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North Bend, Oregon 97459

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Corvallis OR, 97333

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

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Abstract

From 5 April – 21 September 2012 we monitored the distribution, abundance and productivity of the federally Threatened Western Snowy Plover (*Charadrius nivosus nivosus*) along the Oregon coast. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Snowy Plover Management Area, New River HRA and adjacent lands, and Floras Lake. Our objectives for the Oregon coastal population in 2012 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 290-91 adult Snowy Plovers; a minimum of 231-238 individuals was known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990. We monitored 314 nests in 2012; the highest number of nests since monitoring began in 1990. Overall apparent nest success was 45%. Exclosed nests (n = 22) had an 82% apparent nest success rate, and unexclosed nests (n = 289) had a 42% apparent nest success rate. Nest failures were attributed to unknown depredation, unknown cause, corvid depredation, abandonment, one egg nests, wind/weather, mammalian depredation, overwashing, adult plover depredation, and infertility. We monitored 154 broods, including 11 from unknown nests, and documented a minimum of 173 fledglings. Overall brood success was 70%, fledging success was 43%, and 1.37 fledglings per male were produced.

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

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Introduction

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

Oregon Biodiversity Information Center (ORBIC, formerly Oregon Natural Heritage Information Center) completed our 23nd 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, and 2011). Our objectives for the Oregon coastal population in 2012 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 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

In 2012, state and federal agency personnel and volunteers conducted pre-breeding window surveys at historical nesting sites between Clatsop Spit, Clatsop Co. and Pistol River, Curry Co (Elliott-Smith and Haig 2007). Pre-breeding surveys have been implemented since 2001 to locate any plovers

attempting to nest at historic (currently inactive) nesting areas. Agency personnel also assisted surveying plovers during breeding season window surveys in late May and early June. Breeding season window surveys were implemented at both currently active and historic nesting areas (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, Euchre Creek, and Pistol River.

Monitoring

Breeding season fieldwork was conducted from 5 April to 21 September 2012. 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 2012.

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 2012 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 underestimates the actual number of unbanded plovers present. We use this number to give a minimum range of the number of unbanded plovers in the population. 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 but were not confirmed breeders were considered Oregon resident plovers. We estimated an overall Oregon resident plover population by adding the known breeders with the number of plovers present but not confirmed nesting during the breeding season.

We determined the number of individual banded female and male plovers and the number of individual unbanded female and male plovers that were recorded at each nesting area along the Oregon coast from the beginning to the end of the 2012 breeding season. Data from nesting sites with a north and south component (Siltcoos, Overlook, and Tenmile) were pooled because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were 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. Statistical analysis of nest, chick, and adult survival will be published in a refereed journal.

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 was high for the amount of effort (eggs laid) and the productivity index would be high. If plovers produced low numbers of fledglings compared to high numbers of eggs laid, then their productivity was low and the productivity index would be low. 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 (2004-2011). We did not include the years 2002 and 2003 in the analysis because three sites (CBNS, Bandon Beach, and New River) had predator management in those years but all other sites did not.

Exclosures

From mid-May to August, we used a limited number of mini-exclosures (MEs, Lauten *et al.* 2003) to protect plover nests at North and South Overlook, North Tahkenitch, 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 2012 due to good unexclosed hatch rates at Siltcoos, Overlook, North Tahkenitch, and Coos Bay North Spit and due to adult plover depredation concerns in and around ME's, particularly at Tenmile. No exclosures were used at North and South Siltcoos, North and South Tenmile, Coos Bay North Spit, and Floras Lake.

Predator Management

Lethal predator management occurred at all active nesting areas; corvids (*Corvus sp*.) were targeted at all nesting sites. Some mammal trapping, specifically targeting red fox (*Vulpes vulpes*), striped skunks (*Mephitis mephitis*), and coyote (*Canis latrans*) occurred at specific sites. In 2011 a trapping effort targeting deer mice (*Peromyscus maniculatus*) was implemented at CBNS (Lauten *et al*., 2011). In 2012 deer mice were again targeted 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. This trapping effort helped to assess the rodent population compared to the previous year's results while also potentially reducing rodent depredations on plover eggs. For information regarding the predator management program, see Burrell (2012).

Results and Discussion

Abundance and Monitoring

Window Surveys

During the pre-breeding April surveys of beaches with no current nesting activity, one plover was recorded along the Whiskey Run to Coquille River (Coos Co.) survey route, the first time a plover was detected since the pre-breeding surveys were implemented in 2001. During the May window surveys, two plovers were detected in Clatsop County; one at Fort Stevens State Park, and one at Necanicum Spit (USFWS unpublished data). Clatsop spit (Clatsop Co.), the first two plovers to be detected on the north coast during spring window surveys since 2002. The annual breeding window survey in late May counted 206 plovers (Table 1), the highest number of plovers ever detected.

Breeding Season Monitoring

During the 2012 breeding season, we estimated a 290-291 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 290-291 plovers, 270 (93%) were banded. The number of unbanded plovers estimated by the 10 day interval method was 20-21 individuals. For the breeding season we observed 128 banded females, 142 banded males, 17-18 unbanded females, and 3 unbanded males. The totals include two banded males, one banded female, and one unbanded female plover that were killed in or around an exclosed nest, and a minimum of four other banded males and three banded female that disappeared during the breeding season.

Of the total estimated population, 231-238 plovers (79-82%) were known to have nested (Table 1), similar to the mean percentage for 1993-2011 (79%). A minimum of 94 banded females and 119 banded males nested. Approximately 12-17 unbanded females nested and 7 unbanded males were known to have nested; the number of known unbanded males that nested indicates that the 10-day interval method of estimating unbanded plovers underestimates the true number of unbanded plovers present. An additional 21 banded females and 19 banded males were present during the breeding season but were not confirmed nesting. The minimum estimated Oregon resident plover population was 271-278.

For the first time since monitoring began in 1990, all three indices to the Snowy Plover population on the Oregon coast were above 200 individuals (Table 1). The number of plovers recorded by all three indices was the highest since monitoring began in 1990 and continues to show an increasing trend in the Oregon population (Table 1). The window survey count increased by 38 individuals and the total number of plovers present increased by 37-42 individuals, while the number of breeding plovers increased by 17-24 individuals. As we have noted in previous years, increasing plover numbers and densities on the nesting area has resulted in some difficulties positively identifying all nesting individuals (Lauten *et al*., 2010 and 2011), therefore the number of breeding individuals was likely higher than the total tallied because some individuals were not positively identified at a nest but still likely nested based on their presence throughout the breeding season. The number of resident plovers in 2012 increased by 38-45 individuals, similar to the increase in the window survey count and the total number of plovers present. In 2012, the Oregon coastal plover population was above the recovery goal set for the state. Recovery goals have not been met in other states. (U.S. Fish and Wildlife Service 2007).

Overwinter Survival

Adult overwinter survival is very important to maintaining and increasing populations (Sandercock 2003, USFWS 2007, Dinsmore *et al*. 2010, Lauten *et al*. 2010 and 2011). In 2011 the estimated adult plover population was 247-253, of which 220 were banded. Of these 220 banded adult plovers, 59 (27%) were not recorded in Oregon in 2012, and we received no reports of these individuals

being sighted elsewhere in the range. Thus they are presumed not to have survived winter 2011-12. The overwinter return rate based on returning banded adult plovers was 73%, above the 1994-2011 mean of 64% and the fourth consecutive year the adult return rate was above 70% (Lauten *et al*., 2008, 2009, 2010, and 2011).

Due to analysis of hatch year returns, we adjusted the 2011 fledgling total to 168 from 172. Ninety-one of the 172 hatch-year plovers from 2011 (HY11) returned to Oregon in 2012. The return rate was 53%, slightly higher than the average return rate (Table 2, 47%). Of the returning 2011 HY11 birds, 42 (46%) were females and 49 (54%) were males. Seventy of the HY11 returning plovers attempted to nest (77%), and they accounted for 34% of the banded adults. These HY11 returns exceeded the number of banded adults that did not return in 2012.

The number of unbanded plovers was lower than previous years (n = 19-24 in 2012, n = 27-33 in 2011 and n = 27-31 in 2010), and the number of adult plovers banded outside of Oregon was the same as the previous two years (n = 18 in 2011 and 2010), indicating that immigration had a limited role in the increase in plover numbers. The increase in the population in 2012 was due to a combination of high adult and juvenile return rates. As we noted in 2011 (Lauten *et al*., 2011), studying and managing plovers in winter could result in positive management practices that have beneficial effects on plover overwinter survival and thus population levels (Brindock and Colwell 2011, Dinsmore *et al*., 2010).

Emigration from Oregon continues to be important to smaller plover populations in Washington and Humboldt Co., California. Colwell *et al*. (2008, 2009, 2010, 2011, and 2012) has noted that Humboldt Co. populations are maintained by immigration, and Washington populations are also maintained by immigration into that population (S. Pearson, pers. comm.). High reproductive output from Oregon plovers benefits these neighboring plover populations.

During the 2012 season, we captured and rebanded 33 banded adult plovers that either had worn bands or brood band combinations which needed to be updated to unique adult combinations. Nineteen of these were males and 11 were females. We banded eight unbanded adult male plovers, three unbanded adult female plovers and 335 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 2012. Sutton Beach had no recorded plovers in 2012. The overall number of breeding plovers at Siltcoos was the same as in 2011. The number breeding was similar to the recent past (Table 3, 26 in 2011, 23 in 2010, and 24 in 2009). Overlook had slightly more plovers present and slightly more breeding plovers as compared to 2011 (Table 3, 89 plovers present and 49 breeding in 2011). This indicates a relatively stable population after several years of population increases at this site (Lauten *et al*. 2011). At North Tahkenitch in 2012, the number of plovers and the number of breeding plovers increased by about 10 individuals compared to 2011 (Table 3, 58 present and 22 breeding in 2011). Some plovers nesting at North Tahkenitch in 2012 moved from Tenmile after unsuccessfully attempting to nest at Tenmile. The number of plovers and the number of breeding plovers at Tenmile in 2012 was also similar to 2011 (Table 3, 61 plovers present, 25 breeding in 2011). CBNS had the highest increase in plover numbers and breeding plovers in 2012. There were approximately 20 more individual plovers and 20 more breeding plovers at CBNS in 2012 compared to 2011 (Table 3, 69 plovers present and 59 breeding in 2011). The number of plovers using Bandon SPMA generally reflects the number of plovers using the entire Bandon Beach/New River/Floras Lake

area, as the majority of plovers from these areas tend to spend the non breeding season at Bandon SPMA. The estimated number of plovers using Bandon SPMA in 2011 (minimum 56-60) was slightly lower to the total number of plovers using Bandon SPMA in 2012 (Table 3). The number of breeding plovers in 2012 for the Bandon Beach/New River/Floras Lake area was 46, slightly below the number of breeding plovers for 2011 (n = 50). In 2012, Overlook and CBNS had the highest number of plovers for all sites, approximately 31-32% of the total plover population for each site. We recorded a total of 10 individuals at Floras Lake, including five breeding individuals, the first breeding plovers since 2009.

