

The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2009

David J. Lauten, Kathleen A. Castelein, J. Daniel Farrar, Hendrik G. Herlyn, and Eleanor P. Gaines

The Oregon Natural Heritage Information Center
Institute for Natural Resources
Oregon State University
1322 SE Morrison Avenue
Portland, Oregon 97214

December 30, 2009

Submitted to:

Coos Bay District Bureau of Land Management
1300 Airport Way
North Bend, Oregon 97459

Siulsaw National Forest
4077 SW Research Way
Corvallis, OR 97333

U.S. Fish and Wildlife Service
2127 SE OSU Drive
Newport, Oregon 97365

Oregon Department of Fish and Wildlife
3406 Cherry Avenue NE
Salem, OR 97303

Oregon Parks and Recreation Department
725 Summer St. N.E. Suite C
Salem, OR 97301

The Distribution and Reproductive Success of the Western Snowy Plover along the Oregon Coast - 2009

David J. Lauten, Kathleen A. Castelein, J. Daniel Farrar, Hendrik G. Herlyn, and Eleanor P. Gaines

The Oregon Natural Heritage Information Center
Institute for Natural Resources
Oregon State University
1322 SE Morrison Avenue, Portland, Oregon 97214

Abstract

From 3 April – 23 September 2009 we monitored the distribution, abundance and productivity of the federally Threatened Western Snowy Plover (*Charadrius alexandrinus nivosus*) along the Oregon coast. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Beach, New River, and Floras Lake. Our objectives for the Oregon coastal population in 2009 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue selective use of mini-exlosures (MEs) to protect nests from predators and evaluate whether exclosure use can be reduced, 4) determine nest success, 5) determine fledgling success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the effectiveness of predator management.

We observed an estimated 199-206 adult Snowy Plovers; a minimum of 149-150 individuals was known to have nested. The adult plover population was the highest estimate recorded since monitoring began in 1990, and we found 236 nests in 2009. Overall Mayfield nest success was 23%. Exclosed nests (n = 34) had a 76% success rate, and unexclosed nests (n = 202) had a 25% success rate. Nest failures were attributed to unknown depredation (29%), rodent depredation (21%), unknown cause (17%), one-egg nests (12%), corvid depredation (8%), abandonment (7%), wave overwash (2%), infertility (1%), wind (1%), canine depredation (1%), and raccoon depredation (1%). We monitored 88 broods, including eight from unknown nests, and documented a minimum of 106 fledglings. Overall brood success was 73%, fledgling success was 50%, and 1.33 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.

TABLE OF CONTENTS

ABSTRACT	ii
INTRODUCTION.....	1
STUDY AREA	1
METHODS.....	1
RESULTS.....	4
Abundance.....	4
2008 Hatch-Year Returns	5
Distribution.....	5
Nest Activity	5
Nest Success and Exclosures.....	6
Nest Failure	8
Fledgling Success and Productivity	9
Brood Movements	10
Activity Patterns on HRAs	12
Sightings of Snowy Plovers Banded Elsewhere	12
DISCUSSION	12
Habitat Restoration and Development Projects	18
RECOMMENDATIONS	18
Signing of Restricted Areas.....	18
General Recommendations	19
ACKNOWLEDGMENTS.....	19
LITERATURE CITED	20
TABLES 1-20	24
FIGURES 1- 11	44
APPENDIX A. Study Area	55
APPENDIX B. Site Specific Recommendations	56

Introduction

The Western Snowy Plover (*Charadrius alexandrinus 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).

We have completed our 20th year of monitoring the distribution, abundance, and productivity of Snowy Plovers along the Oregon coast during the breeding season. In cooperation with federal and state agencies, plover management has focused on habitat restoration and maintenance at breeding sites, predator management through both lethal and non-lethal predator control methods, and management of human related disturbances to nesting plovers. The goal of management is improved annual productivity leading to increases in Oregon's breeding population and eventually sustainable productivity and stable populations at recovery levels. Previous work and results have been summarized in annual reports (Stern *et al.* 1990 and 1991, Craig *et al.* 1992, Casler *et al.* 1993, Hallett *et al.* 1994, 1995, Estelle *et al.* 1997, Castelein *et al.* 1997, 1998, 2000a, 2000b, 2001, and 2002, and Lauten *et al.* 2003, 2005, 2006, 2006b, 2007, and 2008). Our objectives for the Oregon coastal population in 2009 were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) continue selective use of mini-exlosures (MEs) to protect nests from predators and evaluate whether exclosure use can be reduced, 4) determine nest success, 5) determine fledgling success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the effectiveness of predator management. The results of these efforts are presented in this report.

Study Area

We surveyed Snowy Plover breeding habitat along the Oregon coast, including ocean beaches, sandy spits, ocean-overwashed areas within sand dunes dominated by European beachgrass (*Ammophila arenaria*), open estuarine areas with sand flats, a dredge spoil site, and several habitat restoration/management sites. From north to south, we surveyed and monitored plover activity at Sutton Beach, Siltcoos River estuary, the Dunes Overlook, North Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit (CBNS), Bandon Beach, New River (south from Bandon Beach to the south end of the habitat restoration area), and Floras Lake (Fig. 1). A description of each site occurs in Appendix A.

Methods

In early April 2009, pre-breeding season surveys of historical nesting areas were completed, and in late May 2009 breeding season window surveys were completed. State and federal agency personnel and volunteers surveyed sites between the Necanicum Spit, Clatsop Co. to Pistol River, Curry Co. The surveys were implemented to locate any prospecting plovers at locations not known as currently active nesting sites. The following additional areas were either surveyed in early spring or during the breeding window survey: Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake South Spit, Whiskey Run to the Coquille River, Elk River, Euchre Creek, and Pistol River.

Breeding season fieldwork was conducted from 3 April to 23 September 2009. Survey techniques, data collection methodology, and information regarding locating and documenting nests can be found in Castelein *et al.* 2000a, 2000b, 2001, 2002, and Lauten *et al.* 2003. No modifications to survey techniques were implemented in 2009.

Since 2003 (Lauten *et al.* 2003) we have used mini-exlosures (MEs) to exclose plover nests. In 2009, all exclosures used were MEs. Predator management occurred at all active nesting areas; corvids (*Corvus sp.*) were targeted at all nesting sites and some mammal trapping, specifically targeting red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), skunks (*Mephitis sp.*), raccoon (*Procyon lotor*) and coyote (*Canis latrans*), occurred at specific sites. No avian predators other than corvids were targeted or removed in 2009. For information regarding the predator management program, see Little (2009). Nests were not exclosed during April and into early May until peak raptor migration was believed to have passed (Castelein *et al.* 2001, 2002, Lauten *et al.* 2003). From mid-May through early August exclosures were used at Siltcoos, Bandon, and New River when we determined nest predation by corvids was high enough to warrant their use. Nest failures at Overlook and Tahkenitch in 2009 were mostly attributed to non-predator related causes; therefore we did not use exclosures at these sites because there was little evidence that exclosure use would have increased nest success. At CBNS, most nest failures were attributed to rodent depredation and there were no corvid depredations, therefore exclosures were not used because they would not have afforded any extra protection to the nests. At Tenmile where nest depredations were fairly high, we did not exclose nests because we were uncertain if corvids or rodents were the main cause of nest failure. Exclosures do not prevent rodent depredations, and high rodent populations likely attract Great Horned Owls (*Bubo virginianus*) and possibly other avian predators (i.e., Barn Owl (*Tyto alba*) and Northern Harrier (*Circus cyaneus*)). Continuing concern about adult plover depredations around exclosures, specifically at Overlook, Tahkenitch, and Tenmile, weighed into the decision to be cautious about erecting exclosures at these sites. At Siltcoos, corvid predation pressure in May resulted in exclosure use on the north spit and on one nest on the south spit, but exclosure use was discontinued after mid-June when corvid activity had been reduced. At Bandon Beach and New River, predation pressure from corvids was high enough in May that we began exclosing nests. Although predation pressure declined, it remained high enough throughout the nesting season that we maintained exclosures on most nests at these sites for the remainder of the breeding season.

Male Snowy Plovers typically rear their broods until fledging. In order to track the broods we banded most nesting adult males, sometimes the female, and most hatch-year birds with both a USFWS aluminum band and a combination of colored plastic bands. Trapping techniques are described in Lauten *et al.* 2005 and 2006. We monitored broods and recorded brood activity or adults exhibiting broody behavior at each site. Chicks were considered fledged when they were observed 28 days after hatching.

We estimated the number of Snowy Plovers on the Oregon coast during the breeding season of 2009 by determining the number of uniquely color-banded adult Snowy Plovers observed, and added our estimate of the number of unbanded Snowy Plovers that were also present. We used two techniques to estimate the number of unbanded plovers. We used the 10 day interval method described in Castelein *et al.* 2001 and the daily observation evaluation method described in Castelein *et al.* 2001, 2002 and Lauten *et al.* 2003. We estimated the breeding population by tallying the number of 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 during the breeding season but not confirmed nesting.

We determined the number of individual banded female and male plovers and the number of individual unbanded female and male plovers that were recorded at each nesting area along the Oregon coast from the beginning until the end of the 2009 breeding season. Data from nesting sites with a north and south component (Siltcoos, Overlook, and Tenmile) were pooled because individual plovers use both sides of these estuaries. Data from CBNS nesting sites were all pooled for the same reason. We also pooled the data from Bandon Beach, New River, and Floras Lake because despite the relatively long

distance from the north to the south end (10-12 miles), the plovers that use these nesting sites interchange and move freely between the areas. A tally from each individual site would result in the appearance that more plovers are using the area than actually were present. The total number of individual plovers recorded at each site indicates the overall use of the site, particularly where plovers congregate during post breeding and wintering. We also determined the number of individual breeding female and male plovers for each site. The number of individual breeding adults indicates the level of nesting activity for each site.

We calculated nest success using apparent nest success and the Mayfield method of nest success (Mayfield 1961, Mayfield 1975). 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, and overall Mayfield nest success for all nests. We also calculated an adjusted Mayfield nest success for both exclosed and unexclosed nests. The adjusted nest success calculations for exclosed nests eliminated infertile nests because they did not fail due to an extrinsic cause (i.e., depredation or an environmental factor) and adults incubated the eggs longer than the typical incubation period, which would bias the Mayfield calculations. One egg nests and nests found that had already failed or hatched were eliminated from unexclosed nest success calculations. For the Mayfield calculations, these failed nests have a survival rate of zero because the nests have no known active dates, and therefore the calculation is divided by zero unexclosed days. Adding nests with no survival rates would bias the calculations to lower estimates of survival. We compared apparent nest success of exclosed and unexclosed nests by Chi-square analysis.

We calculated brood success, the number of broods that successfully fledged at least one chick; fledgling success, the number of chicks that fledged divided by the number of eggs that hatched; and fledglings per male for each site.

We continue to review plover productivity prior to lethal predator management activities compared to productivity after implementation of lethal predator management. We specifically continue to evaluate the changes in hatch rate, fledgling rate, productivity index, and fledglings per male from prior to lethal predator management compared to years with lethal predator management. The productivity index is a measure of overall effort based on how many fledglings the plovers produced compared to how many eggs they laid. If plovers produced high numbers of fledglings compared to eggs laid, then their productivity was high for the amount of effort (eggs laid) and the productivity index would be high. If plovers produced low numbers of fledglings compared to high numbers of eggs laid, then their productivity was low and the productivity index would be low. In general, a site with productivity index higher than 20% is considered good, while a site with productivity index less than 20% is usually not very productive. For a five-year review of the predator management program and its effect on plover productivity, see Appendix C of Lauten *et al.* 2006. We used t-test to test for differences in the mean number of fledglings per male prior to predator management (1992-2001) compared to post predator management (2004-2009). 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.

