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The Distribution and Reproductive Success of the Western Snowy Plover Along the Central and Southern Oregon Coast - 2023

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Abstract

We monitored the distribution, abundance and productivity of the federally threatened Western Snowy Plover (*Anarhynchus nivosus nivosus*) along the central and south coast of Oregon from 4 April – 15 September 2023. We surveyed and monitored plover activity in a project area that included, from north to south, Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North 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 2023 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 475 individuals, lower than in 2022. We monitored 567 nests in 2023. Overall apparent nest success was 34%. Nest failures were attributed to unknown depredation, harrier depredation, unknown avian depredation, corvid depredation, unknown cause, abandonment, mammalian depredation, one egg nest, gull depredation, wind/weather, overwashing, and infertility. We sampled 62 of 190 known broods that produced 87 fledglings and estimated 261 total fledglings. Using the sample, brood success was 86%, fledging success was 54%, and based on the overall number of resident males, 0.79 chicks fledged per resident male.

Contents

Introduction

The Western Snowy Plover (*Anarhynchus 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 34th year 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 (Figure 1). 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 adequate annual productivity, leading to a sustainable Oregon breeding population at or above recovery levels. Previous work and results have been summarized in annual reports that are available at https://inr.oregonstate.edu/biblio. Our objectives for the project area in 2023 were to: 1) estimate the size of the adult Snowy Plover population in the project area, 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

Due to the large plover population in the project area, in 2023 ORBIC intensively monitored plover activities, from north to south, at Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, the South Umpqua beach to the north spit at Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Snowy Plover Management Area (SPMA), and New River Area of Critical Environmental Concern (ACEC) (Figure 1). Monitoring was limited at Sutton Beach, South Tenmile, New River private land from the south end of Bandon SPMA to the New River ACEC, and Floras Lake. Additional habitat between South Tahkenitch to the North Umpqua jetty (North Umpqua) was monitored by US Forest Service (FS) biologists. At intensively monitored 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. Sites that were less intensively monitored had limited survey visits, with reduced nest monitoring. In 2023, we sampled broods from CBNS, Bandon SPMA, New River private land, and the New River Habitat Restoration Area (HRA). 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. We report summaries of the number of nests found outside intensive monitoring areas as reported to us by 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 late-May. Breeding season window surveys were conducted at both currently active and historic nesting areas (Elliott-Smith and Haig 2007). All historic nesting areas were searched during the breeding window survey in 2023: Clatsop Spit, Camp Rilea, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake Spits and Sitka Sedge State Natural Area (SNA), Nestucca Spit, Salmon River Spit, Salishan Spit, Agate Beach, Yaquina Point, South Beach State Park, Bayshore Spit, South Alsea Bay, Whisky Run to Coquille River, Sixes River, Cape Blanco to the Elk River, Elk River, Euchre Creek, Otter Point, Myers Creek to Pistol River, and Crissy Field.

Monitoring

Breeding season fieldwork was conducted from 4 April to 15 September 2023. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found 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. No other modifications to survey techniques were implemented in 2023.

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 (1 April through 15 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.

Many adults are banded and thus uniquely identifiable, while 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. The 10-day interval with the highest count was used as an index of the minimum number of unbanded plovers using the project area. This number was added to our count of banded adults present, resulting in the minimum number of adults present. We used the highest number of unbanded adults at each site during the resident period to estimate the number of unbanded resident plovers for each site. We added this number of unbanded birds to our count of banded resident adults for a total estimate of resident birds. We believe the number of resident plovers is the best 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 2023 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. Data from CBNS nesting sites were aggregated as plovers move freely between the beach and the HRA and South Spoil nesting areas. 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.

We began brood sampling in 2016 (Lauten *et al*. 2016) and continued those efforts through 2020 (Lauten *et al*., 2017, 2018, 2019, and 2020). In 2021 and 2022 we modified brood sampling due to the continued increasing plover population and the limits of monitoring capabilities (Lauten *et al*., 2021 and 2022, Appendix C). In 2023 we only sampled broods from CBNS, Bandon SPMA, New River private lands, and New River HRA due to logistical and staffing limitations. Sampling techniques were the same as previous years except for the reduced effort (Appendix C).

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. Some nesting adults that tended broods were already color banded. We did not attempt to band any additional unbanded adults, nor did we attempt to reband any adults in 2023, partly due to health and safety concerns regarding avian flu. 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 that was sampled. We used the average number of fledglings per brood from the sample and the total number of known hatched nests per site to calculate an estimate of the number of fledglings produced at 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 an estimated breeding coefficient for each site (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 2023 to the 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) on a small number of nests 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, North Tahkenitch, Tenmile, and Bandon SPMA in 2023. 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 30 or 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. 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.

Predator management was conducted at all active nesting areas by USDA Wildlife Services (USDA-APHIS-Wildlife Services 2023). ORBIC monitors reported causes of nest failure and daily predator observations to Wildlife Services (WS) staff.

Results

Window Surveys and Monitoring

During the May breeding window surveys, 355 plovers were observed in the project area, 82 fewer plovers than 2022, the second consecutive year of declining plover numbers within the project area. An additional 78 plovers were detected during the window survey at sites outside the project area including the Clatsop Spit, Necanicum Spit, Nehalem Spit, Bayocean Spit, Sand Lake and Sitka Sedge State Natural Area, Agate Beach, Yaquina Point, and Bayshore Spit (USFWS pers. comm.). There was a total of 433 plovers detected on the window survey in Oregon, 50 fewer than in 2022. There were an additional 54 plovers detected in Washington resulting in a total of 487 for Recovery Unit 1 (Washington and Oregon), 54 fewer plovers than counted in 2022 (n = 541). Plover

numbers across the entire Recovery Unit declined between 2022 and 2023. The annual breeding window survey count for the project area and total number of plovers present in the project area throughout the breeding season are in Table 1.

For the second consecutive year, there was an overall decrease in the minimum number of plovers present in the project area (Table 1), with 49 fewer plovers detected in 2023. Of the minimum number of plovers present during the 2023 breeding season, 324 (66%) were banded, 45 fewer adult banded plovers compared to 2022. The maximum number of unbanded plovers estimated by the 10-day interval method was 166, slightly lower than the estimate of unbanded plovers in 2022 (n = 173). Throughout the breeding season we observed 172 banded males, 142 banded females, 13 banded adults of undetermined sex, 101 unbanded males, and 65 unbanded females.

Plovers present between 15 April to 15 July are considered resident and therefore counted as potentially breeding. There was a total of 165 banded resident males, 12 fewer than 2022, and 132 banded resident females, 34 fewer than 2022 (Lauten *et al*. 2022). There were an additional 12 banded adults of uncertain sex present during the 2023 breeding season. Using the minimum number of unbanded individuals estimated by the 10-day interval method during the resident period (n = 166), the minimum estimated resident plover population in the project area was 475, 33 fewer individuals than in 2022. We believe this is the best estimate of the breeding population within the project area. Using the 78 plovers tallied on the window survey from the north coast of Oregon, there were at a minimum 553 adult plovers present in Oregon during the resident season, nearly identical to 2022 (n = 554, Lauten *et al*. 2022).

While the population within the project area declined, the overall plover population on the Oregon coast remained stable. The increase in the number of plovers on the north coast may be due to dispersal of some plovers from within the project area. Plovers that typically nest at some sites in the project area, such as Overlook, may have dispersed due to high levels of nest predation. Other sites such as CBNS and Tenmile may be at or near carrying capacity, resulting in some plovers dispersing to find alternate nesting sites. Overall, the plover population in Oregon continues to be substantially higher than recovery goals set for the state (U.S. Fish and Wildlife Service 2007).

Overwinter Return Rate

Of the 368 banded adult plovers recorded in 2022, a minimum of 258 were recorded in 2023 in the project area. The overwinter return rate based on the minimum number of returning banded adult plovers was 70%, slightly higher than the 1994-2023 mean of 67% and higher than 2022 (66%). The adult male return rate was 75%, higher than 2022 (67%, Lauten *et al.* 2022), and the adult female return rate was 65%, similar to 2022 (64%, Lauten *et al.* 2022). Adult survival is the most important parameter of population growth (Sandercock 2003, USFWS 2007, Dinsmore *et al.* 2010, Gaines 2019). While the male return rate was very good, the lower over winter return rates for females in both 2022 and 2023 likely contributed to lower population levels within the project area in the past two years. We are uncertain whether adult female overwinter survival was actually low, or whether some females dispersed to new locations. The overall Oregon coast population was relatively stable, suggesting that either juvenile survival was high enough to replace adults who did not survive, or some females dispersed to nesting areas outside the project area and thus contributed to a decline in the plover population within the project area while helping to boost plover populations outside the project area.

Of 96 banded fledglings produced in 2022 (Table 2), we observed 42 in the project area in 2023. The return rate was just below the 2013-2023 average (Table 2) and double the previous year. Survival of hatch year 2022 (HY22) 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 2023, but did not return to our project area, were not included in the calculated

return rate. Hatch year plovers that do not return to the project area are important contributors to expanding plover populations at historic and new nesting locations in Northern California, Oregon, and Washington. Despite the lower plover population within the project area in 2023, the overall Oregon coast population remained stable. Of the returning HY22 birds, 18 (43%) were males, 20 (48%) were females, and four were of uncertain sex.

During the 2023 season, we banded a total of 156 chicks. No adults were banded or rebanded.

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 survey South Tahkenitch/North Umpqua area in 2023, and thus do not have an estimate of the number of plovers using this section of beach. The overall number of plovers detected at Sutton Beach in 2023 declined (n = 60 in 2022 vs. n = 37 in 2023, Table 3, Lauten *et al.* 2022) as did the number of resident plovers (n = 39 in 2022 vs. n = 27 in 2023, Lauten *et al*. 2022). The decline in the overall numbers of plovers at Sutton Beach was due to fewer plovers being recorded during the early and late season, but there also was a decline in the number of resident plovers present during the core breeding season. Plovers were noted using the entire beach from Sutton Creek area north to the Holman Vista trail and north to the Berry Creek area (Figure 2).

The number of plovers and resident plovers using the Siltcoos estuary in 2023 was similar to 2022 (n = 94 season-long, and 56 residents in 2022 vs. 87 season-long and 61 residents in 2023, Lauten *et al.* 2022, Table 3). The number of resident plovers has remained relatively stable at Siltcoos over the past five years (Table 3, n = 67, 62, 61, 56, and 61 for 2019, 2020, 2021, 2022, and 2023, respectively, Lauten *et al.* 2019, 2020, 2021, and 2022). The number of plovers and resident plovers at Overlook continues to decline (n = 108 detected plovers season-long and 89 residents in 2022, vs. 96 season-long and 64 residents in 2023, Lauten *et al.* 2022, Table 3). As in 2022, there was very low nest success and quick nest failure at Overlook in 2023 resulting in fewer plovers utilizing this site. The number of resident plovers declined by 25 individuals and was nearly half the number that used this site in 2021 (n = 112 in 2021 vs. 64 in 2023, Lauten *et al*., 2021, Table 3). The number of season-long plovers and resident plovers at North Tahkenitch also declined (n = 119 plovers detected season-long and 101 residents in 2022, vs. 86 season-long and 82 residents, Lauten, *et al.* 2022, Table 3). Fewer plovers at North Tahkenitch was likely the result of low nest success over the past three years (Lauten *et al*., 2021 and 2022, Table 3), causing some breeding adults to disperse to other areas, and low recruitment of previous years' fledglings.

The number of plovers detected season-long at Tenmile was similar to 2022 (n = 124 in 2022 vs. 127 in 2023, Lauten *et al.* 2022, Table 3), however the number of resident plovers declined (n = 116 in 2022 vs. 98 in 2023, Lauten *et al*. 2022, Table 3). Due to extensive good habitat and relatively remote location, Tenmile continues to be one of the most important nesting areas on the Oregon coast with the second highest number of plovers on our study area (Table 3).

USFS biological staff did detect plovers using South Tahkenitch to North Umpqua beaches (pers. comm., USFS staff), indicating that plovers are occupying all available habitat on the Dunes NRA between Siltcoos and Tenmile. Plovers will move between these sites searching for potential nesting locations.

After two years of declining plover numbers at CBNS, there was an increase in both the number of plovers detected season-long and resident plovers compared to 2022 (n = 132 plovers detected season-long and 127 residents in 2022, vs. 154 season-long and 152 residents in 2023, Lauten *et al.* 2022, Table 3). The increase in numbers was mostly due to an increase in the number of unbanded males (Table 3, Lauten *et al*. 2022). The number of unbanded adults has been increasing due to a reduction in banding efforts over the past years, however unbanded adults are difficult to accurately count resulting in greater variability of this number. As noted in 2022 (Lauten *et*

al. 2022), habitat particularly on South Beach continues to degrade as beachgrass moves westward resulting in loss of habitat along the foredune. Plovers continue to seek available and adequate nesting locations at CBNS. Nests were again found north of the FAA towers and between the three vehicle access points north of the FAA towers (Figure 9), and local birders reported multiple broods south of Horsfall Beach and north of the first beach access point at CBNS, indicating multiple nest attempts happening west of the aeration ponds in an area of high public use and no plover management or monitoring. We expect plovers to continue to occupy and attempt to nest at these locations outside of the plover management area.

The number of plovers detected and resident plovers at Bandon SPMA was nearly identical to 2022 (n = 90 plovers detected season-long and 73 residents in 2022, vs. 87 season-long and 75 residents in 2023, Lauten *et al.* 2022, Table 3). Habitat along the Bandon Beach portion of the SPMA is limited due to beachgrass and foredune growth and due to the mouth of Twomile Creek/New River continuing to move northward, eroding the foredune and reducing available habitat on the north side of the river. Plovers continue to attempt to nest along the foredune and north of China Creek (Figure 11). While habitat is limited on the north side, the northward movement of the river continues to create high quality habitat on the south side of the river. During the winter of 2022/2023, New River breached the dunes at the south end of Bandon SPMA, removing a substantial area of beachgrass covered dunes and creating more high-quality habitat at the south end of the SPMA. Due to the dynamic nature of the river, there continues to be much habitat from the mouth of Twomile Creek/New River to the southern boundary of the SPMA. However, nest burial by wind-blown sand is common on the open north end of the spit, and predation from gulls has limited nesting success. Plover use on private land increased in 2023 (n = 10 detected season-long plovers and eight resident plovers in 2022, vs. 22 season-long and 17 residents in 2023, Lauten *et al*. 2022, Table 3). This was due to New River breaching the foredune near the south end of the Bandon SPMA, just north of private land. The resulting habitat created by the breach attracted plovers to the area and therefore more plovers were detected on adjacent private land than in 2022. The numbers of plovers detected at New River HRA was similar to 2022 (n = 25 detected plovers season-long and 24 residents in 2022, vs. 28 season-long and 26 residents in 2023, Lauten *et al.* 2022, Table 3). Plovers used the entire New River HRA from the north end to Clay Island breach (Figure 13), and we noted plover nests and broods utilizing the high-quality habitat on the HRA south of New Lake breach, an area that typically has had limited plover activity. Plover numbers at Floras Lake were slightly lower than in 2022 (6 detected season-long and 6 residents in 2022 vs. 4 season-long and 3 residents in 2023, Lauten *et al*. 2002, Table 3); this site continues to be the least used area within the project area, likely due to limited habitat and fairly high numbers of ravens. 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.