The increasing plover population has resulted in plovers occupying available habitat adjacent to the traditional nesting areas (Lauten *et al*. 2010 and 2011), particularly the beach between South Siltcoos to Overlook and Overlook to North Tahkenitch. In 2012 plovers continued to use these sections of beach for both nesting and brooding (Figures 2 to 4). First year nesting plovers will tend to return to areas where they successfully hatched chicks, therefore we would expect continued use of these beach areas for plover nesting and brooding in the future. Lauten *et al*. (2011) noted that the increasing plover population would likely result in plovers occupying additional beaches that were adjacent to current nesting beaches such as South Tahkenitch to the Umpqua jetty, the beach north of North Tenmile, and CBNS beach north of the FAA tower. 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 (Figure 6) and late in the season we found two very recently fledged unbanded birds from an unknown brood north of the FAA towers that likely came from the beach north of access point one. We also found two nests at Floras Lake in 2012 including the first nests on the CMA in 10 years, as well as two nests along the beach north of Floras Lake and south of Clay Island breach. For the first time since spring surveys have been conducted on the north coast, two plovers were detected at Clatsop spit, although they were not detected on subsequent surveys. A few banded plovers were also reported in late summer and fall along the north coast by birdwatchers (*fide* Oregon Birders On Line).

Nest Activity

With an increasing plover population, the number of nests found continues to increase. We located 314 nests during the 2012 nesting season (Table 4, Figures 2-9), the highest number of nests found since monitoring began in 1990. In addition we recorded a minimum of 11 broods from nests that we did not locate prior to hatching. Nest distribution was similar to 2011 (Table 4). Siltcoos, Overlook and Tenmile had similar numbers of nests in 2012 compared to 2011. North Tahkenitch had 13 more nests in 2012 compared to 2011; the increase in nests was a result of larger numbers of plovers using this site in 2012 compared to 2011. CBNS had similar numbers of nests in 2012 compared to 2011 despite an increase in the number of plovers at this site. The similar number of nests in 2012 compared to 2011 was due to high nest success and therefore a lack of multiple renest attempts. There were fewer nest attempts on South Beach in 2012 compared to 2011 and more nest attempts on the HRAs in 2012. Bandon SPMA had the highest increase in nest numbers in 2012 (n = 60) compared to 2011 (n = 37). The higher number of nests was due to repeated nest failures resulting in many renesting attempts. There were 48 nests on Bandon Beach and 12 nests on the state portion of New River spit. New River HRA had the largest decline in nest numbers in 2012 (n = 17) compared to 2011 (n = 29). The lower number of nests on the New River HRA was partly due to fewer plovers using the HRA in 2012. We suspect there may have been more nests attempts at New River HRA, but were unable to confirm this because high water early in the season prevented us from conducting as many surveys as needed. High predation pressure by corvids likely resulted in some nest attempts failing before we were able to find and document them. Floras Lake had two nests, the first nests at this site since 2009 and only the second time in 10 years that nests were found here.

The first nests were initiated about 6 April (Figure 10). Nest initiation increased through late-May, and remained high into the beginning of July. The maximum number of active nests (n = 100) during 10-day intervals occurred during 31 May – 9 June, two weeks earlier than 2011 and one week earlier than the average peak nesting period. This was the highest number of active nests during any 10 day time interval since monitoring began in 1990 and the first time 100 nests were active at the same time. The last nest initiation occurred on 19 July.

Nest Success and Exclosures

For the sixth consecutive year, the number of days nests were unexclosed was higher than the number of days nests were exclosed (4576 unexclosed days, 323 exclosed days, Figure 11). In 2012, exclosures were used on 8% (n = 25) of the total number of nests (n = 314), and 7% of the total number of exposure days were exclosed (n = 323/4899).

The overall annual apparent nest success rate in 2012 was 45% (Table 5), similar to the average (Table 6). The number of exclosed nests in 2012 (n = 22, 7%) was the lowest since 1991 and the lowest percentage of the total number of nests since monitoring began in 1990. Apparent nest success for exclosed nests in 2012 was 82%, higher than the average for all years (x = 71%, Table 6). The number of unexclosed nests in 2012 (n = 289, 93%) was the highest since monitoring began. Apparent nest success for unexclosed nests in 2012 was 42%, higher than the overall mean (x = 20%, Table 6). Nest success of unexclosed nests in 2012 was significantly lower than nest success of exclosed nests ($\chi^2 = 12.2720$, df = 1, $P < 0.01$).

Siltcoos

No exclosures were used at Siltcoos in 2012 (Table 5), the first time no exclosures were used on both sides of the estuary since 1993. Overall nest success for Siltcoos was 53% (Table 5), above the average for these sites (Figure 12). North Siltcoos had 40% nest success and South Siltcoos had 59% nests success. Causes of nest failure are detailed in Table 7. Despite nest depredations being the main cause of nest failure at Siltcoos, no exclosures were used in 2012 due to good corvid management and good overall nest success.

Overlook

At Overlook in 2012, the overall nest success was 47% (Table 5). Overall nest success for North and South Overlook was 54% and 42% respectively (Table 5), both slightly above average for these sites (Figure 12). Only four of 59 nests were exclosed at Overlook, including one on the north side and three on the south side. All four exclosed nests hatched (Table 7). Of the 15 nests that failed due to depredations or unknown cause, 10 failed at or prior to mid-May before exclosure use was a management option. The other failed nests due to unknown depredation had no evidence that corvids were responsible. Due to good overall nest success and good corvid management after mid-May, exclosure use was limited at Overlook in 2012.

Tahkenitch

Plover activity has increased considerably at North Tahkenitch in the past two years (Table 4). Overall nest success at North Tahkenitch in 2012 was 58% (Table 5), similar to 2011 (61%), and much higher than the average for this site (Figure 12). Of the 36 nests found, only four were exclosed, all of which hatched. Thirty-two nests were unexclosed, and 17 hatched (53%, Table 5). Causes of nest failure are detailed in Table 7. Of the 15 nest failures, five occurred prior to mid-May, so under the exclosure protocol they would not have been exclosed anyway. Due to the good overall nest success and lack of corvid depredations, exclosure use was limited at North Tahkenitch in 2012.

Tenmile

In 2012, Tenmile continued to have very poor nest success with only six of 46 nests successfully hatching (13%, Table 5), similar to 2011 and well below the average for these sites (Figure 12). Causes of nest failure are detailed in Table 7. Nest failures attributed to unknown cause were likely also depredated, suggesting that upwards of 88% of the failed nests at Tenmile may have been due to some depredation event. Both field and camera evidence suggests that the main culprit of nest failures at Tenmile is ravens, and we continue to work with Wildlife Services staff to eliminate the corvids. In 2012 we set up a camera on five nests at Tenmile. All five of these nests hatched, though we did record ravens approaching the nests on multiple occasions. The ravens appeared wary, possibly because of the presence of the camera, and despite evidence that the raven was aware of the eggs it did not depredate the nests. While we did not positively record any raven depredations, the video confirms that ravens are using the area and may be wary of human-related items. Despite the high level of depredations and likely depredations, we did not exclose any nests at Tenmile. Great Horned Owls have targeted adult plovers in and around exclosures at this site (Lauten *et al*. 2011), and we did not have time to run surveys to determine the presence or absence of owls. Because adult survival is the primary driver of population growth (Sandercock 2003, USFWS 2007, Dinsmore *et al*. 2010, Lauten *et al*. 2010 and 2011), we felt it was more important to reduce risk to adult survival than to nest survival. Experience from other nest sites indicates that eliminating and successfully managing corvids increases nest success to sustainable rates and allows exclosure use to be reduced, thus reducing or eliminating risks to incubating adult plovers.

Coos Bay North Spit

No exclosures were used at CBNS for the sixth consecutive year (Table 5). Overall nest success at CBNS was 87%, similar to 2011 (82%). Nest success at CBNS was well above average (Table 5, Figure 12) for all sites. On the HRAs, 34 of 39 nests hatched (87%), on South Spoil 13 of 15 nests hatched (87%), and on South Beach 6 of 7 nests hatched (86%). In 2012 only one nest failed to depredation. Causes of the remaining nest failures are detailed in Table 7.

Bandon SPMA

There were 23 more nests at Bandon SPMA in 2012 compared to 2011 (Table 4). The increase in the number of nests was partly due to poor nest success, which resulted in many renesting attempts (Table 5). Depredations were the main cause of nest failure (79%, Table 7). Many of the unknown depredations were likely caused by corvids, but there was no evidence to determine the exact cause of the depredation. Despite the high levels of nest depredations, we only used nine exclosures in 2012 (seven on the Bandon Beach side and two on the New River spit). Due to previous experience with adult plovers being depredated in and around exclosures at Bandon SPMA (Lauten *et al*., 2006and 2011), we were cautious about erecting exclosures especially if corvid activity was relatively low. In 2012, corvid activity was often minimal, and then episodically increased resulting in nest depredations before we could erect exclosures. One exclosed nest hatched but the adults were found dead within ca. 25 m of the exclosed nest. The hatching chicks were then transported to the Newport Aquarium. The exclosure had canine tracks around it, and the canine attempted to dig under the exclosure. We believed at the time this was indication that fox had attacked the adults and the hatching nest. Another male plover that was incubating on an exclosed nest during the same period was found with a severely injured left leg. Because of these events, we pulled three of the nine exclosures to reduce the likelihood of further adult injuries or mortalities. Five of the six nests that were exclosed for the duration of incubation hatched (83%); one exclosed nest was abandoned, but may have been abandoned before erection of the exclosure. Unexclosed nest success at Bandon SPMA continues to be very poor, and overall nest success at Bandon SPMA in 2012 was well below average (Figure 12).

New River

Overall nest success on non-state lands at New River in 2012 was also low (29%, Table 5), and well below the average for this site (Figure 12). Ten of 18 nests were unexclosed, including one on private land and nine on the HRA; all 10 failed (Table 5). Eight nests were exclosed, and five hatched (Table 5). The causes of nest failure are detailed in Table 7. We believe corvids were the main cause of nest failure as they were present in relatively high densities all summer, particularly on the HRA. While exclosure use at New River does increase nest success, we continue to experience adult mortalities in and around exclosures at this site. In 2012, of the three exclosed nests that failed, two adults were depredated at one, and the other two exclosed nests were abandoned. The adults associated with one of these nests also disappeared, which suggests they were also depredated.

Floras Lake

Of the two nests found at Floras Lake, one hatched (Table 5). One nest was found on the Cooperative Management Area (CMA) and successfully hatched without an exclosure. The second nest was north of Hanson breach and was not exclosed; the nest failed to unknown depredation.

Depredations Around Exclosures

As of 2011, we have documented a minimum of 46 adult plovers (ca. 5% of all known adult plovers) depredated in or around exclosures (ORBIC, unpubl. data). Due to these adult losses as well as the relatively good success of both nests and broods, we continue to carefully evaluate exclosure use and minimize the number of exclosures used and the amount of time exclosures are protecting nests. In 2012, the number of days unexclosed was the highest since monitoring began, and we reduced the number of days exclosed to 7% of the total number of exposure days (Figure 11). Adult survival is very important for population growth (Sandercock 2003, USFWS 2007, and Dinsmore *et al*. 2010), therefore if nest success is relatively good, evidence of predation pressure is minimal, and fledgling productivity is good, exclosure use is not necessary. Exclosures continue to be a management tool that increases nest success, however with a reasonably large population size and good productivity, exclosure use should be carefully evaluated and minimized to the extent possible.

