The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2011

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2127 SE Marine Science Drive
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Recovery Permit TE-839094-5

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Abstract

From 6 April – 19 September 2011 we monitored the distribution, abundance and productivity of the federally Threatened Western Snowy Plover (*Charadrius nivosus nivosus*) along the Oregon coast. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Beach, New River, and Floras Lake. Our objectives for the Oregon coastal population in 2011 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue use of mini-exclosures (MEs) to protect nests from predators when and where needed, 4) determine nest success, 5) determine fledging success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the effectiveness of predator management.

We observed an estimated 247-253 adult Snowy Plovers; a minimum of 214 individuals were known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990. We monitored 289 nests in 2011, the highest number of nests since monitoring began in 1990. Overall apparent nest success was 50%. Exclosed nests (n = 48) had a 71% apparent nest success rate, and unexclosed nests (n = 241) had a 48% apparent nest success rate. Nest failures were attributed to unknown depredation (22%), corvid depredation (20%), unknown cause (18%), one-egg nests (16%), abandonment (15%), wind/weather (3%), mammalian depredation (2%), adult plover depredation (2%), infertility (1%), and rodent depredation (1%). We monitored 148 broods, including four from unknown nests, and documented a minimum of 168 fledglings. Overall brood success was 71%, fledging success was 46%, and 1.57 fledglings per male were produced.

Continued predator management, habitat improvement and maintenance, and management of recreational activities at all sites are recommended to achieve recovery goals.

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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).

We have completed our 22nd 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, predator management through both lethal and non-lethal predator control methods, 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 and eventually 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, and 2010). Our objectives for the Oregon coastal population in 2011 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue use of mini-exclosures (MEs) to protect nests from predators when and where needed, 4) determine nest success, 5) determine fledging success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the effectiveness of predator management. The results of these efforts are presented in this report.

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 Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Beach, New River (south from Bandon Beach to the south end of the habitat restoration area), and Floras Lake (Figure 1). A description of each site occurs in Appendix A.

Methods

In 2011, state and federal agency personnel and volunteers conducted window surveys at historical nesting sites between Clatsop Spit, Clatsop Co. and Pistol River, Curry Co. Pre-breeding surveys have been implemented since 2001 to locate any plovers attempting to nest at historic (currently inactive) nesting areas. Agency personnel also assisted surveying plovers during breeding season window surveys in late May and early June. Breeding season window surveys were implemented at both currently active and historic nesting areas. Historic nesting areas surveyed in either early spring or during the breeding window survey include: 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.

Breeding season fieldwork was conducted from 6 April to 19 September 2011. 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. No modifications to survey techniques were implemented in 2011.

Plover nests were not exclosed during April and into early May until peak raptor migration was believed to have passed (Castelein *et al.* 2001, 2002, Lauten *et al.* 2003). No nests were found and therefore no exclosures were used at Sutton Beach or Floras Lake. From mid-May to August, we used mini-exclosures (MEs, Lauten *et al.* 2003) to protect plover nests at North Siltcoos, Overlook, North Tahkenitch, Tenmile, Bandon Beach and New River. Exclosures were not used at South Siltcoos or CBNS due to low predation rates. Predation pressure was also relatively low at Overlook and North Tahkenitch, therefore we used a minimal number of exclosures at these sites. Predation rates at Tenmile were high, but due to video evidence of Great Horned Owls (*Bubo virginianus*) attacking adult plovers at exclosed nests, exclosures were removed from active nests on 2 June and discontinued for the remainder of the season. At Bandon Beach and New River predation pressure warranted use of exclosures (Appendix B).

Lethal predator management occurred at all active nesting areas; corvids (*Corvus sp*.) were targeted at all nesting sites and some mammal trapping, specifically targeting red fox (*Vulpes vulpes*), striped skunks (*Mephitis mephitis*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*) occurred at specific sites. Prior to the initiation of nesting, an intensive trapping effort targeting deer mice (*Peromyscus maniculatus*) was implemented at CBNS due to high rodent depredations at this site in previous years (Lauten *et al*. 2009 and 2010). Rodent trapping occurred from February through mid-May. In addition, Great Horned Owls were removed from Tenmile after video evidence conclusively identified owls attacking plovers at exclosed nests. For information regarding the predator management program, see Burrell (2011).

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. 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 28 days after hatching.

We estimated the number of Snowy Plovers on the Oregon coast during the 2011 breeding season by determining the number of uniquely color-banded adult Snowy Plovers observed, and added our estimate of the number of unbanded Snowy Plovers observed. We used two techniques to estimate the number of unbanded plovers. We used the 10 day interval method described in Castelein *et al*. 2001 and the daily observation evaluation method described in Castelein *et al.* 2001, 2002 and Lauten *et al.* 2003. We estimated the breeding population by tallying the number of confirmed breeding plovers. Not all plovers recorded during the summer are Oregon breeding plovers; some plovers are recorded early or late in the breeding season indicating that they are either migrant or wintering birds. Plovers that were present throughout or during the breeding season but were not confirmed breeders were considered Oregon resident plovers. We estimated an overall Oregon resident plover population by adding the known breeders with the number of plovers present but not confirmed nesting during the breeding season.

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 until the end of the 2011 breeding season. Data from nesting sites with a north

and south component (Siltcoos, Overlook, and Tenmile) were pooled because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were all pooled for the same reason. We also pooled the data from Bandon Beach, New River, and Floras Lake because despite the relatively long distance from the north to the south end (10-12 miles), the plovers that use these nesting sites interchange and move freely between the areas. A tally from each individual site would result in the appearance that more plovers are using the area than actually were present. 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 level of nesting activity for each site.

Using all nests, we calculated overall apparent nest success, which is the number of successful nests divided by the total number of nests, for all nests and for each individual site. We also calculated apparent nest success for exclosed and unexclosed nests and used Chi-squared analysis to compare the success of exclosed and unexclosed nests.

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 male for each site.

We continue to review plover productivity prior to lethal predator management activities compared to productivity after implementation of lethal predator management. We specifically continue to evaluate the changes in hatch rate, fledging rate, productivity index, and fledglings per male from prior to lethal predator management compared to years with lethal predator management. The productivity index is a measure of overall effort based on how many fledglings the plovers produced compared to how many eggs they laid. If plovers produced high numbers of fledglings compared to eggs laid, then their productivity was high for the amount of effort (eggs laid) and the productivity index would be high. If plovers produced low numbers of fledglings compared to high numbers of eggs laid, then their productivity was low and the productivity index would be low. In general, a site with productivity index higher than 20% is considered good, while a site with productivity index less than 20% is usually not very productive. We used t-test to compare the mean brood success, the mean fledging rate and the mean number of fledglings per male prior to predator management (1992-2001) to post predator management (2004-2011). We did not include the years 2002 and 2003 in the analysis because three sites (CBNS, Bandon Beach, and New River) had predator management in those years but all other sites did not.

Results

Abundance

Pre-breeding April surveys and the late May window survey at sites between the Clatsop spit Clatsop Co., and Pistol River, Curry Co. did not detect any plovers or plover activity outside of known nesting areas. The annual breeding window survey in late May counted 168 plovers (Table 1), the highest number of plovers ever detected.

During the 2011 breeding season, we observed a minimum estimated 247-253 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 247-253 plovers, 220 (87-89%) were banded. For unbanded plovers, the 10 day interval method estimated 27-33 unbanded plovers were present, and the daily observation evaluation method estimated 30-39 unbanded plovers were present during the breeding season. Using the 10-day interval method, for the breeding season we observed 107

banded females, 113 banded males, 15-17 unbanded females, and 12-13 unbanded males. The totals include six banded male and two banded female plovers that were most likely depredated during the breeding season including a minimum of three males and one female that were associated with exclosed nests.

Of the total estimated population, 214 plovers (85-87%) were known to have nested (Table 1), higher than the mean percentage for 1993-2010 (78%). A minimum of 90 banded females and 17 unbanded females nested and 104 banded males and 3 unbanded males nested. An additional 11 banded females and 8 banded males were present during the breeding season but were not confirmed nesting. The estimated Oregon resident plover population was 233.

In 2010 the estimated adult plover population was 232-236, of which 205 were banded. Of these 205 banded adult plovers, 52 (25%) were not recorded in Oregon in 2011, and we received no reports of these individuals being sighted elsewhere in the range. Thus they are presumed not to have survived winter 2010-11. The estimated overwinter survival rate based on returning banded adult plovers was 75%, above the 1994-2010 mean of 64%.

During the 2011 season, we captured and rebanded 33 banded adult plovers - 22 were males and 11 were females; we banded three unbanded adult male plovers; and we banded 312 chicks (Lauten *et al*. 2005, 2006).

2010 Hatch-Year Returns

Based on hatch year returns, we adjusted the 2010 fledgling total to 84 from 80. Fifty-two of the 84 hatch-year plovers from 2010 returned to Oregon in 2011. The return rate was 62%, the second highest return rate since 1992 and higher than the average return rate (Table 2, 46%). Of the returning 2010 hatch-year birds, 27 (52%) were females and 25 (48%) were males. Forty-four of the hatch year 2010 returning plovers attempted to nest (85%), and they accounted for 24% of the banded adults.

Breeding Season Distribution

Table 3 shows the number of individual banded and unbanded adult plovers and the number of breeding adult plovers recorded at each nesting area along the Oregon coast in 2011. Sutton Beach and Floras Lake had no recorded plovers in 2011. Overlook had the highest total number of individual plovers at 89. Plover distribution was widespread in 2011 with all other sites recording between 58 to nearly 70 individuals.

Nest Activity

We located 289 nests during the 2011 nesting season (Table 4), the highest number of nests found since monitoring began in 1990. In addition we recorded four broods from nests that we did not locate prior to hatching.

There were no nest attempts at Sutton Beach or Floras Lake in 2011.

At North Siltcoos (Figure 2), 13 nests were found, four less than in 2010. At South Siltcoos, 21 nests were found, three less than in 2010. Four nests at South Siltcoos were along the beach between the Waxmyrtle trail and north of Carter Lake trail.

At North Overlook 29 nests were found in 2011, the highest number of nests found at this site (Table 4, Figure 3). Seven of the 29 nests and one additional brood from an undiscovered nest were found on the beach between the Carter Lake trail access and the HRA. South Overlook had 28 nests, nearly twice the number of nests at this site in 2010 and higher than any previous year. One nest was found on the beach along the foredune south of the HRA.

At North Tahkenitch 23 nests were found in 2011 (Table 4, Figure 4), including three nests along the foredune, north of the HRA. This is the highest number of nests ever found at either North or South Tahkenitch.

At North Tenmile, 15 nests were found in 2011, similar to the previous three years (Table 4, Figure 5). Four of these nests were found north of the HRA along the foredune, including one nest approximately a half mile north of the spit and another nest approximately a mile north of the spit At South Tenmile, 35 nests were found, similar to the previous two years.

At CBNS (Figure 6), 57 nests were found in 2011 (Table 4), seven less than in 2010. Forty-one nests were on the nesting area: South Spoil had 15 nests, the 94HRA had 10 nests, the 95HRA had 11 nests, and the 98EHRA had five nests. South Beach had 16 nests, continuing a trend of high nest numbers on the beach.

At Bandon Beach north of New River (Figure 7), 28 nests were found in 2011 (Table 4). Two nests were found in the China Creek area, a one egg nest that was quickly abandoned on the north side of the China Creek overwash area, and a successful nest on the north side of China Creek. Eleven nests were found on the HRA, including two in the heavy woody debris area south of the I-beam sign. Eight nests were found within the four new "cutouts" created along the foredune between China Creek overwash and the HRA. Numbering the cutouts from north to south, the first cutout had two nests, the second and third cutout had one nest each, and the fourth cutout had four nests. Shell hash deposited within the fourth cutout may have attracted the plovers. In addition, seven other nests were found in various locations along the beach north of New River. Including nine nests found on state land on the south side of the mouth of New River, a total of 37 nests were found within Bandon State Natural Area.

At New River (Figure 8), 40 nests were found in 2011, similar to the previous two years (Table 4). Twenty-nine nests were found on BLM land from just north of the HRA to Clay Island breach. Two nests were found along the foredune north of the HRA and one nest was in an overwash north of the HRA, all on BLM land. Two nests were found along the foredune just northwest of the campsite at the south end of the HRA and another nest was found along the foredune just southwest of the campsite. One nest was on Clay Island breach; this was the southernmost nest. Two nests were found on Michael Keiser's property, the only nests found on private land in 2011. Nine nests were found on state land from Lower Fourmile access north to the mouth of New River.

The first nests were initiated about 4 April (Figure 9). Nest initiation increased through mid-May, and remained high through the beginning of July. The maximum number of active nests (n = 84) during 10-day intervals occurred during 20 - 29 June, the same as 2010 and two weeks later than average. The last nest initiation occurred on 26 July.

Nest Success and Exclosures

For the fifth consecutive year, the number of days nests were unexclosed was higher than the number of days nests were exclosed (3701 unexclosed days, 767 exclosed days, Figure 10). In 2011, 17%

(n = 48) of the total number of nests (n = 289) were exclosed, and 17% of the total number of exposure days were exclosed (n = 767/4468).

The overall annual apparent nest success rate in 2011 was 50% (Table 5), near the average but considerably higher than the previous three years (Table 6). The number of exclosed nests in 2011 (n = 48, 17%) was lower than in 2010 (n = 67, 26%). Apparent nest success for exclosed nests in 2011 was 71%, similar to 2010 (72%), and nearly the average for all years (x = 70%, Table 6). The number of unexclosed nests in 2011 (n = 241, 83%) was the highest number of unexclosed nests for any given year. Apparent nest success for unexclosed nests in 2011 was 48%, over double the previous year (23% in 2010), higher than the overall mean (x = 19%, Table 6), and the highest in 17 years. While nest success of unexclosed nests in 2011 was improved, it was still significantly lower than nest success of exclosed nests (χ^2 = 12.7328, df = 1, $P < 0.01$).

Nine of 13 nests were unexclosed at North Siltcoos in 2011 (Table 5). Of the seven unexclosed nests that failed, four failed to abandonment or one egg nests, one failed to corvid depredation and two failed to unknown cause (Table 7). Four nests were exclosed, however three of the four nests failed all due to small mammals entering the exclosures and depredating the eggs. Overall, three of 13 nests hatched (23%), below the average for this site (Figure 11).

At South Siltcoos, 13 of 21 nests hatched (59%, Table 5), higher than in 2010 (19%) and above the average for this site (Figure 11). All 21 nests at South Siltcoos were unexclosed. Of the eight nests that failed, five of the nests were abandoned or one egg nests and three failed to unknown cause (Table 7). Due to the lack of known depredations and good nest success, no exclosures were used at South Siltcoos in 2011. Overall at Siltcoos, unexclosed nests were more successful than exclosed nests (Table 5), and the overall nest success rate of 47% was near the average for these two sites (Figure 11).