Plovers continue to reestablished populations in every coastal county in Oregon. In 2023, plovers were documented nesting at Clatsop Spit and Necanicum Spit in Clatsop Co., and Nehalem Bay State Park, Bayocean Spit, and Sitka Sedge State Natural Area and Sand Lake in Tillamook Co., Agate Beach State Park, Ona Beach State Park, Fox Creek, and Beachside State Park in Lincoln Co., and a brood was found at Euchre Creek, Curry Co. (OPRD, unpublished data, USFWS, pers. comm., Roy Lowe, Pers. comm.). 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 2023 nesting season in the study area (Figures 2-14). We found 38 more nests than in 2022 despite the lower number of plovers present (Table 1), and 65 more nests hatched (Lauten *et al.* 2022). Overall nest success in 2023 was higher than in 2022 (24% in 2022 vs. 34% in 2023, Lauten *et al*. 2022), below the overall average ($\bar{x}$ = 45%, Table 5) and just below the average of the last 10 years ($\bar{x}$ = 39%,

Table 6). We detected fewer plovers at Sutton Beach in 2023 (Table 3, Lauten *et al.* 2022) and found eight fewer nests (Table 4). We found similar numbers of nests at Siltcoos, with slightly lower numbers at North Siltcoos and slightly higher numbers at South Siltcoos. There was a substantial decline in the number of nests at South Overlook and a slight increase at North Overlook, but the total number of nests at Overlook was over 100 fewer than in 2021 (Table 4, Lauten *et al*. 2021). Declining plover numbers and nests at Overlook were a product of high, rapid nest failure resulting in plovers abandoning the site in search of better nesting locations, as well as low recruitment rates. North Tahkenitch had similar numbers of nests over the past three years (Table 4). The number of nests found at Tenmile increased (Table 4) despite a slight decline in the resident plover population (Table 3). The higher number of nests was likely due to a decrease in nest success (48% in 2022 vs. 34% in 2023, Table 5, Lauten *et al*. 2022), resulting in more renesting attempts. There was an increase in nest numbers at CBNS in 2023 compared to 2022 (Table 4); this was likely due to higher numbers of plovers using the site (Table 3, Lauten *et al*. 2022) and slightly lower nest success (47% in 2022 vs. 43% in 2023, Table 5, Lauten *et al*. 2022). There were fewer nests at Bandon SPMA compared to 2022 (Table 4) but similar numbers of plovers (Table 3), indicating that the higher nest success in 2023 (11% in 2022 vs. 26% in 2023, Table 5, Lauten *et al*. 2022) likely resulted in fewer renest attempts. Nest numbers at New River HRA doubled (Table 4) despite similar numbers of plovers compared to 2022 (Table 3, Lauten *et al*. 2022) and these individuals had very high nest success (Table 5). This was likely the result of very good predator management of ravens at this site and thus low predation pressure resulting in high nest survival. There was limited use of Floras Lake in 2023 (Table 3) resulting low numbers of nests (Table 4).

The first nests were initiated about 31 March (Figure 15). Nest initiation was slightly below average until the middle of May, likely due to the cold, wet spring. Nesting increased through the end of May and then remained high through 9 July. Peak nesting occurred during the 10 June to 19 June time period, the same as 2022 (Lauten *et al.* 2022). The last nest initiation occurred on 16 July.

An additional 123 nests were documented outside our study area (Table 7, including S Tahkenitch and N Umpqua), more than were found in 2022 (n = 85, Lauten *et al.* 2022, Anholt 2023, Roy Lowe pers. comm.). In Clatsop Co., 28 nests were documented at Clatsop Spit and Necanicum Spit; 61% of these hatched (Table 7). Thirty-nine nests were found at Tillamook Co sites, and 21% hatched (Table 7). In Lincoln Co., 44 nests were documented, the majority at Bayshore Spit, Agate Beach, Fox Creek, and Yaquina Bay State Park, and smaller numbers at Beachside State Park, Ona Beach, and Collins Creek (Table 7). Eight of these nests were successful (18%). Seven nests were found by FS technicians at S Tahkenitch (n = 5) and N Umpqua (n = 2), but none of these were documented hatching (USFS unpublished data). Five nests were documented in Curry County at Paradise Point State Recreational Area (n = 4) and Euchre Creek (n = 1); only the nest at Euchre Creek was documented as having hatched. Nineteen chicks were estimated to have fledged from Clatsop Co., twelve fledglings were produced from Tillamook Co., and seven fledglings were produced from Lincoln Co. One chick was documented fledging from Curry Co.

Nest Failure

Predators were the main cause of nest failure and were responsible for 81% of nest failures (Table 8), higher than 2022 (71%, Lauten *et al.* 2022). Northern Harrier (*Circus hudsonius*) was the most commonly identified predator (35% of known depredations). Harriers were documented depredating 59 nests, over twice as many as in 2022 (n = 22, Lauten *et al*. 2022). At CBNS, harriers were the most common predator and were responsible for at least 40 nest failures. Harriers were also documented depredating nests at Siltcoos, Overlook, Tahkenitch, and Tenmile, indicating that they are a common plover nest predator. Common Ravens (*Corvus corax*) are typically responsible for the highest percentage of known depredations, but they were only responsible for 9% of known depredations and only 15 of the 37 corvid depredations (41%), substantially less than 2022 (Lauten *et al*. 2022).

American Crows were identified depredating 15 of 29 nest failures (52%) on Forest Service lands. Despite the lower number of nests that failed to ravens on Forest Service lands, ravens were noted as present all season. Due to the presence of harriers, ravens, and crows, many nests that failed could not be identified to species other than unknown avian predator (32% of all known depredations, and 33% of known predator failures on Forest Service lands). At Bandon SPMA and New River, effective predator management of ravens resulted in very few raven depredations. Nest success at New River spit however was still poor, and camera and tracking evidence indicated a gull was responsible for at least five known depredations. Unfortunately, due to windy conditions, we could not positively identify the cause of many depredations. Camera evidence indicates gulls are extremely quick and efficient at depredating nests, landing very close to the nests and eating the eggs within seconds before flying off. We believe gulls are responsible for the majority of unknown depredations at New River spit. We were unable to obtain a picture of gulls depredating nests, but we believe Western Gull (*Larus occidentalis*) was the likely responsible species, as that has been the case in previous years and they are the most common gull in the area. We expect the gull(s) to continue to be problematic at this site. Coyotes were responsible for 13 of the 15 mammal depredations (87%), all on Forest Service lands, higher than in 2022 (n = 8, Lauten *et al*. 2022). Skunk (*Mephitis* sp.) and a gray fox (*Urocyon cinereoargenteus*) caused one nest failure each. The red fox (*Vulpes vulpes*) population at Bandon Beach and New River appears to have been substantially reduced, as there has been less evidence of their presence in the area over the past several years and as in 2022, no nests failed due to red fox (Lauten *et al*. 2022).

Corvids typically are the most commonly identified nest predator on the study area (see previous reports at https://inr.oregonstate.edu/biblio). In 2023, Common Raven depredations were relatively low at all sites. We do not have an index to raven numbers on the study area, but monitor observations indicated fewer ravens were present in 2023. It is unknown what effect avian flu or increased rainfall has had on the raven population, but it is possible that these two stochastic events may have negatively impacted raven populations in the area. Despite the lower raven numbers, they were present in the Siltcoos to Tahkenitch area, and in conjunction with Northern Harriers, these two predators are having a negative impact on nesting success in this area. Prior to 2022, Overlook was an important nesting area for plovers, but in the past three years very low nest success due to depredation by ravens and harriers at this site led to the abandonment of much plover nesting. Removal of corvids and harriers continues to be an important management strategy for successful plover nesting. See the APHIS-Wildlife Services report for details concerning predator management (USDA-APHIS-Wildlife Service 2023).

Nest failure data indicate the significant impact Northern Harriers have on nesting plovers (Table 8, see previous reports at https://inr.oregonstate.edu/biblio). Harriers depredated nests at Siltcoos, Overlook, Tahkenitch, Tenmile and were the main predator at CBNS. WS removed harriers from Overlook and CBNS in 2023. Data continues to indicate that fledgling output from the broods on the HRA and South Spoil nesting areas at CBNS is being negatively impacted (Table 9). Lauten *et al*. (2019, 2020, and 2021) documented the negative impact of harriers at CBNS on nest success, brood success, fledgling success, and fledglings per brood, and how removal of harriers has a positive effect on these reproductive parameters. In 2023, removal of some harriers at CBNS helped alleviate predation pressure, but an additional pair of harriers that was not removed continued to cause nest failures and likely impacted brood success on the HRA and South Spoil nesting areas. Plovers moved to the beach later in the season, where there was improved nest success (Table 5) and improved reproductive output (Table 9). Management agencies continue to adjust harrier removal alternatives with the goal of reducing negative impacts on plover nesting and brood rearing.

In some previous years (Lauten *et al*. 2020 and 2021) we discussed negative impacts of Great Horned Owl at Bandon SPMA. In 2022 we documented owl activity at the New River spit, and WS incidentally trapped two Great Horned Owls on the New River spit, however we did not document any negative impacts on plover nesting or brood

survival. In 2023 we noted little owl activity, and we had no evidence that nesting or brood rearing was being impacted by owls.

The highest cause of nest failure was unknown depredation (Table 8), similar to 2022 (Lauten *et al.* 2022). Unknown depredations are nests where failure was determined to be caused by a predator, but there was a lack of evidence as to which predator. Our observations from each site suggests the proportion of predators responsible for these unknown depredations. On the Dunes NRA (Siltcoos to Tenmile), the majority of known nest failures were caused by corvids, harriers and coyotes. The unknown depredations in this area were difficult to assess because multiple predator tracks were often left near the nest locations. In some cases it could be determined it was not coyote, but it could not be determined whether it was corvid or harrier. At CBNS, most of the unknown depredations were likely caused by harriers because harriers caused the largest percentage of known depredations. At Bandon SPMA, the large number of unknown depredations were most likely caused by gulls, as ravens were not present most of the summer. For unknown outcomes, evidence at the nest was typically wiped away by windy and/or wet weather conditions, and therefore we were uncertain whether a predator caused the nest failure, the nest may have been buried, or some other event, such as human activity, caused the failure. Reduced coverage at some nesting sites results in longer time periods between some nest visits which increases the likelihood that evidence at the nest site will be destroyed.

Thirty-one cameras were deployed on plover nests in 2023: six at South Siltcoos, five at North Overlook, three at South Overlook, five at North Tahkenitch, eight at North Tenmile, and four at Bandon SPMA. Thirteen of 31 nests hatched (42%). Cameras positively captured the outcome of 22 of the nests (71%); cameras failed to record the outcome of nine nests due to either not triggering or camera failure (dead batteries or not recording correctly). Of the 22 nests where the camera captured the outcome, nine hatched. Cameras documented four harrier depredations, seven corvid depredations, three coyote depredations, one gull depredation, and two abandonments. One nest failed to unknown depredation, as the camera failed to capture the event.

Productivity

We sampled 62 broods at CBNS, Bandon SPMA, and the New River HRA in 2023 (Table 9). We did not band chicks on USFS sites in 2023 for logistic and permitting reasons. We divided CBNS into two sections, South Beach and the nesting area including the HRAs and South Spoil. On South Beach we sampled 13 of 27 broods (48%), and on the nesting area (HRAs and South Spoil) we sampled 17 of 41 broods (41%). Site access requirements during jetty repair, and the need to band all chicks in a brood, limited our ability to sample broods at CBNS. At Bandon SPMA, we sampled 16 of 22 broods (73%), and at New River we sampled 16 of 25 broods (64%). The sample produced 87 fledglings, slightly less than the number of fledglings in the sample in 2022 (n = 96 fledglings, Lauten *et al*. 2022). We calculated fledgling success, fledglings per sampled brood, and the breeding coefficient for each sampled site. Using the number of fledglings per brood from each sampled site, we multiplied by the number of total broods on that site to get an estimated number of fledglings (Table 10). We then used the sampled sites to calculate an average number of fledglings per brood ($\bar{x}$ = 1.42 +/-0.26). We used the average number of fledglings per brood to calculate an estimated number of fledglings for each site based on the number of known hatched nests (Table 10). The mean fledging success rate based on the sample broods (Table 9) was higher than the post-predator management average (Table 11). The average brood success rate of sampled broods (Table 9) was above the post-predator 2004 – 2023 average ($\bar{x}$ = 74% +/- 7%). We estimated a total of 261 (211-311) fledglings were produced in 2023 (Table 10 and Table 12), considerably higher than 2022. We calculated the number of fledglings per resident male for each site within the project area (Table 13). The average number of fledglings per resident male for the project area was higher or equal to the previous three years, below the mean post-predator management average, and below the 10 year mean (Table 13). We believe these estimates of productivity are a reasonable

assessment of productivity in 2023, and our field observations of unbanded fledglings gave us the impression that brood success and fledgling success was good in 2023 and better than 2022. Based on the total resident male population size within the project area (ca. = 266) and the estimated number of fledglings produced (Table 12, 261/266 = 0.98 fledglings per resident male), overall productivity was at recovery goals of 1.00 fledgling per male.

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 10, 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 were generally not very productive for the amount of effort. In 2023, South Beach at CBNS and New River HRA and private land were very productive, while Siltcoos, North Tenmile, CBNS HRAs and South Spoil nesting areas, and Bandon SPMA were also reasonably productive. North Tahkenitch was not very productive, while North and South Overlook were very unproductive. Sutton Beach and Floras Lake have small numbers of nests and broods and therefore are more subject to fluctuations in the breeding coefficient.

Sutton

We documented eight fewer nests at Sutton Beach in 2023 compared to 2022 (Table 4). Nest success in 2023 (Table 5) was lower than the average for this site ($\bar{x} = 20\%$); nest success at Sutton Beach is historically low due to windy conditions and persistent raven activity. Two broods were estimated to produce three fledglings (Table 10). The hatch rate was much lower than 2022 (29% in 2022 vs. 15% in 2023, Lauten *et al.* 2022, Table 5) and was below the post predator management average (Figure 16). Fledging success was higher than 2022 (Lauten *et al.* 2022) and well above the post predator management average (Figure 17), however the sample was very small. The number of fledglings per resident male was lower than 2022 (Lauten *et al.* 2022) and lower than the post predator management average (Figure 18). The number of fledglings produced was lower than in 2022 (Table 12). Sutton Beach historically produces low number of fledglings (Table 12), has low fledging success rates (Figure 17), low fledglings per male (Figure 18), and a low breeding coefficient (Table 10) indicating that this site has consistently poor reproductive output for the effort.

Siltcoos

There were two more nests at Siltcoos in 2023 compared to 2022 (Table 4). Nest success (Table 5) was near the average for both sides of the estuary ($\bar{x} = 36\%$ for the north side, $\bar{x} = 44\%$ for the south side). The hatch rate was just below the post-predator management average (Figure 16). There were 22 broods and they were estimated to have produced 31 fledglings (Table 12). Fledging success was well above the post-predator management average (Figure 17). The overall number of fledglings per resident male was below the post-predator management average for this site (Table 13, Figure 18) but considerably higher than in 2022 (0.04, Lauten *et al*. 2022). The breeding coefficient on both sides of the river was very good (Table 10), indicating good output for the effort. In 2023, Siltcoos was one of the most productive sites on Forest Service lands.

Overlook

We found 16 fewer nests at Overlook in 2023 compared to 2022 (Table 4), continuing a pattern of declining nest numbers at this important site. Of the nests documented, only two hatched (Table 5), resulting in extremely low nest success for the third consecutive year (Lauten *et al*. 2021 and 2022), and well below the averages for these sites ($\bar{x} = 41\%$ for North Overlook and $\bar{x} = 37\%$ for South Overlook). Only three eggs hatched resulting in a very low hatch rate, well below the average (Figure 16). The estimated number of fledglings was three (Table 12), the second consecutive year of very low fledgling production. Fledging success was above the post predator

management average for this site (Figure 17), but the sample was very small. The number of fledglings per resident male was well below the post-predator management average (Table 13, Figure 18). Due to the extremely poor nest success and low numbers of broods, Overlook had extremely low breeding coefficients resulting in lowest measures of productivity in the project area in 2023 (Table 10).

