The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2013

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North Bend, Oregon 97459

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Corvallis OR, 97333

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2127 SE OSU Drive
Newport, Oregon 97365
Recovery Permit TE-839094-5

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Abstract

From 26 March – 19 September 2013 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 and South Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Snowy Plover Management Area, New River HRA and adjacent lands, and Floras Lake. Our objectives for the Oregon coastal population in 2013 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) determine nest success, 4) use mini-exclosures (MEs) to protect nests from predators as needed, 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 304 adult Snowy Plovers; a minimum of 190-191 individuals was known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990. We monitored 381 nests in 2013; the highest number of nests since monitoring began in 1990. Overall apparent nest success was 24%. Exclosed nests (n = 18) had an 83% apparent nest success rate, and unexclosed nests (n = 362) had a 21% apparent nest success rate. Nest failures were attributed to unknown depredation, unknown cause, avian depredation, corvid depredation, one-egg nests, wind/weather, abandonment, mammalian depredation, overwashed, infertility, and adult plover depredation. We monitored 101 broods, including eight from unknown nests, and documented a minimum of 103 fledglings. Overall brood success was 71%, fledging success was 39%, and 1.04 fledglings per male were produced.

Continued predator management, habitat improvement and maintenance, and management of recreational activities at all sites are recommended to maintain 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).

Oregon Biodiversity Information Center (ORBIC, formerly Oregon Natural Heritage Information Center) completed our 24th year of monitoring the distribution, abundance, and productivity of Snowy Plovers along the Oregon coast during the breeding season. In cooperation with federal and state agencies, plover management has focused on habitat restoration and maintenance at breeding sites, non-lethal and lethal predator management, and management of human related disturbances to nesting plovers. The goal of management is improved annual productivity leading to increases in Oregon's breeding population 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, 2010, 2011, and 2012). Our objectives for the Oregon coastal population in 2013 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) determine nest success, 4) use mini-exclosures (MEs) to protect nests from predators as needed, 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 and South Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Snowy Plover Management Area (SPMA), New River (extending from private land south of Bandon SPMA to the south end of the New River Area of Critical Environmental Concern (ACEC) habitat restoration area), and Floras Lake (Figure 1). A description of each site occurs in Appendix A. For the purposes of this report and for consistency with previous years' data, we define Bandon Beach as the area from China Creek to the mouth of New River, and Bandon SPMA as all the state land from the north end of the China Creek parking lot south to the south boundary of the State Natural Area south of the mouth of New River.

Methods

Abundance

Pre-breeding surveys have been implemented since 2001 to locate any plovers attempting to nest at historic (currently inactive) nesting areas. In 2013, pre-breeding window surveys at historical nesting sites between Clatsop Spit, Clatsop Co. and Pistol River, Curry Co (Elliott-Smith and Haig 2007) were not conducted due to budget restraints. Agency personnel assisted surveying plovers during breeding

season window surveys in late May. Breeding season window surveys were implemented at both currently active and historic nesting areas (Elliott-Smith and Haig 2007). 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, and Euchre Creek. Pistol River was not surveyed in 2013.

Monitoring

Breeding season fieldwork was conducted from 26 March to 19 September 2013. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found in Castelein *et al.* 2000a, 2000b, 2001, 2002, and Lauten *et al.* 2003 and are in Appendix D. No modifications to survey techniques were implemented in 2013.

We report three measures of population size: the total number of Snowy Plovers present, the total number identified breeding, and the total number of plovers resident during the breeding season. We estimated the number of Snowy Plovers on the Oregon coast during the 2013 breeding season by determining the number of uniquely color-banded adult Snowy Plovers observed, and added an estimate of the number of unbanded Snowy Plovers present. We used the 10 day interval method described in Castelein *et al*. 2001 to estimate a minimum number of unbanded plovers, however, based on nesting records and daily observational data this method likely underestimates the actual number of unbanded plovers present. We estimated the breeding population by tallying the number of known 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, whether or not they were 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 to the end of the 2013 breeding season. Data from nesting sites with a north and south component (Siltcoos, Overlook, Tahkenitch, and Tenmile) were pooled because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were pooled for the same reason. We separated data from Bandon SPMA, New River HRA, and Floras Lake because of different management at these sites, despite plovers frequently moving between these areas. The total number of individual plovers recorded at each site indicates the overall use of the site, particularly where plovers congregate during post breeding and wintering. We also determined the number of individual breeding female and male plovers for each site. The number of individual breeding adults indicates the 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.

Male Snowy Plovers typically rear their broods until fledging. In order to track the broods we banded most nesting adult males, females that tended to broods, and most hatch-year birds with both a USFWS aluminum band and a combination of colored plastic bands. Trapping techniques are described

in Lauten *et al.* 2005 and 2006 (Appendix D). 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 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 years 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 eggs the plovers laid divided by the number of fledglings produced. If plovers produced high numbers of fledglings compared to eggs laid, then their productivity and the resulting index was high for the amount of effort (eggs laid). If plovers produced low numbers of fledglings relative to high numbers of eggs laid, then their productivity and the resulting index was low. Data for brood success, fledging success, and fledglings per male were all normally distributed. 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 (2004-2013). 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.

Exclosures

From mid-May to August, we used a limited number of mini-exclosures (MEs, Lauten *et al.* 2003) to protect plover nests at South Siltcoos, North Overlook, North Tenmile, Bandon SPMA and New River as outlined in our exclosure use protocol (Appendix C). No exclosures were used on plover nests found during April and into early May due to concerns related to raptor migration (Castelein *et al.* 2001, 2002, Lauten *et al.* 2003). Exclosure use was limited in 2013 because presence of avian predators (Northern Harriers (*Circus cyaneus*) and Great Horned Owls (*Bubo virginianus*)) resulted in concerns about depredations of adult plovers in and around ME's. No exclosures were used at North Siltcoos, South Overlook, North and South Tahkenitch, South Tenmile, and Coos Bay North Spit.

Predator Management

Lethal predator management occurred at all active nesting areas; corvids (*Corvus sp*.) were targeted at all nesting sites. Mammal trapping targeting red fox (*Vulpes vulpes*) and striped skunks (*Mephitis mephitis*) occurred at Bandon SPMA and New River (Burrell 2013). In 2011 and 2012 a trapping effort targeting deer mice (*Peromyscus maniculatus*) was conducted at CBNS (Lauten *et al*., 2011 and 2012). In 2013 there was a less extensive effort to trap deer mice on a portion of the habitat restoration area (HRA) by several students from Southwest Oregon Community College. Rodent trapping was limited to March, before the plovers were nesting (Burrell 2013).

Results and Discussion

Abundance and Monitoring

Window Surveys

During the May breeding window surveys, no plovers were detected outside of the current known nesting areas (USFWS unpublished data). The annual breeding window survey in late May counted 215 plovers (Table 1), the highest number of plovers ever detected.

Breeding Season Monitoring

During the 2013 breeding season, we estimated 304 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 304 plovers, 281 (92%) were banded. The number of unbanded plovers estimated by the 10 day interval method was 23 individuals. For the breeding season we observed 126 banded females, 155 banded males, 14 unbanded females, and 9 unbanded males. The totals include nine banded males and six banded females, all resident or breeding individuals, which disappeared during the breeding season.

Of the total estimated population, 190-191 plovers (63%) were documented nesting (Table 1), below the mean percentage for 1993-2012 (79%). A minimum of 83 banded females and 84 banded males nested. Approximately 14-15 unbanded females nested and nine unbanded males were known to have nested. An additional 42 banded females and 67 banded males were present during the breeding season but were not confirmed nesting. The estimated Oregon resident plover population was 299-300.

The total number of plovers present and the window survey totals were the highest numbers since monitoring began in 1990 (Table 1), though the rate of population increase was smaller than in the recent past. The number of plovers detected breeding declined by approximately 43 individuals (Table 1) due to difficulties positively identifying all nesting individuals. In 2013, many nests failed early in the incubation period, resulting in an inability to positively identify the associated adults. The actual number of breeding individuals was certainly higher as nearly all adults that are resident birds attempt to nest (ORBIC, personal obs.). The number of resident plovers in 2013 was higher than in 2012 (n = 271-278). The number of resident plovers is likely a better index of the estimated number of plovers breeding along the Oregon coast. In 2013, the Oregon coastal plover population was above the recovery goal set for the state (U.S. Fish and Wildlife Service 2007).

Overwinter Survival

As has been noted in the past, adult overwinter survival has an important effect on population size (Sandercock 2003, USFWS 2007, Dinsmore *et al*. 2010, Lauten *et al*. 2010, 2011, and 2012). Of the 273 banded plovers recorded in 2012 (corrected from 270 in Lauten *et al.* 2012), 96 (40%) were not recorded in 2013 and we received no reports of these individuals being sighted elsewhere in the range. The overwinter return rate based on returning banded adult plovers was 65%, equal to the 1994-2013 mean of 64.8% but below the previous four years (2009 = 72%, 2010 = 78%, 2011 = 75%, and 2012 = 72%; Lauten *et al*., 2009, 2010, 2011, and 2012).

Based on returns of chicks banded in 2012, we adjusted the 2012 fledgling total to 172 from 180. Ninety-one of the 180 hatch-year plovers from 2012 (HY12) returned to Oregon in 2013. The return rate

was 51%, slightly above the average return rate (Table 2, 47%). Of the returning HY12 birds, 40 (44%) were females and 51 (56%) were males. Fifty-one of the HY12 returning plovers were confirmed breeding (56%), and they accounted for 31% of the banded breeding adults. The relatively low rate of confirmed breeding by HY12 plovers was likely due to nests failing early in the incubation period, before monitors could identify nesting adults, and not due to HY12 plovers not attempting to nest. The number of HY12 returns was slightly less than the number of banded adults that did not return in 2013. The average return rates for both adults and hatch year birds contributed to maintaining the plover population, but because the return rates were not above average, the overall plover population did not substantially increase from 2012 (Table 1).

During the 2013 season, we captured and rebanded 18 banded adult plovers with brood band combinations that needed to be updated to unique adult combinations. Thirteen were males and five were females. We banded two unbanded adult male plovers, one unbanded adult female plover and 196 chicks.

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 2013. Sites with high levels of nest loss early in the incubation period resulted in lower numbers of documented breeding plovers. Positive identification of nesting adults increases with nest age because monitors have multiple opportunities to identify nesting adults and because both adults are often present when nests hatch. Five plovers were recorded at Sutton Beach in 2013; there were no plovers recorded at Sutton Beach in 2012. The number of plovers at Siltcoos increased from 67 in 2012 to 91 in 2013. The number of breeding plovers at Siltcoos was similar to previous years (Table 3, 27 in 2012, 26 in 2011, 23 in 2010, and 24 in 2009). Fewer plovers were recorded at Overlook in 2013 compared to 2012 (83 in 2013 compared to 94 in 2012), however the number of breeding adults documented was considerably less (16 in 2013 compared to 51-53 in 2012). More plovers were recorded at Tahkenitch in 2013 (n = 82) compared to 2012 (n = 67-68), however the number of breeding plovers was lower (22 in 2013 compared to 31-32 in 2012). The number of plovers recorded at Tenmile in 2013 increased compared to 2012 (72 in 2013 compared to 58-59 in 2012) and the number of breeding plovers also increased (34-35 in 2013 compared to 20-21). The increase in the number of breeding plovers was related to improved nest success at this site. The number of plovers recorded at CBNS in 2013 was the same as 2012 (n = 92), however the number of breeding plovers declined from 77-78 in 2012 to 52 in 2013. The number of plovers using Bandon SPMA in 2013 slightly increased compared to 2012 (76 in 2013 compared to 68-69 in 2012) and the number of breeding plovers increased (46 in 2013 compared to 29 in 2012). The increase in the number of breeding plovers is partially attributed to higher nest success in 2013 compared to 2012. The number of plovers recorded at New River HRA in 2013 was the same as in 2012 (n = 24). The number of breeding plovers increased from 14 in 2012 to 22 in 2013; the increase in breeding adults was attributed to much higher nest success in 2013 compared to 2012. Only one plover was recorded at Floras Lake in 2013.

We have noted in previous reports that the increased plover population has resulted in plovers occupying available habitat adjacent to the traditional nesting areas (Lauten *et al*. 2010, 2011, and 2012). Lauten *et al*. (2011 and 2012) noted the possibility that the increasing plover population would likely result in plovers occupying additional beaches, such as South Tahkenitch to the Umpqua jetty, the beach north of North Tenmile, and CBNS beach north of the FAA tower. As in 2011 and 2012, plovers did nest north of the North Tenmile spit (Figure 5). At CBNS in 2012, we found one nest north of the FAA towers; in 2013 we found nine nests north of the FAA towers (Figure 6). In 2013 six nests and one brood from an undiscovered nest were found at South Tahkenitch south of Threemile Creek. Plovers and nest scrapes were observed on the beach south of South Tenmile and north of Horsefall Beach, but no nests were

found. The plover population size did not increase substantially between 2012 and 2013 (Table 1). The increased nesting attempts north of the FAA tower and at South Tahkenitch were mostly due to high nest failure rates; when plovers repeatedly fail they will often move to new locations to renest. Due to plovers' propensity to nest in subsequent years where they have successfully hatched, and due to the increasing population size, we expect the plovers to continue to occupy and nest on the sections of beach adjacent and between the main nesting sites.

Nest Activity

We located 381 nests during the 2013 nesting season (Table 4, Figures 2-9), the highest number of nests found since monitoring began in 1990. In addition we recorded eight broods from nests that we did not locate prior to hatching. The increase in the number of nests from 2012 was mostly due to nest failures and therefore repeated renesting attempts. Sutton had one nest attempt in 2013, the first nest since 2010. Siltcoos had 11 more nests in 2013 compared to 2012; eight were on the south side (Table 4). Overlook had a similar number of nests in 2013 compared to 2012. Tahkenitch had a large increase in nest numbers in 2013 compared to 2012. There were 16 more nest attempts on the north side of the creek, and for the first time since 2003, plovers were confirmed nesting on the south side of the creek. The number of plovers and thus the number of nests at Tahkenitch has increased substantially since 2010. At Tenmile, the north side had a similar number of nests compared to 2012, while the south side had a decrease in the number of nests compared to 2012; in addition four of the broods from undiscovered nests were at North Tenmile. CBNS had the largest increase in the number of nests; 45 more nests were found in 2013 compared to 2012. The large number of nests found at CBNS was due to poor nest success and resulting repeated nesting attempts. South Spoil had similar numbers of nests in 2013 compared to 2012, while the HRAs had an increase of 19 nests. South Beach also had a large increase in nest attempts (29 more nest attempts in 2013 compared to 2012). . Nine nests were found along the open section of beach north of the FAA towers after repeated failed nest attempts either on the nesting area or further south on the beach. Bandon SPMA had a similar number of nests in 2013 compared to 2012. There were 44 nests on Bandon Beach and 20 nests on the state portion of New River spit. The number of nests at New River HRA declined; there were nine nests attempts in 2013 compared to 17 in 2012 and two broods from undiscovered nests were on the New River HRA. The lower number of nests on the New River HRA was due to increased nest success, as the number of plovers using the New River HRA remained stable. There were three nests found on private lands along New River, all north of the HRA. Floras Lake had no nesting activity in 2013.

The first nests were initiated about 26 March (Figure 11). Nest initiation increased through early May at which time there was a steep decline in nest activity due to nest failure. Plovers initiated renest attempts in late May into early June, with peak nest activity (n = 109) occurring during the 10 June – 19 June time interval. This was the highest number of active nests during any 10 day time interval since monitoring began in 1990. The last nest initiation occurred on 20 July.

Nest Success and Exclosures

The number of days nests were unexclosed was higher than the number of days nests were exclosed (Figure 12). In 2013, exclosures were used on 5% (n = 19) of the total number of nests (n = 381), and 6% of the total number of exposure days were exclosed (n = 253/4548).