At Overlook in 2011, the overall nest success was 56% (Table 5), above the average for these sites (Figure 11). The majority of nests at Overlook were unexclosed (n = 54). Three nests, all successful, were exclosed, one at North Overlook and two at South Overlook. Of the 25 nests that failed, 16 (64%) failed due to abandonment, one egg nests or wind/weather (Table 7), all causes of failure that exclosures may not have prevented. Eight nests failed due to depredations, including six to corvids. The six corvid depredated nests all occurred between the dates of 21-24 May. After 24 May, we exclosed three nests. We then determined that exclosure use was unwarranted at Overlook due to the lack of observed corvid activity after late May.

Plover nest activity was notably higher at North Tahkenitch compared to all previous years (Table 4). Overall nest success at North Tahkenitch in 2011 was 61% (Table 5), higher than the average for this site (Figure 11). Of the eight nests that failed, corvids caused five of the failures. One corvid depredation occurred on 14 May and two others occurred on 21 May. We exclosed two active nests after these corvid depredations. Two other nests failed to corvid depredation on 20 June. We exclosed two more nests after these corvid depredations. All four exclosed nests hatched (one of the nests was exclosed for just a single day before it hatched). Of the 18 nests not exclosed, 10 successfully hatched (53%).

In 2011, Tenmile had the poorest nest success with only seven of 50 nests successfully hatching (14%, Table 5), below the average for these sites (Figure 11) and the lowest success for Tenmile since monitoring began in 1990. Of the 43 nests that failed, 29 (67%) failed to corvid or unknown depredation (Table 7). Seven additional nests failed to unknown causes, some of which were likely depredation events but there was a lack of evidence to determine the cause of failure. Due to the high level of depredations, we began to exclose nests in mid-May. We exclosed a total of seven nests. On 2 June we video recorded

a Great Horned Owl attacking an adult plover at an exclosed nest. We immediately removed all exclosures at South Tenmile to prevent further adult plover depredations. Of the nests that were exclosed on the south side, only one hatched without an exclosure. Since we had exclosed nests and then removed the exclosures, we did not calculate nest success for these nests as some failed while exclosed due to adult plover depredations, and some failed while not exclosed due to corvid or unknown depredation. After removing the exclosures, two Great Horned Owls were removed from South Tenmile, one lethally and one that was trapped and released elsewhere (Burrell 2011). We did not use any exclosures after this event because we never determined if any other owls were still present and because we were unsure if the released owl would return to the area. Unexclosed nests continued throughout the year to fail at a high rate. The main causes of failure continued to be corvid and unknown depredations.

No exclosures were used at CBNS for the fifth consecutive year (Table 5). Nest success at CBNS was higher in 2011 (82%) than in 2010 (25%), with 47 of 57 nests hatched. Nest success at CBNS was above average (Figure 11) for all sites. On the HRAs, all 26 nests hatched. On South Spoil 11 of 15 nests hatched (73%) and on South Beach 10 of 16 nests hatched (63%). In the past several years, suspected rodent depredations caused the majority of failures at CBNS (Lauten *et al.* 2009, 2010). In 2011, there were no documented rodent depredations and only three of the 10 failed nests were caused by depredations, two raccoon depredations and one unknown depredation (Table 7). Six other failures were either abandonments, one egg nests, or an infertile nest.

At Bandon Beach, 13 of 28 nests hatched (46%, Table 5), similar to 2010 (42%) and above the average for this site (Figure 11). Fourteen nests were unexclosed and only two hatched (14%). Due to the high rate of failure, we exclosed 14 nests, 11 of which hatched (79%). Of the 12 unexclosed nests that failed, eight were either depredations or unknown cause (67%). One of the exclosed nests was abandoned. The resident adult male associated with this nest was not recorded after the nest was abandoned, suggesting he was depredated. There was no evidence that the male was depredated in or near the exclosure.

At New River, 15 of 40 nests hatched (38%, Table 5), similar to 2010 (36%) and below average for this site (Figure 11). Of 24 unexclosed nests, only one hatched (4%). The main causes of nest failure were unknown and corvid depredations (Table 7), therefore we exclosed most of the remaining nests (n = 15) and 14 successfully hatched (93%). On the HRA, 18 nests were unexclosed and only one was successful (5%) and 10 nests were exclosed with nine successfully hatching (91%). On state land there were nine total nests, five unexclosed (all failed) and four exclosed (all successful). Two other nests were on private land, one which was unexclosed and failed and one which was exclosed and hatched.

Nest Failure

Exclosed nests in 2011 had an overall failure rate of 23% (10 of 43, Table 8; five nests from South Tenmile were not included because they failed after removal of the exclosure), similar to previous years (27% in 2010 and 18% in 2009). Four exclosed nests (40%) failed due to infertility (1), unknown cause (1), and abandonment (2) (Table 8). Six exclosed nests failed to predators (60%): three exclosed nests were depredated by small mammals and three exclosed nests failed due to adult plover depredations in or around exclosures. While three nests were considered failed due to adult plover depredations, at least one other adult was depredated at an exclosed nest that hatched and at least one other unbanded adult plover likely was depredated at an exclosed nest, but since the plover was not banded we could not be certain. The number of unexclosed nests that failed in 2011 (n = 133) was lower than the previous two years (n = 149 in 2010 and n = 148 in 2009). The failure rate of unexclosed nests in 2011 (54%) was lower than previous years (77% in 2010, 73% in 2009, and 73% in 2008). In 2011, the main causes of nest failure for

unexclosed nests were unknown depredations (n = 31, 23%), corvid depredations (n = 28, 21%), unknown cause (n = 25, 19%), one egg nests (n = 23, 17%), and abandonment (n = 19, 14%, Table 8). Overall nest failures were attributed to unknown depredation (22%), corvid depredation (20%), unknown cause (18%), one-egg nests (16%), abandonment (15%), wind/weather (3%), mammalian depredation (2%), adult plover depredation (2%), infertility (1%), and rodent depredation (1%, Table 7).

As we have noted in the past several years (Lauten *et al.* 2008, 2009, and 2010), the number of one-egg nests (n = 23 for 2011, n = 25 for 2010, n = 19 for 2009, n = 22 in 2008, and n = 23 for 2007) and abandoned nests (n = 21 for 2011, n = 20 for 2010, n = 11 for 2009, n = 19 in 2008, and n = 18 in 2007) continues to be high. Of 201 abandoned and one egg nests in the past 5 years, 21 were exclosed (10%).

Fledging Success and Productivity

We monitored 148 broods in 2011 including four broods from undiscovered nests, 54 more broods than in 2010 (Lauten *et al*. 2010) and the highest number of broods since monitoring began in 1990. A minimum of 168 fledglings was confirmed (Table 9). Overall fledging success was 46%, above the overall average (Table 10). The overall number of fledglings per male was 1.57 (168/107, Table 11). Considering data from known nests from Siltcoos to New River only (Tables 12-18), the mean fledglings per male was 1.365, above the average (Table 10).

The overall brood success rate was 71% (Table 11), slightly higher than the average (66% +/- 10). Siltcoos had 17 broods, four more than 2010, and 59% of the broods were successful (n = 10/17). Overlook had 33 broods, 15 more than 2010, and 31 were successful (94%). North Tahkenitch had 14 broods, 11 more than in 2010, and 11 were successful (79%). Tenmile had 7 broods, 11 fewer than 2010, and overall brood success was 43% (n = 3/7). CBNS had 49 broods, 33 more than in 2010, and overall brood success rate was 89% (n = 43/49). Bandon Beach had 13 broods, two more than in 2010, and overall brood success was 69% (n = 9/13). New River had 15 broods, the same number of broods as in 2010, and overall brood success was 53% (n = 8/15). Five of 10 broods on the HRA were successful, and three of five broods on the state and private lands were successful.

Overall fledging success at Siltcoos was 31% (Table 12). The north spit had a fledging success rate of 67%, however only six eggs hatched so the sample size was very small (Table 11). The south spit had a relatively low 23% fledging success rate. Overlook had an overall fledging success rate of 60% (Table 13), with 58% success on the north side and 63% success on the south side (Table 11). The fledging success rate at North Tahkenitch was 51% (Table 11 and 14). Overall fledging success at Tenmile was the lowest since 2002 (22%, Table 15), and the second lowest for this site since monitoring began in 1992. Fledging success was 50% on the north spit but only two eggs hatched (Table 11). Fledging success on the south spit was 19%. CBNS had an overall fledging success rate of 48% (Table 16). Despite hatching good numbers of chicks, South Spoil had a poor fledging success rate of 21% (Table 11). Fledging success on the HRAs was 48% and South Beach had the highest fledging success rate of any site (78%, Table 11). Bandon Beach had a fledging success rate of 47% (Table 11 and 17). Overall fledging success at New River was 32%, similar to the previous four years (Table 18). The fledging success rate for state and private lands was 42%, while the HRA had a fledging success rate of 27% (Table 11).

Overall productivity in 2011 was higher than 2010, however productivity did not improve at every site (Tables 12-18). At Siltcoos in 2011 (Table 12), the hatch rate increased compared to 2010, but the number of fledglings produced was only three more than 2010, and the fledging success rate, the productivity index, and the number of fledgling per male all were similar to 2010. The number of eggs

laid by plovers was high, but the number of fledglings produced was relatively low, resulting in a relatively low productivity index. Overall productivity indices were below the post predator management averages and goals at Siltcoos.

Overall productivity at Overlook in 2011 was improved from 2010 and overall numbers were high (Table 13). In 2011, Overlook had the highest number of eggs laid for this site and 53% of the eggs hatched, the highest number of eggs hatched for this site. The number of fledglings produced was three times higher than 2010, the previous highest year, and the fledging success rate was 60%, higher than the post predator management average. The productivity index was 32%, indicating that the plovers produced high numbers of fledglings compared to the number of eggs laid. The number of fledglings per male was above the post predator management average and above recovery goals. Overall this was the most productive year for plovers at Overlook.

North Tahkenitch had the highest improvement of any site on the coast in 2011, and had the highest overall productivity for this site since monitoring began in 1993 (Table 14). The number of eggs laid was the highest since 1996 and over double the number of eggs laid in any of the post predator management years. The number of eggs hatched was the highest of any year since monitoring began, and the hatch rate was 63%, above the post predator management average. The number of fledglings produced was the highest ever and only the second time since monitoring began that the number of fledglings produced was over 10. The fledging success rate was 51%, above the post predator management average. The productivity index was 32%, indicating that the plovers were productive for the number of eggs laid. The number of fledglings per male was double the post predator management average.

Despite much effort as measured by the number of eggs laid, Tenmile had its least productive year to date (Table 15). For the third consecutive year, plovers laid a high number of eggs, but only 15% hatched, the lowest rate for this site since monitoring began in 1992. The fledging success rate was 22%, the lowest rate for post predator management years and only half of the post predator management average. The poor productivity was reflected in the productivity index, which was the lowest since monitoring began in 1992. The number of fledglings per male was the lowest since implementing predator management, and below the average for this site. Tenmile is the only site where productivity has not increased since implementation of predator management.

Productivity at CBNS improved in 2011 compared to the previous two years (Table 16). While the number of eggs laid remained about the same as 2010, the number of eggs hatched more than doubled and the hatch rate increased from 25% in 2010 to 70% in 2011, the highest rate since implementing predator management. Fledging success was 48%, below the post predator management average but the number of fledglings produced was the most of any year. The productivity index improved to more than double of the previous two years, indicating that the plovers produced more fledglings from the number of eggs laid than the previous two years. The number of fledglings per male also improved and was slightly lower than the average for post predator management years. CBNS continues to be the most productive site on the Oregon coast.

Productivity at Bandon Beach in 2011 improved compared to the previous three years (Table 17). The number of eggs laid at Bandon Beach has been relatively consistent since 2005, but generally productivity has been low compared to the number of eggs laid. In 2011, the hatch rate was 49%, similar to 2010, but the number of fledglings produced was higher, resulting in a higher productivity index. The number of fledglings produced in 2011 was the highest ever for this site, and the fledging success rate was 47%, over double the rate in 2010. The number of fledglings per male was over 1.00 for the first time in

three years, and was above the post predator management average. Overall productivity at Bandon Beach in 2011 reached recovery goals.

Despite relatively high number of eggs laid and good hatch rates at New River, productivity for the past four years has generally been lower than recovery goals (Table 18). In 2011, the number of eggs hatched and the number of fledglings produced was nearly identical to 2010, however due to fewer eggs laid the hatch rate actually improved. The fledging rate, the productivity index, and the number of fledglings per male were nearly the same as in 2010, and below the average for post predator management years.

Since the implementation of predator management, the average post predator management brood success rate (2004-2001, 72.5%) was significantly higher than the average pre predator management brood success rate, (1991-2001, 62.9%, t-stat = 2.25, df = 17, $P = 0.04$). The overall mean post predator management fledging success rate (0.47, Figure 12) was higher than the mean pre predator management fledging success rate (0.39, t = 1.76, df = 16, $P = 0.10$). The overall mean number of fledglings per male after implementation of predator management (2004-2010; $x = 1.32$) was significantly higher than the mean number of fledglings per male prior to the implementation of predator management (1992-2001; $x = 1.056$, t = 2.38, df = 16, $P = 0.03$, Figure 13). Productivity as measured by the average fledging success rate has improved at all sites except Tahkenitch and Tenmile since implementation of predator management (Table 19). The average number of fledglings per male since implementation of predator management has improved at all sites except Tenmile where it has remained relatively stable (Table 19).

Brood Movements

All three broods at North Siltcoos used the HRA and spit, and there was no brood movement north of the HRA nor did any of the broods cross the river to the south spit as they have in previous years (Lauten *et al*. 2009 and 2010).

Lauten *et al*. (2009 and 2010) have documented increased nesting attempts along the beach between South Siltcoos and North Overlook, primarily in the Carter Lake area. Increasing plover numbers have resulted in plovers regularly occupying the beach from South Siltcoos to North Overlook. In 2011, plovers successfully nested on the beach between South Siltcoos and North Overlook, and also successfully nested on the beach between South Overlook and Tahkenitch (Figures 2, 3, and 4). Due to the increase in both plover numbers and nesting attempts, there was consistent use of the beach by broods from South Siltcoos to North Overlook. Some broods from the South Siltcoos nesting area moved south of Waxmyrtle Trail along the beach, while some broods from North Overlook moved north along the same section of beach. Similarly, some broods from South Overlook moved south along the beach towards the Overlook Loop Trail, and some broods from Tahkenitch moved north along the same section of beach. Additional broods originated from hatched nests along these sections of beach, resulting in brood use along the entire length of beach between South Siltcoos and Tahkenitch.

There was only one brood at North Tenmile in 2011 and it remained on the nesting area throughout the brood period. There were only two successful broods at South Tenmile in 2011, and both broods stayed within the vicinity of the HRA.