Tahkenitch

The number of nests at North Tahkenitch in 2023 was nearly identical to 2022 (Table 4). Twice as many nests hatched in 2023 compared to 2022 (Lauten *et al*. 2022), however nest success (Table 5) was still well below the average for this site ($\bar{x} = 39\%$). The hatch rate at Tahkenitch in 2023 was well below the post-predator management average (Figure 16). The estimated number of fledglings was 23, higher than the previous two years (Table 12). The fledging success rate higher than post predator management average (Figure 17). The number of fledglings per resident male was well below the post predator management average (Table 13, Figure 18). The breeding coefficient was fairly low indicating poor productivity for this important breeding site (Table 10).

While productivity improved in 2023 at Siltcoos and to a lesser extent at Tahkenitch, there continues to be a trend of poor productivity at Overlook and Tahkenitch due to intense predation pressure particularly by corvids and harriers. Improved predator management at these sites may result in improved productivity.

Tenmile

There were 16 more nests found at North Tenmile in 2023 compared to 2022 (Table 4). Only one nest was monitored at South Tenmile in 2023 due to reduced coverage; it successfully hatched. Nest success at North Tenmile was lower than the average for this site (Table 5, $\bar{x}$ = 43%). The hatch rate at Tenmile was below the post predator management average (Figure 16). The estimated number of fledglings was 44, higher than 2022 (Table 12). The fledging success rate was higher than the post predator management average (Figure 17). The number of fledglings per resident male was below the post predator management average for these sites (Figure 18). The breeding coefficient at North Tenmile was reasonably good, (Table 10), indicating good productivity. North Tenmile and Siltcoos were the only Forest Service sites with good productivity in 2023.

In 2022, the Dunes NRA (Siltcoos to Tenmile) produced 50 fledglings; in 2023 an estimated 102 fledglings were produced, an improvement from the previous year (Table 12). Improved nest success and predator management particularly at Overlook and Tahkenitch would likely result in much higher output from these important nesting areas and help sustain the coastal plover population.

Coos Bay North Spit

We found 56 more nests at CBNS in 2023 compared to 2022 (Table 4). The largest increase in the number of nests occurred on the HRAs (Table 4); South Beach also had an increase in nest numbers. Nest success on South Beach was near average (Table 5, $\bar{x}$= 61%). Nest success on South Spoil was just below average (Table 5, $\bar{x}$ = 58%) and was well below average for the HRAs (Table 5, and $\bar{x}$ = 48%). Harriers were main cause of depressed nest success on the HRAs and South Spoil nesting areas (Table 8). The overall hatch rate for CBNS was just below the average (Figure 16). The estimated number of fledglings was 89, considerably higher than 2022 (Table 12). While brood success was similar on the HRAs and South Spoil nesting area and beach, fledging success and fledglings per brood were depressed on the HRAs and South Spoil nesting area indicating that the harriers were likely negatively impacting chicks as well as nests (Table 9). South Beach produced the most fledglings in 2023 and had the highest breeding coefficient of all sites (Table 10), and thus was the most productive site on the coast. The overall fledging success was average for all of CBNS (Figure 17). The number of fledglings per male was well below average for all of CBNS (Figure 18), however this number may be biased low due to the large number of male plovers that visit

this site during the residency season, and are thus counted as breeding residents, but may not have attempted nesting. The breeding coefficient for South Beach was excellent (Table 10), however the breeding coefficient for the HRA nesting area was depressed indicating that harriers have a negative impact on plover productivity. CBNS continues to be the most important nesting site on the Oregon coast.

Due to a construction project on the north jetty of CBNS, there was a reduction in recreational impacts at CBNS in 2023. There were declines in illegal vehicle use on the beach which Lauten *et al*. (2020, 2021, and 2022) has discussed. However, degradation of habitat on the beach due to beachgrass and western movement of the foredune continues to be a concern, with loss of large amounts of beach slope habitat on the west side of the foredune. This loss of habitat has resulted in a narrowing of available nesting and brooding areas on the beach, and has reduced any buffer between recreational activity on the beach and nesting and brooding plovers. The loss of habitat is detrimental to plover nesting and productivity.

Bandon SPMA

There were 11 fewer nests at Bandon SPMA in 2023 compared to 2022 (Table 4). Nest success was higher than in 2022 (11% in 2022 vs 26% in 2023, Table 5, Lauten *et al*. 2022), but below the average for this site ($\bar{x}$ = 38%). Nest success at Bandon Beach was 29%, higher than 2022 (12%, Lauten *et al*. 2022), and nest success on the New River spit was 25%, also higher than in 2022 (11%, Lauten *et al*. 2021). The estimated number of fledglings produced was 33, higher than the previous two years (Table 12). The hatch rate at Bandon SPMA was just below the post-predator management average (Figure 16). The fledging success rate was well above post predator management average (Figure 17) as was the number of fledglings per resident male (Figure 18), indicating that once broods hatched, they were very successful. Data indicate that one or more gulls were the main cause of nest failure at Bandon SPMA (Table 8), but we do not believe that gulls are a cause of chick mortality. We also noted a lack of ravens, which are a source of chick mortality. Due to the lack of chick predators, once nests hatched at Bandon SPMA, brood and fledgling success were very good. The breeding coefficient was slightly depressed due to the high number of nests that failed (Table 10), indicating that plovers had high input for the amount of chick production at this site. Predator management focusing on improved nest success (i.e., gull removal) at the is site may lead to higher reproductive output.

New River

There were five nests documented south of the Bandon SPMA boundary area on New River private land in 2023 (Table 4, Figure 13). Four of the five nests hatched (80%) and they produced six fledglings (50% fledging success). Data from private land was combined with New River HRA.

We found twice as many nests on the New River HRA in 2023 compared to 2022 (Table 4). Nest success was also very high on the HRA (Table 5) and well above the average for this site ($\bar{x}$ = 51%). The estimated number of fledglings for both the HRA and private land was 33, the highest ever recorded for this area (Table 12). The hatch rate was well above the post predator management average for this site (Figure 16). Fledging success was above the post predator management average (Figure 17) and the number of fledglings per male was well above the post predator management average (Figure 18). The breeding coefficient was excellent (Table 10). The New River HRA area was one of the most productive sites on the coast in 2023. WS efforts to remove red fox from the area as well as successful efforts to reduce raven numbers has had a very positive impact of plover productivity of the New River area.

Floras Lake

There were two nests at Floras Lake in 2023 (Table 4), less than the previous year, and one of the nests hatched and was estimated to produce one fledgling (Table 12).

Summary

In 2023, overall nest success was slightly below the post-predator management average (Table 5, $\bar{x}$ = 40%). While we believe that this is below the level needed for a sustainable population (~ 40%; Gary Page, Lynne Stenzel pers. comm.), poor nest success at two sites in 2023, Overlook and Tahkenitch, contributed the most to the slightly depressed nest success percentage. Improved predator management and higher nest success at these sites would have a positive impact on plover productivity. Based on the brood sample, productivity once broods hatched was at sustainable levels, with brood success above the post predator management average (Table 9, $\bar{x}$ = 74%), fledging success above the post predator management levels (Table 11), and the number of fledglings per sampled brood above recovery goals (Table 9). The estimated number of fledglings produced was 261 (Table 12), nearly equal to the estimated number of resident males (n = 266) and thus close to the recovery goals of 1.00 fledgling per male. The overall breeding coefficient (0.18 +/- 0.12) was double 2022 (0.09 +/-0.09, Lauten *et al.* 2022), indicating overall productivity was much higher in 2023 and there was good reproductive output for the effort. While productivity was particularly poor at Overlook and Tahkenitch, overall productivity within the project area was very good in 2023. Improved productivity at Overlook and Tahkenitch with sustained productivity at the other sites will continue to sustain the Oregon coastal plover population.

Lauten *et al*. (2020) shows that sites between Siltcoos and Bandon SPMA are responsible for nearly 90% of all the eggs laid, eggs hatched, and fledglings produced in the project area since the early 1990s. Management should continue to focus its efforts on enhancing and maintaining good productivity at these sites (Siltcoos, Overlook, North Tahkenitch, CBNS and Bandon SPMA) which 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 (Gaines 2019), and a breeding coefficient over 0.15 should result in a stable to growing plover population along the Pacific Northwest coast.

Productivity Before and After Predator Management

Data from Floras Lake and Sutton Beach are sparse. We did not include data from Floras Lake in the graphs of productivity analysis (Figures 16 - 18), and data from Sutton Beach are displayed solely for the purpose of 2022 comparisons.

The 2023 overall nest success (Table 5) was slightly lower than the ten-year (2014 – 2023) average of 39.0% +/- 12%, and lower than 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 Tahkenitch, Tenmile and CBNS where they have remained relatively stable but above 40% (Figure 17). The post-predator management mean brood success rate for all sites (2004-2023; $\bar{x}$ = 74.3%+/-7.3%) 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 male has improved at all sites except Tenmile and CBNS where it has remained relatively stable at nearly 1.20 for Tenmile and over 1.40 for CBNS (Figure 18). Overall productivity has increased in the post-predator management time period resulting in a substantial increase in the number of fledglings (Table 12). This has resulted in the overall population of plovers, both within the project area and coast-wide in Oregon, being well above recovery goals (Table 1).

Discussion and Recommendations

We have discussed our efforts to balance our ability to sufficiently monitor the nesting sites while collecting adequate data to estimate reproductive parameters (Lauten *et al*., 2021 and 2022). In 2023, a variety of factors including a loss of a long-term monitor, limited time to train new staff, and a major construction project at CBNS that limited access prevented us from sampling broods at the levels we have since 2016 (Lauten *et al.* 2016, 2017, 2018, 2019, 2020, 2021and 2022). In 2023, we were only able to sample at three main nesting sites, and therefore extrapolated reproductive parameters for sites not sampled. We believe the sample provided representative estimates of brood success, fledging success and fledglings per sample brood, and based on our observations we believe the extrapolated data is an accurate assessment of productivity in 2023.

We continue to report different estimates of plover productivity (Tables 9, 10, 11 and 13). In 2023, the estimated number of fledglings produced was nearly equal to the number of resident males, indicating good productivity. The breeding coefficients reflected the reproductive output, with only Overlook, Sutton Beach, and Tahkenitch having coefficients lower than 0.15 (Table 10), the base level of adequate reproductive output. While reductions in banding and sampling will result in less precise data, we believe we obtained an estimate of productivity with acceptable accuracy for the project area in 2023. We intend to continue our efforts to measure productivity in an efficient manner that leads to an accurate assessment of reproductive output.

Predator management continues to be a crucial aspect of a sustainable plover population. Due to the large number of plovers and widespread nesting areas, focusing management actions at nesting sites with high potential output is likely necessary. Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, and Bandon SPMA have contributed most to productivity and the increasing plover population (Lauten *et al*. 2020) and we recommend that future management focus efforts at these nesting sites because they will continue to contribute the most to a sustainable plover population.

Sutton Beach and the Dunes NRA

Sutton Beach continues to have low average reproductive parameters (Figures 16 - 18). There were fewer plovers detected at this site in 2023 (Table 3, Lauten *et al.* 2022) and reproductive parameters were low, resulting in low numbers of fledglings (Table 10). Due to the remote location of the site and the generally small plover population and low reproductive output, monitors and WS agents have had limited available time to visit this site. We expect plovers to continue to occupy this site, but due to the predator community at this site (particularly ravens) and windy conditions, we expect relatively low plover numbers and reproductive output.

There was an improvement in productivity at Siltcoos in 2023 (Table 10) resulting in a good number of fledglings from this site (Table 12). However, Overlook had a third year of very poor productivity (Table 10), resulting in very little fledgling production. North Tahkenitch had better fledgling production than in 2022 (Table 12), however productivity was still depressed (Table 10 and Table 12). These two sites have contributed substantially to annual and long-term plover populations (Lauten *et al.* 2020), and poor fledgling production at these sites has a negative impact on the entire coastal plover population. The cause of low productivity is predation pressure by corvids, harriers and, to a lesser extent, coyotes. Efforts to improve nest success and predator management are needed to increase reproductive output at these important plover nesting areas.

Plovers will abandon sites if high predation pressure results in low nest success and productivity. The number of nests at Overlook has declined substantially over the past three years (Table 4), and unless predation pressure is reduced, we can expect a similar trend in the future. Despite this, there continues to be large amounts of habitat between Siltcoos and the South Tahkenitch/North Umpqua area, and if predation pressure can be reduced, we expect plovers to continue to utilize available habitat throughout this area.

The beach from South Umpqua to Tenmile estuary was one of the most productive areas on Forest Service lands and produced the highest number of fledglings on Forest Service lands (Table 10). Effective predator management, particularly on the North Tenmile spit to South Umpqua has been critical in maintaining high reproductive output. Due to limited time, monitor workload, and relative difficulty accessing South Tenmile, data from this side of estuary has been limited. Data and observations indicate that Northern Harriers are consistently present at Tenmile and, in combination with ravens, are likely the cause of most nest failures. Tenmile is an extremely important nesting site for both the Dunes NRA and for the Oregon coast, and continued predator management will be an important tool to maintain productivity at this site. We recommend efforts to reduce recreational disturbance from the South Umpqua area, as we regularly document human, dogs and occasional vehicle use near nesting plovers.

As noted in Lauten *et al*. (2020), the Dunes NRA (Siltcoos to Tenmile) is critical to maintaining and growing plover populations. Substantial numbers of plovers occupy these sites, and large numbers of nests and fledglings have been produced at these sites (Table 4 and 12). Effective predator management from Siltcoos to South Tenmile continues to be a critical management action resulting in successful plover productivity.

Coos Bay North Spit

As documented in previous reports (Lauten *et al.* 2020, 2021, and 2022), Northern Harriers continue to have a significant impact on nest and brood success at CBNS. In 2023, harriers were documented depredating 40 nests (Table 8), and fledging success on the HRA and South Spoil nesting areas was depressed (Table 9). Multiple harriers were removed from CBNS in 2023 (WS report, 2022), yet additional harriers were present and continued to negatively impact plover productivity. We expect harriers to be an annual presence at CBNS and other sites, negatively impacting plover productivity. The Plover Working Team is continually evaluating and adjusting the best methods to reduce predation pressure by harriers.

We continue to document and discuss the loss of habitat at CBNS due to westward encroachment of beachgrass and rising sea levels (Lauten 2020, 2021, and 2022). In 2023, the north jetty construction project helped reduce recreational activity, and therefore impacts to nesting plovers on South Beach, by limiting access to recreational activity (particularly vehicles) for the majority of each week. However, the reduction of vehicle use on the beach encourages plovers to nest outside of protected areas. In 2023 we received multiple reports of nesting or brooding plovers north of the access points at CBNS, in an area of no management and much human and dog activity. We were unable to survey or monitor this area due to time constraints. Due to the successful nesting and brood rearing on South Beach, we expect plovers to continue to extensively use the beach despite habitat loss and recreational activity. Removal of vegetation in front of the stable, tall foredune would increase available habitat for plovers and provide a buffer from recreational activity. We continue to recommend that ropes and signs be installed along the entire section of closed beach to reduce recreational impacts. We also recommend that maintaining vegetation free corridors through the foredune provides paths for plover broods to either access the beach for foraging and avoiding harrier hunting activity on the HRA and South Spoil nesting areas, or to exit the beach and move onto the HRA and South Spoil nesting areas to avoid vehicle and recreational activity on the beach.