Nest Failure

Exclosed nests in 2012 had an overall failure rate of 18% (4 of 22, Table 8; three nests from Bandon SPMA B\ not included because the exclosures were removed after two adult plovers were found dead outside of an exclosed nest). Of the four failed exclosed nests, two failed to unknown causes, one was abandoned, and one had both adult plovers depredated (Table 8). The banded adult male from one of the exclosed nests that failed to unknown cause disappeared during the incubation period; it is possible he was also depredated. The female to this same nest also disappeared, but she was unbanded so it is unclear if she survived. The number of unexclosed nests that failed in 2012 (n = 167) was higher than the past three years (2011, n = 129; 2010, n = 149; 2009, n = 148). The failure rate of unexclosed nests in 2012 (58%) was similar to 2011 (54%) but lower than previous years (77% in 2010, 73% in 2009, and 73% in 2008). In 2012, the main causes of nest failure for unexclosed nests were unknown depredations, unknown cause, corvid depredations, abandonment, one egg nests, and wind/weather (Tables 7 and 8). Overall nest failures were attributed to unknown depredation, unknown cause, corvid depredation, abandonment, one-egg nests , wind/weather , mammalian depredation , overwashed , adult plover depredation , and infertility (Table 7).

In 2012, the number of one-egg nests (n = 14) and abandoned nests (n = 17) was similar to previous years (Lauten *et al*. 2007, 2008, 2009, 2010, and 2011). Since the number of these nests has been relatively stable for the past six years, we continue to believe that the causes of these abandonments

are natural and are not due to exclosure use (only 9% of these nests have been exclosed), or recreational activity which remains low within the nesting areas, or monitoring activity.

Predator Management

No rodent depredations of nests were confirmed in 2012, the second consecutive year with no or low rodent depredations (Lauten *et al*., 2011). In 2012, 201 deer mice were captured at CBNS (Burrell 2012) during March. Nest success at CBNS in 2012 was again very high (Table 6). It is unclear whether the rodent trapping had any real effect on nest success, however the effort does give an indication of rodent population levels. Similar rodent trapping and removal in the future would at a minimum help us gauge and understand rodent population levels and cycles at CBNS.

Corvid depredations continue to be the main source of known nest depredations (Table 8). Of the 57 unknown depredations, 32 (56%) were at Bandon SPMA and New River HRA where corvid activity was persistent all summer. Corvids were likely responsible for most of these unknown depredations. Predator management continues to have a positive effect on reducing corvid numbers, however controlling corvids is a difficult and time consuming task. Despite apparent reductions in corvid numbers, they continue to be consistently present particularly between Siltcoos to Tahkenitch, Tenmile, Bandon Beach and New River. Due to the amount of area that needs to be covered and the distance between nesting sites, we continue to recommend that Wildlife Services be funded to support three agents. See Burrell (2012) for a complete discussion of the predator management program.

Fledging Success and Productivity

We monitored 154 broods in 2012 including 11 broods from undiscovered nests, six more broods than in 2011 (Lauten *et al*. 2011) and the highest number of broods since monitoring began in 1990. A minimum of 173 fledglings was confirmed (Table 9), the highest number since monitoring began. Overall fledging success was 43%, near the overall average (Table 10). The overall brood success rate was 70% (Table 11), slightly higher than the average (66% +/- 10). The overall number of fledglings per male was above the recovery goal at 1.37 (Table 11). Considering data from known nests from Siltcoos to New River only (Tables 12-18), the mean fledglings per male was 1.186, near the average (Table 10). Despite good overall productivity, productivity varied between sites (Table 11).

Siltcoos

At Siltcoos in 2012 (Table 12), the number of eggs laid and the hatch rate were similar to 2011. There was one more brood than in 2011, and 61% of these broods successfully fledged at least one chick (Table 11). Four more chicks fledged than in 2011, which increased the fledging success rate, the productivity index, and the number of fledglings per male. However, the fledging success rate, the productivity index, and the number of fledglings per male for 2012 were below the post predator management averages for Siltcoos. Fledging success was better on the South Spit, but the North Spit had a small sample size (Table 11).

Overlook

At Overlook in 2012 the number of eggs laid and the number of eggs hatched were similar to 2011 (Table 13). The hatch rate was slightly lower than 2011 but similar to the post predator management average. Overlook had 31 broods, two less than 2011, and 28 were successful (Table 11). The fledging success rate, productivity index, and the number of fledglings per male were slightly lower than in 2011 but still higher than the post predator management averages.

Tahkenitch

North Tahkenitch had the largest increase in plover activity of any site on the Oregon coast in 2012 as measured by the number of eggs laid and the number of known breeding males compared to 2011 (Table 14). The hatch rate was lower than 2011 but slightly higher than the post predator management average. North Tahkenitch had 21 broods, seven more than in 2011, and 18 were successful (Table 11). The number of fledglings produced was the highest since monitoring began in 1993. While the fledging success rate, productivity index, and number of fledglings per male were all lower than in 2011, all three indices were higher than the post predator management averages, and Tahkenitch produced six more fledglings than in 2011. Overall productivity at this site was above recovery goals.

Tenmile

The effort at Tenmile as measured by the number of eggs laid in 2012 was similar to the previous three years (Table 15), however for the second consecutive year the productivity was very poor. Despite laying a minimum of 104 eggs, only 18 hatched, the second consecutive year of very low hatch rates and well below the post predator management average. Tenmile had six broods, one less than 2011, and overall brood success was 83% (Table 11). The fledging success rate improved to 50%, higher than the post predator management average. However the number of fledglings compared to the number of eggs laid was very low, and resulted in a very poor productivity index, well below the post predator management average. The number of fledglings per male was above the post predator management average, however this number is influenced by the number of known breeding males and since most nests failed, many males who unsuccessfully hatched at Tenmile were never identified. If more males had been identified, the actual number of fledglings per male would be much lower. Tenmile continues to be the only site where productivity has not increased since implementation of predator management. Poor nest success is a continuing problem at Tenmile (Table 5), especially given the number of plovers using this site (Table 3).

Coos Bay North Spit

The hatch rate at CBNS in 2012 was the highest on the coast, the highest since predator management was implemented in 2002, and well above the post predator management average (Table 16). CBNS had 58 broods, nine more than in 2011, and overall brood success rate was 59%. While the hatch rate was high and the number of fledglings similar to 2011, the fledging success rate declined from 2011 to 37%, below the post predator management average. This was largely due to low fledging rates on South Spoil and the HRAs. Fledging success on the beach was much higher (Table 11). The productivity index was similar to 2011 and nearly the post predator management average. Despite the relatively good productivity, the number of fledglings per male declined from 2011 and was well below the post predator management average. CBNS continues to be the most productive site on the Oregon coast.

Bandon SPMA

Bandon SPMA had the largest increase in the number of eggs laid compared to 2011 (Table 17). This was not due to more individual plovers but due to poor hatch rates and thus increased renesting attempts. The hatch rate was much lower than in 2011 and well below the post predator management average. Bandon SPMA had 11 broods, six fewer than in 2011, and overall brood success was 67%. The fledging success rate was slightly above the post predator management average, but the productivity index was very poor, indicating that few fledglings were produced compared to the number of eggs laid. The number of fledglings per male was near the post predator management average, and just below the recovery goal.

New River

The number of plovers using the New River HRA has declined since 2010, and therefore the number of eggs laid has also declined (Table 18). The hatch rate in 2012 was much lower than in 2011 and only half of the post predator management average. There were seven broods on the New River HRA; four of these fledged at least one chick. The number of young fledged has also declined since 2009 and the fledging success rate was the lowest since implementation of predator management and well below the post predator management average. The productivity index was very low and also well below the post predator management average. The number of fledglings per male was the lowest since implementation of predator management and well below the post predator management average. Corvids continue to be persistent at Bandon SPMA and New River HRA and are likely the main cause of low productivity at these sites. We recommend efforts to remove corvids at all nesting sites as they continue to be the main cause of known nest failures (Table 7) and are likely responsible for some chick mortality.

Floras Lake

Floras Lake had two broods, one of which was successful (Table 11). The two fledglings produced by the one successful brood were the first fledglings from Floras Lake since 2000. Due to the paucity of data from Floras Lake, we have not calculated hatch rates, fledgling rates, and productivity indices for this site.

Post predator management hatch rates have declined for Overlook, Tenmile, CBNS, Bandon SPMA, and New River HRA, but this is the result of many more nests remaining unexclosed and unexclosed nests have a lower nest success than exclosed nests (Table 6). Since the implementation of predator management, the average brood success rate (2004-2012, 72.2%) was significantly higher than the average pre predator management brood success rate, (1991-2001, 62.9%, t-stat = 2.32, df = 18, P = 0.02). The overall mean post predator management fledging success rate (0.47) was significantly higher than the mean pre predator management fledging success rate (0.39, t = 1.75, df = 17, P = 0.05). The post predator management fledging success rate has improved for Siltcoos, Overlook, CBNS, Bandon SPMA, and New River (Table 19). Tahkenitch and Tenmile have decreased but are still within acceptable levels. The overall mean number of fledglings per male after implementation of predator management (2004-2012; x = 1.31) was significantly higher than the mean number of fledglings per male prior to the implementation of predator management (1992-2001; x = 1.06, t = 2.37, df = 17, P = 0.01). The mean number of fledglings per male has improved at all sites except Tenmile where it has remained relatively stable (Table 19). Productivity as measured by the average fledging success rate has improved at all sites except Tahkenitch and Tenmile since implementation of predator management (Table 19). The 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

Only one of four broods at North Siltcoos in 2012 was successful, and that brood remained within the nesting area for the duration of the brood rearing period.

As plover numbers have increased they have occupied available habitat along the beaches between South Siltcoos and North Tahkenitch (Lauten *et al*. 2009, 2010, and 2011). In 2012, plover nests were found along the beach south of Waxmyrtle trail, near the Carter Lake trail area, and between South Overlook and North Tahkenitch, particularly near the Overlook Loop trail (Figures 3 and 4). While many of the broods that originated on the nesting areas at South Siltcoos, Overlook and North Tahkenitch

remained on or near the roped nesting areas, there was consistent brood activity on all portions of the beach between the main nesting areas. At South Siltcoos, at least two broods moved south along the beach to the Carter Lake area. Broods that originated south of Waxmyrtle trail stayed along the beach, and one brood that originated at Carter Lake moved south to North Overlook. Three broods that originated along the beach north of North Overlook also generally stayed along the beach from Carter Lake to the north end of North Overlook. At least two broods that originated from North Overlook moved to South Overlook. At least five broods from South Overlook moved south along the beach to the Overlook Loop trail area, and one of these broods even moved south to North Tahkenitch. Most broods at North Tahkenitch that originated on the nesting area stayed within and around the nesting area, although one brood moved north along the beach. Two broods that originated from the beach north of the nesting area stayed along the beach and another brood that hatched on the beach moved south to the nesting area.