At CBNS, broods that nest on South Beach remain on the beach for the brood period. In 2011, no broods moved north of the FAA towers, however there was brood activity within a quarter mile of the FAA towers. There continues to be brood activity south of the closed area in the vicinity of the north jetty. We noted on multiple occasions broods using the beach where vehicle traffic is permitted, including

broods on both dry and wet sand when vehicles were present. We also noted brood activity along the foredune near the jetty and the use of the end of the foredune road and parking area above the foredune. We have noted in past (Lauten *et al*. 2009 and 2010) that broods from the HRA and South Spoil tended to move west towards the beach. In 2011, we noted similar behavior. Broods from the 95HRA tended to use both the beach and HRA, accessing the beach near the Olson shipwreck where the foredune is least steep and has a thinner density of beachgrass. Broods from the 98EHRA were able to cross to the 95HRA relatively easily due to breaks in the berms bordering the foredune along the west edge of the 98EHRA. Broods from the 94HRA wandered on restoration area, occasionally moving onto the South Spoil, but also moving north to the 98EHRA and west to the 95HRA. Broods originating from South Spoil have the furthest distance to move west towards the beach. Six of 49 broods failed at CBNS (Table 11), and all six broods were from the South Spoil. While it is likely that the beach has the best available food resources for chicks, there is no data on food availability on the HRAs and Spoil, and therefore it is not known if the distance from beach has any impact on brood and chick survival. Weather may have also had an impact on the South Spoil broods that failed, as many had just hatched prior to the last week in May when a late spring storm with high rain fall amounts occurred.

One brood at Bandon Beach originated from a nest on the north side of China Creek in 2011. Despite minimal ropes and signs around the immediate nesting area, the brood remained along the foredune north of China Creek for the entire brood period and fledged two chicks. We repeatedly noted the chicks and male in the wrackline despite the relatively high level of human and dog use in the area. The brood was observed more often early in the morning and was more difficult to locate later in the day. All other Bandon broods hatched south of China Creek. There was extensive brood use along the foredune the entire length of the beach, particularly towards the south end of the beach just north of the HRA. In the winter of 2010-11, OPRD created four "cutouts" along the foredune: bulldozed areas of 0.25 to one acre to give the plovers some space to nest and brood off the beach and away from the foredune and recreating public. We noted extensive use of the cutouts by broods, especially the southernmost cutout which also had some shell hash spread in it. Several broods that originated on the HRA remained on the HRA throughout the brood period. One brood spent most of the brood period at the very south end of the HRA and beach, and was noted on the dry and wet sand on the north side of New River. One other brood from the HRA crossed New River shortly after hatching and the male raised the chick on the New River spit.

There were five broods that originated on the New River spit in 2011, three of which were successful. Those broods remained at the north end of the spit on state land throughout the brood period. One brood from private land moved south along the stretch of beach that is adjacent to private land, but failed shortly thereafter. Broods from the New River HRA tended to stay within the HRA boundaries, but often moved considerable distances from their nest location. One brood that originated on the New Lake breach area moved in the first two weeks to the north end of the HRA, and then moved further north along the beach where it eventually fledged. Other broods that originated in the New Lake area moved north of Croft Lake breach, and another brood moved south to the south end of the HRA. One brood that originated near the camp site south of the HRA moved as far north as Croft Lake breach.

Sightings of Snowy Plovers Banded Elsewhere

Eighteen adult plovers banded in California were observed in Oregon in 2011. Nine were females and nine were males. Fifteen of the 18 plovers were known to have nested in Oregon in 2011; three females were not confirmed nesting. Five females and four males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. Nine other plovers, four females and five males, were originally banded in California. One female was a hatch year 2006 bird from Salinas, Monterey Co.;

she was captured and rebanded due to a persistent limp and an apparent right foot injury that has been documented for the previous two years. Rebanding revealed the foot had no obvious injury nor were the bands related to any injury, however the foot was unable to fully open for unknown reasons. We removed the bands from the right leg. This female successfully nested. The other three California originated plovers included a hatch year 2006 from Humboldt Co. who has been nesting at Bandon Beach and New River since 2007; an adult banded in 2008 in Humboldt Co. that has not nested in Oregon prior to 2011; and a bird with one band that likely was a hatch year Humboldt Co. bird, but due to the single band we are uncertain of its origin. This last female was not confirmed nesting in 2011. Of the five California originated males, three were hatch year 2010 plovers, two from Moss Landing Salt Ponds, Monterey Co. and one from Oceano Dunes, San Luis Obispo Co. The two other males were both banded in Salinas, Monterey Co.: a male banded in 2009, which was present in Oregon in 2010, and a hatch year 2004 bird that has been present at New River since 2005.

Discussion

Snowy Plovers numbers on the Oregon coast continue to increase as indicated by all indices to population numbers (Table 1). In 2011, all population indices were the highest totals since monitoring began in 1990. The window survey count and the total number of plovers present increased by about 10 plovers, while the number of breeding plovers increased by 39. We have noted that increased plover numbers and numbers of active nests have reduced our ability to identify adults associated with nests (Lauten *et al*. 2010). Our ability to identify adults at a nest tends to improve when the nest is successful due to the length of available time to observe nest activity and to adults being more attached to a hatching nest. In 2011, relatively high nest success rates may have resulted in more adult plovers being identified at nests, and therefore a larger increase in the number of nesting plovers compared to the increases in window survey numbers and the numbers of plovers present. The number of resident plovers in 2011 was 233, 18–26 more plovers than in 2010 (n = 207–215), also suggesting that there was an increase in plover numbers but not as large as the number of breeding plovers indicates. While the Oregon population has not met all recovery criteria, in 2011, the coastal population was within the recovery goal of 200 individuals for Oregon (U.S. Fish and Wildlife Service 2007).

Plover population levels are a result of overwinter survival rates and immigration into the population from outside Oregon (Lauten *et al.* 2007, 2008, 2009, and 2010). In 2011, both adult and juvenile overwinter survival was above average. The number of adult plovers that did not return (n = 52) in 2011 was the same as the number of HY10 plovers that did return (n = 52). This indicates that returning hatch year plovers were not responsible for the increase in plover numbers. The number of unbanded plovers was similar to the previous year (n = 27-33 in 2011 and n = 27 – 31 in 2010), as was the number of adult plovers banded outside of Oregon (n = 18 in 2011 and 2010), indicating that immigration had a limited role in the increase in plover numbers. High adult overwinter survival is likely responsible for the increased population. Adult overwinter survival has been shown to be the most important parameter in models of Mountain Plover populations (Dinsmore *et al*. 2010). Dinsmore *et al*. (2010) suggested that management aimed at improving survival rates over winter may have the most beneficial effects on population size. Mountain Plovers are migratory and do not winter within the breeding range. Most Oregon Snowy Plovers do winter in Oregon (ca. 75%, ORBIC, USFWS, unpubl. data). Brindock and Colwell (2011) documented habitat selection of wintering Snowy Plovers in Humboldt Co., CA, and suggest that management should aim to improve habitat that results in increased food availability, reduces predation pressure, and reduces human disturbance. Currently there are no active winter management practices for plovers in Oregon, nor have there been any studies of wintering plovers in Oregon. Studying and managing plovers in winter could result in positive management practices that have beneficial effects on plover survival and population levels.

While immigration has not been the source of large increases in Oregon plover populations, emigration from Oregon continues to be important to smaller plover populations in Washington and Humboldt Co., California. Colwell *et al*. (2008, 2009, 2010, and 2011) has noted that Humboldt Co. populations are maintained by immigration, and Washington populations are also maintained by immigration into that population (S. Pearson, pers. comm.). High reproductive output from Oregon plovers benefits these neighboring plover populations.

There was a noticeable increase in plover numbers between Siltcoos and North Tahkenitch in 2011 (Table 3). The overall number of plovers at Siltcoos increased from 48 individuals in 2010 to 67-69 individuals in 2011, but the number of breeding individuals has remained stable for the past three years (24 in 2009, 23 in 2010, and 26 in 2011). The number of plovers at Overlook doubled from 2009 to 2010, and further increased by 30 individuals in 2011. In 2011, Overlook had the highest number of plovers for any site (n = 89), approximately 36% of the total plover population. The number of breeding plovers at Overlook also increased by 21 individuals, the highest increase for any site in 2011. The large increase in the number of nests at South Overlook in 2011 reflects the increasing adult plover numbers as well as improvements in habitat (Table 4). North Tahkenitch had the largest increase in total plover numbers for any site in 2011. In 2011, 58 individuals were recorded while only 14 individuals were recorded at this site in 2010. A number of plovers from Tenmile moved north to Overlook and Tahkenitch once their nests failed, which partially accounted for the high use of these two sites. The number of breeding plovers at Tahkenitch increased from seven in 2010 to 22 in 2011 (Table 3). Tenmile had a slight decrease in the number of individuals recorded in 2011 (n = 61 compared to 67–69 in 2010) and the number of breeding individuals (n = 25 compared to n = 33 in 2010). Tenmile, which was formerly one of the most productive sites on the Oregon coast (Table 15), continues to have a downward trend in overall productivity. Increased attention to predator management is recommended for this site because of the high rates of failure and low productivity. CBNS had a slight decrease in plover numbers in 2011 (n = 69) compared to 2010 (n = 75–76), however the number of breeding individuals increased from 39 in 2010 to 59 in 2011. The increase in breeding individuals is likely the result of better identification of breeding adults in 2011 compared to 2010, and may not reflect a true increase in breeding population. The total number of plovers using Bandon Beach/New River remained nearly stable (n = 75 for 2010 compared to n = 69 – 73 in 2011), and the number of nesting adults has remained relatively stable for the past three seasons (n = 49 for 2009, n = 54 in 2010, and n = 50 in 2011).

For the third consecutive year, the 2011 breeding season had the highest number of nests since monitoring began in 1990 (Table 4). Two sites, South Overlook and North Tahkenitch, had large increases in nest numbers while the other sites had similar nest numbers compared to 2010 (Lauten *et al*. 2010). In the past two years, high numbers of nests were partially the result of repeated nest failures resulting in many renesting attempts (Lauten *et al*. 2010). In 2011, nest success was relatively high for both exclosed and unexclosed nests (Table 6). Despite the good nest success, the increase in nest numbers was partially caused by many nest failures at Tenmile which resulted in some plovers moving to Overlook and North Tahkenitch where they nested in greater numbers than in previous years.

We continue to document high numbers of one egg and abandoned nests (Lauten *et al*. 2007, 2008, 2009, and 2010). In 2011, one egg nests accounted for 7% of all nests. At one breeding location in Monterey, CA, only 2% of the nests were one egg nests in 2011 (K. Neuman, pers. comm.). The reasons for the high number of one egg and abandoned nests continue to be difficult to assess. Exclosures do not appear to be an important cause nest abandonment as only 10% of the abandoned nests over the past five years (n = 21/201) have been exclosed. One egg nests are never exclosed. Recreational activity is not likely a major cause of these abandonments either, as most sites have fairly low direct impact from

recreational activity. As we have noted in the past (Lauten *et al*. 2010), permitted activity by monitors and Wildlife Service does cause some disturbance on the nesting areas, but the level of disturbance at any time is also fairly low, so we do not believe that our activities are the main reason for all these failed nests. We continue to suspect that many of these abandonments are natural and likely not preventable.

In 2011, we recorded only one nest failure due to rodent depredation, lower than the previous years (Lauten *et al.* 2009 and 2010). The majority of suspected rodent depredations had occurred at CBNS (2009 and 2010). In 2011, prior to plovers nesting, Wildlife Services conducted an extensive rodent trapping effort at CBNS with the goal of reducing the rodent population and therefore reducing rodent depredations. Wildlife Services removed 217 deer mice (Burrell 2011). Nest success at CBNS on the South Spoil and HRAs was a combined 90% (Table 5). The extremely high nest success at CBNS suggests that the rodent removal project may have been effective, however, rodent depredations were nearly non existent at all sites in 2011, so it is unclear if the trapping effort actually had an effect or whether rodent depredations were down due to natural changes in mouse populations.

Corvid depredations continue to be the main source of known nest depredations (Table 7). Of the 32 unknown depredations, 17 were at Tenmile and 11 were at Bandon Beach/New River, sites with relatively high corvid activity. Corvids were likely responsible for some, if not most, of these unknown depredations. Predator management continues to have a positive effect on reducing corvid numbers, however controlling corvids is a difficult and time consuming task. Despite apparent reductions in corvid numbers, they continue to be consistently present particularly between Siltcoos to Tahkenitch, Tenmile, Bandon Beach and New River.

We continue to explore the use of cameras to better document nest failures. In 2011, Jeff Allen of Willamette University designed and built a portable camera that we intended on using at CBNS to attempt to document rodent depredations at plover nests. Due to the lack of rodent depredations at CBNS and the high nest success, we elected to deploy the camera at South Tenmile to attempt to identify the cause of high nest failures at this site. By late May at Tenmile, we had erected a number of exclosures around nests. Monitors became suspicious of potential adult depredations at exclosed nests when at least one nest was mysteriously abandoned. We deployed the camera on 2 June and that evening we recorded a Great Horned Owl attacking the incubating adult plover inside the exclosure. The following day after checking the video we removed all exclosures at South Tenmile. Wildlife Services responded by removing two Great Horned Owls over the next two nights (Burrell 2011). We did not use exclosures at Tenmile after this incident. Based on nest abandonment and survey results, we estimated that one adult female and three adult males from Tenmile were depredated. In addition, at least one male was depredated at an exclosed nest at New River that had hatched. We have documented a minimum of 46 adult plovers depredated in or around exclosures since monitoring began in 1990 (ORBIC, unpubl. data).

Adult survival is very important to maintaining and increasing populations (Sandercock 2003, USFWS 2007, Dinsmore *et al*. 2010). While exclosures continue to be a management tool that increases nest success, to reduce predation pressure on adults we evaluate potential risks and benefits, and only use exclosures when necessary (Appendix B). In 2011, the number of days unexclosed was the highest since monitoring began, and we reduced the number of days exclosed to 17% of the total number of exposure days (Figure 10). If nest hatch rates are not low and evidence of predation pressure is minimal, exclosure use is not necessary.

Nest success of unexclosed nests continues to improve overall (Table 6), but not at all sites equally (Table 5). Unexclosed nests had relatively high success at South Siltcoos, Overlook, Tahkenitch, and

CBNS. In contrast, unexclosed nests had relatively poor success at North Siltcoos and very poor success at Tenmile, Bandon Beach, and New River. .

Overall productivity in 2011 was good as measured by the above average fledging success rate, the high number of fledglings per male, and the total number of chicks fledged (Table 11). The total number of chicks fledged was 44 more fledglings than the previous high in 2007 (n = 124) and double the number of the previous year. While overall productivity was good, productivity varied between sites. Siltcoos, Tenmile, and New River all produced fewer than 1.00 fledglings per male (Table 11). Conversely Overlook, North Tahkenitch, CBNS, and Bandon Beach were more productive. The beach from Siltcoos to North Tahkenitch is effectively contiguous habitat, so if the data is pooled for these three nesting areas, the overall productivity in 2011 was excellent. The reasons South Siltcoos was not as productive as the remaining areas of this beach are unknown. Tenmile did poorly partly because of very low nest success resulting in low brood numbers. The reasons broods at South Tenmile did not fare well are unknown. The main cause of nest failure was corvids, however we also have definite evidence of Great Horned Owls, so multiple predators, including potentially unknown ones, are contributing to the poor productivity. At New River exclosures helped increase nest success, but fledging success, particularly on the HRA, was poor. Corvids also are persistent at New River due to the neighboring ranches, and may be a contributing factor to the low productivity; however we have no data on causes of chick mortality or food availability. We continue to work closely with Wildlife Services to better understand the predator community and the causes of nest and brood failures.