We did not note any impacts of the construction project on plovers in 2023. Construction work has been on the south side of the HRA nesting area and well away from nesting plovers, and jetty work has been on the inside of the jetty so there were no impacts to plovers on South Beach. We did note brood activity in the vicinity of the north jetty, but we did not document any broods wandering into the construction zone. One nest was found near the jetty early in the season, but failed to unknown depredation relatively quickly. There was no construction work in the area at the time. When construction work begins on the westward side of the jetty, we may encounter plover activity nearby.

CBNS continues to be the most productive nesting site north of central California (Lauten *et al.* 2020). Effective predator management at CBNS is essential to maintain high reproductive output at this critical site. CBNS and the Dunes NRA (Siltcoos to Tenmile) continue to be the most productive nesting sites on the Oregon coast, and are largely responsible for maintaining plover population in the entire recovery unit.

Bandon SPMA

At Bandon Beach, the mouth of Twomile Creek/New River continues to move northward and erode habitat, thus reducing available habitat. In addition, beachgrass growth along the foredune has reduced available nesting habitat. Loss of habitat contributed to fewer nests on the Bandon Beach side of the SPMA (Table 4). However, the northward movement of the mouth of the river has resulted in increasing high quality habitat on the New River spit. The new mouth of New River at the south end of the SPMA also created and helped maintain high quality habitat on the south side of the SPMA. The number of plovers at Bandon SPMA remained stable (Table 3, Lauten *et al.* 2022), and the overall number of nests was similar to 2022 (Table 4). Nest success improved in 2023 (Table 5, Lauten *et al*. 2022), resulting in twice as many nests hatching, however due to gull predation and exposure to blowing sand, nest success was below average. The number of fledglings produced also improved as did the breeding coefficient (Table 12 and Table 10). Bandon SPMA has the most extensive natural habitat in the project area, as well as high numbers of plovers (Table 3). We recommend maintaining the extensive habitat through natural processes as well as habitat management techniques. While it is difficult to manage gull depredation, continued efforts to reduce this unique source of nest failure could result in improvements to productivity at this site.

New River

There was an increase in plover usage of New River private lands (Table 3) due to New River breaching at the south end of the Bandon SPMA in winter of 2023, creating excellent habitat just north of private lands. Plovers nested along the northern-most section of private land, and brood rearing occurred along all private land. Two broods from the New River HRA moved north all the way to the Bandon SPMA. There was regular recreational activity from private land owners in the area, with occasional dog tracks on the beach. We did not however document any negative impacts on the plovers. We recommend continued discussions and education of local residents to minimize impacts on plovers in the area. We expect small numbers of plovers to continue to utilize this section of beach.

While plover numbers at the New River HRA remained similar to 2022 (Table 3, Lauten *et al*. 2022), nesting activity nearly doubled (Table 4). Plovers used the entire HRA, including the beach and overwashes from the north end, the Croft Lake breach area, the New Lake breach area, the extensively cleared section south of New Lake breach, Hammond breach, and Clay Island breach and the beach south of Clay Island. WS has substantially reduced the red fox population resulting in little to no fox activity, and their work in 2023 reduced raven pressure to a minimum. Continued predator management efforts are essential for New River HRA to remain productive as nearby ranches provide a continual population of ravens to replace removed animals. Maintaining habitat at the New River HRA benefits adjacent nesting areas at Bandon SPMA by reducing vegetation cover that red fox and other mammalian predators inhabit, and also provides alternative nesting locations for plovers nesting within the Bandon to Floras Lake system.

Floras Lake

Floras Lake continues to have small numbers of plovers (Table 3) and nests (Table 4). There was one successful nest in 2023 (Table 5). Limited habitat, high predator activity due to the proximity of sheep and cattle

ranches, and recreational activity all contribute to low plover activity at this site. We expect plovers to continue to occupy this site in low densities.

Conclusion

Improved nest success (Table 5), fledgling success and fledglings per male (Table 11) resulted in much higher estimates of fledglings (Table 12) in 2023 compared to 2022. Overall plover numbers declined for the second consecutive year but were still well above recovery goals (Table 1). Improved fledgling output in 2023 should help stabilize adult plover numbers for 2024. Productivity was very poor at Overlook (Table 10); improved nest success at this site and Tahkenitch would likely result in better fledgling numbers. While we sampled considerably fewer broods than previous years, observations suggest our sample still resulted in accurate assessments of plover productivity. We intend to continue sampling when and where we can in 2024. Successful production of plovers within the project area is critical to populations from Washington to Mendocino Co., CA, and effective predator management is important to the success of the plovers (Gaines *et al*. 2020). Management should focus efforts on sites with high plover densities and potential for high reproductive output. Plovers produced within the project area are responsible for the recolonization of former nesting areas particularly along the Oregon coast. Plover productivity within the project area will continue to contribute to stable and sustainable populations in Washington, northern Oregon, and northern California sites. We recommend continued efforts at habitat management, predator management, and recreation management.

Immigrant Plovers

Thirty-one adult plovers banded in California were observed in Oregon in 2023. Thirteen were females, seventeen were males, and one was unknown sex. Twelve females and 14 males were resident plovers. Two females and one male were present outside of the breeding season and were likely either wintering or visiting plovers.

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Table 1. Minimum window survey counts and the minimum number of Snowy Plover present from Sutton Beach to Floras Lake, Oregon Coast, 2012-2023.

YEAR	WINDOW SURVEY	# SNPL PRESENT
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
2021	481	614
2022	437	542
2023	355	493

Table 2. Number of banded Snowy Plover fledglings, number of previous year fledglings returning, and return rate between Sutton Beach and Floras Lake, along the Oregon coast, 2013 - 2023.

Year	**# of banded fledglings from previous year**	**# of HY birds from previous year sighted in project area**	**Return Rate (#HY/#Fled)**
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
2021	231	93	40.3
2022	162	37	22.8
2023	96	42	43.8
		AVERAGE =	45.2
		STDEV =	10.1

Table 3. Plover activity based on the number of adult plovers at each nesting area on the Oregon Coast between Sutton Beach and Floras Lake, 2023. 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	10	9	6	6	13	9	8	3	37	27
Siltcoos	28	15	12	9	34	25	13	12	87	61
Overlook	34	20	14	4	36	28	12	12	96	64
N. Tahkenitch	32	28	12	12	26	26	16	16	86	82
Tenmile	34	29	23	17	42	32	28	20	127	98
CBNS	38	36	21	21	57	57	38	38	154	152
Bandon SPMA	40	33	11	10	20	18	16	14	87	75
New River private	8	3	6	6	3	3	5	5	22	17
New River HRA	11	10	3	3	11	11	3	2	28	26
Floras Lake	1	1	1	1	1	0	1	1	4	3

Table 4. Number of nests for selected sites between Sutton Beach and Floras Lake on the Oregon Coast 2013 – 2023; cells tally nests only and not broods from undiscovered nests.

Site Name	13	14	15	16	17	18	19	20	21	22	23
SU	1	2	8	19	21	20	15	20	11	21	13
SI:											
North	13	6	8	15	25	15	12	13	21	29	25
South	30	18	23	42	31	24	29	24	29	25	31
OV:											
North	33	35	46	48	61	24	38	52	75	24	29
South	28	23	42	56	47	34	35	50	80	39	18
TA											
North	52	32	61	74	56	47	49	62	75	79	78
South	6	4	2	0	2	1	8	8	6	-	-
TM:											
North	19	26	29	34	40	66	52	103	90	76	92
South	17	21	32	59	24	33	26	33	25	16	1
CBNS:											
SB	36	20	41	48	33	32	29	52	26	33	43
SS	12	13	20	38	27	29	27	20	19	17	20
HRAs	58	43	66	97	74	67	78	61	80	52	95
BSPMA											
BB	44	28	40	57	32	36	51	39	62	33	24
NR spit	20	54	48	73	49	43	70	92	83	63	61
NR HRA	9	15	27	14	11	10	16	12	24	15	30
NR other	3	4	8	18	11	5	7	1	3	1	5
FL	0	2	0	1	3	4	9	8	3	6	2
Total nests	**381**	**346**	**501**	**693**	**547**	**490**	**551**	**650**	**712**	**529**	**567**

Table 5. Apparent nest success of Snowy Plovers between Sutton Beach and Floras Lake on the Oregon Coast, 2023.

Site	Total #	Hatch	Fail	Unknown	App Nest Success
Sutton	13	2	9	2	15%
Siltcoos					
North	25	9	14	2	36%
South	31	13	17	1	42%
Combined	56	22	31	3	39%
Overlook					
North	29	2	27	-	7%
South	18	0	17	1	0%
Combined	47	2	44	1	4%
Tahkenitch					
North	78	16	60	2	21%
Tenmile					
North	92	31	58	3	34%
South	1	1	0	-	100%
Combined	93	32	58	3	34%
CBNS					
South Beach	43	27	16	-	63%
South Spoil	20	10	9	1	50%
HRAs	95	31	60	4	33%
Combined	158	68	85	5	43%
Bandon SPMA	85	22	62	1	26%
New River					
HRA	30	21	8	1	70%
Other Lands	5	4	1	-	80%
Floras Lake	2	1	1	-	50%
Totals	567	190	359	18	34%

Table 6. Apparent nest success of Snowy Plover nests between Sutton Beach and Floras Lake on the Oregon coast, 2014 - 2023 with ten-year average and 1990 - 2023 overall average.

2014	60%
2015	48%
2016	25%
2017	42%
2018	49%
2019	41%
2020	40%
2021	27%
2022	24%
2023	33%
average '14-'23	39%
stdev	11.7
average '90-'23	45%
stdev	13.0

Table 7. Snowy Plover nests and fledglings reported from outside the ORBIC intensively monitored area in 2023.

Site Name	County	Nests found	Hatched	Failed	Chicks fledged	Apparent nest success
Clatsop Spit	Clatsop	21	12	8	13	57%
Necanicum Spit	Clatsop	7	5	2	6	71%
Nehalem Spit	Tillamook	9	1	7	3	11%
Bayocean Spit	Tillamook	18	4	11	8	22%
Netarts Spit	Tillamook	0				
Sitka Sedge	Tillamook	12	3	9	1	25%
Sand Lake	Tillamook	0				
Agate Beach	Lincoln	9	1	8		11%
Bayshore	Lincoln	13	0	13		0%
Beachside SP	Lincoln	2	2	0	4	100%
Ona Beach	Lincoln	1	1	0	1	100%
Collins Creek	Lincoln	1	0	1		0%
Fox Creek	Lincoln	9	4	5	2	44%
Yaquina Bay SP	Lincoln	9	0	9		0%
S Tahkenitch/	Douglas	5	0	1		0%
N Umpqua	Douglas	2	0	1		0%
Euchre Creek	Curry	1	1	0	2	100%
Paradise Point	Curry	4	0	2		0%
Total		**123**	**34**	**77**	**40**	**28%**

Table 8. Causes of Snowy Plover nest failure at survey sites between Sutton Beach and Floras Lake along the Oregon coast, 2023.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Corvid	Unk	Mammal	Harrier	Avian	Wind	Over-wash	Abandon	One Egg Nest	Infer	Unk cause
Sutton	13	9	1	7							1		
Siltcoos:													
North	25	14	5	7		1	1						
South	31	17	5	2	3[b]	3	3						1
Overlook													
North	29	27	3	12	4[b]		2		1	2	1		2
South	18	17	4	7	1[b]	3				2			
Tahkenitch													
North	78	60	5	26	1[b]	8	12	1		2	2		3
Tenmile:													
North	92	58	6	16	4[b]	4	15			4	3		6
South	1	0											
Coos Bay North Spit:													
South Beach	43	16	1	5		5		1	1		3		
South Spoil	20	9				6	2	1					
HRAs	95	60	1	9		29	16			2	1	1	1
Bandon SPMA	85	62	3	30	1[c]		5[e]	1	1	6	1		14
New River													
HRA	30	8	2	3	1[d]						1		1
Other lands	8	1		1									
Floras Lake	2	1	1										
TOTALS	567	359	37[a]	125	15	59	56	4	3	18	13	1	28

[a] – 15 raven depredations, 20 crow depredation, 2 unknown corvid
[b] – coyote depredations
[c] – gray fox depredation
[d] – skunk depredation
[e] – gull depredations

Table 9. Number of broods sampled (number successful in parenthesis), brood success, and fledging success based on sample at CBNS, Bandon SPMA, and New River, Oregon coast, 2023.

Site Name	# of broods in sample	% brood success	# of eggs hatched in sample	# of fledglings from sample	% fledging success	fledglings per sampled brood
Coos Bay N. Spit						
South Beach	13(11)	85%	32	22	69%	1.69
South Spoil/HRA	17(14)	82%	51	18	35%	1.06
Bandon SPMA	16(13)	81%	43	24	56%	1.50
New River HRA/PRIVATE	16(15)	94%	41	23	56%	1.44
Average		85.6%			54%	1.42 +/-0.26

Table 10. Number of broods per site, the estimated number of fledglings per site based on sample, and the breeding coefficient, Sutton Beach to Floras Lake, Oregon coast, 2023.

Site Name	# of broods	fledglings per sampled brood	Estimated # of fledglings (range)	# of eggs	breeding coefficient
Sutton Beach	2	$\bar{x}$ = 1.42	3 (2-3)	37	3/37=0.08
Siltcoos:					
North Siltcoos	9	$\bar{x}$ = 1.42	13 (10-15)	67	13/67=0.19
South Siltcoos	13	$\bar{x}$ = 1.42	18 (15-22)	84	18/84=0.21
Overlook					
North Overlook	2	$\bar{x}$ = 1.42	3 (2-3)	68	3/68=0.04
South Overlook	0	$\bar{x}$ = 1.42	0	43	0/43=0.00
Tahkenitch					
North Tahkenitch	16	$\bar{x}$ = 1.42	23 (19-27)	200	23/200=0.12
Tenmile:					
North Tenmile	31	$\bar{x}$ = 1.42	44 (36-52)	248	44/248=0.18
South Tenmile	1	$\bar{x}$ = 1.42	1 (1-2)	3	1/3=0.33
Coos Bay N. Spit					
South Beach	27	1.69	46 (38-53)	108	46/108=0.43
South Spoil/HRA	41	1.06	43 (33-54)	307	43/307=0.14
Bandon SPMA	22	1.50	33 (27-39)	217	33/217=0.15
New River HRA/PRIVATE	25	1.44	33 (27-39)	99	33/99=0.33
Floras Lake	1	$\bar{x}$ = 1.42	1 (1-2)	6	1/6=0.17
Total	190		261 (211-311)		

Table 11. Fledging success and estimated number of fledglings/male (+/- standard deviation) between Sutton Beach and Floras Lake on the Oregon Coast, 2004 – 2023.

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
2021	44	0.62
2022	44	0.35
2023	54	0.79
’04-’22mean	46.9 +/- 5.2	1.15 +/- 0.40
’14-’23mean		0.93 +/-0.41

Table 12. Total number of young fledged from sites between Sutton Beach and Floras Lake on the Oregon Coast 2012-2023, includes fledglings from broods from undiscovered nests.

