The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2020

*Final report for USFWS agreement #*F19AC00443
Interim report for BLM contract # 140L4318P0105
Interim report for USFS contract # 1204R419P4002
Final report for ODFW agreement # 091-20
Final report for OPRD agreement # 8250
Interim report for USACE contract # W9127N19C0013

David J. Lauten, Kathleen A. Castelein, J. Daniel Farrar, Adam A. Kotaich, Jamie N. Harrison, and Eleanor P. Gaines

The Oregon Biodiversity Information Center
Institute for Natural Resources
Portland State University/INR
PO Box 751
Portland, Oregon 97207

December 2020

Submitted to:

Coos Bay District Bureau of Land Management
1300 Airport Way
North Bend, Oregon 97459

Siuslaw National Forest
4077 SW Research Way
Corvallis OR, 97333

U.S. Fish and Wildlife Service
2127 SE OSU Drive
Newport, Oregon 97365
Recovery Permit TE-839094-5

Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive, SE
Salem, OR 97302

Oregon Parks and Recreation Department
725 Summer St. N.E. Suite C
Salem, OR 97301

U.S. Army Corps of Engineers Portland District
CENWP-OD-N
333 SW 1st Ave.
Portland, OR 97204

The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2020

David J. Lauten, Kathleen A. Castelein, J. Daniel Farrar, Adam A. Kotaich, Jamie N. Harrison, and Eleanor P. Gaines

Oregon Biodiversity Information Center
Institute for Natural Resources
Portland State University/INR
PO Box 751, Portland, Oregon 97207

Abstract

We monitored the distribution, abundance and productivity of the federally threatened Western Snowy Plover (*Charadrius nivosus nivosus*) along the central and south coast of Oregon from 2 April – 17 September 2020. We surveyed and monitored plover activity in a project area that included, from north to south, Sutton Beach, Siltcoos River estuary, the Dunes Overlook, Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Snowy Plover Management Area, New River Habitat Restoration Area (HRA) and adjacent lands, and Floras Lake. Our objectives for the project area in 2020 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) determine nest success, 4) implement nest protection as appropriate (e.g. ropes and signs), 5) monitor a sample of broods to determine brood fate and plover productivity, and 6) use cameras and observational data to document predator activity at nests.

We estimated the resident number of Snowy Plovers in Oregon at 549 individuals, the highest number since monitoring began in 1990. We monitored 650 nests in 2020. Overall apparent nest success was 40%. Nest failures were attributed to unknown depredation, corvid depredation, unknown cause, abandonment, mammalian depredation, wind/weather, unknown avian depredation, one egg nests, harrier depredation, overwashing, infertility, gull depredation, and human caused failure. We monitored 209 of 271 known broods that produced 231 fledglings and estimated 299 total fledglings. Overall brood success was 72%, fledging success was 42%, and based on the overall number of resident males, 1.06 chicks fledged per resident male.

Table of Contents

Introduction

The Western Snowy Plover (*Charadrius nivosus nivosus*) breeds along the coast of the Pacific Ocean in California, Oregon, and Washington and at alkaline lakes in the interior of the western United States (Page *et al.* 1991). Loss of habitat, predation pressures, and disturbance have caused the decline of the coastal population of Snowy Plovers and led to the listing of the Pacific Coast Population of Western Snowy Plovers as threatened on March 5, 1993 (U.S. Fish and Wildlife Service 1993). Oregon Department of Fish and Wildlife (ODFW) lists the Western Snowy Plover as threatened throughout the state (ODFW 2009).

Oregon Biodiversity Information Center (ORBIC, formerly Oregon Natural Heritage Information Center) completed our 31st year of monitoring the distribution, abundance, and productivity of Snowy Plovers during the breeding season from Sutton Beach in Lane County to Floras Lake in Curry County on the Oregon coast. We define the project area as coastal habitat between Sutton Beach and Floras Lake. In recent years, Snowy Plovers have extended to sites outside this project area; we did not monitor these new sites due to workload limitations. In 2020 the novel coronavirus resulted in some additional limitations in our ability to monitor all sites within the project area. In cooperation with Federal and state agencies, plover management has focused on habitat restoration and maintenance at breeding sites, non-lethal and lethal predator management, and management of human related disturbances to nesting plovers. The goal of management is maintaining recent improvements in annual productivity, leading to a sustainable Oregon breeding population at or above recovery levels. Previous work and results have been summarized in annual reports (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006a, 2006b, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019). Our objectives for the project area in 2020 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) determine nest success, 4) implement nest protection as appropriate (e.g. ropes and signs), 5) monitor a sample of broods to determine brood fate and plover productivity, and 6) use cameras and observational data to document predator activity at nests.

Study Area

Snowy Plover populations have increased in Oregon, and as a result plovers have begun to winter and nest at locations outside of areas traditionally monitored by ORBIC (USFWS, ORPD, and ORBIC unpublished data). Here we report on activities at sites intensively monitored by ORBIC in 2020: from north to south, Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, the South Umpqua beach to Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Snowy Plover Management Area (SPMA), New River (extending from private land south of Bandon SPMA to the south end of the New River Area of Critical Environmental Concern (ACEC) habitat restoration area), and Floras Lake (Figure 1). Due to staffing issues related to the novel coronavirus and workload that has increased with the population, we did limited monitoring at South Tahkenitch to the North Umpqua jetty (North Umpqua). In 2019 plovers were noted at Cut Creek, Bullard's Beach State Park; we received no reports of plovers in this area and did not survey Cut Creek in 2020. We monitored Johnson Creek, Bandon Beach, due to its proximity to Bandon SPMA, however we did not detect any plover activity at this site in 2020. At these breeding sites, we surveyed and monitored Snowy Plover activity along ocean beaches, sandy spits, ocean-overwashed areas within sand dunes dominated by European beachgrass (*Ammophila arenaria*), open estuarine areas with sand flats, a dredge spoil site, and several habitat restoration/management sites. A description of each site occurs in Appendix A. For the purposes of this report and for consistency with previous years' data, we define Bandon Beach as the area from China Creek to the mouth of New River, and Bandon SPMA as all the state land from the north end of the China Creek parking lot south to the south boundary of the State Natural Area, south of the mouth of New River. Information on wintering and nesting at areas outside these sites is available from Oregon Department of Parks and Recreation (OPRD) and U.S. Fish and Wildlife Service (USFWS).

Methods

Window Surveys

Annual breeding season window surveys were coordinated by USFWS in mid-May. Breeding season window surveys were conducted at both currently active and historic nesting areas (Elliott-Smith and Haig 2007). Historic nesting areas searched during the breeding window survey included: Clatsop Spit, Camp Rilea, Necanicum Spit, Nehalem Spit, Bayocean Spit, Sand Lake Spits and Sitka Sedge State Natural Area (SNA), Agate Beach, South Beach State Park, Yaquina Point, Bayshore Spit, South Alsea Bay, Whisky Run to Coquille River, and Elk River. There were no surveys at Netarts Spit, Nestucca Spit, Salmon River spit, Salishan Spit, Sixes River, Euchre Creek, Otter Point, Myers Creek to Pistol River and Crissy Field.

Monitoring

Breeding season fieldwork was conducted from 2 April to 17 September 2020. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found in Castelein *et al.* 2000a, 2000b, 2001, 2002, and Lauten *et al.* 2003 and are in Appendix B. Some beach surveys, particularly to document brood success and to confirm fledglings, were conducted from a 4x4 vehicle using a window mounted scope. Some surveys conducted on the Dunes National Recreation Area (DNRA) and Sutton Beach were completed with a single observer due to coronavirus restrictions. No other modifications to survey techniques were implemented in 2020.

We report three separate measures of adult population size: resident birds, the minimum number of birds present, and the breeding window survey. Resident plovers are defined here as any adult plover detected during the peak breeding period (between 15 April and 15 July). Plovers present during this period had the potential to attempt to nest. Not all plovers recorded during the summer are Oregon breeding plovers; some are only recorded early or late in the breeding season, suggesting that they are either migrant or wintering birds. These plovers are not included in the tally of resident plovers. The minimum number of Snowy Plovers present includes all adult birds observed within the project area during the field season (2 April through 17 September), and includes breeding birds, birds migrating through the area during that time, and wintering birds that may be present in the project area early or late in the season.

Most adults are banded and thus uniquely identifiable, as unbanded birds are difficult to accurately count because they move within and between sites. To avoid over counting unbanded birds, we recorded the number of unbanded plovers observed at each site within 10-day intervals from April through late July. We selected this period because it encompasses the period of maximum nesting effort and minimum movement between sites. For each 10-day interval we subtracted the number of adults that were subsequently banded during the breeding season and selected the 10-day interval with the highest remaining count. This number was added to our count of banded adults present, resulting in the minimum number of adults present. We also added this number of unbanded birds to our count of banded resident adults for a total estimate of resident birds. While this method may underestimate the actual number of unbanded plovers present, it provides a minimum number of unbanded plovers present (Castelein *et al.* 2001). We believe the number of resident plovers is the most accurate estimate of the total breeding population because it only includes birds present during the peak breeding period.

We tallied the number of individual banded and unbanded plovers by sex recorded at each nesting area within the project area throughout the 2020 breeding season. We combined data from the north and south side of estuaries

(Siltcoos, Overlook, and Tenmile) because individual plovers use both sides of these estuaries. In 2019 we split South Tahkenitch to North Umpqua from North Tahkenitch because of the increased use and numbers of plovers in this area. We did not adequately survey these sites in 2020 and therefore were unable to determine the number of plovers using these sites. Data from CBNS nesting sites were aggregated as plovers move freely between the beach and the nesting area. We separated data from Bandon SPMA, New River private lands, New River HRA, and Floras Lake because of different management at these sites, despite plovers frequently moving between these areas. The total number of individual plovers recorded at each site indicates the overall use of the site, including where plovers congregate during post-breeding and wintering. We also report the number of resident female and male plovers for each site, which indicates the relative level of nesting activity for each site. Because some birds used multiple sites within a season, a tally of the birds at each site does not reflect the total population size.

We calculated overall apparent nest success, the number of successful nests divided by the total number of nests observed, for all nests and for each individual site. The cause of nest failure was recorded when identifiable.

Prior to 2016 we attempted to monitor all nests and broods. As the plover population has grown within the project area, the increase in numbers of nests and broods have made it difficult to monitor all broods with existing staff and available funding. In 2016, in conjunction with Point Blue Conservation Science (Lynne Stenzel, pers. comm.), we developed a strategy to monitor a spatially and temporally distributed sample of broods (Lauten *et al.* 2016). Under this sampling design we attempted to band the first five nests to hatch at each site within fixed 10-day periods. This sampling scheme is detailed in Appendix C, and results in approximately 80% of all broods being monitored. Due to synchronous hatching, in some cases we banded more than five broods at each site within a given 10-day period to ensure at least 80% of broods were banded (see Lauten *et at.*, 2018 and 2019).

All known nests were monitored to determine fate and cause of failure. To track sampled broods, we banded chicks with a USGS aluminum band covered in color taped on the left leg and a colored plastic band covered in colored tape on the right leg. Most nesting adults that tended broods were already color banded. For some unbanded adults, we attempted to trap and mark the tending parent with a combination of a USGS aluminum band covered with colored taped and colored plastic bands. Trapping techniques are described in Lauten *et al.* 2005 and 2006 (Appendix B). We monitored broods and recorded brood activity or adults exhibiting broody behavior at each site approximately weekly (Page *et al.* 2009). Chicks were considered fledged when they were observed at least 28 days after hatching. Using the sample of banded chicks, we calculated brood success, the number of broods that successfully fledged at least one chick; fledging success, the number of chicks that fledged divided by the number of eggs that hatched from the sample; and the number of fledglings per sampled brood for each site. Using the estimate of the number of fledglings per sampled brood and the total number of known hatched nests, we calculated an estimated number of fledglings produced for each site. We used the number of estimated fledglings per site and the number of resident males to calculate the estimated number of fledglings per resident male for each site and the project area. See Appendix C for further details regarding calculation of the number of fledglings per male. We also calculated a breeding coefficient for all known nests (Colwell *et al.* 2017) that measures the level of productivity based on the number of fledglings produced per egg laid; high numbers of eggs laid indicate high effort at a particular site. If the numbers of fledglings produced is large compared to the number of eggs laid, the high breeding coefficient indicates that site was very productive. Alternatively, few fledglings relative to a high number of eggs laid results in a low breeding coefficient.

We compared plover productivity in 2020 to average post-predator management hatch rate, fledge rate and fledglings per male for each nesting area. We also compared the average pre-predator management hatch rate, fledge rate, and fledglings per male to the post-predator management averages to continue to evaluate the success of the current predator management actions. Means are reported +/- standard deviation.

We recorded banded adults and chicks that return to the project area in Oregon from previous seasons and calculated overwinter return rates for each group. Point Blue Conservation Science coordinates observations of banded birds throughout the range, and regularly reports observations of birds banded in Oregon that are sighted elsewhere. Overwinter return rates are the number of banded plovers (adults or first year birds) that returned to the project area in Oregon, divided by the number of banded adults or chicks observed the previous year. Banded plovers detected along the Oregon coast outside of the project area were not included in return rate calculations to maintain consistency with previous years' calculations.

Nest Failure

We monitored all nests we found until they were determined hatched or failed. Failed nests were carefully inspected for signs of cause of failure. Where evidence was present, we categorized failures as either depredations or non-depredated causes. If a failed nest was determined to be caused by predation, we attempted to determine the predator based on the evidence present. Failures caused by predators were generally categorized as corvid, harrier, gull, coyote, fox, skunk, unknown avian, mammalian, or unknown depredation. Failures not caused by predators were categorized as wind/weather, overwashed, human caused, abandoned, one egg nests (never completed clutch), infertile, or unknown cause.

We used Reconyx PC900 cameras (Reconyx Inc., Holmen, WI) and Bushnell Aggressor Trophy Cam HD (Bushnell Outdoor Products, Overland Park, KS) to observe predator activity at plover nests and identify causes of nest failure. Cameras were placed two to four meters from the nest, depending on local conditions (terrain, vegetation height). In general, we placed cameras as far from the nest as possible while keeping the nest visible in the camera's field of view. Cameras were camouflaged with a sand or brown-colored outer case or typical green hunter camouflage painting, and were installed as low to the ground as possible to avoid providing a perch for predators. Cameras were used at Siltcoos, Overlook, Tahkenitch, Tenmile and Coos Bay North Spit in 2020. We placed cameras at nests that were well beyond the view of the public to reduce the potential for camera theft, and to avoid creating an attractive nuisance.

Cameras employed a "no glow" infrared illumination system which eliminates glow or flash from the camera that can alert predators to its presence. Images taken during the day are in color; those at night are monochrome. Depending on the suite of suspected predators at a site, some cameras were set to operate 24 hours per day, taking one image every 60 seconds, and a burst of three to ten images every second when the motion sensor was triggered. Other cameras were set up to take one image per minute from just prior to dawn to just after dusk, and set to only motion sensor trigger at night. Bushnell cameras took only motion sensor triggered pictures. Predator activity at the nest triggered the motion sensor, but plovers were generally too small to trigger the cameras.

We placed cameras at active nests that were already being incubated (Snowy Plovers generally do not incubate until the clutch is complete). After cameras were installed, we ensured that plovers returned to the nest. Batteries and data cards were replaced approximately weekly. Cameras were typically left in place until the fate of the nest was determined. Upon visiting failed nests, we recorded the cause of failure based on evidence at the site, before looking at camera data. We compare cause of failure based on evidence at the nest site with the cause of failure as recorded by the cameras.

Lethal predator management was conducted at all active nesting areas by USDA Wildlife Services (Metzler et *al.* 2020). ORBIC monitors reported causes of nest failure and daily predator observations to Wildlife Services (WS) staff.

Results and Discussion

Window Surveys and Monitoring

During the May breeding window surveys, 403 plovers were observed in the project area, an increase from 2019 and the highest window survey count since monitoring began in 1990. Plovers were also detected during the window survey at sites outside the project area including the Clatsop Spit, Nehalem Spit, Sitka Sedge State Natural Area, South Beach State Park, Yaquina Point, Bayshore Spit, and South Alsea Bay (USFWS pers. comm.). The annual breeding window survey count for the project area and total number of plovers present are in Table 1.

There was a fairly substantial increase in the minimum number of plovers present in the project area in 2020 compared to 2019, resulting in the highest total since monitoring began in 1990 (Table 1). Of the minimum number of plovers present during the 2020 breeding season, 466 (83%) were banded. The number of unbanded plovers estimated by the 10-day interval method was 97. During the breeding season we observed 230 banded males, 230 banded females, six banded adults with undetermined sex, 59 unbanded males, and 38 unbanded females.

Of the minimum number of plovers present in 2020, 355 plovers (63%) were documented nesting, lower than the mean percentage for 1993-2019 (77%). Due to sampling and the large number of nests, the decrease in the number of documented nesting plovers is not a reflection of fewer plovers attempting to nest but reflects a decrease in monitors positively identifying nest ownership. A minimum of 149 banded males and 122 banded females nested, and a minimum of 84 unbanded adults (48 unbanded males and 36 unbanded females) nested. In 2020, 58% of banded adults were confirmed nesting. There were a total of 224 banded resident males and 223 banded resident females present during the 2020 breeding season (15 April – 15 July), and five of six plovers of undetermined sex were also residents. Using the minimum number of unbanded individuals estimated by the 10-day interval method, the minimum estimated Oregon resident plover population was 549. We believe this is the best estimate of the breeding population within the project area.

The overall plover population within the project area was more than double the recovery goal set for the state (U.S. Fish and Wildlife Service 2007) and does not include birds that were present in Oregon outside the project area.

Overwinter Return Rate

Adult survival continues to be the most important parameter of population growth (Sandercock 2003, USFWS 2007, Dinsmore *et al.* 2010, Lauten *et al.* 2010, 2011, 2012, and 2013, Gaines 2019). Of the 450 banded adult plovers recorded in 2019, a minimum of 318 were recorded in 2020 in the project area. The overwinter return rate based on the minimum number of returning banded adult plovers was 71%, higher than the 1994-2020 mean of 67% but slightly lower than 2019 (73%). The adult male return rate was 71%, similar to 2019 (72%, Lauten *et al*., 2019), and the adult female return rate was 71%, lower than 2019 (75%, Lauten *et al.* 2019) but well above the average adult return rate. Consistent above average adult return rates contributes to the increasing plover population.

Of 274 banded fledglings produced in 2019 (Table 2), we observed 124 in the project area in 2020. The return rate was below the 2010-2020 average (Table 2) but higher than in 2019. Survival of hatch year 2019 (HY19) fledglings was higher than reported return rates because first year plovers that occupied other Oregon (ORBIC, OPRD, USFWS unpubl. data), Washington (USFWS, unpubl. data), and northern California (Elizabeth Fuecht, pers. comm.), beaches in 2020, but did not return to our project area, were not included in the calculated return rate. These additional HY19 plovers are important contributors to expanding plover populations at historic and new nesting locations in Oregon. While hatch year return rates were below average, the rate was higher than the previous year and in combination with above average adult survival rates resulted in a higher plover population within the project area in 2020.

Of the returning HY19 birds, 63 (51%) were males, 56 (45%) were females, and five (4%) were questionable sex. Sixty-eight of the HY19 returning plovers were confirmed breeding (55%), slightly lower than 2019 (60%).

During the 2020 season, we captured and rebanded three male and four female adult plovers with brood band combinations that needed to be updated to unique adult combinations. We banded one unbanded adult male plover and 477 chicks.

Distribution

To show relative plover activity within our study area, we recorded total banded and unbanded adults and the number of resident plovers at each site (Table 3). The areas with the lowest plover activity are at the north and south ends of the project area. We did not include any estimates of the number of plovers occupying the South Tahkenitch/North Umpqua area due to limited surveys and monitoring in this area in 2020. We recorded fewer total plovers and resident plovers at Sutton Beach in 2020 compared to 2019 (n = 47 and 28 respectively, Lauten *et al*., 2019). Plover activity was concentrated in the Sutton Creek area north to the Holman Vista trail and on the Berry Creek spit. The number of resident plovers at Siltcoos in 2020 was slightly less than 2019 (n = 67, Lauten *et al*., 2019), and the overall numbers of plovers recorded at this site was lower than in 2019 (n = 90, Lauten *et al*., 2019). Total plover numbers at Siltcoos are driven by detection of pre- and post-breeding plovers utilizing this site, so a decline in the number does not necessarily mean a real decline in resident plover numbers at this site. Plover activity at Overlook in 2020 was nearly identical to 2019 (Lauten *et al*., 2019). There was a slight increase in plover activity at Tahkenitch, with both an increase in total plovers detected and resident number of plovers compared to 2019 (n = 89 and 75, respectively, Lauten *et al*., 2019). Limited surveys detected some plovers and nesting and brooding activity at South Tahkenitch and one brood from an unknown nest at North Umpqua, but we are uncertain how many plovers were utilizing this section of beach. There were a similar number of resident plovers detected at Tenmile in 2020 compared to 2019 (n = 84, Lauten *et al*., 2019), but a slight increase in the total number of plovers detected at this site (n = 86 in 2019). Detection of plovers on the Dunes National Recreation Area (NRA) suggests that plovers are now occupying all available habitat from Tenmile north to Siltcoos. Due to the novel coronavirus beach restrictions in early spring 2020, beaches normally occupied by recreational vehicle use were closed and therefore potentially available for plover use. We were unable to run any additional surveys on these beaches, but we had reports of plovers using the beach south of the south jetty at Siuslaw River, and there was plover activity west of the parking lots at South Umpqua/North Tenmile. Typical recreational activities along these beaches prior to coronavirus likely limits plover use of these sections of beach. CBNS had an increase in plover activity in 2020 compared to 2019 (n = 139 and 131 in 2019, Lauten *et al.* 2019). The total number of plovers detected at CBNS was 151, the first time since monitoring began in 1990 any site has had 150 or more plovers recorded. The Bandon SPMA also had an increase in plover activity compared to 2019 (n = 109 and 96 in 2019, Lauten *et al*., 2019). Similar numbers of plovers were detected on New River private land in 2020 compared to 2019 (Lauten *et al*., 2019), but nesting activity is declining in this area due to habitat degradation. The New River HRA also had similar numbers of plovers in 2020 compared to 2019 (Lauten *et al*., 2019), however there was more activity on the north end of the HRA in 2020 compared to the past several years and plovers formerly nesting on private land nested on the HRA in 2020 where there is much more adequate habitat. Plovers also nested in the New Lake breach area as well as continuing to utilized the Clay Island Breach area. After two very successful breeding seasons at Floras Lake in 2018 and 2019 (Lauten *et al*, 2018 and 2019), there was a slight decrease in plover activity in 2020. Plovers utilizing this area moved north to the New River HRA after repeated failed nest attempts at Floras Lake. The highest concentration of nesting activity, based on the presence of resident plovers, continues to be between Siltcoos and Bandon SPMA. Because plovers moved between sites and attempted to nest at more than one location, the total number of plovers in Table 3 is higher than the actual population estimate.