Tenmile

There were four broods at North Tenmile in 2012, three that originated on the HRA and one that originated on the beach north of the HRA. All three broods that originated on the HRA remained on the HRA and adjacent spit area, and the brood from north of HRA moved south to the HRA and spit area and remained there until fledgling. There were only two successful broods at South Tenmile in 2012, and both broods stayed within the vicinity of the HRA.

Coos Bay North Spit

At CBNS brood movements are varied and often difficult to ascertain partly due to the complex structure of the nesting area in conjunction with berms along the foredune road and vegetated foredune. Broods originating from the 95HRA have the shortest distance to travel to access the beach, and some of these broods would move onto the beach and back onto the 95HRA mostly in the area of the Olson shipwreck where the foredune vegetation is still sparse in some areas. We have documented a general trend of broods originating on South Spoil, the 94HRA and 98EHRA to move westward toward the beach (Lauten *et al*. 2009, 2010, and 2011). In 2012 some broods originating from east of the foredune road did move west to the 95HRA and eventually South Beach, however some broods remained throughout the brood period on the South Spoil and HRAs. In 2012 we had definitive evidence that broods can and will use the foredune road to attempt to access the beach. In late June, BLM staff reported a male with two young chicks on the foredune road just south of the FAA towers. We found the brood well north of the 95HRA and south of the FAA towers in the middle of the foredune road and herded the brood back to the north gate at the HRAs and then onto the 95HRA. This brood had hatched from South Spoil two days prior to finding them on the foredune road. We are uncertain if the brood moved directly north of the South Spoil and onto the reroute road and then north on the foredune road, or whether they moved north along the foredune road behind the gate and further north towards the FAA tower. This brood demonstrates that broods can move several miles within a few days of hatching, and also suggests that some broods may be attempting to gain access to the beach via other routes than west to the 95HRA and over the foredune. In previous years, we have noted older broods using the foredune road in the vicinity of the north jetty (Lauten *et al*. 2011). This example suggests broods are capable of using the foredune road to access the beach. Brood use on South Beach in 2012 was extensive. We noted broods using the beach near the jetty where vehicle access is permitted, and we had multiple broods move as far north as north of the FAA towers. One brood from an undiscovered nest was found north of the FAA towers at about the time of fledgling. Based on the age of the fledglings, the brood was local, and since we did not encounter the brood along South Beach from Access point one to the north jetty, we believe it is possible the brood originated from north of the FAA towers (possibly north of Access point one).

Bandon SPMA

There were a total of 11 broods at Bandon SPMA in 2012, nine on the Bandon Beach side and two on the New River spit side. Two broods on the Bandon Beach side hatched below the China Creek parking lot, and both broods immediately moved south and stayed along the foredune. All the remaining broods on the Bandon Beach side also remained along the foredune or on the HRA, with brood activity as far south as the mouth of New River. We did observe brood use of the cutouts created in winter 2010-11 despite the cutouts being fairly heavily vegetated. No broods crossed the river in either direction. Both broods from the New River spit side remained at the north end of the spit. There was no brood activity north of China Creek in 2012.

New River and Floras Lake

There were seven broods that originated on the New River HRA in 2012. One brood remained close to the area of the nest at the northern end of the HRA and one remained fairly close to the area of the nest near Hammond breach at the south end of the HRA. Two other broods wandered fairly extensively from north of Croft Lake breach to south of New Lake breach. South of Clay Island breach, a brood that hatched along the foredune eventually moved south to Floras Lake and was noted using the beach south of the CMA. It eventually fledged west of the CMA. One other brood from Floras Lake hatched on the CMA and spent the brood period between the CMA area and upwards of a quarter mile south along the beach.

Sightings of Snowy Plovers Banded Elsewhere

Eighteen adult plovers banded in California were observed in Oregon in 2012. Eleven were females and seven were males. Twelve of the 18 plovers were known to have nested in Oregon in 2012. Four females were not confirmed nesting however two were present during the breeding season and may have attempted to nest but were not confirmed. Two males were not confirmed nesting however one was present all summer at Bandon SPMA and likely attempted to nest but was never confirmed; the other male appeared at the end of July and was a post breeding individual. Three females and two males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. Fourteen other plovers, eight females and six males, were originally banded in California. One female was a hatch year 2006 bird from Salinas, Monterey Co. that has been recorded in Oregon in previous years; she nested at Overlook in 2012. Two females were hatch year 2011 plovers, one from Moss Landing Salt Ponds, Monterey Co. and one from Marina State Beach, Salinas Co. Both nested in Oregon in 2012, one at Floras Lake and one at Bandon Beach and New River. Another female was a hatch year 2011 plover from Fort Ord, Monterey Co.; she was only seen once in Oregon in 2012. The other four California originated females included a hatch year 2006 from Humboldt Co. who has been nesting at Bandon Beach and New River since 2007; an adult banded in 2008 in Humboldt Co. that has nested in Oregon in 2011 but was not confirmed nesting in 2012; another adult that was banded in 2010 in Humboldt Co. and nested in 2011 and 2012; and a hatch year 2010 plover banded in Humboldt Co. who was present in Oregon in 2011 but no known nest was confirmed in either 2011 or 2012. Of the five 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 2012; one was a male banded in 2009 at Salinas, Monterey Co., who wintered at Bandon SPMA in the past two years and arrived at Bandon SPMA in late July 2012; one was a hatch year 2010 plover from Salinas, Monterey Co., who successfully nested at CBNS in 2012; one was a hatch year 2010 plover from Moss Landing Salt Ponds, Monterey Co., who nested at Bandon SPMA in 2012; and one was from Oceano Dunes, San Luis Obispo Co., who nested at Overlook in 2012.

Habitat Restoration and Development Projects

Sutton

The USFS contracted the Northwest Youth Corp to handpull beachgrass on 12 acres of habitat south of Holman Vista, Sutton Beach in the winter of 2011-12. Some shellhash was mechanically 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. Seventeen people participated in this event and collected 900 pounds of trash.

Siltcoos

At Siltcoos, 12 acres of beachgrass was hand pulled by the Northwest Youth Corp on both sides of the estuary in winter 2011-12. Beachgrass hummocks near areas covered by oyster shell were mechanically treated. Some oyster shell was spread on both the north and south side of the estuary.

Overlook

At Overlook 20 acres of beachgrass was handpulled on the south side in winter 2011-12. Herbicides were sprayed on 20 acres of beachgrass on both the north and south side. Beachgrass hummocks near areas covered by oyster shell were mechanically treated. Some oyster shell was spread on both the north and south side.

Tahkenitch

At Tahkenitch, 40 acres of beachgrass was handpulledand an additional 40 acres were sprayed with herbicides in winter 2011-12. Beachgrass hummocks near areas covered by oyster shell were mechanically treated. Some oyster shell was spread on the HRA.

Tenmile

At Tenmile, beachgrass was handpulled on 10 acres on the north side and 23 acres on the south side in the winter of 2011-12. Herbicides were sprayed on 23 acres on South Tenmile. Some shellhash was spread on North Tenmile.

Coos Bay North Spit

At CBNS in winter 2011-12, BLM disked 148 acres of habitat restoration area and parts of the spoil. Some hand pulling of sea rocket was also completed. Shell hash (ca. 300 cubic yards) was spread on 26 acres of previously treated habitat and 3 additional acres on BLM lands.

Bandon SPMA

At Bandon SPMA there was no habitat restoration work in winter 2011-12.

New River

At New River HRA, BLM bulldozed and improved 20 acres of habitat from the north end of Hammond breach to the south end of New Lake breach. A breach naturally occurred at Clay Island.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2013 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 that the closed sections of beach are adequately protected throughout the season and the public understands which sections of beach are closed and the message is consistent throughout the nesting season and from year to year. Installing ropes and signs at the beginning of the season also reduces the need to respond to individual nests that are within closed beach sections but not roped and signed. This reduces the disturbance to those nests when ropes and signs have to be installed after a nest is found. High tides early in the season often make posting areas a challenge, and while it is important to have signs in place beginning on 15 March, in areas where the ocean is regularly lapping against the foredune, signs should not be erected or placement should be delayed. Maintenance of signs is important to keep violations to a minimum. To maximize the effectiveness of signs and ropes, each site should continue to be evaluated and ways to improve the signing and ropes should be considered.

General Recommendations

Below are general recommendations. We also provide additional site-specific comments and management recommendations in Appendix 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 on open beach and along the foredune where disturbance from recreational activity is more likely. Increased nest density could lead to density dependent predator relationships which could cause 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 need to annually treat nesting areas and therefore reduced funding for annual habitat maintenance.

The OPRD Habitat Conservation Plan (ICF International 2010) will be fully implemented at occupied Snowy Plover Management Areas (SPMAs) and Recreation Management Areas (RMAs) in

2013. Seasonal recreation restrictions (March 15 - September 15) include no dogs in these occupied areas.. Educating the public about the new 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 intensive 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 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, 1990-2012. For Window Survey, first number is counted plovers minus duplicate band combos and unidentified plovers, number in parenthesis is total head count without considering duplicate combos or unknown plovers.

YEAR	WINDOW SURVEY	# 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	231-238	290-291

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 - 2012.

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
2012	173	91	53%	70	77%
2011	172[a]	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 = 11.3%	0.113143
Average percent of returning HY birds that nest in first season = 69%	69%
SD = 16.9%	0.169162

[a] - adjusted from 168 to 172 based on hatch year returns

Table 3. Number of Adult Snowy Plovers at each nesting area on the Oregon Coast, 2012.

	Females				Males					
	Banded		Unbanded		Banded		Unbanded		Total	
Site	**# banded**	**# nested**	**# unbanded**	**# nested**	**# banded**	**# nested**	**# unbanded**	**# nested**	**# plovers**	**# nested**
Sutton	0	0	0	0	0	0	0	0	0	0
Siltcoos	31	12	2	1	32	13	2	1	67	27
Overlook	43	19	6	3-5	41	25	4	4	94	51-53
N Tahkenitch	31	11	2-3	1-2	33	19	1	0	67-68	31-32
Tenmile	34	14	2	1?	21	6	1-2	0	58-59	20-21
CBNS	37	28	3-5	3-4	48	44	2	2	90-92	77-78
Bandon SPMA	32	14	1-2	1	34	14	1	0	68-69	29
New River HRA	7	4	3-4	3	13	7	1	0	24-25	14
Floras Lake	4	2	0	0	5	3	1	0	10	5

Table 4. Number of nests for selected sites on the Oregon Coast 1998 – 2012; 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
SU	8	3	7	15	3	1	0	0	4	3	0	0	1	0	0
SI:															
North	1	4	8	0	0	0	7	8	12	15	30	14	17	13	10
South	3	17	14	14	10	7	4	9	13	13	6	9	24	21	22
OV:															
North		2	8	12	5	7	11	11	9	13	14	9	21	29	28
South		0	0	3	3	1	3	5	1	3	1	5	16	28	31
TA															
North	0	0	4	7	8	13	8	11	4	10	5	6	7	23	36
South	6	3	1	6	7	1	0	0	0	0	0				
TM:															
North	0	0	1	2	3	5	9	6	10	20	12	13	13	15	17
South	11	5	5	6	9	12	8	11	12	21	16	41	30	35	29
CBNS:															
SB	6	0	1	1	2	3	2	4	0	8	5	19	17	16	7
SS	5	2	5	3	2	9	8	9	14	12	18	16	14	15	15
HRAs	7	12	22	13	15	11	16	16	18	19	26	30	33	26	39
BSPMA															
BB	1	2	2	6	5	5	17	31	23	30	28	31	26	28	48
NR spit	1	8	1	1	2	7	7	11	9	16	6	10	12	9	12
NR HRA		3	4	10	7	5	6	1	7	14	27	27	27	29	17
NR other	25	17	12	12	5	4	11	11	11	5	2	3	3	2	1
FL	4	0	5	0	1	0	0	0	0	0	0	3	0	0	2
Tot nst	**78**	**78**	**100**	**111**	**89**	**91**	**117**	**144**	**147**	**202**	**196**	**236**	**261**	**289**	**314**
Tot brd[a]	**3**	**1**	**2**	**0**	**1**	**4**	**2**	**3**	**15**	**4**	**3**	**8**	**2**	**4**	**11**

[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, 2012.