Site Name	12	13	14	15	16	17	18	19	20[a]	21[a]	22[a]	23[a]
SU			1	3	2	2	8	8	8	3	6	3
SI:												
North	1	2	0	4	3	17	6	0	5	13	0	13
South	16	4	9	25	20	16	18	11	19	18	1	18
OV:												
North	22	3	18	26	33	17	15	40	36	10	0	3
South	27	0	25	39	16	30	25	45	39	12	2	0
TA:												
North	26	9	25	49	28	28	19	40	42	14	13	23
South		3	0	0		0	7	9	1	0		
TM:												
North	5	15	35	26	14	41	46	31	21	61	34	44
South	5	8	27	21	27	24	20	10	8	10	3	1
CBNS:												
SB	16	18	28	24	12	38	20	32	39	13	28	46
SS	10	2	14	13	9	10	20	8	8	9	7	43
HRAs	34	3	49	46	12	10	49	18	26	51	12	
CBNS				51		9	12	21				
BSPMA												
BB	11	8	12	12	8	28	21	18	9	15	6	33
NR spit	1	14	22	19	6	9	21	26	22	6	10	
NR HRA	4	12	3	10	4	3	3	12	16	11	7	33
NR other	0	3	6	2	5	4	0	6	0	2	2	
FL	2		2	0	1	4	6	9	0	2	0	1
Total	**180**	**104**	**276**	**370**	**200**	**290**	**316**	**344**	**299**	**250**	**130**	**261**

[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 13. Number of resident males, estimated number of fledglings, and number of fledglings per male between Sutton Beach and Floras Lake on the Oregon Coast, 2023. 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	12	3	0.25
Siltcoos Spits	37	31	0.84
Dunes Overlook	40	3	0.08
Tahkenitch Creek	42	23	0.55
Tenmile Creek	52	45	0.87
Coos Bay North Spit	95	89	0.94
Bandon SPMA	32	33	1.03
New River HRA/private	21	33	1.57
Floras Lake	1	1	1.00
Overall			0.79 +/- 0.45

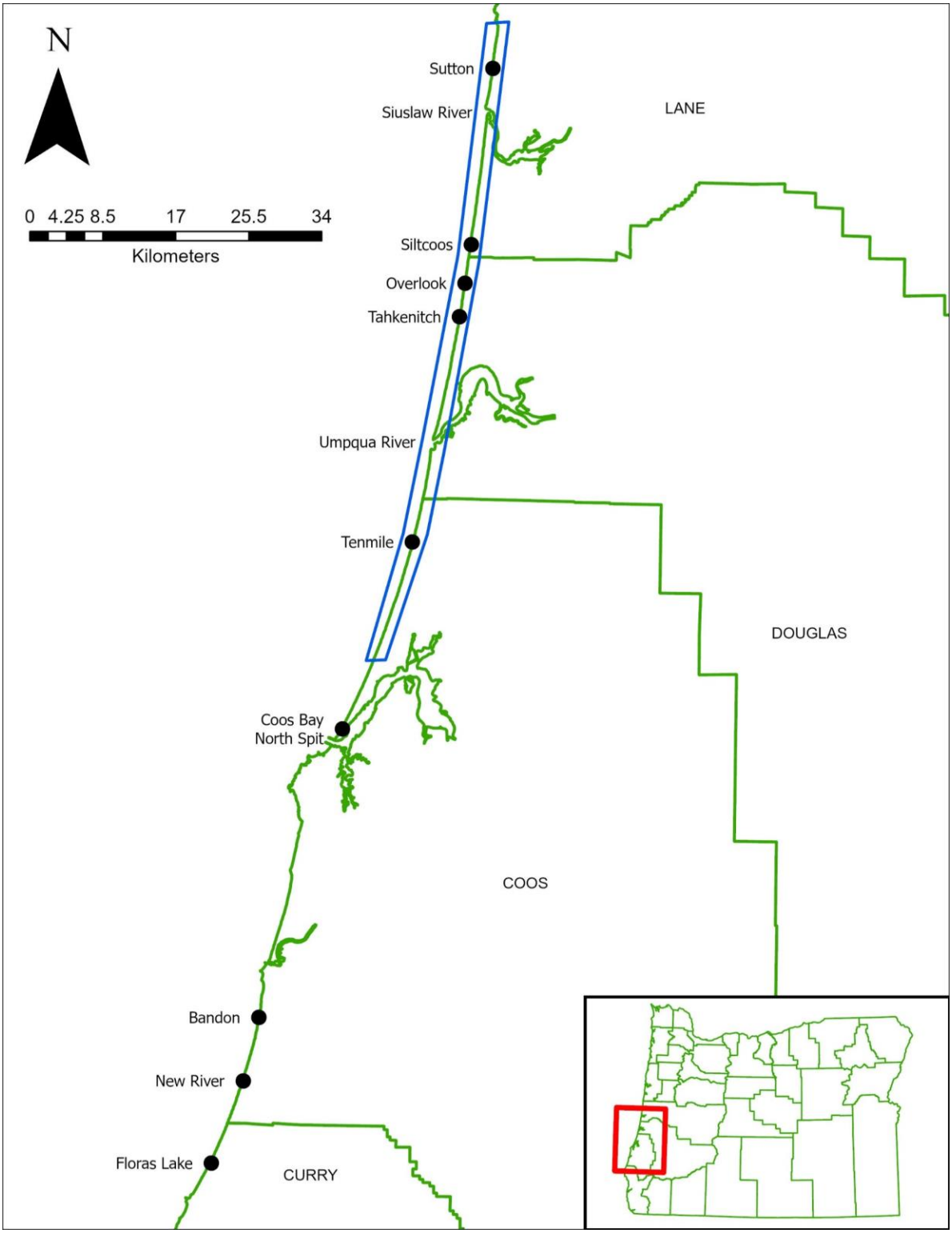

Figure 1. Snowy Plover ORBIC-monitored locations along the Oregon Coast, 2023. Blue polygon shows the approximate boundaries of the Dunes National Recreation Area.

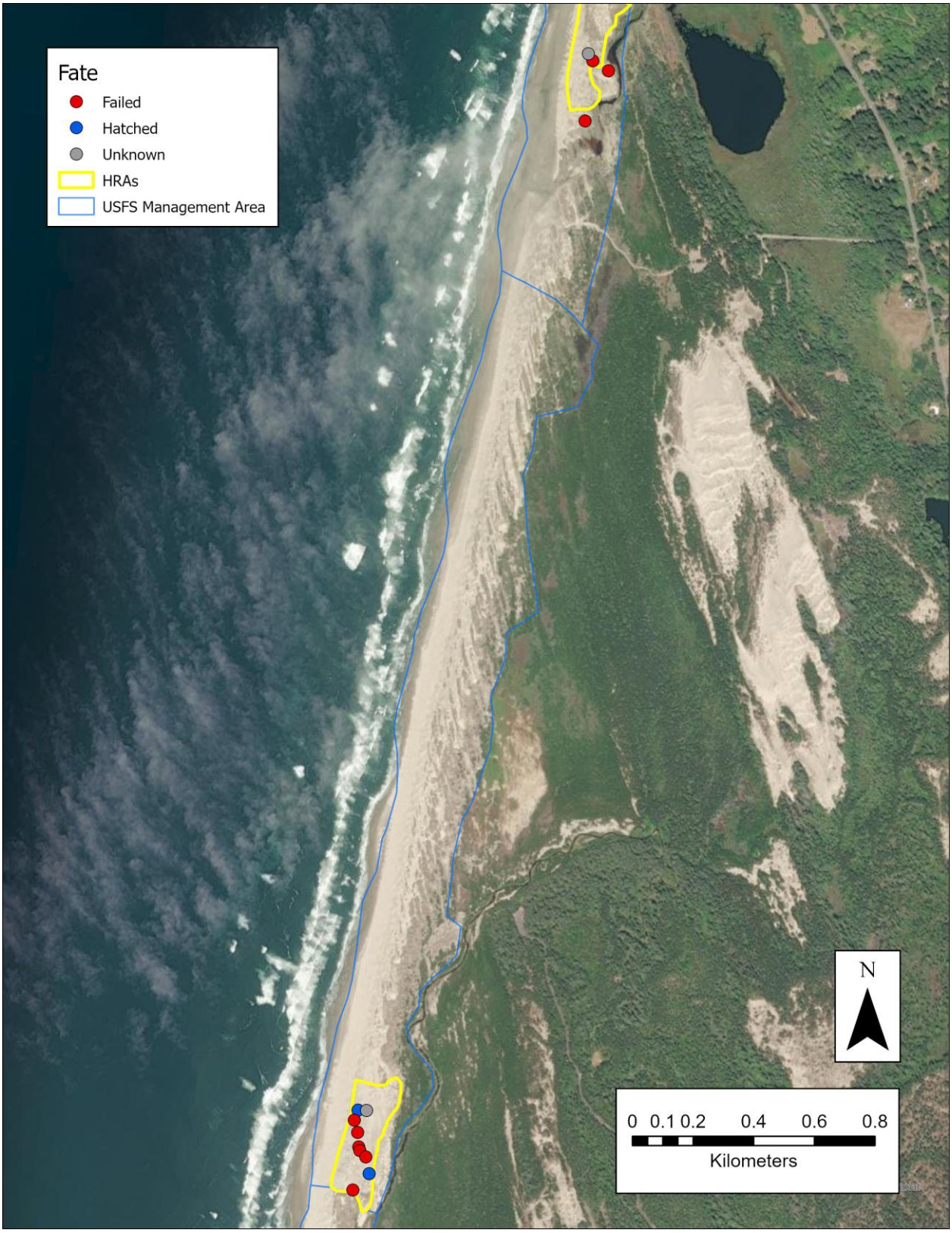

Figure 2. Snowy Plover nest locations at Sutton/Baker Beach, Oregon, 2023.

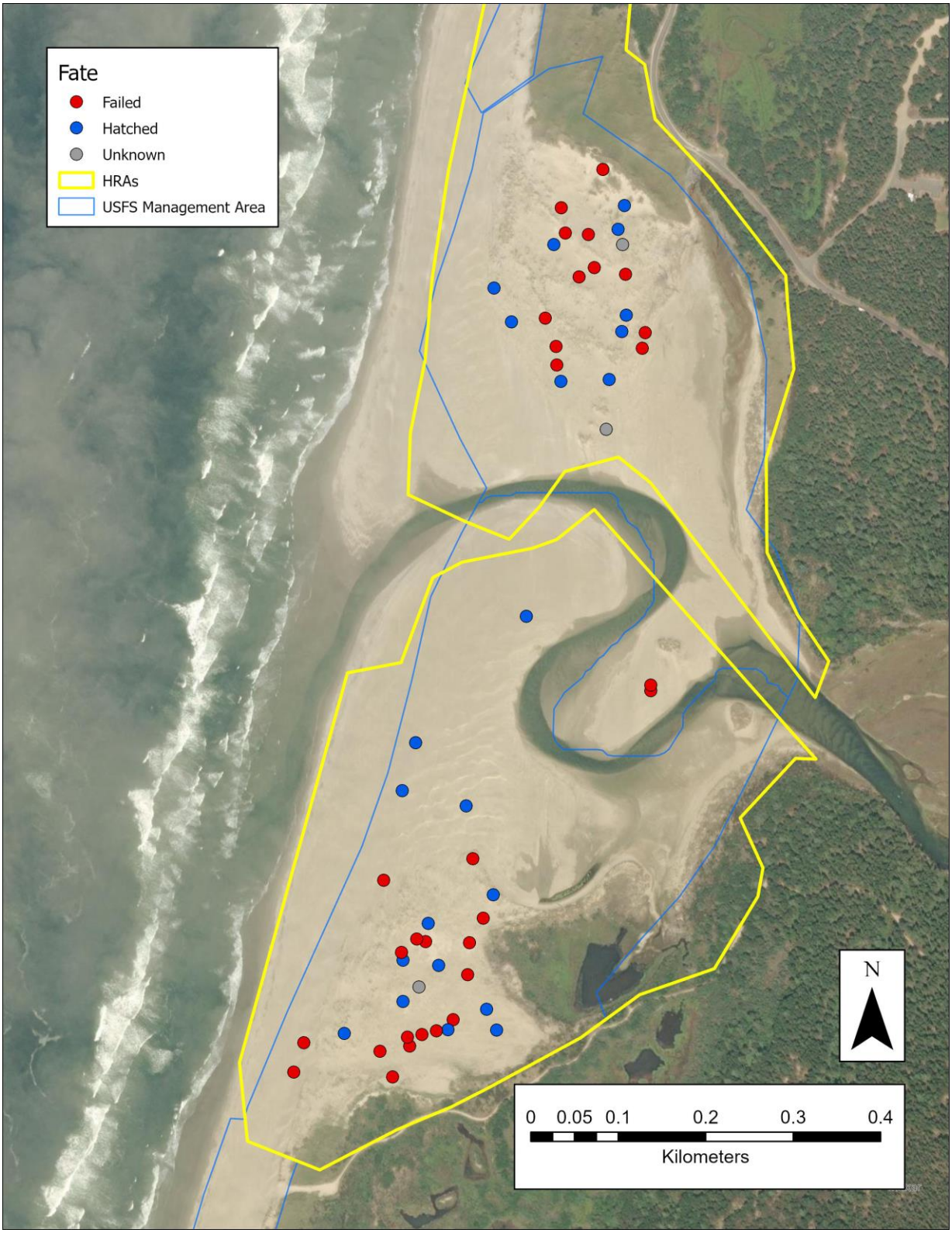

Figure 3. Snowy Plover nest locations at Siltcoos Estuary, Oregon, 2023.

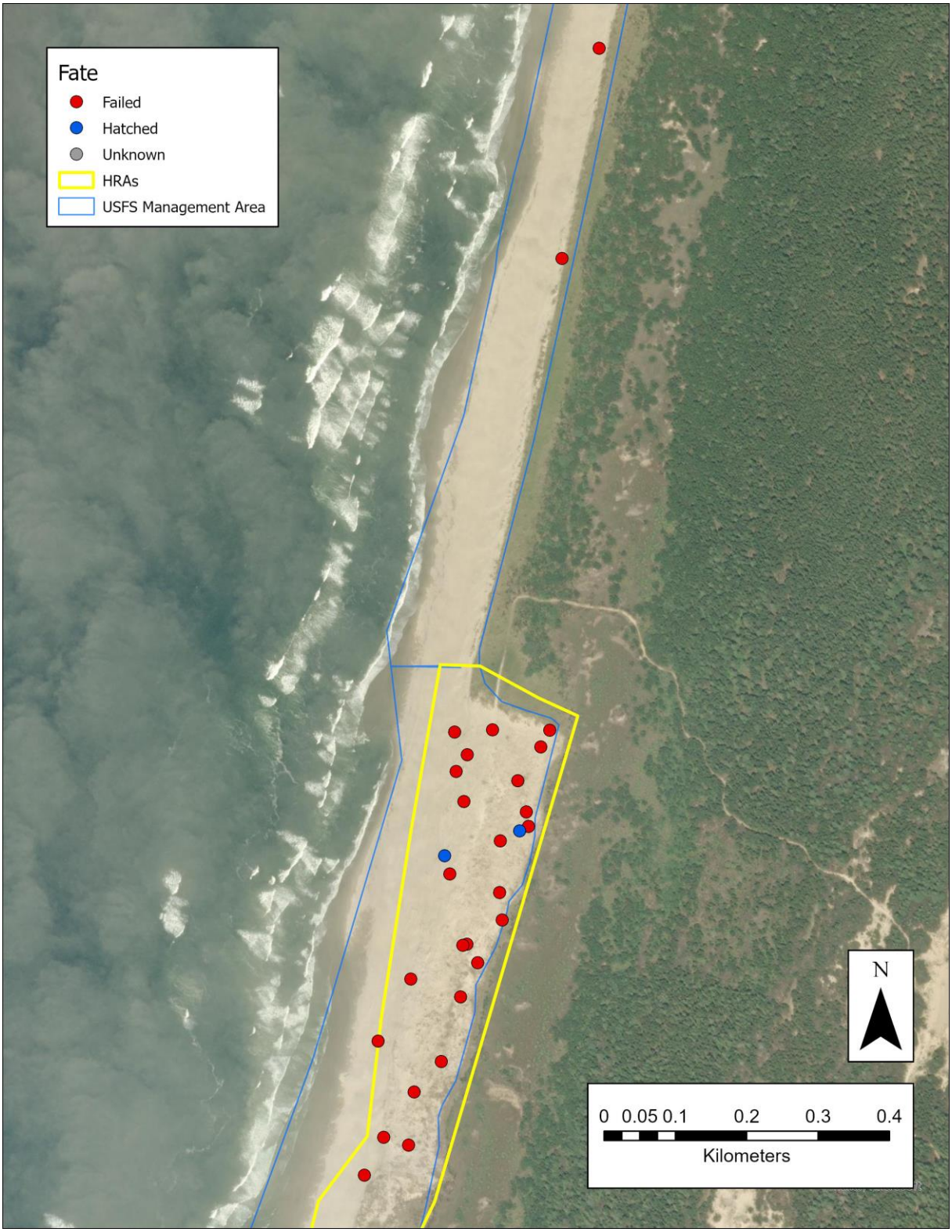

Figure 4. Snowy Plover nest locations at Dunes North Overlook, Oregon, 2023.