We documented plovers occupying available habitat adjacent to the traditional nesting areas in past reports (Lauten *et al.* 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019). In 2020, plovers continued to nest at north coast sites outside the project area. For the third consecutive year, plovers were found in every coastal county and were documented nesting at Clatsop Spit in Clatsop Co., Nehalem Bay State Park and Sitka Sedge State

Natural Area and Sand Lake in Tillamook Co., South Beach State Park, Yaquina Bay, Driftwood State Park, Bayshore Spit, and Patterson State Park in Lincoln Co. (OPRD, unpublished data, USFWS, pers. comm.). Within the project area, plovers have now nested north of Berry Creek at Sutton Beach (Figure 2) for four consecutive years (Lauten *et al.* 2017, 2018 and 2019). Plovers also nested on the Sutton Creek spit in 2019 and 2020 (Figure 2), and a nest was found south of Sutton Creek by a local resident. We found nesting activity at South Tahkenitch (Figure 7); it is likely more nesting may be occurring south to North Umpqua, but we were unable to monitor this area. Plovers continue to nest at South Umpqua from the vicinity of the second parking lot south to the North Tenmile spit (Figure 8). Beach closures early in the season due to the novel coronavirus reduced recreational activity which likely encouraged nesting attempts in the area. At CBNS plovers continue to nest north of the FAA towers on South Beach (Figure 10). At Bandon Beach there was a significant decline in recreational activity due to beach closures from the novel coronavirus. Plovers nested west of the China Creek parking lot and north of China Creek, likely due to good habitat and low recreational activity in the area (Figure 12). Habitat on private lands at New River is degrading due to extensive beachgrass and dune development. Plovers using the area have adequate habitat north of state land and south at the New River HRA, and adults that typically nest in the area moved north or south to the HRA. The north end of the New River HRA had eight nesting attempts south to New Lake breach in 2020 (Figure 14). This is an increase in use of this area over the past several seasons. Plovers continue to occupy the Clay Island breach area (Figure 14). There were eight nest attempts at Floras Lake; three along the foredune south of the Cooperative Management Area (CMA) and five between the CMA and Hansen breach (Figure 15). Plovers should be expected to continue to occupy available habitat along the entire coast of Oregon and may be found at unexpected locations with sufficient habitat along the coast.

Nest Activity

Table 4 shows the number of nests located during the 2020 nesting season (Figures 2-15). Overall nest success in 2020 was below the overall average (Table 5 and 6) but near the average of the last 10 years ($\bar{x}$ = 43%). We found 76 more nests than in 2019. The largest increase in nest numbers occurred at North Tenmile where we found 51 more nests in 2020 compared to 2019. There were increases in nest numbers at Overlook, Tahkenitch, South Beach and New River spit. Some of the increase in nest numbers was due to an increase in plover numbers, however a large portion can be attributed to high failure rates particularly at North Tenmile (Table 7) which resulted in repeated nest attempts.

The first nests were initiated about 24 March (Figure 16). Nest initiation increased through the end of May. Peak nesting occurred during the 21 May to 30 May interval, two time periods earlier than 2019 (Lauten *et al.* 2019). The last nest initiation occurred on 14 July.

Nest Failure

Predators are the main cause of nest failure and were responsible for 62% of nest failures (Table 7), slightly less than 2019 (71%, Lauten *et al.* 2019). Corvids depredations were higher in 2020 compared to 2019 (n = 38, Lauten *et al*., 2019), largely due to a large increase in common raven (*Corvus corax*) depredations at Tenmile (n = 38 in 2020 compared to no documented corvid depredations in 2019, Lauten *et al*., 2019). Corvid depredations at Tenmile may have been even higher as evidence at 28 additional failed nests was insufficient to determine exact cause or what type of avian predator depredated the nest. Corvids were the most common nest predator and were responsible for 19% of the known depredations. Ravens were responsible for 57 of the 68 corvid depredations (84%). Northern Harrier (*Circus hudsonius*) was identified as the predator at nine nests, all at CBNS. Nineteen nests failed due to unknown avian predators; evidence at these nests indicated an avian predator but tracks were inconclusive to determine whether they were corvid or harrier depredations. One nest at Bandon SPMA was depredated by a gull (*Larus* sp.); this failure is included in the unknown avian predation category for convenience. The total number of mammalian depredations in 2020 was similar to 2019 (n = 32, Lauten *et al*., 2019). In 2019 there was a large increase in coyote (*Canis latrans*) depredations on the Dunes NRA with 30 nests failing due to coyotes. In 2020 coyotes depredated fewer nests, however they were responsible for 58% of mammalian caused nest failures and the total number of coyote-caused nest failures was higher than in years previous to 2019 (Lauten *et al*., 2017 and 2018). Coyotes have become problematic at Overlook and Tahkenitch in particular and it appears that the local coyotes are targeting nesting plovers at these sites. Skunks (*Mephitis* sp.) caused five depredations, all in the Bandon SPMA to Floras Lake area. Red fox (*Vulpes vulpes*) have been a persistent presence along the Bandon SPMA, New River HRA and Floras Lake area. Red fox were present near Clay Island breach at the New River HRA early in the season, and were removed by WS (Metzler *et al*., 2020). For the second consecutive year we did not record any red fox depredations. There was no evidence of red fox utilizing the Bandon SPMA in 2020. Red fox numbers appear to be diminishing along the Bandon and New River area, possibly due to persistent efforts to remove them. Interestingly, for the first time since monitoring began, tracks of coyote were noted in the New River HRA and Floras Lake area; they have been traditionally absent from this area largely due to persistent efforts to remove them on adjacent sheep and cattle ranches in the New River bottomlands.

Corvids have traditionally been the most commonly identified nest predator on the study area (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006a, 2006b, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2018). In 2020 common raven depredations increased from 2019 (Lauten *et al*., 2019) at Siltcoos, Overlook, Tahkenitch and Tenmile (Table 7). Ravens were particularly problematic at Tenmile; WS staff believed a couple of pairs of breeding ravens were persistent at Tenmile and unfortunately were never successfully removed. Due to consistent raven activity at Tenmile, plovers repeatedly renested, resulting in high numbers of nest attempts at this site (Table 4) and low nest success (Table 5). Removal of corvids at all sites remains high priority, as the data shows that failure to remove problematic corvids results in poor nest success and productivity.

The increase in coyote depredations over the last two years on the Dunes NRA, particularly Overlook and Tahkenitch, suggests that the resident coyotes are targeting an available food source at these sites. Coyotes appear to have responded to increased density of nesting plovers. Despite the presence of coyotes, nest success and productivity at these sites was excellent in 2020 (Table 5 and 8), however targeted removal of coyotes would likely reduce the predation pressure on incubating adults.

Northern Harriers are a well-documented nest predator of plovers in Oregon (Lauten *et al*., 2013, 2014, 2015, 2016, 2017, 2018, and 2019). In 2020 we only documented harrier depredations at CBNS (Table 7). In 2019 harriers were present at CBNS all season and nested adjacent to the HRAs but no known nests failed due to harriers (Lauten *et al*., 2019). In 2020 harriers were again present at CBNS all season and nine nests were documented as harrier caused nest failures. No harrier nest was located at CBNS in 2020, however recently fledged juveniles were noted on and adjacent to the nesting area indicating successful nesting. Data from CBNS continues to indicate that presence of harriers can have a negative effect on nest success, brood success, fledgling success, and fledglings per brood (Figures –17-20), and removal of harriers has a positive effect on these reproductive parameters. In 2020 harriers were documented hunting over the nesting area while plover broods were active. Productivity data from CBNS in 2020 (Table 8) shows that broods on the HRAs had much lower brood success, fledging success, fledglings per brood, and breeding coefficients than broods from South Beach. Broods from South Spoil were also more successful than the HRA, and while the breeding coefficient was not poor, it also did not indicate high productivity. The data continues to indicate that harriers are a problematic predator at CBNS and removal of harriers results in positive effects on plover productivity.

The main causes of nest failure at Bandon SPMA in 2020 were unknown depredations, unknown cause, and abandonment (Table 7). Ravens were mostly absent from Bandon SPMA in 2020, as were red fox (ORBIC and WS observations). The most common evidence of predators at Bandon SPMA, particularly at New River spit, was great horned owl (*Bubo virginianus)* tracks. Nest success at Bandon SPMA in 2020 was only 34% (Table 5), an increase from 2019 (28%, Lauten *et al*., 2019), but below the average for this site ($\bar{x} = 41\%$). Nest success in 2020 at Bandon SPMA would have been higher except for a dozen nests failing at the end of the season in a short period of time (10 days). The cause of these nest failures were unknown, mostly due to the open habitat of the New River spit where windy conditions easily removes any evidence of causes of nest failure. We do not necessarily believe great horned owls were depredating nests, however, we do believe that evidence suggests the owls may be impacting productivity and possibly adult survival. It is very difficult to document great horned owl impacts, as they are nocturnal, and impacts on brood success are difficult to document because we rarely able to determine causes of chick mortality. Productivity data from Bandon SPMA in 2020 was very poor despite a fairly high number of broods (Table 8), with very low brood success, fledgling success, fledglings per brood, and breeding coefficient. In addition, this is the only site with double digit numbers of abandoned nests (Table 7). Abandoned nests could be due to adult plovers being depredated on or around nests during the night when owls are actively hunting. Loss of adults is particularly troubling because adult survival contributes most to population growth. Due to the lack of evidence of any other predators present at Bandon SPMA, and the evidence that great horned owls are consistently present and hunting on site (based on tracks in the sand that indicate pouncing behavior), we believe the owls may be having a substantial negative effect on plover productivity at this site. Bandon SPMA is a significant site in terms of number of individual plovers occupying the site (one of three sites with over 100 plovers detected, Table 3) and the number of nest attempts (Table 4 and 5), yet consistently has relatively poor productivity output (Table 8, Lauten *et al*., 2018 and 2019). Improvement of productivity at Bandon SPMA, particularly the New River spit, and reduction of abandonments, may occur if these owls are removed from this site.

The number of nests that failed to unknown depredations was lower in 2020 compared to 2019 (Lauten *et al*., 2019), however unknown depredations was still the highest cause of nest failure. As in 2019 (Lauten *et al*., 2019), many of these unknown depredations occurred at CBNS and Bandon SPMA. Windy conditions at Bandon SPMA result in a lack of evidence at many failed nests. At CBNS, both wind and habitat (thick shell hash) contribute to the lack of evidence at failed nests. There were also relatively high numbers of unknown depredations at Tenmile in 2020 (Table 7). At Tenmile, most of these failed nests likely were due to corvid activity, but monitors often could not be certain due to wind or rainy conditions. At CBNS, harriers and raven activity early in the season were likely responsible for most of the failed nests, as most occurred on the HRAs where harriers and ravens were noted hunting. At Bandon SPMA, we detected very few ravens all season, but crows were present throughout the breeding season and we documented one gull depredation. We are uncertain of what was the main cause of depredated nests at this site.

There was a fairly large increase in failures due to unknown cause in 2020 (Table 7) compared to 2019 (n = 32, Lauten *et al*., 2019). The majority of these unknown causes occurred at Tenmile and Bandon SPMA. At Tenmile there was a substantial number of nest attempts near the parking lots at South Umpqua (Figure 8). This area has high amounts of recreational activity, which was exacerbated in 2020 by being one of the few locations early in the season where recreationists could access the beaches due to novel coronavirus restrictions. Monitors documented repeated violations of recreation restrictions in this vicinity, and some nests that failed lacked evidence of the causes of failure. Due to the high human and dog activity, monitors were uncertain if some of these nests may have been negatively impacted by the recreational activity and therefore could not assign a cause of nest failure. At Bandon SPMA, particularly on the New River spit, where the open sandy spit is very susceptible to windy conditions, we were unable to ascertain whether predators or weather conditions were causing nest failures, resulting in high numbers of unknown causes of nest failures. At CBNS, one nest listed as unknown cause was actually crushed by a vehicle that violated the closed area. We placed it in unknown causes due to lack of space in the table.

We placed Reconyx and Bushnel cameras at 24 nests in 2020 to document nest predators (Lauten *et al.* 2015). At one nest the camera failed to record the outcome of the nest due camera failure. At a second nest the outcome could not be determined from the pictures, although there was no indication of any depredation event (one egg remained unhatched at the nest and a second egg may or may not have hatched, but it could not be determined). Eighteen nests with cameras hatched. Four nests with cameras failed; two were abandoned. At two of these failed nests, monitors' assessment of the cause of failure matched what was shown on the camera. Data from the cameras at the two abandoned nests indicated they were already abandoned before the cameras were installed. Use of cameras did not negatively affect nest success. Apparent success at nests with cameras was 75%, much higher than the overall nest success (Table 5). We did not determine any new predator information from cameras in 2020. We intend to continue to use cameras where they are feasible, as time is available, and where better documentation of the cause of nest failure is needed, as long as there is no evidence predators are targeting cameras.

Productivity

We sampled 206 broods from the 258 nests (80%) that were known to have hatched and an additional three broods from undiscovered nests, and these broods produced 231 fledglings (Table 8). The overall fledging success based on the sample broods (Table 8) was lower than the post-predator management average (Table 10). The overall brood success rate of sampled broods (Table 8) was just below the post-predator 2004 – 2020 average ($\bar{x} =$ 74% +/- 7). Using the data from sampled broods, we estimated the total number of fledglings for each site by multiplying the number of fledglings per sampled brood by the total number of broods hatched at each site. Table 9 shows the estimated total number of fledglings produced in 2020. We calculated the number of fledglings per male for each site using the number of resident males from Table 3 (Table 11). The mean number of fledglings per resident male for the project area was well below recovery goals and below the mean post-predator management average (Table 10). We report these mean fledglings per male by site for comparison with previous years, but because the number of resident males reported by site double counts birds that occur at multiple sites and may include males that were present but did not attempt to nest, the resulting overall mean number of chicks fledged per resident male is biased low. In 2020 the estimated number of fledglings was 299 (Table 9), and the estimated number of resident males was 283. The number of fledglings per resident male based on these numbers was 1.06. This number is higher than our reported mean number of fledglings per resident male by site (Table 11) and similar to the number of fledglings per sampled brood (Table 8). We believe the most accurate estimate of productivity is the number of fledglings produced per sample brood, 1.11 (Table 8).

We used the breeding coefficient, the number of fledglings produced per number of eggs laid, as an alternate assessment of the overall productivity of each nesting site (Table 8, Lauten *et al.* 2017, Colwell *et al.* 2017). The breeding coefficient is a measure of productivity based on effort (eggs laid). Any site with a breeding coefficient of 0.20 and above was relatively successful for the amount of effort, while sites with a breeding coefficient below 0.15 are generally not very productive for the amount of effort.

Sutton

The number of nests at Sutton Beach has remained relatively stable for the last five years (Table 4). Nest success in 2020 (Table 5) was average for this site ($\bar{x} = 19\%$); nest success at Sutton Beach is historically low due to windy conditions and persistent raven activity. Three broods were used in the sample (Table 8) and two successfully fledged two chicks each. Due to the discovery of two broods from unknown nests, the number of total fledglings for this site was the same as the previous two years (Table 9). The hatch rate was slightly higher than in 2019 (Lauten *et al*., 2019) and above the post predator management average (Figure 21). Fledging success was the highest ever recorded for this site and well above the post predator management average (Figure 22). The number of fledglings per resident male was much higher than 2019 (Lauten *et al.* 2019) and well above the post predator management average (Figure 23). While the reproductive parameters at Sutton Beach continue to be the lowest within the project area (Figures 21-23), this site produced eight fledglings for three consecutive years and the number of fledglings per sample brood (Table 8) was well above recovery goals, indicating improved productivity. However, the breeding coefficient for Sutton Beach continues to be low (Table 8) indicating poor reproductive output for the effort.

Siltcoos

There were similar numbers of nests at Siltcoos in 2020 compared to 2019 (Table 4). Nest success on the north side was low (Table 5) and well below the average for this site ($\bar{x} = 37\%$). Nest success on the south side (Table 5) was slightly higher than in 2019 (Lauten *et. al*, 2019) but below average for this site ($\bar{x} = 46\%$).

The hatch rate at Siltcoos in 2020 was higher than in 2019 (Lauten *et al*., 2019) but below the post-predator management average (Figure 21). There were similar numbers of broods at Siltcoos in 2020 compared to 2019 (Lauten *et al.* 2019), and they produced 13 more fledglings in 2020 compared to 2019 (Table 9). Fledging success was very good and well above the post-predator management average (Figure 22). The number of fledglings per sampled brood was very good for both sides of the river (Table 8). However due to the relatively high number of males that were detected during the breeding season, the number of fledglings per resident male was below the post-predator management average for this site (Figure 23, Table 11) but improved compared to 2019 (Lauten *et al*., 2019). While all the males detected during the breeding season are considered resident, it is likely that not all of them attempted to nest, but their presence results in a low fledgling per resident male calculation. The number of fledglings per sampled brood (Table 8) is likely more reflective of plover productivity at this site. The breeding coefficient at South Siltcoos indicates very good productivity for this site (Table 8). The breeding coefficient at North Siltcoos improved from 2019 (Table 8, Lauten *et al*., 2019) but productivity on this side of the river was not as good as the south side.

Overlook

There was an increase in the number of nests at Overlook in 2020 compared to 2019 (Table 4), partly due to an increase in the number of failed nests resulting in renesting attempts. However nest success at both North and South Overlook was very good and well above average (Table 5, $\bar{x} = 45\%$ and, $\bar{x} = 42\%$, respectively).

The hatch rate at Overlook in 2020 was above the post-predator management average (Figure 21). While nest success was slightly lower in 2020, there were 10 more broods in 2020 compared to 2019 (Lauten *et al*., 2019) but they produced 10 fewer fledglings in 2020 compared to 2019 (Table 9). The fewer number of fledglings produced resulted in a lower fledging success rate compared to 2019 (Lauten *et al*,. 2019). Fledging success was just below the post predator management average for this site (Figure 22), but still considered within recovery goals. The number of fledglings per resident male was good and at the post-predator management average (Figure 23, Table 11). Both sites had high breeding coefficients (Table 8), indicating very good productivity.

Tahkenitch

The increase in the number of nests at North Tahkenitch in 2020 (Table 4) was caused by an increase in nest attempts and not an increase in failures and renest attempts, as the number of failures at North Tahkenitch (Table 7) was nearly the same as 2019 (Lauten *et al*., 2019). In limited surveying at South Tahkenitch, we documented eight nest attempts in 2020 (Table 4), but five had unknown outcomes due to our limited ability to monitor these nests (Table 5). More nest attempts occurred from South Tahkenitch to North Umpqua jetty, as we documented several broods at South Tahkenitch from unknown nests and one brood from an undiscovered nest on the North Umpqua section of beach for the second consecutive year (Lauten *et al*., 2019). We were unable to fully monitor these sections of beach. Nest success was very high at North Tahkenitch in 2020 (Table 5) and well above average for this site ($\bar{x} = 42\%$). We were only able to confirm the outcome of three nests at South Tahkenitch in

2020 (Table 5); due to unknown outcomes and thus a small sample size, there is low confidence in the success of nests at this site. The measured nest success in 2020 was well below average for this site ($\bar{x}$ = 51% for South Tahkenitch).

The hatch rate at Tahkenitch in 2020 was well above the post-predator management average (Figure 21), and the fledging success rate was just below post predator management average (Figure 22). The number of fledglings per resident male was below the post predator management average (Figure 23), well below 2019 (Lauten *et al*., 2019), but near recovery goals. Despite the lower productivity parameters, Tahkenitch still produced an estimated 43 fledglings, slightly lower than 2019 (Table 9). Due to limited data from South Tahkenitch, we only calculated a breeding coefficient for North Tahkenitch and it indicated that this site had a productive year (Table 8).

As noted in Lauten *et al*. (2019), the population of plovers utilizing Siltcoos to South Tahkenitch is dynamic, with plovers moving between sites throughout the breeding season, frequently responding to predation pressure and nest failure. In 2019, this area produced 145 fledglings; in 2020 this same area produced an estimated 142 fledglings, again suggesting that the overall productivity of this area was excellent (Table 9). Management goals should support maintaining good overall productivity at these sites with fluctuations in reproductive parameters expected at each site from year to year.

Tenmile

Due to high depredation rates on nests at North Tenmile, and thus many renesting attempts, there were twice as many nests found at this site in 2020 compared to 2019 (Table 4). There was a slight increase in the number of nests at South Tenmile in 2020. Due to the high rates of nest failure, nest success at Tenmile in 2020 was very poor (Table 5), the lowest of any site, and well below average for both sides of the creek ($\bar{x}$ = 43% for North Tenmile, $\bar{x}$ = 49% for South Tenmile). Due to the poor nest success, there were substantially fewer broods and fledglings at Tenmile in 2020 compared to 2019 (Table 9, Lauten *et al*., 2019).

The hatch rate at Tenmile was well below the post-predator management average (Figure 21), however broods that did hatch had a relatively good fledging success rate (Figure 22). While the number of fledglings per resident male was well below average (Table 11, Figure 23), the number of fledglings per sampled brood was at or higher than recovery goals for both sides of the creek (Table 8). This indicates that nests that did hatch were reasonably successful at raising chicks. The low number of fledglings per resident male is due to the high number of males that are detected at Tenmile during the breeding season and thus considered resident. Due to the low number of broods, the total number of fledglings for Tenmile was lower than 2019 (Table 9), however the data clearly indicate that nest success was the contributing factor in low fledgling numbers at this site and not fledging success. Due to the high rate of nest failure and renesting attempts, the breeding coefficient at Tenmile in 2020 was very poor indicating high levels of effort (eggs laid) but very poor productivity for the effort (Table 8).

As at Siltcoos to Tahkenitch, plover use of Tenmile is very dynamic, with birds utilizing both spits of the creek but also nesting north to the South Umpqua parking lots. Survey data indicates that plovers are also moving between Tenmile and North Umpqua north to Tahkenitch, Overlook and Siltcoos, and also south to CBNS. The Dunes NRA produced 186 fledglings in 2019; in 2020 this same area produced an estimated 171 fledglings (Table 9). Year to year variations in reproductive parameters at all these sites is to be expected; management goals should be focused on enhancing productivity as best possible to maintain and sustain the regional plover population.

Coos Bay North Spit

The total number of nests at CBNS is 2020 was nearly identical to 2019 (Table 4), however there were higher numbers of nests on South Beach and lower numbers of nests on the HRAs in 2020 compared to 2019. Nest success in 2020 was similar to 2019 (Table 5, Lauten *et al*., 2019). South Beach had high nest success and above average for the second consecutive year (Table 5, $\bar{x}$= 60%). Nest success on South Spoil and the HRAs was similar to 2019 (Lauten *et al*., 2019) and below average for both of these sites ($\bar{x}$ = 60% and $\bar{x}$ = 49%, respectively). The depressed nest success on the nesting area was caused by nest depredations from ravens early in the season (until they were removed) and harriers throughout the season (Table 7). Similar numbers of nests hatched in 2020 compared to 2019 (Table 5, Lauten *et al.*, 2019), and these broods produced a slightly higher estimated number of fledglings (Table 9).

