The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2015

Interim report for USFWS agreement #F14AC00547
Final report for BLM agreement # L10AC20515
Interim report for BLM agreement # L15AC00045
Final report for USFS agreement #AG-04T0-P-14-0029
Interim report for USFS agreement # AG-04T0-P-15-0034
Final report for ODFW agreement # 478-14
Final report for OPRD agreement # 6707

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December 2015

Submitted to:

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2127 SE OSU Drive
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Recovery Permit TE-839094-5

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Abstract

We monitored the distribution, abundance and productivity of the federally threatened Western Snowy Plover (*Charadrius nivosus nivosus*) along the Oregon coast from 3 April – 11 September 2015. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North and South Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Snowy Plover Management Area, New River HRA and adjacent lands, and Floras Lake. Our objectives in 2015 were to: 1) estimate the size of the adult Snowy Plover population along the Oregon coast, 2) locate plover nests, 3) determine nest success, 4) implement nest protection as appropriate (e.g. ropes, signs, exclosures), 5) determine fledging success, 6) monitor brood movements, and 7) collect general observational data about predators.

We estimate the Snowy Plover breeding population in Oregon at 449 individuals; a minimum of 376 individuals were known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990. We monitored 501 nests in 2015. Overall apparent nest success was 48%. Nest failures were attributed to unknown cause, unknown depredation, mammalian depredation, corvid depredation, abandonment, wind/weather, one-egg nests, harrier depredation, infertility, overwashing, gull depredation and human caused. We monitored 271 broods, including 32 from unknown nests, and documented a minimum of 333 fledglings. Overall brood success was 75%, fledging success was 49%, and 1.51 fledglings per male were produced.

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Introduction

The Western Snowy Plover (*Charadrius nivosus nivosus*) breeds along the coast of the Pacific Ocean in California, Oregon, and Washington and at alkaline lakes in the interior of the western United States (Page *et al.* 1991). Loss of habitat, predation pressures, and disturbance have caused the decline of the coastal population of Snowy Plovers and led to the listing of the Pacific Coast Population of Western Snowy Plovers as threatened on March 5, 1993 (U.S. Fish and Wildlife Service 1993). Oregon Department of Fish and Wildlife 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 26th year of monitoring the distribution, abundance, and productivity of Snowy Plovers along the Oregon coast during the breeding season. 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 improved annual productivity leading to increases in Oregon's breeding population, sustainable productivity, and stable populations at recovery levels. Previous work and results have been summarized in annual reports (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014). Our objectives for the Oregon coastal population in 2015 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, signs, exclosures), 5) determine fledging success, 6) monitor brood movements, and 7) collect general observational data about predators.

Study Area

We surveyed Snowy Plover breeding habitat along the Oregon coast, including 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. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North and South Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Snowy Plover Management Area (SPMA), New River (extending from private land south of Bandon SPMA to the south end of the New River Area of Critical Environmental Concern (ACEC) habitat restoration area), and Floras Lake (Figure 1). 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.

Methods

Window Surveys

Annual breeding season window surveys were coordinated by US Fish and Wildlife Service in late May. Breeding season window surveys were conducted at both currently active and historic nesting areas (Elliott-Smith and Haig 2007). Historic nesting areas searched during the breeding window survey included: Clatsop Spit, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake South Spit, Nestucca Spit, South Beach (Newport), Whiskey Run to Coquille River, Elk River, Euchre Creek, Otter Point to Rogue River, and Myers Creek to Pistol River.

Monitoring

Breeding season fieldwork was conducted from 3 April to 11 September 2015. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found in Castelein *et al.* 2000a, 2000b, 2001, 2002, and Lauten *et al.* 2003 and are in Appendix B. No modifications to survey techniques were implemented in 2015.

We report three separate measures of adult population size: resident plovers, minimum number of birds present, and birds documented breeding. Resident plovers are defined here as any adult plover detected during the peak nesting period (between 15 April and 15 July). Not all plovers recorded during the summer are Oregon breeding plovers; some plovers 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 along the Oregon coast during the field season (3 April through 11 September), and includes both breeding birds and those migrating through the area during that time. Most adults are banded and thus uniquely identifiable, but 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 during the peak nesting season (May, June and the first week of July). We selected this period because it encompasses the period of maximum nesting effort and minimum movement between sites. For each 10-day interval we subtracted the number of adults that were subsequently banded during the breeding season and selected the 10-day interval with the highest remaining count. Based on nesting records and daily observation data, this method underestimates the actual number of unbanded plovers present, but it provides a minimum number of unbanded plovers present (Castelein *et al.* 2001). This number was added to our count of banded adults present, resulting in the minimum number of adults present. We also report the total number of plovers positively identified breeding. Because some nests are undetected or the nest fate was determined before the adults could be identified, we are unable to identify 100% of plovers that attempt breeding. Because the number of resident plovers includes all birds that were present during the peak nesting period, including those not confirmed at a nest, and excludes birds seen only early or late in the season, we believe it is the most accurate estimate of the total breeding population.

We determined the number of individual banded female and male plovers and the number of individual unbanded female and male plovers that were recorded at each nesting area along the Oregon coast from the beginning to the end of the 2015 breeding season. Data from nesting sites with a north and south component (Siltcoos, Overlook, Tahkenitch, and Tenmile) were combined because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were aggregated for the same reason. We separated data from Bandon SPMA, 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, particularly where plovers congregate during post breeding and wintering. We also determined the number of individual breeding female and male plovers for each site. The number of individual

breeding adults indicates the relative level of nesting activity for each site, but does not reflect the total population because some birds used multiple sites.

We calculated overall apparent nest success, which is 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.

Male Snowy Plovers typically rear their broods until fledging. In order to track the broods, we banded most nesting adult males, females that tended to broods, and most hatch-year birds with both a USFWS aluminum band and a combination of colored plastic bands. Trapping techniques are described in Lauten *et al.* 2005 and 2006 (Appendix B). We monitored broods and recorded brood activity or adults exhibiting broody behavior at each site (Page *et al.* 2009). Chicks were considered fledged when they were observed at least 28 days after hatching. 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; and fledglings per known breeding male for each site.

We report annual plover productivity for each nesting area and separate the data into years prior to and after implementation of lethal predator management activities (by site and coast-wide). We report hatch rate, fledging rate, productivity index, and fledglings per male for all years, and calculate means for the periods prior to lethal predator management and post lethal predator management. Means are reported +/- standard deviations. The productivity index is a measure of overall effort based on how many eggs the plovers laid divided by the number of fledglings produced. If plovers produced many fledglings compared to eggs laid, then their productivity and the resulting index was high for the amount of effort (eggs laid). If plovers produced low numbers of fledglings relative to high numbers of eggs laid, then their productivity and the resulting index was low. When calculating means for pre- and post-predator management productivity coast-wide, we did not include the years 2002 and 2003 in the calculations because three sites (CBNS, Bandon Beach, and New River) had predator management in those years but all other sites did not. We did not include Sutton and Floras Lake in our comparisons of productivity by site because occupancy at these sites has been low and sporadic, making such comparisons misleading.

We report brood movements based on the nest site (for example, broods that originated from a nest at Overlook, but moved to Tahkenitch, are reported as Overlook broods). We record banded adults and chicks that return to Oregon from previous seasons and calculate 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 return to Oregon, divided by the number of banded adults or chicks observed the previous year.

Predator Management

Nest exclosure use has declined in recent years due to concerns about adult mortality in and around exclosed nests (Lauten *et al.* 2010, 2011, 2012, and 2013), improved unexclosed nest success, and inability to adequately monitor exclosed nests given the workload associated with the increasing population. Nest exclosures continue to be an option for protecting some nests particularly at sites with high levels of corvid predation and relatively low number of plover nests (Appendix C). Exclosures are not used until after May 15, to reduce predation of adult plovers incubating inside exclosures by migrating raptors (Castelein *et al.* 2001, 2002, Lauten *et al.* 2003). In 2015, mini-exclosures (MEs, Lauten *et al.* 2003) were only deployed at Sutton Beach.

We used Reconyx PC900 cameras (Reconyx Inc., Holmen, Wisconsin) to observe predator activity at plover nests and identify causes of nest failure. Cameras were placed from 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-

colored outer case, and were installed as low to the ground as possible to avoid providing a perch for predators. Cameras were used at Sutton Beach, Siltcoos, Overlook, Tahkenitch, Tenmile, Coos Bay North Spit, and Bandon. 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.

The Reconyx PC900 cameras employ 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. Cameras were set to operate 24 hours per day, taking one image every 60 seconds, and a burst of four images every second when the motion sensor was triggered. Predator activity at the nest triggered the motion sensor, but plovers were generally too small to trigger the cameras.

In most cases, we placed cameras at active nests that were already being incubated (Snowy Plovers generally do not incubate until the clutch is complete). However, in early May we observed that many nests were being lost to unidentified causes before the clutch was complete. To verify the cause of failure, we placed some cameras on incomplete clutches. After cameras were installed, we ensured that plovers returned to the nest. Batteries and data cards were replaced approximately weekly. In all cases, cameras were left in place until the fate of the nest was determined. Upon visiting failed nests, we recorded the cause of failure based on evidence at the site, before looking at camera data. We compare cause of failure based on evidence at the nest site with the cause of failure as recorded by the cameras.

Lethal predator management was conducted at all active nesting areas by USDA Wildlife Services (Bell 2015). ORBIC monitors reported causes of nest failure and daily predator observations to Wildlife Services staff.

Results and Discussion

Window Surveys and Monitoring

During the May breeding window surveys, 277 plovers were observed, and none were detected outside of the current known nesting areas (USFWS 2015). The annual breeding window survey count and number of resident plovers is in Table 1.

Of the minimum number of plovers present during the 2015 breeding season, 418 (91%) were banded. The number of unbanded plovers estimated by the 10-day interval method was 40; however we know that the number of unbanded birds was actually higher because we counted 47 individual unbanded birds nesting at different nests. During the breeding season we observed 241 banded males, 177 banded females, 13 unbanded males, and 27 unbanded females.

Of the total estimated population, 376 plovers (82%) were documented nesting, near the mean percentage for 1993-2014 (78%). A minimum of 200 banded males and 129 banded females nested, and approximately 20 unbanded males and 27 unbanded females nested. There were a total of 238 banded resident males and 171 banded resident females present during the 2015 breeding season (15 April – 15 July). Using the minimum number of unbanded individuals estimated by the 10-day interval method, the minimum estimated Oregon resident plover population was 449. We believe this is the best estimate of the Oregon breeding population.

By all measures, the Oregon coastal population was the largest recorded since monitoring began in 1990 (Table 1). In 2015, the Oregon coastal plover population was above the recovery goal set for the state (U.S. Fish and Wildlife Service 2007).

Overwinter Return Rate

Adult overwinter survival is known to be an important parameter of population growth (Sandercock 2003, USFWS 2007, Dinsmore *et al.* 2010, Lauten *et al.* 2010, 2011, 2012, and 2013). A large part of overwinter survival is reflected in adults returning to breed the following year. Of the 305 banded adult plovers recorded in 2014, a minimum of 232 were recorded in 2015 along the Oregon coast. The overwinter return rate based on the minimum number of returning banded adult plovers was 76%, above the 1994-2015 mean of 66%. An additional 13 adult plovers with incomplete band combos likely were present in 2014 and 2015; if these plovers are included in the return rate calculations, the return rate was 80%, the same as in 2014 (Lauten *et al.* 2014), and the second consecutive year with the highest recorded adult return rate for Oregon. These high adult overwinter survival rates contributed substantially to the increase in the Oregon plover population size in both 2014 and 2015.

In 2014, we reported 272 chicks fledged (Lauten *et al.* 2014). Of these, we observed 146 in Oregon in 2015. We also recorded four banded hatch year birds in 2015 that had not been documented fledged in 2014, raising the total number of chicks known to have fledged in 2014 to 276 (Table 2). The return rate was above the 1992-2015 average (Table 2). Of the returning HY14 birds, 79 (54%) were males and 67 (46%) were females. One hundred and seven of the HY14 returning plovers were confirmed breeding (73%).

During the 2015 season, we captured and rebanded 10 adult plovers with brood band combinations that needed to be updated to unique adult combinations. Six were males and four were females. We banded five unbanded adult male plovers and 539 chicks.

Distribution

To show relative plover activity at sites, we recorded banded and unbanded adults and the number that nested at each site on the Oregon coast (Table 3). Nesting areas with low activity are at the northern and southern extreme of the current Oregon plover nesting range (i.e., Sutton Beach and Floras Lake). In 2015, the number of plovers at Sutton Beach was similar to 2014 (Lauten *et al*. 2014), while Floras Lake had no plover activity in 2015. The distribution of plovers is similar to previous years (Lauten *et al.* 2013 and 2014), with nesting activity concentrated between Overlook and Bandon SPMA, however there was an increase in nesting activity at both Siltcoos and New River HRA (Lauten *et al*., 2014). In previous years, some sites (particularly Siltcoos) had a high ratio of plovers present to nesting adults, because of use during the non-nesting season. In 2015, winter use was more evenly distributed from Siltcoos to Tahkenitch, and the ratio of plovers present to those confirmed nesting was similar across sites. In 2015 there was a substantial increase in the number of adults confirmed nesting compared to 2014 (95 more plovers confirmed nesting), however the percentage of plovers confirmed nesting was the same in 2014 and 2015 (83% verse 82%), indicating that the increase in confirmed nesting plovers was because of an increased population (Table 1).

Plovers continue to occupy available habitat adjacent to the traditional nesting areas (Lauten *et al.* 2010, 2011, 2012, 2013, and 2014). We have documented nesting or brood rearing activities occurring between South Siltcoos and North Overlook and South Overlook and North Tahkenitch (Lauten *et al*., 2013 and 2014), and in 2015 plovers used these areas throughout the nesting season (Figures 4 and 5). Plovers attempted to nest at South Tahkenitch (Figure 5, Lauten *et al*., 2014) and also nested along the beach north of North Tenmile spit (Figure 6). At CBNS plovers nested north of the FAA towers (Figure 8; in 2014 there were no nests north of the FAA towers) and we found evidence of brood activity well north of Access 1 and west of the aeration ponds on CBNS. It is possible due to the wide beach in this area north of Access 1 that plovers attempted or successfully nested in this area in 2015, but we were unable to adequately cover this section of beach. There was no known nesting activity north of China Creek at Bandon SPMA. While some of this nesting activity outside of traditional nesting areas is the result of plovers seeking new places to nest after a nest failure, increased plover densities are resulting in plovers occupying more available habitat. We expect the plovers to continue to utilize sections of beach adjacent and between the main nesting sites. Snowy Plovers also nested at Nehalem Bay State Park in 2015. Information on that nest is available from OPRD.

Nest Activity

Table 4 shows the number of nests and broods we located during the 2015 nesting season (Figures 2-12). The number of nests found was the highest ever, substantially higher than 2014, and over a hundred greater than the previous high in 2013. Overall nest success in 2015 was equal to the average (Table 5 and Table 6) and unexclosed nest success was higher than the ten year (2006 – 2015) average for unexclosed nests (x = 36% +/- 12.8). There was nesting activity at Sutton and South Tahkenitch for the third consecutive year, however Floras Lake had no nest attempts in 2015 (Table 4).

The first nests were initiated about 18 March (Figure 13), similar to 2014 and the earliest initiation date since monitoring began in 1990. Prior to 2013, nest initiation rarely began in March, but from 2013 to 2015 there has been a substantial increase in nest initiations in March. In 2013 and 2014, nine nests were initiated in March, and in 2015, 15 nests were initiated in March. Nest initiation increased through the end of May and remained high through the end of June. Peak nest activity (n = 159) occurred during the 20 - 29 June time interval, later than in previous years (Lauten et al., 2010, 2011, 2012, 2013, and 2014). The last nest initiation occurred on 15 July.

Predator Management

Predators continue to be the main cause of nest failure (Table 7, 54% of nest failures attributed to depredations), and corvids continue to be the most commonly identified nest predator. Over the past several years Northern Harriers were positively identified depredating plover nests at multiple sites (Burrell 2013 and 2014, Lauten *et al.* 2013 and 2014). In 2015 harriers were identified depredating nests at Tenmile and CBNS, and while there were no positive harrier depredations at Siltcoos, Overlook, and Tahkenitch, harriers were noted hunting over the nesting areas. In 2015 one harrier was removed from CBNS, one harrier was removed from Tenmile, and a harrier nest was removed from Tahkenitch due to its close proximity to the plover nesting area (see Bell 2015 for details). Despite the removal of one harrier at CBNS, harrier depredations continued sporadically particularly on South Beach, indicating that more than one harrier was hunting plover nests. No further harriers were removed from CBNS. The number of nests that failed due to mammal depredations in 2015 was high (Table 7). Typically only a small number of depredated nests are identified as failed due to mammals (Lauten *et al.*, 2010, 2011, 2012, 2013, and 2014). In 2015, 18 nests were depredated by coyotes and 11 nests failed due to skunks, much higher numbers than previous years. It is not clear whether this represents an increase in mammal predator numbers or whether mammalian predators are reacting to higher densities of plovers and plover nests. Predator management continues to be successful in reducing corvid numbers at all sites, removing non-native red fox from the Bandon SPMA and New River area, and identifying and targeting specific new or unique threats to plovers. See Bell (2015) for a complete discussion of the predator management program.