The overall annual apparent nest success rate in 2013 was 24% (Table 5), the lowest rate since monitoring began in 1990 (Table 6). Nineteen nests were exclosed in 2013 (5%), the fewest since 1991. Apparent nest success for exclosed nests in 2013 was 83%, higher than the average for all years (x = 71%,

Table 6). The number of unexclosed nests in 2013 (n = 362, 95%) was the highest since monitoring began. Apparent nest success for unexclosed nests in 2012 was 21%, near the overall mean (x = 20%, Table 6). Nest success of unexclosed nests in 2013 was significantly lower than nest success of exclosed nests ($\chi^2 = 32.6931$, df = 1, $P < 0.01$).

Sutton

There was only one nest at Sutton Beach in 2013 early in the season (Table 5). Two eggs were laid but incubation was not confirmed before it failed quickly due to unknown cause (Table 7). There was no other plover activity at Sutton after April.

Siltcoos

No exclosures were used at North Siltcoos in 2013 (Table 5); three of 13 nests successfully hatched (23%). Two exclosures were used at South Siltcoos, and three of 28 unexclosed nests successfully hatched (12%). Overall nest success for Siltcoos was 19% (Table 5), well below the average for these sites (Figure 13). The main cause of nest failure at Siltcoos was unknown cause and unknown depredation (Table 7). Corvid activity at Siltcoos was considered moderate with crows being more prevalent at North Siltcoos and ravens present early and late in the season. One nest was depredated by a Northern Harrier based on tracks at the nest site, and harrier activity was regularly noted. Due to raptor activity and concerns about adult plovers in and around exclosures, we limited the use of exclosures at Siltcoos.

Overlook

The overall nest success at Overlook in 2013 was 5% (Table 5). Three of 33 nests hatched at North Overlook (9%) and no nests were successful at South Overlook (Table 5), both well below average for these sites (Figure 13). Only one nest was exclosed at Overlook, on the north side, and it failed after the adult male associated with the nest disappeared. We found raptor tracks around the exclosure, which we believe were Northern Harrier, leading us to conclude the male was depredated. One nest at South Overlook failed with evidence of Northern Harrier at the nest site, and another nest at South Overlook also had evidence of an avian predator but we were uncertain if it was harrier or corvid. Seven total nests failed due to corvids and 36 other nests failed to unknown depredation (Table 7). Six other nests failed due to unknown cause. Six of the seven corvid depredated nests occurred prior to 15 May, before implementation of exclosure use. After 15 May corvid activity was not considered high, but harrier activity was consistently observed. Due to the evidence that harriers were regularly hunting the nesting area, we did not erect exclosures.

Tahkenitch

Plover activity continued to increase at Tahkenitch since 2009 (Table 4). There was an increase in the number of nests at North Tahkenitch, but this was due to poor nest success. Only six of 52 nests hatched at North Tahkenitch (12%, Table 5), much lower than the average for this site (Figure 13). Due to nest failures, plovers moved south of the creek and for the first time since 2003 nests were found at South Tahkenitch. Six nests and one brood from an undiscovered nest were found at South Tahkenitch; only one of the nests hatched (17%). The main cause of nest failure at North Tahkenitch was unknown cause and unknown depredation (Table 7). Five nests failed to avian depredation, including three that had evidence of Northern Harrier (at one nest a harrier was filmed depredating the nest). We did not document any corvid depredations at North Tahkenitch. Northern Harrier activity was noted at North Tahkenitch throughout the season. Due to the harrier activity, we did not erect exclosures. In July, we received reports that plovers were nesting along the South Tahkenitch creek area, as far south as Three Mile Creek. A brood was discovered already hatched well south of the Threemile Creek area, and six more nests were found, including one as far south as the south end of Threemile Lake. Raven activity was

high in the area (partly due to a large sea lion carcass); two of the nests were found already depredated by ravens and three others failed the day after discovery.

Tenmile

For four of the past five years Tenmile has had relatively poor nest and hatch success (Table 15). In 2013, Tenmile had an overall nest success rate of 42%, much higher than in 2012 (13%). Nine of 19 nests successfully hatched at North Tenmile (47%), above the average for this site (Figure 13). Six of 17 nests hatched at South Tenmile (35%), much higher than in 2012 (7%) but below the average for this site (Figure 13). The main causes of nest failure at Tenmile were unknown cause, corvid depredation, and unknown depredation (Table 7). We used only two exclosures at North Tenmile. Exclosure use was minimized due to previous issues with Great Horned Owls at Tenmile targeting plovers around exclosures (Lauten *et al*. 2011). In 2013 Great Horned Owl tracks were noted throughout the season, most often on at South Tenmile. Successful removal of ravens at Tenmile in 2013 contributed to the improved nest success (Burrell 2013). Fewer corvids reduces the need for exclosures, and thus reduces the threat of adults being depredated near exclosures.

Coos Bay North Spit

At CBNS in 2013 overall nest success was 27% (Table 5). Nest success on the HRAs was 17% and on South Spoil was 33%, both well below average (Figure 13). Nest success was better on South Beach (42%), but still below average (Figure 13). Of the nine nests north of the FAA towers, only one hatched. Many renest attempts due to low nest success contributed the high number of nests. The main cause of nest failure was unknown depredation (Table 7), however 15 nests were confirmed depredated by Northern Harrier (either video evidence or tracks at the nest site). This is the first year we have confirmed harrier depredations of nests. We suspect that most if not all of the unknown depredations at CBNS were caused by harriers because corvid activity was very low to non-existent all summer. We did not erect any exclosures because we were concerned that the harriers would target and depredate adult plovers. Seven adults disappeared from CBNS this summer, however we cannot be certain these were harrier depredations .Wildlife Services removed two harriers from CBNS, but it was towards the end of the nesting season (Burrell 2013). We hope the removal of these harriers will result in future benefits and better nest success in the coming year.

Bandon SPMA

Nest success at Bandon SPMA in 2013 was 33%, much higher than in 2012 (14%) but below the average for this site (Figure 13). Only seven nests of 44 hatched (16%) on the north side of New River (from north of China Creek south to the mouth of New River); 15 of 20 nests hatched on the south side of the New River mouth (75%). Eight total exclosures were erected; four on the north side and four on the south side. Of the four nests that were exclosed on the north side, three successfully hatched, however, a male associated with one of the exclosed nests and one of the chicks disappeared upon hatching. The female successfully raised one of the two remaining chicks. We suspect the male and first chick were depredated near the exclosure when the nest hatched. The fourth exclosed nest was found with one hatched chick and two hatching eggs, but the adults disappeared at hatching and we suspect they were depredated. We collected the hatched chick and two eggs, which were then transported to the Oregon Coast Aquarium (OCA) in Newport, where the eggs were hatched and the three chicks raised to fledge age. They were later released at the New River spit. We did not include this nest in our calculations of nest success in Table 5 since the nest only partially hatched in the field. The cause of the depredations was not known, however we repeatedly noted Great Horned Owl tracks at Bandon SPMA all summer, and we noted both Northern Harriers and Peregrine Falcons hunting the SPMA. Three of the four exclosed nests on the south side hatched; the nest that did not hatch was infertile. The main cause of nest failure was unknown cause and unknown depredation (Table 7). Corvid activity at Bandon SPMA in 2013 was

relatively low; however at least three nests were depredated by corvids (all on the north side). In late April, at a time when corvid activity was low and plover nests had been relatively successful, Wildlife Services found a dog running unattended on the nesting area north of the New River mouth. Within days, we found eight of 11 the nests failed, with several eggs removed from the nest bowl but not eaten, and missing eggs at other nests. Poor weather conditions prevented us from determining a cause of these failures, but we suspect the lost dog may have been responsible. We have rarely noted predators leaving or removing eggs from nests without depredating them.. Due to concerns about raptors, and a lack of corvid activity, we minimized the use of exclosures in 2013.

New River

Overall nest success on non-state lands at New River in 2013 was very good with two of three nests successfully hatching on private lands (67%) and seven of nine nests successfully hatching on the BLM HRA (78%, Table 5), above the average for this site (Figure 13). One nest was exclosed on private land and five nests were exclosed on the HRA; five of these six nests hatched (83%). Four of six unexclosed nests also hatched (67%). Three nests failed, one to infertility and two to unknown depredation (Table 7). We did not document any adult mortalities around exclosed nests at New River in 2013. Corvid activity, particularly ravens, was fairly consistent until mid to late season when activity was minimal.

Nest Failure

Exclosed nests in 2013 had an overall failure rate of 17% (3 of 18, Table 8; one nest from Bandon SPMA is not included because the hatched chick and two unhatched eggs were transported to the OCA when adults disappeared at hatching and were presumed depredated). Of the three failed exclosed nests, two failed to infertility and one had an adult plover depredated and was subsequently abandoned (Table 8). The number of unexclosed nests that failed in 2013 (n = 285) was higher than any previous year. The failure rate of unexclosed nests in 2013 (79%) was higher than in 2012 (58%) and 2011 (54%) but similar to 2008 – 2010 (73%, 73%, and 77% respectively). In 2013, the main causes of nest failure for unexclosed nests were unknown depredation, unknown cause, avian depredation, and corvid depredation (Tables 8). Additional causes of nest failure included one-egg nests, wind/weather, abandonment, mammalian depredation, overwashed, infertility, and adult plover depredation (Table 7).

Predator Management

There was a limited effort to trap rodents at CBNS in 2013; 26 deer mice were captured during March (Burrell 2013). It remains unclear whether the rodent trapping has had any real effect on nest success. In the previous two years over 200 rodents were trapped at CBNS (Burrell 2011 and 2012). During these years nest success at CBNS was high (82% in 2011 and 87% 2012; Lauten *et al*., 2011 and 2012). In 2013, despite the limited trapping effort, only two nests on the CBNS HRA had evidence that rodents caused the nest failures (Table 7). Continuing rodent trapping and removal in the future would at a minimum help us gauge and understand rodent population levels and cycles at CBNS.

In the past, corvid depredations have been the main cause of known nest depredations (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, 2008, 2009, 2010, 2011, and 2012). In 2013, the main known causes of nest failure were avian depredation and corvid depredation (Table 7). Corvids continue to be the most serious threat to plover nests, however in 2013 for the first time we identified Northern Harriers depredating nests. We identified 20 nests that had either harrier prints at the nest site or harriers were captured on remote cameras

depredating nests (Table 7). Known harrier depredations occurred at CBNS and from South Siltcoos to North Tahkenitch. At CBNS 15 nests had positive evidence of harrier depredations (either tracks or pictures from cameras), and because corvids were not present at CBNS during this time, suspect that the majority of nests that failed to unknown depredation (n = 38) were likely from harrier. On Forest Service land, one nest at South Siltcoos, two nests at South Overlook, and five nests at North Tahkenitch had positive evidence of harrier depredation. We suspect that some of the unknown depredations particularly at Overlook and North Tahkenitch were caused by harriers. It is possible, despite the distance between South Siltcoos and North Tahkenitch, that the same individual harrier was causing these nest failures. Harriers have been identified depredating plover nests in the Monterey Bay area both in the past and in 2013 (G. Page, pers. comm.) as well as at the San Francisco Bay National Wildlife Refuge (Demers and Robinson-Nilsen 2012). Many depredations attributed to harriers at both CBNS and Forest Service occurred shortly after initiation, indicating that the harriers were very efficient at finding and depredating nests. Burrell (2013) documents Wildlife Services' response and efforts to capture and remove the harriers, particularly from CBNS and North Tahkenitch. At CBNS a female harrier was photographed depredating four plover nests; this female was targeted and removed. Another harrier, a juvenile, was also eventually removed from CBNS. No harriers were removed from Forest Service lands. We are hopeful that the removal of the individual suspected to be causing nest depredations at CBNS will result in improved nest success next season. On Forest Service lands we suspect the harriers will continue to depredate nests. We are also concerned that higher nest densities of plovers on the nesting areas may result in continued attraction of harriers and other potential nest and plover predators (such as Great Horned Owl).

Predator management continues to have a positive effect on reducing corvid numbers at all sites and removing non-native red fox from the Bandon SPMA and New River area. Corvids are an annual problem at all sites. In 2013, Wildlife Services was funded to support three agents, allowing them to more completely cover the occupied nesting sites and provide more effective predator management. We believe this had a positive effect on the plover reproductive success. See Burrell (2013) for a complete discussion of the predator management program.

Fledging Success and Productivity

There were a total of 101 broods in 2013 (Table 11), however two broods were not included in productivity data because both broods were transported to the OCA and later release at fledge age. We monitored 99 broods in the field including 8 broods from undiscovered nests, substantially fewer than in 2012 (n = 154 broods, Lauten *et al*. 2012). We confirmed a minimum of 98 fledglings from the 99 broods (Table 11), and a total of 103 fledglings including the five chicks raised at the OCA (Table 9). Overall fledging success was 39%, near the overall average (Table 10). The overall brood success rate was 71% (Table 11), slightly higher than the average (67% +/- 10). The overall number of fledglings per male was 1.04 (Table 11). Considering data from known nests from Siltcoos to New River only (Tables 12-18), the mean fledglings per male was 0.926, below the average (Table 10). We caution that due to many nests failures, and due to the relatively short time many nests were active before failing, we undoubtedly failed to identify all the males that attempted to nest in 2013. As noted above, the documented number of breeding individuals was much lower than the number of resident individuals, indicating that the true number of breeding individuals was higher than the number we positively identified breeding. The failure to identify all known breeding males biases the number of fledglings per male; we believe that the number of fledglings per male is high and would likely be lower if all males who attempted to nest were successfully identified.

Siltcoos

There were nine broods at Siltcoos in 2013 (Table 11), half the number of broods as in 2012 (Lauten *et al*. 2012); 44% of the broods were successful compared to 61% in 2012. More eggs were laid in 2013 compared to 2012 (Table 12), however the hatch rate was considerably lower than in 2012 and well below the post predator management average. Only four chicks fledged from known nests in 2013, resulting in the lowest fledge rate at Siltcoos since 2002, well below the post predator management average. Due to the high number of eggs laid and the low number of fledglings produced, the productivity index for Siltcoos in 2013 was extremely low, indicating poor productivity for this site. The number of fledglings per male was well below 1.00 and well below the post predator management average for this site (Table 11 and 12).

Overlook

The number of eggs laid at Overlook in 2013 was similar to the previous two years (Table 13), however only nine eggs hatched resulting in the lowest hatch rate ever and well below the post predator management average. There were only three broods at Overlook (Table 11) substantially fewer than the previous two years (n = 31 broods in 2012, n = 33 broods in 2011). Two of the broods were successful and they fledged three chicks (Table 11 and 13). The fledging success rate was well below the post predator management average (Table 13). Due to the high number of eggs laid but few fledglings produced, the productivity index was extremely low, indicating poor productivity for this site. The number of fledglings per male was well below 1.00 and below the post predator management average for this site (Table 11 and 13).

Tahkenitch

The number of eggs laid at Tahkenitch was the highest number since monitoring began at this site in 1993 (Table 12), however only 14 eggs hatched resulting in a very low hatch rate well below the post predator management average. Of the nests that hatched, broods were very successful (Table 11) and the fledgling success rate was well above the post predator management average for this site (Table 14). However, the number of fledglings was considerably less than the previous two years (Table 14), and due to the high number of eggs laid, the productivity index was very low, indicating that there was much effort at this site (as measured by the number of eggs laid) but poor productivity (as measured by the total number of fledglings produced). The number of fledglings per male was higher than the post predator management average (Table 14), however this is based on only identifying five males from known nests. Due to the high number of nests at Tahkenitch (Table 4), there were undoubtedly many more males who attempted to nest at Tahkenitch but were not positively identified.