		Nests Exclosed			Nests Not Exclosed			Exclosed Nests	Nests Not Exclosed	
Site	**Total #**	**Hatch**	**Fail**	**Unknown**	**Hatch**	**Fail**	**Unknown**	**App Nest Success**	**App Nest Success**	**Overall Nest Success**
Sutton	0	-	-		-	-		-	-	-
Siltcoos										
North	10	-	-		4	5	1	-	40%	40%
South	22	-	-		13	9		-	59%	59%
Combined	32				17	14	1		53%	53%
Overlook										
North	28	1	-		14	13		100%	52%	54%
South	31	3	-		10	18		100%	36%	42%
Combined	59	4			24	31		100%	44%	47%
N Tahkenitch	36	4	-		17	15		100%	53%	58%
Tenmile										
North	17	-	-		4	13		-	24%	24%
South	29	-	-		2	27		-	7%	7%
Combined	46				6	40			13%	13%
CBNS										
South Beach	7	-	-		6	1		-	86%	86%
South Spoil	15	-	-		13	2		-	87%	87%
HRAs	39	-	-		34	5		-	87%	87%
Combined	61				53	8			87%	87%
Bandon SPMA	60[a]	5	1		3	48		83%	6%	14%
New River										
HRA	17	5	3		0	9		63%	0%	29%
Other Lands	1	0	0		0	1		0%	0%	0%
Floras Lake	2	-	-		1	1		-	50%	50%
Totals	314	18	4		121	167	1	82%	42%	45%

a – Three nests not included in analysis because they were exclosed, and then exclosure was removed before hatching; all three nests hatched.

Table 6. Apparent nest success of exclosed and unexclosed Snowy Plover nests on the Oregon coast, 1990 - 2012.

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
Average =	48.00	70.91	19.78
STDEV =	12.30	10.35	17.69

* Multiple experimental designs used, data not included

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2012.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Corvid	Unk	Canine	Skunk	Adult plover	Wind-Weather	Overwash	Abandon	One Egg Nest	Infer	Unk cause
Siltcoos:													
North	10	5	1	2				1					1
South	22	9	3	2				1	1	1			1
Overlook													
North	28	13		4					1	4	1		3
South	31	18	3	5				3		2	5		
N Tahkenitch	36	15		3	1[a]			3		3	1		4
Tenmile:													
North	17	13	5	2				1		1			4
South	29	27	5	5					1		2		14
Coos Bay North Spit:													
South Beach	7	1							1				
South Spoil	15	2								1	1		
HRAs	39	5		1						2	1	1	
Bandon SPMA	60	49	8	26	2[b]	1		2		3	3		4
New River HRA	17	12	1	6	1[c]		1						3
Other lands	1												1
Floras Lake	2	1		1									
TOTALS	**314**	**171**	26	57	4	1	1	11	4	17	14	1	35

[a] – coyote depredation
[b] – 2 fox depredation
[c] – 1 fox depredations

Table 8. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2012.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	**Corvid**		26	26
	Unknown		57	58
	Canine		4	4
	Skunk		1	1
Depredation	**Adult Plover**	1		
Other	**Wind/Weather**		11	11
	Overwashed		4	4
	Infertile		1	1
	One Egg Nests		14	14
	Abandoned	1	16	17
	Unknown Cause	2	33	33
Totals		4	167	171

Table 9. Total number of young fledged from select sites on the Oregon Coast 1998-2012, includes fledglings from broods from undiscovered nests.

Site Name	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
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
South	4	2	7	0	0	2	5	7	7	4	3	11	4	8	16
OV:															
North		3	5	1	2	3	3	5	8	12	3	7	12	27	22
South		0	0	1	0	0	3	2	0	1	0	2	7	23	23
TA:															
North	0	0	2	4	1	3	6	8	5	2	0	1	3	20	26
South	1	1	3	4	5	2	0	0	0	0	0				
TM:															
North	0	0	0	0	3	1	3	6	12	13	3	2	3	1	5
South	3	7	5	4	3	9	9	5	7	14	6	19	13	5	4
CBNS:															
SS	6	5	3	4	2	7	13	9	11	7	17	4	2	6	10
SB	2	0	0	1	1	3	0	8	1	10	7	17	13	22	15
HRAs	1	23	6	6	8	14	22	6	19	9	16	10	5	28	33
BSPMA															
BB	1	1	0	1	0	4	16	11	12	13	2	6	6	16	11
NR spit	0	2	0	0	0	1	10	0	3	12	2	1	0	5	1
NR HRA		2	1	3	3	7	5	1	7	16	7	17	12	7	4
NR other	11	4	4	3	3	4	6	8	7	4	2	2	0	0	0
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[a]**	**173**

[a] – adjusted from 168 to 172 based on hatch year returns

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 – 2012.

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	43	173	1.186
	Overall = 40.9 $\pm$ 10.3	Total = 1568	Mean = 1.148

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

Table 11. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2012.

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	4	25%	7	1		14%	3	0.33	1.15 (13)
South Siltcoos	14	71%	31	14	2	45%	10	1.60	
Overlook									
North Overlook	16	88%	36	20	2	56%	12	1.83	1.80 (25)
South Overlook	15	93%	34	20	3	59%	14	1.64	
North Tahkenitch	21	86%	56	26		46%	19	1.37	1.37 (19)
Tenmile:									
North Spit	4	75%	12	5		42%	3	1.67	1.50 (6)
South Spit	2	100%	6	4		67%	5	0.80	
Coos Bay N. Spit									
South Spoil	13	54%	33	10		30%	10	1.00	1.23 (44)
South Beach	8	100%	16	11	4	69%	8	1.88	
HRA	37	51%	86	29	4	34%	33	1.00	
Bandon SPMA	11	63%	30	12		40%	14	0.86	0.86 (14)
New River									
HRA	7	57%	13	2	2	15%	7	0.29	0.29 (7)
Other lands	0								
Floras Lake	2	50%	3	2		67%	2	1.00	1.00 (2)
TOTALS	**154**	**70%**	**363**	**156**	**17**	**43%**	**126**[b]	**1.37**	
TOTAL FLEDGED				**173**					

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

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

* Includes broods from undiscovered nests:

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

[a] – number of known individual breeding males for each site

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

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

Table 12. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2012.

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
	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 (2004-2012)	**total**	608	235		104			104	83	
	AVE			41%		47%	20%			1.36
	STDEV			9%		14%	10%			0.59

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

Table 13. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2012.

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
	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 (2004-2012)	**total**	622	200		146			139	94	
	AVE			43%		50%	21%			1.39
	STDEV			13%		10%	8%			0.46

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

Table 14. Productivity of Snowy Plovers at Tahkenitch, Douglas Co., Oregon coast, 1993-2012.
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
	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 (2004-2012)	**total**	286	149		67			66	47	
	AVE			48%		37%	21%			1.10
	STDEV			23%		18%	12%			0.68

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

Table 15. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2012.

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
	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 (2004-2012)	**total**	775	256		116			116	98	
	AVE			36%		44%	16%			1.21
	STDEV			16%		14%	9%			0.43

[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, 1992-2012.
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
	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 (2002-2012)	**total**	1239	634		324			319	206	
	AVE			51%		55%	28%			1.75
	STDEV			15%		12%	9%			0.42

[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, 1995-2012.

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	fledgling success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	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 (2002-2012)	**total**	939	317		124			118	135	
	AVE			35%		34%	13%			0.78
	STDEV			16%		18%	11%			0.53

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

Table 18. Productivity of Snowy Plovers at New River HRA, Coos Co., Oregon coast, 1999-2012.

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	fledgling success rate	productivity index[a]	# fledged from known males	# of known breeding males	# of fledglings/ male
	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 (2002-2012)	**total**	415	198		80			80	84	
	AVE			54%		42%	24%			0.98
	STDEV			16%		16%	13%			0.41

[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, 1992-2012.

	Siltcoos		Overlook		Tahkenitch		Tenmile		CBNS		Bandon SPMA		New River HRA	
	Pre-pred mang (1993-2003)	Post-pred mang (2004-2012)	Pre-pred mang (1999-2003)	Post-pred mang (2004-2012)	Pre-pred mang (1993-2003)	Post-pred mang (2004-2012)	Pre-pred mang (1992-2003)	Post-pred mang (2004-2012)	Pre-pred mang (1992-2001)	Post-pred mang (2002-2012)	Pre-pred mang (1995-2001)	Post-pred mang (2002-2012)	Pre-pred mang (1999-2001)	Post-pred mang (2002-2012)
ave hatch rate	38%+/-26%	41%+/-9%	54%+/-28%	43%+/-13%	46%+/-27%	48%+/-23%	59%+/-23%	36%+/-16%	60%+/-20%	51%+/-15%	41%+/-23%	35%+/-16%	70%+/-20%	54%+/-16%
ave fledging success rate	20%+/-21%	47%+/-14%	36%+/-20%	50%+/-10%	43%+/-33%	37%+/-18%	53%+/-26%	44%+/-14%	51%+/-12%	55%+/-12%	14%+/-20%	34%+/-18%	23%+/-12%	42%+/-16%
ave productivity index	11%+/-17%	20%+/-10%	21%+/-9%	21%+/-8%	18%+/-16%	21%+/-12%	30%+/-19%	16%+/-9%	32%+/-18%	28%+/-9%	6%+/-6%	13%+/-11%	15%+/-7%	24%+/-13%
ave # of fledglings/male	0.47+/-0.61	1.38+/-0592	0.79+/-0.41	1.39+/-0.46	0.87+/-0.73	1.10+/-0.68	1.25+/-0.61	1.21+/-0.43	1.55+/-0.52	1.75+/-0.42	0.28+/-0.36	0.78+/-0.53	0.51+/-0.23	0.98+/-0.41