Exclosures were used on two nests in 2015 (Figure 14, see Appendix C for exclosure protocols), both at Sutton Beach. One nest was exclosed for 19 days and hatched. The second nest was exclosed for 11 days, however high winds and blowing sand resulted in accumulating sand in and around the nest and exclosure, and the female struggled to maintain incubating the eggs. The exclosure was removed after finding the nest had drifted into the corner of the exclosure, and one egg was buried. The nest then failed due to the adverse weather conditions.

Nest Failure

In 2015, most nests failures were attributed to unknown depredation and unknown cause (Table 7, 49% of the total failures). Nest depredations were classified as unknown because they had clearly been depredated, but the predator could not be identified. Of the 60 nest failures to unknown depredation, 18 (30%) occurred CBNS, 18 (30%) occurred at Bandon SPMA, and 16 (27%) occurred between Overlook and Tenmile. Corvids continue to be the main cause of known nest failure (Table 7, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, 2008, 2009, 2010, 2011, 2012, and 2013). Other known predators included coyotes, skunks, harriers, and fox.

At Siltcoos, Overlook, and Tahkenitch, corvids and coyotes were positively identified depredating nests (Table 7). Harriers were noted hunting at all three sites, but no failed nests were positively depredated by harriers. Coyotes have been present on most if not all nesting sites for many years (ORBIC and WS observations), but typically cause a very limited number of nest depredations. In 2015 coyotes were responsible for 17 nest failures from Siltcoos to Tahkenitch, indicating that they may be responding to higher plover densities. The persistent presence of coyotes, corvids, and harriers from Siltcoos to Tahkenitch makes it difficult to suggest which predators may be responsible for unknown depredations at these sites.

At Tenmile, five of the 14 nest depredations were from unknown predators (Table 7). Seven nests failed to corvids and 2 nests failed due to harriers, but no failures were due to mammalian predation. It is likely that avian predators were responsible for the unknown depredations at Tenmile. One harrier was removed from Tenmile in 2015 (Bell 2015).

At CBNS the majority of the unknown depredations (72%) occurred on South Beach. Corvid activity at CBNS and on South Beach was very low to nonexistent after the early part of the season. Three nests on South

Beach and four nests on the HRAs were positively identified as harrier depredations. Harriers were present all season and were noted hunting both over the nesting area and the beach. One nest was depredated by a coyote, however that depredation appeared to be opportunistic as the nest was along the path the coyote was traveling. We did not document evidence that coyotes were deliberately hunting for plover nests at CBNS. From the pattern of nest failures at CBNS and the limited evidence observed, we believe harriers were likely responsible for most of the unknown depredations at this site. One harrier was removed by Wildlife Services (Bell 2015), but depredations and harrier observations continued after the removal.

At Bandon SPMA, corvids, skunks, and fox were all documented depredating nests (Table 7). Corvid activity was highest early in the season, while skunks and fox were persistent throughout the breeding season. Ten of the unknown depredations occurred during the first week of May, when 18 nests failed within several days. Evidence of ravens was documented at five of these nests, and based on the pattern of the failures, we believe most of the other unknown depredations during this time also failed due to ravens. Raven depredations are often episodic; once a raven moves onto a nesting area and discovers eggs, they will continue to hunt the area until they are removed. Raven activity declined after mid-May due to Wildlife Service's efforts. Fox also were persistent throughout the breeding season in 2015 at Bandon SPMA and New River. Due to the persistent mammal activity, we recorded more skunk depredations than any previous year, and it is likely that some of the other unknown depredations were due to these mammals. Eleven nests were depredated by skunks at Bandon SPMA and New River in 2015 (Table 7). This is a high number of nests depredated by skunks.

For the first time, a gull (*Larus sp*.) was documented as a nest predator in Oregon. Gull tracks were found at a failed nest at Bandon SPMA that was not due to hatch. While this was the only documented gull depredation, two other nests, one on the Bandon Beach side of Bandon SPMA and another on the New River side of the Bandon SPMA, also had gull tracks present at the nest site. However in both of those cases the nests were due to hatch, and it was unclear whether the gull ate the eggs or the hatched chicks. At the time many subadult California Gulls (*Larus californicus*) were present at Bandon SPMA, feeding on numerous mole crabs (*Emerita sp.*). California Gulls are a known plover nest predator (Page *et al*., 2009), but have never been problematic in Oregon (ORBIC observations). It is not clear if these potential depredations were caused by a single individual or multiple individuals, or whether the gull(s) was targeting plover nests or opportunistically depredating nests that it happened upon.

The main cause of known nest failure at New River was corvids and mammalian predators (Table 7). As noted at Bandon SPMA, skunk and fox activity were persistent all season despite concerted efforts to target these species. Although WS removed 10 skunks from these areas (Bell 2015), evidence of skunk activity remained high throughout the breeding season, and their activity was persistent. It is not clear whether the increase in the number of skunk depredations was due to a larger skunk population leading to increased opportunistic depredations, or whether skunks were responding to higher densities of nesting plovers by focusing attention on plover nests. Corvid activity is always persistent at New River particularly on the HRA due to the proximity to nearby sheep and cattle ranches.

As has been the case in past years, a large portion of the nest failures were due to unknown causes (25% in 2015, Table 7). These nests have no evidence at the nest site to allow us to identify the cause of failure (typically due to windy conditions that remove all evidence). A portion of these may have been depredated, but due to their location (i.e., on the beach, close to recreational activity) we cannot be certain of the cause of failure. We placed Reconyx cameras at two exclosed and 33 unexclosed nests in 2015 in an effort to more clearly understand the causes of nest failure. Of the nests with cameras, 14 failed and in all cases the cameras clearly identified the cause of failure. At eight of the failed nests, monitors' assessment of the cause of failure matched what was shown on the camera. At six of the failed nests, monitors were unable to identify the predator responsible for nest failure based on evidence left at the nest, but we were able to more accurately identify the cause of failure based on camera data. These nests failed to ravens (3), harrier (1), coyote (1), and red fox (1). In one case, monitors incorrectly determined that a nest failed to raven predation based on tracks in the vicinity of the nest, but camera data showed that the nest had never been consistently incubated, so the actual cause of failure was abandonment. This nest abandonment did not appear to be caused by the presence of the camera; after camera placement the pair can be

seen copulating and attending to the nest for brief periods, but sustained incubation never occurred. Use of cameras did not negatively affect nest success. Apparent success at nests with cameras was 60% -- higher than overall nest success (Table 5), and higher than apparent success at nests without cameras (48%). We intend to continue to use cameras where they are feasible, as time is available, and where better documentation of the cause of nest failure is needed.

Productivity

In general, productivity was excellent in 2015. We monitored 50 more broods in 2015 (Table 8) compared to 2014 (n = 221) and confirmed a record high number of fledglings (Table 9). Of the 271 broods we monitored, 32 were from undiscovered nests. There may have been additional broods from undiscovered nests, but due to the number of plovers and plover nests, we were only certain of 32 additional broods. We also tallied an additional 31 unbanded fledglings at CBNS that we could not assign to specific broods. These fledglings were not included in any of the data analysis because we were uncertain of their origin and did not want to double count. Adding these fledglings to the total of known fledglings resulted in a minimum of 364 fledglings (Table 9). The overall fledging success (Table 8) was slightly higher than the post-predator management average (Table 10). The overall brood success rate (Table 8) was above the 1991 – 2015 average (67% +/- 10). The overall number of fledglings per male (Table 8) was higher than the 2004 – 2015 post-predator management average (Table 10).

Sutton

The number of nests at Sutton Beach in 2015 (Table 4) was the highest since 2001 (n = 15). Two nests hatched, one exclosed and one unexclosed (Table 5). Three fledglings were confirmed from Sutton Beach, only the second year Sutton Beach had more than one fledgling confirmed (Table 9). The productivity index at Sutton was 13% due to the relatively high number of eggs laid compared to the number of eggs hatched (Table 11). The number of fledglings per male was the highest ever for this site (Table 11), however only two males were confirmed nesting at Sutton Beach in 2015 (Figure 2).

Siltcoos

Overall nest success was much higher at Siltcoos in 2015 (Table 5, Figure 3) compared to 2014 (33%) due to very high nest success at South Siltcoos. North Siltcoos had the lowest nest success of any site in 2015 (Table 5) and below the average for this site (39%). South Siltcoos had the highest nest success of any site (Table 5), nearly double the average for this site (46%).

Due to the high nest success at South Siltcoos, overall productivity for Siltcoos was excellent (Table 12). More eggs hatched than in any previous year resulting in the highest hatch rate since 1998 and well above the post-predator management average (Table 12). There were 15 more broods at Siltcoos in 2015 (Table 8) compared to 2014 (Lauten *et al.* 2014) and they produced the highest number of fledglings ever for this site (Table 12). Fledging success was excellent and slightly higher than the post predator management average, and the productivity index was well above the post predator management average indicating that many fledglings were produced for the number of eggs laid. The number of fledglings per male was much higher than the post predator management average and a notable improvement over the previous five years.

Overlook

Nest success at North Overlook in 2015 (Table 5, Figure 4) was similar to 2014 (51%) and slighter higher than the average (45%). Nest success at South Overlook in 2015 (Table 5) was lower than in 2014 (74%) but higher than the average (39%). However, nine more nests hatched at Overlook in 2015 compared to 2014.

We monitored 30 more nests at Overlook in 2015 compared to 2014 (Lauten *et al*., 2014), and the plovers laid 79 more eggs in 2015 compared to 2014 (Table 13), the highest number of eggs laid at this site. While the hatch rate was slightly lower than in 2014 (Table 13), 26 more eggs hatched in 2015 and the hatch rate was above the post predator management average. There were 13 more broods in 2015 compared to 2014 and overall brood

success was 79% (Table 8), similar to 2014. The number of chicks fledged was the highest ever for this site, and the fledging success rate was much higher than the post predator management average (Table 13). The productivity index was the same as 2014 and above the post-predator management average, and the number of fledglings per male was much higher than the post predator management average (Table 13).

Tahkenitch

Nest success at North Tahkenitch in 2015 (Table 5) was average (43%) and slightly lower than in 2014 (50%), however 11 more nests hatched in 2015 compared to 2014 (Lauten *et al*., 2014) and there were nearly twice as many nests at North Tahkenitch in 2015 compared to 2014. There were only two nest attempts at South Tahkenitch, and both failed.

Due to the increase in nest attempts, there was a large increase in the number of egg laid (Table 14). Despite the hatch rate being slightly lower than the post predator management average, the number of chicks hatched, and the number of chicks fledged, were the highest ever for this site. Fledging success was well above the post predator management average. The high number of fledglings produced compared to the number of eggs laid resulted in a high productivity index, above the post predator management average. The number of fledglings per male was much higher than the post-predator management average (Table 14).

Tenmile

There were 14 more nest attempts at Tenmile in 2015 compared to 2014 (Table 4, Figures 6 & 7), but fifteen fewer nests hatched in 2015 and therefore the nest success rates were much lower than in 2014 (Table 5, Lauten *et al*., 2014). Nest success at North Tenmile was near average (44%), while nest success at South Tenmile was well below average (51%).

Despite the increase in nest attempts, the number of eggs laid in 2015 was similar to 2014 (Table 15). This is because 16 nests failed while they only had one egg recorded, increasing the number of nest attempts without adding many more eggs. The hatch rate was lower than in 2014, however it was still higher than the post predator management average (Table 15). Eighteen fewer fledglings were produced in 2015 compared to 2014, but the fledging success rate was higher than the post predator management average (Table 15). There were 17 fewer broods in 2015 compared to 2014, but brood success was identical both years (85%, Table 8, Lauten et al., 2014). While the productivity index was lower than 2014, it was higher than the post-predator management average, and the number of fledglings per male was equal to the post-predator management average (Table 15).

Coos Bay North Spit

There were 51 more nest attempts at CBNS in 2015 compared to 2014, including 21 more nest attempts on South Beach and 23 more nest attempts on the HRAs. The number of eggs laid at CBNS increased by 126 over 2014 (Table 16), the highest number of eggs laid at any site in any year. These increases are a function of both an increased population using CBNS, and higher numbers of nest failures. The overall nest success at CBNS in 2015 (Table 5) declined compared to 2014 (Lauten *et al*., 2014) with South Beach having the largest decline in success (70% in 2014 compared to 39% in 2015). South Spoil and the HRAs had higher than average nest success (63% and 52%, respectively), while South Beach was well below average (61%, Table 5). The hatch rate in 2015 declined compared to 2014, but was still higher than the post predator management average. Despite lower nest and hatching success, 16 more nests hatched and there were a minimum of 26 more broods at CBNS in 2015 compared to 2014 (Lauten *et al*., 2014). Overall brood success (78%) was similar to 2014 (79%). While productivity was good at CBNS in 2015, fledging success, the productivity index, and the number of fledglings per male were below the post predator management averages (Table 16).

We counted a minimum of 17 broods from undiscovered nests at CBNS. Due to the amount of habitat, the number of plovers and the density of nests, it has become increasingly difficult to find and monitor every nest and brood at CBNS. Because broods range widely at CBNS, it is impossible to know where broods from undiscovered nests originated. Thus, we did not attempt to assign the location of the broods from undiscovered nests, but lumped

them as general CBNS broods. Due to the number of unbanded fledglings that we could not assign to known broods, we suspect there were more broods from undiscovered nests than we counted. Between broods from undiscovered nests, additional broods that we likely missed, and chicks from nests that did not get banded, we counted a minimum of 31 unbanded fledglings that originated from CBNS but could not be assigned to a known nest or brood. These additional fledglings were not used in any of the productivity parameters we calculated.

Bandon SPMA

In 2015, Bandon SPMA had the highest number of nests ever for this site (Table 4), including 40 nests on the Bandon Beach side despite New River continually eroding the beach and significantly reducing the length of beach on the north side of the river mouth. Nest success (Table 5) was lower than in 2014 (44%) and below the average (x = 42%), and eight fewer nests hatched in 2015 compared to 2014 (Lauten *et al*., 2014).

Due to the increase in the number of nests, more eggs were laid than in any previous year (Table 17), however 33 fewer eggs hatched in 2015 compared to 2014, and the hatch rate was lower than the post predator management average. There were 6 fewer broods in 2015 (Table 8) compared to 2014 (Lauten *et al*., 2014), and the brood success rate was slightly higher in 2015 compared to 2014 (68%). Despite the lower hatch rate, the number of fledglings produced was just slightly lower than in 2014 and the fledging success rate was higher than the post predator management average (Table 17). The large number of eggs laid, and the relatively large number of fledglings produced resulted in a productivity index near the post predator management average. For the second consecutive year, the number of fledglings per male was higher than 1.00, and was above the post-predator management average (Table 17).

New River

Compared to 2014, there were 12 more nests on the New River HRA and twice as many nests on private land at New River in 2015 (Table 4). The increase in nest attempts was due to an increase in plover numbers in these areas (Table 3). Overall nest success in 2015 at New River (29%) was similar to 2014 (32%), and well below average (54%). The New River HRA had slightly better nest success in 2015 (Table 5) than in 2014 (21%), but private lands had much lower nest success in 2015 (75% in 2014, however the sample size is small).

The increase in plover activity and nest attempts resulted in the largest number of eggs laid at New River in any one season (Table 18). While nearly double the number of eggs hatched, the hatch rate was the same as 2014 and well below the post predator management average (Table 18). Brood success on the New River HRA was similar to 2014 (Table 8, 75% in 2014), but brood success on private lands at New River in 2015 was well below 2014 (100%). The number of fledglings produced was similar to the previous two years, and the fledging success rate was just below the post predator management average. Due to the relatively high number of eggs laid compared to fledglings produced, the productivity index was lower than the previous two years and much lower than the post-predator management average (Table 18). Despite the relatively low productivity index, the number of fledglings per male was equal the post-predator management average (Table 18).

Floras Lake

There were no nests at Floras Lake in 2015, and we did not record any plover activity at this site in 2015.

Productivity Before and After Lethal Predator Management

Data from Floras Lake and Sutton Beach are very sparse and not normally distributed. We did not include them in any productivity analyses.