The hatch rate at CBNS in 2020 was slightly above the post-predator management average (Figure 21). Fledging success was below average for this site (Figure 22), but still at recovery goals. The number of fledglings per resident male was well below average for CBNS (Figure 23). South Beach continues to be very productive as reflected by good fledging success, fledglings per sampled brood, and the breeding coefficient (Table 8), however brood success was low for this site, as broods are typically very successful on South Beach. We are uncertain as to why broods were not as successful as usual on South Beach, as we had little evidence of predator activity on the beach in 2020. We did however note that recreational vehicle traffic on South Beach was relatively high this summer, probably related to novel coronavirus restrictions. CBNS was one of the few places that was open to recreational activities in spring of 2020. We also note that there is significant habitat degradation on the beach due to beachgrass and western movement of the foredune. This loss of habitat is resulting in a narrowing of available nesting and brooding areas on the beach, and results in a lack of buffer between recreational activity on the beach and nesting and brooding plovers. In addition, limited ropes were installed on South Beach in 2020. We repeatedly noted vehicle violations, particularly overnight, within the closed area on South Beach, with many vehicles traveling against or east of carsonite signs due to nightly high tides. In addition, up to seven nests were active north of the FAA towers where vehicle use was not restricted. The beach west of these nests was covered in vehicle tracks at the time these nests hatched, and only two of these nests produced fledglings. Repeated vehicle use and violations of the closed area may be negatively impacting plover broods.

While reproductive parameters on South Spoil were generally very good (Table 8), nest success was poor for this site and there were only seven total broods for this area. Nest success and reproductive parameters on the HRAs was poor in 2020 (Table 5 and 8), with low brood success rate, fledging success rate, fledglings per sampled brood, and breeding coefficient. Harriers were the only diurnal predator present on site throughout 2020, and as in 2019 (Lauten *et al*., 2019), we suspect that harriers are having a negative effect on brood success particularly on the nesting area. Data from CBNS indicate that nests and broods are negatively impacted when harriers are present (Figures 17-20). Despite the depressed reproductive parameters at CBNS in 2020, more fledglings were produced in 2020 than in 2019 (Table 9). Removal of harriers and prevention of nesting by harriers near the plover nesting area would likely result in higher reproductive output.

Bandon SPMA

There were 10 more nests at Bandon SPMA in 2020 compared to 2019 (Table 4), but approximately the same number of nest failures (Table 7, Lauten *et al*., 2019). There were more birds detected at Bandon SPMA in 2020 compared to 2019 (Table 3, Lauten *et al*., 2019), suggesting that the increase in nest attempts were partly due to an increase in population size. Nest success improved in 2020 compared to 2019 (Table 5, Lauten *et al*., 2019), but was below the average for this site ($\bar{x}$ = 41%). Nest success would likely have been higher, but approximately a dozen nests on the New River spit failed at the end of the season after good nest success prior to July. We are uncertain as to what predator was responsible due to the lack of evidence at any of the nests. Ravens and fox were absent from the spit at the time, and we had no evidence that harriers were consistently present. Nest success at Bandon Beach was 33%, higher than 2019 (24%, Lauten *et al*., 2019), and nest success on the New River spit was 35%, slightly higher than 2019 (31%, Lauten *et al*., 2019). Both Bandon Beach and the New River spit produced fewer fledglings in 2020 compared to 2019 (Table 9).

The hatch rate at Bandon SPMA was just below the post-predator management average (Figure 21) and the fledging success rate was well below average (Figure 22). Fledging success at Bandon Beach was 40%, but the fledging success rate on the New River spit was a low 23%. The number of fledglings per resident male was well below average (Figure 23). Due to the high numbers of eggs laid at the SPMA and the low number of fledglings, the breeding coefficient at Bandon SPMA was poor (Table 8). Despite 10 more broods at Bandon SPMA in 2020 compared to 2019, reproductive parameters were all lower compared to the previous year (Lauten *et al*., 2019). ORBICs observations of predator activity noted an absence of ravens and fox all summer; the most common predator tracks noted were great horned owl, almost entirely on the New River spit. The depressed brood and fledging success rates at New River spit, even in comparison to Bandon Beach, suggests that despite a reasonable number of nests hatching, broods were not surviving. While we noted gulls present throughout the summer, and documented one gull depredation on the spit (Table 7), there was little evidence that gulls were hunting broods, and they spent most of their time roosting on the beach and spit area. In addition, the SPMA, especially the New River spit, had the highest levels of abandoned nests of any site (Table 7). Abandoned nests may be caused by incubating adults being depredated, particularly at night on the nest or near the nest. We believe that the data suggest that great horned owls may be negatively impacting productivity especially on the New River spit. Removal of the owls would potentially provide an opportunity to evaluate the impact that they are having on nesting plovers on this site.

New River

Only one nest was found south of the Bandon SPMA boundary area on New River private land in 2020 (Figure 13, Table 4) due to loss of quality habitat from beachgrass and dune growth, and it failed. Plovers traditionally nesting in this area nested either north on state land or south on the New River HRA. While plovers utilized the north end of the New River HRA more extensively in 2020, fewer nests were found in the Clay Island breach area (Figure 14). Overall, there was a decline in the number of nests in these locations (Table 4), but that was partly due to excellent nest success at New River HRA (Table 5), much higher than average ($\bar{x}$ = 52%), resulting in fewer renest attempts. Typically, the New River area can be a challenging place to nest due to the diversity and number of predators in the area. In 2020 there was very little evidence of red fox except early in the season near Clay Island breach, and once the fox were removed we did not document any more fox activity. Ravens are often problematic at New River HRA due to the proximity to local sheep and cattle ranches east of New River, however raven numbers in 2020 were fairly well controlled by WS staff. Not only was nest success high at New River HRA in 2020 (Table 5), but brood success, fledging success, the number of fledglings per sampled brood, and the breeding coefficient were excellent for this site (Table 8). There were similar numbers of broods in 2020 compared to 2019 (Lauten *et al*., 2019), but they produced more fledglings (Table 9).

The hatch rate, fledging success rate, and fledglings per resident males at New River in 2020 were excellent and all well above the post-predator management average (Figures 21-23). The breeding coefficient for New River HRA in 2020 was the highest of all sites, and overall productivity at this site was excellent.

Floras Lake

After two very successful years at Floras Lake, none of the nine nest attempts in 2020 (Table 4) were successful (Table 5). Predation pressure at Floras Lake from ravens and skunks was problematic all season and difficult to control. Fortunately, most plovers utilizing this area moved north to the New River HRA where they were very successful.

Summary

Based on productivity data from the sampled broods, overall productivity for 2020 was good (Table 8). Overall nest success was slightly below the post-predator management average (Table 5, $\bar{x}$ = 43%) but at a level that will sustain recovery goals (~ 40%). Overall fledging success was just below average (Table 10) but also at a level that will sustain recovery goals (~ 40%). The overall fledglings per sample brood was 1.11, above recovery goals (~ 1.00). The estimated number of fledglings produced was 299, the fifth time in six years that the number of fledglings produced was near or over 300 individuals (Table 9). The overall breeding coefficient (0.18 +/- 0.05) was lower than in 2019 (0.23 +/-0.04, Lauten *et al*., 2019) indicating less productivity for the effort in 2020, but still reasonably good. Due to the high number of males that move from site to site within the breeding season and inflate the number of resident males at each site, the overall number of fledglings per resident male was below recovery goals and well below average (Table 10). As is typical of any given year, productivity parameters fluctuate between sites and years, and this was the case in 2020 with South Siltcoos, North and South Overlook, North Tahkenitch, South Beach CBNS, and New River HRA all having a productive year while Sutton Beach, North Siltcoos, North and South Tenmile, the HRAs at CBNS, Bandon SPMA and Floras Lake having a less productive year (Table 8). Sites with small numbers of plovers like Sutton Beach, North Siltcoos, and Floras Lake generally contribute small numbers of fledglings to the population (Table 9) and thus poor reproductive output at these sites does not have a large overall effect on the plover population. However, when sites such as Tenmile and Bandon SPMA with large numbers of plovers and plover nests have poor reproductive output there can be a much larger effect on the numbers of fledglings produced and thus subsequent adult plover populations. Data shows that Siltcoos to Bandon SPMA is responsible for nearly 90% of all the eggs laid, eggs hatched, and fledglings produced since the early 1990s (Figures 24-26). Enhancing and maintaining good productivity at these sites (Siltcoos, Overlook, North Tahkenitch, CBNS and Bandon SPMA) will lead to sustainable plover populations within the project area while supplementing and assisting to sustain populations along the Northern California coast, the Northern Oregon coast, and Washington. Maintaining overall average nest success of 40%, fledging success of 40%, fledgling per male at approximately 1.00, and a 0.20 breeding coefficient should result in a stable to growing plover population along the Pacific Northwest coast.

Productivity Before and After Lethal Predator Management

Data from Floras Lake and Sutton Beach are very sparse. We did not include data from Floras Lake in the graphs of productivity analysis, and data from Sutton Beach are displayed solely for the purposes of 2020 comparisons.

The 2020 overall nest success (Table 5) was slightly lower than the ten-year (2011 – 2020) average of 42.0% +/- 11, and within the mean observed and calculated success rates reported by Page et al. (2009) from multiple studies. Post-predator management fledging success rates have improved at all sites except at Tenmile and CBNS where they have remained relatively stable but above 40% (Figure 22). The post-predator management mean brood success rate for all sites (2004-2020; $\bar{x} = 73.6\%$+/-7.4) was higher than the pre-predator management brood success rate (1991-2001; $\bar{x} = 62.9\%$+/-8.5). The post-predator management number of fledglings per resident male has improved at all sites except Tenmile and CBNS where it has remained relatively stable and above 1.20 for Tenmile and 1.50 for CBNS (Figure 23). The overall productivity has increased in the post-predator management time period resulting in a substantial increase in the number of hatched eggs and fledglings (Figure 27) and the overall population of plovers both within the project area and on the Oregon coast in general.

Discussion

Sutton Beach and the Dunes NRA

Sutton Beach has averaged nearly 20 nests per year for the past five years (Table 4) and has produced eight fledglings for the past three years (Table 9). Plovers now occupy the Sutton spit, the Sutton HRA, and Berry Creek spit. Due to windy conditions and number of ravens at this site, average nest success at Sutton Beach is poor and overall reproductive effort and output at this site is very low (Figures 21-26), however reproductive parameters have improved over the past several years. Due to much larger populations of plovers from Siltcoos to Tenmile, and the relative remoteness of this site, both monitors and WS agents have limited available time to visit this site. We expect plovers to continue to occupy this site in low numbers and produce limited fledglings.

North Siltcoos has averaged just 12 nests per year for the past five years (Table 4) and produces low numbers of fledglings (Table 9) due to its relatively small size and high recreational use. While five fledglings were produced from this site in 2020 (Table 9), all five were raised by one male who successfully renested and raised two broods. This site has only produced a high number of fledglings in one year (2017, Table 9) and that was the result of the Siltcoos river meandering south and creating a very large north spit in that given year. We expect low numbers of plovers to continue to occupy this site and their reproductive output to be low and limited.

South Siltcoos has averaged 30 nests per year for the past five years (Table 4) and has produced nearly three times as many fledglings as North Siltcoos in the past five years (Table 9). Recreational activity at South Siltcoos is much less than North Siltcoos and generally there is more available habitat than on the north spit. Plovers also occupy the beach south to North Overlook, resulting in connectivity between these sites. Due to the lower recreational activity and the increased plover numbers, WS agents spend more time from Siltcoos south to Tahkenitch and have an important positive effect on plover productivity in this area.

There are large numbers of plovers occupying the beaches and nesting areas from South Siltcoos to North Tahkenitch (Table 3), and a quarter of all nests found in 2020 were at the Dunes Overlook and North Tahkenitch (Table 4). Plovers occupying Overlook and North Tahkenitch have been responsible for nearly a quarter of all eggs laid, eggs hatched, and fledgling produced since the monitoring project began in 1990 (Figures 24-26). Plovers now consistently nest and rear broods on all available beach habitat between South Siltcoos and North Tahkenitch. The relatively low level of recreational activity in this area contributes to both WS success managing predators and plover's success raising fledglings. In 2020, 45% of all fledglings produced were raised between South Siltcoos and North Tahkenitch (Table 9). This area is a very important to plover recovery in Oregon and management goals should aim to maintain high productivity in this area by continuing to provide predator control, maintain habitat, and limit recreational use.

As the plover population continues to grow, we should expect plovers to occupy all available beach habitat, and data from the last two years indicates that plovers are now occupying and nesting from South Tahkenitch to the North Umpqua jetty (Lauten *et al.*, 2019). In the limited surveys that have been conducted, we found eight nests in two consecutive years at South Tahkenitch as well as active broods at North Umpqua indicating successful nesting. We expect plovers to continue to occupy this area, and if any dune restoration work is completed in this area, we expect plovers to quickly utilize the newly available habitat. Due to limited monitoring staff, we are unable to consistently survey these areas and monitor plover activity. This area is relatively remote, which reduces recreational pressure on the plovers, however, it is partially open to vehicle use which could have a detrimental effect on fledging success.

For the past five years, plovers have consistently occupied the beach from South Umpqua to Tenmile estuary (Lauten *et al*., 2016, 2017, 2018, and 2019). High numbers of plovers (Table 3), nests (Table 4), and fledglings (Table 9) have been produced from the Tenmile area (Figures 24-26), and plovers have been very productive at this site (Figure 23). While Tenmile has been very productive most years, predation pressure from ravens and harriers can be problematic as it was in 2020 (Table 7), resulting in depressed reproductive output (Table 8). Most of Tenmile estuary is very remote and has few recreational impacts, however nesting plovers near the South Umpqua parking lots sustain a much higher level of recreational disturbance. In 2020, we documented repeated human and dog violations of roped and signed nests in the South Umpqua area with some of the activity appearing deliberate. Tenmile is a very important area for sustaining recovery, and management goals should focus on reducing predator and recreational pressure on the plovers.

The Dunes NRA is a critical area for nesting and wintering plovers with nearly 50% of all eggs laid, eggs hatched, and fledglings produced since 1990 (Figures 24-26). Large numbers of plovers occupy the Dunes NRA (Table 3), and maintaining plover number and reproductive output in this area is critical not just to maintaining plover numbers within the project area, but also seeding and maintaining plover numbers in Northern California, Northern Oregon, and Washington. . Due to the large plover population, ORBIC, WS staff, and Dunes NRA staff have an increasingly challenging task of monitoring and managing these areas. For maximum efficiency, future management efforts should concentrate on the core breeding sites that produce the large majority of nests and fledglings.

Coos Bay North Spit

CBNS is the most important plover nesting site north of central California and is responsible for over a quarter of all eggs laid, eggs hatched, and fledglings produced since 1990 (Figures 24-26). In 2020, we recorded over 150 individual plovers at CBNS (Table 3), the first time any one site in Oregon has had over 150 individuals since monitoring began in 1990 and likely for several decades prior to 1990. In recent years, harriers have been the most impactful predator at CBNS, and data indicate that reproductive output is depressed when harriers are present (Figures 17-20). Despite the presence of harriers, CBNS continues to produce high numbers of fledglings (Table 9). Plovers continue to occupy all available habitat, and continue to expand their use of South Beach by nesting north of the FAA towers and possibly north towards Horsfall Beach (Figure 10). Harriers appear to have a greater negative impact on the nesting area (Figures 17-20) than South Beach. Management goals that include preventing harriers from nesting near the plover nesting area, and/or removal of hunting harriers at CBNS, and would likely result in higher reproductive output.

Management goals could also include maintaining vegetation free corridors through the foredune to create paths for plover broods to access the beach, where food availability is higher and predation pressure is lower. As noted in Lauten *et al*. (2019), new growth of invasive beachgrass continues to move westward from the foredune towards the ocean, reducing available habitat for nesting and brood rearing on the beach. Due to sea level rise and beachgrass encroachment, plovers have reduced available habitat on the beach, resulting in closer contact with recreational activity, and the increased possibility of nests being overwashed during high tide or storm events. In 2019 and 2020, we documented plover nests crushed by vehicles in violation of recreation restrictions on the beach. Restoration of quality habitat west of the foredune would benefit both nesting and brooding plovers, and improve recreational management issues by increasing the space between nesting plovers and recreating public.

Data shows that over 71% of all eggs laid, nearly 80% of all eggs hatched, and just over 80% of all fledglings produced since 1990 in the project area are from Siltcoos to CBNS (Figure 24-26). This area is essentially the majority of the Oregon dunes ecosystem, and it clearly indicates that the Oregon dunes ecosystem is the core of plover distribution and productivity on the northwest Pacific coast. Maintaining reproductive output and plover populations in this dunes ecosystem is critically important to sustaining plover populations in the future. Management goals that focus on maintaining habitat at these nesting sites, reducing predation pressure on nesting and brooding plovers, and managing recreational activity to reduce negative human effects on nesting plovers will help maintain this crucial population.

Bandon SPMA

Bandon SPMA is divided into two sections, Bandon Beach, north of the mouth of New River, and the New River spit, south of the mouth of New River (Figures 12 and 13). New River continues to erode the foredune north of the mouth of the river at Bandon Beach, essentially reducing available habitat on that side of the river mouth. In addition, lack of habitat management on the Bandon Beach side has further reduced available habitat, with nesting habitat only west of the foredune and no available nesting habitat east of the foredune. Bandon Beach also has relatively high numbers of recreational users due to the proximity to China Creek parking lot. Despite numerous signs and ropes, recreational violations, particularly dog-related, continue to be a problem at this site. Due to the loss of habitat east of the foredune, beachgrass growth and westward movement of the foredune, and large amounts of woody driftwood, available habitat for the plovers is limited to a thin section of beach west of the foredune. This loss of habitat results in plover and recreational interactions, as recreating public is often near or even east of the roped and signed nesting area. In 2020, due to the novel coronavirus, OPRD closed the China Creek parking lot and it remained closed throughout the breeding season. The closure of the parking lot significantly reduced recreational pressure at Bandon Beach. Plover management goals at Bandon Beach could focus on maintaining signs and ropes, patrolling the beach to manage recreation activities, and conducting habitat restoration to reduce beachgrass, slow or reduce the buildup and westward movement of the foredune, and create a buffer between recreating public and nesting plovers. Closure of the parking lot seasonally would reduce breeding season recreational activity and likely have a positive impact on nesting plovers at this beach.

While the movement of the mouth of New River to the north has decreased available habitat at Bandon Beach, it has increased available habitat on the New River spit, and the majority of nesting plovers at Bandon SPMA are on the south side of the mouth of the river. The Bandon SPMA, particularly the New River spit, has a very high number of plovers using the site (Table 3), and the area is responsible for 18% of all eggs laid and 15% of all eggs hatched since 1990 (Figures 24 and 25). Because of the mouth of New River and the distance from the China Creek parking lot, recreational activity on the New River spit is much less than at Bandon Beach, and currently due to overwashing and the movement of the river, there is a large amount of available, and high quality, nesting habitat at New River spit. Alternatively, the central and south end of the New River spit has significant beachgrass and dune growth, and overwash areas are slowly but progressively filling in, reducing available habitat in this area. Plover management goals should consider reducing the beachgrass and dune growth in this area to maintain as much available plover habitat as possible. Efforts to enhance and maintain high quality plover nesting habitat further from recreating public reduces negative impacts from recreational interactions with nesting and brooding plovers at Bandon Beach and reduces the need for active plover recreation management on site.

While Bandon SPMA has large numbers of plovers (Table 3) and high reproductive effort (Table 8, 24 and 25), reproductive output at this site has traditionally been lower than at Dunes NRA sites and CBNS (Figures 23 and 26). Despite having high numbers of eggs laid and hatched (Figures 24 and 25), the Bandon SPMA has produced a smaller percentage of fledglings (Figure 26). The number and variety of predators at Bandon SPMA throughout the project has been substantial, as it is one of the only sites with consistent red fox presence, often has problematic ravens, and is the only site with documented gull depredations. Data from ORBIC surveys, particularly in 2019 and 2020, suggests that great horned owls are a common predator on the New River spit, and may be having a detrimental effect on plover productivity. Management goals could aim at managing and reducing predation pressure on nesting plovers at Bandon SPMA, with removal of the owls as a means to increase productivity. Despite the lower reproductive output at Bandon SPMA compared to the Dunes NRA and CBNS, this site is an extremely important nesting area, with large numbers of plovers (Table 3) who have produced over 10% of all fledglings since 1990 (Table 9, Figure 26). Nearly 90% of all eggs laid, eggs hatched, and fledglings produced since 1990 have been from Siltcoos to Bandon SPMA (Figure 24-26). With a large number of plovers using this site, higher reproductive output would be beneficial, and improvements in reproductive output at Bandon SPMA would result in this site contributing more to the sustainability of the plover population on northwestern Pacific coast.

New River

Habitat along private land at New River continues to degrade due to beachgrass and dune growth, and plovers in 2020 moved north to the New River spit or south to the New River HRA where there is much more adequate habitat and where our ability to manage them is feasible. Due to the inability to manage habitat along private land, we expect reduced plover numbers in this area.

Plover use of the New River HRA in recent years has been relatively low (Table 4) with a majority of the nesting activity near the Hammond breach to Clay Island breach area (Lauten *et al*., 2018 and 2019). Due to habitat loss along New River private land, the north end of the New River HRA in 2020 had an increase in plover nesting activity (Figure 14). The New River area has only been responsible for a low percentage of eggs laid, eggs hatched, and fledglings produced since 1990 (Figures 24-26). The HRA area has extensive available habitat, but proximity to local sheep and cattle ranches has resulted in relatively high levels of raven and red fox presence, both detrimental to plover reproductive success. However, the extensive habitat in this area, increases available nesting habitat for plovers, reducing the density of plover nests and reducing predator cover, making it more difficult for predators to locate nests and benefiting productivity. In addition, plovers have much available habitat to move to if nesting attempts fail at Floras Lake (as they did in 2020), private lands, or the New River spit. Maintaining habitat at the New River HRA also benefits Bandon SPMA by reducing vegetation cover that red fox and other mammalian predators inhabit and thus reducing the number of these predators that reside along this section of the coast. Management goals should focus on maintaining available habitat and reducing predators in this area. Recent data indicates that annual WS predator management at this site has reduced red fox numbers, and annual raven management has had a positive effect on plover productivity in this area.

Floras Lake

After two years of very good productivity at Floras Lake (Table 9, Lauten *et al*., 2018 and 2019), Floras Lake was unproductive in 2020. Despite the poor productivity, this area has seen an increase in plover use over the past five years (Table 9), and the plovers that failed here in 2020 were successful at the New River HRA. Predator management at Floras Lake is challenging because of high recreational use, limited area to conduct predator management activities, and relatively high numbers of ravens, skunks, and red fox. Plovers can be successful here in low nesting densities, however, Floras Lake does not contribute much to the total reproductive output within the project area. Habitat at Floras Lake is naturally maintained by ocean wave and overwash activity, and therefore is relatively low cost. Management goals should focus on protecting the current available habitat and reducing predation and recreational pressure when feasible.

Conclusion

Due to increasing numbers and distribution of plovers, monitoring every site and nest is no longer possible in Oregon with current staffing levels. Prior to 2016, we attempted to color band as many broods as we could to measure reproductive output. Beginning in 2016 we began a sampling scheme with the goal of banding 80% of broods. In 2020 we monitored a sample of 209 broods, nearly four times the number of broods monitored in 2006. During this time period nesting areas have increased in size, the plover population within the project area has increased from about 178 individuals to 563, the number of nests has increased from 147 to 650, and plovers are occupying more beach and nest sites. Data indicate that nearly 90% of fledglings produced occurred between Siltcoos and the Bandon SPMA. To sustain the plover population, future management and monitoring of plovers should prioritize these areas as they have been instrumental in the recovery of plovers on the northwest Pacific coast.