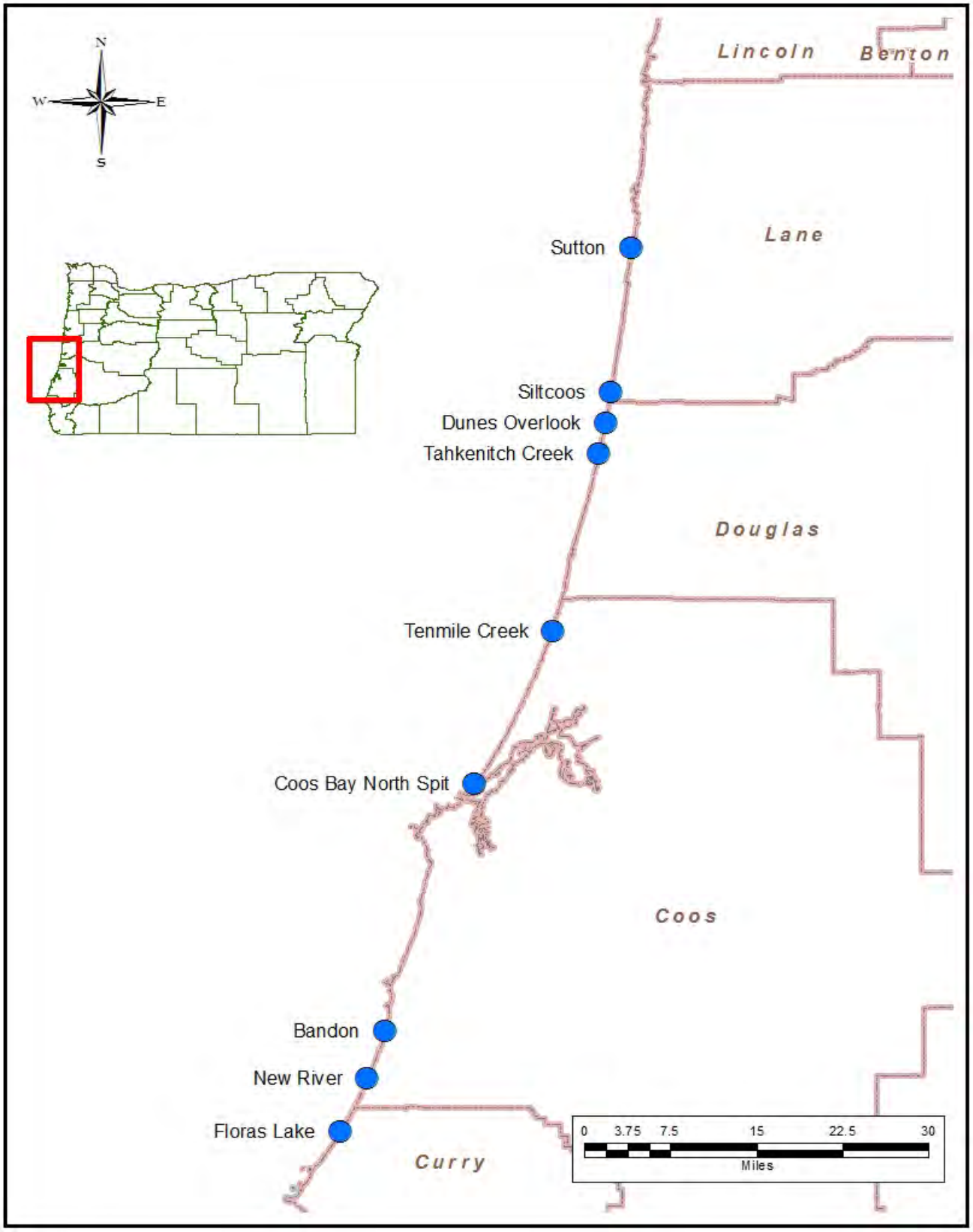


Figure 1. Snowy Plover monitoring locations along the Oregon coast, 2012

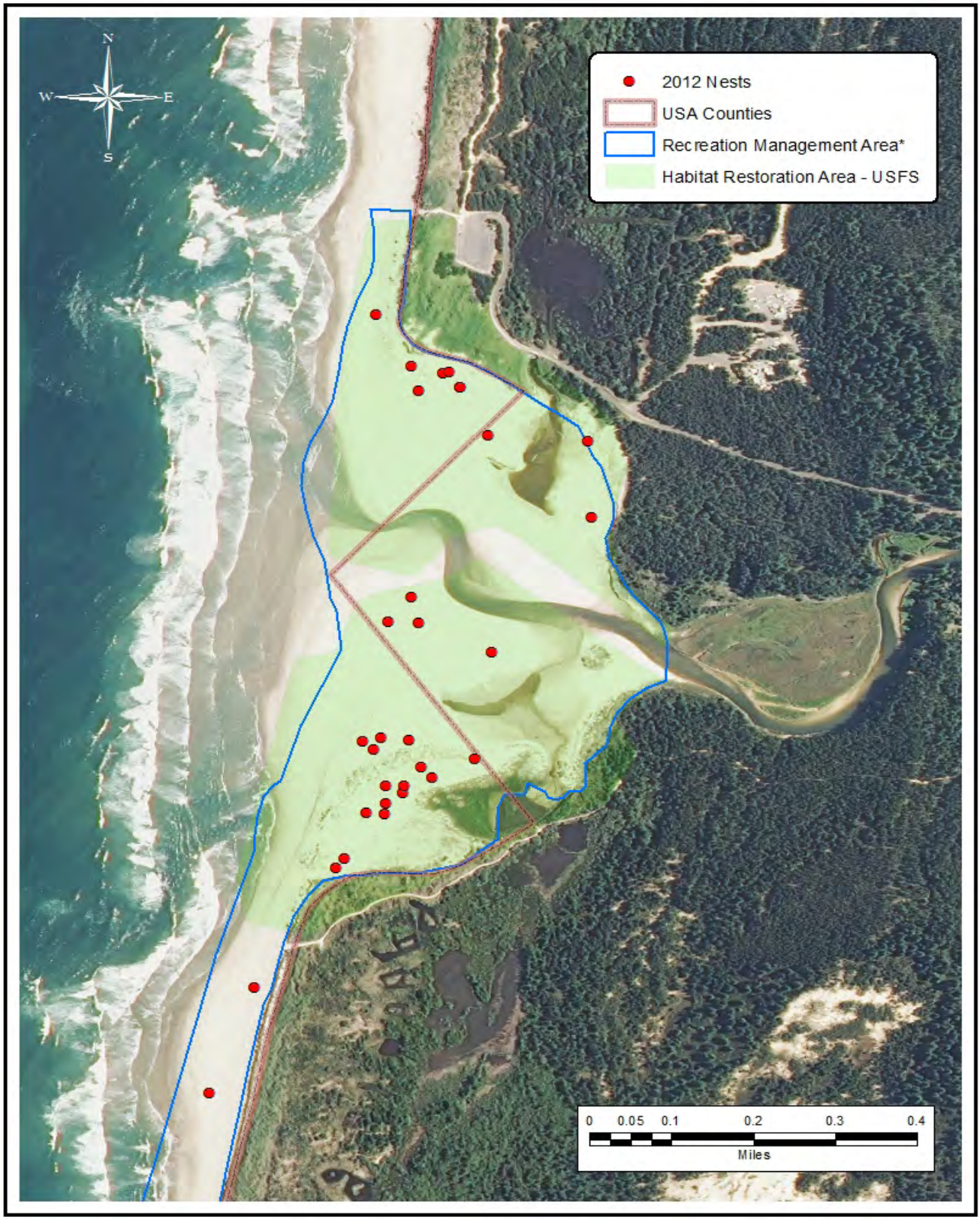


Figure 2. Snowy Plover nest locations at Siltcoos Beach, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

Figure 3. Snowy Plover nest locations at Dunes Overlook, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

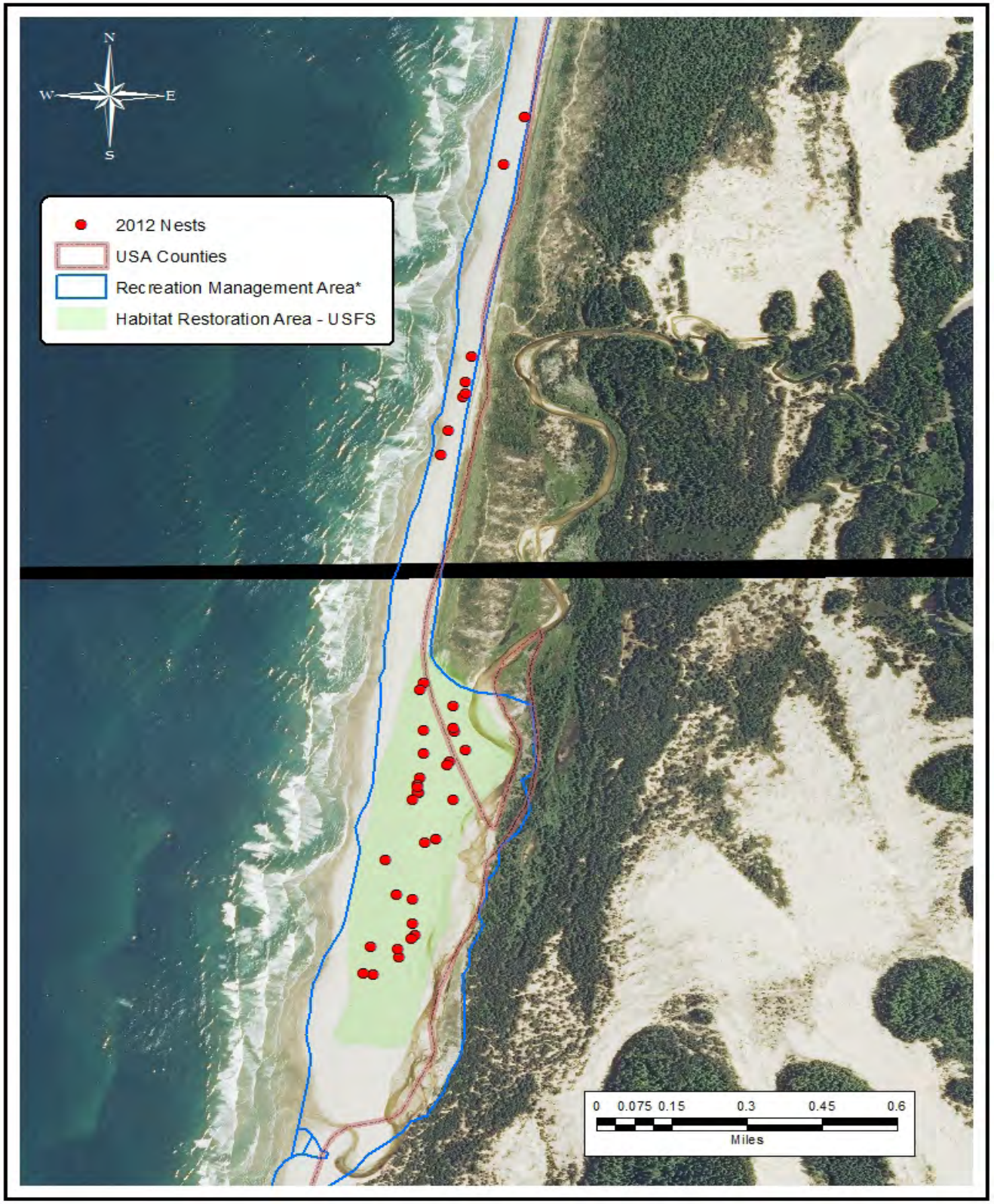


Figure 4. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2012
*Layer provided by Oregon Parks and Recreation Department