Post predator management productivity continues to be generally better than pre predator management productivity (Table 19). Siltcoos, Overlook, Bandon Beach, and New River all have had large positive changes in fledging success. Tahkenitch and Tenmile have decreased but are still within acceptable levels. Overall mean fledging success has improved from 39% to 47% (Figure 12). The mean number of fledglings per male has improved at all sites except Tenmile where it has remained relatively stable (Table 19). The overall mean number of fledglings per male has significantly improved from 1.06 to 1.32 (Figure 13).

In Lauten *et al*. 2010 we discussed the increased plover use of the beach between South Siltcoos and Overlook. In 2011 plovers extended their use of the beach from South Overlook to North Tahkenitch (Figures 2, 3, and 4). Plovers tend to return to areas where they successfully hatch chicks. Nesting success was high from South Siltcoos to North Tahkenitch (Table 5). Average hatch year return rates for Oregon are 45% (Table 2). Due to the high productivity of the plovers in 2011, and the current adult population level, we would expect high number of birds to return and continue to occupy the length of beach between South Siltcoos to North Tahkenitch. Increasing plover numbers could lead to plover pairs attempting to nest in locations outside of the typical nesting beaches (for example South Tahkenitch to the Umpqua jetty, the beach north of North Tenmile, CBNS north of the FAA tower). There have been increased late summer and fall observations of Snowy Plovers along the north coast by birdwatchers (*fide* Oregon Birders On Line), also indicating that the increased population and productivity results in dispersal. First summer pairs of plovers are the likeliest individuals to attempt to colonize new nesting areas. We recommend continued recreation management of the beach from Waxmyrtle trail south past Overlook.

As the plover population continues to increase, it is important to maintain, improve, and expand the nesting areas. The increasing plover population is leading to increased nest density. Increased nest density could attract predators, and a predator could become focused on the nesting area and cause significant nest depredations. In addition, in California when Red Fox were removed from nesting areas leading to increased nest success, increased chick numbers on the landscape attracted additional avian

predators (Neuman *et al*. 2004). Predators could become attracted to plover nesting areas due to the high numbers of nests and chicks on the landscape. Improving and expanding the nesting area would increase the available habitat for plovers and could help alleviate predation pressure. "Cutouts" created along the foredune at Bandon Beach in winter 2010 – 2011 provided new available habitat for the plovers. Plovers responded by nesting and brooding within the cutouts. The cutouts provide protected, undisturbed areas for plovers and chicks to retreat off the beach when recreationists or predators are present on the beach. Plovers using linear beaches would potentially benefit from cutouts, and cutouts are relatively smaller and easier to make and maintain compared to large habitat restoration areas. Cutouts also give the plovers a place to nest off the beach where recreational activity is highest and nests are more susceptible to wind, weather, and wave events.

Staff dedicated to recreational monitoring and volunteers continue to help reduce violations and educate the public about plovers and dog related issues. At Siltcoos and Bandon Beach where parking lots and recreational activities are adjacent to nesting plovers, monitoring by staff and volunteers has been essential to improving plover success and reducing disturbance issues. The OPRD Habitat Conservation Plan (ICF 2010) is scheduled to be implemented starting in 2012 with further requirements in the following years. Educating the public as to new rules, especially regarding no dogs on plover beaches, will be essential.

Illegal camping continues to be a problem at Bandon Beach and New River from hikers traversing the coastal trail. Hikers are starting north of China Creek, often too late in the afternoon to successfully hike to the legal campsite south of the New River HRA. The number of hikers appears to be increasing (Kip Wright, BLM, pers. comm.), and with increasing plover numbers conflicts may occur. Some hikers also have dogs, which will be illegal when the HCP is fully implemented.

Habitat Restoration and Development Projects

The USFS bulldozed 12 acres of habitat south of Holman Vista, Sutton Beach in the winter of 2010-11.

At Siltcoos, 5 acres of grass was hand pulled on the north side and 7 acres on the south side of the estuary were hand pulled in winter 2010-11.

At Overlook 15 acres of habitat on the north side was disked and 20 acres on the south side were bulldozed in winter 2010-11. One hundred and fifty cubic yards of shell hash was spread at South Overlook.

At Tahkenitch, 40 acres of habitat was bulldozed in winter 2010-11 and 150 cubic yards of shell hash was spread.

At Tenmile, 10 acres on the north side and 23 acres on the south side were bulldozed in the winter of 2010-11.

At CBNS in winter 2010-11, BLM disked 147 acres of habitat restoration area and parts of the spoil. Shell hash (ca. 180 cubic yards) was spread on 1.7 additional acres on the 95HRA.

At Bandon Beach, 15 acres of the habitat restoration area was bulldozed during winter 2010-11 and another 15 acres was restored at the southern end of the habitat restoration area. In addition, four

"cutouts" between ¼ to 1 acres were created from south of China Creek overwash to north of the HRA. A small amount of shell hash was spread on the southernmost cutout.

At New River, BLM bulldozed and improved 20 acres of habitat south of Croft Lake breach and also south of New Lake breach.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2012 nesting season should again be implemented at all sites to inform the public of plover nesting habitat and direct the public away from the nesting areas. Ropes and signs should be installed as early in the season as practical so that the closed sections of beach are adequately protected throughout the season and the public understands which sections of beach are closed and the message is consistent throughout the nesting season and from year to year. Installing ropes and signs at the beginning of the season also reduces the need to respond to individual nests that are within closed beach sections but not roped and signed. This reduces the disturbance to those nests when ropes and signs have to be installed after a nest is found. High tides early in the season often make posting areas a challenge, and while it is important to have signs in place beginning on 15 March, in areas where the ocean is regularly lapping against the foredune, signs should not be erected or placement should be delayed. Maintenance of signs is important to keep violations to a minimum. To maximize the effectiveness of signs and ropes each site should continue to be evaluated and ways to improve the signing and ropes should be considered.

General Recommendations

Below are general recommendations. We also provide additional site-specific comments and management recommendations in Appendix C.

- Continue intensive breeding season monitoring; continue monitoring plover populations and productivity to ensure recovery goals are maintained.
- Maintain, enhance and expand habitat restoration areas. We continue to support additional shell hash on any nesting area as it has proven to be a beneficial management technique. Plovers are attracted to nest within the shell hash as it provides good cover for both nests and chicks.
- Selectively use mini-exclosures in conjunction with predator management to reduce the risks to adult plovers, decrease the time monitors spend around individual nests, and decrease disturbance to plovers. Determine exclosure use dependent on predation pressure, density of plover nests, and nest locations. We recommend continued selective use of exclosures where nest success is poor and corvid activity is elevated (Appendix B).
- Expand use of cameras to help determine causes of nest failures; coordinate with Wildlife Services to set up and maintain cameras. With increased work load, cameras help monitors better document nest failures. Knowledge of the causes of nest failures permits monitors and Wildlife Services staff to make better adjustments to predator management activities and methods.
- Conduct rodent removal in 2012 to further evaluate the effect of this effort.
- Increase and/or maintain predator management at all sites and explore ways of better understanding the activity patterns and population levels of predators, particularly corvids.
- The overall productivity data has generally improved since the implementation of predator management, and we continue to recommend that predator management be funded, as this is critical to

increasing plover population. Due to the amount of area that needs to be covered and the distance between nesting sites, we continue to recommend that Wildlife Services be funded for three personnel.
- Continue to coordinate with federal agency employees regarding time frames of any habitat management work to be completed to minimize disturbance to nesting activity and broods.
- Coordinate agency activities in restricted/closed areas with plover biologists to minimize disturbance to nesting and brood rearing.
- Continue and explore ideas to document and monitor human disturbance by various recreational users in plover nesting areas.
- Continue to expand and refine volunteer efforts to monitor recreational use.
- Continue to provide staff dedicated to recreational monitoring and volunteers to help reduce violations and educate the public about plovers and dog related issues.
- Design educational programs to inform and educate the local communities and annual visitors about plover issues. Design informative/interactive presentations for school children.

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Table 1. Population estimates of the Western Snowy Plover on the Oregon Coast, 1990-2011. For Window Survey, first number is counted plovers minus duplicate band combos and unidentified plovers, number in parenthesis is total head count without considering duplicate combos or unknown plovers.

YEAR	WINDOW SURVEY	TOTAL SNPL DOCUMENTED BREEDING	TOTAL SNPL OBSERVED
1990	59	-	-
1991	35	-	-
1992	28	-	-
1993	45	55-61	72
1994	51	67	83
1995	64 (67)	94	120
1996	85	110-113	134-137
1997	73 (77)	106-110	141
1998	57 (59)	75	97
1999	49 (51)	77	95-96
2000	NC	89	109
2001	71 (85)	79-80	111-113
2002	71 (76)	80	99-102
2003	63	93	102-107
2004	82 (83)	120	136-142
2005	100	104	153-158
2006	91	135	177-179
2007	125	162	181-184
2008	98-105	129	188-200
2009	136-143 (139-146)	149-150	199-206
2010	158	175	232-236
2011	168	214	247-253

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, 1990 - 2011.

Year	# of Fledglings	# of HY birds from previous year sighted on OR coast	Return Rate (#HY/#Fled)	# that nested on OR coast	% nested on OR coast
2011	168	52	62%	44	85%
2010	84[a]	54	50%	38	70%
2009	107	35	48%	26	74%
2008	73	52	42%	27	52%
2007	124	32	29%	26	81%
2006	110	29	37%	23	79%
2005	78	43	40%	33	77%
2004	108	26	43%	21	81%
2003	60	14	45%	14	100%
2002	31	18	56%	15	83%
2001	32	23	53%	14	61%
2000	43	31	58%	25	81%
1999	53	18	56%	12	67%
1998	32	14	34%	11	79%
1997	41	30	64%	18	60%
1996	47	18	32%	10	55%
1995	57	37	66%	13	35%
1994	56	16	44%	8	50%
1993	36	10	30%	6	60%
1992	33	6*	38%	2	33%
1991	16	No chicks banded in 1990			
1990	3	x	x		

* - minimum number sighted

Average return rate = 46.3%	46%
SD = 11.4%	0.114399
Average percent of returning HY birds that nest in first season = 68.1%	68%
SD = 17.2%	0.172422

[a] - adjusted from 80 to 84 based on hatch year returns

Table 3. Number of Adult Snowy Plovers at each nesting area on the Oregon Coast, 2011.

	Females				Males					
	Banded		Unbanded		Banded		Unbanded		Total	
Site	# banded	# nested	# unbanded	# nested	# banded	# nested	# unbanded	# nested	# plovers	# nested
Sutton	0	0	0	0	0	0	0	0	0	0
Siltcoos	37	13	2-4	0	27	13	1	0	67-69	26
Overlook	44	23	6	4	39	22	0	0	89	49
N Tahkenitch	33	12	1	1	24	10	0	0	58	22
Tenmile	32	13	2	1	24	10	3	1	61	25
CBNS	30	22	5	5	33	31	1	1	69	59
NR/BB/FL	29	18	6-7	6	31	25	3-6	1	69-73	50

01/13/12

Table 4. Total number of nests for all sites on the Oregon Coast 1990 – 2011 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year and site only.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	Tot nst	Totbrd[a]
NEC													1	0	0	0	0	0	0				1	1
SU				2	1	2	6	14	8	3	7	15	3	1	0	0	4	3	0	0	1	0	70	1
NSIU													1	0	0	0	0	0	0				1	0
SI:																								
North				0	2	4	2	0	1	4	8	0	0	0	7	8	12	15	30	14	17	13	137	0
South				1	2	2	1	3	3	17	14	14	10	7	4	9	13	13	6	9	24	21	173	4
OV:																								
North										2	8	12	5	7	11	11	9	13	14	9	21	29	151	4
South										0	0	3	3	1	3	5	1	3	1	5	16	28	69	1
TA																								
North				0	0	0	0	0	0	0	4	7	8	13	8	11	4	10	5	6	7	23	106	1
South				0	3	9	18	14	6	3	1	6	7	1	0	0	0	0	0				68	2
3mileCr/ Umpqua R				0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0				1	0
TM:																								
North					2	2	1	0	0	0	1	2	3	5	9	6	10	20	12	13	13	15	114	3
South	2	0	9	8	5	4	3	2	11	5	5	6	9	12	8	11	12	21	16	41	30	35	255	7
CBNS:																								
SB	0	4	6	3	4	3	3	6	6	0	1	1	2	3	2	4	0	8	5	19	17	16	113	14
SS	20	9	4	6	9	12	22	14	5	2	5	3	2	9	8	9	14	12	18	16	14	15	228	13
NS	5	1	1	0	0	0																	7	0
HRAs					4	3	2	3	7	12	22	13	15	11	16	16	18	19	26	30	33	26	276	20
Anad. Sp	0																						0	1
Menasha	1	0																					1	0
BB	0	14	8	10	5	9	3	4	1	2	2	6	5	5	17	31	23	30	28	31	26	28	288	6
NR	6	6	2	0	6	20	18	25	26	28	17	23	14	16	24	23	27	35	35	40	42	40	473	12
FL	2	2	6	11	8	6	9	8	4	0	5	0	1	0	0	0	0	0	0	3	0	0	65	3
Tot nst	**36**	**36**	**36**	**41**	**51**	**76**	**89**	**93**	**78**	**78**	**100**	**111**	**89**	**91**	**117**	**144**	**147**	**202**	**196**	**236**	**261**	**289**	**2597**	
Tot brd[a]	**2**	**1**	**5**	**7**	**4**	**6**	**11**	**5**	**3**	**1**	**2**	**0**	**1**	**4**	**2**	**3**	**15**	**4**	**3**	**8**	**2**	**4**		**93**

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

NEC – Necanicum, SU – Sutton, NSIU – N Siuslaw, SI – Siltcoos, OV – Overlook, TA – Tahkenitch, TM – Tenmile, CBNS – Coos Bay North Spit (SB - South Beach, SS – South Spoil, NS – North Spoil), BB – Bandon Beach, NR – New River, FL – Floras Lake

Table 5. Apparent nest success of Snowy Plovers on the Oregon Coast, 2011.

		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	0	-	-		-	-		-	-	-
Siltcoos										
North	13	1	3		2	7		25%	22%	23%
South	21	-	-		13	8		-	57%	59%
Combined	34	1	3		15	15		25%	50%	47%
Overlook										
North	29	1	0		16	12		100%	57%	59%
South	28	2	0		13	13		100%	50%	54%
Combined	57	3	0		29	25		100%	57%	56%
N Tahkenitch	23	4	0		10	8	1	100%	53%	61%
Tenmile										
North	15	0	1		1	13		0%	7%	7%
South	35	1	6		5	23		a	18%	17%
Combined	50	1	7		6	36			14%	14%
CBNS										
South Beach	16	-	-		10	6		-	63%	63%
South Spoil	15	-	-		11	4		-	73%	73%
HRAs	26	-	-		26	0		-	100%	100%
Combined	57				47	10			82%	82%
Bandon	28	11	3		2	12		79%	14%	46%
New River										
HRA	29	9	1		1	17	1	91%	5%	34%
Other Lands	11	5	0		0	6		100%	0%	45%
Combined	40	14	1		1	23	1	93%	4%	38%
Floras Lake	0	-	-		-	-		-	-	-
Totals	289	34	14		110	129	2	71%	46%	50%

a – Not calculated because six of the seven exclosures used were removed before the outcome of the nest was determined.

