway Beach in 2019.
    - Tribal clam harvest was permitted in July at Graveyard Spit.
- *Law Enforcement* – Washington Department of Fish and Wildlife coordinated law enforcement activities with State Parks and US Fish and Wildlife enforcement, during clam tides.

- Additional law enforcement effort was directed to the plover nesting beaches during high traffic events such as the July 4 holiday and locally organized events.
- Refuge enforcement patrols were conducted periodically during the nesting season.

- *Outreach* –
  - Radio Advertising – A 60-second public service announcement produced by WDFW to promote plover conservation was aired on local radio stations during Earth Day weekend (April 20-21), which coincided with recreational clam digging.
    - > Midway Beach – 13% of the estimated 2,000+ recreational clam diggers reported hearing the radio announcement on April 21.
    - > Long Beach – Approximately 31% of the estimated 14,000+ recreational clam diggers reported hearing the radio announcement on April 21.
  - A local public radio program produced by The Friends of Willapa NWR, Willapa Nature Notes, airs a feature story on snowy plover each spring corresponding to habitat restoration and the upcoming nesting season.
  - The Friends of Willapa NWR conducted a shorebird ambassador program focused on direct public information exchange targeted for scheduled events on Long Beach area beaches.
  - Trailside shorebird interpretive signs are installed at locations around the Long Beach Peninsula and Willapa Bay.
  - Willapa NWR social media posts included information about snowy plover activities at Leadbetter Point.
  - WDFW Shellfish program distributes a brochure entitled "Razor Clamming and Nesting Birds" to recreational diggers.
  - Wings over Willapa birding festival, held annually in late September, included two guided trips to Leadbetter Point to showcase snowy plover conservation efforts.

- *Predator Management* –
  - Wildlife specialists with USDA APHIS Wildlife Services on both Leadbetter Point and Midway Beach conducted predator management in 2019. Management actions began the first week of April and continued until the end of 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 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 razor clam harvests.
  - The Midway Beach area is open to vehicle traffic except during and preceding the July 4 holiday. There are vehicle access points at Cranberry Beach Road and Warrenton-Cannery Road.
  - Overnight camping and fires are prohibited on the Refuge and the State Park at Leadbetter Point. Fireworks are prohibited at Midway Beach and Leadbetter Point during and preceding the July 4 holiday. Campfires on State Park managed beaches are not permitted in driftwood or within 100 feet of the dunes.

- *Nest exclosures* – No nests exclosures were installed during 2019 and have not been used since 2010.

Habitat Restoration

Leadbetter Point

- Pre-breeding –
  - Seven acres of invasive beachgrass was removed using bulldozers and disks on the Refuge. An additional 80 acres previously cleared on the Refuge and on State Park land was disked to reduce resprouting beachgrass.
- Post-breeding –
  - Strategic aerial herbicide treatment included 285 acres of invasive beachgrass and 97 acres of gorse and Scot's broom.
  - A small area near native plants was hand weeded on the refuge.

DISCUSSION

The Recovery Unit (RU1) 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. 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, streaked horned larks nesting at Leadbetter Point appear to be stable, although a more thorough examination of the current situation is warranted. It should also be noted that the lack of nesting and fledging success data from Graveyard Spit and Midway Beach impair our ability to understand statewide reproductive rates.

Refuge staff have begun to track potential nest predator numbers and locations more thoroughly. As capacity allows, monitoring of lark nests will also increase in an attempt to better track nest success on refuge lands. Habitat quality is another important factor that can influence productivity. A vegetation sampling plan and wrack monitoring assessment may help inform management to improve the quality and quantity of suitable habitat and quantify food availability.

Discussion amongst a larger group of managers may be 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 long-term population source locations. We recommend defining what constitutes a "secure site" and determine the number and location of sites considered "secure" to sustain a viable population in Washington.

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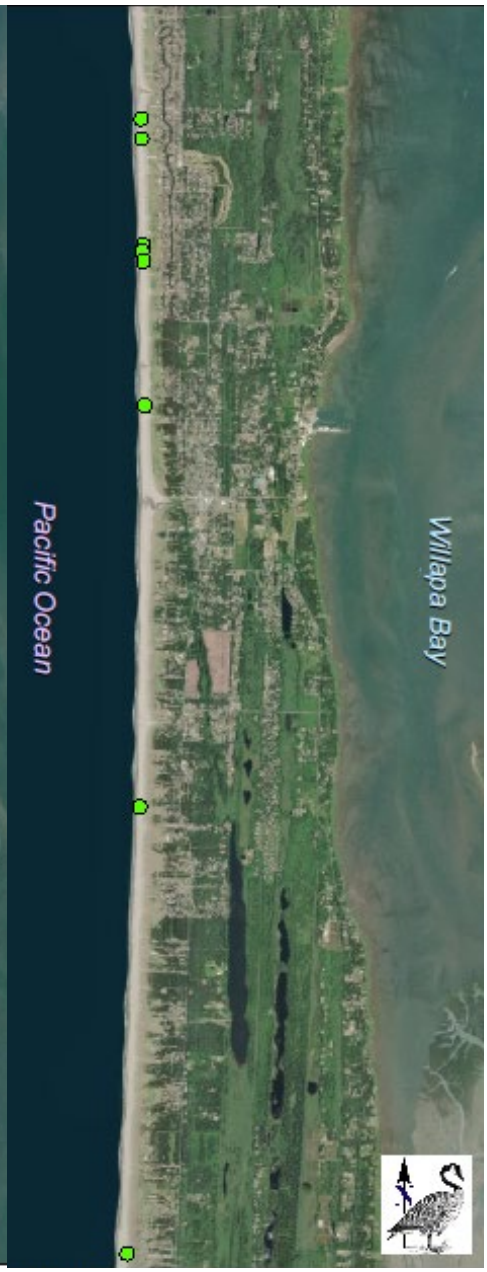
APPENDIX I

Long Beach Peninsula Nest Locations

Yellow circles indicate approximate locations of snowy plover nests on the Long Beach Peninsula, Washington in 2019.

Leadbetter Point



Long Beach