Figure 5. Snowy Plover nest locations at Tenmile Creek, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

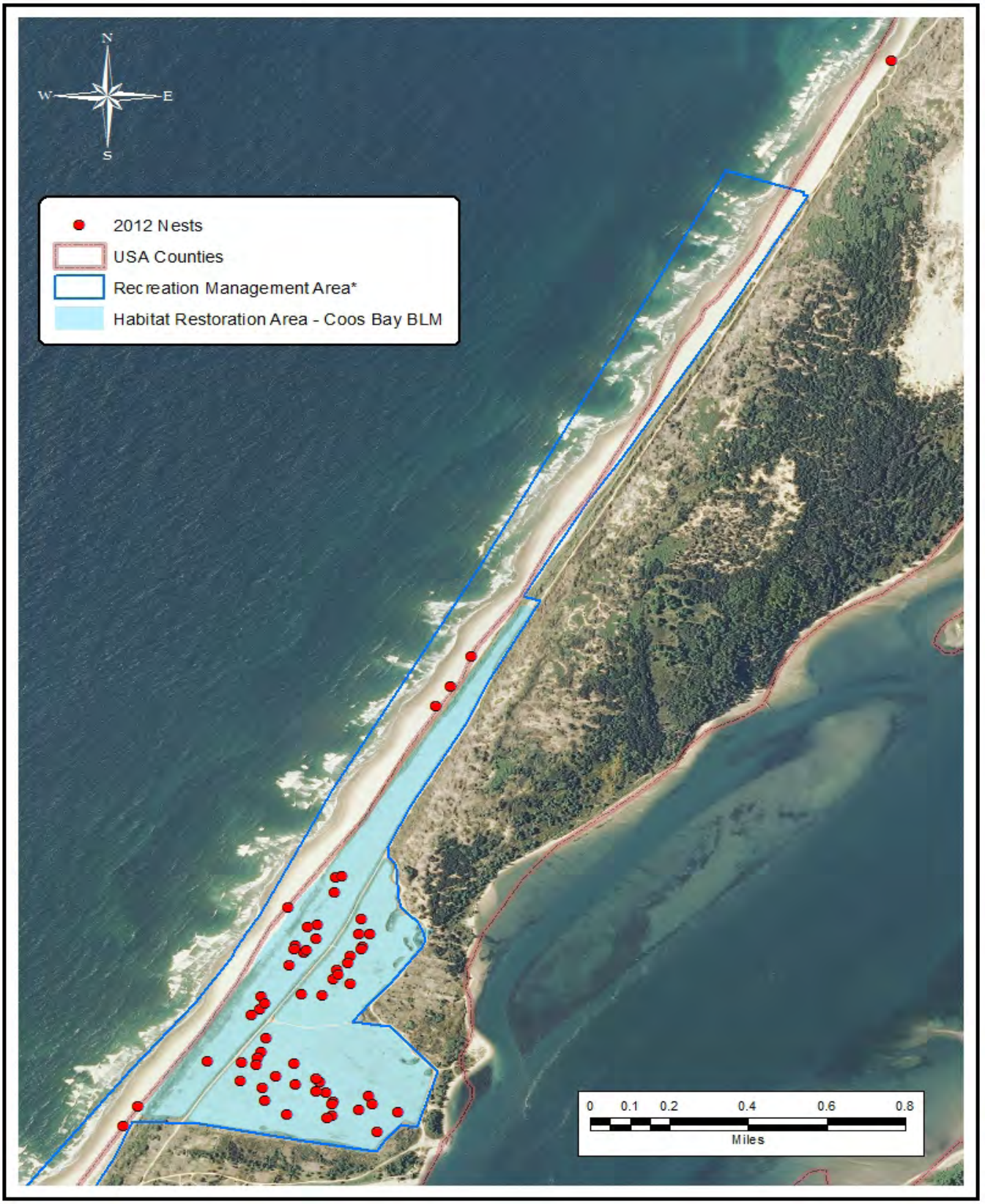


Figure 6. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

Figure 7. Snowy Plover nest locations at Bandon Snowy Plover Management Area, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

Figure 8. Snowy Plover nest locations at New River, Oregon, 2012

*Layer provided by Oregon Parks and Recreation Department

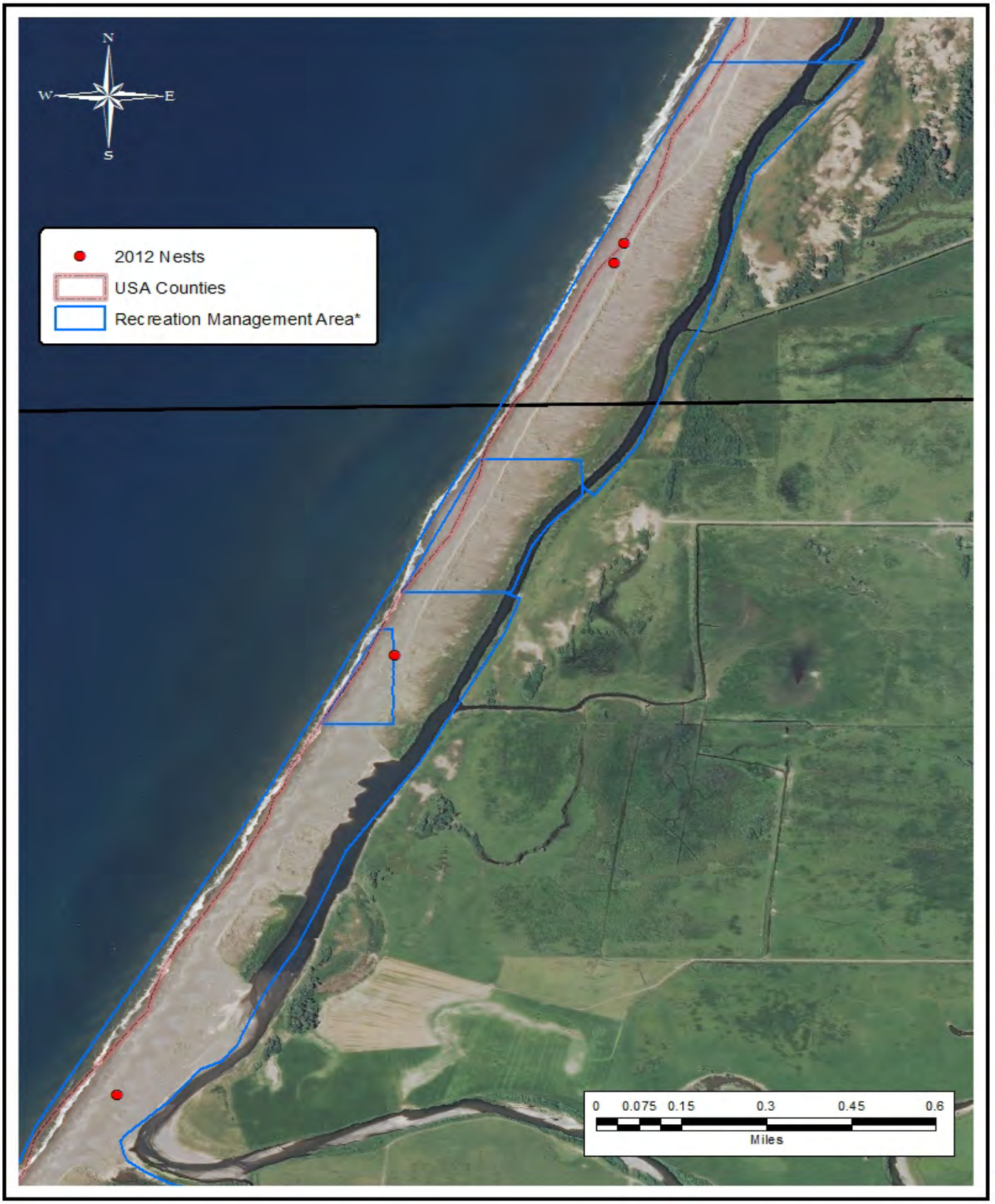


Figure 9. Snowy Plover nest locations at Floras Lake, Oregon, 2012
*Layer provided by Oregon Parks and Recreation Department

Figure 10. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2012. Dashed lines represent +/- 2 standard deviations.

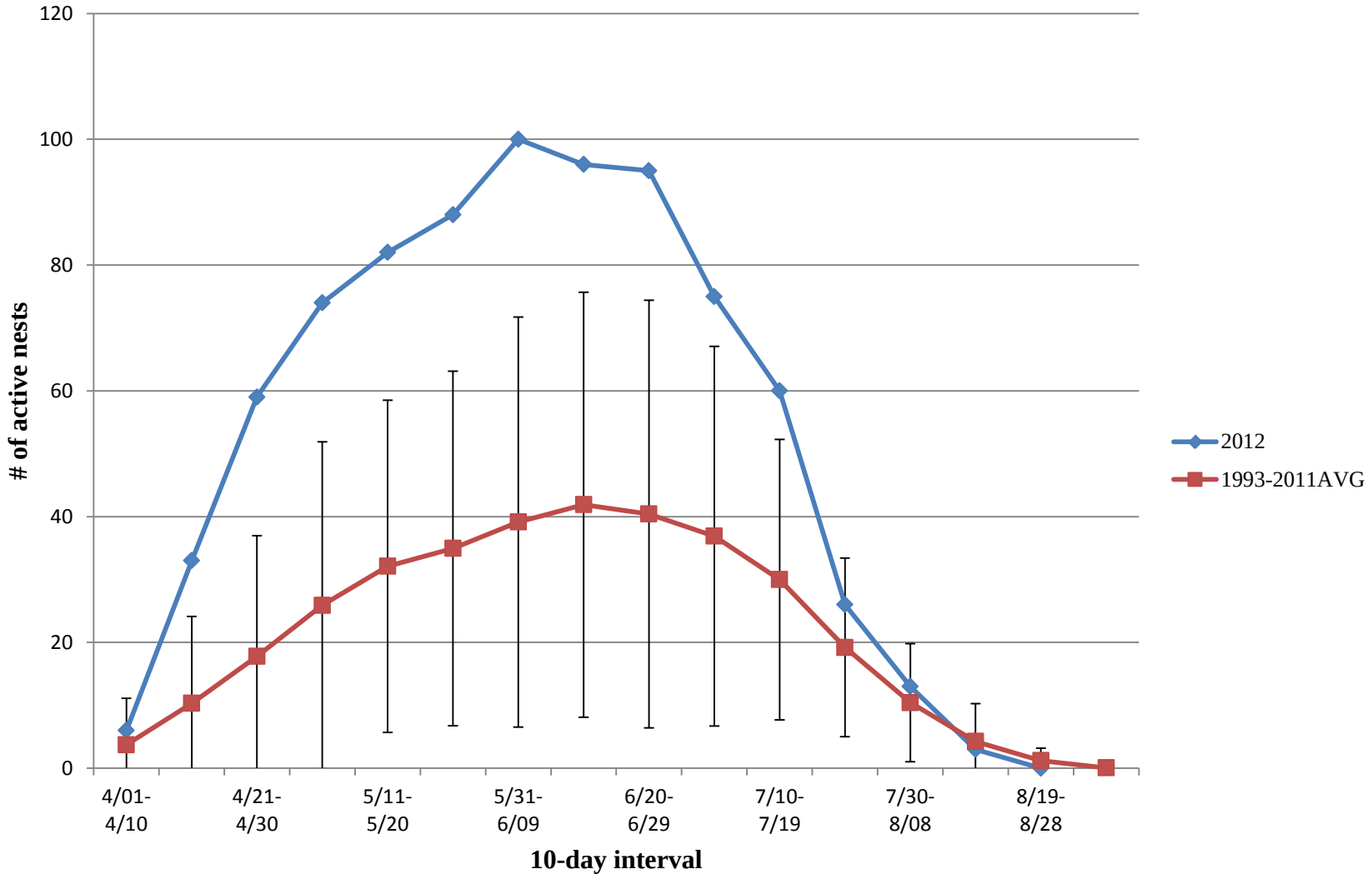


Figure 11. The number of exclosed and unexclosed days of Snowy Plover nests along the Oregon coast, 1992 – 2012.