Table 6. Apparent nest success of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1990 - 2011.

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
Average =	48.14	70.19	18.68
STDEV =	12.57	10.02	17.26

* Multiple experimental designs used, data not included

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2011.

Site Name	Tot Nsts	# Fail	Depredations					Other				
			Corvid	Unk	Mam-mal	Rodent	Adult plover	Wind/Wea-ther	Abandon	One Egg Nest	Infer	Unk cause
Siltcoos:												
North	13	10	1	1	1 [a]	1			1	3		2
South	21	8							3	2		3
Overlook												
North	29	12	3					1	5	2		1
South	28	13	3	2				1	4	3		
N Tahkenitch	23	8	5						1			2
Tenmile:												
North	15	14	3	6					1	3		1
South	35	29	9	11			2		1			6
Coos Bay North Spit:												
South Beach	16	6		1	2 [b]				1	2		
South Spoil	15	4							2		1	1
HRAs	26	0										
Bandon	28	15	1	2			1	1	1	2	1	6
New River	40	24	3	9				1	1	6		4
TOTALS	**289**	**143**	28	32	3	1	3	4	21	23	2	26

[a] – unknown small mammal inside exclosure

[b] – raccoon depredations

Table 8. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2011.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	**Corvid**		28	28
	Unknown	1	31	32
	Rodent	1		1
	Raccoon		2	2
	Unknown Mammal	1		1
Depredation	**Adult Plover**	3		3
Other	**Wind/Weather**		4	4
	Infertile	1	1	2
	One Egg Nests		23	23
	Abandoned	2	19	21
	Unknown Cause	1	25	26
Totals		10	133	143

Table 9. Total number of young fledged for all sites on the Oregon Coast 1990-2011 includes fledglings from broods from undiscovered nests.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	Tot
NEC											1	0	0	0	0	0	0	0	0				1
SU				0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0				5
NSIU													0	0	0	0	0	0	0				0
SI:																							
North					0	0	0	0	2	4	0	0	0	0	7	2	11	7	5	8	4	4	54
South				0	1	2	0	0	4	2	7	0	0	2	5	7	7	4	3	11	4	8	67
OV:																							
North										3	5	1	2	3	3	5	8	12	3	7	12	27	91
South										0	0	1	0	0	3	2	0	1	0	2	7	22	38
TA:																							
North				0	0	0	0	0	0	0	2	4	1	3	6	8	5	2	0	1	3	19	54
South				0	1	12	8	7	1	1	3	4	5	2	0	0	0	0	0				44
TM:																							
North					0	1	0	0	0	0	0	0	3	1	3	6	12	13	3	2	3	1	48
South	0	0	14	7	3	3	4	4	3	7	5	4	3	9	9	5	7	14	6	19	13	3	142
CBNS:																							
SS	3	2	4	13	17	17	22	8	6	5	3	4	2	7	13	9	11	7	17	4	2	6	182
SB	0	11	9	2	6	2	2	7	2	0	0	1	1	3	0	8	1	10	7	17	13	22	124
HRAs					7	2	1	1	1	23	6	6	8	14	22	6	19	9	16	10	5	28	184
BB	0	1	1	3	5	1	1	0	1	1	0	1	0	4	16	11	12	13	2	6	6	16	101
NR	0	0	4	0	7	12	8	9	11	8	5	6	6	12	21	9	17	32	11	20	12	12	222
FL	0	2	2	11	9	6	1	4	0	0	3	0	0	0	0	0	0	0	0	0	0		38
Total	**3**	**16**	**34**	**36**	**56**	**58**	**47**	**41**	**32**	**54**	**43**	**32**	**31**	**60**	**108**	**78**	**110**	**124**	**73**	**107**	**84** [a]	**168**	**1395**

[a] – adjusted from 80 to 84 based on hatch year returns

Table 10. Overall fledging success, total number of fledglings, and mean number of fledglings/male on the Oregon Coast, 1990 – 2011.

Year	% Fledging Success[a]	# Fledglings[b]	Mean # Fled/Male[a]
1990	11	3	-
1991	45	16	-
1992	41	34	1.250
1993	42	36	1.000
1994	50	56	1.483
1995	50	58	1.194
1996	32	47	0.881
1997	30	41	0.833
1998	26	32	0.833
1999	43	54	1.268
2000	41	43	0.973
2001	34	32	0.842
2002	29	31	0.700
2003	47	60	1.061
2004	55	108	1.645
2005	41	78	1.259
2006	48	110	1.559
2007	54	124	1.494
2008	47	73	1.060
2009	50	107	1.288
2010	35	84	0.920
2011	46	168	1.365
	Overall = 40.8 $\pm$ 10.5	Total = 1395	Mean = 1.15

a – does not include fledglings from broods from undiscovered nests
b – total number of fledglings including from broods from undiscovered nests

Table 11. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2011.

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				
Siltcoos:									
North Siltcoos	3	100%	6	4		67%	3	1.33	0.85 (13)
South Siltcoos	14	50%	30	7	1	23%	11	0.64	
Overlook									
North Overlook	18	89%	45	26	1	58%	12	2.17	2.18 (22)
South Overlook	15	100%	35	22		63%	10	2.20	
North Tahkenitch	14	79%	37	19		51%	9	2.11	2.11 (9)
Tenmile:									
North Spit	1	100%	2	1		50%	4	0.25	0.40 (10)
South Spit	6	33%	16	3		19%	8	0.38	
Coos Bay N. Spit									
South Spoil	11	45%	28	6		21%	6	1.00	
South Beach	12	100%	23	18	4	78%	11	2.00	1.81 (31)
HRA	26	100%	58	28		48%	21	1.33	
Bandon	13	69%	34	16		47%	13	1.23	1.23 (13)
New River									
HRA	10	50%	26	7		27%	10	0.70	0.71 (17)
Other lands	5	60%	12	5		42%	7	0.71	
TOTALS**	**148**	**71%**	**352**	**162**	**6**	**46%**	**107**	**1.57**	
TOTAL FLEDGED				**168**					

% 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 known individual breeding males for each site

[b] – number of known breeding males in entire population; this is not a tally of known 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 12. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2011.

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
	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 (2004-2011)	**total**	516	197		89			89	70	
	AVE			41%		48%	20%			1.38
	STDEV			10%		15%	10%			0.62

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

Table 13. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2011

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
	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 (2004-2011)	**total**	464	127		106			99	69	
	AVE			42%		49%	21%			1.37
	STDEV			13%		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, 1993-2011.
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
	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 (2004-2011)	**total**	182	93		41			40	28	
	AVE			48%		36%	20%			1.07
	STDEV			24%		19%	13%			0.72

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

Table 15. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2011.

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
	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 (2004-2011)	**total**	671	238		107			107	92	
	AVE			38%		44%	17%			1.18
	STDEV			15%		15%	9%			0.44

[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, 1992-2011.
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
	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 (2002-2011)	**total**	1064	499		274			269	162	
	AVE			49%		57%	28%			1.81
	STDEV			13%		11%	9%			0.38

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

Table 17. Productivity of Snowy Plovers at Bandon Beach, Coos Co., Oregon coast, 1992-2011.
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.

	Bandon	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
	2011	69	34	49%	16	47%	23%	16	13	1.23
	2010	60	31	52%	6	19%	10%	6	8	0.75
	2009	70	12	17%	6	50%	9%	6	8	0.75
	2008	68	5	7%	2	40%	3%	2	11	0.18
	2007	73	24	33%	13	54%	18%	13	8	1.63
	2006	53	19	36%	8	42%	15%	7	6	1.16
	2005	83	37	46%	11	30%	13%	11	12	0.92
	2004	50	33	66%	15	45%	30%	14	10	1.40
	2003	13	6	46%	2	33%	15%	2	4	0.50
	2002	10	0	0%	0	0%	0%	0	2	0.00
	2001	13	6	46%	1	17%	8%	1	3	0.33
	2000	6	0	0%	0	0%	0%	0	2	0.00
	1999	4	3	75%	1	33%	25%	1	2	0.50
	1998	3	0	0%	0	0%	0%	0	1	0.00
	1997	12	0	0%	0	0%	0%	0	2	0.00
	1996	9	6	67%	1	17%	11%	1	2	0.50
	1995	22	4	18%	0	0%	0%	0	3	0.00
	1994	15	15	100%	5	33%	33%	5	4	1.25
	1993	21	10	48%	3	30%	14%	3	5	0.60
	1992	23	7	30%	1	14%	4%	1	4	0.25
Pre-pred mang (1992-2001)	**total**	128	51		12			12	28	
	AVE			38%		14%	10%			0.34
	STDEV			35%		14%	12%			0.40
Post-pred mang (2002-2011)	**total**	480	167		63			55	69	
	AVE			35%		36%	14%			0.85
	STDEV			21%		16%	9%			0.52

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

Table 18. Productivity of Snowy Plovers at New River, Coos Co., Oregon coast, 1992-2011.

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.

	New River	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
	2011	87	38	44%	12	32%	14%	12	17	0.71
	2010	107	36	34%	12	33%	11%	12	20	0.60
	2009	109	49	45%	19	39%	17%	19	18	1.06
	2008	92	34	40%	10	29%	11%	10	18	0.56
	2007	96	47	49%	30	64%	31%	29	17	1.70
	2006	69	34	49%	16	47%	23%	16	12	1.33
	2005	63	36	57%	9	26%	14%	9	10	0.90
	2004	70	37	53%	21	57%	30%	21	12	1.75
	2003	44	25	57%	12	48%	27%	12	10	1.20
	2002	39	17	44%	6	35%	15%	6	9	0.67
	2001	53	22	42%	6	27%	11%	6	8	0.75
	2000	46	14	30%	5	36%	11%	5	8	0.63
	1999	74	42	57%	8	19%	11%	8	14	0.57
	1998	73	60	82%	11	18%	15%	11	16	0.69
	1997	65	41	63%	8	20%	12%	8	12	0.67
	1996	54	41	76%	7	17%	13%	7	12	0.58
	1995	48	12	25%	8	67%	17%	8	8	1.00
	1994	18	14	78%	6	43%	33%	5	5	1.00
	1993	0	0	0%	0	0%	0%	0	0	0.00
	1992	6	6	100%	1	17%	17%	1	2	0.50
Pre-pred mang (1992-2001)	**total**	437	252		60			59	85	
	AVE			55%		26%	14%			0.64
	STDEV			31%		18%	8%			0.28
Post-pred mang (2002-2010)	**total**	689	315		135			134	126	
	AVE			47%		41%	19%			1.05
	STDEV			7%		13%	8%			0.44

[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, 1992-2011.

	Siltcoos		Overlook		Tahkenitch		Tenmile		CBNS		Bandon Beach		New River	
	Pre-pred mang (1993-2003)	**Post-pred mang (2004-2011)**	**Pre-pred mang (1999-2003)**	**Post-pred mang (2004-2011)**	**Pre-pred mang (1993-2003)**	**Post-pred mang (2004-2011)**	**Pre-pred mang (1992-2003)**	**Post-pred mang (2004-2011)**	**Pre-pred mang (1992-2001)**	**Post-pred mang (2002-2011)**	**Pre-pred mang (1992-2001)**	**Post-pred mang (2002-2011)**	**Pre-pred mang (1992-2001)**	**Post-pred mang (2004-2011)**
ave hatch rate	38%+/-26%	41%+/-10%	54%+/-28%	42%+/-13%	46%+/-27%	48%+/-24%	59%+/-23%	38%+/-15%	60%+/-20%	49%+/-13%	38%+/-35%	35%+/-21%	55%+/-31%	47%+/-7%
ave fledging success rate	20%+/-21%	48%+/-15%	36%+/-20%	49%+/-10%	43%+/-33%	36%+/-19%	53%+/-26%	44%+/-15%	51%+/-12%	57%+/-11%	14%+/-14%	36%+/-16%	26%+/-18%	41%+/-13%
ave productivity index	11%+/-17%	20%+/-10%	21%+/-9%	21%+/-9%	18%+/-16%	20%+/-13%	30%+/-19%	17%+/-9%	32%+/-18%	28%+/-9%	10%+/-12%	14%+/-9%	14%+/-8%	19%+/-8%
ave # of fledglings/male	0.47+/-0.61	1.38+/-0.62	0.79+/-0.41	1.37+/-0.48	0.87+/-0.73	1.07+/-072	1.25+/-0.61	1.18+/-0.44	1.55+/-0.52	1.81+/-0.38	0.34+/-0.40	0.85+/-0.52	0.64+/-0.28	1.05+/-0.44