Immigrant Plovers

Thirty-one adult plovers banded in California and one adult plover banded in Washington were observed in Oregon in 2020. Eighteen were females and 14 were males. Fifteen females and eleven males were resident plovers and three females and three males were present outside of the breeding season and were likely either wintering or visiting plovers.

Of the 32 plovers banded in California, three females and three males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. All other immigrant plovers were originally banded in Washington or California.

Acknowledgments

We would like to thank Joe Metzler, Andrew Partin, Harry McNall, Kurtis Fisher, and Paul Wolf of Wildlife Services for their assistance in the field and thoughtful insight about predators; Rob Brazie, RJ Rapelje, Jason Hennessey, and Ryan Parker of OPRD for their hours educating the public and monitoring recreational activity on the beach; BLM wildlife technicians Samantha Langley and Nicole Koelztow, and interns Erika Shook and Jordan Mao of BLM for monitoring recreational activity, predator and wildlife observations, and logistical support at CBNS; Statia Ryder and Mary Spini of South Coast Watershed Association for their enthusiasm monitoring and educating recreationists and campers at New River and Floras Lake; Jamie Harrison, Laurie Karnatz, Paul and Dorothy Steele, Courtney Gabriel, Amanda Heyerly, Karen Klein, Vicki Penwell, of Siuslaw National Forest Valuing People and Places Field Rangers for their work monitoring and educating recreationists; Shane Presley and Justin Castro of BLM Law Enforcement, Sgt. Levi Harris, Joshua Mullins, and Jay Evans of Oregon State Police, Deputy Josh Boswell of Coos County Sheriff's Department, Josh Putzier and Blake Dornbusch of Lane County Sheriff's Department, Oliver Grover of the USFS Dunes National Recreation Area Law Enforcement; Cheryl Strong, Michele Zwartjes, Madeleine Vander Heyden, Jeff Everett, David Leal, and Susie Tharrat of the USFWS; William Ritchie of USFWS at Leadbetter Point NWR, WA; Mark Stern of The Nature Conservancy; Stuart Love and Martin Nugent of ODFW; Charlie Bruce, retired ODFW volunteer; Kip Wright, Amy Price, Eric Baxter, Carol Aron, Jeanne Standley (retired), Jenny Sperling, Megan Harper, Goldie Warncke, and all the managers at Coos Bay BLM District whose support is invaluable; Lura Huff and Matt Chamberlain of BLM who disk and maintain the nesting areas at CBNS; Vanessa Blackstone, Laurel Hillman, and Larry Becker of OPRD; Nick Schoeppner and all the rangers and staff at Bullard's Beach State Park; Cindy Burns and Deanna Williams of the USFS Siuslaw National Forest; Kate Groth, Nathan McClain, Robert Werthheimer, Paul Schmidt, and Nathan Zorich of ACOE; Dave Williams of Wildlife Services; Roy Lowe, retired USFWS, for his interest and work with Lincoln Co. plovers; a big thanks to Elizabeth J Feucht and Sean McAllister in Humboldt Co., CA, who work closely with us on banding, distribution, and important plover biology topics; Gary Page, Lynne Stenzel, Doug George, Kris Neumann, Carlton Eyster, and Dave Dixon of Point Blue Conservation Science; Amber Clark (Oceano Dunes), Matt Lau (Pt. Reyes), Jamie Miller (Vanderberg AFB), Regina Orr (Morro Bay), Kimberly Paradis (Guadalupe Dunes), Ben Pearl (SF Bay), and Travis Wooten (San Diego) for helping to coordinate and report plover band combinations in California; Alison Cebula of California State Parks, Mendocino Division, for band reports and plover management in Mendocino Co., CA; Jenny Erbes in Sonoma Co., CA for band reports and plover management; anyone and everyone who we may have accidentally forgotten – we sincerely appreciate the support, assistance, and input of all, without which the program would not be a success.

Literature Cited

Brudney, L. J., T. W. Arnold, S. P. Saunders, and F. J. Cuthbert. 2013. Survival of Piping Plover (*Charadrius melodus*) Chicks in the Great Lakes Region. The Auk 130:150–160.

Casler, B.R., C.E. Hallett, and M.A. Stern. 1993. Snowy Plover nesting and reproductive success along the Oregon coast - 1993. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.

Castelein, K.A., D.J. Lauten, R. Swift, and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1997. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Castelein, K.A., D.J. Lauten, R. Swift, M.A. Stern, and K.J. Popper. 1998. Snowy Plover distribution and reproductive success along the Oregon coast - 1998. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, K.J. Popper, J.A. Fukuda, and M.A. Stern. 2000a. Snowy Plover distribution and reproductive success along the Oregon coast – 1999. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, K.J. Popper, D.C. Bailey, and M.A. Stern. 2000b. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast – 2000. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, L.N. Renan, S.R. Pixley, and M.A. Stern. 2001. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2001. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Castelein, K.A., D.J.Lauten, S.R. Pixley, L.N. Renan, M.A. Stern, and C. Grinnell. 2002. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2002. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Catlin, D. H., J. D. Fraser, and J. H. Felio. 2015. Demographic responses of Piping Plovers to habitat creation on the Missouri River. Wildlife Monographs 192:1-42.

Colwell, M. A., E. J. Feucht, S. E. McAllister, and A. N. Transou. 2017. Lessons learned from the oldest Snowy Plover. Wader Study 124:157-159.

Colwell, M. A., S. J. Hurley, J. N. Hall, and S. J. Dinsmore. 2007. Age-related survival and behavior of Snowy Plover chicks. Condor 109:638-647.

Craig, D.P., M.A. Stern, K.A. Mingo, D.M. Craig, and G.A. Rosenberg. 1992. Reproductive Ecology of the Western Snowy Plover on the South Coast of Oregon, 1992. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.

Dinsmore, S. J., E. P. Gaines, S. F. Pearson, D. J. Lauten, and K. A. Castelein. 2017. Factors affecting Snowy Plover chick survival in a managed population. The Condor: Ornithological Applications: in press.

Dinsmore, S. J., M. B. Wunder, V. J. Dreitz, and F. L. Knopf. 2010. An assessment of factors affecting population growth of the Mountain Plover. Avian Conservation and Ecology 5(1): 5.

Dinsmore, S. J., D. J. Lauten, K. A. Castelein, E. P. Gaines, and M. A. Stern. 2014. Predator exclosures, predator removal, and habitat improvement increase nest success of for Oregon Snowy Plovers. The Condor: Ornithological Applications 116:619-628.

Dunn, E. H., Hussell, D. J. T. and R. E. Ricklefs. 1979. The determination of incubation stage in starling eggs. Bird-Banding 50:114-120.

Elliot-Smith, E., and S.M. Haig. 2007. Western Snowy Plover breeding window survey protocol – final draft. Unpublished report prepared for USFWS.

Estelle, V., T.J. Mabee, and A.H. Farmer. 1996. Effectiveness of predator exclosures for Pectoral Sandpiper nests in Alaska. Journal of Field Ornithology 67:447-452.

Estelle, V.B., C.E. Hallett, M.R. Fisher and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1996. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Gaines, E. P. 2019. Snowy Plover Demography in Oregon. https://pdxscholar.library.pdx.edu/open_access_etds/5004 10.15760/etd.6880

Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1994. Snowy Plover distribution and reproductive success along the Oregon coast - 1994. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Dunes National Recreation Area, Reedsport, and the Coos Bay District Bureau of Land Management, Coos Bay.

Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1995. Snowy Plover distribution and reproductive success along the Oregon coast - 1995. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

Hays, H., and M. LeCroy. 1971. Field criteria for determining incubation stage in eggs of the common tern. Wilson Bulletin 83:425-429.

Lauten, D.J., K.A. Castelein, B.V. Smithers, K.C. Jander, E. Elliot-Smith, and E.P. Gaines. 2003. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2003. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, E. Seckinger, E. Kolkemo, and E.P. Gaines. 2005. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2004. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, E. Seckinger, and E.P. Gaines. 2006a. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2005. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, S. Weston, K. Eucken, and E.P. Gaines. 2006b. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2006. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, Raya Pruner, Marvin Friel, and E.P. Gaines. 2007. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2007. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, D.C. Bailey, T. Lewis, and E.P. Gaines. 2008. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2008. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, H.G. Herlyn, and E.P. Gaines. 2009. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2009. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, and E.P. Gaines. 2010. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2010. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, and E.P. Gaines. 2011. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2011. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, and E.P. Gaines. 2012. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2012. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, M. F. Breyer, and E.P. Gaines. 2013. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2013. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, and E.P. Gaines. 2014. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2014. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, and E.P. Gaines. 2015. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2015. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, E. Krygsman, and E.P. Gaines. 2016. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2016. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, E. Krygsman, and E.P. Gaines. 2017. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2017. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, A.A. Kotaich, E. Krygsman, and E.P. Gaines. 2018. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2018. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Lauten, D.J., K.A. Castelein, J.D. Farrar, E. Krygsman, S. Michishita, and E.P. Gaines. 2018. The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast – 2019. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

Metzler, J., K. Fisher, H. McNall, and P. C. Wolf. 2020. Integrated Predator Damage Management Report for the Western Snowy Plover (*Charadrius nivosus nivosus*) 2020 Breeding Season. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.

ODFW. 2009. Oregon Administrative Rules, Oregon Department of Fish and Wildlife, Division 100 Wildlife Diversity Plan. http://www.dfw.state.or.us/OARs/100.pdf

Page, G.W., L.E. Stenzel, and C.A. Ribic. 1985. Nest site selection and clutch predation in the Snowy Plover. The Auk 102:347-353.

Page, G.W., L.E. Stenzel, W.D. Shuford, and C.R. Bruce. 1991. Distribution and abundance of the Snowy Plover on its western North American breeding grounds. J. Field Ornithol. 62:245-255.

Page, G. W., L. E. Stenzel, J. S. Warriner, J. C. Warriner and P. W. Paton. 2009. Snowy Plover (Charadrius nivosus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/154

Rizzolo, D. J., and J. A. Schmutz. 2007. Egg flotation estimates nest age for Pacific Red-throated Loons. Waterbirds 30:207-213.

Sandercock, BK. 2003. Estimation of survival rates for wader populations: a review of mark recapture methods. Wader Study Group Bulletin. 100:163-174

Saunders, S. P., T. W. Arnold, E. A. Roche, and F. J. Cuthbert. 2014. Age-specific survival and recruitment of piping plovers *Charadrius melodus* in the Great Lakes region. Journal of Avian Biology 45:437–449.

Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1990. Investigations of the western Snowy Plover at the Coos Bay North Spit and adjacent sites in Coos and Curry Counties, 1990. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Oregon.

Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1991. Nesting and reproductive success of the Snowy Plovers along the south Oregon coast, 1991. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland and the Coos Bay District Bureau of Land Management, Coos Bay

U.S. Fish and Wildlife Service. 1993. Final rule. Endangered and threatened wildlife and plants; Determination of threatened status for the Pacific coast population of the Western Snowy Plover. Federal Register 58 FR 12864 03/05/93.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In two volumes. Sacramento, California. xiv + 751pp.

Warriner, J. S., J. C. Warriner, G. W. Page, L. E. Stenzel. 1986. Mating system and reproductive success of a small population of polygamous Snowy Plovers. The Wilson Bulletin, *98*(1): 15–37.

Westerskov, K. 1950. Methods for determining the age of game bird eggs. The Journal of Wildlife Management 14: 56–67.

Table 1. Minimum window survey counts and the minimum number of Snowy Plover present from Sutton Beach to Floras Lake, Oregon Coast, 2009-2020.

YEAR	WINDOW SURVEY	# SNPL PRESENT
2009	136	199
2010	158	232
2011	168	247
2012	206	293
2013	215	304
2014	228	338
2015	277	458
2016	375	529
2017	282	468
2018	311	502
2019	356	517
2020	403	563

Table 2. Number of banded Snowy Plover fledglings, number of previous year fledglings returning, and return rate along the Oregon coast, 2010 - 2020.

Year	**# of banded fledglings from previous year**	**# of HY birds from previous year sighted on OR coast**	**Return Rate (#HY/#Fled)**
2010	105	54	51.4
2011	84	53	63.1
2012	161	92	57.1
2013	162	91	58.7
2014	98	54	56.3
2015	260	146	56.2
2016	305	135	44.4
2017	171	69	40.4
2018	245	120	48.9
2019	270	109	40.3
2020	274	124	45.2
		AVERAGE =	51.1
		STDEV =	7.8

Table 3. Plover activity based on the number of adult plovers at each nesting area on the Oregon Coast, 2020. Plovers move between nesting areas throughout the breeding season, therefore this is not a tally of the total number of plovers present.

	Females				Males					
	Banded		Unbanded		Banded		Unbanded		Total	
Site	# banded	# residents	# unbanded	# residents	# banded	# residents	# unbanded	# residents	# plovers	# residents
Sutton	15	10	1	1	9	7	2	2	27	20
Siltcoos	38	32	2	2	34	26	2	2	76	62
Overlook	59	51	4	4	53	48	9	9	125	112
Tahkenitch	46	40	6	6	38	36	8	8	98	90
Tenmile	43	35	5	5	44	37	5	5	97	82
CBNS	66	63	7	7	68	64	10	10	151	144
Bandon SPMA	53	46	7	7	51	39	12	12	123	104
New River private	10	7	0	0	9	7	0	0	19	14
New River HRA	10	8	2	2	10	8	2	2	24	20
Floras Lake	4	4	2	2	4	4	0	0	10	10

Table 4. Number of nests for selected sites on the Oregon Coast 2010 – 2020 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year only.

Site Name	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
SU	1	0	0	1	2	8	19	21	20	15	20
SI:											
North	17	13	10	13	6	8	15	25	15	12	13
South	24	21	22	30	18	23	42	31	24	29	24
OV:											
North	21	29	28	33	35	46	48	61	24	38	52
South	16	28	31	28	23	42	56	47	34	35	50
TA											
North	7	23	36	52	32	61	74	56	47	49	62
South				6	4	2	0	2	1	8	8
TM:											
North	13	15	17	19	26	29	34	40	66	52	103
South	30	35	29	17	21	32	59	24	33	26	33
Horsefall							1	1	0		
CBNS:											
SB	17	16	7	36	20	41	48	33	32	29	52
SS	14	15	15	12	13	20	38	27	29	27	20
HRAs	33	26	39	58	43	66	97	74	67	78	61
Cut Creek										1	
BSPMA											
BB	26	28	48	44	28	40	57	32	36	51	39
NR spit	12	9	12	20	54	48	73	49	43	70	92
NR HRA	27	29	17	9	15	27	14	11	10	16	12
NR other	3	2	1	3	4	8	18	11	5	7	1
FL	0	0	2	0	2	0	1	3	4	9	8
Tot nst	**261**	**289**	**314**	**381**	**346**	**501**	**694**	**548**	**490**	**552**	**650**
Tot brd[a]	**2**	**4**	**11**	**8**	**12**	**32**	**19**	**9**	**15**	**25**	**13**

[a] – broods from undiscovered nests only; these broods are not tallied in the total number of nests

SU – Sutton, SI – Siltcoos, OV – Overlook, TA – Tahkenitch, TM – Tenmile, CBNS – Coos Bay North Spit (SB - South Beach, SS – South Spoil, BSPMA – Bandon Snowy Plover Management Area (BB - Bandon Beach, NR spit - New River spit), NR HRA – New River HRA, NR other - private and other owned lands, FL – Floras Lake

Table 5. Apparent nest success of Snowy Plovers on the Oregon Coast, 2020.

Site	Total #	Hatch	Fail	Unknown	App Nest Success
Sutton	20	4	16		20%
Siltcoos					
North	13	3	9	1	23%
South	24	9	15		38%
Combined	37	12	24	1	32%
Overlook					
North	52	28	22	2	54%
South	50	31	19		62%
Combined	102	59	41	2	58%
Tahkenitch					
North	62	38	24		61%
South	8	1	2	5	13%
Combined	70	39	26	5	56%
Tenmile					
North	103	17	83	3	17%
South	33	7	26		21%
Combined	136	24	109	3	18%
CBNS					
South Beach	52	35	16	1	67%
South Spoil	20	7	11	2	35%
HRAs	61	24	31	6	39%
Combined	133	66	58	9	50%
Bandon SPMA	131	45	81	5	34%
New River					
HRA	12	9	3		75%
Other Lands	1	0	1		0%
Floras Lake	8	0	8		0%
Totals	650	258	367	25	40%

Forest Service total = 138/365=38% (DNRA=134/345=39%)

Table 6. Apparent nest success of Snowy Plover nests on the Oregon coast, 2011 – 2020 with ten year average and total average from 1990 – 2020.

2011	50
2012	45
2013	24
2014	60
2015	48
2016	25
2017	42
2018	49
2019	41
2020	40
average '11-'20	42.4
stdev	10.7
average '90-'20	46.2
stdev	12.4

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2020.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Corvid	**Unk**	**Mammal**	**Harrier**	**Avian**	**Wind**	**Over-wash**	**Abandon**	**One Egg Nest**	**Infer**	**Unk cause**
Sutton	20	16	2	6	2 [a]		1			2			3
Siltcoos:													
North	13	9	4	3						1		1	
South	24	15	2	4	3 [b]		1	1		2	2		
Overlook													
North	52	22	2	3	12 [c]					5			
South	50	19	3	5	4 [d]					2	2		3
Tahkenitch													
North	62	24	8	4	4 [d]		3	1				1	3
South	8	2											2
Tenmile:													
North	103	83	31	15			7	9	2	1	2	1	15
South	33	26	7	11			3	1		1			3
Coos Bay North Spit:													
South Beach	52	16			1 [e]			3	1	2			9 [f]
South Spoil	20	11	1	4		4	1			1			
HRAs	61	31	4	18	1[g]	5					2	1	
Bandon SPMA	131	81	3	18	4[i]		3[h]	7	3	18	3	2	20
New River HRA	12	3	1	2									
Other lands	1	1		1									
Floras Lake	8	8		3	2[k]						1		2
TOTALS	650	367	68	97	33	9	19	22	6	35	12	6	60

[a] – 2 coyote depredations
[b] – 3 coyote depredations
[c] – 9 coyote depredations, 3 unknown mammalian depredations
[d] – 4 coyote depredations
[e] – 1 opossum depredation
[f] – 1 human caused failure included
[g] – 1 coyote depredation
[h] – 1 gull depredation
[i] – 3 skunk depredations, 1 rodent depredation
[k] – 2 skunk depredations

Table 8. Number of broods sampled (number successful in parenthesis), brood success, and fledging success based on sample from Sutton Beach to Floras Lake, Oregon coast, 2020.

Site Name	# of broods in sample	% brood success	# of eggs hatched in sample	# of fledglings from sample	% fledging success	fledglings per sampled brood	breeding coefficient
Sutton Beach	3 (2)	67%	7	4	57%	1.33	5/51=0.10
Siltcoos:							
North Siltcoos	3 (2)	67%	9	5	56%	1.67	5/38=0.13
South Siltcoos	11 (11)	100%	29	17	59%	1.55	17/71=0.24
Overlook							
North Overlook	21 (16)	76%	51	23	45%	1.10	31/143=0.22
South Overlook	27 (24)	89%	79	35	44%	1.30	37/136=0.27
Tahkenitch							
North Tahkenitch	31 (21)	68%	84	33	39%	1.06	37/181=0.20
South Tahkenitch	NS						
Tenmile:							
North Tenmile	9 (7)	78%	25	9	36%	1.00	12/239=0.05
South Tenmile	5 (4)	80%	14	8	57%	1.60	9/88=0.10
Coos Bay N. Spit							
South Beach	31 (23)	61%	80	36	45%	1.16	36/152=0.24
South Spoil	6 (5)	83%	14	8	57%	1.33	8/53=0.15
HRA	15 (8)	53%	39	13	33%	0.87	13/161=0.08
Bandon SPMA	38 (19)	50%	96	26	27%	0.68	27/351=0.08
New River							
HRA	9 (8)	89%	22	14	64%	1.56	14/30=0.47
Other lands	0						
Floras Lake	0						
Total	**209**	**72%**	**549**	**231**	**42%**	**1.11**	

Table 9. Total number of young fledged from select sites on the Oregon Coast 2002-2020, includes fledglings from broods from undiscovered nests.

Site Name	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20[a]
SU	0	0	0	0	0	0	0						1	3	2	2	8	8	8
SI:																			
North	0	0	7	2	11	7	5	8	4	4	1	2	0	4	3	17	6	0	5
South	0	2	5	7	7	4	3	11	4	8	16	4	9	25	20	16	18	11	19
OV:																			
North	2	3	3	5	8	12	3	7	12	27	22	3	18	26	33	17	15	40	36
South	0	0	3	2	0	1	0	2	7	23	27	0	25	39	16	30	25	45	39
TA:																			
North	1	3	6	8	5	2	0	1	3	20	26	9	25	49	28	28	19	40	42
South	5	2	0	0	0	0	0					3	0	0		0	7	9	1
TM:																			
North	3	1	3	6	12	13	3	2	3	1	5	15	35	26	14	41	46	31	21
South	3	9	9	5	7	14	6	19	13	5	5	8	27	21	27	24	20	10	8
CBNS:																			
SS	2	7	13	9	11	7	17	4	2	6	10	2	14	13	9	10	20	8	8
SB	1	3	0	8	1	10	7	17	13	22	16	18	28	24	12	38	20	32	39
HRAs	8	14	22	6	19	9	16	10	5	28	34	3	49	46	12	10	49	18	26
CBNS														51		9	12	21	
BSPMA																			
BB	0	4	16	11	12	13	2	6	6	16	11	8	12	12	8	28	21	18	9
NR spit	0	1	10	0	3	12	2	1	0	5	1	14	22	19	6	9	21	26	22
NR HRA	3	7	5	1	7	16	7	17	12	7	4	12	3	10	4	3	3	12	16
NR other	3	4	6	8	7	4	2	2	0	0	0	3	6	2	5	4	0	6	0
FL	0	0	0	0	0	0	0	0	0	0	2		2	0	1	4	6	9	0
Total	**31**	**60**	**108**	**78**	**110**	**124**	**73**	**107**	**84**	**172**	**180**	**104**	**276**	**370**	**200**	**290**	**316**	**344**	**299**

[a] – numbers are estimated number of fledglings based on number of broods and # of fledglings per sampled brood

SU – Sutton, SI – Siltcoos, OV – Overlook, TA – Tahkenitch, TM – Tenmile, CBNS – Coos Bay North Spit (SB - South Beach, SS – South Spoil, BSPMA – Bandon Snowy Plover Management Area (BB - Bandon Beach, NR spit - New River spit), NR HRA – New River HRA, NR other - private and other owned lands, FL – Floras Lake

Table 10. Fledging success and mean number of fledglings/male (+/- standard deviation) on the Oregon Coast, 2004 – 2020.