We evaluated the activity patterns of plovers on four habitat restoration/management areas (HRAs): Overlook, the HRAs at CBNS, Bandon Beach HRA, and the New River HRA. We defined four main usage types: roosting, foraging, nesting, and brooding. Our intent was to show in a simple manner the response of plovers to restored habitats, and therefore, the potential benefits to plovers afforded by habitat management projects.

Results

Abundance

Pre-breeding April surveys and the late May window survey at sites between the Columbia River and Pistol River, Curry Co. did not detect any plovers or plover activity outside of known nesting areas.

During the 2009 breeding season, we observed an estimated 199-206 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 199-206 plovers, 172 (83-86%) were banded. For unbanded plovers, the 10 day interval method estimated 20-24 unbanded plovers were present, but using the daily observation evaluation method for unbanded plovers, an estimate of 27-34 unbanded plovers were present during the breeding season. For the breeding season, we observed 81 banded females, 91 banded males, 20-25 unbanded females, and 7-9 unbanded males.

Of the total estimated population, 149-150 plovers (72-75%) were known to have nested (Table 1), slightly less than the mean percentage for 1993-2008 (79%). A minimum of 56 banded females and 16 unbanded females nested and 73 banded males and 4-5 unbanded males nested. An additional 20 banded females and 15 banded males were present during the breeding season but were not confirmed nesting. The estimated Oregon resident plover population was 184-185.

In 2008 the estimated adult plover population was 188-200, of which 160 were banded. Of these 160 banded adult plovers, 45 (28%) were not recorded in 2009 and therefore are presumed not to have survived winter 2008-2009. The estimated overwinter survival rate based on returning banded adult plovers was 72%.

During the 2009 season, we captured and rebanded 23 banded adult plovers - 17 were males and 6 were females; we banded 10 unbanded adult plovers - nine were males and one was a female; and we banded 180 chicks.

While there were no plovers detected during spring and breeding season surveys at locations other than known nesting locations, there were several late summer sightings along the north coast. On 30 August, two banded plovers were seen at Necanicum Spit, Clatsop Co., by both David Leal of USFWS and Stefan Schlick, an Oregon birder. The band combos were not sufficiently seen by either observers, so it was not clear if these individuals were from Oregon or Washington. On 6 September, Oregon birder Greg Baker photographed a banded Snowy Plover at Nehalem Bay State Park, Tillamook Co. The photographs were not close enough to definitively determine the band combo, but we believe this may have been a Washington bird. This record is the first record for Nehalem Bay since 13 July 1984 when one adult plover was reported. Prior to the 1984 record, there was a record from 1972. On 12 September, Oregon birders Daniel Battaglia and Ariel Muldoon reported a Snowy Plover from the North Jetty, Nye Beach, Newport, Lincoln Co. No bands were reported for this plover. In addition to these sightings, a HY09 CBNS fledgling was photographed by Oregon birder Kevin Smith off Pigeon Point, Coos Bay on 30 August. While this location is east of the CBNS nesting area, it is on the east side of the river channel and we have had very few reports of plovers using the interior bay.

2008 Hatch-Year Returns

Due to analysis of hatch year returns, we adjusted the 2008 fledgling total to 73 from 71. Thirty-five of the 73 hatch-year plovers from 2008 returned to Oregon in 2009. The return rate was 48%, nearly the average return rate for 1992-2008 (Table 2, 45%). Of the returning 2008 hatch-year birds, 18 (51%) were females and 17 (49%) were males. Twenty-six of the hatch year 2008 returning plovers attempted to nest (74%), and they accounted for 20% of the banded adults.

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 2009. No plovers were recorded at Sutton Beach for the second year in a row. Bandon Beach/New River/Floras Lake is a long, linear nesting area covering approximately 12 miles and had the most plovers. Tahknenitch was the occupied site with the fewest birds.

Nest Activity

We located 236 nests during the 2009 nesting season (Table 4), the highest number of nests found since monitoring began in 1990. In addition we recorded eight broods from nests that we did not locate prior to hatching.

There was no nesting activity at Sutton Beach in 2008 or 2009.

At North Siltcoos (Figure 2), 14 nests were found, half the number found in 2008. At South Siltcoos, nine nests were found and there was one brood from an undiscovered nest. Twenty-three total nests were found at Siltcoos, down from 36 in 2008 (Table 4).

At North Overlook nine nests were found in 2009, slightly less than the previous two years (Table 4, Figure 3). No nests were found in the vicinity of Carter Lake trail access in 2009. South Overlook had five nests, the same number found in 2005 and the highest number of nests found at this site.

At North Tahkenitch, six nests were found in 2009 (Figure 4), continuing the trend of few nests and plovers at this site.

At Tenmile, 54 total nests were found in 2009, the highest ever found at this site (Table 4). The north spit had 13 nests (Figure 5). At South Tenmile, 41 nests were found, the highest number of nests ever found in one season at this site and nearly double the previous high found in 2007. In addition, three broods from undiscovered nests were found late in the season at South Tenmile.

At CBNS (Figure 6), 65 nests were found in 2009 (Table 4), the highest number of nests ever found at any site on the Oregon coast. In addition there were three broods from undiscovered nests. South Spoil had 16 nests and the 94HRA had 14 nests. The 95HRA had 12 nests including two in the newly shell hashed area, and the 98EHRA had four nests. South Beach had 19 nests, the highest number of nests ever on South Beach and over double the previous high in 2007. All three broods from undiscovered nests were found on the HRAs (two on the 94HRA and one on the 98EHRA).

At Bandon Beach (Figure 7), the 31 nests found in 2009 is equal to the previous high number found in 2005 (Table 4). Plovers continue to nest around the China Creek overwash area, and at least one nest was found north of China Creek and south of Devil's Kitchen. Despite steepening and degrading

foredune habitat, plovers continue to nest along the foredune south to the HRA. Thirteen nests were found on the HRA, including two along the foredune south of the maintained area of the HRA and one at the very south end of the HRA just north of the mouth of New River.

At New River (Figure 7 and 8), 40 nests were found in 2009, the highest number of nests ever found at New River (Table 4). In addition one brood from an undiscovered nest was found on state land on the New River spit. Twenty-three of the 40 nests were found on the BLM HRA and four other nests were on BLM land just north of the HRA. The northern half of the HRA from New Lake breach north had the best habitat, and most of the nests were from the New Lake breach north. The open breached areas remain some of the best habitat, and 13 of the nests (48% of the HRA nests) were found on Croft Lake breach and New Lake breach or between the two breaches. For the second year in a row, two nests were found on the very large Clay Island breach south of the maintained HRA (incorrectly called Bono Ditch breach in the 2008 report). Four nests were found just north of the HRA along the foredune, and one other nest was found on the open beach adjacent to private land. Two nests were found on the former Coos Co. land, which is now owned by Michael Keiser of Bandon Dunes Resort. On state land, 10 nests were found in 2009. Bandon Beach State Natural Area from China Creek to the south boundary north of Mr. Keiser's land had a total of 41 nests and one brood from an undiscovered nest in 2009.

We found three plover nests at Floras Lake in 2009, the first nests at this site since 2002 (Table 4). All three nests were north of the Cooperative Management Area (CMA). One nest was along the foredune just north of the CMA, one nest was at the mouth of Hansen Breach, and the third nest was north of the breach opening.

The first nests were initiated about 2 April (Figure 10). Nest initiation increased throughout April and into early May, declined slightly in mid-May and increased again in late May into early June. The maximum number of active nests ($n = 66$) during 10-day intervals occurred during 31 May – 9 June. Due to increasing plover populations, the past several years have had higher numbers of active nests than the average. The last nest initiation occurred on 20 July.

Nest Success and Exclosures

The overall Mayfield nest success in 2009 was 23%, nearly half the mean and the lowest success rate since 1991 (Table 5). The low success rate was due to high numbers of nests being depredated by rodents and unknown predators. Adjusted Mayfield nest success for all exclosed nests in 2009 was 72%, considerably higher than 2008 and near the mean. For the third year in a row, the number of days nests were unexclosed was considerably higher than the number of days nests were exclosed (2522 unexclosed days, 527 exclosed days), and the number of days exclosed was the lowest total since 1992 when there were considerably fewer nests (Table 4). The low number of exclosed days is due to exclosures being used at only three sites in 2009: Siltcoos, Bandon, and New River. The adjusted Mayfield nest success rate for unexclosed nests in 2009 was 28%, less than the previous three years when unexclosed nest success had improved considerably.

In 2009, the overall annual apparent nest success rate was 33%, slightly lower than in 2008 (35%) and well below the 20-year mean of 46% (Table 6 and Figure 11). The number of exclosed nests in 2009 ($n = 34$, 14%) was lower than in 2008 ($n = 51$, 26%). Apparent nest success for exclosed nests in 2009 was 76%, much higher than in 2008 (49%). The number of unexclosed nests in 2009 ($n = 202$, 86%) was much higher than in past several years (2008, $n = 140$, 71%; 2007, $n = 164$, 81%; and 2006, $n = 79$, 54%). Apparent nest success for unexclosed nests in 2009 was 25%, less than the previous three years (2008, 30%; 2007, 35%; and 2006, 32%). Nest success of unexclosed nests was significantly lower than nest success of exclosed nests ($\chi^2 = 36.9007$, $df = 1$, $P < 0.01$), however the mean nest success of unexclosed

nests for 2006-2009 ($x = 30.5\%$) continues to be much higher than the mean success rates of unexclosed nests for 1995-2005 ($x = 9\%$).

On Forest Service sites, exclosures were used only at Siltcoos in 2009. This is the first year that no exclosures were used at Overlook, Tahkenitch, and Tenmile. Early in the season, we did not exclose any nests, as has been our practice since the early 2000's (Lauten *et al.* 2004). While some nests were being depredated, we only documented one corvid depredation at Overlook and five at Tenmile. We did not have much evidence that corvids were the cause of failed nests except at Tenmile, and we were documenting that rodents were depredating some nests. We also continued to be concerned about avian depredation of adult plovers around exclosures, and the evidence of rodent activity on the nesting areas reinforced our concerns about avian predators, particularly Great Horned Owls. Exclosures do not prevent rodent depredations. We had little evidence that other predators were causing many nest depredations except at Tenmile, therefore we decided not to exclose nests at Forest Service sites other than Siltcoos. At Siltcoos we were concerned about crow activity, especially on the north side, so we exclosed nests from mid-May until mid-June. After mid-June, when corvid activity appeared to be controlled, we stopped exclosing nests at Siltcoos.

At Siltcoos, four nests on the north side and one on the south side were exclosed and all five hatched (Table 6). Eighteen total nests at Siltcoos were unexclosed, and six hatched (33%). Of the 12 unexclosed nests that failed, four (33%) failed due to depredation, none of which were documented corvid takes (Table 7). Five nests failed to unknown causes, and three nests were one egg nests.

At Overlook, five of fourteen nests successfully hatched (36%). Of the nine unexclosed nests that failed, only two were documented depredations (Table 7), one corvid and one unknown predator. Five nests failed due to abandonment or one egg nests, and two nests failed to unknown causes. In 2008 we recommended that exclosure use be eliminated at Overlook due to repeated adult plover mortalities related to exclosed nests (Lauten *et al.* 2008). We did not erect any exclosures at Overlook and we did not document any adult plover mortalities at this site in 2009.