Tenmile

Productivity at Tenmile improved by all measures in 2013 and was substantially better than the previous two years (Table 15). The number of eggs laid was slightly less than the previous four years, however the hatch rate was much higher than the previous two years and was near the post predator management average (Table 15). There were 19 total broods, 13 more than in 2012, and brood success was high (Table 11). Twenty-three total fledglings were produced including 19 from known nests, the highest number of fledglings produced at Tenmile since 2007. The fledging success rate was 51%, above the post predator management average (Table 15). The productivity index was 20%, higher than the previous five years and above the post predator management average (Table 15). The number of fledglings per male was above the post predator management average (Table 15).

Coos Bay North Spit

Due to high nest failure rates (Table 5), the number of eggs laid at CBNS in 2013 was the highest ever for any year or any individual site (Table 16). The hatch rate was considerably lower than the

previous two years, similar to 2010 when the lowest rate ever was recorded for this site, and well below the post predator management average (Table 16). There were 29 total broods at CBNS in 2013, nearly half the number recorded in 2012 (n = 58; Table 11). Brood success was very poor on the South Spoil and the HRAs, however was much better on South Beach (Table 11). Fledging success was also very poor on South Spoil and the HRAs (Table 11); the overall fledging success rate was the lowest ever recorded for CBNS, and substantially below the post predator management average (Table 16). Due to the high level of effort and relatively low number of fledglings, the productivity index was the lowest ever recorded for this site and well below the post predator management average (Table 16). The number of fledglings per male for CBNS was below 1.00 for the first time and well below the post predator management average (Table 16).

Bandon SPMA

The number of eggs laid at Bandon SPMA was the highest ever for this site (Table 17). The hatch rate improved from 2012 but was still low and slightly below the post predator management average (Table 17). We monitored 21 broods at the SPMA (not including one brood raised at the OCA and later released), nearly double the number of broods compared to 2012 (n = 11), and they had a very good brood success rate of 71% (Table 11). The fledging success rate was slightly above the post predator management average (Table 17). Despite the improved hatch rate and relatively good fledging success rate, the productivity index was low due to the high number of eggs laid, and was below the post predator management average (Table 17). The number of fledglings per male was near the post predator management average (Table 17), and just below the recovery goal.

New River

The number of plovers recorded at the New River HRA and adjacent areas remained similar to 2012 (Table 3; in 2012 n = 24), however the number of eggs laid at this site declined (Table 18). The decline in the number of nests (Table 4) and the number of eggs laid was due to an increase in nest success, and the number of eggs hatched in 2013 and was much higher than the post predator management average (Table 18). The high nest success and hatch rate resulted in fewer nest attempts and therefore a reduction in the number of eggs laid. Brood success was also very good in 2013 (Table 11), and overall fledging success was higher than the post predator management average (Table 18). Due to the number of fledglings produced at New River in 2013, the productivity index was very high and well above the post predator management average. The number of fledglings per male was over 1.00 for the first time since 2009 and above the post predator management average (Table 18).

Post predator management hatch rates declined for Overlook, Tenmile, CBNS, Bandon SPMA, and New River HRA while remaining stable at Siltcoos and Tahkenitch (Table 19). The decline in hatch rates is attributed to the decreased use of exclosures (Figure 12); unexclosed nests have a lower nest success rate than exclosed nests (Table 6). The post predator management average brood success rate (2004-2012, 72.1%) was significantly higher than the average pre predator management brood success rate (1991-2001, 62.9%, t-stat = 2.42, df = 19, $P = 0.01$). The overall mean post predator management fledging success rate (0.46) was higher than the mean pre predator management fledging success rate (0.39, t = 1.60, df = 18, $P = 0.06$). The post predator management fledging success rate has improved for Siltcoos, Overlook, Bandon SPMA, and New River and has remained relatively stable at Tahkenitch and CBNS (Table 19). Tenmile has decreased but was still within acceptable levels. The overall post predator management mean number of fledglings per male (2004-2012; $x = 1.25$) was significantly higher than the pre predator management mean number of fledglings per male (1992-2001; $x = 1.06$, t = 1.91, df = 18, $P = 0.04$). The mean number of fledglings per male has improved at all sites except Tenmile where it has remained relatively stable (Table 19). 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 and maintaining the plover population.

Brood Movements

Siltcoos, Overlook, and Tahkenitch

Plovers (both nests and broods) continue to occupy the beaches between South Siltcoos and North Overlook and South Overlook and North Tahkenitch (see Figures 3-5; Lauten *et al*. 2009, 2010, 2011, and 2012). Due to increasing plover numbers and high nest failures in 2013, plovers also occupied the beach at South Tahkenitch south of Threemile Creek. Since plovers were successful at both nesting and brood rearing along these lengths of beach, we would expect plovers to continue to occupy these areas in the future.

Only one of three broods at North Siltcoos in 2013 was successful, and that brood remained on the spit and within the nesting area for the duration of the brood rearing period. There were six total broods from South Siltcoos, and three were successful (Table 11) including one brood from an undiscovered nest. One of the successful broods hatched on the roped nesting area at South Siltcoos and moved south to the Carter Lake trail area within three days of hatching and then was found at South Overlook six days after hatching. The brood from the undiscovered nest also moved from South Siltcoos to North Overlook over an eight day period.

Two of three broods were successful from North Overlook. One brood hatched on the beach north of North Overlook and remained on the beach until fledged. The other successful brood hatched at the south end of North Overlook and seven days later was noted at South Overlook. The brood remained at South Overlook until fledged.

There were five broods from North Tahkenitch, four from the nesting area and one that hatched along the beach north of the nesting area. The brood that hatched along the beach north of the nesting area stayed along the beach until fledged. One of the broods from the nesting area was confirmed fledged at South Overlook. Two broods remained on the nesting area; one of these broods hatched at the south end of the spit and spent most of the brood rearing period at the north end of the HRA. The fifth brood failed within two days of hatching. There were two successful broods from South Tahkenitch, one from an undiscovered nest. Both of these broods were located in the Threemile Creek area and remained in this area. This area is open to motor vehicle use. Forest Service roped the area and the broods remained in and around the roped section of beach.

Tenmile

Of the 13 broods from North Tenmile in 2013, four, including three broods from undiscovered nests, originated on the beach north of the HRA. Three of these broods were successful; two remained on the beach north of the HRA and one of the broods moved south to the HRA. Three broods that originated on the HRA moved north along the beach up to a half mile during the brood period. Most broods that originated on the HRA remained on the HRA and the adjacent spit area. At South Tenmile, all broods originated on the HRA or the beach adjacent to the HRA. Only one brood moved south of the HRA along the beach but remained within the closed area; all other broods remained on or adjacent to the HRA.

Coos Bay North Spit

At CBNS in 2013 only one of four broods from the South Spoil and two of 10 broods from the HRAs were successful. The one brood from South Spoil moved west to the 94HRA and 98EHRA where it remained for the brood period. Both broods from the HRAs originated on the 95HRA; one brood

remained on the 95HRA until it fledged. The other brood, which hatched early in May, moved immediately to the beach and remained there until it fledged. There was very poor success of broods from South Spoil and the HRAs in 2013 (Table 11). There is no data as to the cause of brood failures due to the difficulty assessing when and why chicks do not survive; however, nest failure data and observational data indicated that Northern Harriers were present on a regular basis. It is possible that harriers were depredating broods as well as nests. In 2013 both the berms along the foredune road and the foredune itself have become wide and covered in dense beachgrass. The dense vegetation prevents brood movement between the east side of the foredune road and the west side, and also from the 95HRA to the beach. Food resources for broods are best on the beach. We believe improving habitat to enhance brood movement west towards the beach would benefit brood and chick survival. We recommend that openings in the berms along the foredune road be created and maintained each season and the width of the berms be reduced to eliminate some of vegetation. We also recommend that pathways be created through the foredune to permit easy access to the beach by broods and some vegetation be removed from the east side of the foredune to reduce the width. We recognize that destabilizing the foredune is not acceptable; therefore we recommend just removal of the top vegetation without lowering the foredune.

Broods on South Beach were much more successful than broods originating from the nesting area (Table 11). Twelve of 15 broods were successful. All broods hatched within the closed area except one brood that hatched just south of access point 2, well north of the FAA towers. This brood failed within a week of hatching. Another brood that hatched near the FAA towers but just south of I-beam also failed within a week of hatching. Seven broods hatched at the far south end of the beach north of the I-beam near the jetty. Three of these broods used the jetty area throughout the brood period including the area open to motor vehicles south of the I-beam to the jetty. Two of these broods repeatedly were noted along the jetty and around the parking area at the base of the jetty. One of the broods was found on the foredune road; one chick was found along the edge of the foredune road near the bay beach. This chick was picked up and returned by monitors to the beach; it was later confirmed fledged. All the remaining broods remained within the closed section of beach.

Bandon SPMA

There were six broods, four of which were successful, on the north side of New River at Bandon SPMA. One brood hatched early in the season on the north side of China Creek. The male and one chick remained on the north side of the creek for the first two weeks. The male then disappeared; he was a resident Bandon SPMA bird and we believe he may have been depredated. The chick remained on the north side of the creek by itself until it was fledged. One brood hatched along the west edge of cutout 3 and spent the brood period wandering the beach from the China Creek overwash area south to the area around cutout 3. A third brood hatched along the foredune south of cutout 3. The male and one chick disappeared at hatching; we believe the male was depredated. The female brooded the remaining two chicks, eventually moving south and spending most of the brood period along the south end of the HRA south of the I-beam. She fledged one chick. The fourth brood hatched on the HRA and remained on and adjacent to the HRA for the brood period.

There were 15 broods that originated on the south side of the mouth of New River at Bandon SPMA; 11 were successful. Fourteen of the 15 broods hatched on the north end of the spit; one brood hatched near the southern boundary of the SPMA. Eight of the broods that hatched at the north end of the spit remained on the north half of the spit. Two other broods from the north end of the spit crossed New River and raised their broods on and adjacent to the HRA. The brood that hatched near the southern boundary of the SPMA quickly moved his brood south to just north of the BLM HRA. He remained in this area and successfully fledged one chick.

New River

There were two broods that hatched on private land. One brood hatched on Michael Keizer's property just south of the Bandon SPMA. This brood stayed in this vicinity, using both the overwashes and the river side, and eventually at fledge age was noted on the New River spit portion of the Bandon SPMA. A second brood that nested on the beach adjacent to private land between Keizer's property and the BLM HRA moved north along the beach and was noted on near the southern boundary of the Bandon SPMA. The brood was confirmed fledged on the New River spit portion of the Bandon SPMA. Eight of nine broods that originated on the BLM HRA successfully fledged. One brood that hatched along the north end of the HRA disappeared after the first week of the brood period and was later confirmed fledged on the New River spit portion of the Bandon SPMA. We believe the brood had moved north during the brood period and may have even been using the river. Three broods originated north of Croft Lake breach; two broods remained on the HRA and along the beach north of Croft Lake and one brood eventually moved just north of the HRA and fledged. One brood originated north of New Lake breach and moved south, spending the brood period between New Lake and Hammond breaches. Three broods originated south of New Lake breach and remained in this area for the brood period.

Sightings of Snowy Plovers Banded Elsewhere

Fifteen adult plovers banded in California were observed in Oregon in 2013. Six were females and nine were males. Nine of the 15 plovers were known to have nested in Oregon in 2013. Four females were confirmed nesting and two were present during the breeding season and may have attempted to nest but were not confirmed. Five males were confirmed nesting and three others were present during the breeding season and may have attempted to nest but were not confirmed. One male arrived post breeding season. Four females and five males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. Six other plovers, two females and four males, were originally banded in California. One female was banded as a hatch year 2006 from Humboldt Co. and has been nesting at Bandon Beach and New River since 2007; the second female was banded in 2010 in Humboldt Co. and nested in Oregon in 2011, 2012, and 2013. Of the four California originated males, one was a hatch year 2004 bird from Salinas, Monterey Co., that has been present at New River since 2005 and successfully nested at New River in 2013; one was a hatch year 2010 plover from Moss Landing Salt Ponds, Monterey Co., who nested at Bandon SPMA in 2013; one was a hatch year 2010 bird from Oceano Dunes, San Luis Obispo Co., that was confirmed nesting in 2012 but we did not confirm nesting in 2013; and one was a hatch year 2011 bird from Centerville, Humboldt Co. who arrived at the end of July and was present in August at Bandon SPMA.

Habitat Restoration and Development Projects

Sutton

Beachgrass hummocks were mechanically treated on the Sutton Beach HRA in the winter of 2012-13. Some oyster shell was manually spread on the HRA. In addition, 3.8 miles of beach cleanup was conducted at Baker Beach with the help of the Emerald Empire Back Country Horseman group. Twenty five participated in this event and collected 920 pounds of trash.

Siltcoos

At Siltcoos in winter 2012-13, 3 acres of beachgrass was hand pulled by the Northwest Youth Corp on the south side of the estuary in winter 2012-13. Beachgrass hummocks near areas covered by oyster shell were mechanically treated. Some oyster shell was spread on the south side of the estuary. No work occurred on the north side of the estuary due to the Siltcoos River moving north during the winter and losing most of the HRA on the north side.

Overlook

At Overlook, 20 acres of beachgrass and hummocks were mechanically treated in winter 2012-13. Some oyster shell was spread on both the north and south side.

Tahkenitch

At Tahkenitch, 19 acres of beachgrass and hummocks were mechanically treated in winter 2012-13. Some oyster shell was spread on the HRA.

Tenmile

At Tenmile, 12 acres of beachgrass hummocks were mechanically treated on the north side in the winter of 2012-13. Some oyster shell was spread on North Tenmile.

Coos Bay North Spit

The 95HRA and 98EHRA at CBNS were disked once in November 2012 and once in February 2013 to limit the amount of invasive beachgrass on all BLM HRAs. Shell hash was purchased from Coos Watershed Association, cleaned of debris, and applied to 6 acres in the 98EHRA and 95HRA to provide improved nesting habitat.

Before the disking occurred in the fall 2012, a botanist collected seeds of sensitive species to be used for restoration work in other coastal areas. Approximately 300,000 pink sandverbena (*Abronia umbellata breviflora*) seeds were collected and spread at other coastal sites. (J. Sperling, pers. com.) In October 2012, the Youth Corp spent 40 hours at the north spit pulling non-native sea rocket, sour dock and dandelion.

There was only limited disking of the 94HRA and South Spoil on ACOE lands.

Bandon SPMA

At Bandon SPMA, OPRD conducted maintenance actions on approximately 62 acres of habitat in winter 2012-13. All four cutouts along the foredune were bulldozed and treated with glyphosate. Five acres on the HRA north of the mouth of New River were bulldozed. On the south side of the mouth of New River approximately 58 acres were treated with glyphosate and imazapyr.

New River

At New River in winter 2012-13, 15 acres of the HRA were bulldozed between New Lake breach and Croft Lake Breach.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2014 nesting season should again be implemented 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 a clear, consistent message is conveyed to the public throughout the nesting season and between years, and so that the closed sections of beach are adequately protected throughout the season. 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 are 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 B.

Maintaining, improving, and expanding the nesting areas is essential to maintaining a healthy and sustainable plover population. Despite years of treatment, European beachgrass continues to annually resprout resulting in degraded nesting habitat. When new habitat is created, such as the cutouts at Bandon SPMA (Lauten *et al*., 2011), it is important to annually maintain the habitat or it quickly degrades resulting in reduced plover use. With an increasing plover population, any reduction in available nesting habitat can result in high nest densities which may attract predators or result in plovers nesting in sub-optimal habitat, where predation or disturbance from recreational activity is more likely. Increased nest density could lead to increased nest depredations. Increased chick numbers on the landscape may attract additional avian predators (Neuman *et al*. 2004). Expansion of the nesting areas would increase the available habitat for plovers and could help alleviate predation pressure. Creation of cutouts along sections of beach that have nesting plovers but no nesting area behind the foredune would give the plovers safe areas to nest and brood away from recreational activity on the beach. We continue to support additional shell hash on any nesting area as it has proven to be a beneficial management technique. We continue to recommend that additional habitat be created and maintained at South Overlook, North Tenmile, Bandon SPMA and New River HRA. We support any efforts to find new and effective treatments of European beachgrass that could result in reduced resprouting, less density of beachgrass, and ultimately reduced maintenance costs.