Year	% Fledging Success	Mean # Fled/Male
2004	55	1.73
2005	41	1.28
2006	48	1.56
2007	54	1.60
2008	47	1.13
2009	50	1.33
2010	35	0.97
2011	47	1.61
2012	44	1.41
2013	39	1.04
2014	48	1.68
2015	49	1.51
2016	43	0.60
2017	50	0.90
2018	49	1.03
2019	54	1.07
2020	42	0.79
’04-’20 mean	46.8 ± 5.5	1.25 ± 0.34

Table 11. Number of resident males, estimated number of fledglings, and number of fledglings per male on the Oregon Coast, 2020. Plovers move between nesting areas throughout the summer, therefore the number of resident males is not a tally of the total number of plovers present.

Site Name	**# of resident males**	**estimated # of fledglings**	**estimated # of fledglings/male**
Sutton Beach	9	8	0.89
Siltcoos Spits	28	24	0.86
Dunes Overlook	57	75	1.32
Tahkenitch Creek	44	43	0.98
Tenmile Creek	42	29	0.69
Coos Bay North Spit	74	73	0.99
Bandon SPMA	51	32	0.63
New River			
HRA	10	16	1.60
Other lands	7	0	0.00
Floras Lake	4	0	0.00
Overall			0.79 +/-0.51

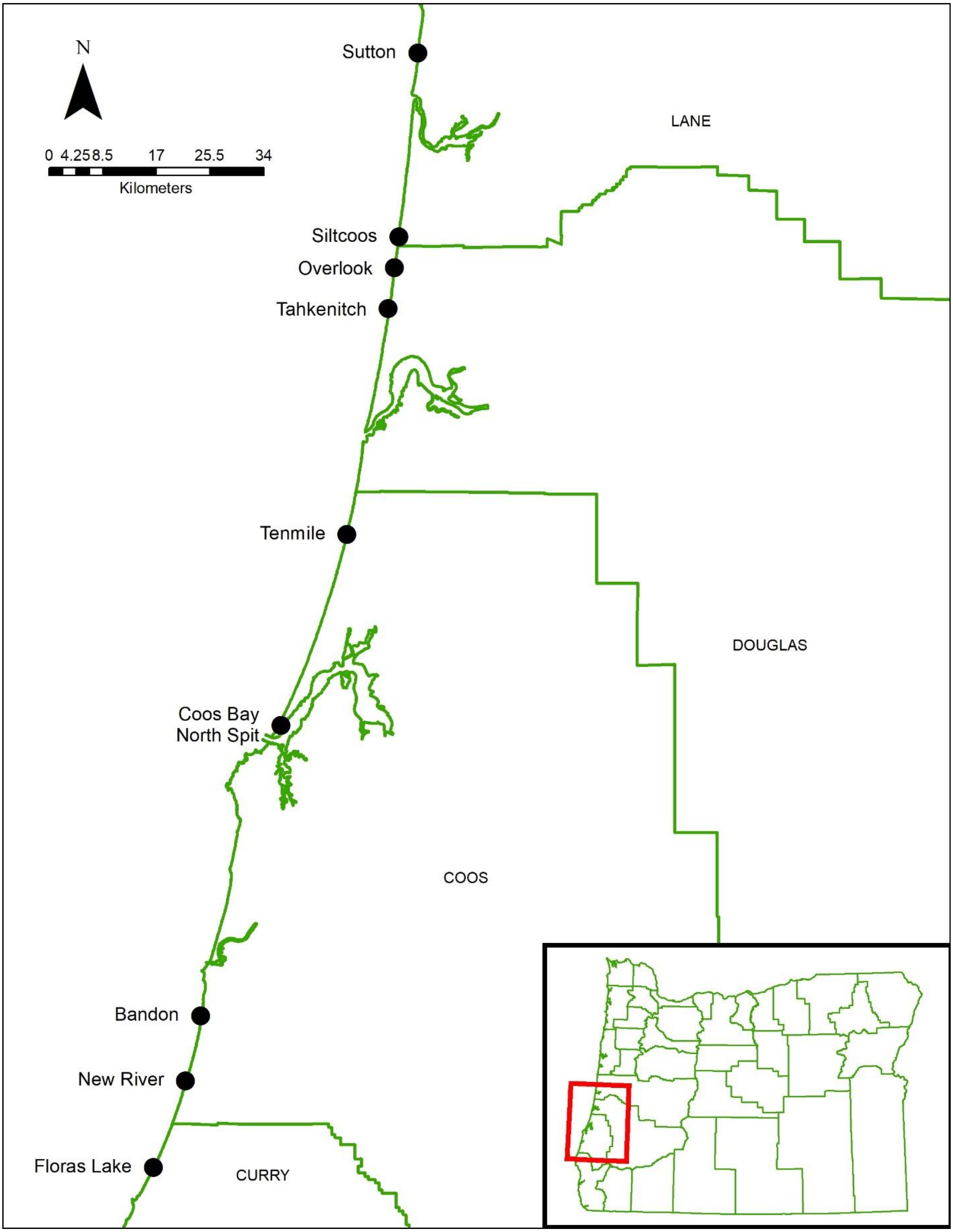


Figure 1. Snowy Plover monitoring locations along the Oregon Coast, 2020

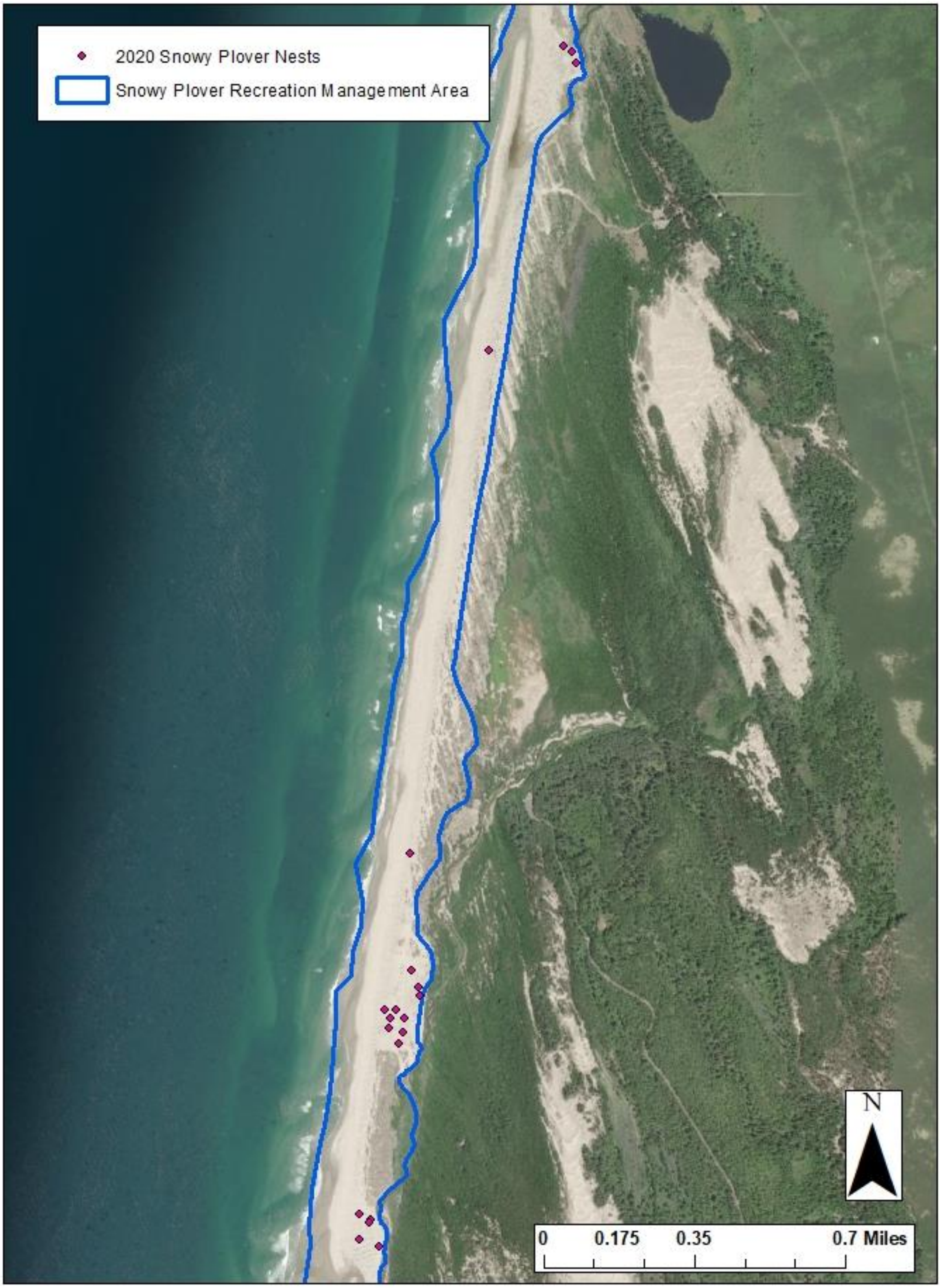


Figure 2. Snowy Plover nest locations at Sutton/Baker Beach, Oregon, 2020.

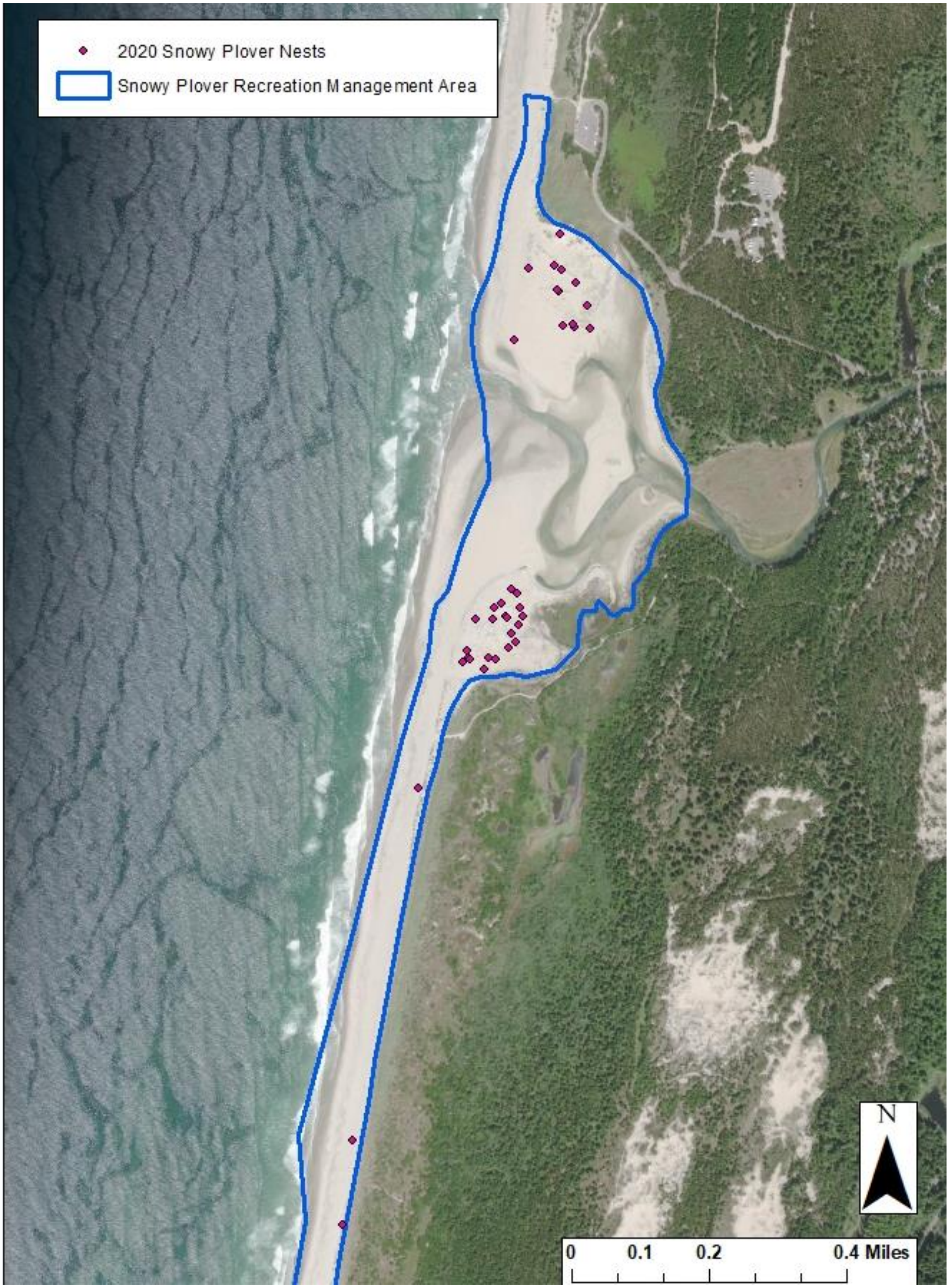


Figure 3. Snowy Plover nest locations at Siltcoos Estuary, Oregon, 2020.

Figure 4. Snowy Plover nest locations at Dunes North Overlook, Oregon, 2020.

Figure 5. Snowy Plover nest locations at Dunes South Overlook, Oregon, 2020.

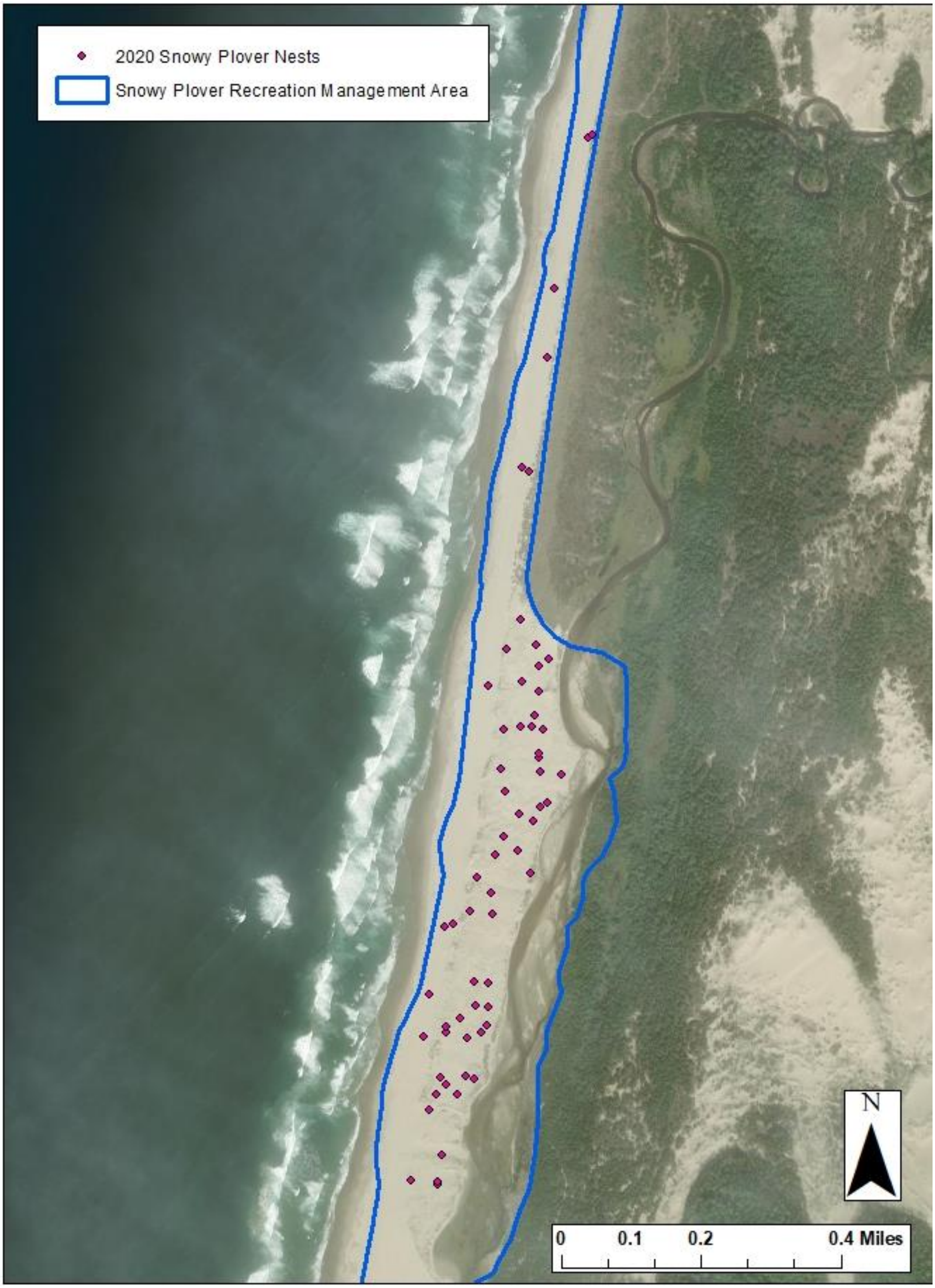


Figure 6. Snowy Plover nest locations on north side of Tahkenitch Creek, Oregon, 2020.

Figure 7. Snowy Plover nests on south side of Tahkenitch Creek, Oregon, 2020.

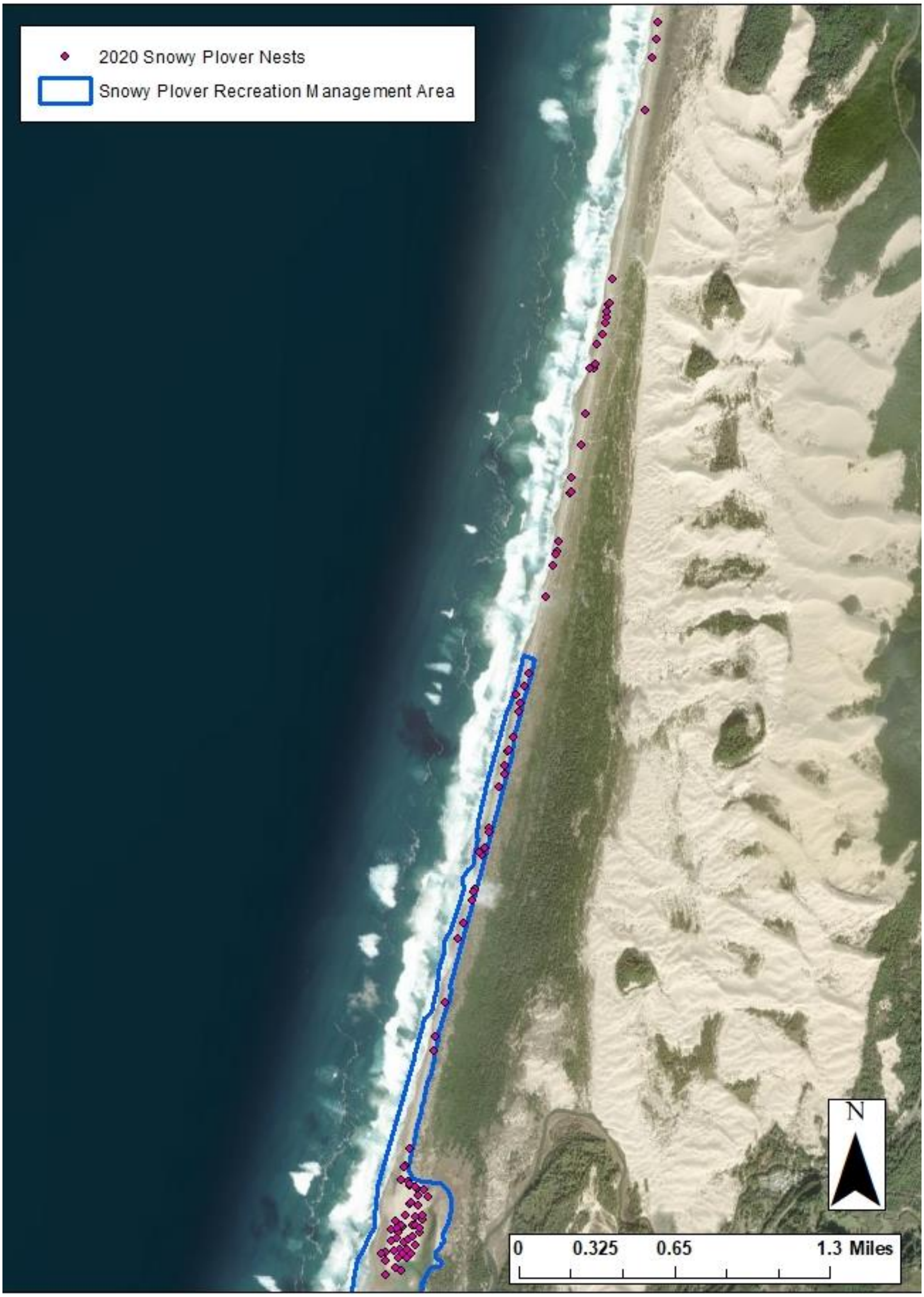


Figure 8. Snowy Plover nests on north side of Tenmile Creek, Oregon, 2020.

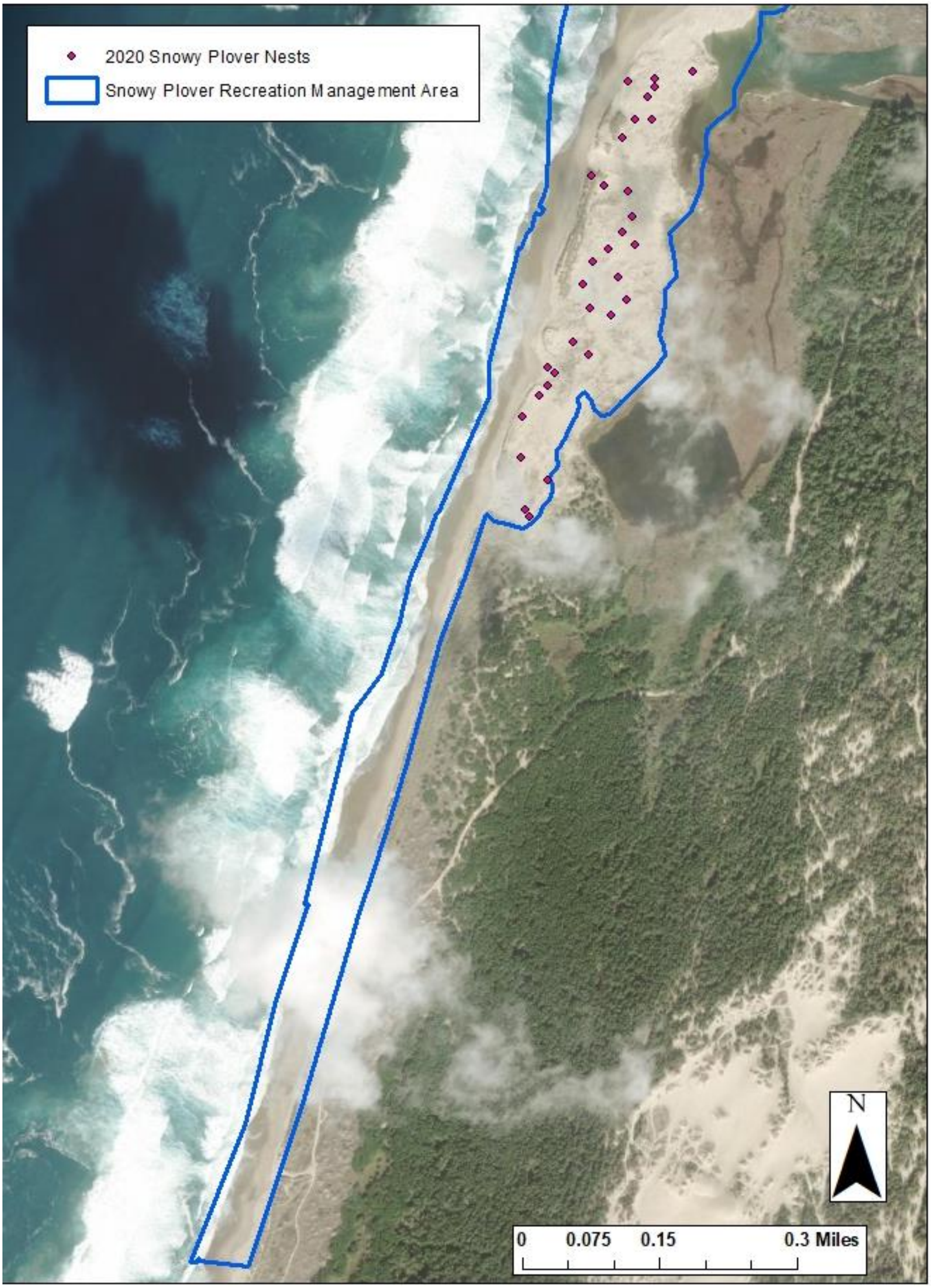


Figure 9. Snowy Plover nests south of Tenmile Creek, Oregon, 2020.