At Tahkenitch, two of six nests hatched (33%), however the remaining four nests that failed were not depredated, so no nests failed due to predators. Of the four nests that failed, three were abandoned or one egg nests and one was unknown cause (Table 7).

Twelve nests hatched at Tenmile (22%), including two on the north side and 10 on the south side. Forty-one nests failed and 27 (66%) of these failed due to predators. Of the 27 depredated nests, five were depredated by rodents, five by corvids, one by a canine, and the remaining ($n = 16$) were unknown predators. Because we were not certain whether corvids or rodents were the main cause of failure, and because of past documented adult depredations by Great Horned Owls at Tenmile (see Lauten *et al.* 2008), we elected not to use exclosures. Eight nests were abandoned or one egg nests, five nests failed to unknown causes, one nest was infertile, and one nest had an unknown outcome. There were no known adult plover depredations at Tenmile in 2009. While nest success was relatively poor at Tenmile, three late season broods from undiscovered nests boosted the number of fledglings produced at this site, which resulted in fairly good overall production despite the poor nesting success.

Overall, despite not using exclosures, nest success for Siltcoos and Overlook was fairly good, but Tenmile in particular was very poor compared to the average (compare Table 6 to Figure 11).

For the third year in a row, no exclosures were used at CBNS in 2009. Of a total of 65 nests, 23 successfully hatched (35%, Table 6), a very poor rate for CBNS (Figure 11). Nests on the HRAs had a 27% success rate, and nests on South Spoil had a 31% success rate, well below the average for these sites

(Table 6, Figure 11). After repeated failures on the nesting areas, plovers moved to South Beach where we found the highest number of nests for this site ($n = 19$, Table 4). Nest success on South Beach was much higher than the nesting areas (53%). The majority of failed nests were caused by depredation (66%, Table 7), and after two years of struggling to identify mysterious nest depredations, we concluded that rodents were responsible for the majority of failed nests on the HRAs and South Spoil. Since rodents were depredating the nests, exclosure use was not an option, as exclosures do not stop rodents. Seven nests were abandoned or one egg nests, three nests on South Beach were overwashed, two failed from unknown causes, one nest was buried by wind blown sand, and one nest was infertile.

At Bandon Beach, six of 31 nests were exclosed in 2009, and four of these hatched (Table 6). In 2008 all unexclosed nests failed at Bandon Beach ($n = 21$). In 2009, 24 of 25 unexclosed nests failed. As was the case in 2008, many of these unexclosed nests failed quickly, often less than a week after being discovered. Depredations were the main cause of failure ($n = 16$, 62%), and seven other nests failed to unknown causes. Three nests were one egg nests. Overall only 13% of the nests at Bandon were successful, similar to 2008 (11%). In the past two years, only eight of 59 nests (14%) have hatched at Bandon Beach, well below the average for this site (Figure 11).

At New River 22 nests were exclosed and 18 nests were unexclosed (Table 6). Exclosed nests at New River did very well, with an overall 77% nest success rate. On the HRA, exclosed nests had an 87% success rate while on state and private land exclosed nests had a 57% success rate. Unexclosed nests at New River had an overall 20% success rate, and unexclosed nests on both the HRA and state or private land had similar success rates (17% and 20% respectively). Predators were the main cause of nest failure ($n = 15$, 83%), with corvids continuing to be the most identified predator of nests ($n = 5$, 28%, Table 7). Overall nest success at New River was close to the average (Figure 11).

Corvid activity at Bandon and New River remains persistent enough that exclosure use continues to be needed throughout the entire season. There were no documented cases of adult plovers being depredated at or around exclosures at Bandon and New River in 2009.

Three nests were found at Floras Lake at the end of June. Two of the adults were California marked adults, and another pair was from the New River HRA where they had recently lost a newly hatched brood. One nest was exclosed, but failed quickly when rodents raided the nest. Another nest was at the mouth of Hansen breach, and was either overwashed or depredated. The third nest was found along the foredune with one egg just north of the CMA, and two people were camping within 50 meters of the nest. The nest was subsequently abandoned.

Nest Failure

Exclosed nests in 2009 had an overall failure rate of 18% (6 of 34), lower than the previous four years (49% in 2008, 29% in 2007, 34% in 2006, and 27% in 2005). Of the six failed exclosed nests, three failed due to rodent depredation and three failed to unknown causes (Table 8). The number of unexclosed nests that failed in 2009 ($n = 148$) was much higher than the previous two years (2008, $n = 102$ and 2007, $n = 104$), but the failure rate in 2009 (73%) was similar to the past three years (73% in 2008, 66% in 2007 and 68% in 2006). The mean failure rate for unexclosed nests for 2006-2009 (70%) is less than the mean failure rate for 2000-2005 (94%), indicating that more unexclosed nests were successful over the past four years. In 2009, the main causes of nest failure for unexclosed nests were unknown depredations, ($n = 44$, 30%), rodent depredation ($n = 30$, 20%), and unknown cause ($n = 23$, 16%, Table 8). Overall nest failures were attributed to unknown depredation (29%), rodent depredation (21%), unknown cause (17%), one-egg nests (12%), corvid depredation (8%), abandonment (7%), wave overwash (2%), infertility (1%), wind (1%), canine depredation (1%), and raccoon depredation (1%, Table 7). Corvids in previous years

have been responsible for a majority of egg depredations, but in 2009 corvids were known to be responsible for just 8% of the failures and 14% of egg depredations, well below previous years (see Lauten *et al.* 2008, 2007). While corvids remain a serious threat, predator management activities continue to reduce corvid impacts on nesting plovers.

As in the previous two years, there were a high number of one-egg nests ($n = 19$ for 2009, $n = 22$ in 2008, and $n = 23$ for 2007) and abandoned nests ($n = 11$ for 2009, $n = 19$ in 2008, $n = 18$ in 2007). Of 112 abandoned and one egg nests in the past 3 years, only 12 were exclosed. While the reasons for these abandoned and one egg nests are unclear, it appears that exclosures are not a significant contributing factor.

Fledgling Success and Productivity

We monitored 88 broods in 2009 including eight broods from undiscovered nests, 18 more broods than in 2008 (Lauten *et al.* 2008). A minimum of 106 fledglings was confirmed, the fourth time in the previous six years that there were over 100 fledglings (Table 9). Overall fledgling success was 50%, the seventh consecutive year that fledgling success was higher than the average (Table 10). The overall number of fledglings per male was 1.33 (106/80, Table 11). Using the productivity data from Siltcoos to New River only (Tables 13-19), the mean fledglings per male was above 1.00 for the seventh consecutive year (Table 12).

The overall brood success rate was 73% (Table 11), higher than in 2008 (66%). At Siltcoos, 100% of the broods were successful ($n = 12/12$). Overlook had five broods, up from two in 2008 and four were successful (80%). One brood of two at Tahkenitch was successful in 2009. At Tenmile, overall brood success was 73% ($n = 11/15$). At CBNS, all 10 broods on South Beach successfully fledged, and overall CBNS had a 77% brood success rate ($n = 20/26$). Bandon Beach had five broods, four of which were successful (80%). At New River, three of six broods on state and private land were successful, and 10 of 15 broods were successful on the HRA. Overall brood success at New River was 62% ($n = 13/21$).

Overall fledgling success at Siltcoos was 61%, with 82% success on the south spit and 47% success on the north spit (Table 11). Overlook had an overall fledgling success rate of 64%, with 88% success on the north side and 33% success on the south side. Tahkenitch was the only site with a poor fledgling success rate, with only one chick fledgling of six hatched (17%). Overall fledgling success at Tenmile was 62%. There were only four hatched eggs on the north side, two of which fledged (50%), while the south side had a fledgling success rate of 64%. For South Tenmile, five fledglings from undiscovered broods were not included in the calculations because we do not know how many chicks actually hatched. However, fledgling success and fledgling per male calculations for South Tenmile would even be higher if these fledglings were included in the calculations. CBNS had an overall fledgling success rate of 48%. South Spoil had a relatively poor fledgling success rate of 29%, while the HRAs had a 42% fledgling success rate and South Beach had a 64% fledgling success rate. Bandon Beach had only five broods, and fledgling success was 50%. Overall fledgling success at New River was 39%. The HRA had a fledgling success rate of 42%, while the other lands had a relatively poor 27% fledgling success rate.

In 2009, productivity at all sites except CBNS improved from 2008 (Tables 13-19). At Siltcoos in 2009 (Table 13), hatch rates increase by 20 percentage points compared to 2008, the number of fledglings doubled, and fledgling success and the number of fledglings per male nearly doubled. The productivity index more than doubled from 2008, indicating that there was excellent productivity for the amount of effort. At Overlook in 2009 (Table 14), hatch rates more than doubled compared to 2008, the number of fledglings increased by four, fledgling success improved by 24 percentage points, and the number of

fledglings per male more than doubled. The productivity index was nearly five times better in 2009 than 2008, indicating that productivity was excellent for the amount of effort. While Tahkenitch had improved productivity in 2009 compared to 2008, sample sizes remained relatively small and therefore subject to much variance (Table 15). Hatch rates in 2009 at Tahkenitch were average, but fledgling success, the number of fledglings per male, and productivity index all were relatively poor. At Tenmile (Table 16), hatch rate remained poor for the second year in a row and well below average. However, the number of fledglings doubled, fledgling success improved and the number of fledglings per male was very good. The productivity index at Tenmile in 2009 was only 14%, indicating that predation pressure was high at this site and there was much effort for the number of fledglings produced. While productivity at CBNS remains very good, plovers were not as successful in 2009 as previous years (Table 17). Hatch rates declined to 34%, indicating the level of egg depredations at this site in 2009. Despite having relatively good numbers, the number of fledglings, the fledgling success, and the number of fledglings per male all declined. The productivity index declined to below 20% for the first time in nine years, indicating that the plovers put in much effort for the number of fledglings produced. While Bandon Beach in 2009 improved from 2008, this site continues to have poor productivity for the amount of effort (Table 18). The hatch rate was very poor and about half the average, and while fledgling success was relatively good and the number of fledglings improved, the number of fledglings per male was below 1.00 and the productivity index was very poor. New River had better productivity in 2009 compared to 2008 (Table 19). Hatch rates remained about the same, but the number of fledglings, the fledgling success rate, and the number of fledglings per male all increased to very good levels. The productivity index also improved and indicates that plovers produced a good number of fledglings for the effort.

Overall, since lethal predator management was implemented at all sites, productivity has generally improved. The overall mean number of fledglings per male prior to predator management (Table 12, 1992-2001; $\bar{x} = 1.056$) was significantly lower than the mean number of fledglings per male post predator management (2004-2009; $\bar{x} = 1.038$, $t = 2.144789$, $df = 14$, $P = 0.0146$). As predation pressure from corvids has been reduced, we have limited enclosure use, resulting in several sites having slightly lower average hatch rates than prior to lethal predator management (Overlook, Tenmile, CBNS, Bandon and New River). However, the average fledgling success and the average number of fledglings per male has increased dramatically at Siltcoos, Overlook, Bandon, and New River, and less so at CBNS. Tahkenitch and Tenmile are the only sites where productivity has not greatly improved, but Tenmile has not changed much and Tahkenitch has been subject to small sample sizes and thus much variance. The productivity index has also improved considerably at Siltcoos, Bandon, and New River.