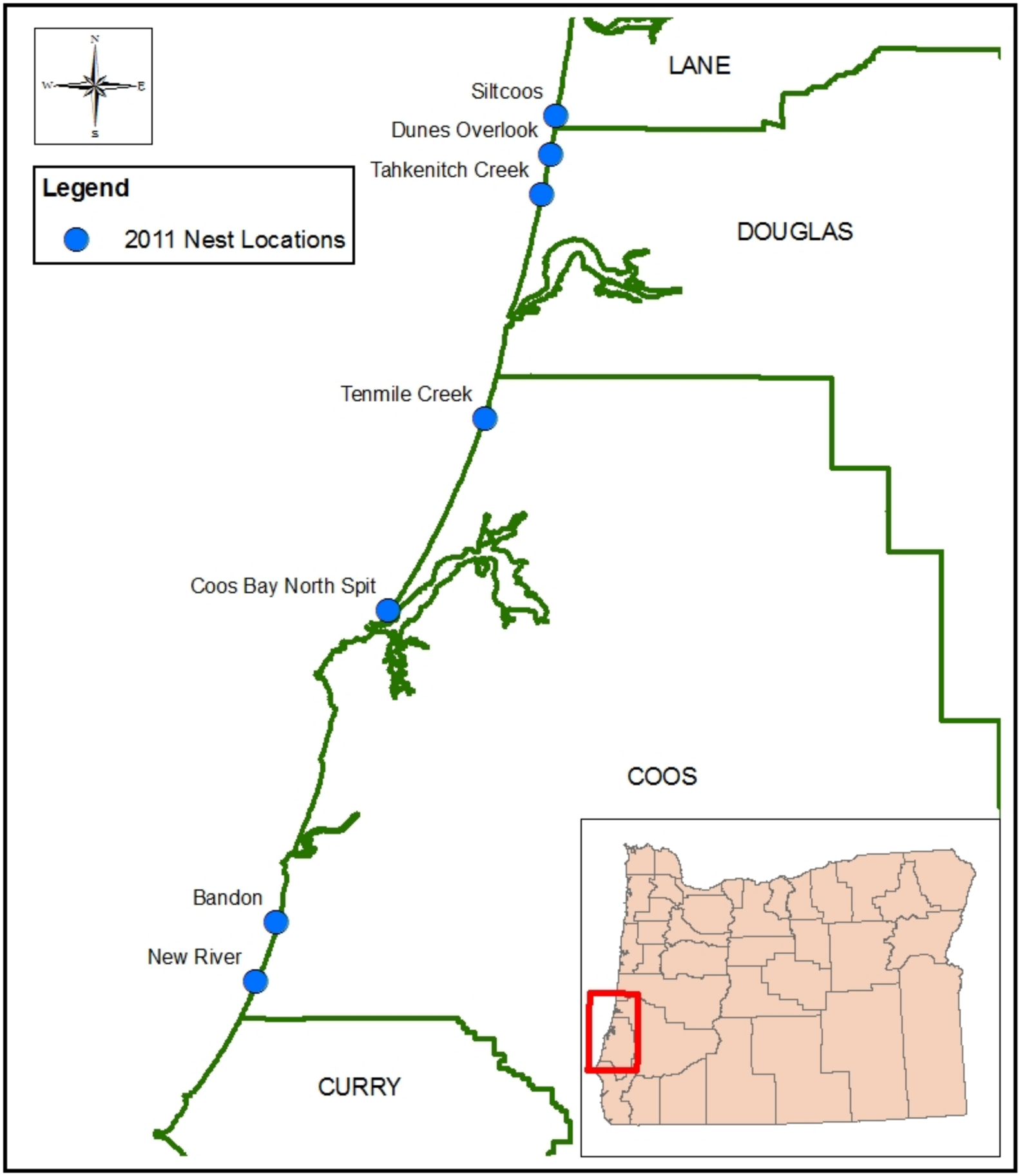


Figure 1. Snowy Plover nest locations on Oregon coast, 2011

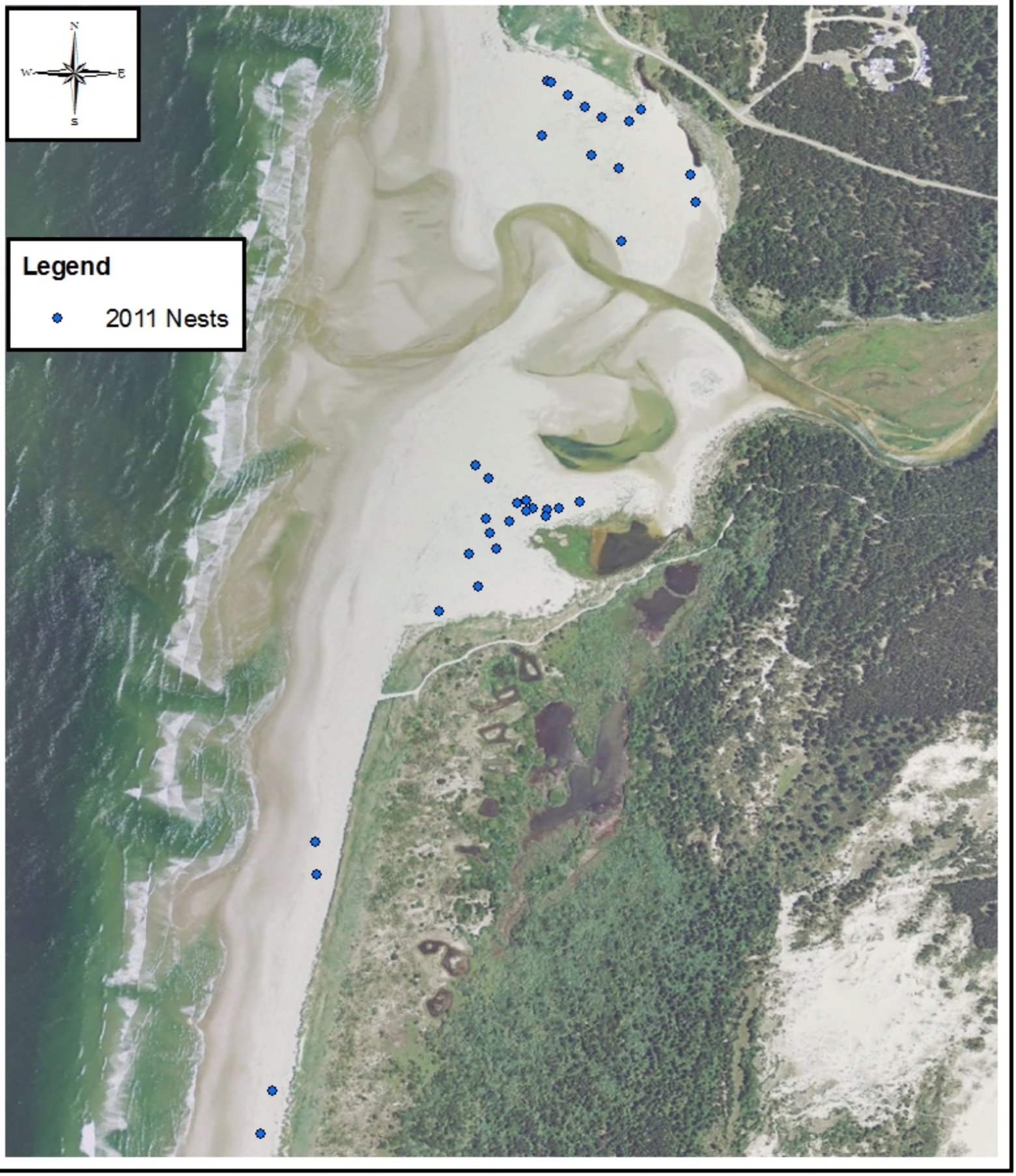


Figure 2. Snowy Plover nest locations at Siltcoos Beach, Oregon, 2011

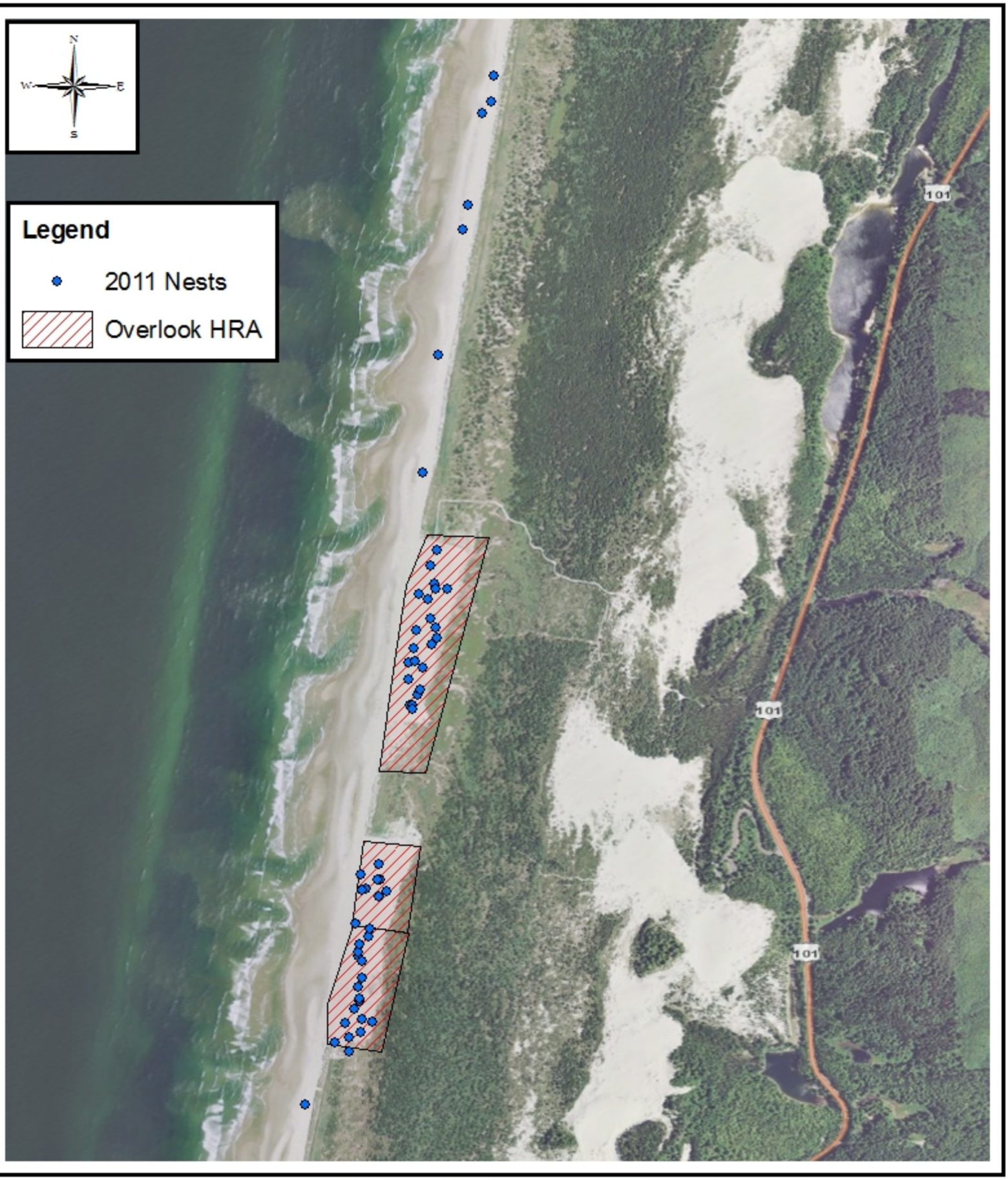


Figure 3. Snowy Plover nest locations at Dunes Overlook, Oregon, 2011

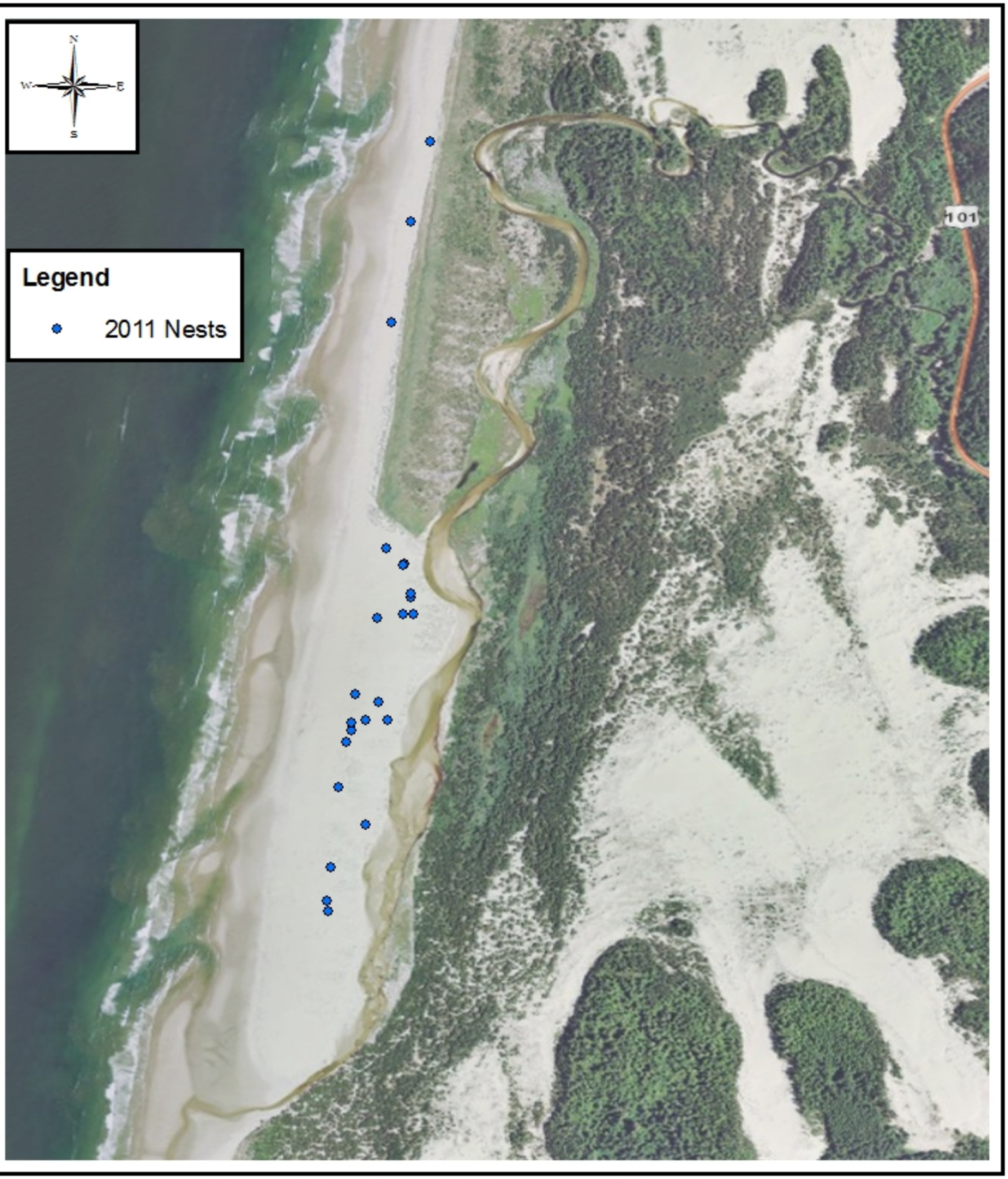


Figure 4. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2011

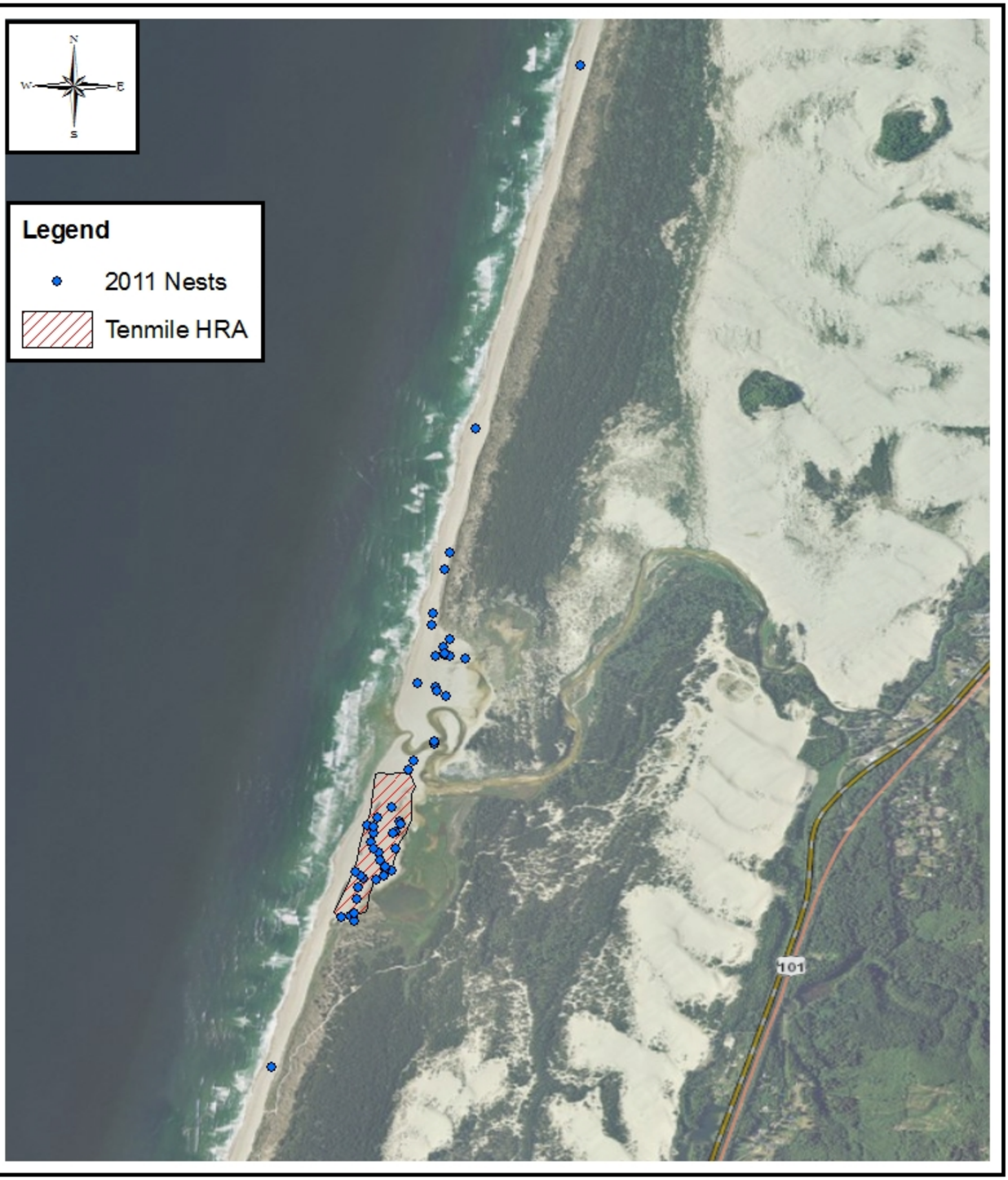


Figure 5. Snowy Plover nest locations at Tenmile Creek, Oregon, 2011

Figure 6. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2011

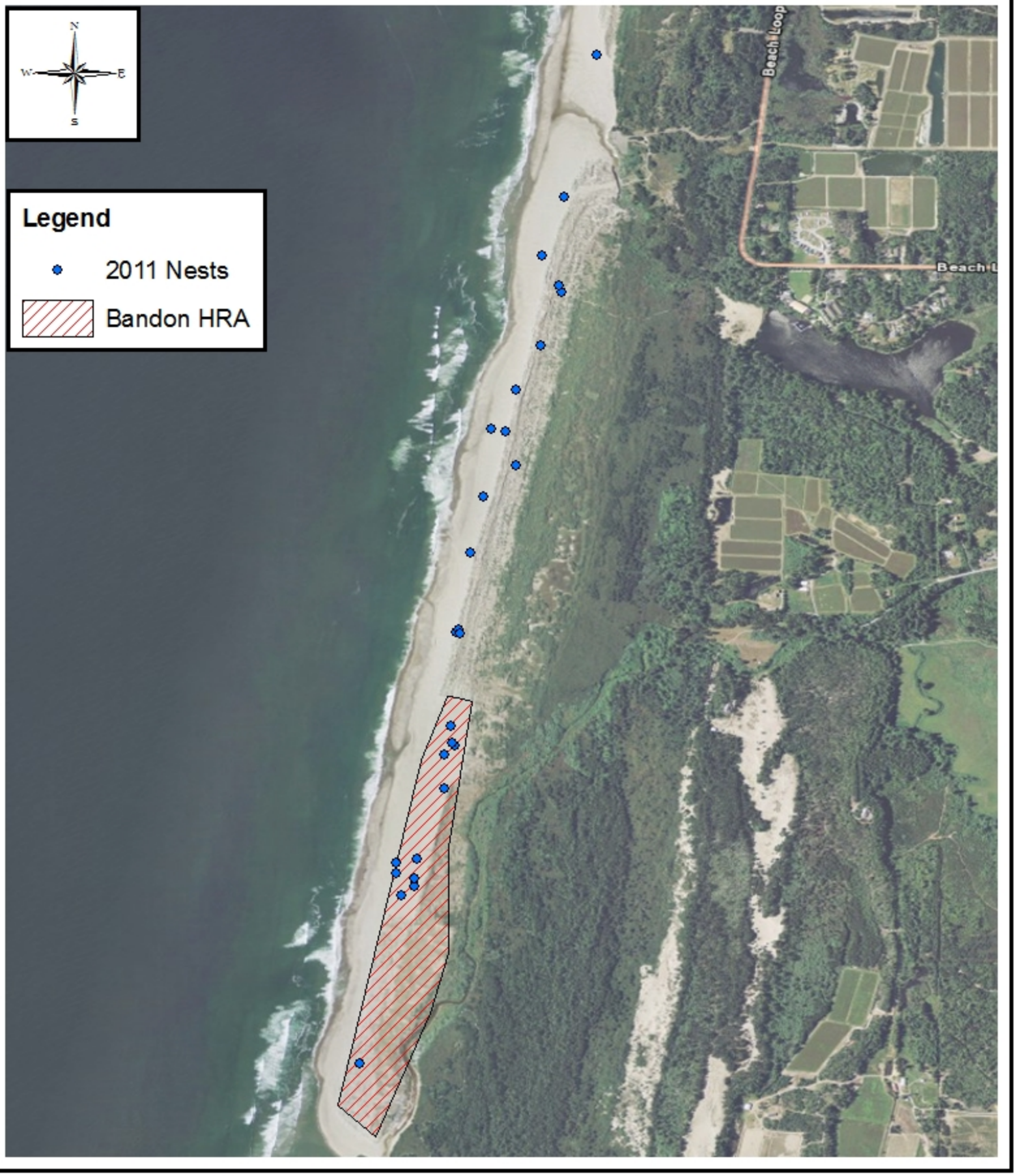


Figure 7. Snowy Plover nest locations at Bandon, Oregon, 2011

Figure 8. Snowy Plover nest locations at New River, Oregon, 2011