As has been noted in the past (Lauten *et al*., 2014), post-predator management hatch rates have declined for Overlook, Tenmile, CBNS, Bandon SPMA, and New River while remaining stable at Siltcoos and Tahkenitch

(Table 19). The overall post-predator management nest success rate (44%) is also lower than the pre-predator management nest success rate (51%). The decline in nest success and hatch rates is attributed to the decreased use of exclosures (Figure 14); unexclosed nests have a lower nest success rate than exclosed nests (Table 6). However, due to predator management, unexclosed nest success has improved to a ten year average (2006 – 2015) of 36.4% +/- 12.8, slightly less than the overall ten year nest success average of 41.8% +/- 10.4. These rates fall between the mean observed and calculated success rates reported by Page et al. (2009) from four different studies. Despite the lower hatch rates and nest success since implementation of lethal predator management, the actual number of eggs hatched and chicks fledged has increased dramatically (Figure 15). We believe that the current nest success and hatch rates are sufficient to sustain a healthy plover population.

Productivity as measured by fledging success, brood success, number of fledglings per male, and the overall number of fledglings produced has increased. Using the data from the productivity tables (Tables 12-18, excluding Sutton Beach), the overall mean post-predator management fledging success rate (0.46) was higher than the mean pre-predator management fledging success rate (0.39). The post-predator management fledging success rate has improved for Siltcoos, Overlook, Bandon SPMA, and New River and has remained relatively stable at Tahkenitch and CBNS (Table 19). Tenmile is the only site where the fledging success rate has declined (Table 15 and 19), but it remains equal to the overall post predator management average. The post-predator management mean brood success rate for all sites (2004-2015; 72.8%) was higher than the pre-predator management brood success rate (1991-2001; 62.9%). The overall mean number of fledglings per male post-predator management (2004-2015; 1.31) was higher than the pre-predator management mean number of fledglings per male (1992-2001; 1.11). The mean number of fledglings per male has improved at Siltcoos, Overlook, Tahkenitch, CBNS, Bandon SPMA and New River (Table 19), and has remained stable but above recovery goals at Tenmile. Overall productivity has increased in the post-predator management time period resulting in a substantial increase in the number of fledglings and the overall population of plovers on the Oregon coast.

Brood Movements

Sutton, Siltcoos, Overlook, and Tahkenitch

There were two successful broods at Sutton Beach (Table 8) and both remained in the vicinity of the HRA and adjacent beach until fledging. There were two successful broods at North Siltcoos in 2015 (Table 8); both broods remained on the spit area until fledged. Sixteen of 21 broods were successful at South Siltcoos (Table 8). Most broods spent the majority of the brood period on the spit and the adjacent HRA. One brood that originated south of Waxmyrtle trail spent the brood period on the beach south of the Waxmyrtle trail, and three other broods that originated from the spit moved south along the beach. One brood was noted south of Carter Lake trail.

Nine of 24 broods originated from nests on the beach north of the HRA at North Overlook. These broods remained on the beach throughout the brood period. One brood that originated on the HRA at North Overlook moved north along the beach; six broods from the HRA remained on the HRA for the brood period. One brood from the HRA at North Overlook moved south to the HRA at South Overlook. One brood originated from a nest on the beach south of the HRA at North Overlook and remained on the beach in the vicinity of the Overlook trail. At South Overlook, four broods that originated on the HRA moved south onto the beach, including one brood that moved to North Tahkenitch. Three other broods originated from nests on the beach south of the HRA and remained on the beach until fledgling. The remaining broods remained on or adjacent to the HRA area.

Three of the 30 broods from North Tahkenitch originated from nests on the beach north of the HRA. One brood from an undiscovered nest was also found on the beach north of the HRA. These broods remained along the beach north of the HRA, and one brood that originated from the HRA moved north along the beach. The remaining broods stayed on the spit and HRA area and the adjacent beach of North Tahkenitch. There were no broods at South Tahkenitch in 2015.

Tenmile

Of the 16 broods from North Tenmile, 15 originated from nests on the beach north of the HRA. In 2014 only one brood originated from a nest north of the HRA (Lauten *et al*., 2014). This is the highest level of nesting and brood activity that we have documented north of the HRA at North Tenmile. Ten nests were active at the same time in June on the beach; one of these was crushed by a vehicle that illegally accessed the beach. Only one brood originated from the HRA, and it remained on the HRA for the brood period. At South Tenmile, one nest and one brood from an undiscovered nest was found on the beach south of the HRA. One other brood moved off the HRA and used the beach south of the HRA. All the other broods originated on the HRA, the spit, or the adjacent beach, and all remained on the HRA, the spit and adjacent beach for the brood rearing period.

Coos Bay North Spit

The HRAs and South Spoil at CBNS are the only nesting areas on the Oregon coast that are isolated from the beach habitat by a densely vegetated foredune. All other nesting areas typically have substantial gaps or breaks in the foredune that connect the beach with adjacent nesting areas east of the foredune. Further isolating the South Spoil, 94HRA and 98EHRA are berms along the foredune road that bisects the HRAs. Using data from 2010 to 2015, average brood success, fledging success, and fledglings per male were highest on the beach and lowest on South Spoil, the eastern-most nesting area (Figure 16). Food resources are most abundant on the beach, and data indicates that broods that originate on South Beach, or those that move west to South Beach, have better success (Lauten *et al*. 2014). Since the fall of 2013, vegetation has been removed from gaps in the berms along the foredune road and the foredune to create corridors for plover broods to move west to access the beach. Because of the large number of plovers and broods at CBNS in 2015, it is difficult to determine how many broods moved from the eastern nesting areas to South Beach. Observations indicated that broods were using the gaps to cross the foredune road and access the beach. In 2015, South Beach had higher fledging success and fledglings per male than the HRAs and South Spoil (Table 8). We believe that maintaining and increasing the number of gaps in the foredune road and along the foredune are important management actions that facilitate movement of the broods to the beach where food resources and brood survival are highest. While we have not directly documented broods using the foredune road to move south from the nesting area to the jetty, we believe that gaps facilitating westward movement to the beach reduce the likelihood of broods wandering onto the open section of the foredune road where interactions with vehicles and recreationists could occur.

Plover brood activity on South Beach in 2015 was extensive. We documented multiple broods using the jetty area south of the closed section of beach, and noted active broods using the same beach area as vehicles and tent-campers. We observed multiple broods using the parking area at the base of the jetty, the adjacent foredune roads, and one male and chick on the foredune road as far east as the southeast side of the South Spoil (in this latter case the chick was ‘walked’ back to the jetty area and safely returned to South Beach). Several broods originated from nests just north of the FAA towers, and one nest was found near Access 2. These broods spent the majority of the brood rearing period north of the FAA towers, an area without ropes and signs, and were repeatedly noted running in extensive tire tracks from vehicles. One brood was active considerably north of Access 1 in the area west of the aeration ponds. We were unable to survey this area for nests, but the habitat was adequate for nesting and we noted multiple fledglings here.

Bandon SPMA

The mouth of New River continues to move north and has eroded a large portion of the HRA at the south end of the beach, essentially reducing the area to about a quarter of the original size. Only three nests were found on the HRA (Figure 9), one of which hatched. The brood from this nest spent the brood period on and adjacent to the HRA until it fledged. Two nests were found west of the China Creek parking lot, north of the SPMA boundary. One of these nests hatched, and the brood spent the majority of the brood period on the beach west of China Creek overwash, within the SPMA boundary, until it fledged. The remaining broods originated from nests that were on the beach and along the foredune. All of these broods spent the brood period between the northern boundary of the SPMA and the mouth of the river, with much of the brood rearing occurring on the southern half of the beach. Due to excessive grass regrowth, the cutouts had little activity in 2015. The last nest to hatch was on 20 July, and that

brood failed by the end of the month. There was little plover activity at Bandon Beach after the beginning of August.

Fifteen of 19 broods (79%) that originated on the south side of New River at Bandon SPMA in 2015 were successful. Most brood activity was noted within the SPMA, and we did not document any broods moving south of the SPMA, however it is possible that some broods temporarily moved onto private lands. The section of the SPMA south of New River has become very large due to the movement of the mouth of the river to the north. Plover broods have extensive available habitat from the ocean to the river side, and we observed broods utilizing all the available habitat including near the ocean, in the wrackline west the carsonite signs, within the dunes, and along the river mudflats.

New River

Three broods originated on private land in 2015; we only confirmed one fledged. Two broods originated on Bandon Biota property just south of the Bandon SPMA; the male was the same for both these broods. The first brood failed quickly; the second brood moved north onto the SPMA and successfully fledged. The third brood hatched on the beach south of Bandon Biota property but north of the New River HRA. This brood slowly moved south to the north end of the New River HRA. The brood was active for the entire brood period, and we repeatedly noted one chick. However, we never confirmed the fledgling despite repeated attempts.

Brood activity on the New River HRA was concentrated from the northern end to New Lake breach, with a majority of the brood activity centered on Croft Lake breach. Seven of the nine broods that originated from the New River HRA in 2015 were successful (Table 8). The first brood of the year found on Croft Lake breach was from an undiscovered nest that would have been initiated about 20 March. Only one brood spent most of the brood period on New Lake breach and was noted once south of New Lake breach. No broods moved south of the HRA area, and no broods from the HRA moved to the SPMA nor did any broods from the SPMA move to the HRA.

Floras Lake

There was no brood activity at Floras Lake in 2015.

Immigrant Plovers

Twenty-eight adult plovers banded in California and two adult plovers banded in Washington were observed in Oregon in 2015. Fifteen were females, 14 were males, and one was of uncertain sex. Both Washington banded plovers were females. Eight females were confirmed nesting and the other seven were present during the breeding season, although four were only seen briefly and may not have attempted to nest. Eleven males were confirmed nesting and the other three were present during the breeding season and may have attempted to nest but were not confirmed. One bird of uncertain sex was only seen briefly and was likely passing through Oregon.

Of the 28 plovers banded in California, seven females and eight males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. The other 13 plovers, six females, six males, and one uncertain sex were originally banded in California. Both adults from Washington were present for the second consecutive year and were originally banded in WA in 2013.

Acknowledgments

We would like to thank Micah Bell, Zack Perdue, Joe Metzler, Patrick Flory, Paul Wolf, and Mike Burrell of Wildlife Services for their assistance in the field and thoughtful insight about predators; RJ Rapelje, Trisha Wymore, Ryan Parker, and Keith Saylor of OPRD for their hours educating the public and monitoring recreational activity on the beach; Sarah Schapira of BLM for monitoring recreational activity and logistical support at CBNS; BLM seasonal employees for their assistance at New River and CBNS; Statia Ryder of South Coast Watershed

Association for monitoring and education with recreationists and campers at New River and Floras Lake; Crystal Mullins, and Christina Bailey of Forest Service for their many hours maintaining signs and ropes, monitoring recreational activity and interacting with the public; volunteers Steve & Laura Paulson, Garrie and Nancy Bolger, Bob and Lynette Voegtlin, Doug and Lois Roberts, Jay and Susan Feagan, Art and Bev Redmond, and John Gee spent numerous hours educating the public at China Creek parking lot on Bandon Snowy Plover Management Area; volunteers Carol Bylsma, Paula McDonnell, Jim and Jeanette Scott, and Glenn Pannier spent numerous hours educating the public for USFS; Interpretive Specialist David Thompson and his staff of Valuing People and Places Field Rangers; Ted Gage and Shane Presley of BLM Law Enforcement, Adam Slater of Coos County Sheriff's Department, Ed Lagorne of Lane County Sheriff's Department, Oliver Grover and Tyler Smith of the USFS Dunes National Recreation Area Law Enforcement; Dan Elbert, Madeleine Vander Heyden, and Laura Todd of the US Fish and Wildlife Service; Mark Stern and Ken Popper of The Nature Conservancy; Stuart Love and Martin Nugent of the Oregon Department of Fish and Wildlife; Charlie Bruce, retired ODFW volunteer; Kip Wright, Jenn Kirkland, Carol Aron, Jeanne Standley, Megan Harper, and all the managers at Coos Bay BLM District whose support is invaluable; Calum Stevenson, Larry Becker, and Vanessa Blackstone of the Oregon Parks and Recreation Department; Ben Fisher, Jerry Phillips, Chuck Littlejohn, , Nick Schoeppner, Pete Hockett, Leah Shepard, and all the staff at Bullard's Beach State Park; Cindy Burns and Deanna Williams of the USFS Siuslaw National Forest; Patricia Clinton and Kate Groth of ACOE; Dave Williams of Wildlife Services; Sean McAllister in Humboldt Co., CA,; Mark Colwell and students at Humboldt State Univ., Arcata, CA,; Jim Watkins of US Fish and Wildlife Service, Humboldt Co.; Gary Page, Lynne Stenzel, Doug George, Kris Neumann, Jenny Erbes, and Carlton Eyster of Point Blue Conservation Science; special thanks to Frances Bidstrup of Point Blue who coordinates all banding information and who is essential to the project; also special thanks to Kerrie Palermo, recently retired BLM biologist whose tireless support for more than 20 years has been essential to the success of the project; anyone and everyone who we may have accidentally forgotten – we sincerely appreciate the support, assistance, and input of all, without which the program would not be a success.

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Table 1. Minimum window survey counts, minimum number of Snowy Plover present, and minimum number of resident Snowy Plovers present between 15 April and 15 July on the Oregon Coast, 2005-2015. Number of plovers present during peak breeding season is not available prior to 2009.

YEAR	WINDOW SURVEY	# SNPL PRESENT	# RESIDENT SNPL*
2004	82	136	
2005	100	153	
2006	91	177	
2007	125	181	
2008	98	188	
2009	136	199	184
2010	158	232	207
2011	168	247	233
2012	206	293	274
2013	215	304	299
2014	228	338	327
2015	277	458	449

* Because it includes all birds that were present during the peak nesting season of 15 April to 15 July, we believe the number of resident plovers is the most accurate estimate of the total breeding population. We did not distinguish resident plovers prior to 2009, however due to smaller population sizes, the number of adults confirmed breeding was a close approximation of the resident population prior to 2009.

Table 2. Number of Snowy Plover fledglings, number of previous year fledglings returning, return rate, number nesting, and percent nesting in first year of return along the Oregon coast, 1992 - 2015.

Year	# of fledglings from previous year	# of HY birds from previous year sighted on OR coast	Return Rate (#HY/#Fled)
2015	276 [a]	146	54%
2014	104	54	52%
2013	180	91	51%
2012	172	92	51%
2011	84	53	63%
2010	107	54	50%
2009	73	35	48%
2008	124	52	42%
2007	110	32	29%
2006	78	29	37%
2005	108	43	40%
2004	60	26	43%
2003	31	14	45%
2002	32	18	56%
2001	43	23	53%
2000	53	31	58%
1999	32	18	56%
1998	41	14	34%
1997	47	30	64%
1996	57	18	32%
1995	56	37	66%
1994	36	16	44%
1993	33	10	30%
1992	16	6*	38%

* - minimum number sighted

Average return rate = 47%
SD = 11.0%

[a] - adjusted from 272 to 276 based on hatch year returns

Table 3. Plover activity based on the number of adult plovers at each nesting area on the Oregon Coast, 2015. Plovers move between nesting areas throughout the summer, therefore this is not a tally of the total number of plovers present.

	Females				Males					
	Banded		Unbanded		Banded		Unbanded		Total	
Site	# banded	# nested	# unbanded	# nested	# banded	# nested	# unbanded	# nested	# plovers	# nested
Sutton	3	3	2	1	3	2	1	0	9	6
Siltcoos	20	11	4	2	31	16	2	2	57	31
Overlook	44	26	5	5	49	33	4	4	102	68
Tahkenitch	34	20	3	3	47	25	2	2	86	50
Tenmile	35	16	5	2	41	27	5	4	86	49
CBNS	51	33	9	7	77	61	9	6	146	107
Bandon SPMA	50	27	12	7	51	27	5	2	118	63
New River HRA	24	10	4	0	23	13	2	0	53	23
Floras Lake	0	0	0	0	0	0	0	0	0	0

Table 4. Number of nests for selected sites on the Oregon Coast 2006 – 2015 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year only.

Site Name	06	07	08	09	10	11	12	13	14	15
SU	4	3	0	0	1	0	0	1	2	8
SI:										
North	12	15	30	14	17	13	10	13	6	8
South	13	13	6	9	24	21	22	30	18	23
OV:										
North	9	13	14	9	21	29	28	33	35	46
South	1	3	1	5	16	28	31	28	23	42
TA										
North	4	10	5	6	7	23	36	52	32	61
South	0	0	0					6	4	2
TM:										
North	10	20	12	13	13	15	17	19	26	29
South	12	21	16	41	30	35	29	17	21	32
CBNS:										
SB	0	8	5	19	17	16	7	36	20	41
SS	14	12	18	16	14	15	15	12	13	20
HRAs	18	19	26	30	33	26	39	58	43	66
BSPMA										
BB	23	30	28	31	26	28	48	44	28	40
NR spit	9	16	6	10	12	9	12	20	54	48
NR HRA	7	14	27	27	27	29	17	9	15	27
NR other	11	5	2	3	3	2	1	3	4	8
FL	0	0	0	3	0	0	2	0	2	0
Tot nst	**147**	**202**	**196**	**236**	**261**	**289**	**314**	**381**	**346**	**501**
Tot brd[a]	**15**	**4**	**3**	**8**	**2**	**4**	**11**	**8**	**12**	**32**

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

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

Table 5. Apparent nest success of Snowy Plovers on the Oregon Coast, 2015.