Brood Movements

Broods movements are unpredictable and variable, and are difficult to assess without focused efforts on this aspect of plover ecology. Since our focus tends to be on surveying and enhancing plover productivity, observations of broods and their movements are mostly opportunistic, and thus we have little data on what habitats broods are using, and when, where, and why they actually move. Roped nesting areas act as a safe refuge from recreational activity on the beach, but plover broods do not stay within the confines of the nesting area and broods are often found in the wrackline and on wet sand, particularly in the morning before beach activity increases.

North Siltcoos is the most confined nesting area for plovers. Due to the beach being open for vehicular use to the north and fairly heavy recreational use north of the spit, plover broods have limited ability to move north away from the nesting area. As we have visually witnessed, plover chicks do have the ability to swim across creeks. In 2009, of the six broods at North Siltcoos, two crossed the creek and eventually fledged on the south spit. The other four broods remained on the north side. On the south side, four of the broods remained on the south spit, but one brood moved south of Waxmyrtle trailhead and eventually was noted using North Overlook, where it fledged. The last brood of the year (from an

undiscovered nest) spent the majority of its brood period south of Waxmyrtle trailhead and north of Carter Lake trailhead. We have noted over time repeated plover use of the beach between South Siltcoos and North Overlook, with both nests and broods being found using this portion of beach. While this section of beach is not currently roped or signed, this beach is plover habitat and should be considered for plover management. With increasing populations, plovers will continue to seek areas like this that provide low disturbance and good chick rearing habitat. We may continue to see increased plover use of this section of beach as populations increase.

At Overlook, the three broods from the north side generally stayed within the nesting area, however one brood eventually was confirmed fledged at South Siltcoos. While there were no records of this brood along the beach north of North Overlook, this brood undoubtedly moved north as it was not seen for the last two weeks before being confirmed at South Siltcoos. This again indicates that plovers are using the beach between South Siltcoos and North Overlook. Of the two broods from South Overlook, one brood moved to North Overlook, and the other brood disappeared quickly after hatching and was never confirmed fledged.

The two broods at North Tahkenitch remained at North Tahkenitch and did not to our knowledge leave the spit. One brood was successful, and while we recorded the second brood more than two weeks after hatching in the roped nesting area, we never confirmed this brood fledged.

There were only two broods at North Tenmile, one of which failed quickly. The second brood may have crossed the creek as the male was noted acting broody on both the north and south spits, however, the chicks were never seen on the south spit. Of the thirteen broods at South Tenmile, one brood crossed the creek to the north side. The remainder of the broods stayed at South Tenmile. Broods were noted using the HRA and spit, but there was brood movement south along the foredune to just north of the large vehicle sign at the south end of the beach.

Brood movement at CBNS was quite extensive. As we have noted in the past, the contiguous aspect of the nesting areas, combined with gaps in the foredune road berms, and areas of relatively grass free foredune along the beach, particularly in the area of the Olson shipwreck, permit broods to move freely and easily about the nesting areas and from the nesting areas to the beach and back again. Broods hatched from South Spoil, the 94HRA, and the 98EHRA moved around on this large contiguous area. Some broods moved west and eventually crossed the foredune road and used the 95HRA before moving to the beach. Broods on the 95HRA tended not to move east, but stayed on the 95HRA or moved to the beach. One brood from an undiscovered nest was actually found on the foredune road adjacent to the 94HRA. Broods from South Beach tended to stay on South Beach, but due to the exposed foredune near the Olson shipwreck, some of these broods moved on and off the 95HRA repeatedly. Broods on South Beach were noted as far south as the north jetty and as far north as up to a half mile north of the Olson.

At Bandon Beach, two broods hatched near China Creek overwash. Both broods moved south along the foredune. One brood failed, and the other brood remained along the foredune and successfully fledged. The three other broods all hatched on the HRA. One brood remained in and around the HRA, while the other two broods moved north along the foredune, but also used the north end of the HRA. One brood was noted as far north as China Creek overwash, but in general these broods remained south of the China Creek overwash area.

New River is a remote, extensive, long beach with few barriers to prevent brood movements. While broods that hatch on either the spit or the HRA tend to stay in the general vicinity of their nest site, some broods at New River move long distances. For instance, one brood from an undiscovered nest that was found on state land on the spit, was noted within several days at the north end of the HRA, some two

miles to the south. This brood moved back to the spit and eventually was confirmed fledged on the spit. Other cases of long brood movements include both broods hatched on Clay Island breach. One brood moved south along the beach and was last noted within a quarter mile of the Floras Lake area before it failed. The other brood from Clay Island breach moved quickly north and spent the remainder of its brood rearing time at the south end of the HRA. While these examples show the ability of even young broods to move quite far within a short time period, many of the broods remained within a half mile of their nest site, moving frequently, but not too far from their origin.

Activity Patterns on HRAs

Table 20 shows the activity patterns of plovers on four habitat restoration areas: Overlook, CBNS, Bandon Beach, and New River. As the table indicates, HRAs are very important aspects to plover management and plovers use these areas for all activities.

Sightings of Snowy Plovers Banded Elsewhere

Eighteen adult plovers banded in California or Washington were observed in Oregon in 2009. Twelve were females and six were males. Nine of the 18 plovers were known to have nested in Oregon in 2009 including four males and five females. Five females and four males originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. Three of these Oregon originated males nested in Oregon in 2009, and the fourth was present only from the end of June to mid-July. Of the five Oregon originated females, two nested in Oregon in 2009. The other three females included a female at Tenmile recorded from April to June but not known to have nested, a female noted briefly at Tenmile in June, and a female noted only in September at Bandon Beach.

Two of the female plovers were from Washington, one HY07 bird and one HY08 bird. One was present at Overlook all summer, but she was not associated with any nests. The second female was seen in the month of June at CBNS and Siltcoos, but was not known to have nested.

The seven other plovers, five females and two males, were originally banded in California. Two females were banded as chicks in Humboldt Co. One female was a HY07 plover rebanded in 2008; she nested at New River HRA in both 2008 and 2009. The second female still retains her HY band combo, so we are uncertain what year she originally hatched. She nested at New River in 2008 and 2009. The other three females were a HY05 from Salinas NWR, a HY06 from Salinas NWR, and a HY08 from Sunset State Beach (all Monterey Co.). The HY05 female, who has past history in Oregon, was only seen in April and was not recorded again. The HY06 female was recorded throughout June, but was not known to have nested. The HY08 female was found incubating a nest at Floras Lake. One male was a HY04 from Salinas NWR, and has nested at New River since 2006. The second male was banded at Salinas NWR in June of 2009, and arrived at Bandon Beach in late July and was present for the remainder of the season.

Discussion

The number of Snowy Plovers present on the Oregon coast and the window survey count for 2009 were the highest totals tallied since monitoring began in 1990 (Table 1). While the window survey count increased by about 35-40 plovers, the overall number of plovers did not increase substantially from 2008. The number of breeding plovers did increase by about 20 plovers, however the number of breeding plovers, as well as the window survey, are subject to variance due to several factors. The window survey is subject to both survey conditions and plover detectability. The number of breeding plovers is subject to the ability to identify adults at a nest. Few adults are identified at nests that fail quickly, which was often the case in 2009. In addition, because we have been using fewer exclosures, we approached unexclosed

nests less often to minimize human activity around unprotected nests. The result was fewer opportunities to identify fleeing plovers. The number more likely to represent how many plovers are actually within the nesting population of Oregon is the number of resident plovers. The number of resident plovers in 2009 was 184-185, slightly higher than the previous two years (172 in 2008 and 174-177 in 2007). Thus, all indices to the population increased, and while the increase was not substantial, the population continues to move closer to recovery goals (U.S. Fish and Wildlife Service 2007).

The lack of a substantial increase in the plover population is a result of previous years' productivity in combination with overwinter survival rates and immigration into the population from other populations outside Oregon. In 2008, Oregon plovers produced 73 fledglings (Table 2), and the estimated overwinter survival based on hatch year returns was 48%, very close to the average. Adult overwinter survival was estimated to be approximately 72%, considerably better than the previous two years (62% in 2008 and 61% in 2007) and similar to those reported in the Recovery Plan (U.S. Fish and Wildlife Service 2007). The number of HY08 plovers that returned in 2009 was 35, and the number of adults from 2008 that did not return in 2009 was 45. Therefore the number of HY08 plovers did not completely replace lost adult plovers, yet the population slightly increased. This indicates, as noted in previous years (Lauten *et al.* 2007 and 2008), that the Oregon population is partially being maintained by immigration into the population. Colwell *et al.* (2008) 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.). While immigration into the Oregon population is important, the number of immigrants into the population is not large, as evidenced by the number of color banded plovers from outside the state that are detected in Oregon as well as the number of unbanded plovers that are in the population or subsequently banded. Only 18 adults plovers banded outside of Oregon were detected in 2009 and the number of unbanded adult plovers has remained essentially the same (28-35 in 2009 compared to 27-39 in 2008), as has the number of newly captured unbanded plovers ($n = 10$ in both 2008 and 2009), thus the population did not substantially increase. Collectively, data from Oregon, Washington, and Humboldt Co., CA, continues to show the importance of immigration, with all populations being maintained or influenced by immigration.

There was little change in the distribution of plovers along the Oregon coast in 2009 (Table 3). The number of plovers at Siltcoos remains fairly stable, with about 40 individuals using this site over the past four years (49/16 in 2006, 36-37/26 in 2007, 40-44/20 in 2008, and 39-40/24 in 2009). While the number of nests at Siltcoos declined slightly in 2009 (Table 4), the decline is mostly attributed to fewer one egg nests ($n = 9$ in 2008 and $n = 3$ in 2009) and abandoned nests ($n = 4$ in 2008 and $n = 0$ in 2009). Overlook and Tahkenitch had approximately the same number of individuals and nests in 2009 compared to 2008. Tenmile had similar numbers of plovers present in 2009 compared to the previous two years ($n = 56-61$ in 2008 and $n = 52$ in 2007). Nearly 30% of the total number of plovers on the Oregon coast use Tenmile at some point during the year. The number of nests at Tenmile increased from 28 in 2008 to 54 in 2009, however this increase is due to many failed nests and therefore many renest attempts. Tenmile continues to be one of the most productive sites on the Oregon coast (Table 16); habitat and predator management at this site are critical to the overall Oregon plover population. We continue to recommend that habitat at Tenmile, particularly on the north side, be expanded and improved. CBNS also has high plover activity, with about 30% of the total number of plovers on the Oregon coast using this site at some point during the year. CBNS continues to be the most productive site on the Oregon coast (Table 17). Plover numbers at CBNS were slightly higher compared to 2008 ($n = 53/37$), and for the second year in a row this site had the highest number of nests at any site in any given year (Table 4). The increase in nests however was due to repeated nest failures from rodent depredations, and thus many renest attempts. The total number of plovers using Bandon Beach/New River/Floras Lake at some time in 2009 represents 40% of all the plovers on the Oregon coast (Table 3). There was a slight increase in the number of plovers detected at Bandon Beach and New River compared to 2008 ($n = 68$), but the number of nesting plovers

was very similar to the previous two years ($n = 54$ in 2008 and $n = 53$ in 2007). The number of nests has also remained essentially the same for the past three years (Table 4).