Figure 9. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2011. Dashed lines represent +/- 2 standard deviations.

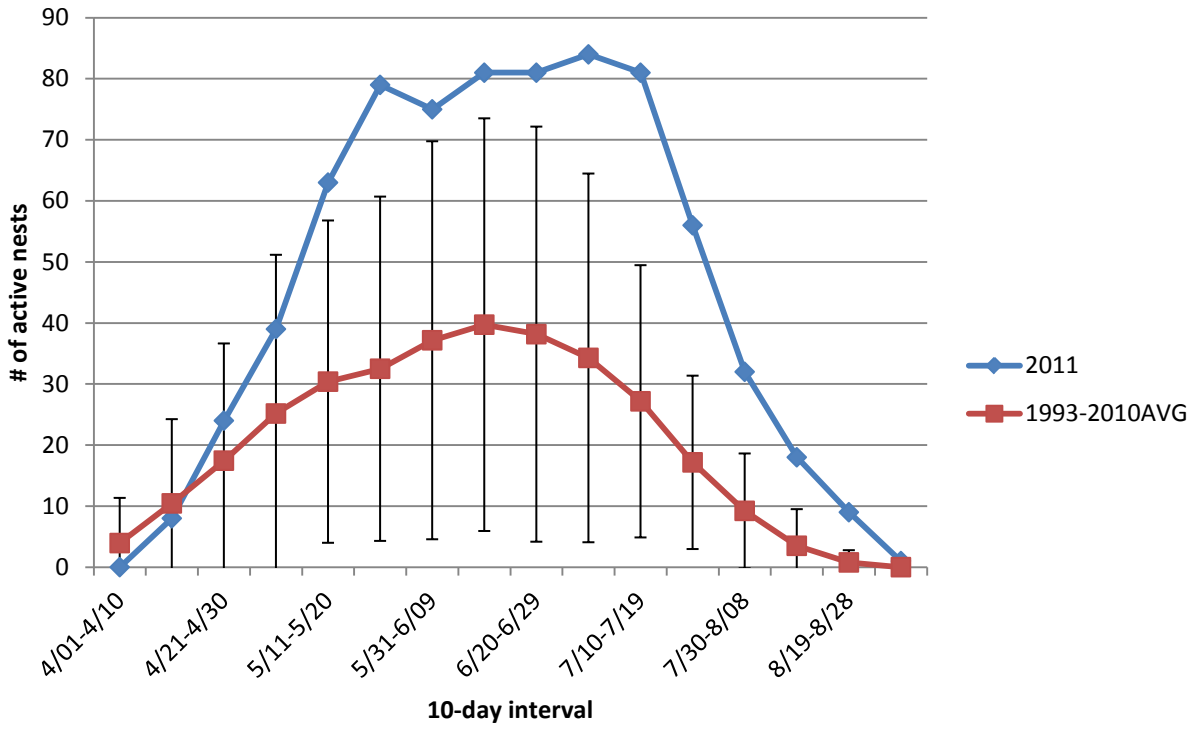


Figure 10. The number of exclosed and unexclosed days of Snowy Plover nests along the Oregon coast, 1992 – 2011.

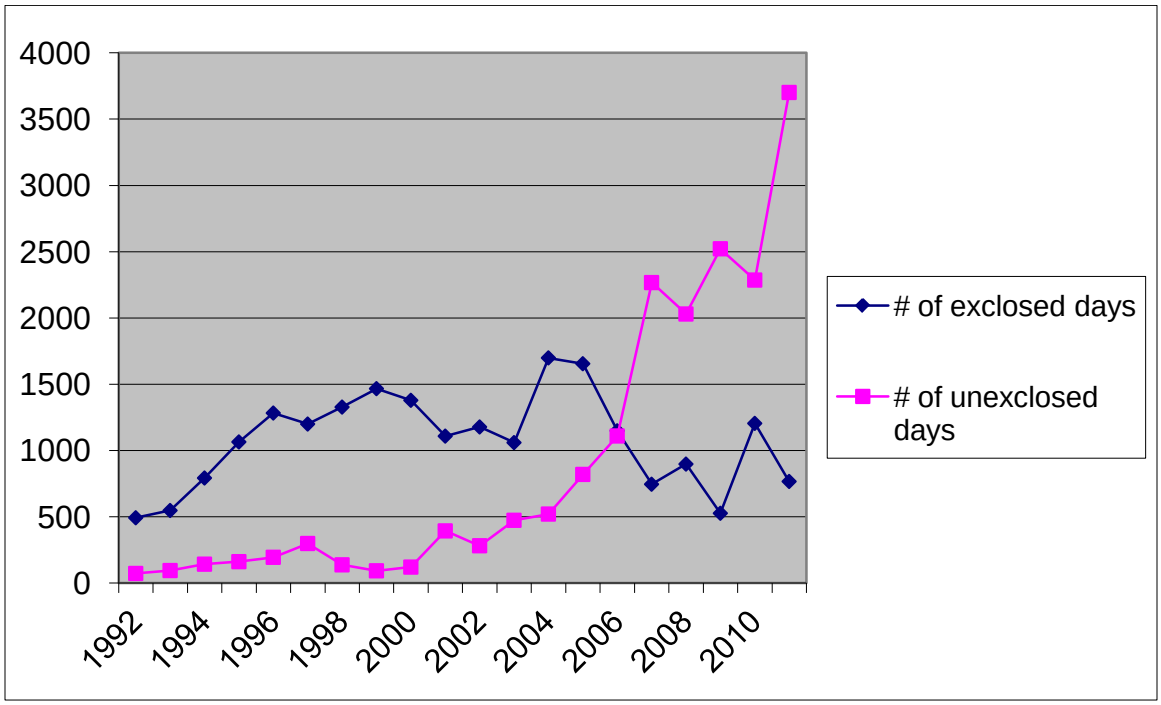


Figure 11. Mean percent nest success for Snowy Plovers along the Oregon coast, 1990-2011, with standard error bars. Number above each bar is the sample size.

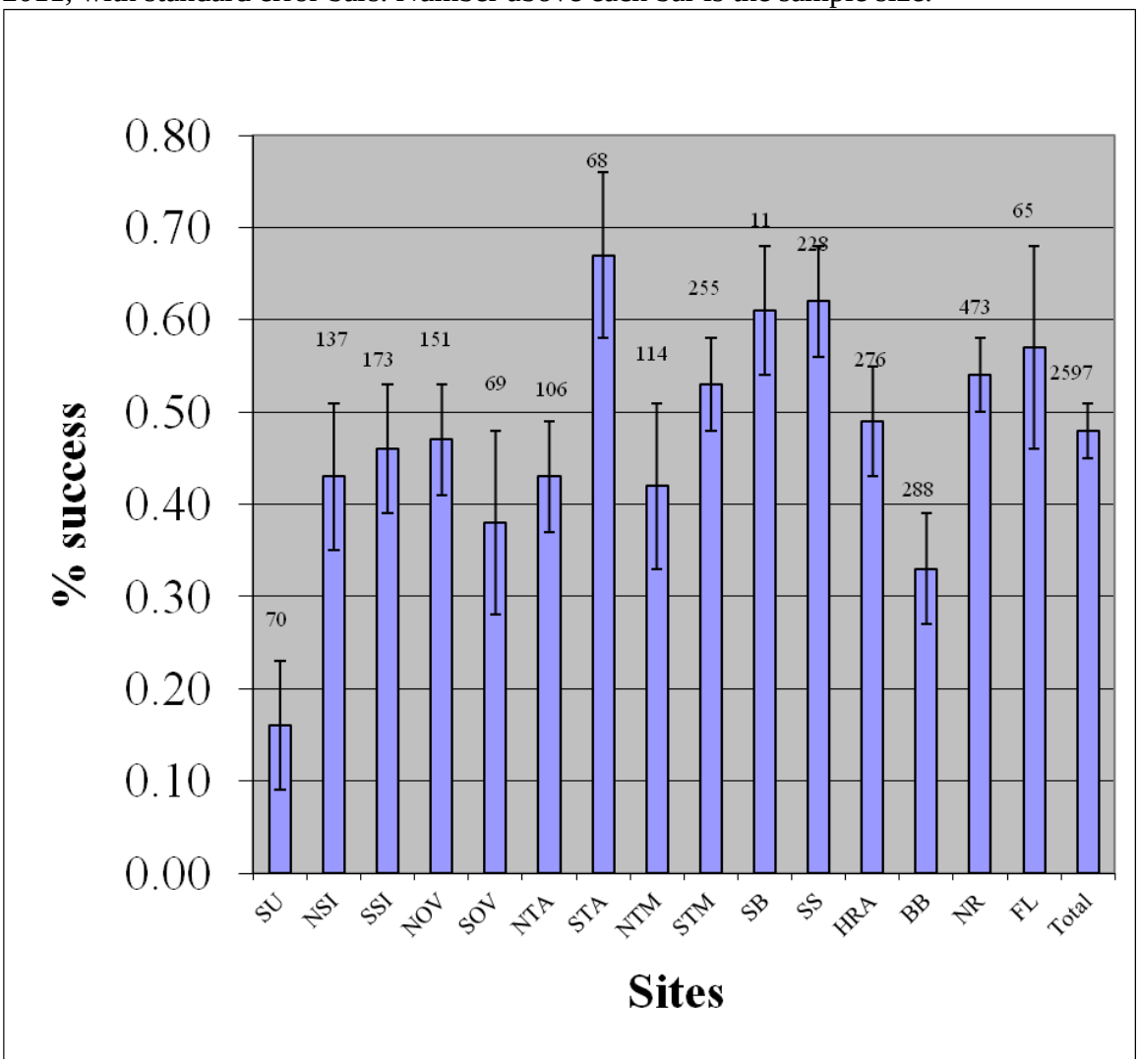


Figure 12. The mean fledging success rate of Snowy Plover along the Oregon coast before and after implementation of lethal predator management. Data pooled from Siltcoos to New River; before = 1992 – 2001, after = 2004 – 2011, 2002 and 2003 not included because some sites had predator management, and some did not. Error bars are standard error.