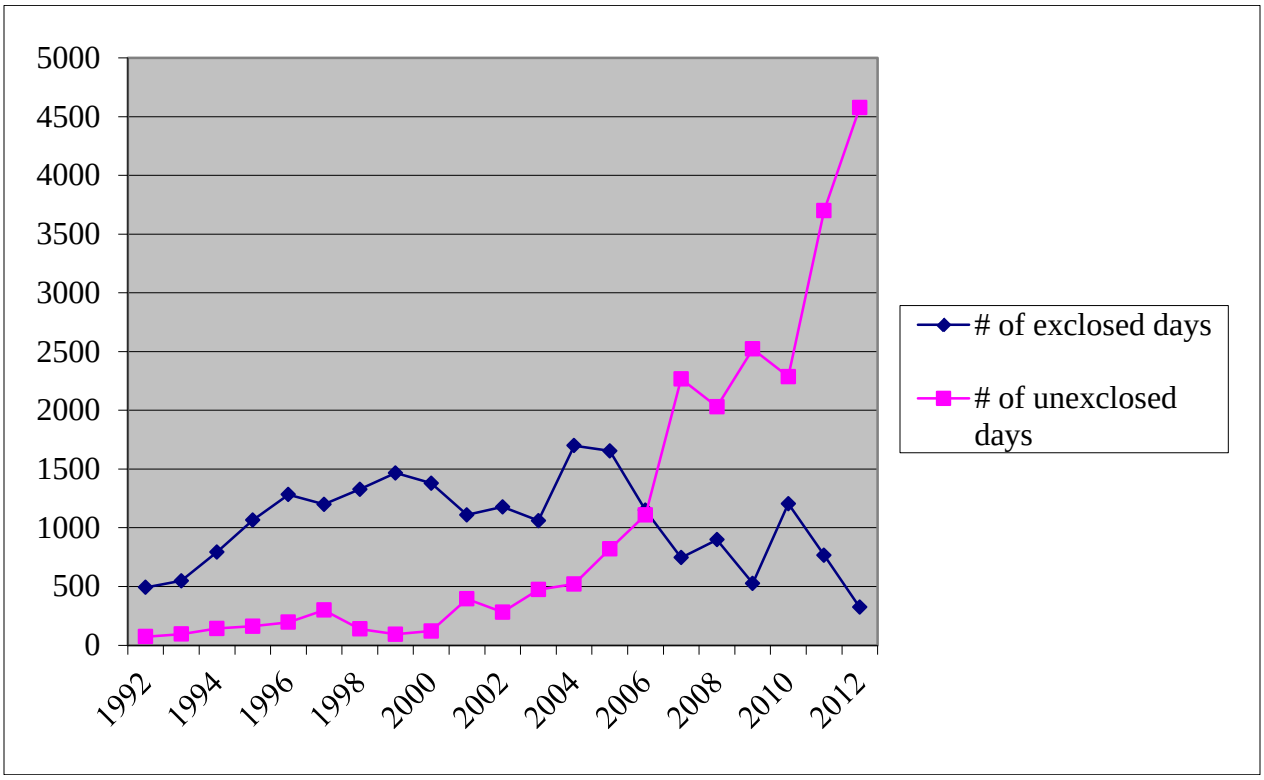
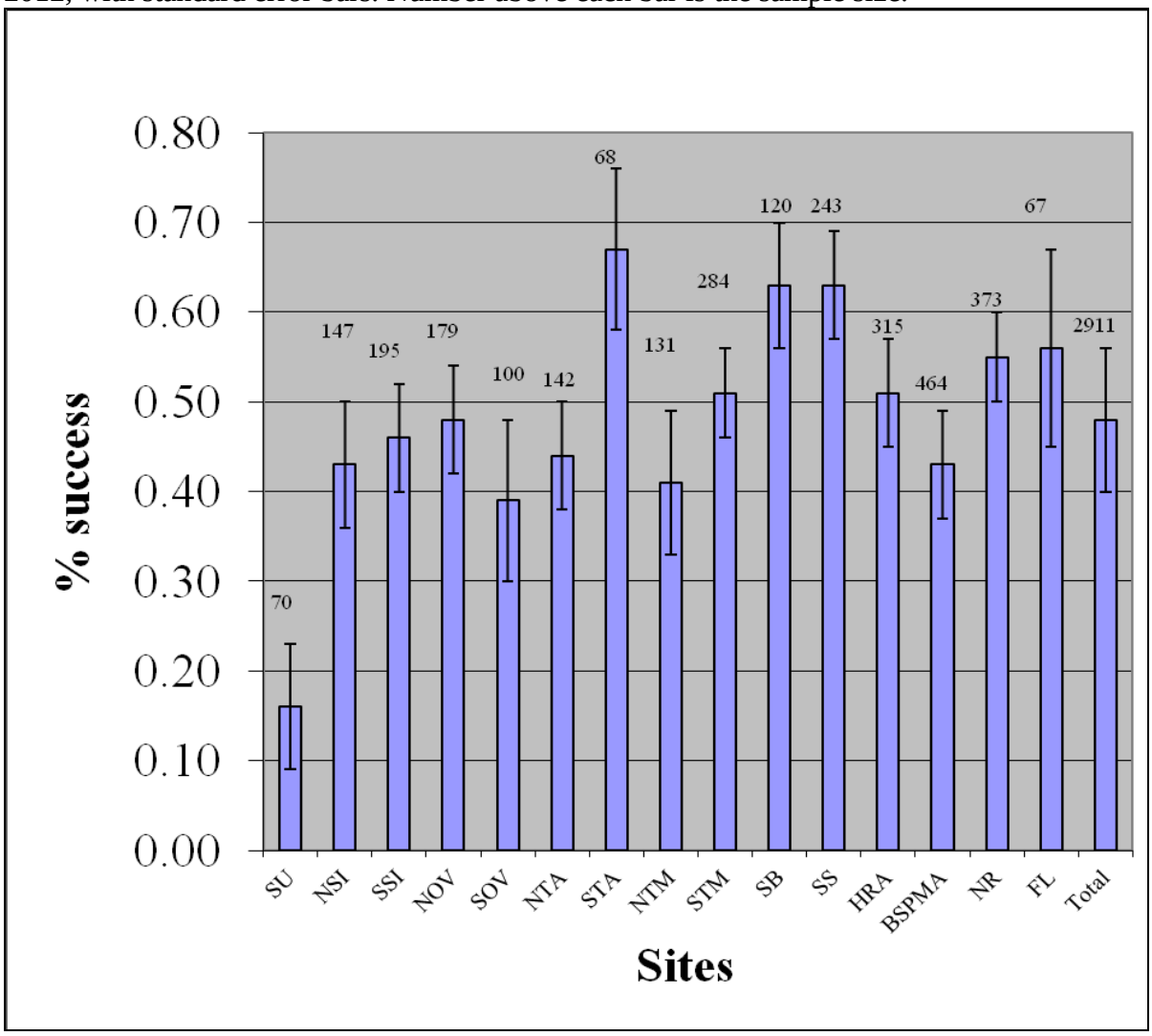


Figure 12. Mean percent nest success for Snowy Plovers along the Oregon coast, 1990-2012, with standard error bars. Number above each bar is the sample size.



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. - the beach north of Berry Creek south to the mouth of Sutton Creek.

Siltcoos: North Siltcoos, Lane Co. (Figure 2). - the north spit, beach, and open sand areas between Siltcoos River mouth and the parking lot entrance at the end of the paved road on the north side of the Siltcoos River; and South Siltcoos, Lane Co. - the south spit, beach, and open sand areas between Siltcoos River mouth and south to Carter Lake trail beach entrance.

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

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

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

Coos Bay North Spit (CBNS), Coos Co. (Figure 6): South Beach - the beach between the north jetty and the F.A.A. towers; and South Spoil/HRAs - the south dredge spoil and adjacent habitat restoration areas (94HRA, 95HRA, 98HRA);

Bandon Snowy Plover Management Area, Coos Co. (Figure 7): This site includes the Bandon SPMA and all nesting areas from north of China Creek to the south end of state land south of the mouth of New River.

New River, Coos Co. (Figure 8) - the privately owned beach and sand spit south of Bandon Snowy Plover Management Area south to BLM lands, and the BLM Storm Ranch Area of Critical Environmental Concern habitat restoration area (HRA).

Floras Lake, Curry Co. (Figure 9) – 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 - 2012.

Sutton:

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

Siltcoos North and South Spits:

- Continue predator management to reduce the number of corvids using the nesting area. Continue to 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 the beach is street legal vehicles only.
- Continue closure of the foredune road through the nesting area. Consider a permanent reroute of the foredune road.
- Enforce current dog regulations.

Bandon:

- Continue predator management to control mammal and corvid populations.
- Continue to improve and maintain the habitat restoration area north of New River/Twomile Creek. Maintain and improve “cutouts” along the foredune to increase available nesting habitat for plovers; consider additional cutouts along foredune.
- Sign and rope the entire beach from China Creek overwash to the Habitat 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.

- In 2012, there was probable take of two adult plovers at an exclosed nest at Bandon SPMA. There have been ongoing violations and vandalism at this site. We recommend frequent ranger patrols of this area and continued use of volunteers in the parking lot.
- Based on BLM registrations and monitors' observations, the number of hikers along the coast trail between Bandon SPMA and Floras Lake was reduced in 2012, however, there was some illegal camping along the New River area. New signs with maps have helped educate hikers. We recommend this education effort be continued.

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.
- Illegal camping continues in the New River area although new signs and maps have. Hikers will need to continue to be informed about new regulations regarding dogs. We recommended that a permit process be considered 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.*2002). There was no difference in fledging success between exclosed and unexclosed nests for all studies involving snowy plovers.
- Adult mortality associated with exclosures was reported in 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 (Westerkov 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.