		Nests Exclosed			Nests Not Exclosed			Exclosed Nests	Nests Not Exclosed	
Site	**Total #**	**Hatch**	**Fail**	**Unknown**	**Hatch**	**Fail**	**Unknown**	**App Nest Success**	**App Nest Success**	**Overall Nest Success**
Sutton	8	1	1[a]		1	5		50%	16%	25%
Siltcoos										
North	8	-	-		2	6		-	25%	25%
South	23	-	-		20	3		-	87%	87%
Combined	31				22	9			71%	71%
Overlook										
North	46	-	-		22	22	2	-	48%	48%
South	42	-	-		22	20		-	52%	52%
Combined	88				44	43	2		50%	50%
Tahkenitch										
North	61	-	-		27	33	1	-	44%	44%
South	2	-	-		0	2	-	-	0%	0%
Combined	63				27	35	1		43%	43%
Tenmile										
North	29	-	-		14	15		-	48%	48%
South	32	-	-		12	20		-	37%	37%
Combined	61				26	35			43%	43%
CBNS										
South Beach	41	-	-		16	24	1	-	39%	39%
South Spoil	20	-	-		15	4	1	-	75%	75%
HRAs	66	-	-		49	14	3		74%	74%
Combined	127				80	42	5		63%	63%
Bandon SPMA	88	-	-		28	59	1	-	32%	32%
New River										
HRA	27	-	-		7	20		-	26%	26%
Other Lands	8	-	-		3	5		-	38%	38%
Floras Lake	0	-	-		-	-		-	-	-
Totals	501	1	1		238	252	9	50%	48%	48%

a - nest had exclosure, then exclosure was removed because of wind blown sand, then nest failed due to wind.

Table 6. Apparent nest success of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1990-2015.

Year	All nests (%)	Exclosed (%)	Not Exclosed (%)
1990	31	*	28
1991	33	75	9
1992	67	85	11
1993	68	83	27
1994	75	80	71
1995	50	65	5
1996	56	71	10
1997	48	58	14
1998	56	72	8
1999	56	64	0
2000	38	48	0
2001	35	68	0
2002	44	66	6
2003	51	77	9
2004	62	85	8
2005	48	72	14
2006	47	66	32
2007	42	71	35
2008	34	49	30
2009	33	76	25
2010	35	72	23
2011	50	71	48
2012	45	86	42
2013	24	83	21
2014	60	50	60
2015	48	50	48
Average =	47.5	69.7	22.5
STDEV =	12.7	11.6	19.1
10 year average =	41.8	67.4	36.4
STDEV =	10.4	13.6	12.8

* Multiple experimental designs used, data not included

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2015.

Site Name	Tot Nests	# Fail	Depredations					Other						
			Corvid	Unk	Mammal	Harrier	Gull	Human cause	Wind-Weather	Overwash	Abandon	One Egg Nest	Infer-tile	Unk cause
Sutton	8	6	1						4					1
Siltcoos:														
North	8	6	2								2			2
South	23	3			1[a]						2			
Overlook														
North	46	22	1	3	3[b]				1	2	3	2	1	6
South	42	20	1	2	7[c]							2		8
Tahkenitch														
North	61	33	5	6	6[d]				2		1	1	1	11
South	2	2	1											1
Tenmile:														
North	29	15	5	1				1			3			5
South	32	20	2	4		2				1	1	3		7
Coos Bay North Spit:														
South Beach	41	24		13		3				1	2	1		4
South Spoil	20	4									1		3	
HRAs	66	14		5	1[e]	4					1	1	2	
Bandon SPMA	88	59	6	18	10[f]		1		6			1		17
New River														
HRA	27	20	8	5	5[g]				1					1
Other lands	8	5		3	2[h]									
TOTALS	**501**	**253**	32	60	35	9	1	1	14	4	16	11	7	63

[a] – 1 coyote depredation
[b] – 3 coyote depredations
[c] – 7 coyote depredations
[d] – 6 coyote depredations
[e] – 1 coyote depredation
[f] – 3 fox depredations, 7 skunk depredations
[g] – 1 raccoon depredation, 4 skunk depredations
[h] – 2 fox depredations

Table 8. Fledging success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2015.

Site Name	Total # Broods*	% Brood Success*	Total # Eggs Hatched	Min. # Fledged		% Fledging Success**	# of Breeding Males[a]	# of Fledglings/ Male*	# of Fledglings/Male – Combined[c]
				From Known Nests	From Undiscovered Nests				
Sutton Beach	2	100%	6	3	-	50%	2	1.50	1.50 (2)
Siltcoos:									
North Siltcoos	2	100%	5	4	-	80%	3	1.33	1.61 (18)
South Siltcoos	21	76%	52	24	1	46%	16	1.56	
Overlook									
North Overlook	24	71%	57	25	1	44%	19	1.37	1.73 (37)
South Overlook	23	87%	58	38		66%	19	2.00	
Tahkenitch									
North Tahkenitch	30	80%	75	46	3	61%	27	1.81	1.81 (27)
South Tahkenitch	0	-	0	-	-	-	-	-	
Tenmile:									
North Tenmile	16	88%	40	20	4	50%	17	1.41	1.39 (31)
South Tenmile	13	77%	34	18	1	53%	14	1.36	
Coos Bay N. Spit									
South Spoil	15	73%	35	13		37%	14	0.93	
South Beach	16	81%	41	23		56%	15	1.53	1.52 (67)
HRA	49	80%	125	46		37%	35	1.31	
Broods only	17	71%	-		20		16	1.25	
Bandon SPMA	31	74%	61	29	2	48%	29	1.07	1.07 (29)
New River									
HRA	9	78%	19	9	1	47%	11	0.91	0.92 (13)
Other lands	3	33%	9	2		22%	2	1.00	
TOTALS	**271**	**75%**	**617**	**300**	**33**	**49%**	**220**[b]	**1.51**	
TOTAL FLEDGED				**333**					

% Brood success = # broods with at least 1 chick fledged / total # of broods

% Fledging Success = # of young fledged / # of eggs hatched

* Includes broods from undiscovered nests.

** Does not include fledglings from undiscovered nests because we do not know how many eggs hatched from those nests.

[a] – number of males confirmed nesting at each site; some males were confirmed nesting at multiple sites.

[b] – number of confirmed breeding males in entire population; this is not a tally of confirmed males from each site as some males may have nested at more than one location.

[c] – number of fledglings for both sites combined and number of known individual breeding males for both sites combined. Sample size of males in parenthesis.

Table 9. Total number of young fledged from select sites on the Oregon Coast 2000-2015, includes fledglings from broods from undiscovered nests.

Site Name	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
SU	3	0	0	0	0	0	0	0	0						1	3
SI:																
North	0	0	0	0	7	2	11	7	5	8	4	4	1	2	0	4
South	7	0	0	2	5	7	7	4	3	11	4	8	16	4	9	25
OV:																
North	5	1	2	3	3	5	8	12	3	7	12	27	22	3	18	26
South	0	1	0	0	3	2	0	1	0	2	7	23	27	0	25	38
TA:																
North	2	4	1	3	6	8	5	2	0	1	3	20	26	9	25	49
South	3	4	5	2	0	0	0	0	0					3	0	0
TM:																
North	0	0	3	1	3	6	12	13	3	2	3	1	5	15	35	24
South	5	4	3	9	9	5	7	14	6	19	13	5	5	8	27	19
CBNS:																
SS	3	4	2	7	13	9	11	7	17	4	2	6	10	2	14	13
SB	0	1	1	3	0	8	1	10	7	17	13	22	16	18	28	23
HRAs	6	6	8	14	22	6	19	9	16	10	5	28	34	3	49	46
CBNS[b]																20[b]
BSPMA																
BB	0	1	0	4	16	11	12	13	2	6	6	16	11	8	12	12
NR spit	0	0	0	1	10	0	3	12	2	1	0	5	1	14	22	19
NR HRA	1	3	3	7	5	1	7	16	7	17	12	7	4	12	3	10
NR other	4	3	3	4	6	8	7	4	2	2	0	0	0	3	6	2
FL	3	0	0	0	0	0	0	0	0	0	0	0	2		2	0
Total	**43**	**32**	**31**	**60**	**108**	**78**	**110**	**124**	**73**	**107**	**84**	**172**	**180**	**104**	**276[a]**	**313**
																31[c]
																364[d]

[a] – adjusted from 272 based on hatch year returns

[b] – for 2015, all broods from undiscovered nests at CBNS lumped under CBNS

[c] – minimum additional unbanded fledglings from CBNS that could not be assigned to a specific brood

[d] – total estimated fledglings, including unbanded fledglings from CBNS

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

Table 10. Fledging success and mean number of fledglings/male on the Oregon Coast, 2004 – 2015.

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
’04-’15 mean	46.4 +/- 5.9	1.40 +/- 0.26

Table 11. Productivity of Snowy Plovers at Sutton Beach, Lane Co., Oregon coast, 1993-2015.
Number of eggs laid, number hatched, hatch rate, # fledged, fledgling success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

Sutton	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/male
2015	23	6	26%	3	50%	13%	3	2	1.50
2014	4	2	50%	1	50%	25%	1	2	0.50
2013	2	0	0%	0	0%	0%	0	1	0.00
2012	0	0	0%	0	0%	0%	0	0	0.00
2011	0	0	0%	0	0%	0%	0	0	0.00
2010	2	0	0%	0	0%	0%	0	1	0.00
2009	0	0	0%	0	0%	0%	0	0	0.00
2008	0	0	0%	0	0%	0%	0	0	0.00
2007	6	0	0%	0	0%	0%	0	1	0.00
2006	9	0	0%	0	0%	0%	0	1	0.00
2005	0	0	0%	0	0%	0%	0	0	0.00
2004	0	0	0%	0	0%	0%	0	0	0.00
2003	3	2	67%	0	0%	0%	0	1	0.00
2002	7	0	0%	0	0%	0%	0	2	0.00
2001	36	2	6%	0	0%	0%	0	2	0.00
2000	21	8	38%	3	38%	14%	3	5	0.60
1999	9	2	22%	0	0%	0%	0	1	0.00
1998	20	8	40%	1	13%	5%	1	4	0.25
1997	39	7	18%	1	14%	3%	1	7	0.14
1996	14	0	0%	0	0%	0%	0	3	0.00
1995	2	0	0%	0	0%	0%	0	1	0.00
1994	3	0	0%	0	0%	0%	0	1	0.00
1993	2	0	0%	0	0%	0%	0	0	0.00
total	202	37		9			9	35	
Average			12%		7%	3%			0.13
STDEV			20%		16%	6%			0.34

[a] - productivity index = number of fledglings/number of eggs laid

Table 12. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2015.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Siltcoos	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	90	57	63%	28	49%	31%	28	18	1.55
	2014	57	22	39%	8	36%	14%	7	7	1.00
	2013	102	22	22%	4	18%	4%	4	10	0.40
	2012	92	38	41%	15	39%	16%	15	13	1.15
	2011	87	36	41%	11	31%	13%	11	13	0.85
	2010	105	30	29%	8	27%	8%	8	10	0.80
	2009	54	28	52%	17	61%	31%	17	11	1.55
	2008	68	22	32%	8	36%	12%	8	9	0.88
	2007	67	24	36%	11	46%	16%	11	10	1.10
	2006	60	22	37%	13	60%	22%	11	5	2.20
	2005	44	17	39%	9	53%	20%	9	7	1.29
	2004	31	18	58%	12	67%	39%	12	5	2.40
	2003	16	5	31%	2	40%	13%	2	4	0.50
	2002	28	8	29%	0	0%	0%	0	2	0.00
	2001	33	1	3%	0	0%	0%	0	3	0.00
	2000	55	19	35%	7	37%	13%	7	8	0.88
	1999	59	21	36%	6	29%	10%	6	8	0.75
	1998	10	10	100%	6	60%	60%	6	3	2.00
	1997	8	4	50%	0	0%	0%	0	2	0.00
	1996	7	3	43%	0	0%	0%	0	1	0.00
	1995	12	6	50%	2	33%	17%	2	3	0.67
	1994	9	4	44%	1	25%	11%	1	3	0.33
	1993	1	0	0%	0	0%	0%	0	0	0.00
Pre-pred mang (1993-2003)	**total**	238	81		24			24	37	
	AVE			38%		20%	11%			0.47
	STDEV			26%		21%	17%			0.61
Post-pred mang (2004-2015)	**total**	857	336		144			141	118	
	AVE			41%		44%	19%			1.26
	STDEV			12%		15%	10%			0.58

[a] - productivity index = number of fledglings/number of eggs laid

Table 13. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2015.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Overlook	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	240	115	48%	63	55%	26%	63	36	1.75
	2014	161	89	55%	42	47%	26%	39	31	1.26
	2013	152	9	6%	3	33%	2%	3	6	0.50
	2012	158	73	46%	40	55%	25%	40	25	1.60
	2011	152	80	53%	48	60%	32%	41	22	1.86
	2010	92	39	42%	15	38%	16%	15	15	1.00
	2009	31	14	45%	9	64%	29%	9	5	1.80
	2008	34	5	18%	2	40%	6%	2	3	0.67
	2007	46	19	41%	11	58%	24%	11	9	1.22
	2006	28	18	64%	8	44%	29%	8	4	2.00
	2005	42	16	38%	7	44%	17%	7	5	1.40
	2004	39	14	36%	6	43%	15%	6	6	1.00
	2003	17	9	53%	3	33%	18%	3	4	0.75
	2002	24	13	54%	2	15%	8%	2	4	0.50
	2001	39	10	26%	2	20%	5%	2	4	0.50
	2000	22	8	36%	5	63%	23%	5	7	0.71
	1999	6	6	100%	3	50%	50%	3	2	1.50
Pre-pred mang (1999-2003)	**total**	108	46		15			15	21	
	AVE			54%		36%	21%			0.79
	STDEV			28%		20%	18%			0.41
Post-pred mang (2004-2015)	**total**	1175	491		254			244	167	
	AVE			41%		48%	21%			1.34
	STDEV			16%		10%	9%			0.48

[a] - productivity index = number of fledglings/number of eggs laid

Table 14. Productivity of Snowy Plovers at Tahkenitch, Douglas Co., Oregon coast, 1993-2015.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Tahkenitch	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	179	72	40%	46	64%	26%	46	27	1.70
	2014	93	46	49%	24	52%	26%	24	13	1.85
	2013	141	14	10%	8	57%	6%	8	5	1.60
	2012	104	56	54%	26	46%	25%	26	19	1.37
	2011	59	37	63%	19	51%	32%	18	9	2.00
	2010	14	7	50%	3	43%	21%	2	3	1.00
	2009	13	6	46%	1	17%	8%	1	2	0.50
	2008	14	0	0%	0	0%	0%	0	1	0.00
	2007	23	6	26%	2	33%	9%	2	4	0.50
	2006	12	9	75%	4	44%	33%	4	3	1.33
	2005	26	14	54%	8	57%	31%	8	4	2.00
	2004	21	14	67%	6	43%	29%	6	5	1.20
	2003	37	17	46%	3	18%	8%	3	10	0.30
	2002	30	16	53%	6	38%	20%	6	5	1.20
	2001	36	22	61%	8	36%	22%	8	8	1.00
	2000	15	6	40%	5	83%	33%	5	2	2.50
	1999	9	1	11%	1	100%	11%	1	2	0.50
	1998	18	11	61%	1	9%	6%	1	4	0.25
	1997	41	10	24%	6	60%	15%	6	7	0.86
	1996	51	21	41%	8	38%	16%	8	9	0.89
	1995	21	16	76%	12	75%	57%	12	7	1.71
	1994	9	8	89%	1	13%	11%	1	3	0.33
	1993	0	0	0%	0	0%	0%	0	0	0.00
Pre-pred mang (1993-2003)	**total**	267	128		51			51	57	
	AVE			46%		43%	18%			0.87
	STDEV			27%		33%	16%			0.73
Post-pred mang (2004-2015)	**total**	699	281		147			145	95	
	AVE			45%		42%	21%			1.25
	STDEV			22%		18%	12%			0.65

[a] - productivity index = number of fledglings/number of eggs laid

Table 15. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2015.

Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Tenmile	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	141	74	52%	38	51%	27%	38	29	1.31
	2014	136	101	74%	56	55%	41%	56	32	1.75
	2013	95	37	39%	19	51%	20%	19	14	1.36
	2012	104	18	17%	9	50%	7%	9	6	1.50
	2011	117	18	15%	4	22%	3%	4	10	0.40
	2010	113	51	45%	16	31%	14%	16	18	0.89
	2009	117	27	23%	16	59%	14%	16	9	1.78
	2008	77	21	27%	8	38%	10%	8	8	1.00
	2007	89	43	48%	27	63%	30%	27	19	1.42
	2006	59	28	47%	16	57%	27%	16	10	1.60
	2005	49	21	43%	8	38%	16%	8	8	1.00
	2004	50	29	58%	12	41%	24%	12	9	1.33
	2003	43	20	47%	10	50%	23%	10	8	1.25
	2002	32	14	44%	3	21%	9%	3	8	0.38
	2001	24	10	42%	4	40%	17%	4	4	1.00
	2000	18	14	78%	5	36%	28%	5	4	1.25
	1999	13	8	62%	7	88%	54%	7	3	2.33
	1998	20	8	40%	3	38%	15%	3	4	0.75
	1997	6	6	100%	4	67%	67%	4	2	2.00
	1996	11	6	55%	4	67%	36%	4	4	1.00
	1995	13	11	85%	2	18%	15%	2	4	0.50
	1994	18	3	17%	3	100%	17%	3	2	1.50
	1993	24	15	63%	5	33%	21%	5	5	1.00
	1992	27	19	70%	14	74%	52%	14	7	2.00
Pre-pred mang (1992-2003)	**total**	249	134		64			64	55	
	AVE			59%		53%	30%			1.25
	STDEV			23%		26%	19%			0.61
Post-pred mang (2004-2015)	**total**	1147	468		229			229	172	
	AVE			41%		46%	19%			1.28
	STDEV			18%		12%	11%			0.40

[a] - productivity index = number of fledglings/number of eggs laid

Table 16. Productivity of Snowy Plovers at Coos Bay North Spit, Coos Co., Oregon coast, 1992-2015.
Number of eggs laid, number hatched, hatch rate, # fledged, fledging success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	CBNS	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	345	202	59%	83	41%	24%	79	56	1.41
	2014	220	164	75%	82	50%	37%	77	41	1.87
	2013	266	70	26%	23	33%	9%	23	24	0.96
	2012	175	135	77%	50	37%	29%	50	44	1.14
	2011	156	109	70%	52	48%	33%	52	31	1.69
	2010	160	40	25%	20	50%	13%	20	17	1.18
	2009	171	58	34%	28	48%	16%	28	22	1.27
	2008	125	63	50%	40	63%	32%	38	19	2.00
	2007	108	45	42%	26	58%	24%	26	12	2.17
	2006	86	54	63%	22	41%	26%	22	14	1.57
	2005	80	38	48%	23	61%	29%	21	12	1.75
	2004	73	42	58%	31	74%	42%	31	15	2.06
	2003	57	29	51%	21	72%	37%	20	9	2.22
	2002	48	21	44%	11	52%	23%	11	10	2.22
	2001	49	21	43%	11	52%	22%	11	8	1.38
	2000	75	23	31%	9	39%	12%	9	6	1.50
	1999	38	35	92%	26	74%	68%	26	10	2.60
	1998	49	18	37%	9	50%	18%	9	8	1.13
	1997	64	32	50%	12	38%	19%	12	11	1.09
	1996	77	48	62%	20	42%	26%	17	14	1.21
	1995	53	35	66%	20	57%	38%	19	11	1.72
	1994	50	44	88%	29	66%	58%	28	12	2.33
	1993	26	18	69%	9	50%	35%	9	7	1.29
	1992	32	21	66%	9	43%	28%	9	7	1.29
Pre-pred mang (1992-2001)	**total**	513	295		154			149	94	
	AVE			60%		51%	32%			1.55
	STDEV			20%		12%	18%			0.52
Post-pred mang (2002-2015)	**total**	2070	1070		512			498	326	
	AVE			52%		52%	27%			1.68
	STDEV			17%		12%	9%			0.43

[a] - productivity index = number of fledglings/number of eggs laid

Table 17. Productivity of Snowy Plovers at Bandon Snowy Plover Management Area, Coos Co., Oregon coast, 1995-20

Number of eggs laid, number hatched, hatch rate, # fledged, fledgling success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Bandon SPMA	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	214	61	29%	29	48%	14%	29	27	1.07
	2014	210	94	45%	33	35%	16%	33	28	1.18
	2013	185	51	28%	19	37%	10%	19	23	0.83
	2012	160	30	19%	12	40%	8%	12	14	0.86
	2011	92	43	47%	21	49%	23%	21	15	1.40
	2010	87	36	41%	6	17%	7%	6	12	0.50
	2009	95	20	21%	7	35%	7%	7	12	0.58
	2008	85	8	9%	3	38%	4%	3	15	0.20
	2007	114	40	35%	24	60%	21%	23	16	1.44
	2006	75	29	39%	11	38%	15%	7	8	0.88
	2005	111	45	41%	11	24%	10%	11	17	0.65
	2004	71	48	68%	26	54%	37%	25	15	1.67
	2003	33	14	42%	3	21%	9%	3	7	0.43
	2002	16	4	25%	0	0%	0%	0	4	0.00
	2001	16	8	50%	1	13%	6%	1	3	0.33
	2000	9	0	0%	0	0%	0%	0	2	0.00
	1999	26	16	62%	3	19%	12%	3	9	0.33
	1998	6	3	50%	0	0%	0%	0	2	0.00
	1997	34	9	26%	0	0%	0%	0	6	0.00
	1996	12	8	67%	1	13%	8%	1	3	0.33
	1995	37	11	30%	6	55%	16%	6	6	1.00
Pre-pred mang (1995-2001)	**total**	140	55		11			11	31	
	AVE			41%		14%	6%			0.28
	STDEV			23%		20%	6%			0.36
Post-pred mang (2002-2015)	**total**	1548	523		205			199	213	
	AVE			35%		35%	13%			0.84
	STDEV			15%		16%	9%			0.48

[a] - productivity index = number of fledglings/number of eggs laid

Table 18. Productivity of Snowy Plovers at New River (HRA and private lands), Coos Co., Oregon coast,

Number of eggs laid, number hatched, hatch rate, # fledged, fledgling success rate, and productivity index based on all known nests. Number of fledglings per male based on nests with known adult males only, therefore number of fledglings may vary from total number of fledglings.

	Year	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2015	97	28	29%	11	39%	11%	11	11	1.00
	2014	52	15	29%	9	60%	17%	9	9	1.00
	2013	35	23	68%	12	52%	34%	12	11	1.09
	2012	46	13	28%	2	15%	4%	2	6	0.33
	2011	59	26	44%	7	27%	12%	7	10	0.70
	2010	71	24	34%	12	50%	17%	12	15	0.80
	2009	76	38	50%	16	42%	21%	16	13	1.23
	2008	54	28	52%	7	25%	13%	7	12	0.58
	2007	38	24	63%	14	58%	37%	14	8	1.75
	2006	18	14	78%	6	43%	33%	6	6	1.00
	2005	3	2	67%	1	50%	33%	1	1	1.00
	2004	18	11	61%	5	45%	28%	5	4	1.25
	2003	14	10	71%	7	70%	50%	7	5	1.40
	2002	18	8	44%	3	38%	17%	3	4	0.75
	2001	21	11	52%	3	27%	14%	3	5	0.60
	2000	11	10	91%	1	10%	9%	1	4	0.25
	1999	9	6	67%	2	33%	22%	2	3	0.67
Pre-pred mang (1999-2001)	**total**	41	27		6			6	12	
	AVE			70%		23%	15%			0.51
	STDEV			20%		12%	7%			0.23
Post-pred mang (2002-2015)	**total**	599	264		112			112	115	
	AVE			51%		44%	23%			0.99
	STDEV			17%		15%	13%			0.36

[a] - productivity index = number of fledglings/number of eggs laid

Table 19. Average Snowy Plover productivity on the Oregon coast pre- and post-predator management, 1992-2015.

	Siltcoos		Overlook		Tahkenitch		Tenmile		CBNS		Bandon SPMA		New River HRA	
	Pre-pred mang (1993-2003)	Post-pred mang (2004-2015)	Pre-pred mang (1999-2003)	Post-pred mang (2004-2015)	Pre-pred mang (1993-2003)	Post-pred mang (2004-2015)	Pre-pred mang (1992-2003)	Post-pred mang (2004-2015)	Pre-pred mang (1992-2001)	Post-pred mang (2002-2015)	Pre-pred mang (1995-2001)	Post-pred mang (2002-2015)	Pre-pred mang (1999-2001)	Post-pred mang (2002-2015)
ave hatch rate	38%+/-26%	41%+/-12%	54%+/-28%	41%+/-16%	46%+/-27%	45%+/-22%	59%+/-23%	41%+/-18%	60%+/-20%	52%+/-17%	41%+/-23%	35%+/-15%	70%+/-20%	51%+/-17%
ave fledging success rate	20%+/-21%	44%+/-15%	36%+/-20%	48%+/-10%	43%+/-33%	42%+/-18%	53%+/-26%	46%+/-12%	51%+/-12%	52%+/-12%	14%+/-20%	35%+/-16%	23%+/-12%	44%+/-15%
ave productivity index	11%+/-17%	19%+/-10%	20%+/-10%	21%+/-9%	18%+/-16%	21%+/-12%	30%+/-19%	19%+/-11%	32%+/-18%	27%+/-9%	6%+/-6%	13%+/-9%	15%+/-7%	23%+/-13%
ave # of fledglings/male	0.47+/-0.61	1.26+/-0.58	0.79+/-0.41	1.34+/-0.48	0.87+/-0.73	1.25+/-0.65	1.25+/-0.61	1.28+/-0.40	1.55+/-0.52	1.68+/-0.43	0.28+/-0.36	0.84+/-0.48	0.51+/-0.23	0.99+/-0.36

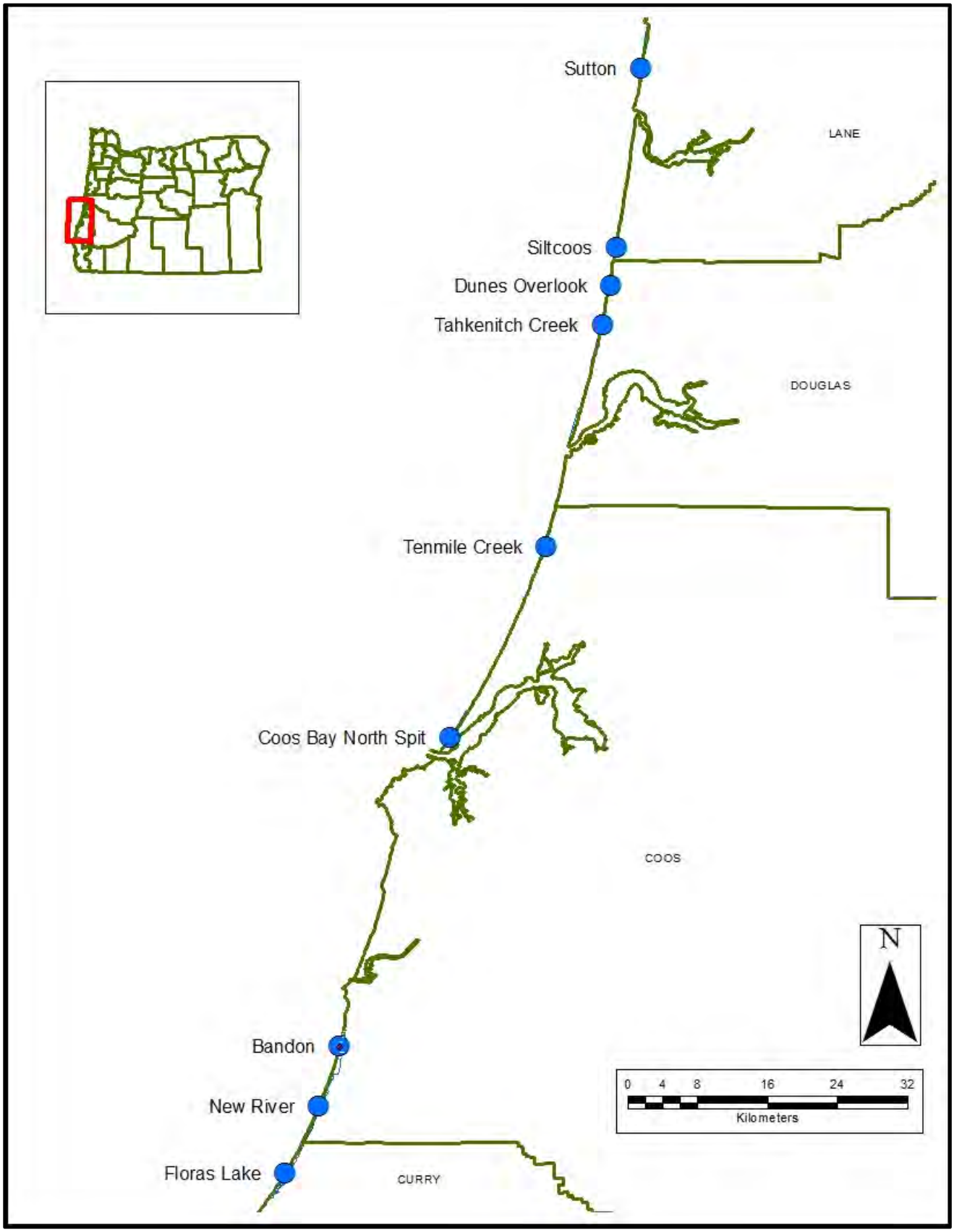


Figure 1. Snowy Plover monitoring locations along Oregon coast, 2015

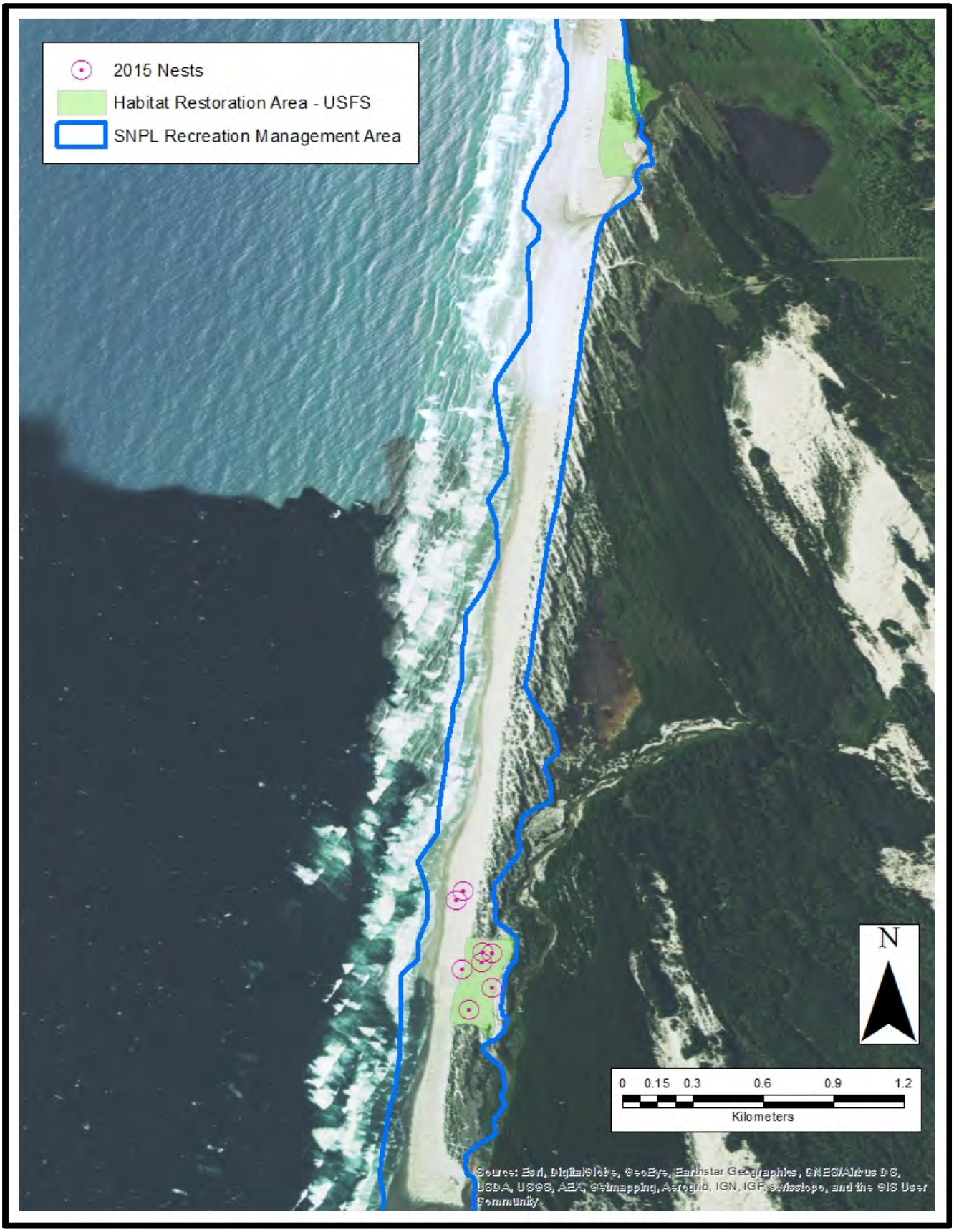


Figure 2. Snowy Plover nest locations at Sutton Beach, Oregon, 2015.