The 2009 breeding season had the highest number of nests since monitoring began in 1990 (Table 4). While the plover population was also at its highest level since monitoring began in 1990, and this contributes to high nest numbers, repeated failures resulted in many renesting attempts, which resulted in high nest numbers. In addition, we continue to have fairly high numbers of one egg ($n = 19$) and abandoned nests ($n = 11$), similar to 2007 (22 one egg nests and 18 abandoned nest) and 2008 (22 one-egg nests and 19 abandoned nests, Lauten *et al.* 2007 and 2008). The number of one-egg and abandoned nests has been much higher in the past three years than any year from 2000 to 2006 (Castelein *et al.* 2000, 2001, 2002, Lauten *et al.* 2003, 2004, 2005, and 2006). We have speculated on the reasons for the high number of one egg and abandoned nests (Lauten *et al.* 2007 and 2008), but the actual reasons are difficult to assess. The distribution of abandoned nests in 2009 was widespread (Table 7) as it was in the previous two years. The distribution of one egg nests was wide spread in 2007 and 2009, but in 2008 a majority of the one egg nests occurred at Siltcoos. Disturbance may play a role in the outcome of some of these nests, however, recreational activity on the nesting areas of most sites is low. The level of permitted activity in one area at any time is also fairly low, and we also continue to reduce the number of exclosures used. While permitted activity by monitors and Wildlife Service undoubtedly causes some disturbance, we do not believe that our activities are the main reason for all these failed nests.

We did not document widespread nest depredations due to rodents prior to this year (Lauten *et al.* 2007 and 2008). In 2009, rodent and unknown depredations accounted for 50% of all nest failures (Table 7). We have reported that corvids have been the main source of nest failures, and speculated that many of the unknown depredations in previous years were likely attributable to corvids (Lauten *et al.* 2008, 2007, 2006). In 2007 and 2008 there were a number of unknown depredations, particularly at CBNS. WS and our staff did not conclusively determine the cause of these failures, however there was some suggestion that the cause may have been rodents. In 2009, we again had similar nest failures, and after evaluating the evidence we determined that rodents were the cause of the nest failures. The evidence at the nest sites includes missing eggs, crushed eggs shells in very tiny fragments, spilled yolk, no sign of medium to large predator foot tracks or nest disturbance by any sizable predator, depredations inside exclosed nests, and rodent tracks inside depredated exclosed nests. In addition to this evidence, rodent activity on all sites based on tracking was very common, and while we did not video record any rodent depredations, Wildlife Services did video record deer mice (*Peromyscus maniculatus*) consuming chicken eggs at Tahkenitch, and deer mice were captured at Siltcoos, Overlook, Tahkenitch, Tenmile, and CBNS. Rodent depredation has not been a documented problem before, and while we believe that corvids have in the past been responsible for many unknown depredations, we believe that in 2009 and possibly 2008 rodents were potentially responsible for some of the unknown depredations.

Overall apparent nest success was well below the average for the second year in a row (Table 6, Figure 11). The low overall apparent nest success was due to poor success of unexclosed nests. In particular, there was very poor nest success of unexclosed nests at Tenmile, Bandon, New River and Floras Lake. At Tenmile, no exclosures were used partly because of adult depredations that have occurred there in previous years. We were reluctant to use exclosures at this site and other Forest Service nesting areas because loss of adult plovers is much more detrimental to the population than loss of eggs (USFWS 2007). High rodent populations on the beach undoubtedly attract hunting raptors and plovers incubating in exclosures may become targets, particularly for owls. While we did have five documented corvid depredations at Tenmile, we had few other documented corvid depredations on Forest Service sites (Table 7). Exclosures are effective at preventing corvid and large mammal nest depredations, but exclosures do not prevent rodent depredations and expose adults to additional risks (Murphy *et al.* 2003, Neuman *et al.* 2004). Therefore erecting exclosures simply because nests were failing may not have prevented some of

the nest failures (those due to rodents) and could have resulted in loss of adult plovers. For the first time since 2004, and only the third time since 1999, we did not document any adults being depredated at or near exclosures. While we recognize that nest success for unexclosed nests was low, it is important to note that no adults were known to have been depredated, and fledgling success, the number of fledglings, and the number of fledglings per male were all very good (Table 11). We continue to recommend that exclosure use be minimized and that they only be erected when there is evidence of persistent corvid or large mammal activity that threatens plover nesting success.

We did elect to use exclosures at Siltcoos, Bandon, and New River. We determined to use exclosures at these sites because of corvid activity. At Siltcoos, exclosures were mostly used on the north spit where crows were a persistent problem until about mid-June. At that time we ceased using exclosures due to reduced crow activity. At Bandon, we used a limited number of exclosures, and likely would have used more but many of the nests failed before we could erect exclosures. We did document corvid depredation of two nests at Bandon, however the majority of failures were due to unknown depredation and we are uncertain if rodents may have been a significant factor. The majority of exclosures were used at New River (65%, $n = 22$) where raven activity, particularly on the HRA, was relatively consistent all season. Controlling raven activity at New River is very difficult partly due to the ranches to the east, which have a very large population of ravens that continuously visit the beach. In addition, the area is very large, making coverage difficult. In 2009, Wildlife Services for the first time employed three agents, which enabled one person to be on the beach at Bandon Beach and New River daily during the workweek. We recommend that Wildlife Services continue to be funded for three personnel, as the workload at Bandon Beach and New River is large and there is a consistent need to be present on site on a regular, daily basis to control the ravens and continue to improve conditions for the plovers.

In the past two years, Bandon Beach has had 59 total nests (Table 4) yet only eight nests have hatched (14%). The productivity index at Bandon Beach in the past two years has been below 10% (Table 18), indicating that there has been very poor productivity for the amount of effort. This follows two years (2006 and 2007) when productivity at this site was improving based on both the productivity index and the number of fledglings per male (Table 18). The Bandon Beach and New River area harbor 40% of all the plovers on the Oregon coast (Table 3) at any given time, and Bandon Beach has had approximately 15% of all the nests on the Oregon coast in each of the last two years. This is a very important nesting area for plovers and management efforts need to focus on improving plover productivity on this beach. OPRD has already rerouted the old camp trail, which reduced recreational activity along the foredune south of the China Creek overwash area. In 2009, there was multiple volunteer staff that monitored the parking lot at China Creek six days a week, also helping to reduce recreational conflicts. Recreational violations are still occurring, mostly in the China Creek area, however the signing of the Habitat Conservation Plan (Jones and Stokes 2007) will eventually result in no dogs at Bandon Beach, which should help reduce recreational violations further.

We continue to recommend that a gate be considered to close the China Creek parking lot at night, as we have found that many of the violations are occurring in the evening and at night when there is no monitoring of the parking lot. Technically the parking lot is closed from about 9:00 PM until sunrise, however there is little enforcement of this restriction and no means of preventing vehicles from entering the parking lot at night. We have also recommended that Bandon Police Department be contacted to discuss the potential for patrolling the parking lot or closing and opening a gate.

While improved recreation management can help the plovers, it is very important that degrading habitat at Bandon Beach be restored. We have noted that the foredune has become very steep due to European beachgrass growth. This has resulted in loss of habitat as the foredune has moved westward and filled in many of the formerly wide sections of beach. Discussion with OPRD staff have led to the

concept of improving the foredune from the China Creek overwash area to the north end of the HRA by carving out scalloped shaped contours along the length of the beach and widening the foredune area. This effectively gives the plovers distributed along the length of the beach some wide, grass-free areas to nest. While we have recommended that the entire 50 acre HRA at Bandon Beach be restored to usable habitat as stated in the HCP, there has been some loss of acreage on the HRA due to the mouth of New River moving north, and therefore we recognize that restoration of all 50 acres may not be attainable at this time.

There is approximately a mile of suitable plover habitat on state land on the south side of the mouth of New River. However, there are areas that are degrading due to beachgrass establishment, which has resulted in dune growth. We have recommended in the past (Lauten *et al.* 2007 and 2008) that this area receive habitat maintenance and that these dunes be removed before they grow to sizes that make it both expensive and difficult to maintain. We continue to recommend that funding be found to complete habitat maintenance on this stretch of beach. This area historically has been a key nesting area for plovers, and it continues to be an important area for plovers. It is very remote, has little recreational activity, and is very large. We recognize that OPRD has limited funding for habitat maintenance work, so we encourage all cooperating agencies that have potential funding resources assist in maintaining this area. We would consider this area a priority area for habitat maintenance because there has been and continues to be significant numbers of plovers using this area, and because there is limited beachgrass and dune formation in the area at this time. If this area is not maintained, the beachgrass and dunes will continue to grow and plover habitat will be reduced. The cost of improving this area will only increase in the future, so we strongly recommend that the Working Team attempt to find some solutions to adequately manage this area. In addition, Michael Keiser of Bandon Dunes Golf Resort now owns the former Coos Co. land just south of the state land at New River. Mr. Keiser has graciously permitted us to continue all plover management activities on his land, and we are very grateful for his cooperation. Plovers continue to nest and use this area, but this area is also degrading from beachgrass growth and dune formation. We recommend that this land be secured through management agreements with an appropriate agency if the opportunity arises. If this area was to become public land, we would potentially be able to complete habitat maintenance and we would have better abilities to manage recreational access via Lower Fourmile Road.

The BLM HRA at New River continues to be a very important plover nesting area. The number of nests found in 2009 on this HRA was the highest ever ($n = 27$), and overall success on this area was very good (Table 6, Table 11). The BLM, for the first time in three years, will complete habitat maintenance of about 30 acres of the HRA from Croft Lake breach to the north end. Due to the degradation of habitat, plovers tended to nest on the beach, along the foredune edge and on the open breach areas (Figure 8). We had multiple nests active at the same time on the open beach, and nesting on the open beach leaves plovers susceptible to disturbance from hikers, recreationists, and even monitoring and Wildlife Services staff as we travel up and down the beach. Disturbed plovers are typically bumped off the nest, leaving it susceptible to wind blown sand. New plans to maintain the habitat on the HRA have been discussed and will be implemented, and we expect the improvements will give plovers better opportunities to nest off the beach. In addition we recommend that carsonite signs be erected along the foredune of BLM property north of the HRA as four plover nests were found in this area in 2009, and we have repeatedly noted adults, nests, and broods using this portion of the beach.

We continue to support winter breaching of the foredune to drain New River when it is in flood stage. These breach areas have excellent habitat, and plovers continue to nest and brood rear on these areas as evidenced by the number of nests on or near breaches in 2009 (Figure 8, including Croft Lake, New Lake, and Clay Island breaches). Corvids and red fox continue to be a threat at Bandon Beach and New River, and we recommend that predator management continue to be fully funded in these areas as we

refine our methods of predator removal. Bandon Beach and New River continue to have the need for enclosure use, and while we recognize that enclosures are an important tool for plover management, we also continue to recommend that reduction in enclosure use is best for adult plover survival.

There continues to be an increase in the number of hikers traveling from the Coquille jetty area south along Bandon Beach and New River to Floras Lake. We have learned from questioning hikers that much of the information pertaining to this area comes from either published hiking books or the OPRD web page that describe the Oregon coast trail. However, there has been a lack of information regarding the length of the hike as well as the legalities of where to camp. We have assisted initiating a subgroup with OPRD, USFWS, and BLM staff to manage this recreational activity. In particular, the subgroup has placed a map and information sign near the Coquille River south jetty to inform hikers of the length of the hike as well as information pertaining to plover nesting areas and camping locations. The subgroup is scheduled to meet and further improve signage both at the south jetty area, but also potentially along the route at key locations such as the China Creek area and possibly the New River mouth and near the BLM HRA. USFWS also initiated a letter to publishers of hiking books to inform them of plover related issues and asking that updated versions of any hiking book improve the information regarding plover nesting areas and camping locations.