We recommend increased use of cameras to help document causes of nest failure and to positively identify individual raptors that are preying on plovers so land management agencies can effectively manage this threat. We recommend monitoring staff and Wildlife Services staff continue to document raptor activity in and around the nesting areas.

Continued efforts to educate the public about the OPRD Habitat Conservation Plan (ICF International 2010) and beach rules will be essential both before and during the nesting season. Staff dedicated to recreational monitoring and volunteers continue to help reduce violations and educate the public about plovers and dog related issues, and we recommend that these aspects of management continue and be funded. At Siltcoos and Bandon Beach where parking lots and recreational activities are adjacent to nesting plovers, monitoring by staff and volunteers is essential to improving plover success and reducing disturbance issues.

- Continue breeding season monitoring; continue monitoring plover populations and productivity to ensure recovery goals are maintained.
- Maintain, enhance and expand habitat restoration areas. Spread shell hash to enhance nesting substrate.
- Selectively use mini-exclosures in conjunction with predator management to reduce the risks to nests and 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.

- Expand use of cameras to help determine causes of nest failures; coordinate with Wildlife Services to set up and maintain cameras.
- 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. Fully fund three Wildlife Services employees.
- Continue to coordinate with federal and state 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 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.
- 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, 1990-2013. For Window Survey, first number is counted plovers minus duplicate band combos and unidentified plovers, and the number in parenthesis is total head count without considering duplicate combos or unknown plovers.

YEAR	WINDOW SURVEY	# SNPL BREEDING	# SNPL PRESENT
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
2012	206	233-238	293-294
2013	215	190-191	304

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 - 2013.

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
2013	103	91	51%	51	56%
2012	180[a]	92	51%	70	76%
2011	172	53	63%	45	85%
2010	84	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 = 47%	47%
SD = 11.0%	0.110352
Average percent of returning HY birds that nest in first season = 68%	68%
SD = 16.7%	0.167004

[a] - adjusted from 172 to 180 based on hatch year returns

Table 3. Number of Adult Snowy Plovers at each nesting area on the Oregon Coast, 2013.

	Females				Males					
	Banded		Unbanded		Banded		Unbanded		Total	
Site	# banded	# nested	# unbanded	# nested	# banded	# nested	# unbanded	# nested	# plovers	# nested
Sutton	1	0	1	0	2	0	1	0	5	0
Siltcoos	41	12	2	1	46	10	2	0	91	23
Overlook	38	9	4	1	39	5	2	1	83	16
Tahkenitch	35	14	3	0	39	6	5	2	82	22
Tenmile	32	13	4	3-4	32	14	4	4	72	34-35
CBNS	37	24	5	4	47	23	3	1	92	52
Bandon SPMA	30	20	7	2	36	24	3	0	76	46
New River HRA	6	5	3	3	14	12	1	0	24	22
Floras Lake	0	0	0	0	1	0	0	0	1	0

Table 4. Number of nests for selected sites on the Oregon Coast 1998 – 2013 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year only.

Site Name	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13
SU	8	3	7	15	3	1	0	0	4	3	0	0	1	0	0	1
SI:																
North	1	4	8	0	0	0	7	8	12	15	30	14	17	13	10	13
South	3	17	14	14	10	7	4	9	13	13	6	9	24	21	22	30
OV:																
North		2	8	12	5	7	11	11	9	13	14	9	21	29	28	33
South		0	0	3	3	1	3	5	1	3	1	5	16	28	31	28
TA																
North	0	0	4	7	8	13	8	11	4	10	5	6	7	23	36	52
South	6	3	1	6	7	1	0	0	0	0	0					6
TM:																
North	0	0	1	2	3	5	9	6	10	20	12	13	13	15	17	19
South	11	5	5	6	9	12	8	11	12	21	16	41	30	35	29	17
CBNS:																
SB	6	0	1	1	2	3	2	4	0	8	5	19	17	16	7	36
SS	5	2	5	3	2	9	8	9	14	12	18	16	14	15	15	12
HRAs	7	12	22	13	15	11	16	16	18	19	26	30	33	26	39	58
BSPMA																
BB	1	2	2	6	5	5	17	31	23	30	28	31	26	28	48	44
NR spit	1	8	1	1	2	7	7	11	9	16	6	10	12	9	12	20
NR HRA		3	4	10	7	5	6	1	7	14	27	27	27	29	17	9
NR other	25	17	12	12	5	4	11	11	11	5	2	3	3	2	1	3
FL	4	0	5	0	1	0	0	0	0	0	0	3	0	0	2	0
Tot nst	**78**	**78**	**100**	**111**	**89**	**91**	**117**	**144**	**147**	**202**	**196**	**236**	**261**	**289**	**314**	**381**
Tot brd[a]	**3**	**1**	**2**	**0**	**1**	**4**	**2**	**3**	**15**	**4**	**3**	**8**	**2**	**4**	**11**	**8**

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

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

Table 5. Apparent nest success of Snowy Plovers on the Oregon Coast, 2013.

		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	1	-	-		0	1		-	0%	0%
Siltcoos										
North	13	-	-		3	10		-	23%	23%
South	30	2	0		3	25		100%	12%	17%
Combined	43	2	0		6	35		100%	17%	19%
Overlook										
North	33	0	1		3	29		0%	9%	9%
South	28	-	-		0	28		-	0%	0%
Combined	61	0	1		3	57		0%	5%	5%
Tahkenitch										
North	52	-	-		6	46		-	12%	12%
South	6	-	-		1	5		-	17%	17%
Combined	58				7	51			12%	12%
Tenmile										
North	19	2	0		7	10		100%	41%	47%
South	17	-	-		6	11		-	35%	35%
Combined	36				13	21		100%	36%	42%
CBNS										
South Beach	36	-	-		15	21		-	42%	42%
South Spoil	12	-	-		4	8			33%	33%
HRAs	58	-	-		10	48			17%	17%
Combined	106				29	77			27%	27%
Bandon SPMA	64 [a]	6	1		15	41		86%	27%	33%
New River										
HRA	9	4	1		3	1		80%	75%	78%
Other Lands	3	1	0		1	1		100%	50%	67%
Floras Lake	0	-	-		-	-		-	-	-
Totals	381 [a]	15	3		77	285		83%	21%	24%

a – One nest not included in analysis because adults depredated, one chick hatched, two eggs and chick taken to aquarium.

Table 6. Apparent nest success of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1990 - 2013.

Year	All nests (%)	Exclosed (%)	Not Exclosed (%)
1990	31	*	28
1991	33	75	9
1992	67	85	11
1993	68	83	27
1994	75	80	71
1995	50	65	5
1996	56	71	10
1997	48	58	14
1998	56	72	8
1999	56	64	0
2000	38	48	0
2001	35	68	0
2002	44	66	6
2003	51	77	9
2004	62	85	8
2005	48	72	14
2006	47	66	32
2007	42	71	35
2008	34	49	30
2009	33	76	25
2010	35	72	23
2011	50	71	48
2012	45	86	42
2013	24	83	21
Average =	47.00	71.43	19.83
STDEV =	12.99	10.42	17.31

* Multiple experimental designs used, data not included

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2013.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Corvid	Unk	Avian	Mammal	Adult plover	Wind-Weather	Overwash	Abandon	One Egg Nest	Infer	Unk cause
Sutton	1	1											1
Siltcoos:													
North	13	10		3				1	1		2		3
South	30	25		7	1			3		3	2		9
Overlook													
North	33	30	4	20			1			1	1		3
South	28	28	3	16	2					3	1		3
Tahkenitch													
North	52	46		16	5			4		1			20
South	6	5	3	1									1
Tenmile:													
North	19	10	4	2							1	1	2
South	17	11	3	2									6
Coos Bay													
North Spit:													
South Beach	36	21		2	4	1 [a]			2	2	1		9
South Spoil	12	8		7							1		
HRAs	58	48		29	11	2 [b]				1	4		1
Bandon													
SPMA	64	42	3	16				4				1	18
New River													
HRA	9	2		1								1	
Other lands	3	1		1									
TOTALS	**381**	**288**	20	123	23 [c]	3	1	12	3	11	13	3	76

[a] – raccoon depredation

[b] – 2 rodent depredation

[c] – 20 Northern Harrier depredations, 3 unknown avian depredations

Table 8. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2013.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	**Corvid**		20	20
	Unknown		123	123
	Avian		23	23
	Mammalian		3	3
Depredation	**Adult Plover**	1		1
Other	**Wind/Weather**		12	12
	Overwashed		3	3
	Infertile	2	1	3
	One Egg Nests		13	13
	Abandoned		11	11
	Unknown Cause		76	76
Totals		3	285	288

Table 9. Total number of young fledged from select sites on the Oregon Coast 1998-2013, includes fledglings from broods from undiscovered nests.

Site Name	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13
SU	1	0	3	0	0	0	0	0	0	0	0					
SI:																
North	2	4	0	0	0	0	7	2	11	7	5	8	4	4	1	2
South	4	2	7	0	0	2	5	7	7	4	3	11	4	8	16	3
OV:																
North		3	5	1	2	3	3	5	8	12	3	7	12	27	22	3
South		0	0	1	0	0	3	2	0	1	0	2	7	23	27	0
TA:																
North	0	0	2	4	1	3	6	8	5	2	0	1	3	20	26	9[b]
South	1	1	3	4	5	2	0	0	0	0	0					3
TM:																
North	0	0	0	0	3	1	3	6	12	13	3	2	3	1	5	15
South	3	7	5	4	3	9	9	5	7	14	6	19	13	5	5	8
CBNS:																
SS	6	5	3	4	2	7	13	9	11	7	17	4	2	6	10	2
SB	2	0	0	1	1	3	0	8	1	10	7	17	13	22	16	18
HRAs	1	23	6	6	8	14	22	6	19	9	16	10	5	28	34	3
BSPMA																
BB	1	1	0	1	0	4	16	11	12	13	2	6	6	16	11	8[c]
NR spit	0	2	0	0	0	1	10	0	3	12	2	1	0	5	1	14
NR HRA		2	1	3	3	7	5	1	7	16	7	17	12	7	4	12
NR other	11	4	4	3	3	4	6	8	7	4	2	2	0	0	0	3
FL	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	
Total	**32**	**54**	**43**	**32**	**31**	**60**	**108**	**78**	**110**	**124**	**73**	**107**	**84**	**172**	**180[a]**	**103**

[a] – adjusted from 172 to 180 based on hatch year returns

[b] - includes 2 fledglings raised at Oregon Coast Aquarium

[c] - includes 3 fledglings raised at Oregon Coast Aquarium

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

Table 10. Overall fledging success, total number of fledglings, and mean number of fledglings/male on the Oregon Coast, 1990 – 2013.

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	47	172	1.371
2012	44	180	1.223
2013	39	103[c]	0.926
	Overall = 40.9 $\pm$ 10.1	Total = 1680	Mean = 1.139

a – does not include fledglings from broods from undiscovered nests, nor any data from Sutton Beach and Floras Lake

b – total number of fledglings including from broods from undiscovered nests

c - includes five chicks raised at Oregon Coast Aquarium

Table 11. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2013.

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	33%	9	2	-	22%	5	0.40	0.50 (10)
South Siltcoos	6	50%	13	2	1	15%	5	0.40	
Overlook									
North Overlook	3	67%	9	3	-	33%	5	0.60	0.50 (6)
South Overlook	0	-	-	-	-	-	1	-	
Tahkenitch									
North Tahkenitch	6[d]	80%	12	7	-	58%	5	1.40	1.43 (7)
South Tahkenitch	2	100%	2	1	2	50%	2	1.50	
Tenmile:									
North Tenmile	13	92%	22	11	4	50%	14	1.07	1.21 (19)
South Tenmile	6	83%	15	8	-	53%	6	1.33	
Coos Bay N. Spit									
South Spoil	4	25%	10	2	-	20%	3	0.67	0.95 (24)
South Beach	15	80%	39	18	-	46%	15	1.20	
HRA	10	20%	21	3	-	14%	8	0.38	
Bandon SPMA	22[e]	71%	51	19	-	37%	23	0.83	0.83 (23)
New River									
HRA	9	89%	18	9	3	50%	9	1.33	1.25 (12)
Other lands	2	100%	5	3	-	60%	3	1.00	
TOTALS	**101[f]**	**71%**	**228**	**88**	**10**	**39%**	**94**	**1.04**	
TOTAL FLEDGED				**103[g]**					

% 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.

[d] – includes one brood that hatched but chicks later captured and raised at Oregon Coast Aquarium and later release; this brood not included in calculations.

[e] – includes one brood that was raised at Oregon Coast Aquarium and later released; this brood not included in calculations.

[f] – includes two broods raised at Oregon Coast Aquarium; these broods not included in calculations.

[g] – includes 5 fledglings raised at Oregon Coast Aquarium.

Table 12. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2013.
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
	2013	102	22	22%	4	18%	4%	4	10	0.4
	2012	92	38	41%	15	39%	16%	15	13	1.15
	2011	87	36	41%	11	31%	13%	11	13	0.85
	2010	105	30	29%	8	27%	8%	8	10	0.80
	2009	54	28	52%	17	61%	31%	17	11	1.55
	2008	68	22	32%	8	36%	12%	8	9	0.88
	2007	67	24	36%	11	46%	16%	11	10	1.10
	2006	60	22	37%	13	60%	22%	11	5	2.20
	2005	44	17	39%	9	53%	20%	9	7	1.29
	2004	31	18	58%	12	67%	39%	12	5	2.40
	2003	16	5	31%	2	40%	13%	2	4	0.50
	2002	28	8	29%	0	0%	0%	0	2	0.00
	2001	33	1	3%	0	0%	0%	0	3	0.00
	2000	55	19	35%	7	37%	13%	7	8	0.88
	1999	59	21	36%	6	29%	10%	6	8	0.75
	1998	10	10	100%	6	60%	60%	6	3	2.00
	1997	8	4	50%	0	0%	0%	0	2	0.00
	1996	7	3	43%	0	0%	0%	0	1	0.00
	1995	12	6	50%	2	33%	17%	2	3	0.67
	1994	9	4	44%	1	25%	11%	1	3	0.33
	1993	1	0	0%	0	0%	0%	0	0	0.00
Pre-pred mang (1993-2003)	**total**	238	81		24			24	37	
	AVE			38%		20%	11%			0.47
	STDEV			26%		21%	17%			0.61
Post-pred mang (2004-2013)	**total**	710	257		108			108	93	
	AVE			39%		44%	18%			1.26
	STDEV			10%		16%	11%			0.63

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

Table 13. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2013.
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
	2013	152	9	6%	3	33%	2%	3	6	0.5
	2012	158	73	46%	40	55%	25%	40	25	1.60
	2011	152	80	53%	48	60%	32%	41	22	1.86
	2010	92	39	42%	15	38%	16%	15	15	1.00
	2009	31	14	45%	9	64%	29%	9	5	1.80
	2008	34	5	18%	2	40%	6%	2	3	0.67
	2007	46	19	41%	11	58%	24%	11	9	1.22
	2006	28	18	64%	8	44%	29%	8	4	2.00
	2005	42	16	38%	7	44%	17%	7	5	1.40
	2004	39	14	36%	6	43%	15%	6	6	1.00
	2003	17	9	53%	3	33%	18%	3	4	0.75
	2002	24	13	54%	2	15%	8%	2	4	0.50
	2001	39	10	26%	2	20%	5%	2	4	0.50
	2000	22	8	36%	5	63%	23%	5	7	0.71
	1999	6	6	100%	3	50%	50%	3	2	1.50
Pre-pred mang (1999-2003)	**total**	108	46		15			15	21	
	AVE			54%		36%	21%			0.79
	STDEV			28%		20%	18%			0.41
Post-pred mang (2004-2013)	**total**	774	209		149			142	100	
	AVE			39%		48%	20%			1.31
	STDEV			17%		11%	10%			0.51