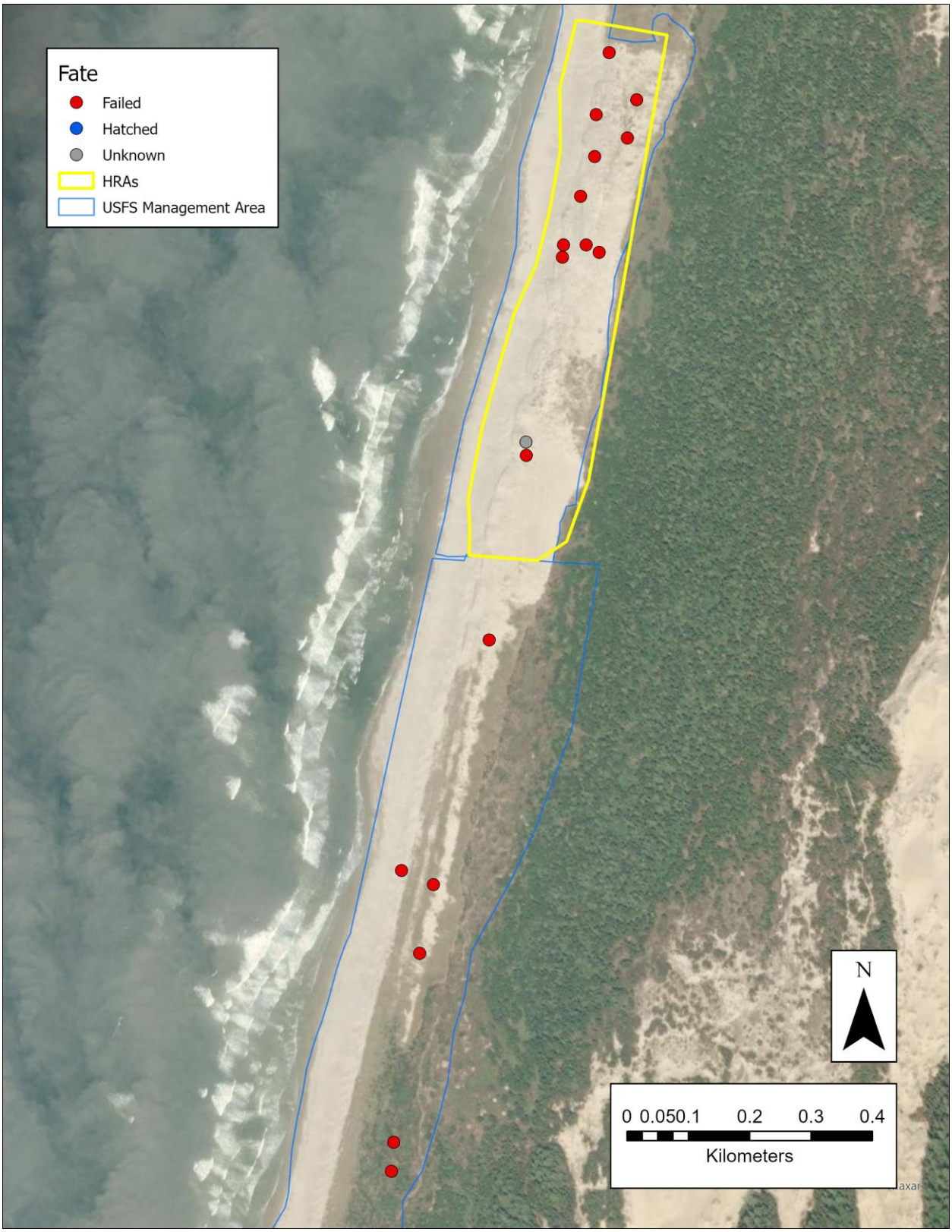

Figure 5. Snowy Plover nest locations at Dunes South Overlook, Oregon, 2023.

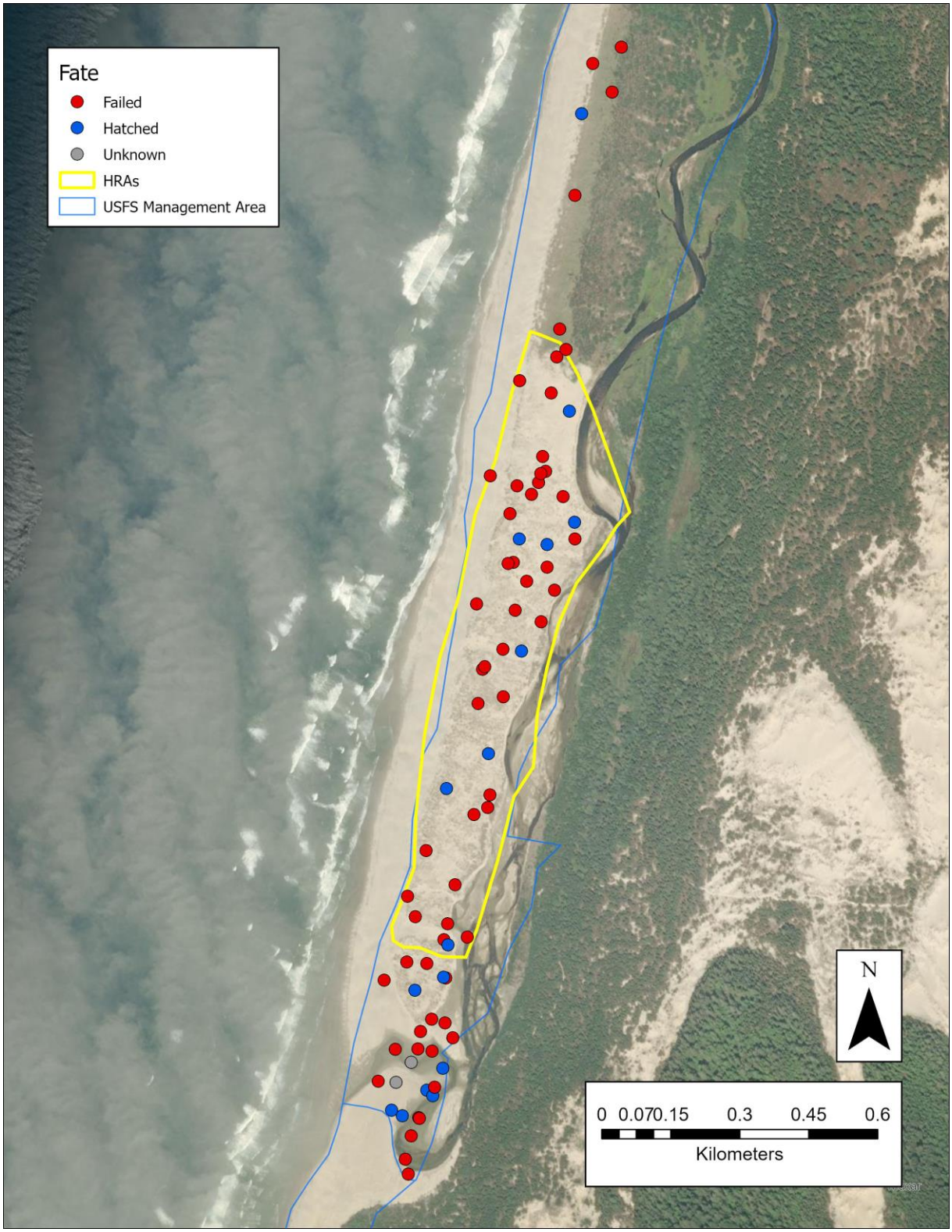

Figure 6. Snowy Plover nest locations on north side of Tahkenitch Creek, Oregon, 2023. River mouth has moved since imagery was taken.

Figure 7. Snowy Plover nests on far north end of Tenmile Creek, Oregon, 2023.

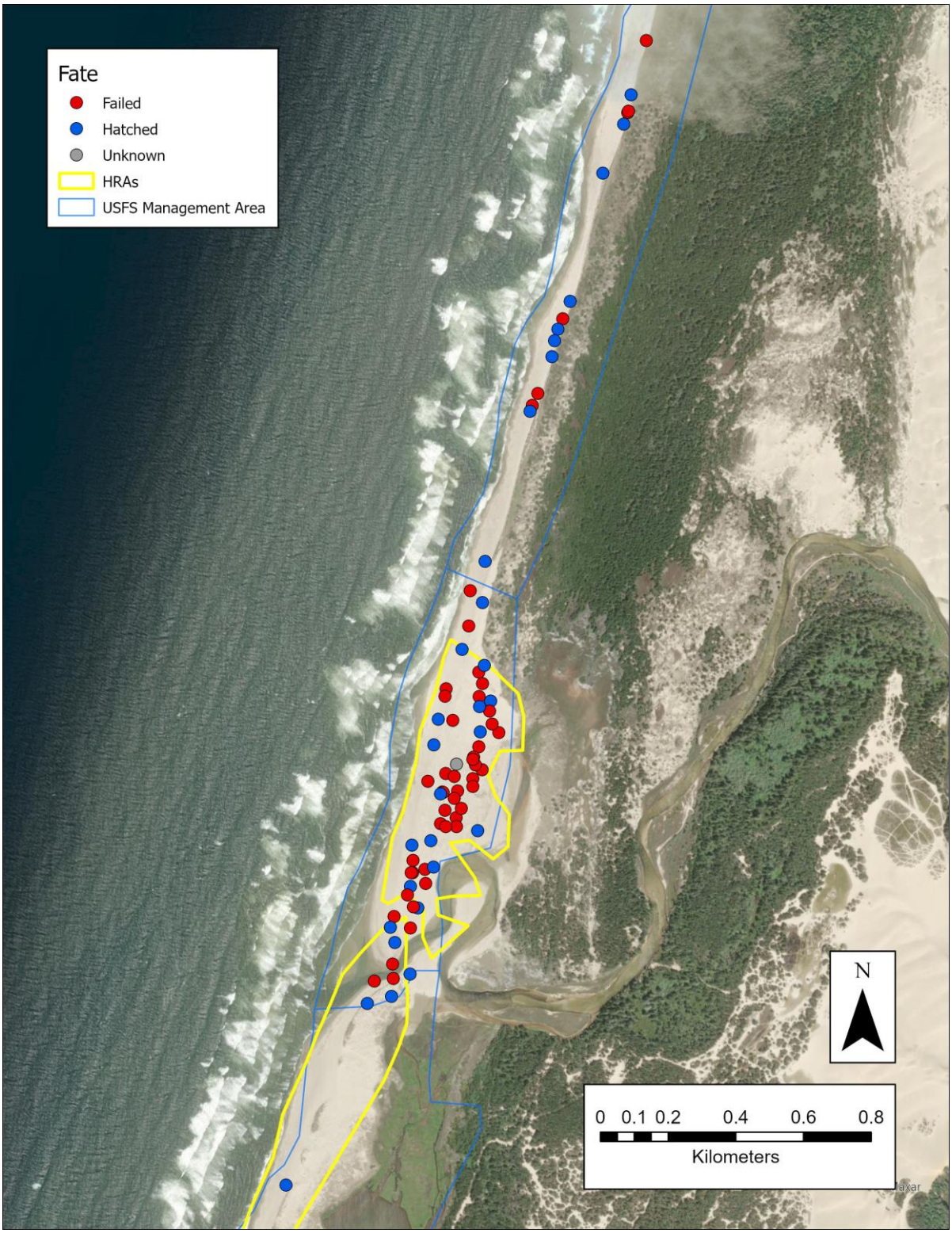

Figure 8. Snowy Plover nests on north and south sides of Tenmile Creek, Oregon, 2023. Note that river mouth has moved slightly since imagery was taken.

Figure 9. Snowy Plover nests on north end of Coos Bay North Spit, Oregon, 2023.

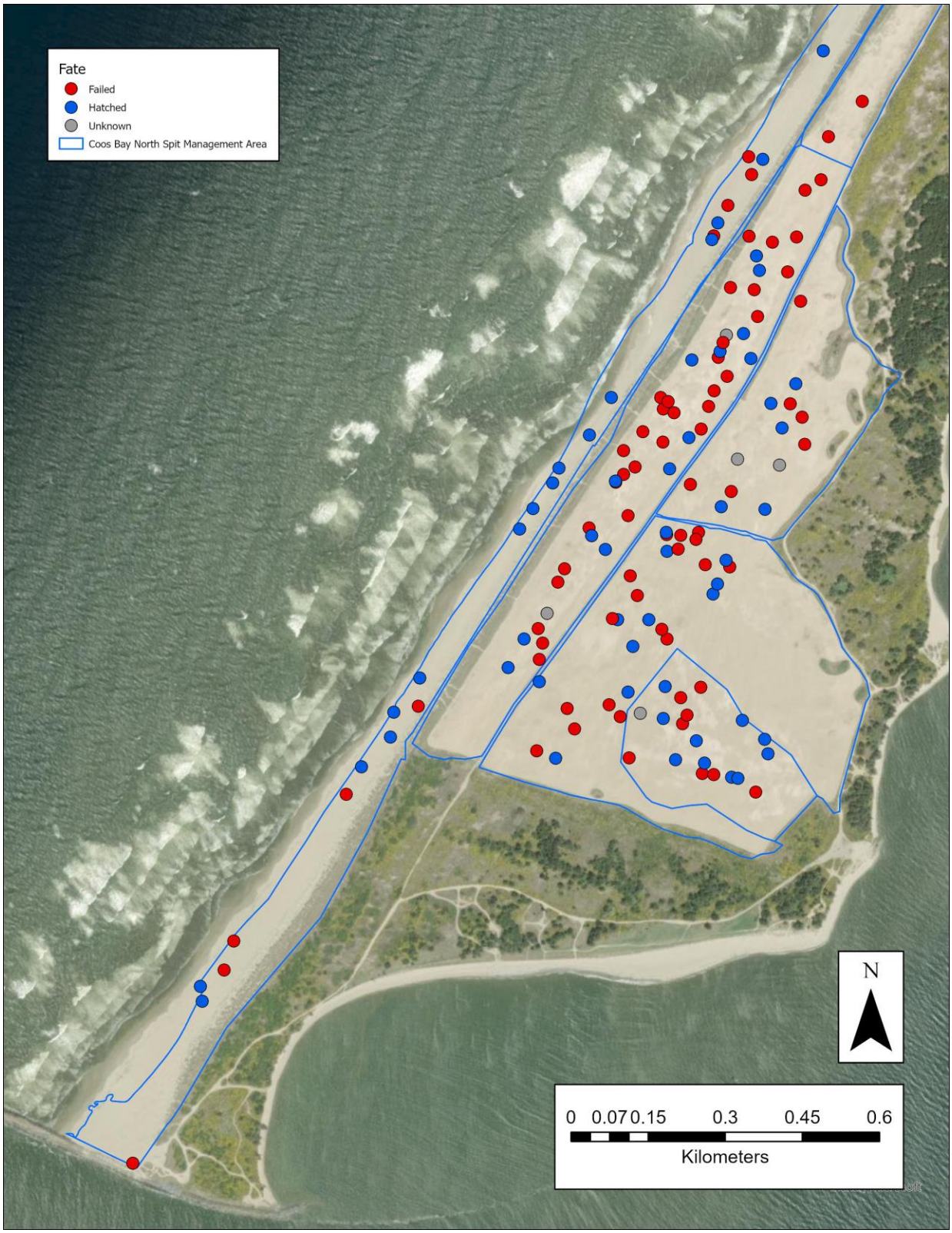

Figure 10. Snowy Plover nests on south end of Coos Bay North Spit, Oregon, 2023.