Plover productivity in 2009 generally improved compared to 2008 and overall plover productivity at individual sites continues to be higher than previous to predator management (Tables 13-19). The only site in 2009 that had lower fledglings per male than in 2008 was CBNS, and yet plover productivity at this site was still well above 1.00 (Table 17). Two sites had less than 1.00 fledglings per male, Tahkenitch and Bandon Beach, but Tahkenitch had a very small sample size (Table 15). Despite the high number of fledglings and generally good fledglings per male in 2009, the productivity index at several sites was poor to very poor (Tahkenitch, Tenmile, CBNS, Bandon, and New River). The low productivity index (i.e., less than 20%) reflects high nest failure, and despite the high number of fledglings, plovers laid high numbers of eggs to produce that many fledglings. The high nest failure however was due to rodent depredations, and we have few options as to how to reduce rodent populations. While the predator subgroup continues to discuss the rodent situation and potential solutions, we are hopeful that the rodents are at a population high and that populations will decline on their own in the near future.

The plover population had an initial increase in the early 1990's, a peak in the mid-1990's, and then a decline and leveling off from the late 1990's into the early 2000's (Table 1). This period had a mean fledgling per male of 1.056, and reflects a relatively stable population. After the initiation of predator management at all sites (2004-2009), the population had a mean fledgling per male of 1.380, and the population has increased. The overall productivity data has generally improved since the implementation of predator management, and we continue to recommend that predator management be fully funded, as this aspect of plover management is critical to increasing plover population.

Data from Washington (S. Pearson, pers. comm.) and Humboldt Co., CA, (Colwell *et al.* 2009) indicate that both locations had a poor nesting season in 2009. While Oregon did have poor nest success in 2009, overall productivity was very good, and this suggests that Oregon specific management is improving the overall plover population. Plover populations in the Monterey Bay, CA. area also had a very productive year (G. Page, pers. comm.), but like Oregon, plover success was much better later in the season than early in the season. Overall the data continues to support that predator management, habitat restoration, and recreational management are having a positive effect on the plover population and productivity. We continue to recommend that these management actions be supported at current or higher levels.

We recommend the continued use at all sites of ropes and signs along nesting beaches and habitat restoration 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. We also continue to recommend the use of volunteers as well as paid staff to monitor nesting beaches. Recreational staff, law enforcement staff, and our monitoring crews continue to note that violations are reduced when agency staff or volunteers are present on site.

Habitat Restoration and Development Projects

The USFS bulldozed 12 acres of habitat south of Holman Vista and at Berry Breek, Sutton Beach in the winter of 2008-09. Spreading small woody debris or shell hash on the areas may attract plovers as well as improve nesting potential.

At Siltcoos, 10 acres on the north side and nine acres on the south side of the estuary were bulldozed in winter 2008-09. An additional four acres had beachgrass handpulled on the north side.

At Overlook 20 acres of habitat was bulldozed in winter 2008-09. In addition five acres on the north side had beachgrass handpulled.

At Tahkenitch, 20 acres of habitat was bulldozed in winter 2008-09.

At Tenmile, 21 acres on the south side was bulldozed in the winter of 2008-09. There was no work completed on the north side. Further maintenance and improvement of the north spit should be considered for the future.

At CBNS in winter 2008-09, BLM disked the entire habitat restoration area and parts of the spoil (up to ca. 165 acres). Three hundred cubic yards of shell hash was spread on the 95HRA. An additional 400 cubic yards of shell will be spread in winter 2009-10.

At Bandon Beach, the existing HRA and five additional acres were plowed in winter 2008-09. There is now about 20 acres of habitat. Sixteen additional acres are heavily vegetated and need improvement, but due to woody debris issues and funding issues it is not clear how soon this area will be completely improved. Discussions have been occurring regarding how to improve the foredune and HRA at Bandon Beach with the limited funding available. In addition, OPRD is having discussion with the National Guard as to whether they can do some of the habitat work in the future.

At New River, BLM did not do any habitat management in winter 2008-09. Thirty acres of habitat is scheduled for maintenance in 2009, with additional work scheduled for the following years.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2010-nesting season should again be implemented to inform the public of plover nesting habitat and direct the public away from the nesting areas. High tides early in the season often make posting areas a challenge, but it is important to have signs in place beginning on 15 March.

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.

- Maintain, enhance and expand habitat restoration areas.
- Reduce use of mini-exlosures 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 enclosure use dependent on predation pressure, density of plover nests, and nest locations. Continue to move toward elimination of enclosures at all sites.
- When faced with a large number of unknown nest depredations, coordinate with Wildlife Services to use remote trail cameras to try to identify nest predators where feasible.
- 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 agency employees regarding time frames of any habitat management work to be completed to minimize disturbance to nesting activity and broods.
- Coordinate agency activities in restricted/closed areas with plover biologists to minimize disturbance to nesting and brood rearing.
- Continue and explore ideas to document and monitor human disturbance by various recreational users in plover nesting areas.
- Continue to expand and refine volunteer efforts to monitor recreational use.
- Design educational programs to inform and educate the local communities and annual visitors about plover issues.
- Design informative/interactive presentations for schools for children.
- Continue intensive breeding season monitoring until plover numbers have reached the goals to be established in the USFWS Recovery Plan for Snowy Plovers, then monitor plover populations and productivity to ensure recovery goals are maintained.

Acknowledgments

We would like to thank Dylan Little, Brady Smith, Dan Godfrey and Mike Burrell of Wildlife Services for their assistance in the field, companionship, and thoughtful insight about predators; Robin Sears and Trisha Wymore of OPRD for their hours educating the public and monitoring recreational activity on the beach; Morgan Bell and Theresa Bolch of BLM for their diligence monitoring recreational activity at CBNS; Heather Lester and Kael Pokliuha of BLM at Floras Lake/New River for monitoring and education with recreationists and campers; Crystal Mullins of Forest Service for her many hours maintaining signs and ropes, monitoring recreational activity and interacting with the public; volunteers Ellen and Thomas Morris, Tim and Denise Schmidling, Pam and Les Trout, Don Carter and Clara Miller for OPRD spent numerous hours educating the public at China Creek parking lot, Bandon Beach State Natural Area; special thanks to volunteer Denny Porter and his two pals for ODFW/USFS at Siltcoos who spent their fifth summer educating and monitoring the public – Denny’s presence continues to be invaluable due to his knowledge of the plovers, the area, and through the numerous people who now know him and his dogs; volunteers Robert and Rosemarie Rogers and Dina Pavlis for USFS at Siltcoos; volunteers Calvin Salyona and Michael Ahillen for USFS at Overlook; Ted Gage and Carrie Pope of

BLM Law Enforcement, Ernie Mitchell of Coos County Sheriff's Department, Roger Geeting, Beaver Bowen, and Sara Wassam of the USFS Dunes National Recreation Area – we particularly thank Beaver for years of support and wish her a happy retirement, and John Franklin of Lane Co. Sheriff's Department; Liz Kelly, Madeleine Vander Heyden, and Laura Todd of the US Fish and Wildlife Service; Mark Stern, Ken Popper, and Karen Gleason of The Nature Conservancy; Charlie Bruce, formerly of ODFW and now happily retired; Stuart Love, Bill Kinyoun, Bryan Wright and Martin Nugent of the Oregon Department of Fish and Wildlife; Kip Wright, Steve Langenstein, Kerrie Palermo, Sharon Morse, Megan Harper, and all the managers at Coos Bay BLM District whose support is invaluable; Calum Stevenson, Jay Schleier, Ben Fisher, and Jeff Farm of the Oregon Parks and Recreation Department; Cindy Burns, Melissa Shelley and Paul Thomas of the USFS Mapleton Ranger District; Dave Williams of Wildlife Services; Sean McAllister and Ron LeValley of Mad River Biologists in Humboldt Co., CA.; Mark Colwell and students at Humboldt State Univ., Arcata, CA.; Jim Watkins of US Fish and Wildlife Service, Humboldt Co.; Gary Page, Lynne Stenzel, Doug George, Kris Neumann and Jenny Erbes of Point Reyes Bird Observatory; a very special thanks to Frances Bidstrup of Point Reyes Bird Observatory whose knowledge of banded plovers is unparalleled, whose cooperation is essential, and whose friendship is invaluable; everyone provided assistance, input and logistical support without which the program would not be a success.

LITERATURE CITED

- Casler, B.R., C.E. Hallett, and M.A. Stern. 1993. Snowy Plover nesting and reproductive success along the Oregon coast - 1993. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.
- Castelein, K.A., D.J. Lauten, R. Swift, and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1997. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.
- Castelein, K.A., D.J. Lauten, R. Swift, M.A. Stern, and K.J. Popper. 1998. Snowy Plover distribution and reproductive success along the Oregon coast - 1998. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.
- Castelein, K.A., D.J. Lauten, K.J. Popper, J.A. Fukuda, and M.A. Stern. 2000a. Snowy Plover distribution and reproductive success along the Oregon coast – 1999. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Castelein, K.A., D.J. Lauten, K.J. Popper, D.C. Bailey, and M.A. Stern. 2000b. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast – 2000. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Castelein, K.A., D.J. Lauten, L.N. Renan, S.R. Pixley, and M.A. Stern. 2001. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2001. Unpublished

report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.

- Castelein, K.A., D.J.Lauten, S.R. Pixley, L.N. Renan, M.A. Stern, and C. Grinnell. 2002. The distribution and reproductive success of the Western Snowy Plover along the Oregon Coast - 2002. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Colwell, M.A., K.M. Brindock, N.S. Burrell, M.A. Hardy, J. J. Muir, S.A. Peterson, S.E. McAllister, K.G. Ross and R.R. LeValley. 2008. Final Report: 2008 Snowy Plover Breeding in Coastal Northern California, Recovery Unit 2. Unpublished report submitted to MRB Research, Inc.
- Colwell, M.A., N.S. Burrell, M.A. Hardy, K. Kayano, J.J. Muir, W. J. Pearson, S. A. Peterson, K.A. Sesser, and R.R. Thiem. 2009. Final report: 2009 Snowy Plover breeding in coastal northern California, Recovery Unit 2. Submitted to MRB Research, Inc., and California Department of Fish and Game.
- Craig, D.P., M.A. Stern, K.A. Mingo, D.M. Craig, and G.A. Rosenberg. 1992. Reproductive Ecology of the Western Snowy Plover on the South Coast of Oregon, 1992. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay.
- Estelle, V.B., C.E. Hallett, M.R. Fisher and M.A. Stern. 1997. Snowy Plover distribution and reproductive success along the Oregon coast - 1996. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.
- Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1994. Snowy Plover distribution and reproductive success along the Oregon coast - 1994. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, the Dunes National Recreation Area, Reedsport, and the Coos Bay District Bureau of Land Management, Coos Bay.
- Hallett, C.E., B.R. Casler, M.A. Platt, M.A. Stern. 1995. Snowy Plover distribution and reproductive success along the Oregon coast - 1995. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.
- Jones and Stokes. 2007. Habitat Conservation Plan for the Western Snowy Plover. September. (J&S 06537.06) Portland, OR. Prepared for U.S. Fish and Wildlife Service and Oregon Parks and Recreation Department.
- Lauten, D.J., K.A. Castelein, B.V. Smithers, K.C. Jander, E. Elliot-Smith, and E.P. Gaines. 2003. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2003. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Lauten, D.J., K.A. Castelein, E. Seckinger, E. Kolkemo, and E.P. Gaines. 2005. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2004. Unpublished