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

Table 14. Productivity of Snowy Plovers at Tahkenitch, Douglas Co., Oregon coast, 1993-2013.
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
	2013	141	14	10%	8	57%	6%	8	5	1.60
	2012	104	56	54%	26	46%	25%	26	19	1.37
	2011	59	37	63%	19	51%	32%	18	9	2.00
	2010	14	7	50%	3	43%	21%	2	3	1.00
	2009	13	6	46%	1	17%	8%	1	2	0.50
	2008	14	0	0%	0	0%	0%	0	1	0.00
	2007	23	6	26%	2	33%	9%	2	4	0.50
	2006	12	9	75%	4	44%	33%	4	3	1.33
	2005	26	14	54%	8	57%	31%	8	4	2.00
	2004	21	14	67%	6	43%	29%	6	5	1.20
	2003	37	17	46%	3	18%	8%	3	10	0.30
	2002	30	16	53%	6	38%	20%	6	5	1.20
	2001	36	22	61%	8	36%	22%	8	8	1.00
	2000	15	6	40%	5	83%	33%	5	2	2.50
	1999	9	1	11%	1	100%	11%	1	2	0.50
	1998	18	11	61%	1	9%	6%	1	4	0.25
	1997	41	10	24%	6	60%	15%	6	7	0.86
	1996	51	21	41%	8	38%	16%	8	9	0.89
	1995	21	16	76%	12	75%	57%	12	7	1.71
	1994	9	8	89%	1	13%	11%	1	3	0.33
	1993	0	0	0%	0	0%	0%	0	0	0.00
Pre-pred mang (1993-2003)	**total**	267	128		51			51	57	
	AVE			46%		43%	18%			0.87
	STDEV			27%		33%	16%			0.73
Post-pred mang (2004-2013)	**total**	427	163		75			74	52	
	AVE			45%		39%	21%			1.15
	STDEV			25%		18%	12%			0.66

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

Table 15. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2013.
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
	2013	95	37	39%	19	51%	20%	19	14	1.36
	2012	104	18	17%	9	50%	7%	9	6	1.50
	2011	117	18	15%	4	22%	3%	4	10	0.40
	2010	113	51	45%	16	31%	14%	16	18	0.89
	2009	117	27	23%	16	59%	14%	16	9	1.78
	2008	77	21	27%	8	38%	10%	8	8	1.00
	2007	89	43	48%	27	63%	30%	27	19	1.42
	2006	59	28	47%	16	57%	27%	16	10	1.60
	2005	49	21	43%	8	38%	16%	8	8	1.00
	2004	50	29	58%	12	41%	24%	12	9	1.33
	2003	43	20	47%	10	50%	23%	10	8	1.25
	2002	32	14	44%	3	21%	9%	3	8	0.38
	2001	24	10	42%	4	40%	17%	4	4	1.00
	2000	18	14	78%	5	36%	28%	5	4	1.25
	1999	13	8	62%	7	88%	54%	7	3	2.33
	1998	20	8	40%	3	38%	15%	3	4	0.75
	1997	6	6	100%	4	67%	67%	4	2	2.00
	1996	11	6	55%	4	67%	36%	4	4	1.00
	1995	13	11	85%	2	18%	15%	2	4	0.50
	1994	18	3	17%	3	100%	17%	3	2	1.50
	1993	24	15	63%	5	33%	21%	5	5	1.00
	1992	27	19	70%	14	74%	52%	14	7	2.00
Pre-pred mang (1992-2003)	**total**	249	134		64			64	55	
	AVE			59%		53%	30%			1.25
	STDEV			23%		26%	19%			0.61
Post-pred mang (2004-2013)	**total**	870	293		135			135	112	
	AVE			36%		45%	17%			1.23
	STDEV			15%		13%	9%			0.41

[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, 1992-2013.
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
	2013	266	70	26%	23	33%	9%	23	24	0.96
	2012	175	135	77%	50	37%	29%	50	44	1.14
	2011	156	109	70%	52	48%	33%	52	31	1.69
	2010	160	40	25%	20	50%	13%	20	17	1.18
	2009	171	58	34%	28	48%	16%	28	22	1.27
	2008	125	63	50%	40	63%	32%	38	19	2.00
	2007	108	45	42%	26	58%	24%	26	12	2.17
	2006	86	54	63%	22	41%	26%	22	14	1.57
	2005	80	38	48%	23	61%	29%	21	12	1.75
	2004	73	42	58%	31	74%	42%	31	15	2.06
	2003	57	29	51%	21	72%	37%	20	9	2.22
	2002	48	21	44%	11	52%	23%	11	10	2.22
	2001	49	21	43%	11	52%	22%	11	8	1.38
	2000	75	23	31%	9	39%	12%	9	6	1.50
	1999	38	35	92%	26	74%	68%	26	10	2.60
	1998	49	18	37%	9	50%	18%	9	8	1.13
	1997	64	32	50%	12	38%	19%	12	11	1.09
	1996	77	48	62%	20	42%	26%	17	14	1.21
	1995	53	35	66%	20	57%	38%	19	11	1.72
	1994	50	44	88%	29	66%	58%	28	12	2.33
	1993	26	18	69%	9	50%	35%	9	7	1.29
	1992	32	21	66%	9	43%	28%	9	7	1.29
Pre-pred mang (1992-2001)	**total**	513	295		154			149	94	
	AVE			60%		51%	32%			1.55
	STDEV			20%		12%	18%			0.52
Post-pred mang (2002-2013)	**total**	1505	674		347			342	230	
	AVE			49%		53%	26%			1.69
	STDEV			16%		13%	10%			0.46

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

Table 17. Productivity of Snowy Plovers at Bandon Snowy Plover Management Area, Coos Co., Oregon coast, 1995-2013.

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

	Bandon SPMA	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2013	185	51	28%	19	37%	10%	19	23	0.83
	2012	160	30	19%	12	40%	8%	12	14	0.86
	2011	92	43	47%	21	49%	23%	21	15	1.40
	2010	87	36	41%	6	17%	7%	6	12	0.50
	2009	95	20	21%	7	35%	7%	7	12	0.58
	2008	85	8	9%	3	38%	4%	3	15	0.20
	2007	114	40	35%	24	60%	21%	23	16	1.44
	2006	75	29	39%	11	38%	15%	7	8	0.88
	2005	111	45	41%	11	24%	10%	11	17	0.65
	2004	71	48	68%	26	54%	37%	25	15	1.67
	2003	33	14	42%	3	21%	9%	3	7	0.43
	2002	16	4	25%	0	0%	0%	0	4	0.00
	2001	16	8	50%	1	13%	6%	1	3	0.33
	2000	9	0	0%	0	0%	0%	0	2	0.00
	1999	26	16	62%	3	19%	12%	3	9	0.33
	1998	6	3	50%	0	0%	0%	0	2	0.00
	1997	34	9	26%	0	0%	0%	0	6	0.00
	1996	12	8	67%	1	13%	8%	1	3	0.33
	1995	37	11	30%	6	55%	16%	6	6	1.00
Pre-pred mang (1995-2001)	**total**	140	55		11			11	31	
	AVE			41%		14%	6%			0.28
	STDEV			23%		20%	6%			0.36
Post-pred mang (2002-2013)	**total**	1124	372		143			137	158	
	AVE			35%		34%	13%			0.79
	STDEV			16%		17%	10%			0.51

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

Table 18. Productivity of Snowy Plovers at New River HRA, Coos Co., Oregon coast, 1999-2013.

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

	Year	total # eggs laid	total # hatched	hatch rate	total # fledged	fledging success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	2013	35	23	68%	12	52%	34%	12	11	1.09
	2012	46	13	28%	2	15%	4%	2	6	0.33
	2011	59	26	44%	7	27%	12%	7	10	0.70
	2010	71	24	34%	12	50%	17%	12	15	0.80
	2009	76	38	50%	16	42%	21%	16	13	1.23
	2008	54	28	52%	7	25%	13%	7	12	0.58
	2007	38	24	63%	14	58%	37%	14	8	1.75
	2006	18	14	78%	6	43%	33%	6	6	1.00
	2005	3	2	67%	1	50%	33%	1	1	1.00
	2004	18	11	61%	5	45%	28%	5	4	1.25
	2003	14	10	71%	7	70%	50%	7	5	1.40
	2002	18	8	44%	3	38%	17%	3	4	0.75
	2001	21	11	52%	3	27%	14%	3	5	0.60
	2000	11	10	91%	1	10%	9%	1	4	0.25
	1999	9	6	67%	2	33%	22%	2	3	0.67
Pre-pred mang (1999-2001)	**total**	41	27		6			6	12	
	AVE			70%		23%	15%			0.51
	STDEV			20%		12%	7%			0.23
Post-pred mang (2002-2013)	**total**	450	221		92			92	95	
	AVE			55%		43%	25%			0.99
	STDEV			16%		15%	13%			0.39

[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, 1992-2013.

	Siltcoos		Overlook		Tahkenitch		Tenmile		CBNS		Bandon SPMA		New River HRA	
	Pre-pred mang (1993-2003)	Post-pred mang (2004-2013)	Pre-pred mang (1999-2003)	Post-pred mang (2004-2013)	Pre-pred mang (1993-2003)	Post-pred mang (2004-2013)	Pre-pred mang (1992-2003)	Post-pred mang (2004-2013)	Pre-pred mang (1992-2001)	Post-pred mang (2002-2013)	Pre-pred mang (1995-2001)	Post-pred mang (2002-2013)	Pre-pred mang (1999-2001)	Post-pred mang (2002-2013)
ave hatch rate	38%+/-26%	39%+/-10%	54%+/-28%	39%+/-17%	46%+/-27%	45%+/-25%	59%+/-23%	36%+/-15%	60%+/-20%	49%+/-16%	41%+/-23%	35%+/-16%	70%+/-20%	55%+/-16%
ave fledging success rate	20%+/-21%	44%+/-16%	36%+/-20%	48%+/-11%	43%+/-33%	39%+/-18%	53%+/-26%	45%+/-13%	51%+/-12%	53%+/-13%	14%+/-20%	34%+/-17%	23%+/-12%	43%+/-15%
ave productivity index	11%+/-17%	18%+/-11%	21%+/-9%	20%+/-10%	18%+/-16%	21%+/-12%	30%+/-19%	17%+/-9%	32%+/-18%	26%+/-10%	6%+/-6%	13%+/-10%	15%+/-7%	25%+/-13%
ave # of fledglings/male	0.47+/-0.61	1.26+/-0.63	0.79+/-0.41	1.31+/-0.51	0.87+/-0.73	1.15+/-0.66	1.25+/-0.61	1.23+/-0.41	1.55+/-0.52	1.69+/-0.46	0.28+/-0.36	0.79+/-0.51	0.51+/-0.23	0.99+/-0.39

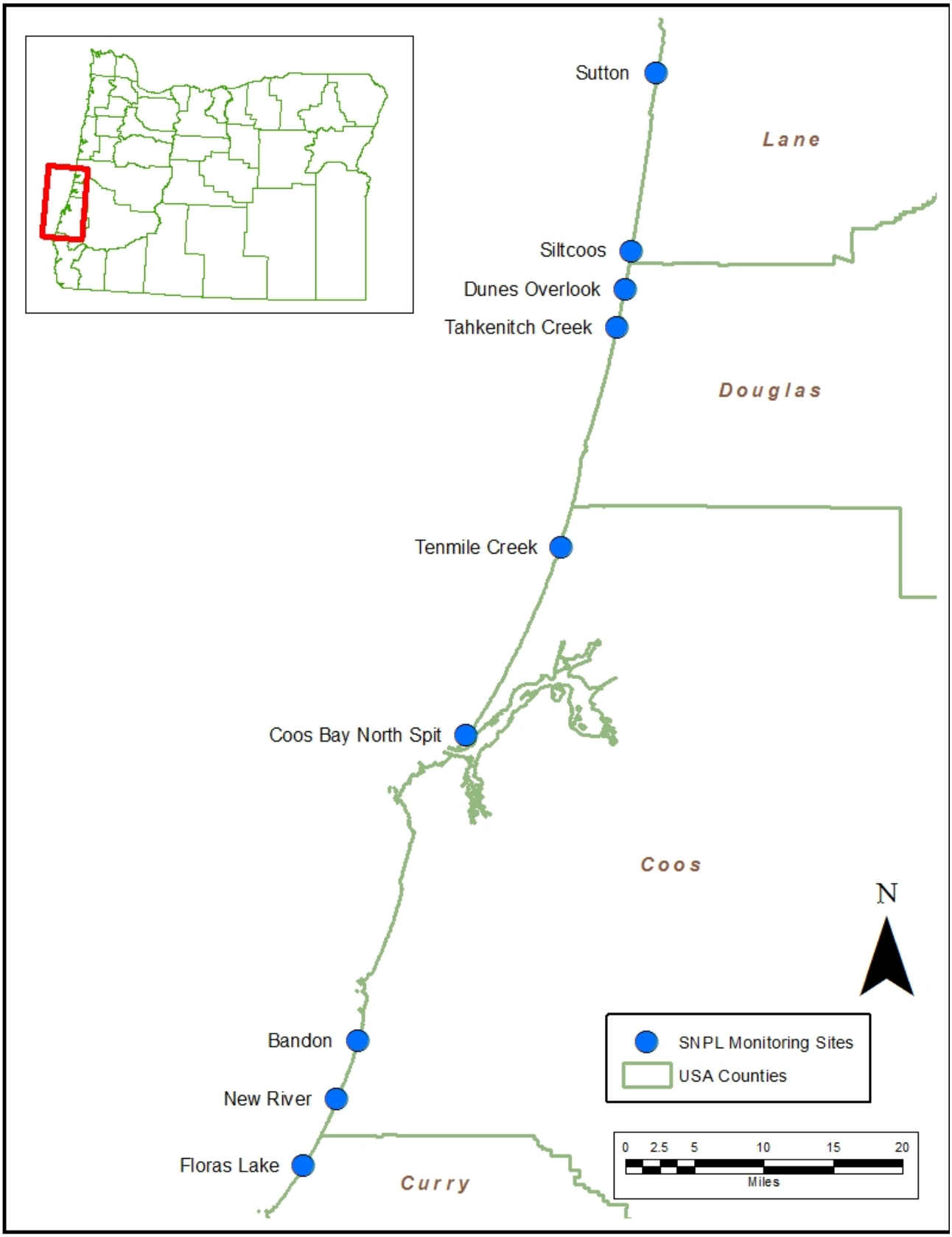


Figure 1. Snowy Plover monitoring locations along the Oregon coast, 2013.