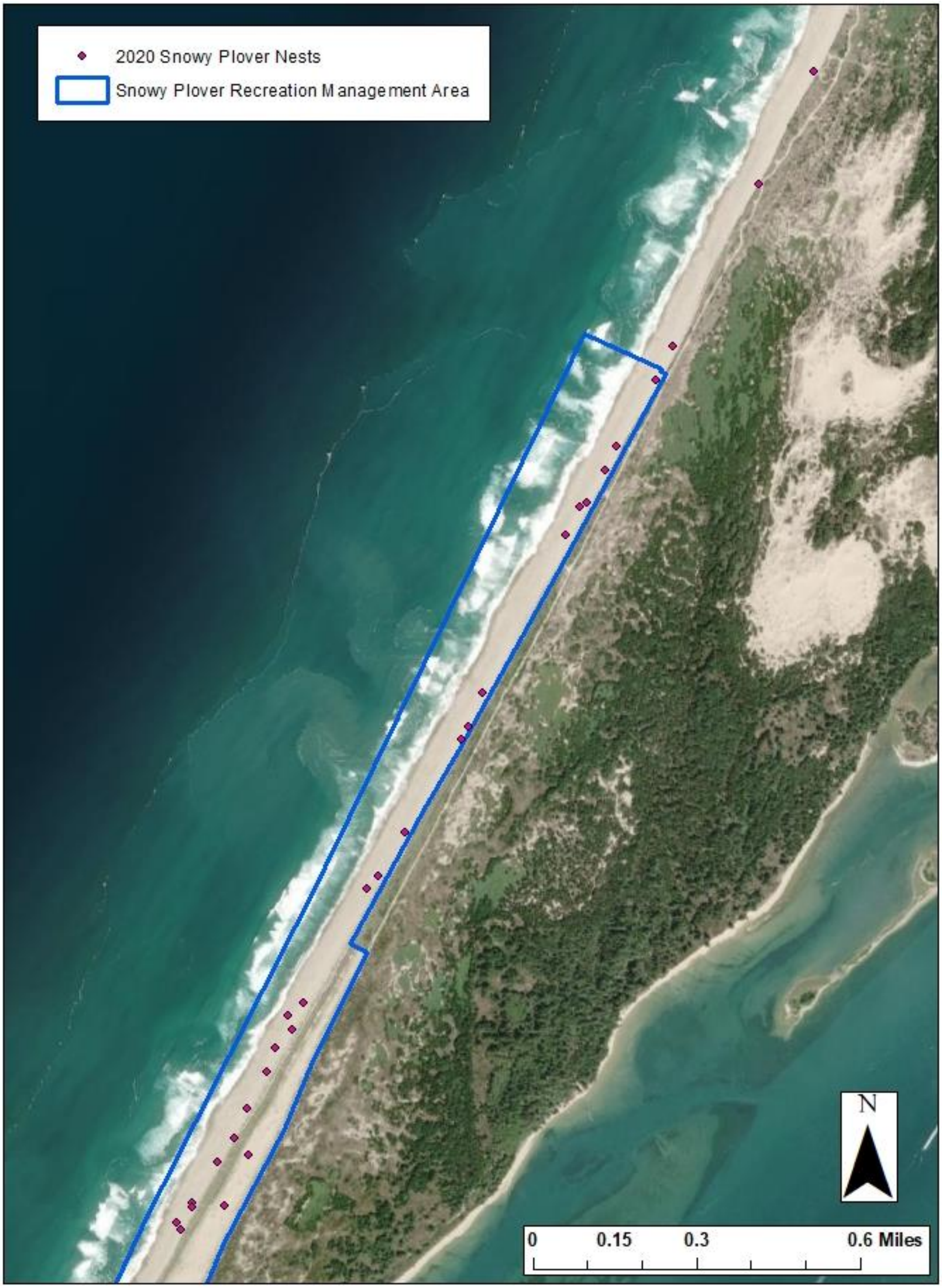


Figure 10. Snowy Plover nests on north end of Coos Bay North Spit, Oregon, 2020.

Figure 11. Snowy Plover nests at Coos Bay North Spit, Oregon, 2020.

Figure 12. Snowy Plover nests at Bandon SPMA, north of the mouth of New River, Oregon, 2020.

Figure 13. Snowy Plover nests at Bandon SPMA, south of the mouth of New River, Oregon, 2020.

Figure 14. Snowy Plover nest locations on New River Habitat Restoration Area, Oregon, 2020.

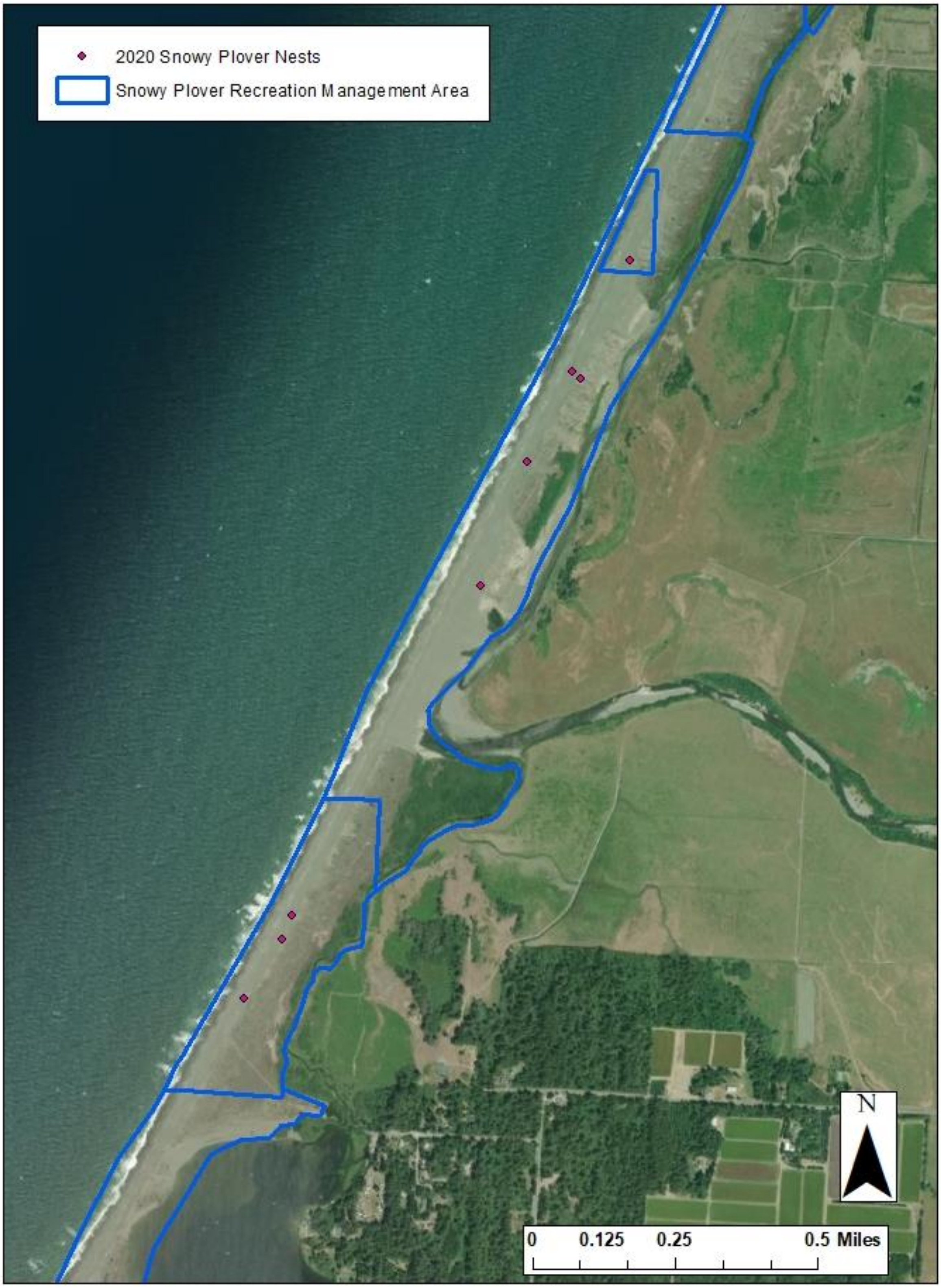


Figure 15. Snowy Plover nest locations at Floras Lake, Oregon, 2020

.

Figure 16. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2020. Dashed lines represent +/- standard deviation.

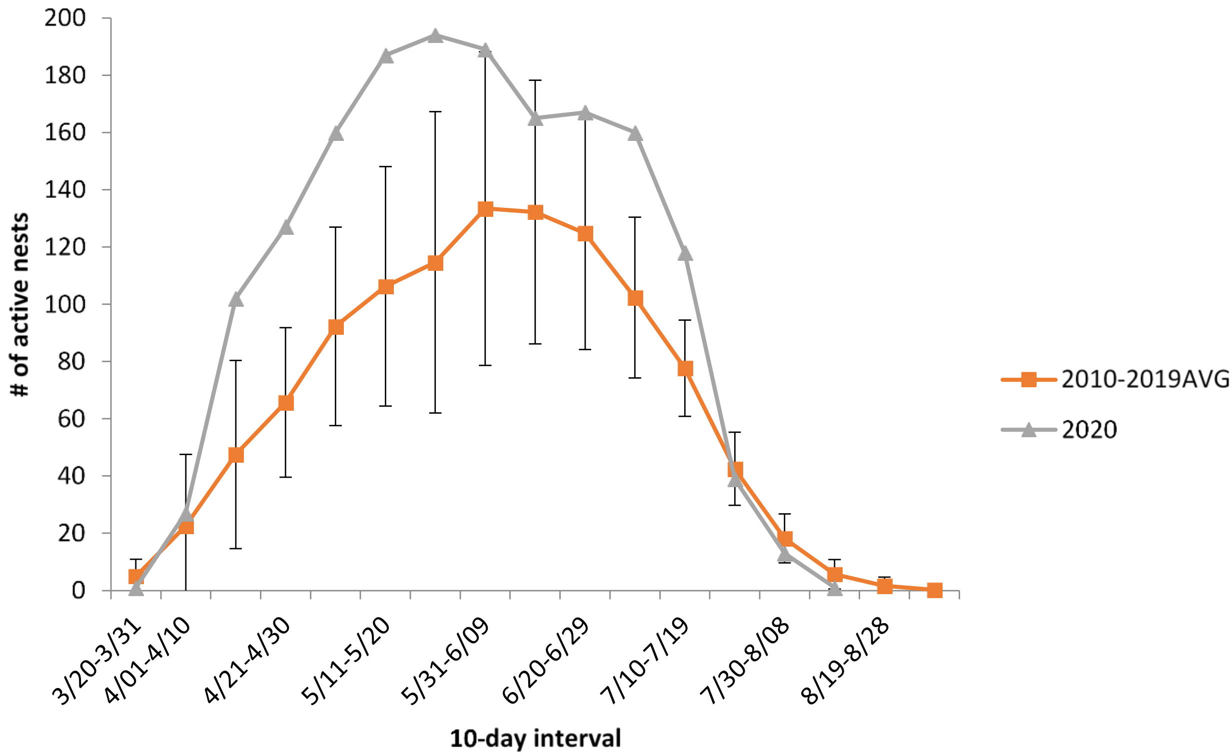


Figure 17. Nest success at CBNS 2012 -2020. A pair of Northern Harriers were removed after being identified as significant nest predator in 2013 and 2017. Note how nest success substantially increases in years after harriers were removed, indicating that harrier removal had a positive increase on plover nest success.

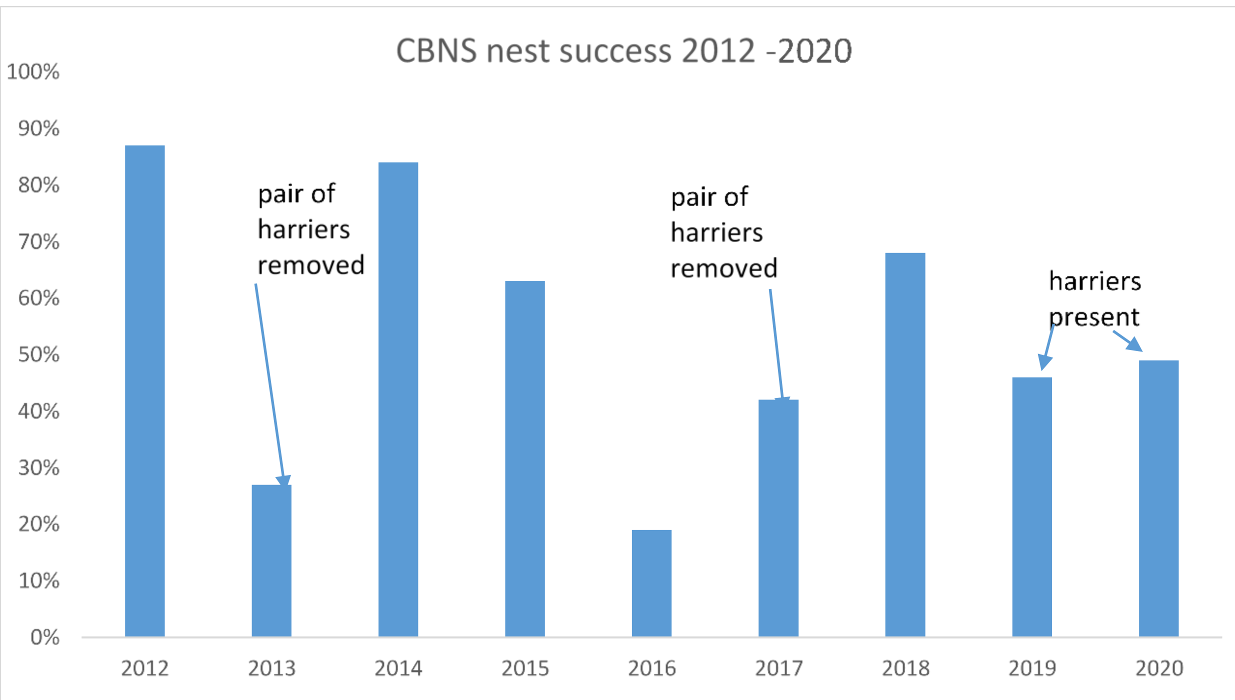


Figure 18. Fledging success, brood success, and fledglings per male for the HRAs at Coos Bay North Spit, 2012-2020. Northern Harriers were removed in 2013 and 2017. Reproductive parameters improved after harrier removal.

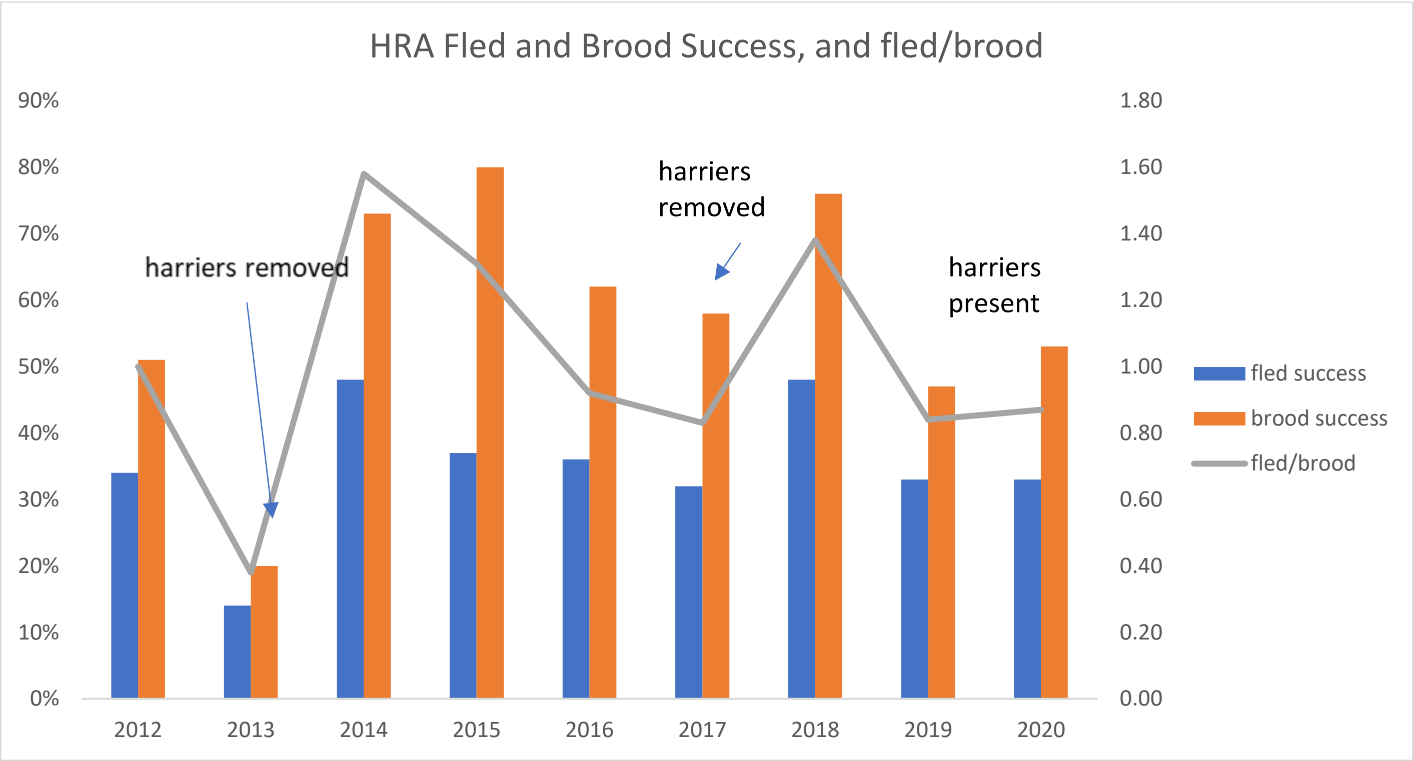


Figure 19. Fledging success, brood success, and fledglings per male for South Beach at Coos Bay North Spit, 2012-2020. Northern Harriers were removed in 2013 and 2017. Reproductive parameters are not as impacted by harriers on South Beach.

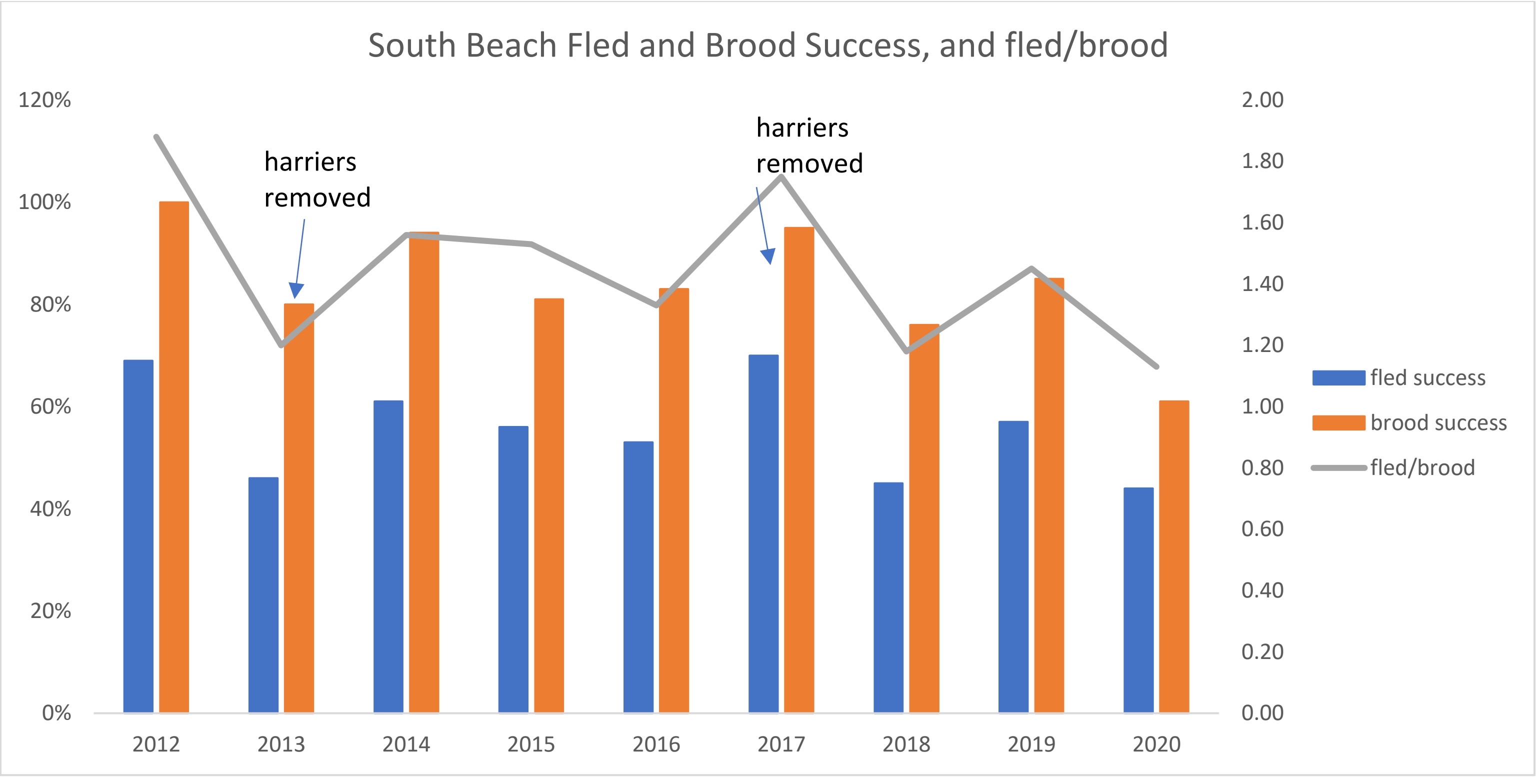


Figure 20. Fledging success, brood success, and fledglings per male for South Spoil at Coos Bay North Spit, 2012-2020. Northern Harriers were removed in 2013 and 2017. Reproductive parameters improved after harrier removal.