- report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Lauten, D.J., K.A. Castelein, E. Seckinger, and E.P. Gaines. 2006. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2005. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Lauten, D.J., K.A. Castelein, S. Weston, K. Eucken, and E.P. Gaines. 2006b. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2006. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Lauten, D.J., K.A. Castelein, Raya Pruner, Marvin Friel, and E.P. Gaines. 2007. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2007. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Lauten, D.J., K.A. Castelein, D.C. Bailey, T. Lewis, and E.P. Gaines. 2008. The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast – 2008. Unpublished report for the Oregon Department of Fish and Wildlife – Nongame Program, Portland, the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes Recreational Area, Reedsport.
- Little, D. T. 2009. Integrated Predator Damage Management Report for the Western Snowy Plover (*Charadrius alexandrinus nivosus*) 2009 Breeding Season. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, and the Coos Bay District Bureau of Land Management, Coos Bay, and the Dunes National Recreational Area, Reedsport.
- Mayfield, H.F. 1975. Suggestions for calculating nest success. *Wilson Bulletin*. 87:456-466.
- Mayfield, H.F. 1961. Nesting success calculated from exposure. *Wilson Bulletin*. 73:255-261.
- Murphy, R. K., I. M G. Michaud, D. R C. Prescott, J. S. Ivan, B. J. Anderson, and M. L. French-Pombier. 2003b. Predation on adult piping plovers at predator exclosure cages. *Waterbirds* 26:150–155.
- Neuman, K. K, G. W. Page, L E. Stenzel, J. C. Warriner, and J. S. Warriner. 2004. Effect of Mammalian Predator Management on Snowy Plover Breeding Success. *Waterbirds* 27(3):257-263.
- Page, G.W., L.E. Stenzel, W.D. Shuford, and C.R. Bruce. 1991. Distribution and abundance of the snowy plover on its western North American breeding grounds. *J. Field Ornithol.* 62:245-255.
- Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1990. Investigations of the western Snowy Plover at the Coos Bay North Spit and adjacent sites in Coos and Curry Counties, 1990. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland, Oregon.
- Stern, M.A., J.S. McIver, and G.A. Rosenberg. 1991. Nesting and reproductive success of the Snowy Plovers along the south Oregon coast, 1991. Unpublished report for the Oregon Department of Fish and Wildlife-Nongame Program, Portland and the Coos Bay District Bureau of Land Management, Coos Bay

U.S. Fish and Wildlife Service. 1993. Final rule. Endangered and threatened wildlife and plants; Determination of threatened status for the Pacific coast population of the western snowy plover. Federal Register 58 FR 12864 03/05/93.

U.S. Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants: Proposed special rule pursuant to Section 4(d) of the Endangered Species Act for the Pacific coast distinct population segment of the Western Snowy Plover. Federal Register 71(77): 20625-20636.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). In two volumes. Sacramento, California. xiv + 751pp.

Table 1. Population estimates of the Western Snowy Plover on the Oregon Coast, 1990-2009. 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 unidentified 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 ^a
2001	71 (85)	79-80	111-113 ^b
2002	71 (76)	80	99-102 ^c
2003	63	93	102-107 ^d
2004	82 (83)	120	136-142 ^e
2005	100	104	153-158 ^f
2006	91	135	177-179 ^g
2007	125	162	181-184 ^h
2008	98-105	129	188-200
2009	136-143 (139-146)	149-150	199-206

^a - includes 13-15 adult plovers that were depredated during the breeding season

^b - includes at least two adult male plovers that were depredated and 1M and 1F thought to have been depredated during the breeding season

^c - includes at minimum of 6 adult plovers that were depredated and another 4 that possibly were depredated during the breeding season

^d - includes 2 adult female plovers that were probably depredated during the breeding season

^e - includes 2-3 males and 1-2 females believed to have depredated during the breeding season

^f - includes 1 female and 6 males that may have been depredated during the breeding season

^g - includes a minimum of 16 resident breeding plovers that probably were depredated during the breeding season

^h - includes 4 plovers known to have died and an additional 8 other plovers that were likely depredated

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 - 2009.

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
2009	106	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 = 45.3%

SD = 11.4%

Average percent of returning HY birds that nest in first season = 67.1%

SD = 17.7%

Table 3. Number of Adult Snowy Plovers at each nesting area on the Oregon Coast, 2009. First number is number of adults recorded at each site, and the second number is the number of breeding adults recorded at each site.

	Sutton	Siltcoos Total	Overlook Total	N Tahkenitch	Tenmile Total	CBNS	New River/Bandon/Floras Lake Total
# of banded females/# nested	0/0	19/10	13/1	5/2	28/11	24/14	35/18
# of unbanded females/# nested	0/0	1-2/1	2-3/2	2/0	3-4/1	6/6	8-10/7
# of banded males/# nested	0/0	18/12	9/5	3/2	25/11	26/22	34/21
# of unbanded males/# nested	0/0	1/0	1/0	1/0	1/0	3/3	3/3
Total	0/0	39-40/24	25-26/8	11/4	57/23	59/45	80-82/49

01/11/10

Table 4. Total number of nests for all sites on the Oregon Coast 1990 – 2009 cells tally nests only and not broods from undiscovered nests. The number of broods from undiscovered nests is totaled for each year and site only.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	Tot nst	Totbrd ^a
NEC													1	0	0	0	0	0	0		1	1
SU				2	1	2	6	14	8	3	7	15	3	1	0	0	4	3	0	0	69	1
NSIU													1	0	0	0	0	0	0		1	0
SI:																						
North				0	2	4	2	0	1	4	8	0	0	0	7	8	12	15	30	14	107	0
South				1	2	2	1	3	3	17	14	14	10	7	4	9	13	13	6	9	128	3
OV:																						
North										2	8	12	5	7	11	11	9	13	14	9	101	2
South										0	0	3	3	1	3	5	1	3	1	5	25	0
TA																						
North				0	0	0	0	0	0	0	4	7	8	13	8	11	4	10	5	6	76	1
South				0	3	9	18	14	6	3	1	6	7	1	0	0	0	0	0		68	2
3mileCr/ Umpqua R				0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0		1	0
TM:																						
North					2	2	1	0	0	0	1	2	3	5	9	6	10	20	12	13	86	3
South	2	0	9	8	5	4	3	2	11	5	5	6	9	12	8	11	12	21	16	41	190	7
CBNS:																						
SB	0	4	6	3	4	3	3	6	6	0	1	1	2	3	2	4	0	8	5	19	80	12
SS	20	9	4	6	9	12	22	14	5	2	5	3	2	9	8	9	14	12	18	16	199	13
NS	5	1	1	0	0	0															7	0
HRAs					4	3	2	3	7	12	22	13	15	11	16	16	18	19	26	30	217	20
Anad. Sp	0																				0	1
Menasha																						
	1	0																			1	0
BB	0	14	8	10	5	9	3	4	1	2	2	6	5	5	17	31	23	30	28	31	234	6
NR	6	6	2	0	6	20	18	25	26	28	17	23	14	16	24	23	27	35	35	40	391	12
FL																						
	2	2	6	11	8	6	9	8	4	0	5	0	1	0	0	0	0	0	0	3	65	3
Tot nst	36	36	36	41	51	76	89	93	78	78	100	111	89	91	117	144	147	202	196	236	2049	
Tot brd^a	2	1	5	7	4	6	11	5	3	1	2	0	1	4	2	3	15	4	3	8		87

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

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

Table 5. Nest Success (Mayfield Method) of Snowy Plovers on the Oregon coast, 1990-2009.

Year	% Nest Success				
	Overall ¹	Exclosed ²	Unexclosed ²	(N) ¹	(N) ²
1990	13	- ³	13	(36)	(29)
1991	20	77	5	(36)	(33)
1992	55	79	9	(36)	(34)
1993	56	77	16	(41)	(39)
1994	72	75	68	(51)	(47)
1995	41	62	7	(76)	(70)
1996	47	66	7	(89)	(87)
1997	40	52	26	(93)	(87)
1998	52	70	15	(78)	(70)
1999	54	62	40	(78)	(72)
2000	31	46	2	(100)	(91)
2001	26	67	4	(111)	(101)
2002	38	67	13	(89)	(76)
2003	43	79	23	(91)	(79)
2004	56	86	20	(117)	(109)
2005	45	70	27	(144)	(128)
2006	38	60	40	(147)	(126)
2007	33	66	41	(202)	(159)
2008	30	45	38	(196)	(159)
2009	23	72	28	(236)	(184)
mean	40.7 ± 14.6	67.3 ± 11.1	22.1 ± 16.8	(2047)	(1780)

¹Overall includes exclosed nests, unexclosed nests, infertile nests, and nests with one egg that were subsequently abandoned.

²Does not include infertile nests, nests with one egg that were subsequently abandoned, or nest found failed because the outcome of these nests was not affected by the presence or absence of an exclosure.

³Exclosed nests not included as multiple experimental designs were employed.

Table 6. Apparent nest success of Snowy Plovers on the Oregon Coast, 2009.

		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	14	4	0		2	8		100%	20%	43%
South	9	1	0		4	4		100%	50%	56%
Combined	23	5	0		6	12		100%	33%	48%
Overlook										
North	9	0	0		3	6		-	33%	33%
South	5	0	0		2	3		-	40%	40%
Combined	14	0	0		5	9		-	36%	36%
N Tahkenitch	6	0	0		2	4		-	33%	33%
Tenmile										
North	13	0	0		2	10	1	-	15%	15%
South	41	0	0		10	31		-	24%	24%
Combined	54	0	0		12	41		-	22%	22%
CBNS										
South Beach	19	0	0		10	9		-	53%	53%
South Spoil	16	0	0		5	10	1	-	31%	31%
HRAs	30	0	0		8	22		-	27%	27%
Combined	65	0	0		23	41	1	-	35%	35%
Bandon	31	4	2		1	24		67%	4%	13%
New River										
HRA	27	13	1	1	2	10		87%	17%	52%
Other Lands	13	4	2	1	1	5		57%	20%	38%
Combined	40	17	3	2	3	15		77%	20%	50%
Floras Lake	3	0	1		0	2		0%	0%	0%
Totals	236	26	6	2	52	148	2	76%	25%	33%

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2009.

Site Name	Tot Nsts	# Fail	Depredations					Other					
			Egg Depredations					Wind	Abandon	One Egg Nest	Over-wash	Infer	Unk cause
			Corvid	Unk	Canine	Rodent	Raccoon						
Sutton	0	0											
Siltcoos:													
North	14	8		1		1				2			4
South	9	4		1			1			1			1
Overlook													
North	9	6	1						2	2			1
South	5	3		1					1				1
N Tahkenitch	6	4							1	2			1
Tenmile:													
North	13	10		4		2			1	1		1	1
South	41	31	5	12	1	3			3	3			4
Coos Bay													
North Spit:													
South Beach	19	9						1	2	2	3	1	
South Spoil	16	10		2		4			1	1			2
HRAs	30	22		3		18				1			
Bandon	31	26	2	12		2				3			7
New River	40	18	5	8		2							3
Floras Lake	3	3				1				1			1
TOTALS	236	154	13	44	1	33	1	1	11	19	3	2	26

^a – one nest had partially developed embryos

Table 8. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2009.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	Corvid		13	13
	Unknown		44	44
	Rodent	3	30	33
	Raccoon		1	1
	Canine		1	1
Other	Wind/Weather		1	1
	Overwashed		3	3
	Infertile		2	2
	One Egg Nests		19	19
	Abandoned		11	11
	Unknown Cause	3	23	26
Totals		6	148	154

Table 9. Total number of young fledged for all sites on the Oregon Coast 1990-2009 includes fledglings from broods from undiscovered nests.