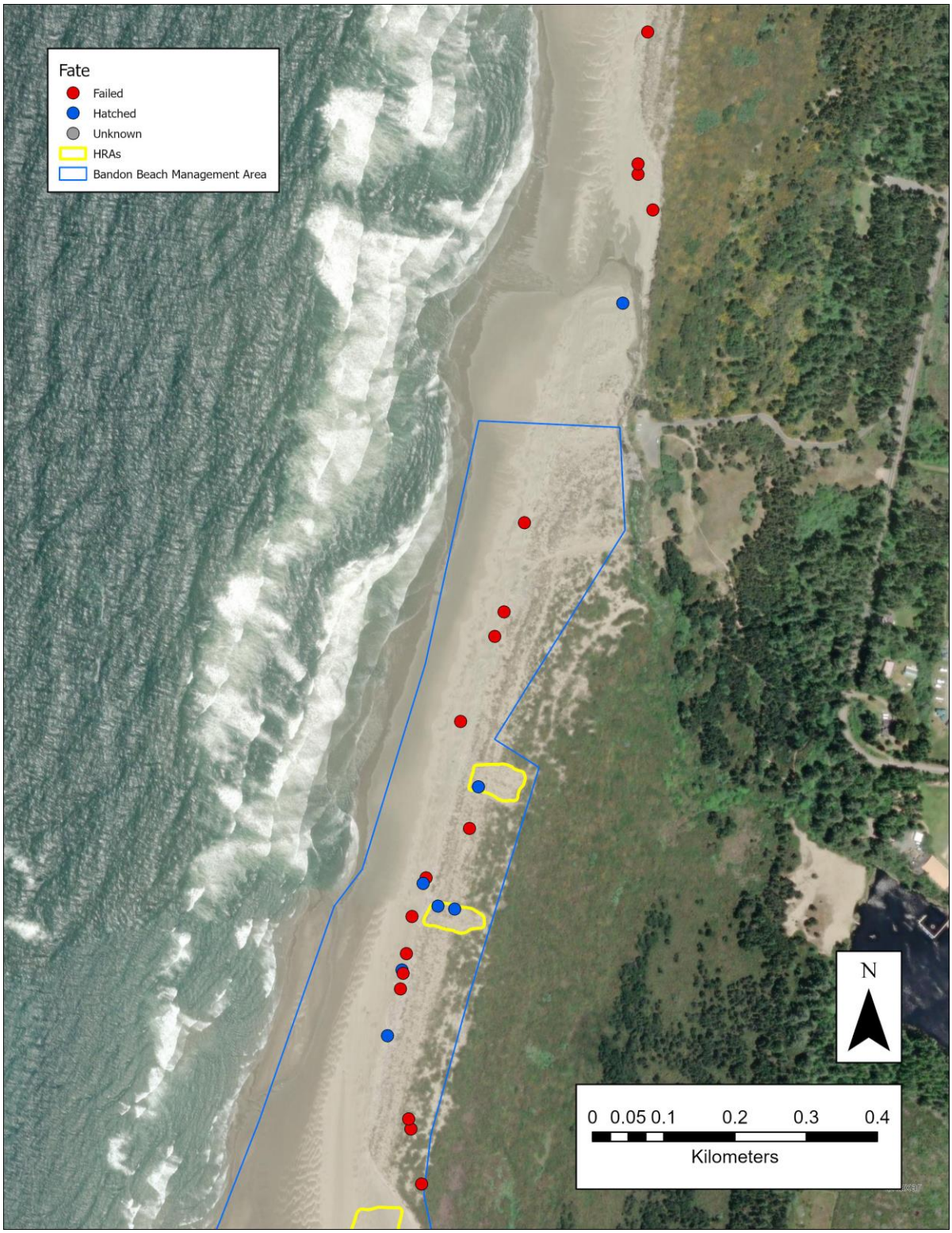

Figure 11. Snowy Plover nests at Bandon SPMA north of the mouth of New River, Oregon, 2023.

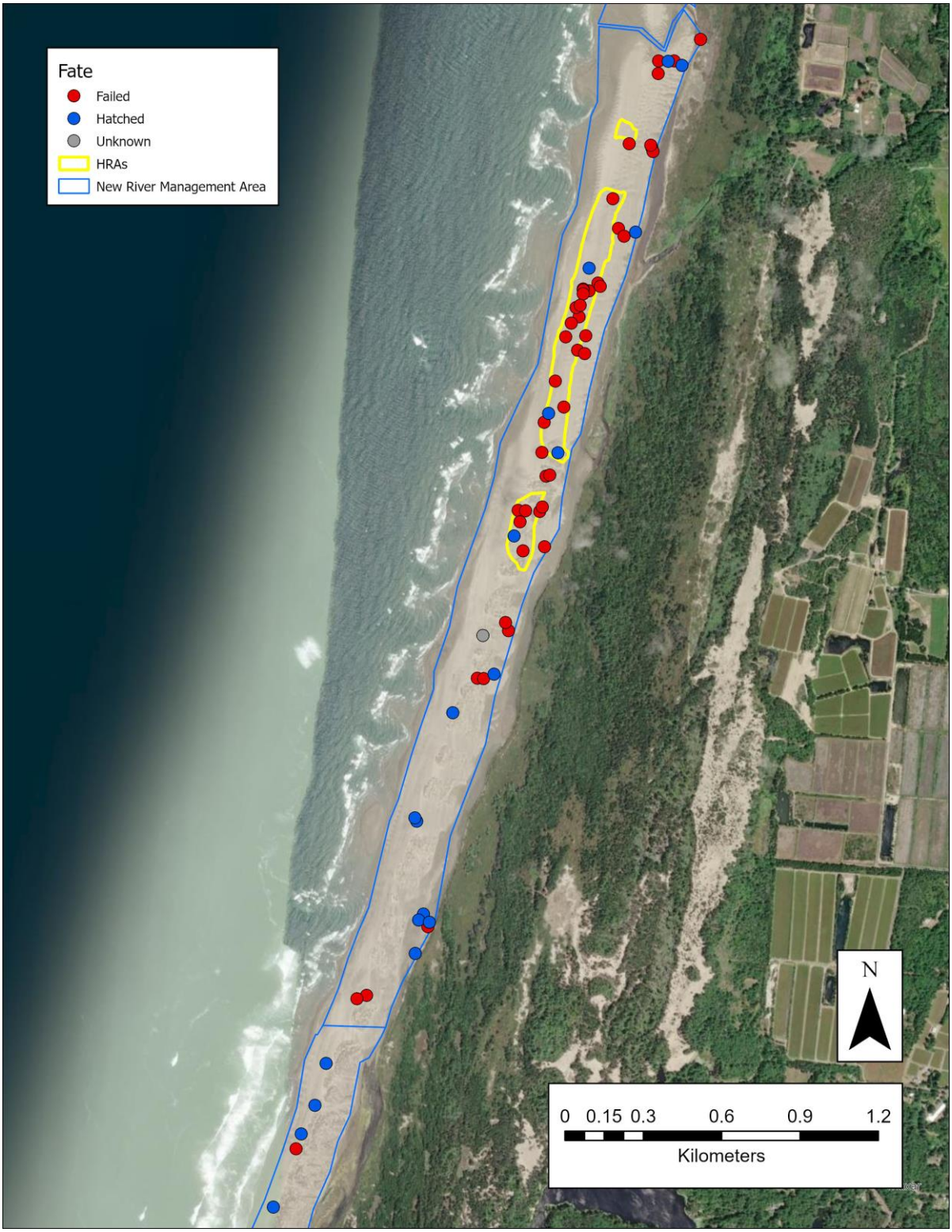

Figure 12. Snowy Plover nests at Bandon SPMA and private lands south of the mouth of New River, Oregon, 2023. The 5 southern-most nests are on private land.

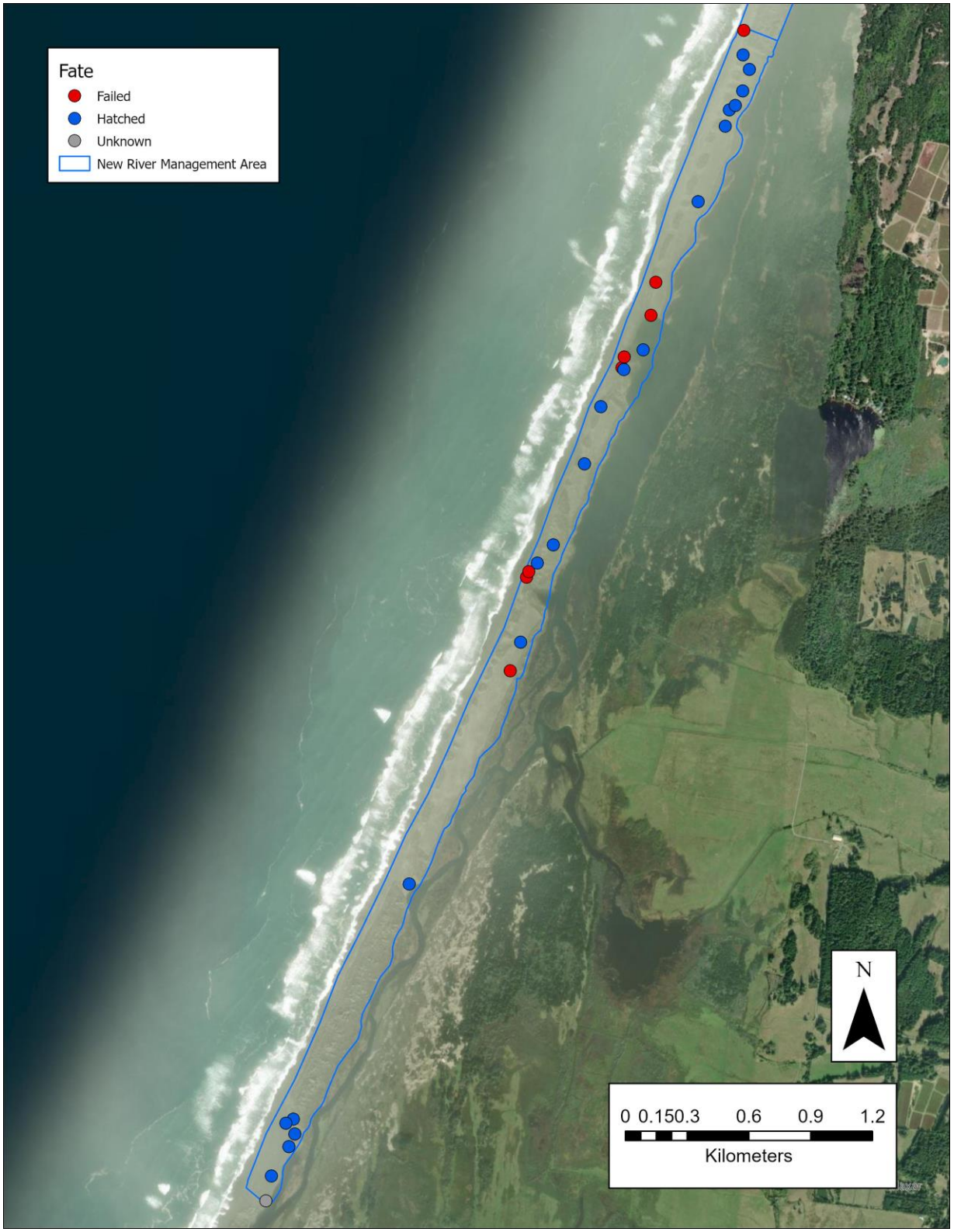

Figure 13. Snowy Plover nests at New River Habitat Restoration Area, Oregon, 2023.

Figure 14. Snowy Plover nest locations at Floras Lake, Oregon, 2023.

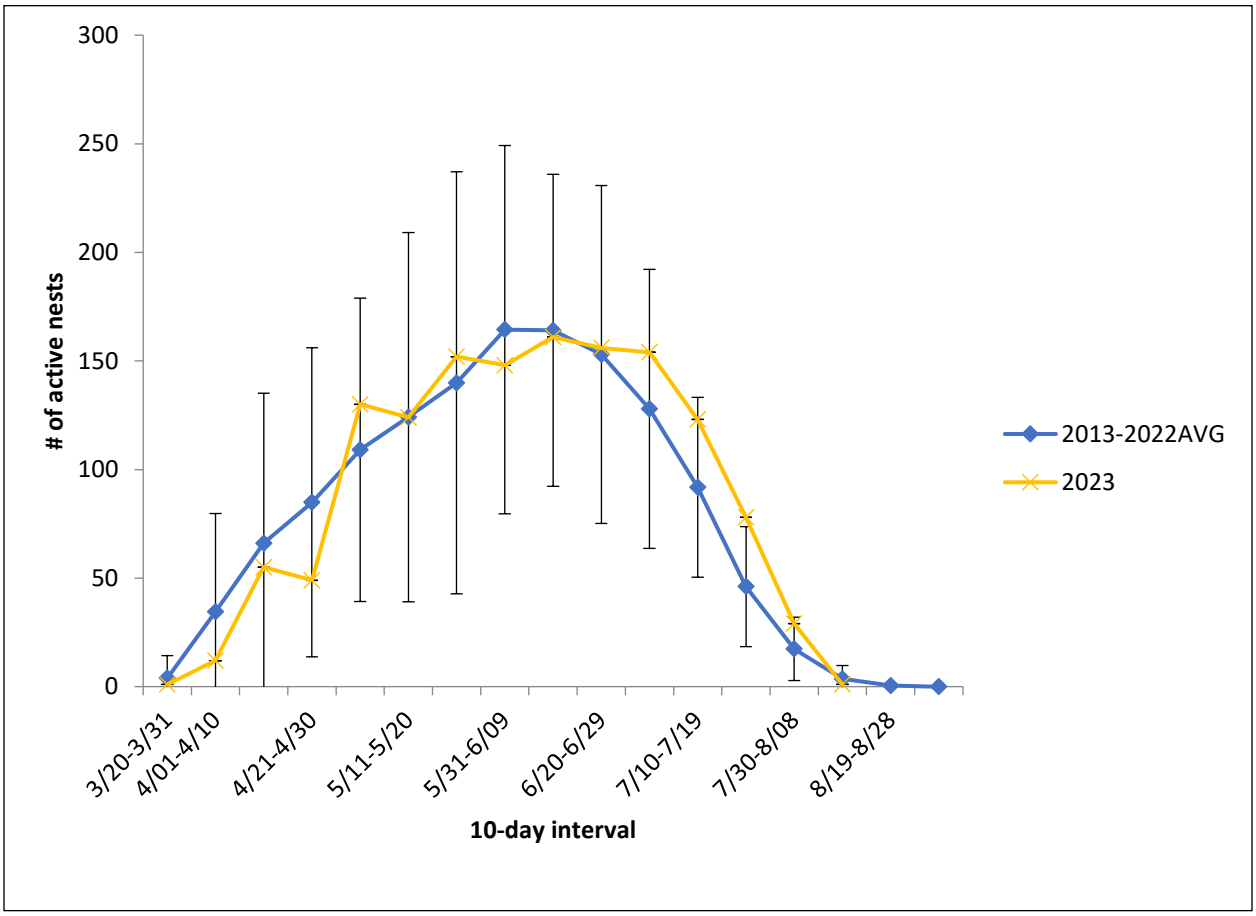

Figure 15. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2023. Bars represent +/- 2x standard deviation.