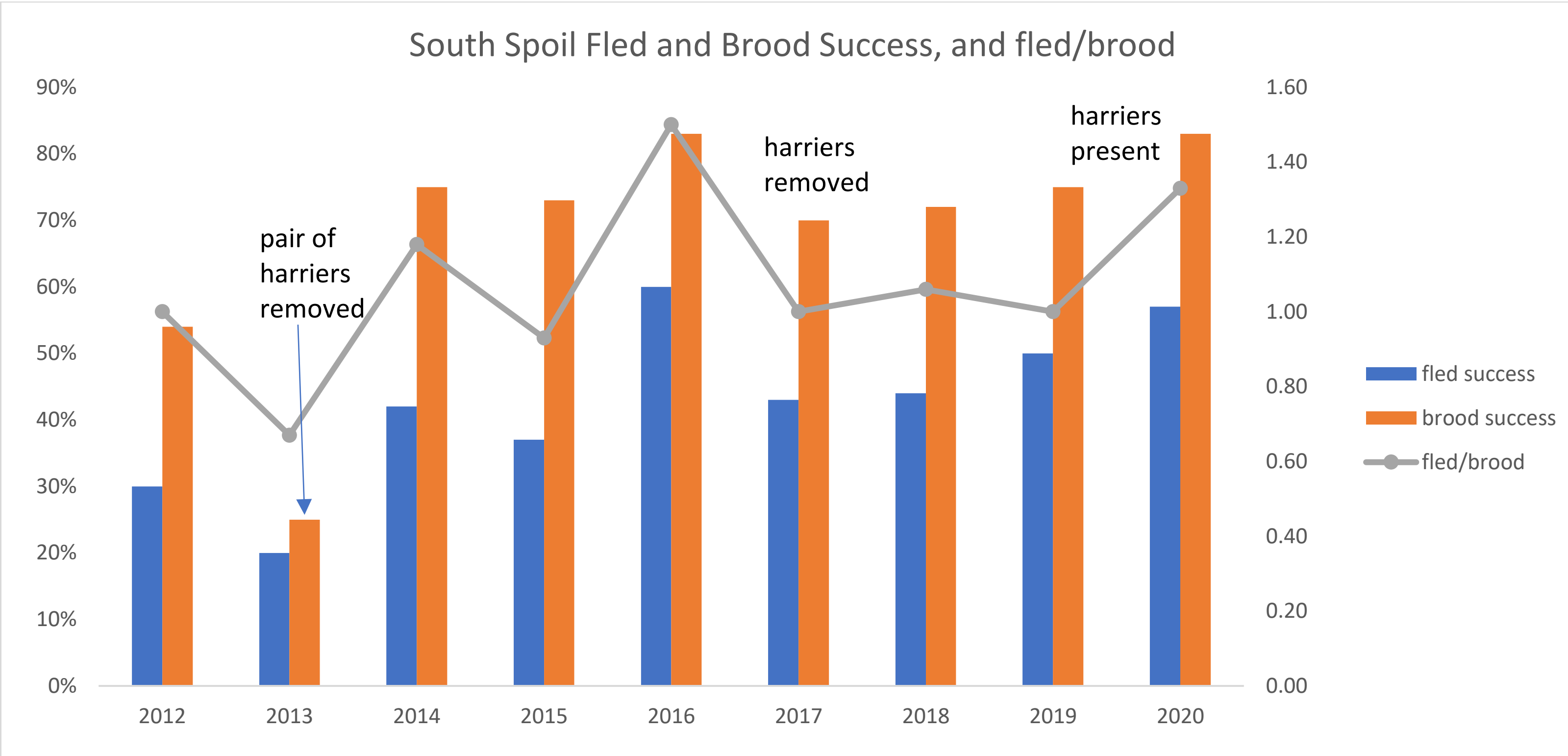


Figure 21. 2020 hatch rate, mean pre predator management hatch rate, and mean post predator management hatch rate for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

Figure 22. 2020 fledge rate, mean pre predator management fledge rate, and mean post predator management fledge rate for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

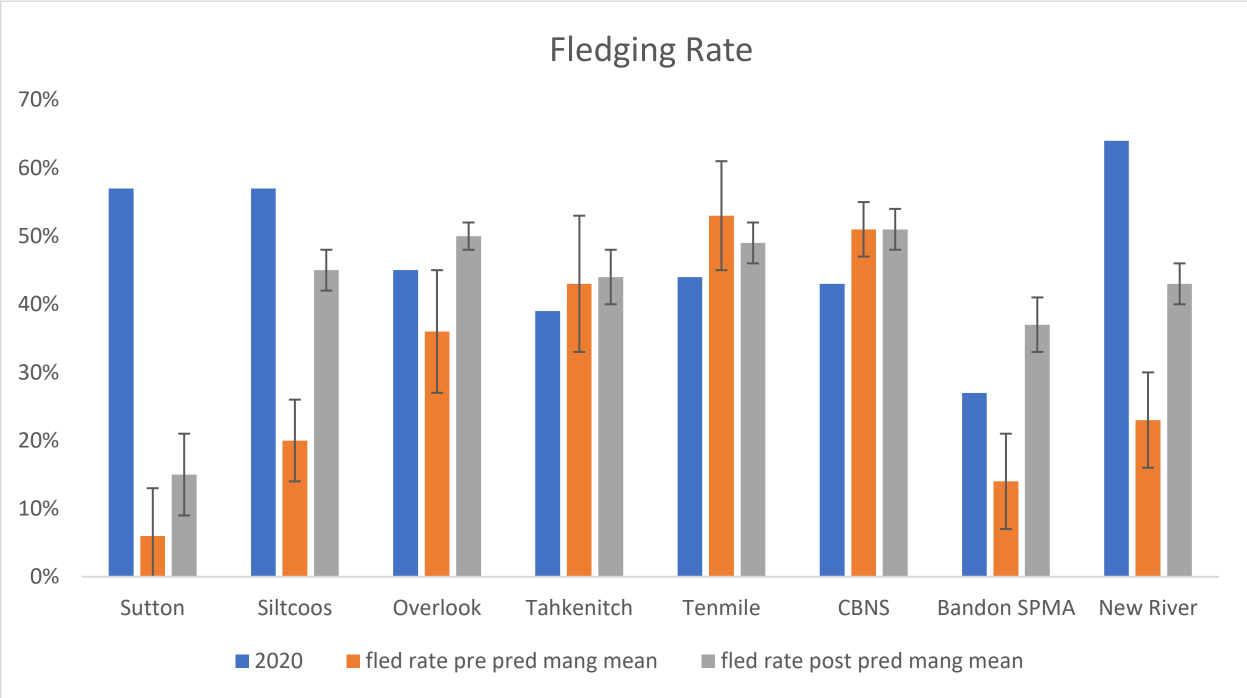


Figure 23. 2020 fledglings per male, mean pre predator management fledglings per male, and post predator management fledglings per male for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

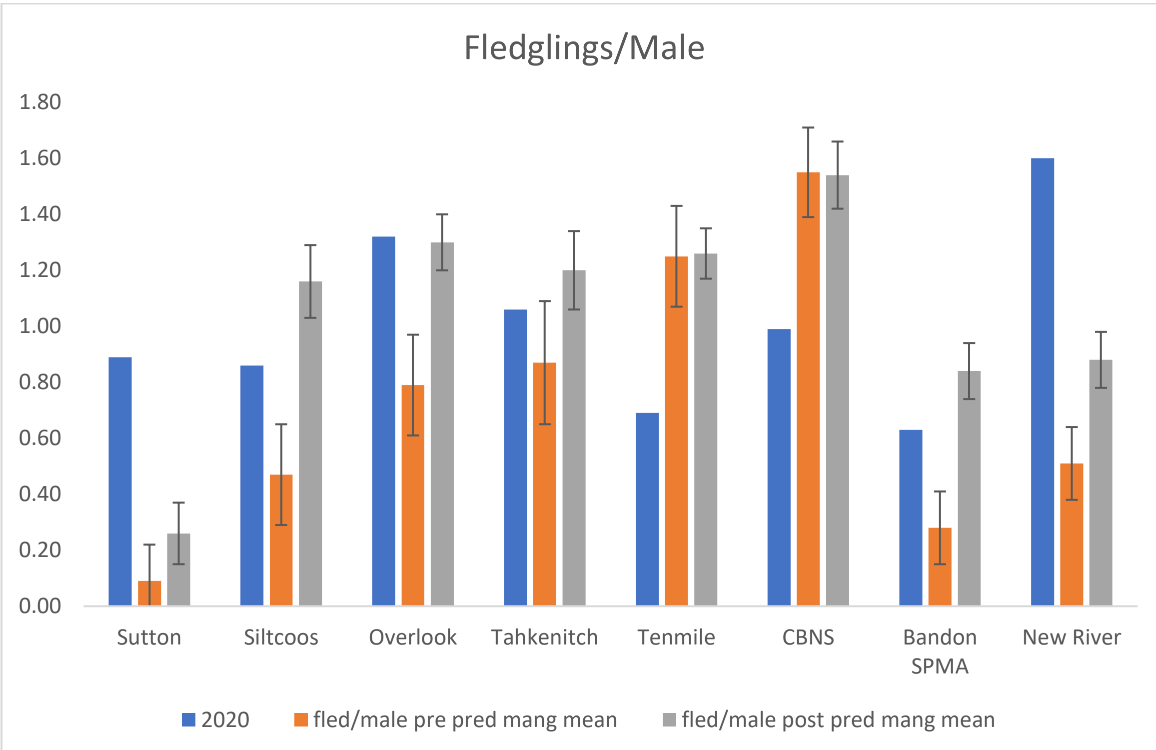


Figure 24. Percentage of the total number of eggs hatched from Sutton Beach to New River, Oregon coast, 1992 – 2020.

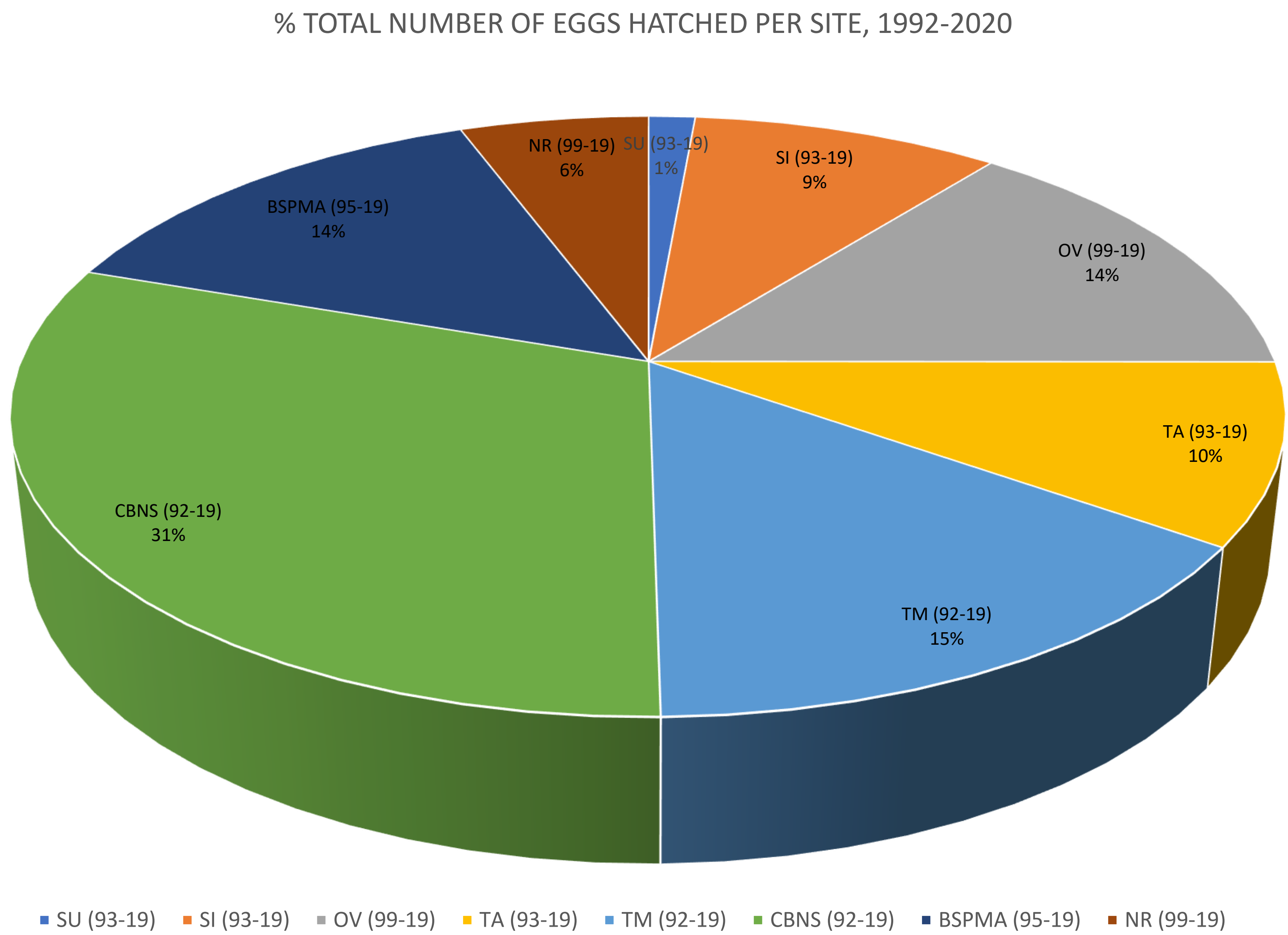


Figure 25. Percentage of total number of eggs laid from Sutton Beach to New River, Oregon coast, 1992 – 2020.

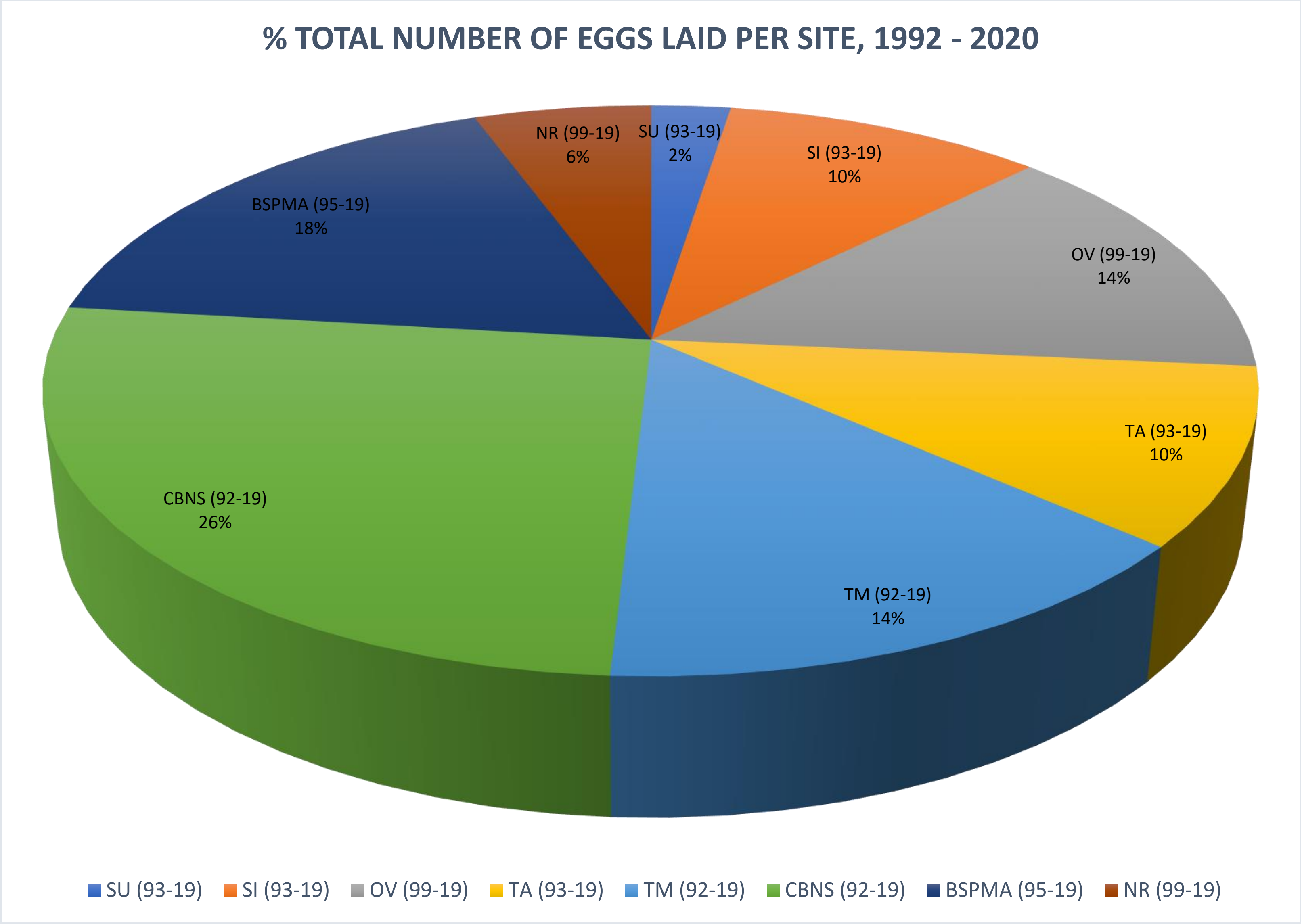


Figure 26. Percentage of total number of fledglings produced from Sutton Beach to Floras Lake, Oregon coast, 1990 – 2020.

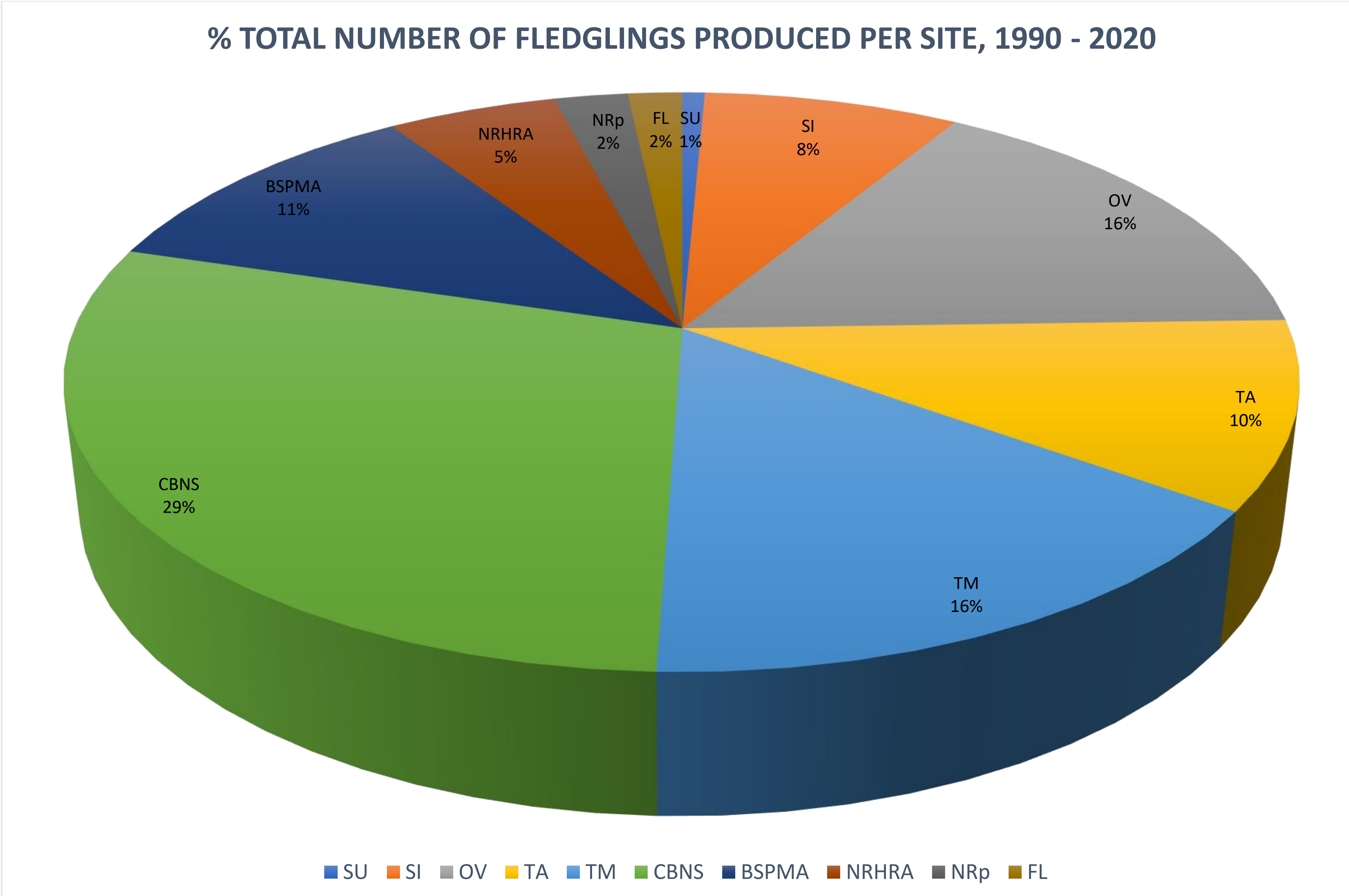
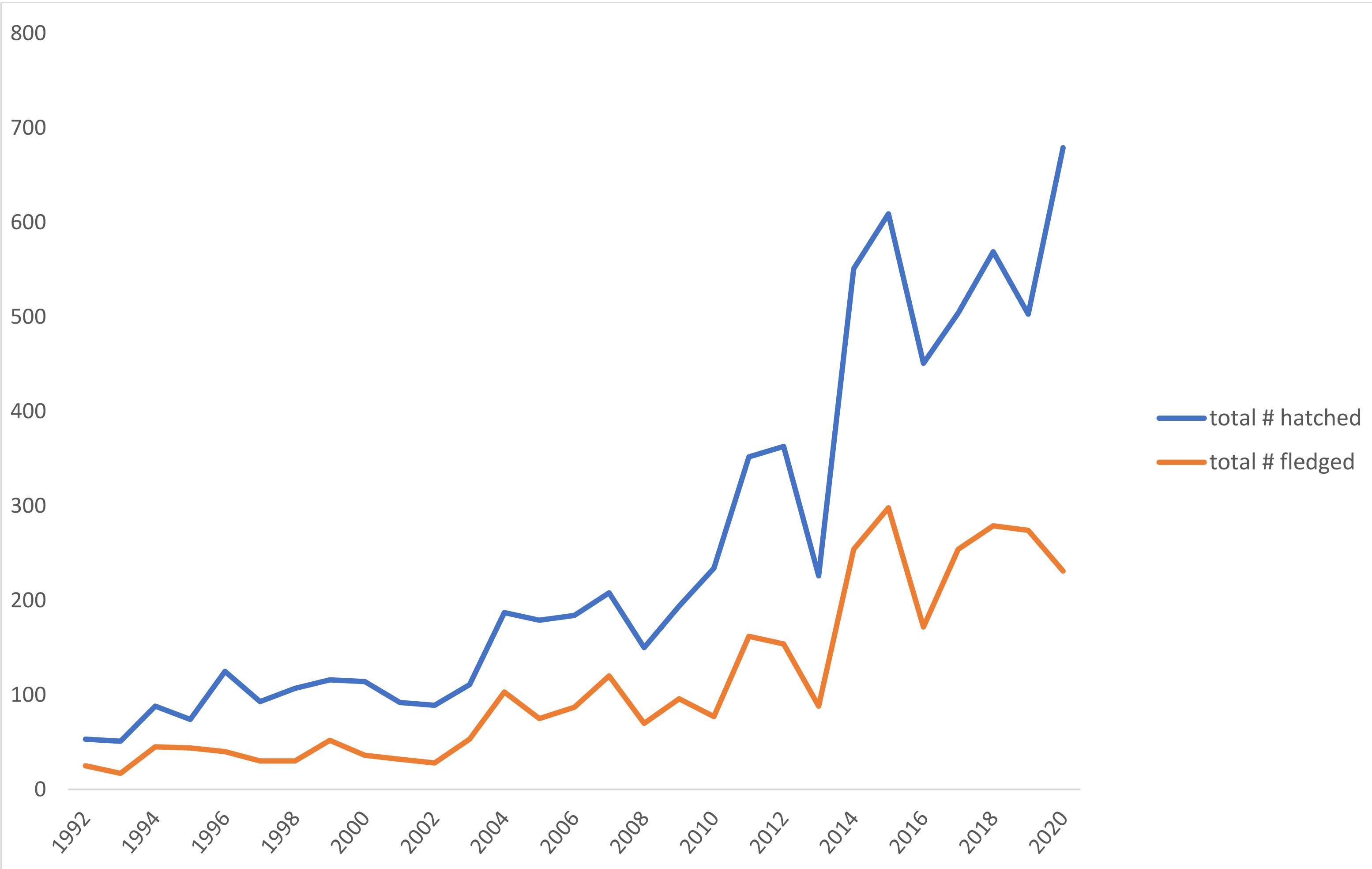


Figure 27. The number of eggs hatched and the number of fledglings on the Oregon coast, 1992-2020.