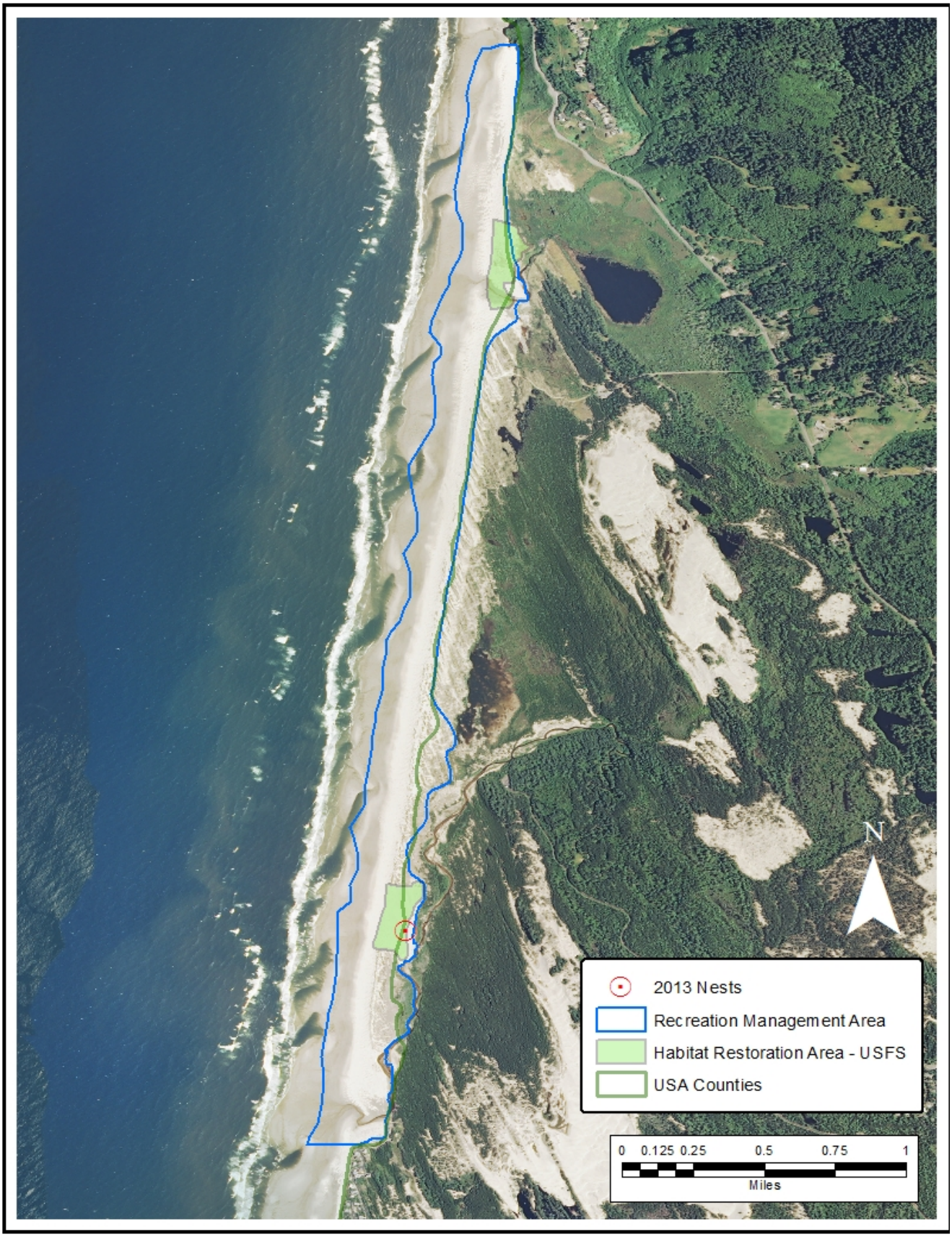


Figure 2. Snowy Plover nest locations at Sutton Beach, Oregon, 2013

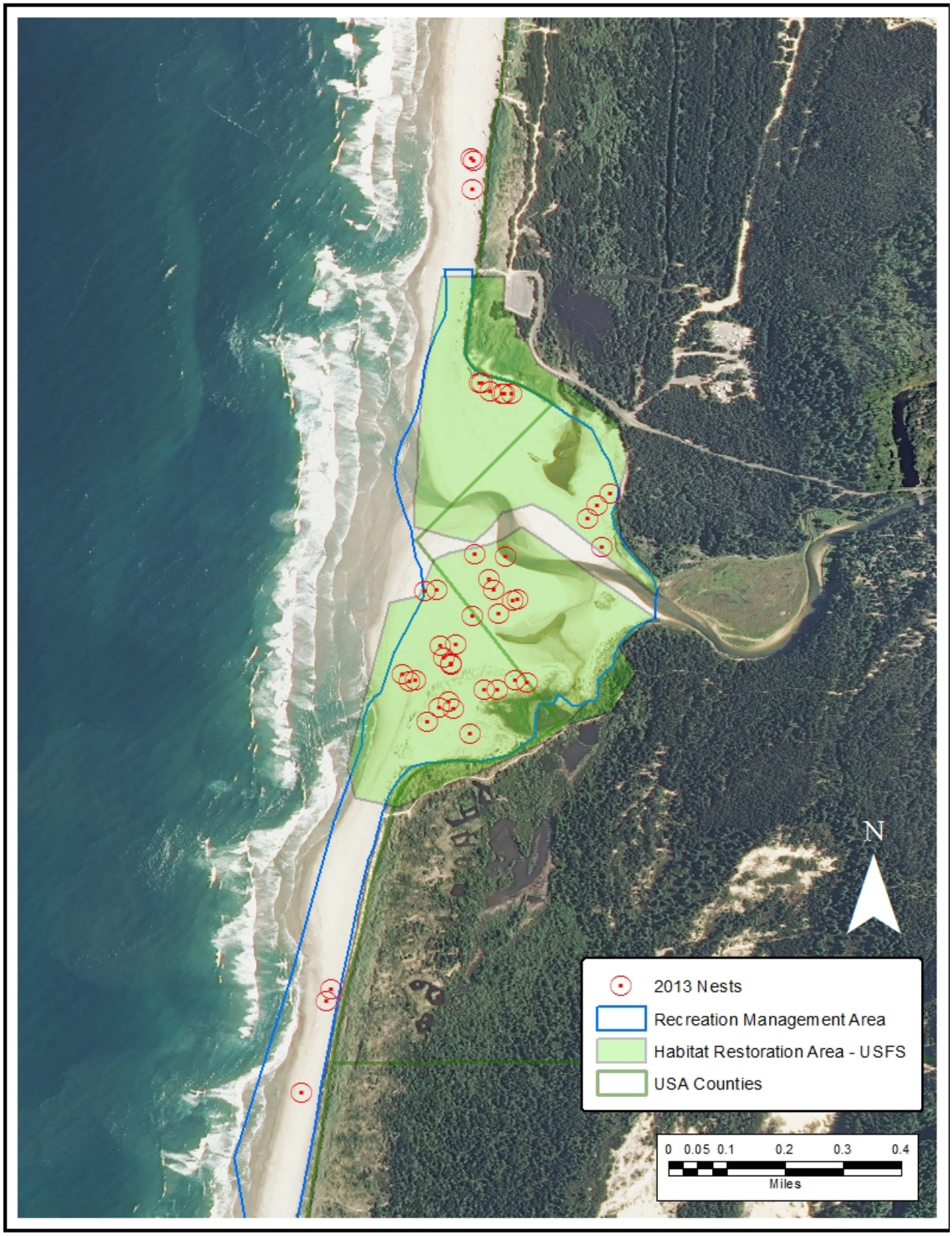


Figure 3. Snowy Plover nest locations at Siltcoos Estuary, Oregon, 2013

Figure 4. Snowy Plover nest locations at Dunes Overlook, Oregon, 2013

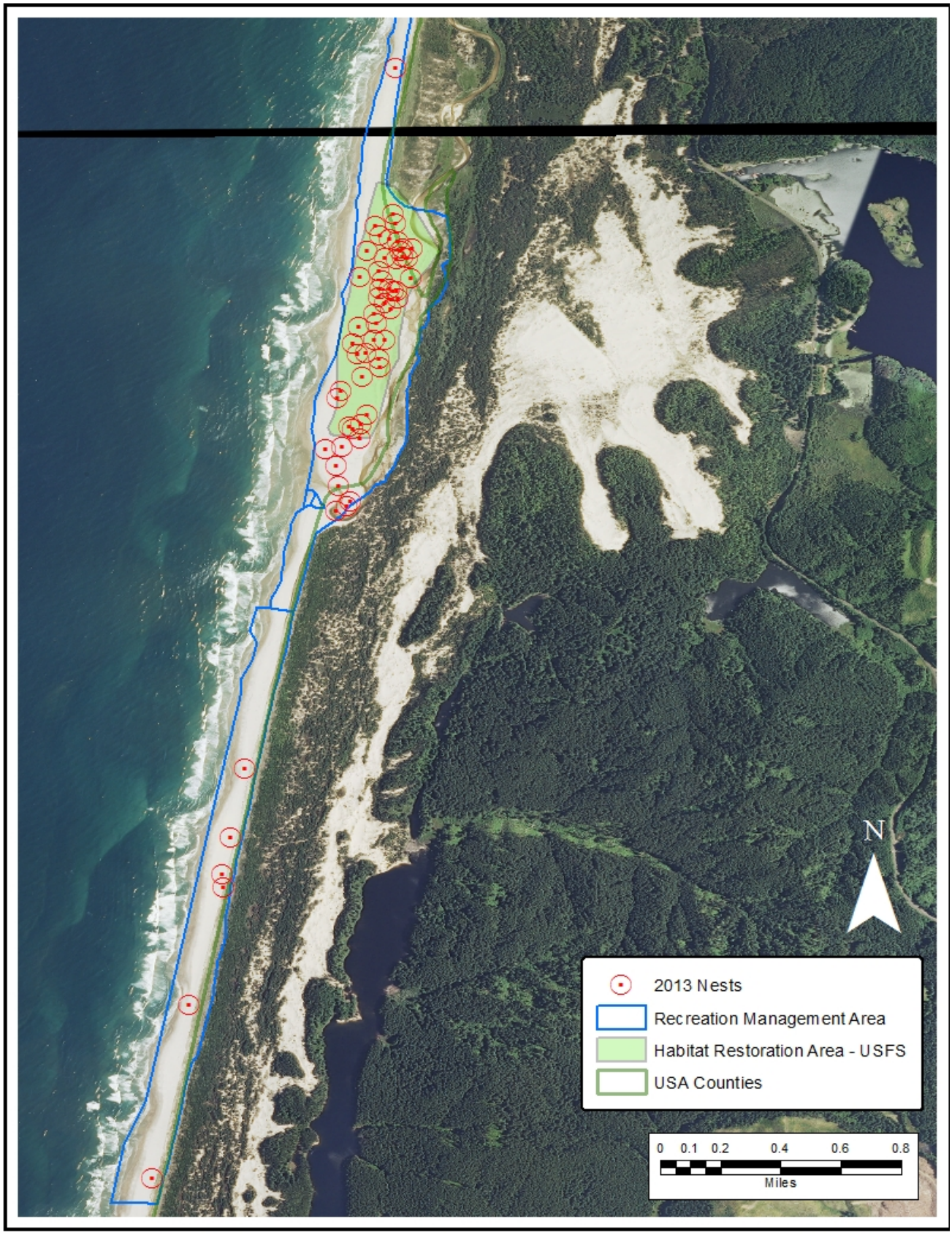


Figure 5. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2013

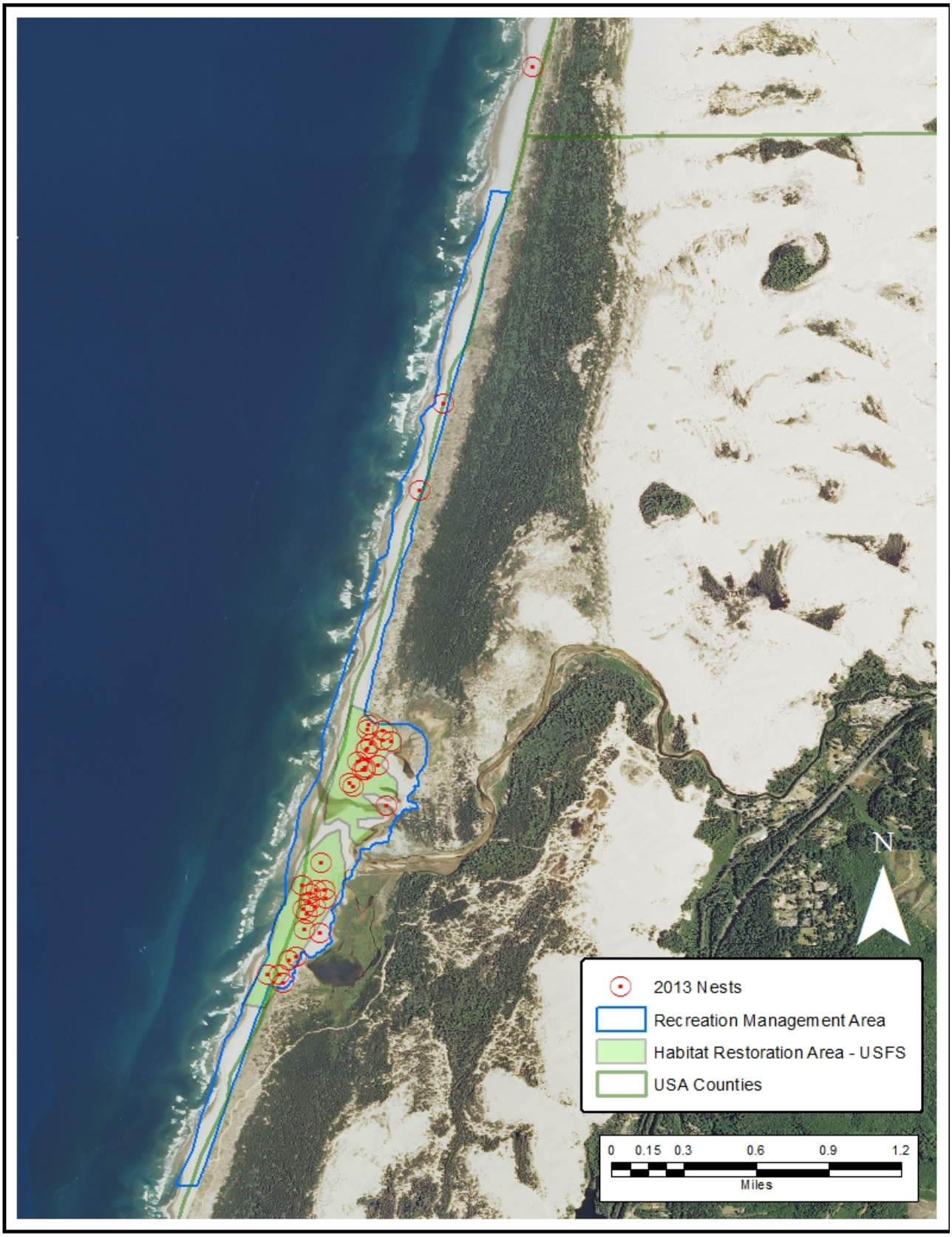


Figure 6. Snowy Plover nest locations at Tenmile Creek, Oregon, 2013

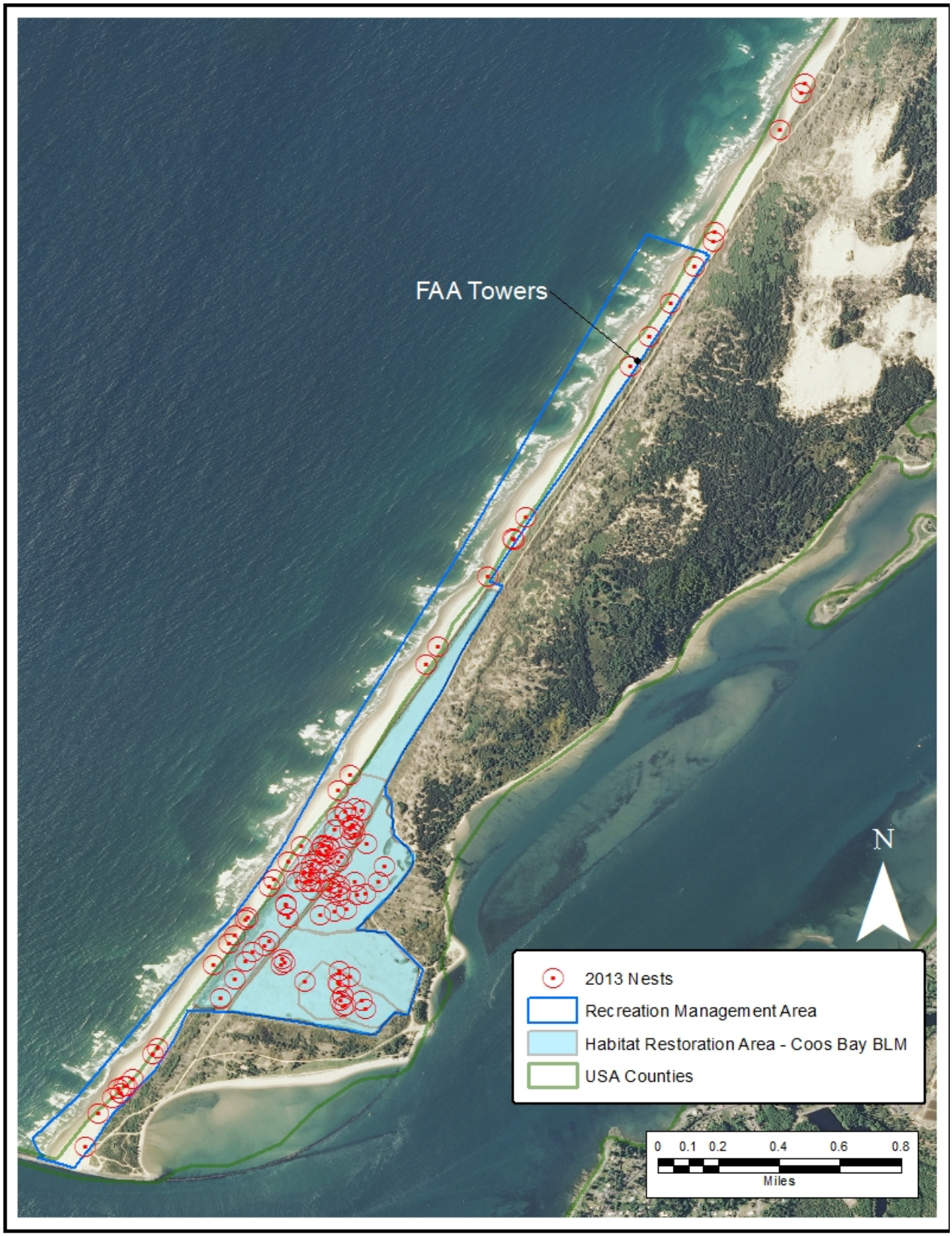


Figure 7. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2013