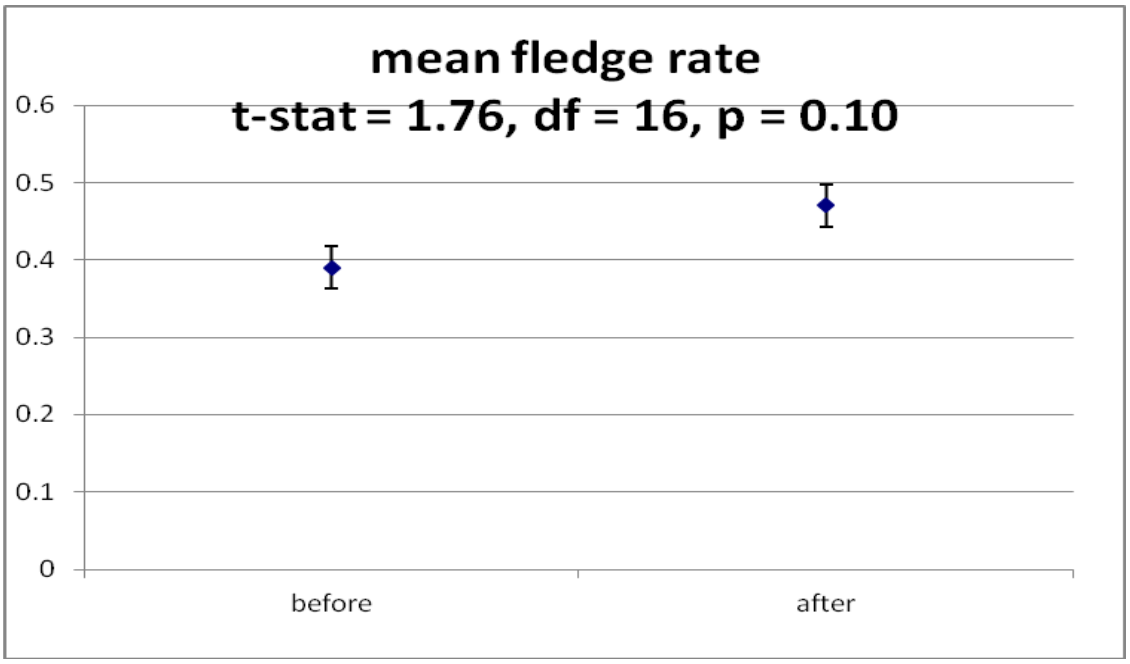
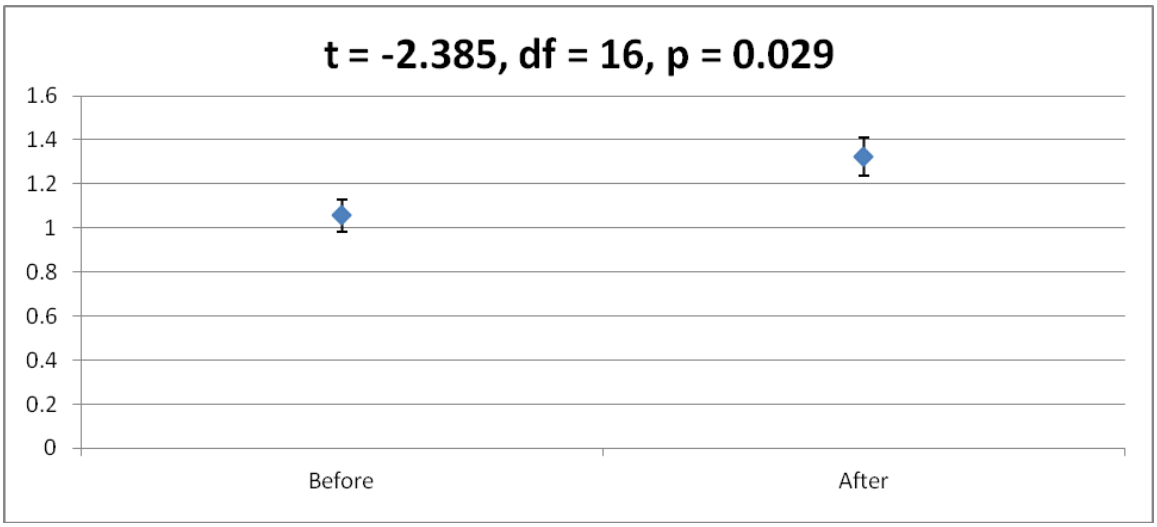


Figure 13. The mean number of fledglings per male for Snowy Plover along the Oregon coast before and after implementation of lethal predator management. Data pooled from Siltcoos to New River; before = 1992 – 2001, after = 2004 – 2011, 2002 and 2003 not included because some sites had predator management, and some did not. Error bars are standard error.



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. (Figure1). Survey effort was concentrated at the following sites, listed from north to south:

Sutton Beach, Lane Co. - The beach north of Berry Creek south to the mouth of Sutton Creek. There were no nests here in 2011.

Siltcoos: North Siltcoos, Lane Co. (Figure 2). - 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 4) - Tahkenitch North Spit - the spit and beach on the north side of Tahkenitch Creek including the beach north to Overlook trail.

Tenmile: North Tenmile, Coos and Douglas Cos. (Figure 5) - the spit and ocean beach north of Tenmile Creek, north to the Umpqua River jetty; and South Tenmile, Coos Co. - the south spit, beach, and estuary areas within the Tenmile Estuary vehicle closure, and continuing south of the closure for approximately 1/2 mile.

Coos Bay North Spit (CBNS), Coos Co. (Figure 6): 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 Beach, Coos Co. (Figure 7): the beach between China Creek and the location of the New River/Twomile Creek mouth, including the large habitat restoration area north of the mouth of Twomile Creek.

New River Spit, Coos Co. (Figure 8) - the beach and sand spit on the south side of the location of the mouth of New River/Twomile Creek, and the oceanside beach, overwashes and riverside deltas between the open spit and south to BLM lands, and the habitat restoration area (HRA) adjacent to the BLM boat launch at the Storm Ranch ACEC.

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. Recovery Unit 1 (Oregon & Washington) Draft Exclosure Use Guidelines 5/11/2010

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 have suffered high rates of nest depredation. Exclosures have been successful at increasing nest success rates
(Table 6) (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, Lauten *et al.* 2004). 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*).

Over 2000 nests have been found along the Oregon coast since 1990, and over 50% of these nests have been exclosed. Over the years we have had to adapt exclosure techniques as predators apparently became familiar them (see Castelein *et al.* 2000a, 2000b, 2001, Lauten *et al.* 2003), resulting in reduced efficacy.

In 1995 we began seeing evidence of adult depredations in or immediately outside exclosures. From 1995 to 2009 we documented 40 adult losses associated with exclosure use. These losses include 18 cases where blood, feathers, or plover body parts were found in or adjacent to exclosures and 22 cases where incubating adults disappeared from an established, exclosed nest. Forty adult losses associated with 1050 exclosed nests indicate that exclosures subject adult plovers to additional predation risk. 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 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). 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. We recommend studying exclosure use in Oregon to assess their impacts on all life stages (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 related species. Their findings are summarized below:

- Nest survival of exclosed nests was significantly higher in 10 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 2 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 4 studies (Hardy and Colwell 2008, Pauliny *et al.* 2008, Lauten *et al.* 2004, Pearson *et al.* unpublished) and higher fledging success for exclosed nests in 2 studies (Larson *et al.* 2002, Melvin *et al.* 2002). 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 6 of the 8 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 3 studies compared adult mortality between exclosed and unexclosed nests and 2 reported significant increases in adult mortality associated with exclosures (Murphy *et al.*2003 and Isacsson 2007) and 1 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 a. 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 2 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 1 day but did not influence chick condition (Isaksson *et al.* 2007).
- Egg hatchability was higher in 3 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 propose the following guidelines for exclosure use in Oregon:

- 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 Wildlife Services and ORBIC biologists time to assess causes of early nest failures, although weather conditions can make accurate assessment difficult. During this time, we recommend an owl survey be run at each site by Wildlife Services.

- 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 adult plover predators early (Pauliny *et al.* 2008). Weather permitting, exclosed nests should be checked at least twice per week.

- Adult predation associated with exclosures is often episodic. 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 adults, exclosures should not placed within sight of each other (this puts multiple adults at risk), should not be placed along the foredune, and their use should be limited on linear beaches.

- Every effort should be made to place exclosures in areas with no perch habitat.

APPENDIX C. Recommendations for Management of Recreational Activities and Habitat Restoration for sites with Snowy Plovers along the Oregon Coast - 2011.

Sutton:

- Continue to manage the nesting areas particularly at the Sutton Beach HRA; consider spreading shell hash or woody debris to improve the nesting substrate.
- Continue predator management when and if plovers are nesting to reduce predation pressure on broods, particularly corvids.
- Rope and sign around Sutton Beach HRA; rope and sign any other areas if plovers are detected using the beach.
- Place signs notifying people of current dog regulations.

Siltcoos North and South Spits:

- Continue predator management to reduce the number of corvids using the nesting area. Continue to monitor closely for evidence of feral cats in the area. Continue to monitor and possibly remove coyotes that are using and possibly denning near the nesting area.
- Continue signage along river, especially east of nesting area and on any "islands" that may develop to alert kayak/canoe users about plover management activities.
- Continue to post the area with updated maps of the estuary and beach at several locations. These areas include the Stagecoach Trailhead, the north parking lot, and both ends of the Waxmyrtle Trail.
- Erect ropes and signs on to 15 March, to be as effective as possible.
- Enforce dog closure regulations within the Siltcoos estuary during nesting season.
- Continue the use of campground plover hosts/volunteers to inform visitors of plover management, dry sand restrictions and plover biology. Use hosts/volunteers, especially during peak periods on weekends, and stagger their hours to cover evenings. Have hosts/volunteers in contact with Law Enforcement Officers to improve enforcement of the closures, and have them engage people on the beach before violations occur.
- Continue to extend appropriate signing to both riverbanks, to prevent hikers from walking up the closed estuary.
- Rope and sign along the foredune south of Waxmyrtle trail access to the Carter Lake trail area; monitor this area for roosting, nesting and brooding plovers.

Overlook:

- Continue predator management to control corvid use of the area. Monitor Northern Harrier and Great Horned Owl use of the area and consider removal if harriers and owls continue to pose problems to breeding plovers.
- Continue to rope and sign Snowy Plover nesting habitat by 15 March.
- Continue to improve and enlarge the restoration area, especially to the south towards Tahkenitch.
- Erect and maintain interpretive signing at the beginning of the Overlook trailhead (near viewing platforms). This signing is intended to provide more information on the ecology of the Snowy Plover and the reasoning for current management techniques and restricted areas.
- Enforce current dog on leash regulations.

Tahkenitch:

- Continue to maintain and improve the habitat.

- Continue predator management to control corvid use of the area. Identify if Great Horned Owls or other avian predators are hunting the area. Remove if necessary.
- Continue to rope and sign all suitable habitat. Place signs along east and south edge outside of the roped area to prevent hiking and camping within nesting area.
- Enforce current dog on leash regulations.

Tenmile North and South Spits:

- Continue predator management to control corvid use of the area; continue to monitor coyote use and possibly remove coyotes if warranted. Monitor and remove Great Horned Owls if necessary. Evaluate rodent populations and depredations.
- Create and maintain additional habitat at North Tenmile where recreational disturbance is very low and where there is adequate available habitat for improvement.
- Continue to maintain and improve the south side for nesting. Continue to rope and sign plover nesting habitat on both north and south spits.
- Enforce vehicle closure to prevent violators from driving in the habitat restoration areas.
- Enforce current dog regulations.

Coos Bay North Spit:

- Continue predator management of the area for corvids, feral cats, skunks, and raccoons; monitor the coyote population and remove coyotes if warranted; continue early season rodent trapping to reduce rodent population.
- Continue to improve and maintain the habitat restoration areas. Continue to spread shell hash to improve nesting substrate.
- Maintain gaps in the berm along the 95HRA to facilitate brood movement from the 94HRA and 98WHRA to the 95HRA and to the beach. Maintain small vegetation free gaps in the foredune to facilitate brood access to the beach without destabilizing the foredune.
- Continue to rope and sign the beach as early in the nesting season as possible; avoid erecting signs where the ocean is repeatedly lapping against the foredune to reduce sign loss.
- Clearly sign all entrance points on the spit that the beach is street legal vehicles only.
- Continue closure of the foredune road through the nesting area. Consider a permanent reroute of the foredune road.
- Enforce current dog regulations.

Bandon:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area north of New River/Twomile Creek. Maintain and improve “cutouts” along the foredune to increase available nesting habitat for plovers; consider additional cutouts along foredune.
- Sign and rope the entire beach from China Creek overwash to the habitat management area near to the mouth of Twomile Creek/New River before the nesting season.
- Enforce current dog regulations. Monitor hiker use from Bandon to Blacklock Point, and check the beach and HRA on weekends for illegal camping activity. Consider beginning a permit system to limit the number of hikers and campers, educate hikers about the plovers before they get on the beach, and ensure that they are in compliance with restrictions surrounding dogs and camping.
- Continue monitoring by staff and volunteers to improve plover success and reduce disturbance issues

- Consider a gate to close the China Creek parking lot at night to help reduce violations (Lauten *et al*. 2009 and 2010).

New River:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area. Grassy dunes are currently growing and expanding. Maintenance of this area before the habitat further degrades would be more cost effective.
- Sign the foredune north of the HRA along the foredune.
- Place interpretive signs near the Lower Fourmile access along the river to inform the public of plover activity.
- Sign State Parks lands on the open spit south of the mouth of New River.
- Enforce current dog regulations.
- Use interpretive specialist to help monitor recreational activities in the area and explain the management efforts in the area.
- Continue to close the gate at the Storm Ranch for 15 April- 15 September.

Floras Lake:

- Monitor the site for any plover activity.
- Enforce dogs on leash rules at all times.
- Continue to hire an on-site interpretive specialist, to contact the public, monitor the beach, and present slide shows.