Figure 3. Snowy Plover nest locations at Siltcoos Estuary, Oregon, 2015

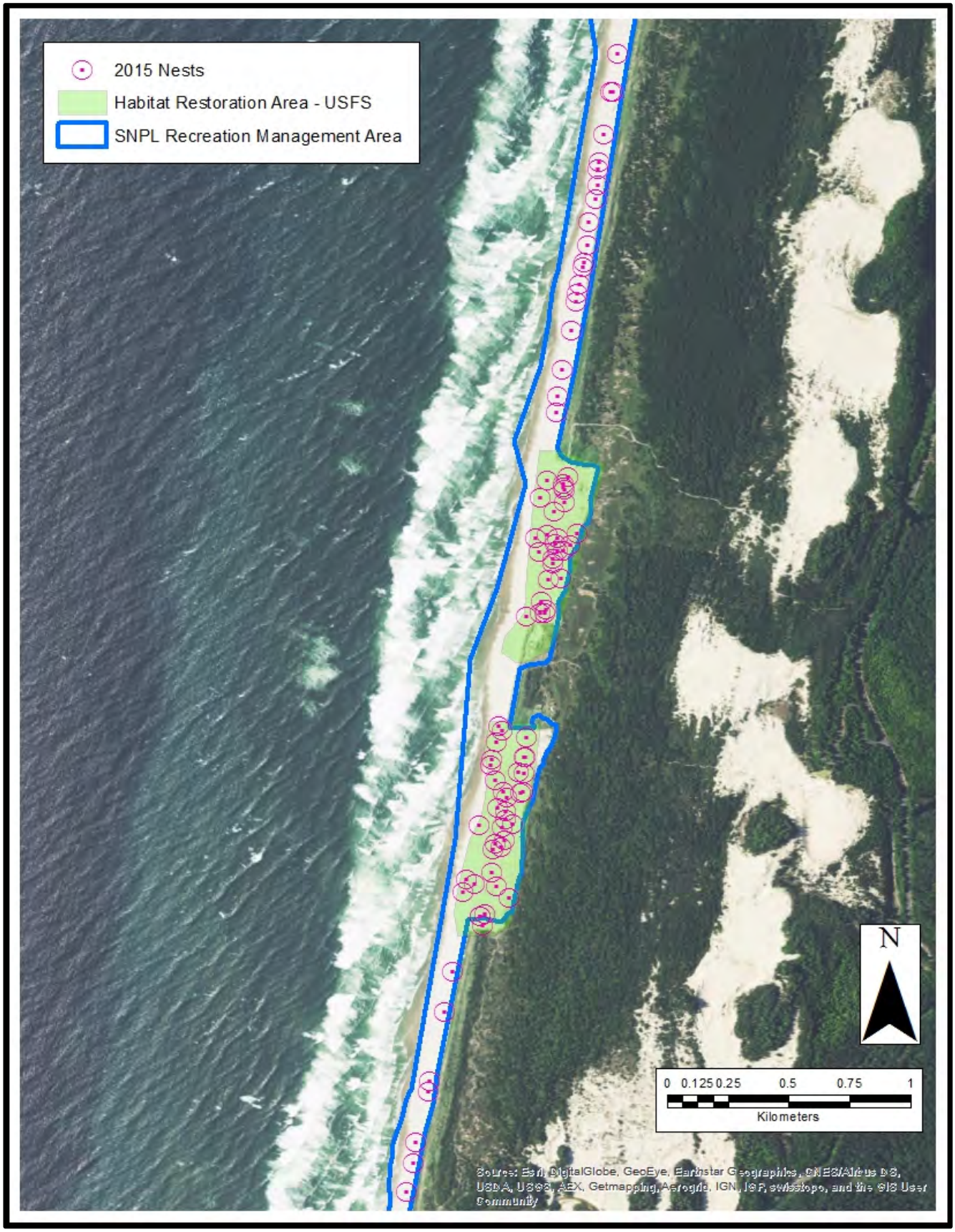


Figure 4. Snowy Plover nest locations at Dunes Overlook, Oregon, 2015.

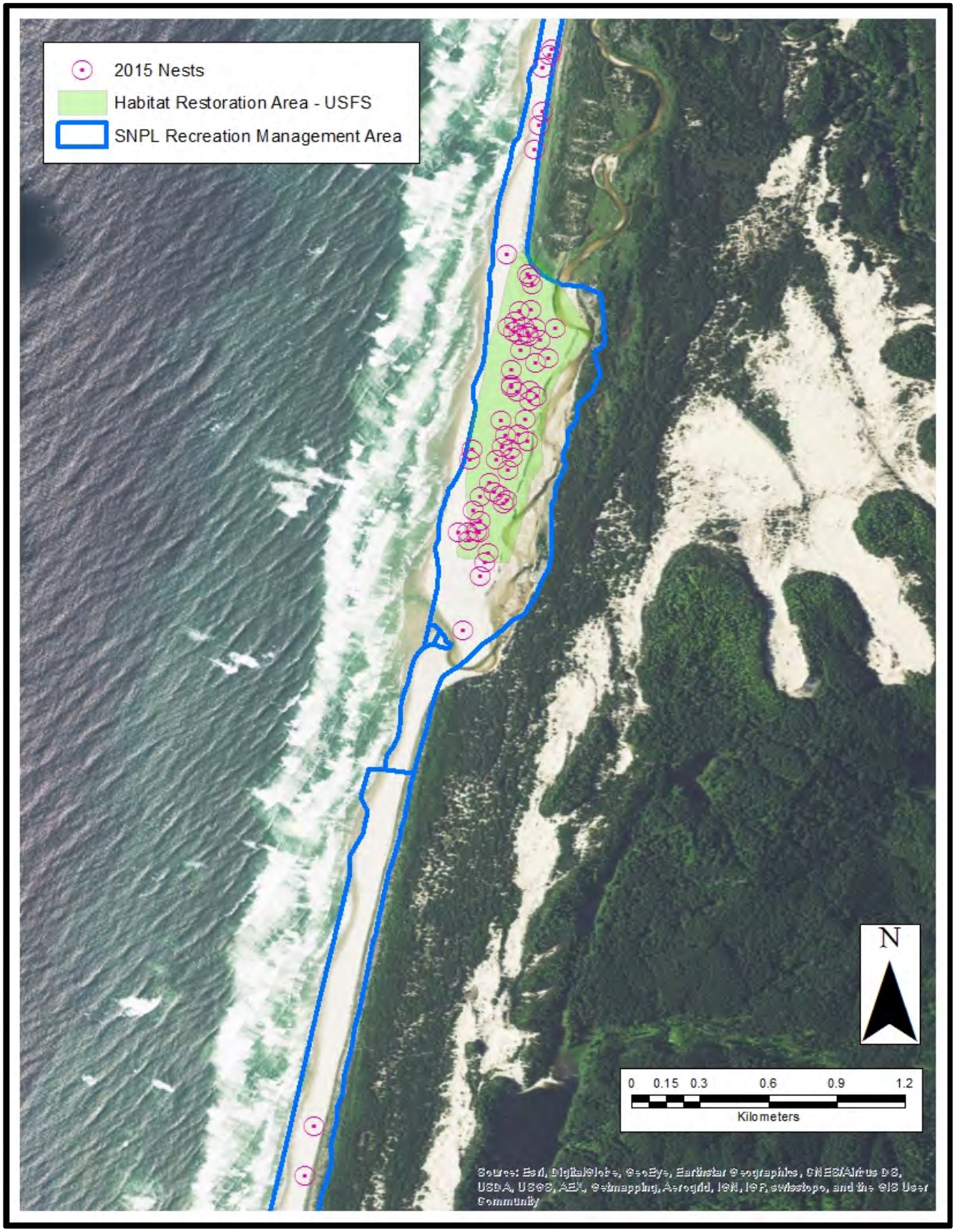


Figure 5. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2015.

Figure 6. Snowy Plover nest locations at North Tenmile Creek, Oregon, 2015.

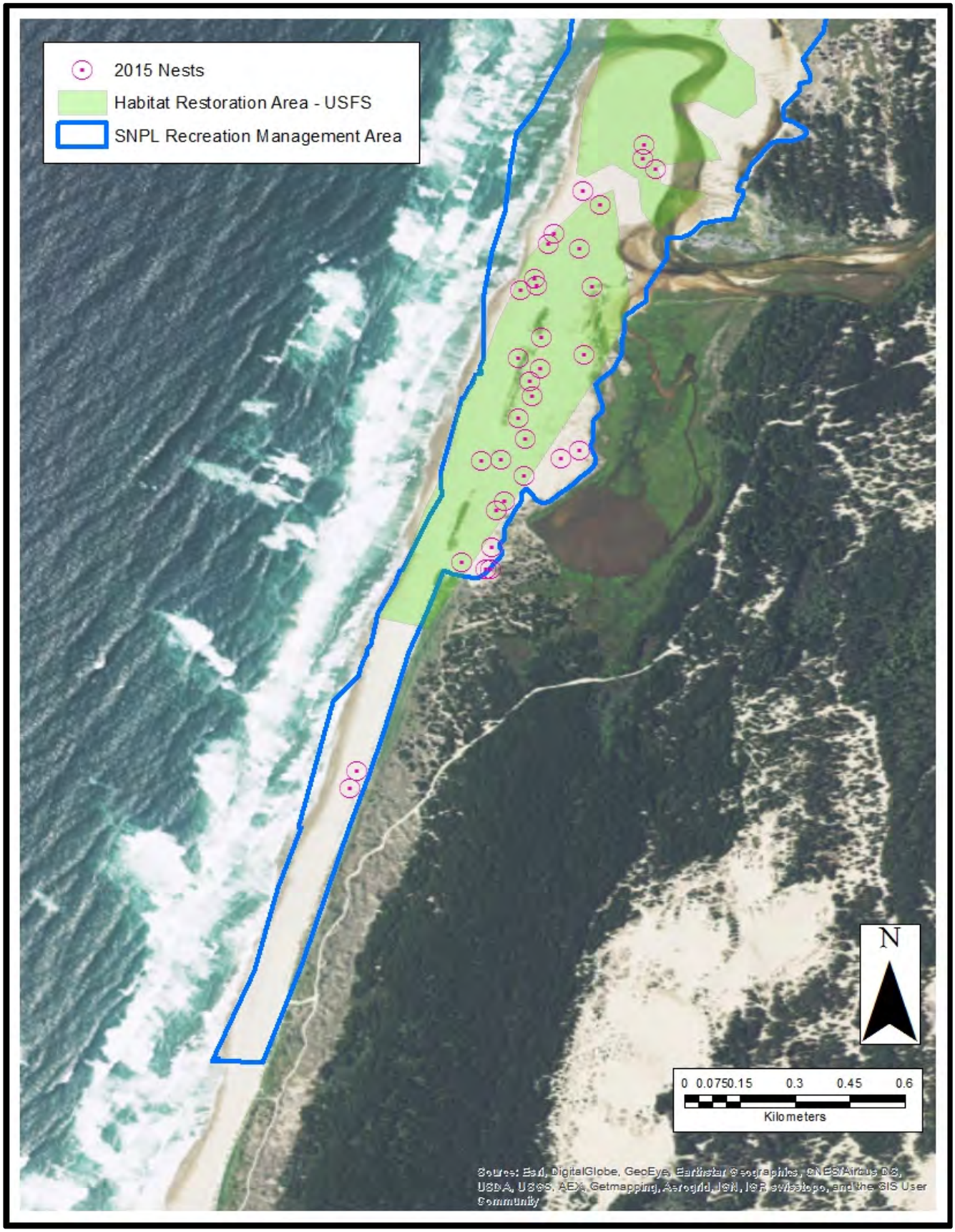


Figure 7. Snowy Plover nest locations at South Tenmile Creek, Oregon, 2015.

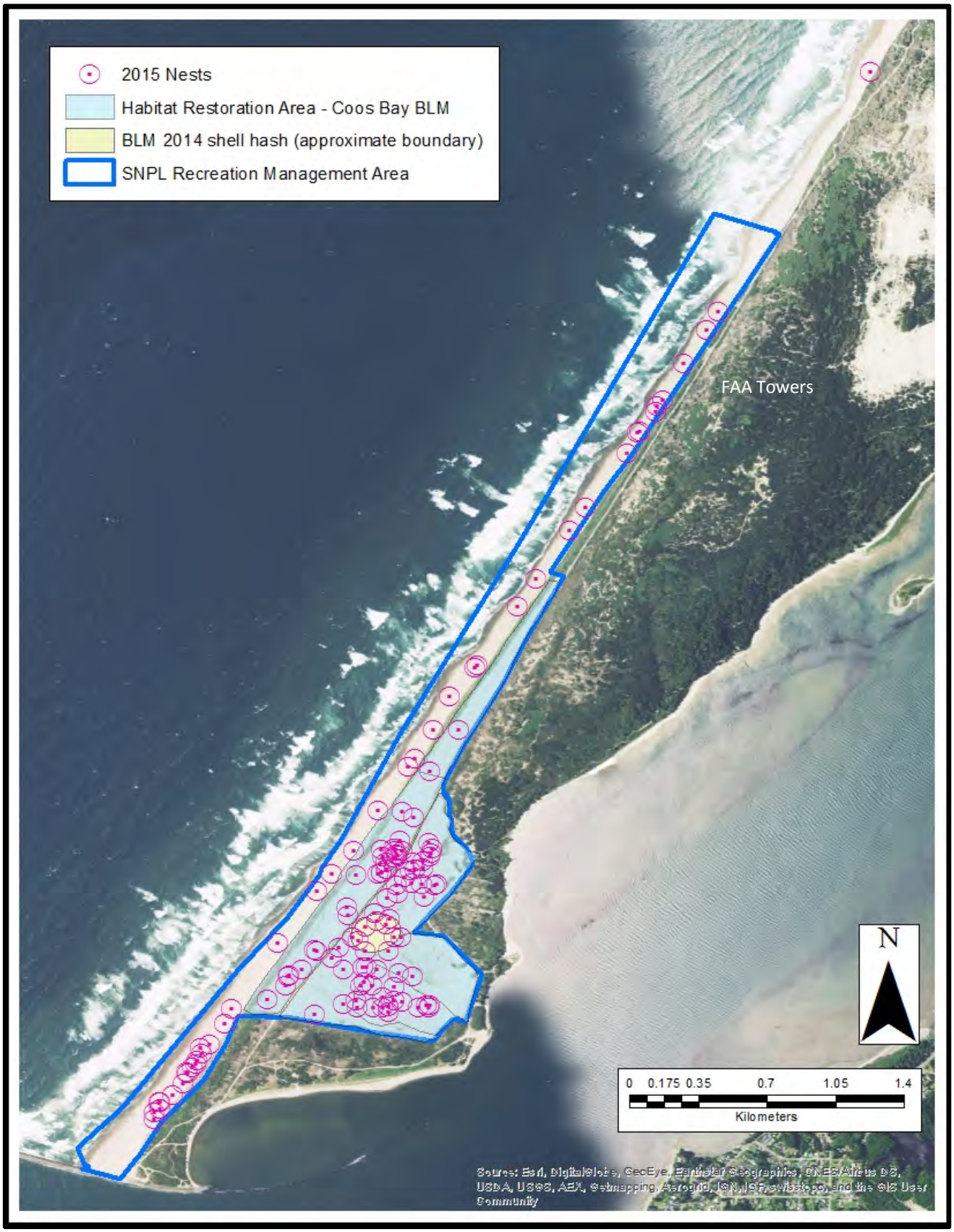


Figure 8. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2015.