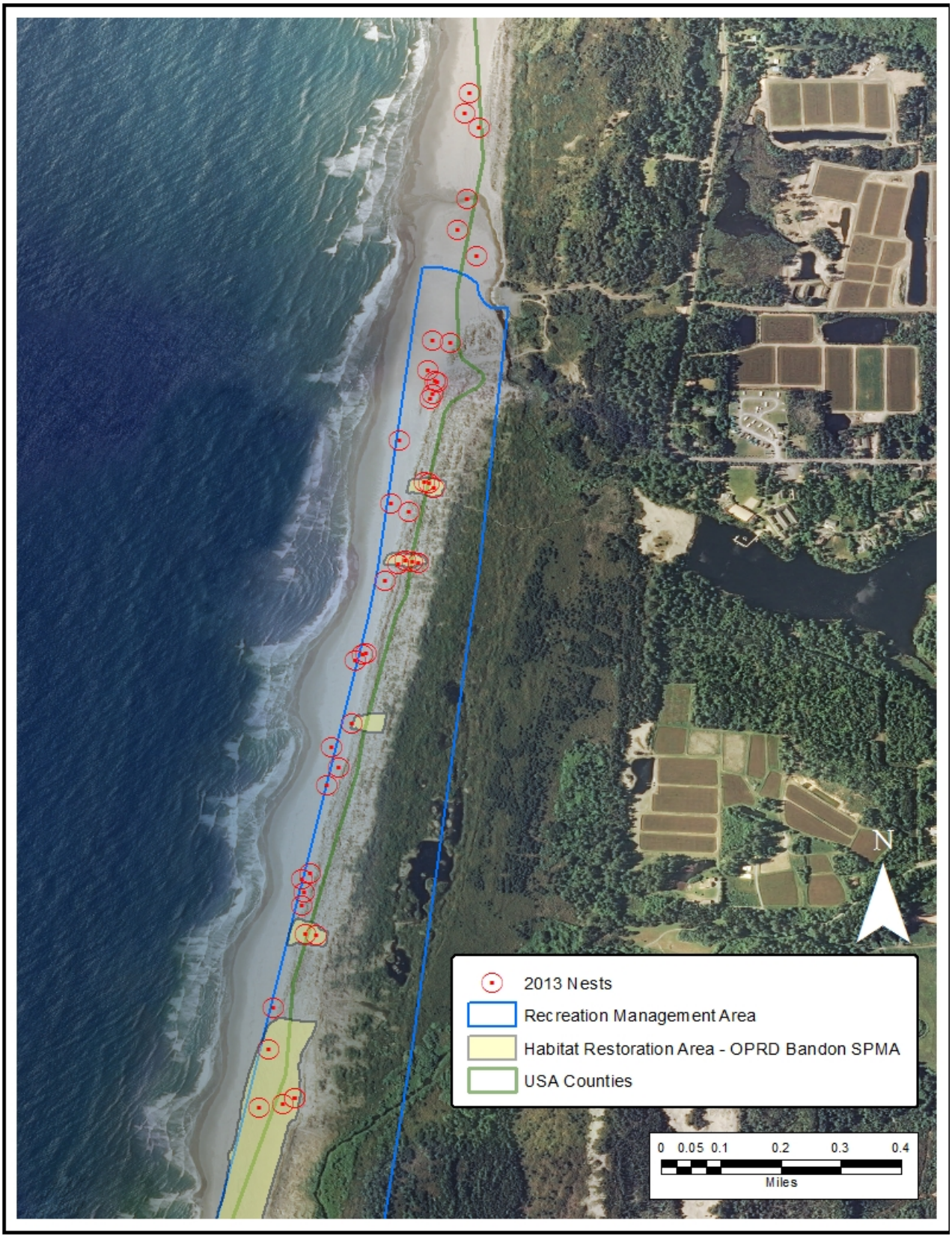


Figure 8. Snowy Plover nest locations at Bandon Beach, Oregon, 2013

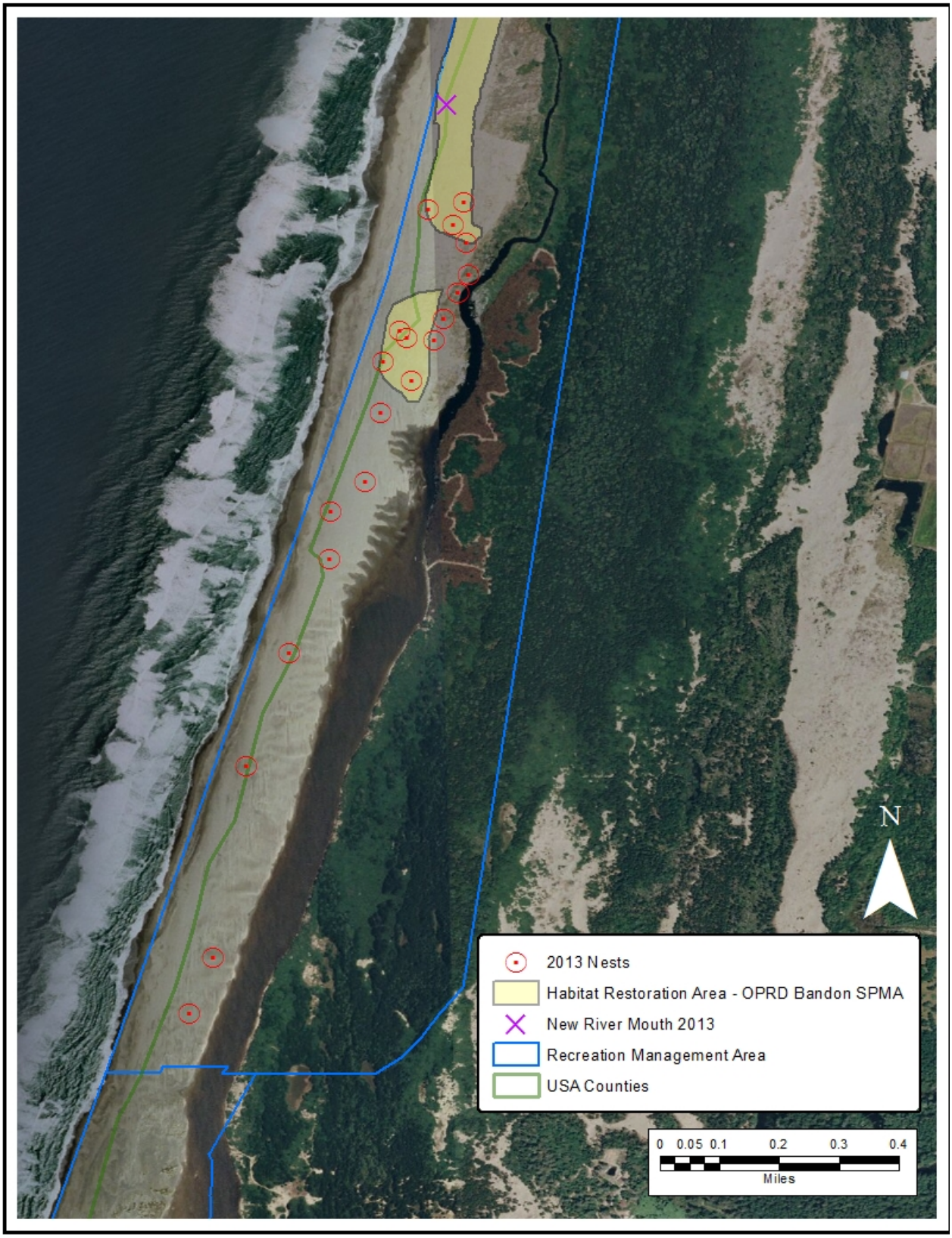


Figure 9. Snowy Plover nest locations at Bandon/New River, Oregon

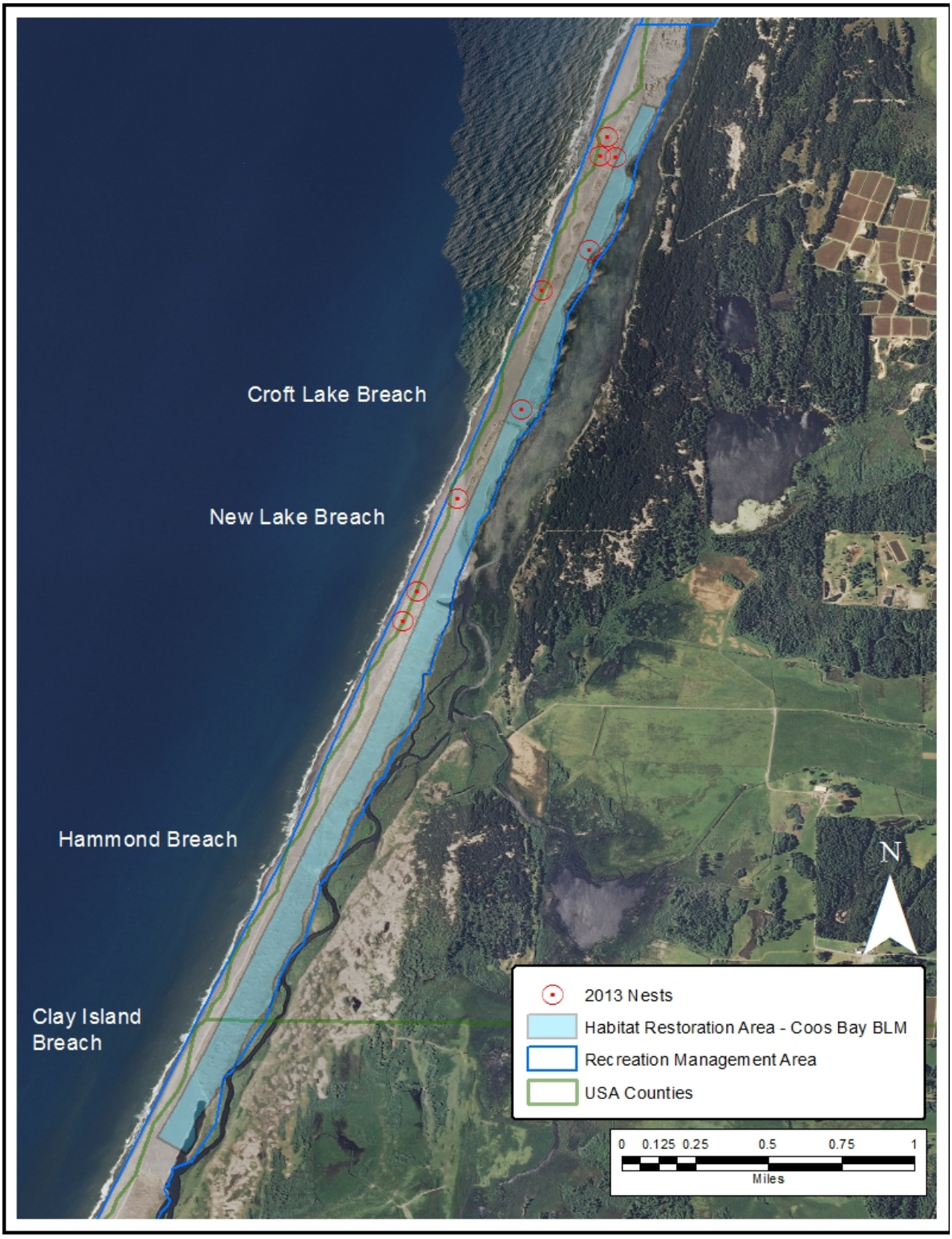


Figure 10. Snowy Plover nest locations at New River HRA, Oregon, 2013

Figure 11. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2013. Dashed lines represent +/- 2 standard deviations.

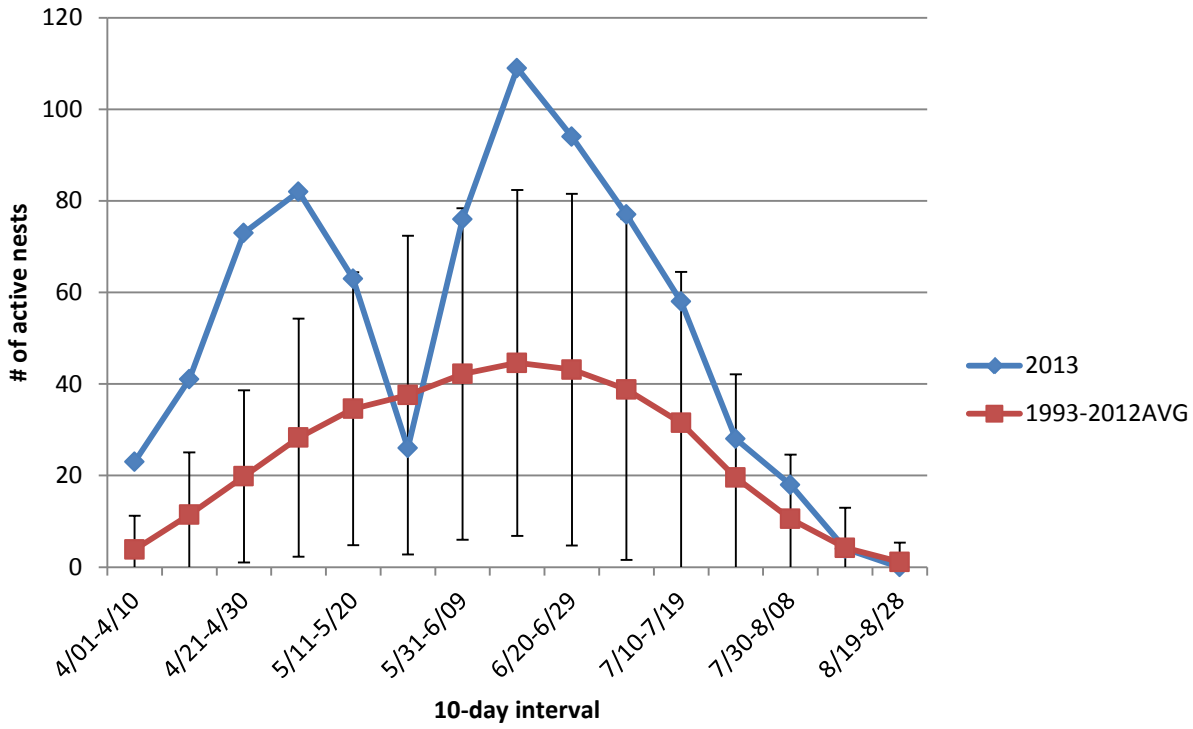


Figure 12. The number of exclosed and unexclosed days of Snowy Plover nests along the Oregon coast, 1992 – 2013.