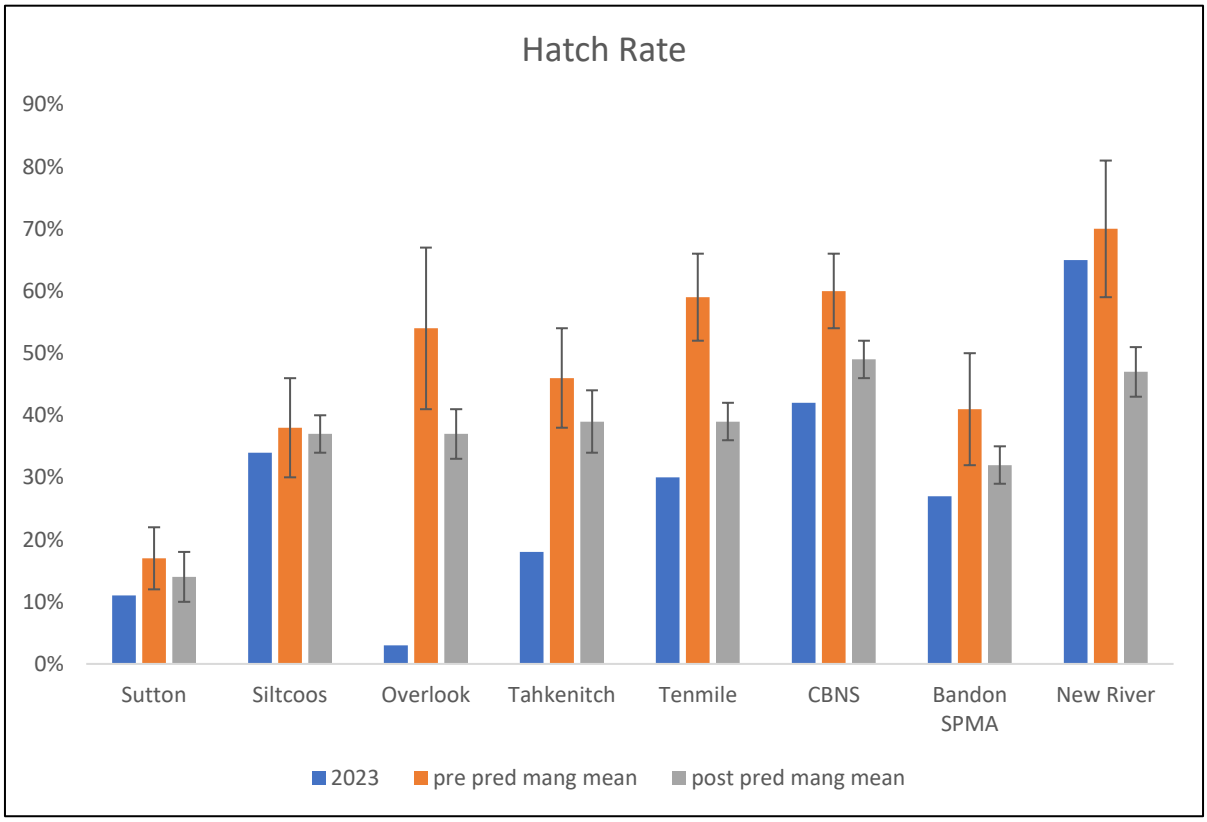

Figure 16. 2023 hatch rate, mean pre-predator management hatch rate, and mean post-predator management hatch rate for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

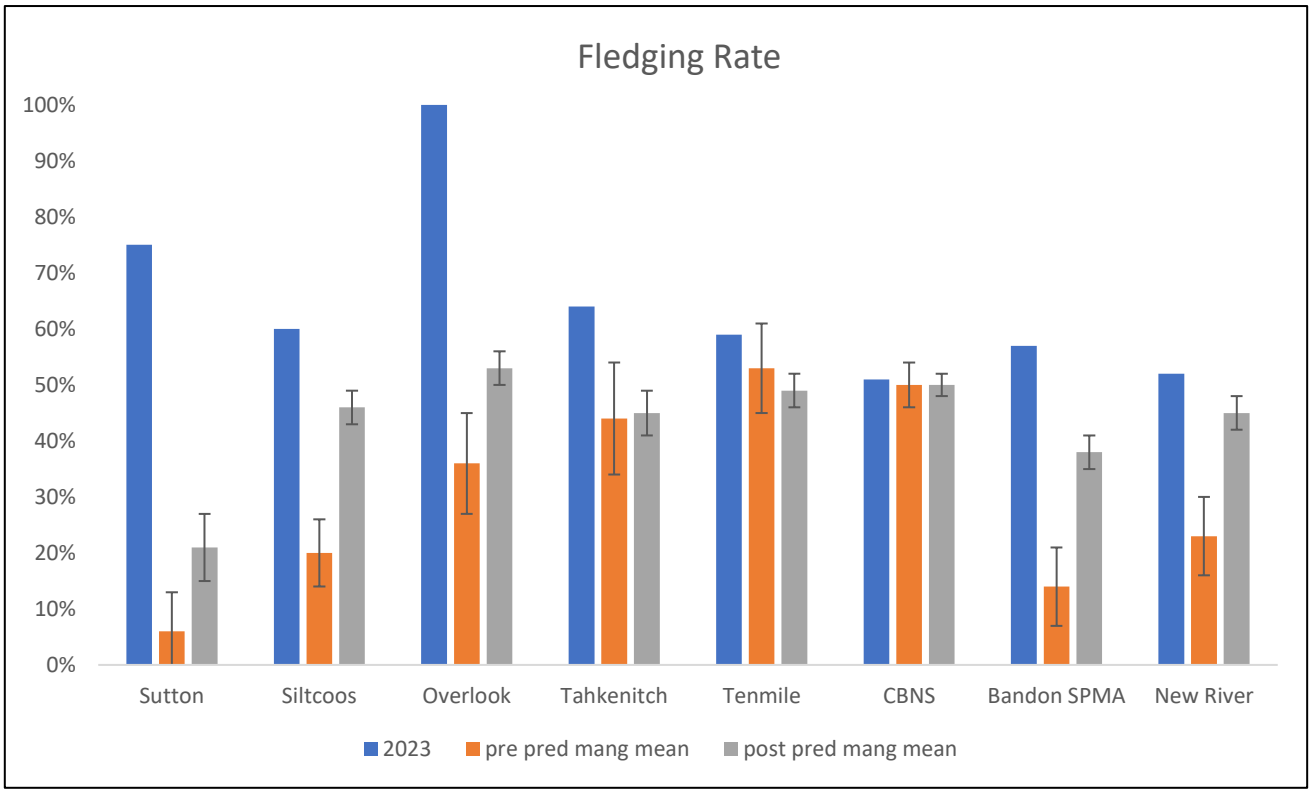

Figure 17. 2023 fledge rate, mean pre-predator management fledge rate, and mean post-predator management fledge rate for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

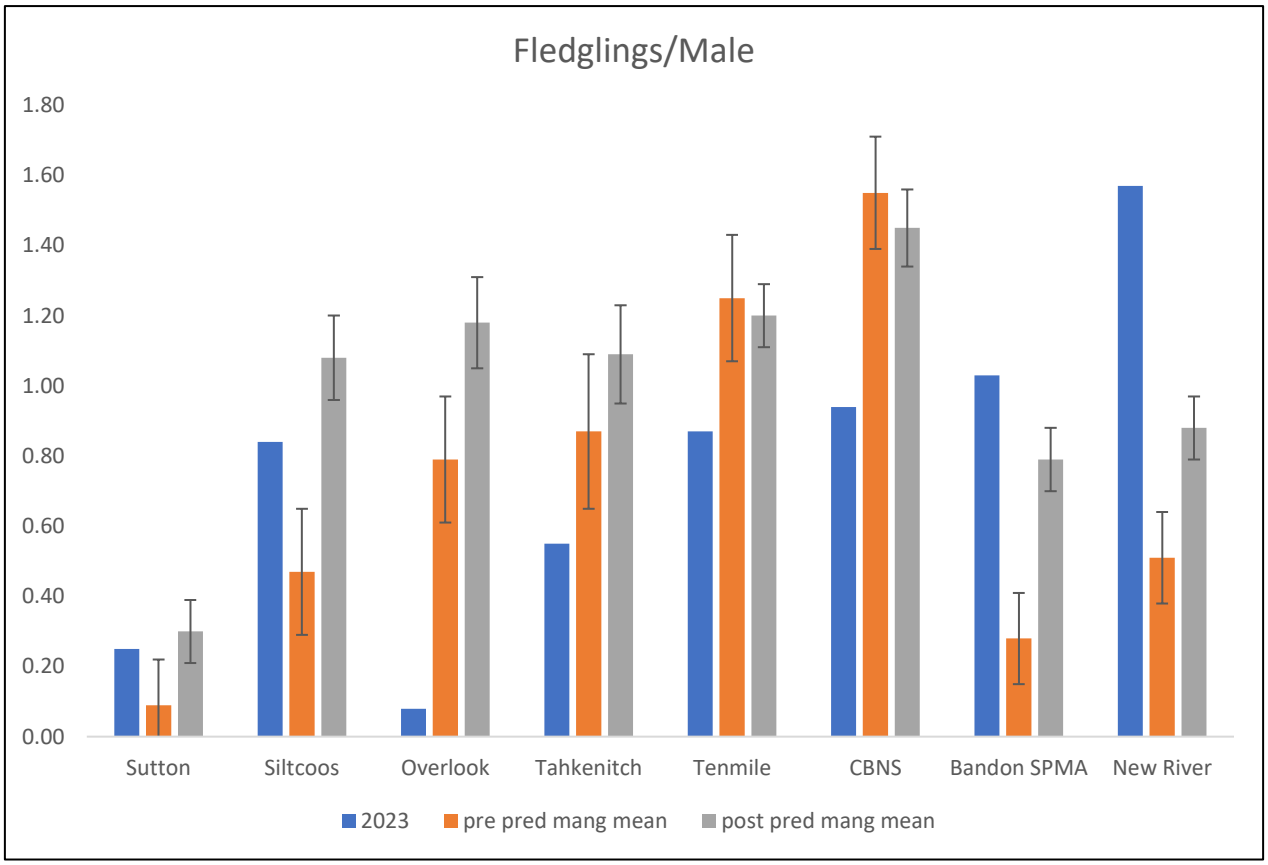

Figure 18. 2023 fledglings per resident male, mean pre-predator management fledglings per male, and post-predator management fledglings per male for Sutton, Siltcoos, Overlook, Tahkenitch, Tenmile, CBNS, Bandon SPMA and New River, Oregon coast, with standard error bars.

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. This site is part of the Dunes NRA.

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. This site is part of the Dunes NRA.

Tahkenitch Creek, Douglas Co. (Figure 6) 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. This site is part of the Dunes NRA.

Tenmile: North Tenmile, Coos and Douglas Cos. (Figures 7 and 8). 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. This site is part of the Dunes NRA.

Coos Bay North Spit (CBNS), Coos Co. (Figures 9 and 10): 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 11 and 12): 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. (Figures 12 and 13): 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 14). 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: Fort Stevens State Park, Camp Rilea, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake Spit/ Sitka Sedge, Nestucca Spit, Salmon River Spit, Salishan Spit, Yaquina Point, Agate Beach, South Beach Newport, Bayshore Spit, South Alsea Bay, Sutton Creek to Siuslaw River North Jetty, Siuslaw River South Jetty to Siltcoos, Tahkenitch Creeks to Umpqua Rier North Jetty, Whiskey Run to Coquille River, Blacklock Point to Cape Blanco,

Elk River, Euchre Creek to Gregg's Creek, Myers Creek to Pistol River, Otter Point to Rogue River, Crissy Field to Pelican State Park

APPENDIX B

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 two teams of biologists; one two-person team covering Tenmile and sites north, and a two-person team covering Coos Bay North Spit and sites south (Fig. 1). 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 plovers 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

Concerns about spreading avian influenza prevented us from trapping and banding adults in 2023. However, with appropriate sanitary precautions we believed newly-hatched chicks could be safely captured and banded. Crew inexperience prevented us from banding chicks on US Forest Service sites, but we banded a sample of broods from CBNS, Bandon SPMA, and New River. 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, and in 2021 we reduced the number of sampled broods to approximately 50%. See Appendix C for brood sampling methods. 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 – 2023

Statement of problem:

Prior to 2016, Oregon Snowy Plover monitors 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 experienced the same problems at sites they monitor. 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.

Lauten *et al.* (2016, 2017, 2018, 2019, and 2020) documents efforts to sample approximately 80% of monitored broods. Continued increases in the plover population, as well as staff and workload limitations, made this goal unreachable by 2021. For the 2021 field season we worked with Point Blue Conservation Science to further adjust the sampling plan to provide adequate productivity information (Lynne Stenzel, pers. comm.). Sampling techniques remained the same except for a reduction in the percentage of broods sampled, and a reduction in the number of sites that would have sampled broods.

2021 and beyond 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 (Lauten *et al.* 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.

From 2016 to 2020 we addressed site variation in fledging success (Dinsmore *et al*. 2017) by sampling broods from all currently occupied nesting sites in the project area. 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. In 2023, our sample consisted of the first 5 known nests to hatch at CBNS, Bandon SPMA, and New River HRA 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).
- 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. For 2021 and subsequent years, we continue to follow the basic outline of the sampling technique, except we reduced the percentage of sampled broods from 80% to 50%. We also did not sample any broods with banding techniques at Sutton Beach, South Tahkenitch to North Umpqua, South Tenmile, and New River private lands. At Sutton Beach and Floras Lake, small numbers of broods from successful nests were sufficiently monitored without banding to use for sample calculations.

Table C-1. Ten-day intervals used to determine brood sample. 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

Summary

From 2016 to 2020 the sampling plan resulted in sufficient estimates of productivity (Lauten *et al.* 2016, 2017, 2018, 2019, and 2020). The Oregon Snowy Plover population has continued to increase (Lauten *et al.* 2020). The reduction in sampling effort will result in a lower percentage of hatched nests being sampled, and will increase variability estimates. However, we believe the estimates will be sufficient to estimate productivity while alleviating workload issues. This method will also allow monitors more time to search for and monitor nests.

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 12).