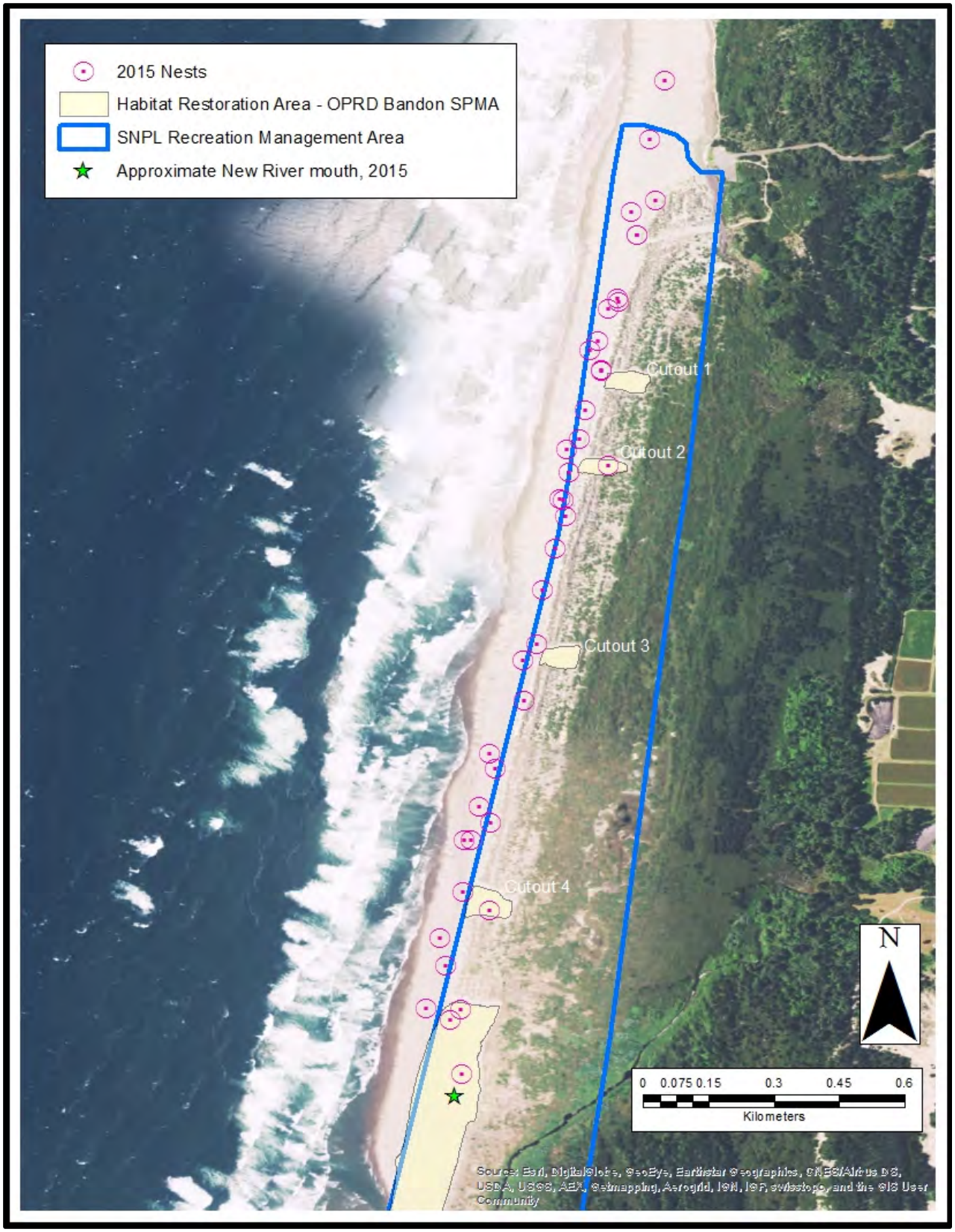


Figure 9. Snowy Plover nest locations at Bandon SPMA north of New River mouth, Oregon, 2015. Because of river movement, the mouth of New River is not correctly shown in the photo. Correct location is as marked.

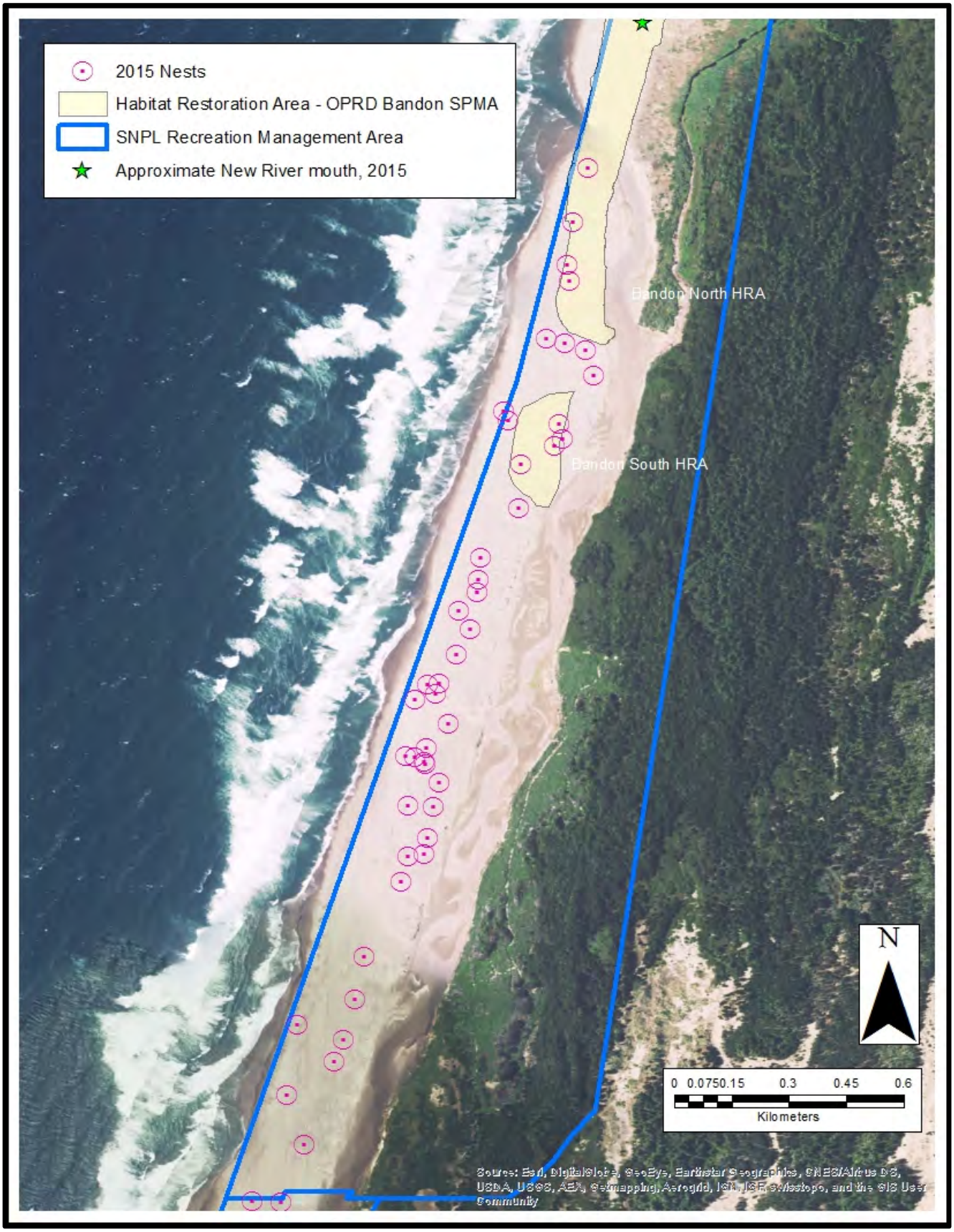


Figure 10. Snowy Plover nest locations at Bandon SPMA south of New River mouth, Oregon, 2015. Two southernmost nest points are duplicated on Figure 11.

Figure 11. Snowy Plover nest locations at New River Spit, north of the HRA, Oregon, 2015. Two northernmost nest points are duplicated on Figure 10.

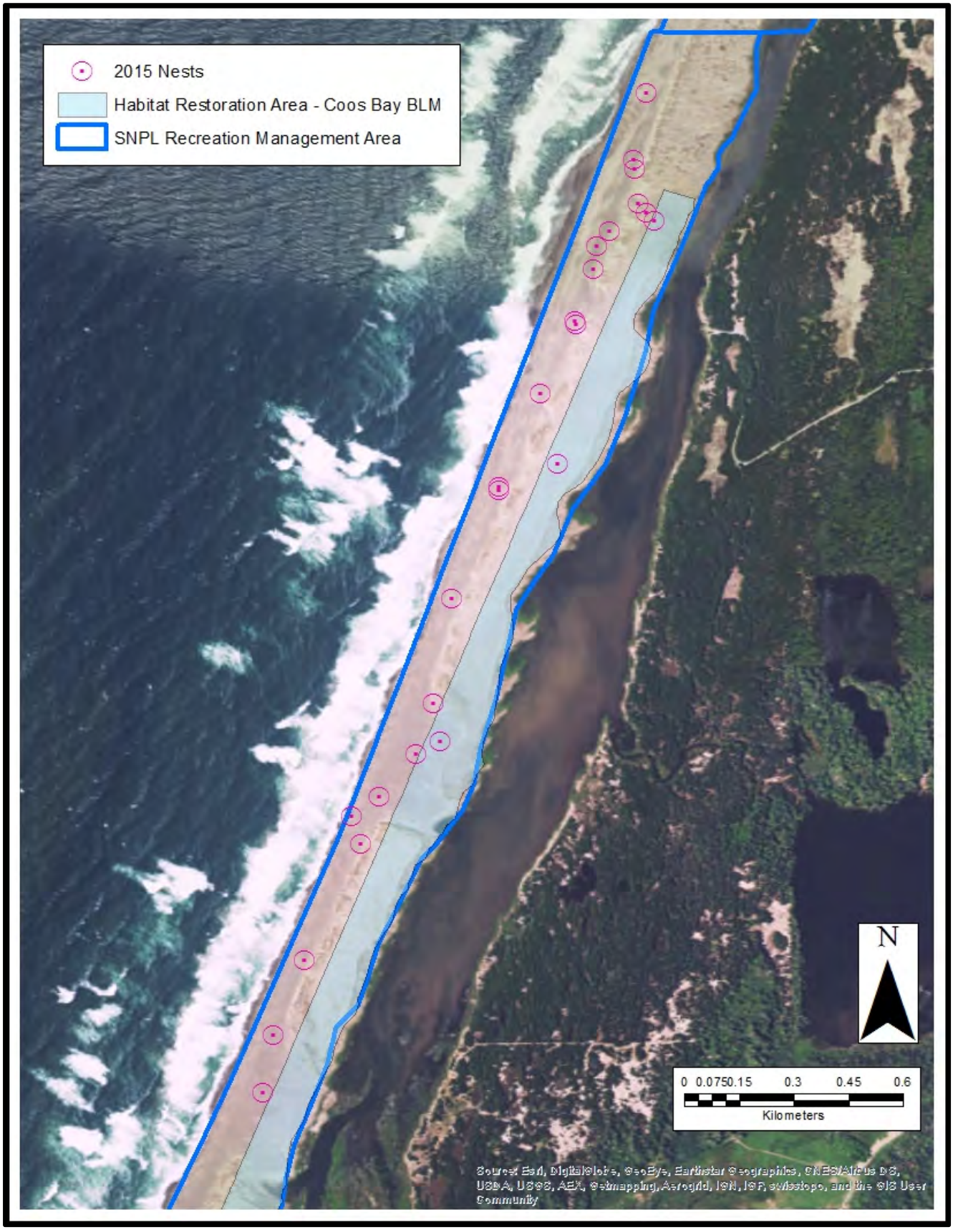


Figure 12. Snowy Plover nest locations at New River HRA, Oregon, 2015.

Figure 13. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2015. Bars represent +/- 2 standard deviations.

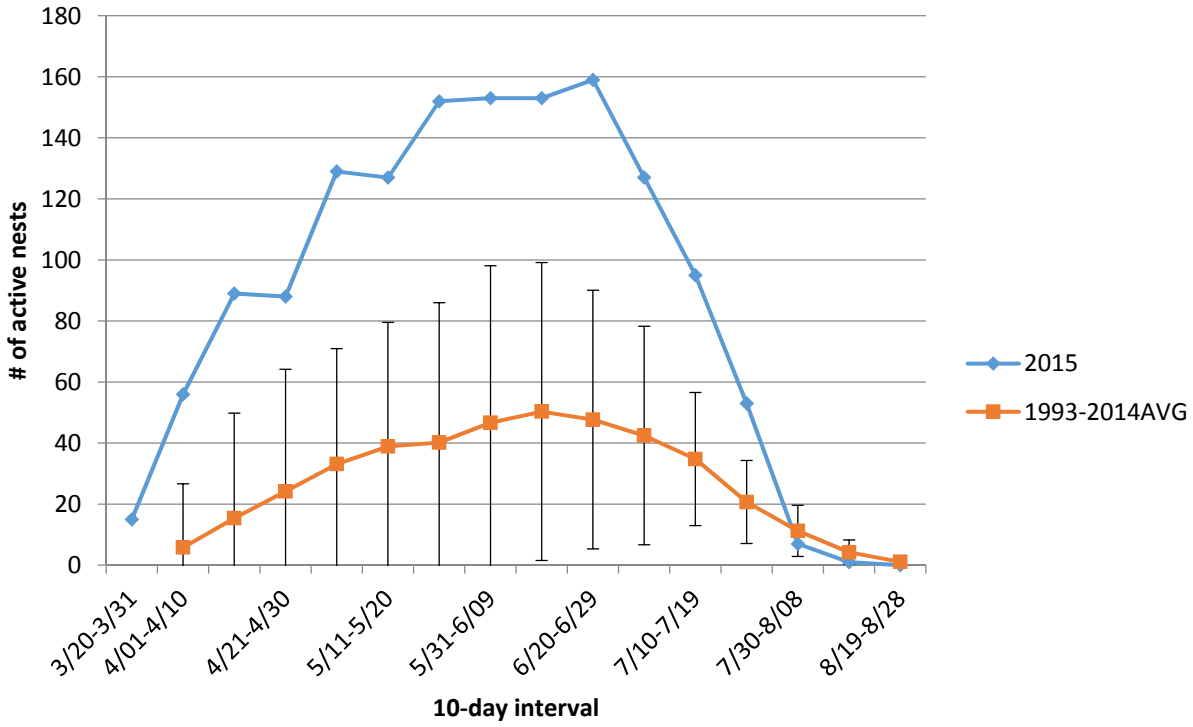


Figure 14. The number of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1992-2015.

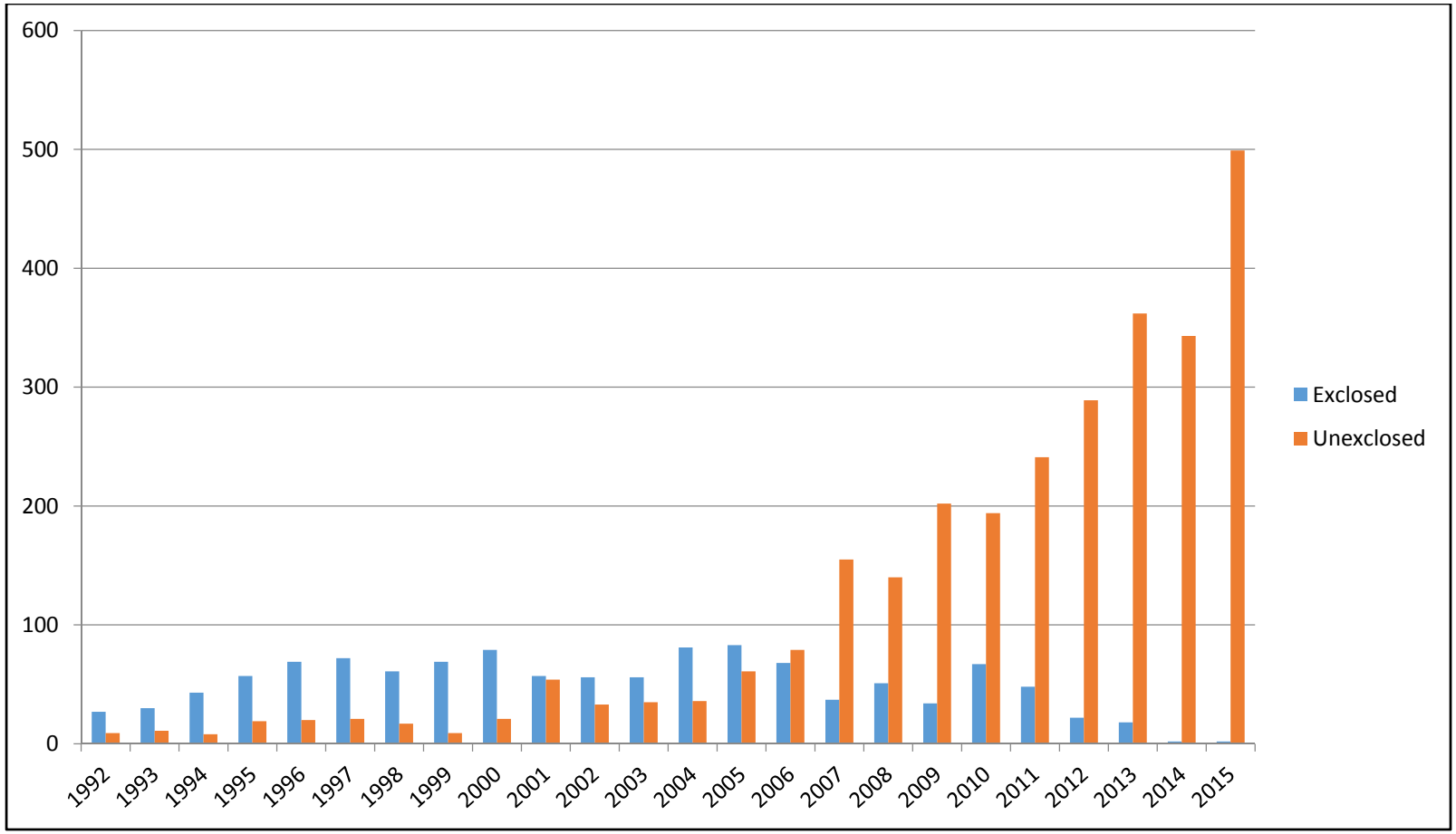


Figure 15. The number of eggs hatched and number of fledglings on the Oregon coast, 1992 – 2015.