APPENDIX A.

Study Area

The study area encompassed traditional nesting areas along the Oregon coast including all sites between Berry Creek, Lane Co., and Floras Lake, Curry Co. (Fig. 1). Survey effort was concentrated at the following sites, listed from north to south:

Sutton Beach, Lane Co. (Figure 2). The beach north of Berry Creek south to the mouth of Sutton Creek.

Siltcoos: North Siltcoos, Lane Co. (Figure 3). The north spit, beach, and open sand areas between Siltcoos River mouth and the parking lot entrance at the end of the paved road on the north side of the Siltcoos River; and South Siltcoos, Lane Co. - the south spit, beach, and open sand areas between Siltcoos River mouth and south to Carter Lake trail beach entrance.

Dunes Overlook Clearing, Douglas Co. (Figures 4 and 5). The area directly west of the Oregon Dunes Overlook off of Hwy 101 including the beach from Carter Lake trail to the north clearing, and south to the Overlook trail south of the south clearing.

Tahkenitch Creek, Douglas Co. (Figures 6 and 7) Tahkenitch North Spit **-** the spit and beach on the north side of Tahkenitch Creek including the beach north to Overlook trail; and South Tahkenitch – from the south side of Tahkenitch Creek to south of Threemile Creek north of the north Umpqua River jetty.

Tenmile: North Tenmile, Coos and Douglas Cos. (Figures 8 & 9). The spit and ocean beach north of Tenmile Creek, north to the Umpqua River jetty; and South Tenmile, Coos Co. The south spit, beach, and estuary areas within the Tenmile Estuary vehicle closure, and continuing south of the closure for approximately 1/2 mile.

Coos Bay North Spit (CBNS), Coos Co. (Figures 10 & 11): South Beach **-** the beach from the north jetty north to the Horsfall area; and South Spoil/HRAs - the south dredge spoil and adjacent habitat restoration areas (94HRA, 95HRA, 98HRA).

Bandon Snowy Plover Management Area, Coos Co. (Figures 12 & 13): This site includes the Bandon SPMA and all nesting areas from north of China Creek to the south end of state land south of the mouth of New River.

New River, Coos Co. (Figure 14): The privately owned beach and sand spit south of Bandon Snowy Plover Management Area south to BLM lands, and the BLM Storm Ranch Area of Critical Environmental Concern habitat restoration area (HRA).

Floras Lake, Curry Co. (Figure 15). The beach and overwash areas west of the confluence of Floras Creek and the beginning of New River, north to Hansen Breach.

The following additional areas were either surveyed in early spring or the breeding window survey: Clatsop Spit, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake South Spit, Nestucca Spit, Whiskey Run to Coquille River, Sixes River South Spit, Elk River, Euchre Creek, and Pistol River.

Snowy Plover Monitoring Methods

Nest Surveys

Monitoring began the first week in April and continued until all broods fledged, typically by mid-September. We used three teams of biologists; one two-person team covering Tahkenitch and sites north, one person covering Tenmile, and a two-person team covering Coos Bay North Spit and sites south (Fig. 1). In some years this division has been modified to accommodate staff needs. All data collected in the field was recorded in field notebooks and later transferred onto computer. Surveys were completed on foot and from an all-terrain vehicle (ATV). Data recorded on nest surveys included:

- site name
- weather conditions
- start time and stop time
- direction of survey
- number of plover seen, broken down by age and sex
- band combinations observed
- potential predators or tracks observed
- violations/human disturbance observed

Weekly surveys were attempted, but were not always possible due to increasing workload associated with an increased plover population. Additional visits were made to check nests, band chicks, or monitor broods.

Population Estimation

We estimated the number of Snowy Plovers in the project area by counting the number of individually color banded adult Snowy Plovers recorded during the breeding season, and then adding an estimated number of unbanded Snowy Plovers. To arrive at an estimate of the number of unbanded birds present, we counted the number of unbanded birds recorded during each 10-day interval across all sites. We selected the 10-day interval with the highest number of unbanded adults and subtracted the number of unbanded adults that were captured and banded during the breeding season. We added this minimum number of unbanded adults present to the count of banded adults to arrive at the minimum number of adults present during the breeding season. We also determined the number of plovers known to have nested at the study sites, including marked birds and a conservative minimum estimate of the number of unbanded plovers.

Nest Monitoring

We located nests using methods described by Page *et al.* (1985) and Stern *et al.* (1990). We found nests by scoping for incubating plovers, and by watching for female plovers that appeared to have been flushed off a nest. We also used tracks to identify potential nesting areas. We defined a nest as a nest bowl or scrape with eggs or tangible evidence of eggs in the bowl, i.e. egg shells. We predicted hatching dates by floating eggs (Westerskov 1950) and used a schedule, developed by G. Page based on a 29-day incubation period (Gary Page, pers. comm.). We attempted to monitor nests once a week at minimum. We checked nests more frequently as the expected date of hatching approached. We defined a successful nest as one that hatched at least one egg. A failed nest was one where we found buried or abandoned eggs, infertile eggs, depredated eggs, signs of depredation (e.g. mammalian or avian tracks or eggshell remains not typical of hatched eggs or nest cup disturbance) or eggs disappeared prior to the expected hatch date and were presumed to have been predated. In some instances, we found nests with only one egg; often there was no indication of incubation or nest defense, and it was uncertain to what extent the nest was abandoned, or simply a “dropped” egg. Because it was difficult to make this determination, we considered all one egg clutches as nest attempts, and classified them as abandoned when there was no indication of incubation or nest defense. Data recorded at nest checks included:

- nest number
- number of eggs in nest
- adult behavior
- description of area immediately around nest
- whether or not the nest is exclosed
- GPS location

Brood Monitoring

We monitored broods during surveys and other field work, and recorded brood activity or males exhibiting brood defense behavior at each site. “Broody” males will feign injury, run away quickly or erratically, fly around and/or vocalize in order to distract a potential threat to his chicks. Information recorded when broods were detected included:

- Number of adults and chicks
- Band combinations of adults/chicks seen
- Sex of adults
- Behavior of adults
- Brood location

See Appendix C for information on brood sampling in 2016 and later years.

Banding

Adults were normally trapped for banding on the nest, during incubation, using a lilly pad trap and noose carpets. Lilly pad traps are small circular traps made of hardware cloth with a blueberry net top. The traps have a small door that the plover will enter. Noose carpets are 4” x 30” lengths of hardware cloth covered with small fishing line nooses. Plovers walk over the carpets and the nooses snag their legs. We limited attempts to capture adults to 20 minutes per trapping attempt. Chicks were captured for banding by hand, usually in the nest bowl. Banding was completed in teams of two to minimize time at the nest and disturbance to the plovers. As the Oregon plover population has grown, it has become impossible to band all broods. In 2016 we attempted to band approximately 80% of broods, spread over all sites and across the nesting season. See Appendix C for brood sampling methods.

Adults were banded with a four-band combination of a USFWS aluminum band covered with colored taped and colored plastic bands. We banded broods with a brood-specific two-band combination of USFWS aluminum band covered in colored taped on the left leg and a colored plastic band on the right leg.

APPENDIX C.

Sampling Plan for Banding– Oregon – 2016 to 2018

Statement of problem:

In past years, Oregon Snowy Plover monitors have attempted to band all chicks, to allow accurate estimates of number of chicks fledged per male at each site. As the population has grown this has become impossible with existing staff because of limited time and limited band combinations. Banding chicks at the nest is time-intensive because it often requires multiple visits as the anticipated hatch date approaches. Point Blue is experiencing the same problems at sites they monitor. Recovery Unit 1 (Oregon and Washington) is working on developing a sampling plan through structured decision making that will address survival and productivity estimates for the growing Oregon population, but this plan was not ready for the 2016 field season. Thus, ORBIC worked with Lynne Stenzel at Point Blue Conservation Science and Laird Henkel at California Department of Fish and Game to develop a plan to band a spatially and temporally representative sample of broods starting in 2016.

2016 Brood sampling plan:

Plover productivity is a function of nest success (percent of nests that hatch at least one egg) and fledging success (percent of chicks that survive at least 28 days). We identify nest success by determining the fate of all known nests (see Appendix B). In reality, a small proportion of nests are not located each year, but under this plan we will continue to attempt to locate all nests. This intensive effort to locate nests informs adult population estimates and allows us to provide land management agencies and Wildlife Services with timely information on nest predation.

Starting in 2016, we modified our field methods (see Appendix B) to limit banding and brood tracking to a spatially and temporally representative subset of broods. We used this sample of broods to identify fledging success and chicks fledged per male.

We addressed site variation in fledging success (Dinsmore *et al*. 2017) by sampling broods from all currently occupied nesting sites. We incorporated potential temporal variation in fledging success by banding across the season, dividing the nesting season into 15 10-day periods (Table C-1). Other plover populations exhibit seasonal variation in survival to fledging (Colwell *et al*. 2007, Brudney *et al*. 2013, Saunders *et al*. 2014, Catlin *et al*. 2015). We have not documented this in Oregon (Dinsmore *et al*. 2017), but a 10-day interval allows us to collect data that will be comparable with sampling being done in Recovery Unit 3 (Lynne Stenzel, pers. comm.).

For each 10-day period, at each site, we:

- Attempted to locate all nests.
- Estimated hatch date for all known nests based on number of eggs in nest when found, or by floating eggs (Westerskov 1950, Hays and LeCroy 1971, Dunn et al. 1979, Rizzolo and Schmutz 2007, Gary Page personal communication).
- Recorded fate of all known nests.
- Color banded all chicks from a sample of hatched nests. Our sample consisted of the first 5 known nests to hatch at each site in a given 10-day period (Table C-1). At sites with fewer than 5 hatched nests during an interval, we banded all broods from known nests (but see next bullet point). At sites with more than 5 hatched nests during an interval, we banded all chicks from the first 5 known nests that hatched. As in previous years, chicks did not receive unique color combinations; instead we used brood-specific combinations. Each chick received a USGS metal band wrapped with a brood-specific color tape combination on the left leg and a color band on the right leg (see Appendix B).
- It is not necessary to band chicks at sites with fewer than 3 breeding pairs (e.g. Floras Lake in recent years). At low-occupancy sites, even if birds nest simultaneously, the likelihood of all nests surviving to hatch at the same time is extremely low. Thus, the likelihood of these sites having multiple same-age broods is low, and

monitors can track broods and determine fledging without banding, thus saving limited band combinations for more populated sites. Because there are not more than 5 nests hatching in a 10-day period at low-occupancy sites, all broods from these sites are included in the sample, whether banded or not.

- Broods from undiscovered nests that were not banded, were not included as part of the sample, and were not included in productivity estimates for the site. If a brood from an undiscovered nest was found and captured with all three chicks, this brood was used in the productivity calculations.
- Broods were selected for sampling based on actual hatch date, not on expected hatch date.
- If we incorrectly estimated the expected hatch date of a known nest, and the brood was out of the nest before we were able to band it, we skipped that brood and banded the next brood that hatched, up to a total of 5 broods per site per 10-day interval.
- Conducted approximately weekly surveys to relocate banded broods during the fledging period. Banded chicks observed were recorded, but status of very young broods was also confirmed based on adult behavior. As broods approached fledging age, we increased effort to count individual chicks. Chicks observed at or after 28 days after hatching were considered fledged (Warriner et al. 1986).
- The banded sample of broods and their attending male was used to report brood success, fledging success, and to calculate the number of fledglings per sampled brood. The banded sample of chicks that fledged was multiplied by a weighting factor (total broods/broods sampled) to give an estimated number of chicks fledged per site. The number of fledglings per male was then calculated from the estimated number of fledglings and the number of resident males for each site and overall. Standard deviations and 95% confidence intervals will be calculated on these estimates.

This proposed design is flexible; if the population decreases, the sample would return to a census because fewer than 5 nests would hatch within a given interval at a site. We incorporated this plan as a pilot in 2016. We hope that by the 2017 field season a comprehensive sampling plan will have been developed through the strategic decision making process.

Table C-1. Ten-day intervals used to determine brood sample in 2016 and 2017. Within each interval, the first five hatched broods were banded and tracked to fledging.

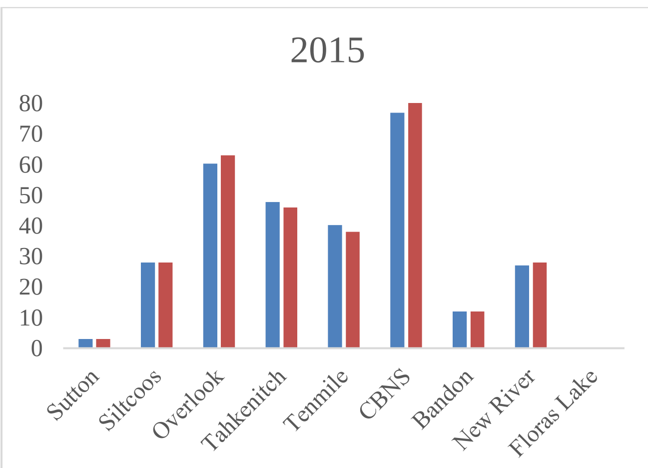
Ten day intervals	**Interval number**
April 1 - April 10	1
April 11 - April 20	2
April 21 - April 30	3
May 1 - May 10	4
May 11-May 20	5
May 21 - May 30	6
May 31 - June 9	7
June 10 - June19	8
June 20 - June 29	9
June 30 - July 9	10
July 10 - July 19	11
July 20 - July 29	12
July 30 - August 8	13

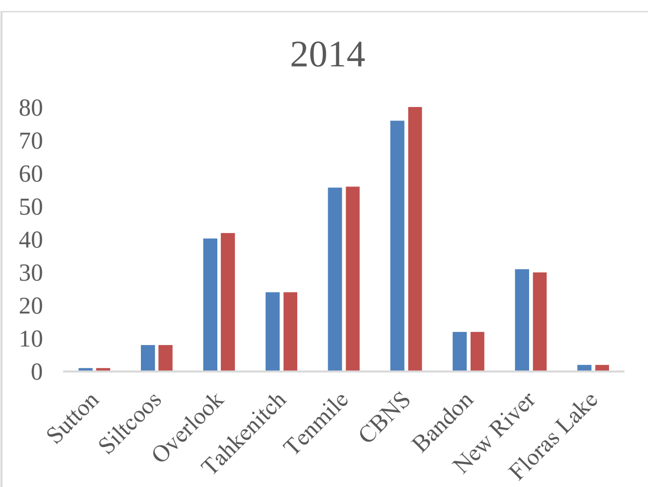
August 9 - August 18	14
August 19 - August 28	15

Test of sampling plan using recent data

We used data from 2013 – 2015 to test how well this sampling plan would have estimated the number of fledglings in those years. We chose those years because prior to 2013 the population was small enough that these methods would have resulted in a sample nearly identical to the total number of broods banded and tracked (i.e. we would have sampled the full population under this plan). For this analysis, we only used nests for which we had a hatch date and known brood outcome, so the numbers of total broods and fledglings in this analysis are slightly lower than totals reported in our annual reports. Based on hatch dates, we identified the nests that would have been sampled under this proposed scheme, and recorded the numbers of chicks that fledged from these sampled nests. We then used the sample to estimate the number of chicks fledged by site and across all sites per year. We compared these estimates to the numbers from the full (unsampled) data set (Figure C-1).

This approach used observed data and simulated samples to characterize the population estimates and the accuracy of the estimates. Based on a review of the data and sample variances associated with the historical data it is clear that the sample weights are low and in many cases equal one (and thus are representative of the entire population [i.e. a census]). Confidence intervals are extremely small. In all cases, over 80% of the broods were sampled. Figure C-1 shows that estimates of the number of fledglings derived from this example closely track the observed number of fledglings.





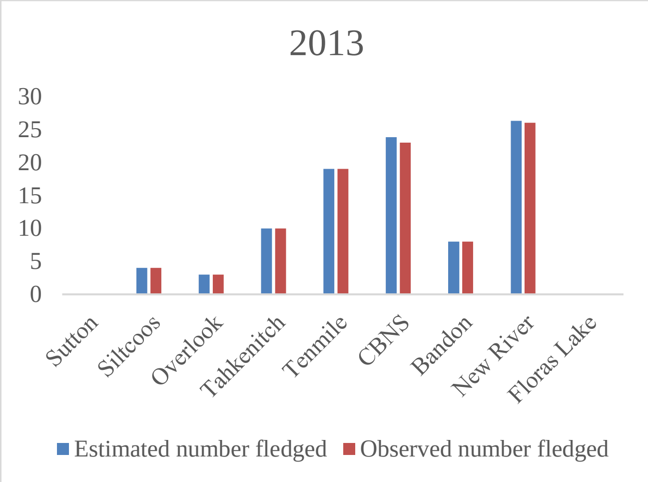


Figure C-1. Comparison of estimated number of fledglings from sample to observed data for 2013 – 2015.

Summary

This conservative sampling plan is intended to continue banding and tracking a large percentage of the plover population to ensure continued highly accurate productivity estimates with associated confidence intervals while using repeatable methods. If the Oregon Snowy Plover population continues to grow, and increased numbers of nests hatch, the percentage of hatched nests sampled will decline and variability estimates may increase. However, as shown in the above review of historic data, variance is small and the estimates are close to the observed data. If the population declines and/or nest success is low, this sampling plan will by design approach a full census.

This sampling plan will save monitors time by allowing them to track a subset of broods through fledging. In 2015, this sampling plan would have reduced the number of broods tracked by 42. Time savings will occur once 5 nests have hatched in a 10-day interval at a site because at that point monitors need only document a nest's fate; they will not have to be physically present while it is hatching. Being present at hatchings is time intensive because monitors may have to make repeated visits to a nest to band all chicks. Timing of these visits is not flexible, affecting monitors' ability to complete other tasks efficiently. Documenting fate of a nest can be determined via camera or by visiting the nest once. After nest fate is determined monitors do not need to return. This plan would allow monitors to skip a small and clearly identified portion of nest hatchings.

Using the sample to estimate plover productivity

Using the sample, we calculated brood success for each site (the number of broods that successfully fledged at least one chick). Based on the number of eggs and fledglings counted from the sample, we calculate fledging success for each site (the number of chicks fledged/the number of eggs laid). In order to determine fledglings per male for each site and the entire project area, we treated each sampled brood as an independent unit and used the sample to calculate the estimated fledglings per sampled brood. Not all males on each site are sampled. To estimate the number of breeding males for each site, we use the survey data to determine how many males were resident at each site. Males were considered resident if they were present at a site between 15 April and 15 July and therefore had an opportunity to attempt to nest. Using the number of fledglings produced per sampled brood, we calculated an estimated number of fledglings produced for all broods at each site:

$$f_{sy} * k_y = E_y$$

where f_{sy}= the number of fledglings per sample brood at site y; k_y = total number of known broods at site y; and E_y = the estimated number of fledglings for site y.

We then divided E_y by the number of resident males for site y (R_y):

$$\frac{E_y}{R_y} = F_y$$

So that F_y is the estimated number of fledglings produced per male for site y.

We calculated the estimated number of fledglings per male for each site. Since males can and do roam between sites, and can breed at more than one site in a given year, to estimate fledglings per male for the project area, we determined the total number of resident males within the project area, and divided that by the estimated number of fledglings produced for all known broods. We calculated a mean number of fledglings per male from all sites, and display the mean with the standard deviation (Table C-2).

Table C- 2. Data used to calculate estimated number of fledglings by site in 2020.

Site Name	total # of known broods	broods in sample	% brood success of sample	total # of eggs hatched in sample	# fledged from sample	% fledging success from sample	# of fledglings/brood sampled	# of fledglings/brood sampled – combined	# of resident males	estimated # of fledglings[a]	estimated # of fledglings/male[b]
Sutton Beach	6	3	67%	7	4	57%	1.33	1.33	9	8	0.89
Siltcoos:											
North Siltcoos	3	3	67%	9	5	56%	1.67	1.57	28	24	0.86
South Siltcoos	12	11	100%	29	17	59%	1.55				
Overlook											
North Overlook	30	21	76%	51	23	45%	1.10	1.21	57	75	1.32
South Overlook	32	27	89%	79	35	44%	1.30				
Tahkenitch											
North Tahkenitch	40	31	68%	84	33	39%	1.06	1.06	44	43	0.98
South Tahkenitch	1	0									
Tenmile:											
North Tenmile	17	9	78%	25	9	36%	1.00	1.21	42	29	0.69
South Tenmile	7	5	80%	14	8	57%	1.60				
Coos Bay N. Spit											
South Beach	35	31	61%	80	36	45%	1.16	1.10	74	73	0.99
South Spoil	7	6	83%	14	8	57%	1.33				
HRA	24	15	53%	39	13	33%	0.87				
Bandon SPMA	46	38	50%	96	26	27%	0.68	0.68	51	31	0.63

New River											
HRA	10	9	89%	22	14	64%	1.56	1.56	10	16	1.60
Other lands	0	0							7		0.00
Floras Lake	0	0							4		0.00
TOTALS	**270**	**209**	**72%**	**549**	**231**	**42%**	**1.11**			299	

a - number of fledglings/brood sampled x the total number of known broods = estimated number of fledglings produced

b - number of estimated fledglings/number of resident males = estimated number of fledglings per male