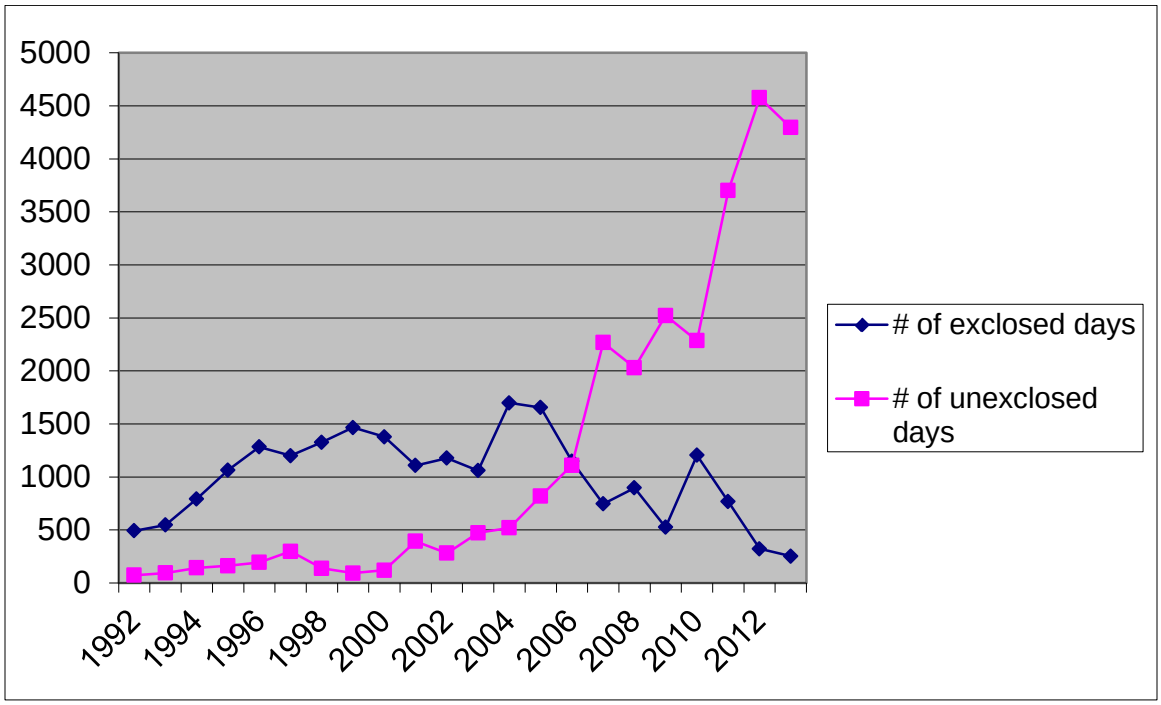
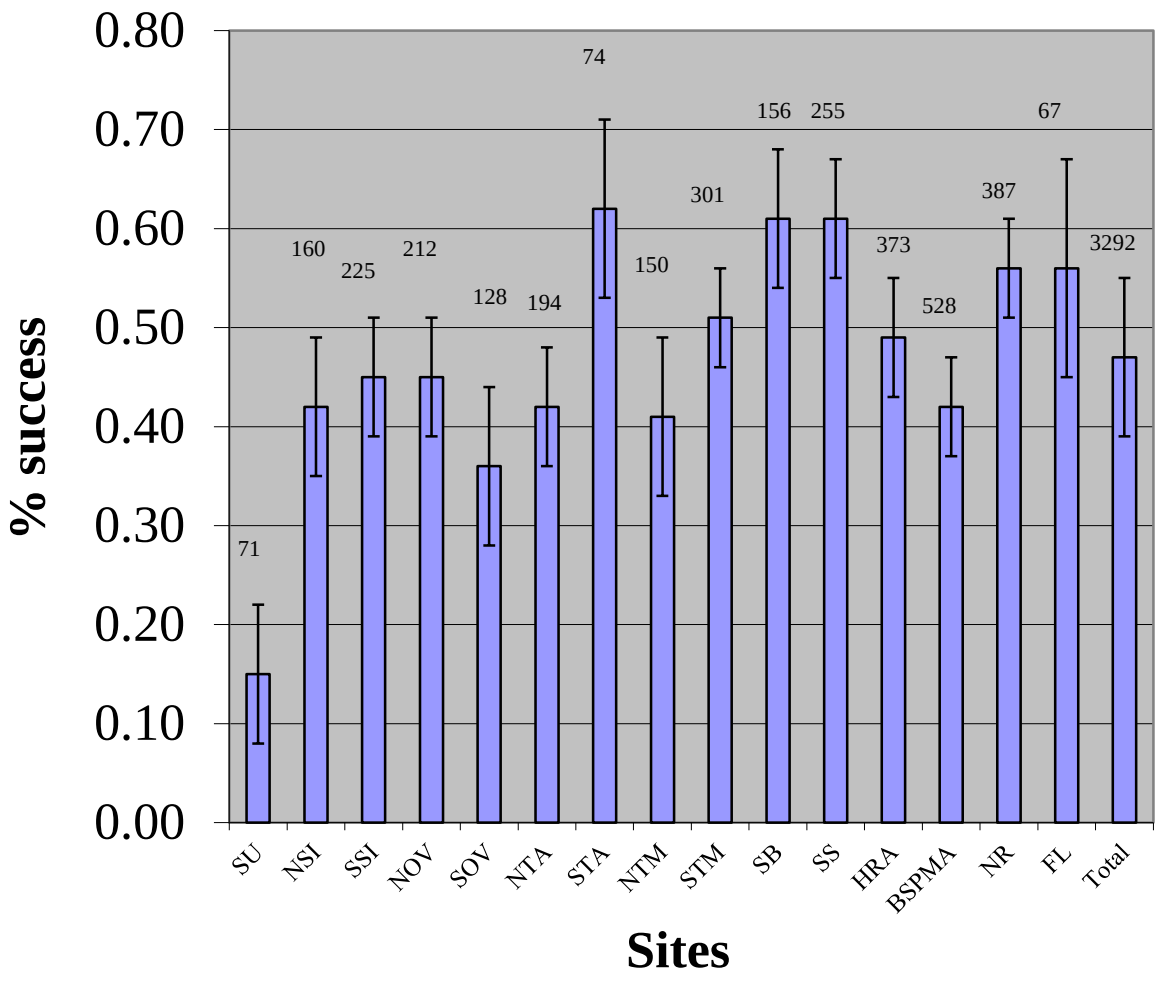


Figure 13. Mean percent nest success for Snowy Plovers along the Oregon coast, 1990-2013, with standard error bars. Number above each bar is the sample size.



APPENDIX A.

Study Area

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

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

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

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

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

Tenmile: North Tenmile, Coos and Douglas Cos. (Figure 6) - the spit and ocean beach north of Tenmile Creek, north to the Umpqua River jetty; and South Tenmile, Coos Co. - 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 7): South Beach - the beach between the north jetty and the F.A.A. towers; and South Spoil/HRAs - the south dredge spoil and adjacent habitat restoration areas (94HRA, 95HRA, 98HRA);

Bandon Snowy Plover Management Area, Coos Co. (Figures 8 and 9): This site includes the Bandon SPMA and all nesting areas from north of China Creek to the south end of state land south of the mouth of New River.

New River, Coos Co. (Figures 9 and 10) - the privately owned beach and sand spit south of Bandon Snowy Plover Management Area south to BLM lands, and the BLM Storm Ranch Area of Critical Environmental Concern habitat restoration area (HRA).

Floras Lake, Curry Co. – the beach and overwash areas west of the confluence of Floras Creek and the beginning of New River, north to Hansen Breach.

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

APPENDIX B.

Recommendations for Management of Recreational Activities and Habitat Restoration for sites with Snowy Plovers along the Oregon Coast - 2013.

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.

Siltcoos North and South Spits:

- Continue predator management to reduce the number of corvids using the nesting area. Continue to reduce the feral cat population 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 prior to 15 March, to be as effective as possible. Place signs and ropes on east and south side of the north spit nesting area as well as continued signage to the west and north.
- Enforce dog regulations on the spits and near the estuary during nesting season.
- Continue the use of campground plover hosts/volunteers to educate people and restrict them from closed areas. 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 both north and south closures for 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 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 near nesting area.
- Enforce current dog 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.
- Continue to maintain and improve the south side for nesting. Consider expanding and improving habitat on the north side.
- 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 vehicle use on the beach is limited to 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 Restoration Area near 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 for hikers and campers.

New River:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area.
- 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.
- Consider a permit process for hikers/campers to help educate hikers, limit their numbers, ensure that they do not have dogs, are legally camping, and are in compliance.

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.

APPENDIX C

Recovery Unit 1 (Oregon & Washington)
Exclosure Use Guidelines Developed by Oregon Biodiversity Information Center for the Western Snowy Plover Working Team
2/27/2012

Nest exclosures are mesh fences that surround a Western Snowy Plover (*Charadrius nivosus nivosus*) nest and act to keep out predators. Nest exclosures have been used in Oregon since 1991 to protect plover nests from depredation by mammalian and avian predators. Prior to implementation of comprehensive predator management, plovers have suffered high rates of nest depredation. Exclosures have been successful at increasing nest success rates (Table 1) (Stern *et al.* 1990, 1991, Craig *et al.* 1992, Casler *et al.*1993, Hallett *et al.*1994, 1995, Estelle *et al.*1997, Castelein *et al.*1997, 1998, 2000a, 2000b, 2001, 2002, Lauten *et al.*2003, 2005, 2006, 2006b, 2007, 2008, 2009, 2010, 2011). Predators that prey on snowy plover eggs include mammalian predators such as skunk (*Mephitis sp*.), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), mice (*Peromyscus* sp.), and weasel (*Mustela sp*.); and avian predators, mostly American crows (*Corvus brachyrhynchos*) and common ravens (*Corvus corax*).

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

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

Predator exclosures increase snowy plover hatching success and the number of chicks hatched per male, but not fledging success or the number of chicks fledged per male (Neuman *et al.*2004). 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 are working with Steve Dinsmore (Department of Natural Resource Ecology and Management, Iowa State University) to evaluate the effectiveness of exclosure use on nest success and adult survival. Preliminary results indicate that, predictably, exclosure use has a strong positive impact on nest success. Further analysis is underway to determine potential impacts of exclosure use on adult success and fledging success (Dinsmore et al., unpublished data) (see Pearson *et al.*2009, Neuman *et al.*2004).

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

- Nest survival of exclosed nests was significantly higher in ten studies (Rimmer and Deblinger 1990, Melvin *et al.*1992, Estelle *et al.*1996, Johnson and Oring 2002, Lauten *et al.*2004, Niehaus *et al.*2004, Isaksson *et al.*2007, Hardy and Colwell 2008, Pauliny *et al.*2008, Pearson *et*

*al.*unpublished), and there was no difference in two studies (Nol and Brooks 1982, Mabee and Estelle 2000).

- Exclosed nests appear to be only vulnerable to reptilian and small mammal predators while unexclosed nests are vulnerable to predators of all sizes (Mabee and Estelle 2000).
- No difference in fledging success between exclosed and unexclosed nests in four studies (Hardy and Colwell 2008, Pauliny *et al.*2008, Lauten *et al.*2004, Pearson *et al.* unpublished data) and higher fledging success for exclosed nests in two studies (Larson *et al.*2002, Melvin *et al.*1992). There was no difference in fledging success between exclosed and unexclosed nests for all studies involving snowy plovers.
- Adult mortality associated with exclosures was reported in six of the eight studies that included or mentioned this response variable (Murphy *et al.*2003, Lauten *et al.*2004, Isaksson *et al.*2007, Hardy and Colwell 2008, Pauliny *et al.*2008, Pearson *et al.*unpublished). Only three studies compared adult mortality between exclosed and unexclosed nests and two reported significant increases in adult mortality associated with exclosures (Murphy *et al.*2003 and Isacsson 2007) and one reported no difference (Pauliny *et al.*2008).
- Adult mortality appears to be largely attributable to raptors and appears to be episodic (Murphy *et al.*2003, Neuman et 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 two studies where this was compared directly (Isaksson et al., 2007, Hardy and Colwell 2008).
- Abandonment was not associated with the construction process, size, shape, mesh size and fence height (Vaske *et al.*1994). Covered exclosures are more likely to be abandoned than uncovered exclosures (Vaske *et al.*1994).
- Exclosures increased incubation length by one day but did not influence chick condition (Isaksson *et al.*2007).
- Egg hatchability was higher in three studies (Melvin *et al.*1992, Isaksson *et al.*2007, Pauliny *et al.*2008) but no difference was observed in one study (Hardy and Colwell 2008).
- Breeding adults may receive false messages regarding site quality and encouragement to continue to breed in sink habitats (Hardy and Colwell 2008). This is an important research question that should be examined but no data support this contention.

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

- Since raptors appear to be the primary threat to adult plovers in exclosures, delay use of exclosures until peak raptor migration has passed. Currently, we have identified May 15 as a suitable cutoff, but this date could be altered as needed.

- Delaying exclosure use until May 15 allows field personnel time to assess causes of early nest failures, although weather conditions can make accurate assessment difficult. During this time, and contingent on funding, we recommend an owl survey be run at each site.

- If nests are being lost primarily to mice, exclosures will not help the problem, and may pose additional risk if the mice are being preyed upon by raptors. In this case exclosure use is not appropriate.

- If corvids and/or large mammals are identified as the main predator at a site, removal of the predators should be the primary goal with exclosures used as a supplemental measure to help protect nests.

- Any use of exclosures should be accompanied by close monitoring to evaluate their effectiveness (Hardy and Colwell 2008) and to detect predators of adult plovers early (Pauliny *et al.*2008). Weather permitting, exclosed nests should be checked at least twice per week. If conditions do not allow checks twice a week, exclosure use should be seriously reconsidered.

- Adult predation associated with exclosures is often episodic (Castelein *et al*. 2000b, Lauten *et al.* 2006). Once adult predation is suspected, all exclosures should be removed from the site and their use discontinued for the season.

- To minimize the risk of episodic predation on adult plovers, additional caution should be used when placing exclosures within sight of each other (this puts multiple adults at risk).

- Exclosures should not be placed along the foredune.

- Exclosures should not be placed in a windy location that might result in nest drifting. Since the ME's are 4 feet per side, the nest is only about 2 feet from each sidewall. If the nest begins to drift, it could come close to a sidewall, and a predator such as a raccoon could reach in and grab the eggs. If an exclosed nest is in a potentially windy location, it must be monitored frequently to ensure the safety of the nest and adults (especially on windy days).

Appendix D

Snowy Plover Monitoring Methods

Nest Surveys

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

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

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

Population Estimation

We estimated the number of Snowy Plovers on the Oregon Coast by determining the number of individually color banded adult Snowy Plovers recorded during the breeding season, and then adding an estimated number of unbanded Snowy Plovers. We determined the number of unbanded Snowy Plovers observed within ten-day intervals during the breeding season, selected the highest count of unbanded birds and then subtracted the number of adults that were banded subsequently. We also determined the number of plovers known to have nested at the study sites, including marked birds and a conservative minimum estimate of the number of unbanded plovers.

Nest Monitoring

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

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

Brood Monitoring

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

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

Banding

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