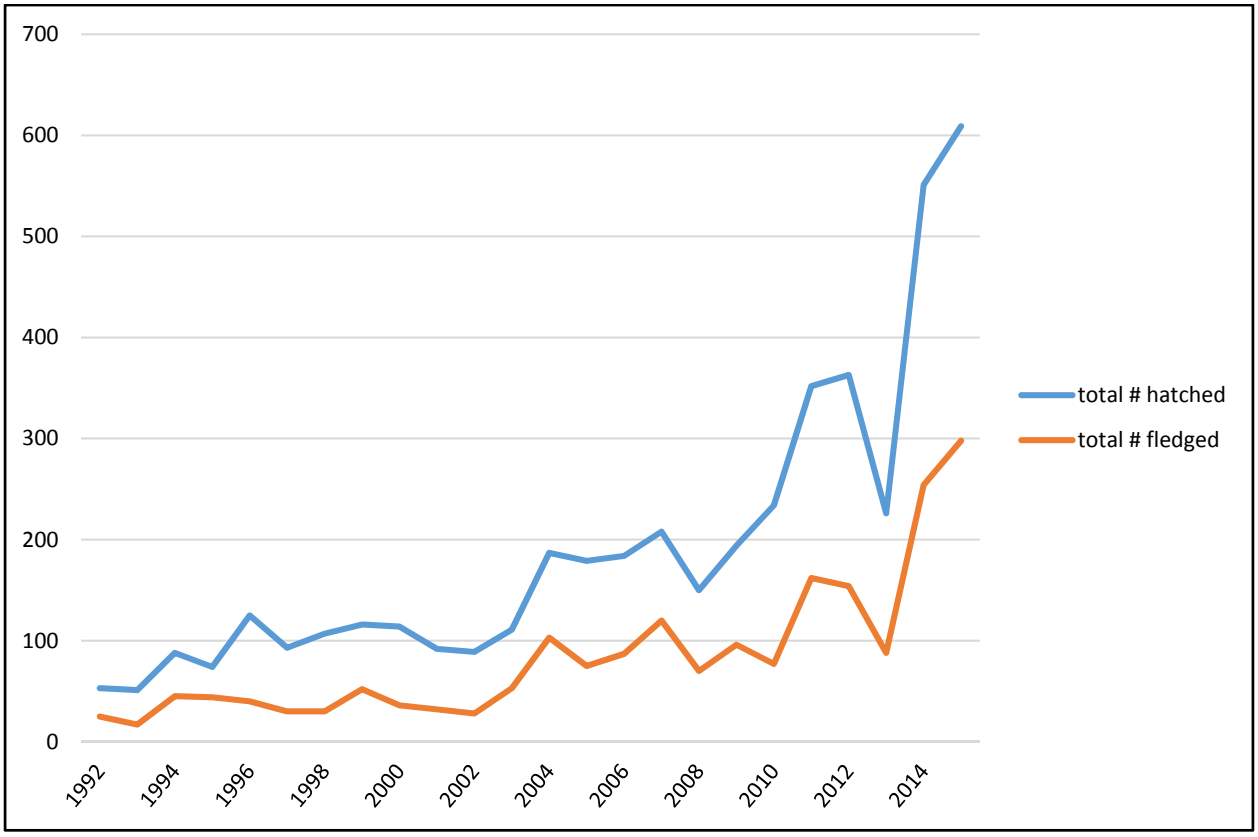
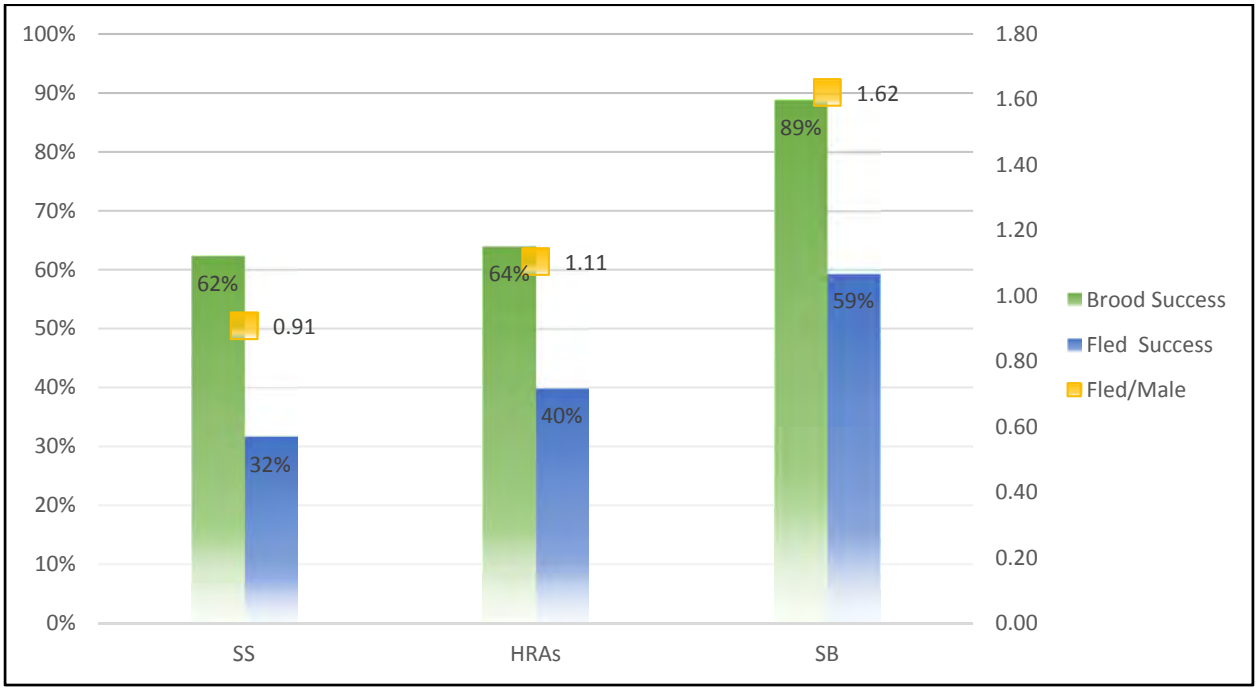


Figure 16. Average brood success, fledging success, and fledglings per male for South Spoil (SS), the habitat restoration areas (HRAs), and South Beach (SB), Coos Bay North Spit, 2010 – 2015.



APPENDIX A.

Study Area

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

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

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

Dunes Overlook Clearing, Douglas Co. (Figure 3). The area directly west of the Oregon Dunes Overlook off of Hwy 101 including the beach from Carter Lake trail to the north clearing, and south to the Overlook trail south of the south clearing.

Tahkenitch Creek, Douglas Co. (Figure 5) Tahkenitch North Spit - the spit and beach on the north side of Tahkenitch Creek including the beach north to Overlook trail; and South Tahkenitch – from the south side of Tahkenitch Creek to south of Threemile Creek north of the north Umpqua River jetty.

Tenmile: North Tenmile, Coos and Douglas Cos. (Figure 6) The spit and ocean beach north of Tenmile Creek, north to the Umpqua River jetty; and South Tenmile, Coos Co. (Figure 7)The south spit, beach, and estuary areas within the Tenmile Estuary vehicle closure, and continuing south of the closure for approximately 1/2 mile.

Coos Bay North Spit (CBNS), Coos Co. (Figure 8): South Beach - the beach between the north jetty and the F.A.A. towers; and South Spoil/HRAs - the south dredge spoil and adjacent habitat restoration areas (94HRA, 95HRA, 98HRA).

Bandon Snowy Plover Management Area, Coos Co. (Figures 9 & 10): 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 11 & 12) 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. The beach and overwash areas west of the confluence of Floras Creek and the beginning of New River, north to Hansen Breach.

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

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 two biologists; one team covering Tenmile and sites north, and the other covering Coos Bay North Spit and sites south (Fig. 1). In some years this division has been modified to accommodate staff needs. All data collected in the field was recorded in field notebooks and later transferred onto computer. Surveys were completed on foot and from an all-terrain vehicle (ATV). Data recorded on nest surveys included:

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

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

Population Estimation

We estimated the number of Snowy Plovers on the Oregon Coast by determining the number of individually color banded adult Snowy Plovers recorded during the breeding season, and then adding an estimated number of unbanded Snowy Plovers. We determined the number of unbanded Snowy Plovers observed within ten-day intervals during the breeding season, selected the highest count of unbanded birds and then subtracted the number of adults that were banded subsequently. 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

Banding

Adults were normally trapped for banding on the nest, during incubation, using a lilly pad trap and noose carpets. Lilly pad traps are small circular traps made of hardware cloth with a blueberry net top. The traps have a small door that the plover will enter. Noose carpets are 4" x 30" lengths of hardware cloth covered with small fishing line nooses. Plovers walk over the carpets and the nooses snag their legs. We limited attempts to capture adults to 20 minutes per trapping attempt. Chicks were captured for banding by hand, usually in the nest bowl. Banding was completed in teams of two to minimize time at the nest and disturbance to the plovers.

APPENDIX C.

Recovery Unit 1 (Oregon & Washington)

Exclosure Use Guidelines Developed by Oregon Biodiversity Information Center for the Western Snowy Plover Working Team

2/27/2012

Nest exclosures are mesh fences that surround a Western Snowy Plover (*Charadrius nivosus nivosus*) nest and act to keep out predators. Nest exclosures have been used in Oregon since 1991 to protect plover nests from depredation by mammalian and avian predators. Prior to implementation of comprehensive predator management, plovers suffered high rates of nest depredation. Exclosures have been successful at increasing nest success rates (Table 5) (Stern *et al.* 1990, 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, 2002, Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, 2008, 2009, 2010, 2011). Predators that prey on snowy plover eggs include mammalian predators such as skunk (*Mephitis sp*.), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), mice (*Peromyscus* sp.), and weasel (*Mustela sp*.); and avian predators, mostly American crows (*Corvus brachyrhynchos*) and common ravens (*Corvus corax*).

Since 1990, we have found 2650 snowy plover nests along the Oregon coast, of which 1057 (40%) have been exclosed. Over the years we have had to adapt exclosure techniques in response to predator behavior around exclosures (see Castelein *et al.* 2000a, 2000b, 2001, Lauten *et al.* 2003).

In 1995 we began seeing evidence of adult snowy plover depredations in or immediately outside exclosures. From 1995 to 2011 we documented a minimum of 48 adult losses associated with exclosure use. These losses include 21 cases where blood, feathers, or plover body parts were found in or adjacent to exclosures and 27 cases where incubating adults disappeared from an established, exclosed nest. Forty-eight adult losses associated with 1057 exclosed nests indicate that exclosures subject adult plovers to additional predation risk (approximately 4%). Similar threats associated with exclosures have been reported in other plover populations (Murphy *et al.* 2003, Hardy and Colwell 2008, Pearson *et al.* 2009). We do not have information on how many adults may be lost at nests not associated with exclosures.

Predator exclosures increase snowy plover hatching success and the number of chicks hatched per male, but not fledging success or the number of chicks fledged per male (Neuman *et al.* 2004, Dinsmore *et al.*, 2014). In Oregon, they pose an additional risk to incubating adults and may negatively impact adult survival. As in Washington, exclosure use in Oregon has been a management technique, not part of a study of their effectiveness in increasing the overall plover population. Data from Oregon indicates that exclosure use has a strong positive impact on nest success (Dinsmore *et al.* 2014). Further analysis is underway to determine potential impacts of exclosure use on adult success and fledging success *et al.* (see Pearson *et al.* 2009, Neuman *et al.* 2004).

Scott Pearson *et al.* (2009) conducted a search of existing literature on the effects of nest exclosures on nest success for plovers and other ground nesting species (primarily shorebirds). Their findings are summarized below:

- Nest survival of exclosed nests was significantly higher in ten studies (Rimmer and Deblinger 1990, Melvin *et al.* 1992, Estelle *et al.* 1996, Johnson and Oring 2002, Lauten *et al.* 2004, Niehaus *et al.* 2004, Isaksson *et al.* 2007, Hardy and Colwell 2008, Pauliny *et al.* 2008, Pearson *et al.* unpublished), and there was no difference in two studies (Nol and Brooks 1982, Mabee and Estelle 2000).
- Exclosed nests appear to be only vulnerable to reptilian and small mammal predators while unexclosed nests are vulnerable to predators of all sizes (Mabee and Estelle 2000).

- No difference in fledging success between exclosed and unexclosed nests in four studies (Hardy and Colwell 2008, Pauliny *et al.* 2008, Lauten *et al.* 2004, Pearson *et al.* unpublished data) and higher fledging success for exclosed nests in two studies (Larson *et al.* 2002, Melvin *et al.* 1992). There was no difference in fledging success between exclosed and unexclosed nests for all studies involving snowy plovers.
- Adult mortality associated with exclosures was reported in six of the eight studies that included or mentioned this response variable (Murphy *et al.* 2003, Lauten *et al.* 2004, Isaksson *et al.* 2007, Hardy and Colwell 2008, Pauliny *et al.* 2008, Pearson *et al.* unpublished). Only three studies compared adult mortality between exclosed and unexclosed nests and two reported significant increases in adult mortality associated with exclosures (Murphy *et al.* 2003 and Isacsson 2007) and one reported no difference (Pauliny *et al.* 2008).
- Adult mortality appears to be largely attributable to raptors and appears to be episodic (Murphy *et al.* 2003, Neuman *et al.* 2004, Hardy and Colwell 2008) and differs among habitats (Murphy *et al.* 2003).
- Larson *et al.* 2002 examined the effect of exclosures on population growth for piping plovers and found the effect to be positive.
- Abandonment was higher for exclosed nests in two studies where this was compared directly (Isaksson *et al.* 2007, Hardy and Colwell 2008).
- Abandonment was not associated with the construction process, size, shape, mesh size and fence height (Vaske *et al.* 1994). Covered exclosures are more likely to be abandoned than uncovered exclosures (Vaske *et al.* 1994).
- Exclosures increased incubation length by one day but did not influence chick condition (Isaksson *et al.* 2007).
- Egg hatchability was higher in three studies (Melvin *et al.* 1992, Isaksson *et al.* 2007, Pauliny *et al.* 2008) but no difference was observed in one study (Hardy and Colwell 2008).
- Breeding adults may receive false messages regarding site quality and encouragement to continue to breed in sink habitats (Hardy and Colwell 2008). This is an important research question that should be examined but no data support this contention.

Our data and that of others (Murphy *et al.* 2003, Hardy and Colwell 2008, Pearson *et al.* 2009) indicate that adult plovers are at increased risk of predation while in exclosures. In the absence of research to quantify that risk, and based on the above information, we developed the following guidelines for exclosure use in Oregon:

- Since raptors appear to be the primary threat to adult plovers in exclosures, delay use of exclosures until peak raptor migration has passed. Currently, we have identified May 15 as a suitable cutoff, but this date could be altered as needed.
- Delaying exclosure use until May 15 allows field personnel time to assess causes of early nest failures, although weather conditions can make accurate assessment difficult. During this time, and contingent on funding, we recommend an owl survey be run at each site.
- If nests are being lost primarily to mice, exclosures will not help the problem, and may pose additional risk if the mice are being preyed upon by raptors. In this case exclosure use is not appropriate.
- If corvids and/or large mammals are identified as the main predator at a site, removal of the predators should be the primary goal with exclosures used as a supplemental measure to help protect nests.
- Any use of exclosures should be accompanied by close monitoring to evaluate their effectiveness (Hardy and Colwell 2008) and to detect predators of adult plovers early (Pauliny *et al.* 2008). Weather permitting, exclosed nests should be checked at least twice per week. If conditions do not allow checks twice a week, exclosure use should be seriously reconsidered.

- Adult predation associated with exclosures is often episodic (Castelein *et al.* 2000b, Lauten *et al.* 2006). Once adult predation is suspected, all exclosures should be removed from the site and their use discontinued for the season.
- To minimize the risk of episodic predation on adult plovers, additional caution should be used when placing exclosures within sight of each other (this puts multiple adults at risk).
- Exclosures should not be placed along the foredune.
- Exclosures should not be placed in a windy location that might result in nest drifting. Since the ME's are 4 feet per side, the nest is only about 2 feet from each sidewall. If the nest begins to drift, it could come close to a sidewall, and a predator such as a raccoon could reach in and grab the eggs. If an exclosed nest is in a potentially windy location, it must be monitored frequently to ensure the safety of the nest and adults (especially on windy days).