Site Name	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	Tot
NEC											1	0	0	0	0	0	0	0	0		1
SU				0	0	0	0	1	1	0	3	0	0	0	0	0	0	0	0		5
NSIU													0	0	0	0	0	0	0		0
SI:																					
North					0	0	0	0	2	4	0	0	0	0	7	2	11	7	5	8	46
South				0	1	2	0	0	4	2	7	0	0	2	5	7	7	4	3	11	55
OV:																					
North										3	5	1	2	3	3	5	8	12	3	7	52
South										0	0	1	0	0	3	2	0	1	0	2	9
TA:																					
North				0	0	0	0	0	0	0	2	4	1	3	6	8	5	2	0	1	32
South				0	1	12	8	7	1	1	3	4	5	2	0	0	0	0	0		44
TM:																					
North					0	1	0	0	0	0	0	0	3	1	3	6	12	13	3	2	44
South	0	0	14	7	3	3	4	4	3	7	5	4	3	9	9	5	7	14	6	19	126
CBNS:																					
SS	3	2	4	13	17	17	22	8	6	5	3	4	2	7	13	9	11	7	17	4	174
SB	0	11	9	2	6	2	2	7	2	0	0	1	1	3	0	8	1	10	7	16	88
HRAs					7	2	1	1	1	23	6	6	8	14	22	6	19	9	16	10	151
BB	0	1	1	3	5	1	1	0	1	1	0	1	0	4	16	11	12	13	2	6	79
NR	0	0	4	0	7	12	8	9	11	8	5	6	6	12	21	9	17	32	11	20	198
FL	0	2	2	11	9	6	1	4	0	0	3	0	0	0	0	0	0	0	0	0	38
Total	3	16	34	36	56	58	47	41	32	54	43	32	31	60	108	78	110	124	73^a	106	1142

^a – Adjusted to 73 fledglings based on HY08 returns.

Table 10. Overall Mayfield nest success, fledgling success and total number of fledglings on the Oregon Coast, 1990 – 2009.

Year	% Nest Success ^a	% Fledgling Success ^b	# Fledglings ^c
1990	13	11	3
1991	20	45	16
1992	55	41	33
1993	56	42	36
1994	72	50	56
1995	41	50	57
1996	47	32	47
1997	40	30	40
1998	52	26	32
1999	54	43	54
2000	31	41	43
2001	26	34	32
2002	38	29	31
2003	43	47	60
2004	56	55	108
2005	45	41	78
2006	38	48	110
2007	33	54	123
2008	30	47	73
2009	23	50	106
	Mean = 40.7 \pm 14.6	Overall = 40.8 \pm 10.9	Total = 1142

a – Overall Mayfield Success from Table 5

b – does not include fledglings from broods from undiscovered nests

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

01/11/10

Table 11. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2009.

Site Name	Total # Broods*	% Brood Success*	Total # Eggs Hatched	Min. # Fledged		% Fledgling Success**	# of Breeding Males ^a	# of Fledglings/ Male	# of Fledglings/Male – Combined ^c
				From Known Nests	From Undiscovered Nests				
Sutton	0	-	-	-	-	-	-	-	-
Siltcoos:									
North Siltcoos	6	100	17	8	0	47	6	1.33	1.73 (11)
South Siltcoos	6	100	11	9	2	82	5	2.20	
Overlook									
North Overlook	3	100	8	7	0	88	3	2.33	1.80 (5)
South Overlook	2	50	6	2	0	33	2	1.00	
North Tahkenitch	2	50	6	1	0	17	2	0.50	0.50 (2)
Tenmile:									
North Spit	2	50	4	2	0	50	1	2.00	1.91 (11)
South Spit	13	77	22	14	5	64	10	1.90	
Coos Bay N. Spit									
South Spoil	5	80	14	4	0	29	6	0.67	
South Beach	10	100	25	16	0	64	13	1.23	1.20 (25)
HRA	11	55	19	8	2	42	12	0.67	
Bandon	5	80	12	6	0	50	8	0.75	0.75 (8)
New River									
HRA	15	67	38	16	0	42	13	1.23	1.11 (18)
Other lands	6	50	11	3	1	27	7	0.43	
Floras Lake	0	-	-	-	-	-	-	-	-
TOTALS**	88	73	193	96	10	50	80	1.33	
TOTAL FLEDGED				106					

% 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. Overall productivity of male Snowy Plovers along the Oregon

Year	Mean	n	Min	Max	std
1992	1.250	20	0	4	1.164
1993	1.000	17	0	3	1.000
1994	1.483	29	0	5	1.353
1995	1.194	36	0	4	1.167
1996	0.881	42	0	3	0.942
1997	0.833	36	0	3	0.845
1998	0.833	36	0	3	0.971
1999	1.268	41	0	5	1.323
2000	0.973	37	0	5	1.190
2001	0.842	38	0	3	0.855
2002	0.700	40	0	3	0.939
2003	1.061	49	0	4	1.107
2004	1.645	62	0	5	1.161
2005	1.259	58	0	3	1.036
2006	1.559	68	0	4	0.983
2007	1.481	77	0	4	1.108
2008	1.060	67	0	4	1.028
2009	1.275	80	0	4	1.006

Average = 1.144 STDEV = 0.279197

STERROR = 0.065807

Average pre pred mang = 1.056 STDEV = 0.228419

STERROR = 0.072232

Average post pred mang = 1.380 STDEV = 0.21934

STERROR = 0.089545

Table 13. Productivity of Snowy Plovers at Siltcoos, Lane Co., Oregon coast, 1993-2009.

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.

Siltcoos	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
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
total before predator management (1993-2003)	238	81	38.3+/-26.5	24	20.4+/-21.4	11.3+/-17.5	24	37	0.47+/-0.61
total after predator management (2004-2009)	324	131	42.3+/-10.3	70	53.8+/-11.3	23.3+/-10.0	70	47	1.57+/-0.61

^a - productivity index = number of fledglings/number of eggs laid

Table 14. Productivity of Snowy Plovers at Overlook, Douglas Co., Oregon coast, 1999-2009

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.

Overlook	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
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
total before predator management (1999-2003)	108	46	53.8+/-28.4	15	36.2+/-20.2	20.8+/-17.9	15	21	0.79+/-0.41
total after predator management (2004-2009)	220	86	40.3+/-14.9	43	48.8+/-9.7	20.0+/-9.0	43	32	1.35+/-0.50

^a - productivity index = number of fledglings/number of eggs laid

Table 15. Productivity of Snowy Plovers at Tahkenitch, Douglas Co., Oregon coast, 1993-2009.

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.

Tahkenitch	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
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
total before predator management (1993-2003)	267	128	45.6+/-26.7	51	42.7+/-32.8	18.1+/-15.6	51	57	0.87+/-0.73
total after predator management (2004-2009)	109	49	44.7+/-27.8	21	32.3+/-20.7	18.3+/-14.3	21	19	0.92+/-0.72

^a - productivity index = number of fledglings/number of eggs laid

Table 16. Productivity of Snowy Plovers at Tenmile, Coos Co., Oregon coast, 1992-2009.

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.

Tenmile	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
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
total before predator management (1992-2003)	249	134	58.6+/-22.7	64	52.7+/-26.3	29.5+/-18.6	64	55	1.25+/-0.61
total after predator management (2004-2009)	441	169	41.0+/-13.4	87	49.3+/-11.5	20.2+/-8.0	87	64	1.36+/-0.32

^a - productivity index = number of fledglings/number of eggs laid

Table 17. Productivity of Snowy Plovers at Coos Bay North Spit, Coos Co., Oregon coast, 1992-2009.

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.

CBNS	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
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
total before predator management (1992-2001)	513	295	60.4+/-20.3	154	51.1+/-11.8	32.4+/-18.1	149	94	1.55+/-0.52
total after predator management (2002-2009)	748	350	48.8+/-9.1	202	58.6+/-11.4	28.6+/-8.3	197	114	1.91+/-0.35

^a - productivity index = number of fledglings/number of eggs laid

Table 18. Productivity of Snowy Plovers at Bandon Beach, Coos Co., Oregon coast, 1992-2009.

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 Beach	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
2009	70	12	17%	6	50%	9%	6	8	0.75
2008	68	5	7%	2	40%	3%	2	11	0.18
2007	73	24	33%	13	54%	18%	13	8	1.63
2006	53	19	36%	8	42%	15%	7	6	1.16
2005	83	37	46%	11	30%	13%	11	12	0.92
2004	50	33	66%	15	45%	30%	14	10	1.40
2003	13	6	46%	2	33%	15%	2	4	0.50
2002	10	0	0%	0	0%	0%	0	2	0.00
2001	13	6	46%	1	17%	8%	1	3	0.33
2000	6	0	0%	0	0%	0%	0	2	0.00
1999	4	3	75%	1	33%	25%	1	2	0.50
1998	3	0	0%	0	0%	0%	0	1	0.00
1997	12	0	0%	0	0%	0%	0	2	0.00
1996	9	6	67%	1	17%	11%	1	2	0.50
1995	22	4	18%	0	0%	0%	0	3	0.00
1994	15	15	100%	5	33%	33%	5	4	1.25
1993	21	10	48%	3	30%	14%	3	5	0.60
1992	23	7	30%	1	14%	4%	1	4	0.25
total before predator management (1992-2001)	128	51	38.4+/-35.0	12	14.4+/-14.1	9.5+/-11.6	12	28	0.34+/-0.40
total after predator management (2002-2009)	420	136	31.4+/-22.2	57	36.8+/-16.9	12.9+/-9.3	49	61	0.82+/-0.57

^a - productivity index = number of fledglings/number of eggs laid

Table 19. Productivity of Snowy Plovers at New River, Coos Co., Oregon coast, 1992-2009.

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.

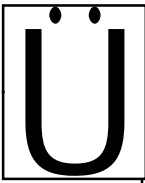
New River	total # eggs laid	total # hatched	hatch rate	total # fledged	fledgling success rate	productivity index^a	# fledged from known males	# of known breeding males	# of fledglings/ male
2009	109	49	45%	19	39%	17%	19	18	1.06
2008	92	34	40%	10	29%	11%	10	18	0.56
2007	96	47	49%	30	64%	31%	29	17	1.70
2006	69	34	49%	16	47%	23%	16	12	1.33
2005	63	36	57%	9	26%	14%	9	10	0.90
2004	70	37	53%	21	57%	30%	21	12	1.75
2003	44	25	57%	12	48%	27%	12	10	1.20
2002	39	17	44%	6	35%	15%	6	9	0.67
2001	53	22	42%	6	27%	11%	6	8	0.75
2000	46	14	30%	5	36%	11%	5	8	0.63
1999	74	42	57%	8	19%	11%	8	14	0.57
1998	73	60	82%	11	18%	15%	11	16	0.69
1997	65	41	63%	8	20%	12%	8	12	0.67
1996	54	41	76%	7	17%	13%	7	12	0.58
1995	48	12	25%	8	67%	17%	8	8	1.00
1994	18	14	78%	6	43%	33%	5	5	1.00
1993	0	0	0%	0	0%	0%	0	0	0.00
1992	6	6	100%	1	17%	17%	1	2	0.50
total before predator management (1992-2001)	437	252	55.3+/-30.8	60	26.4+/-18.4	14+/-8.2	59	85	0.64+/-0.28
total after predator management (2002-2009)	582	279	49.3+/-6.2	123	43.1+/-13.3	21.0+/-7.8	122	106	1.15+/-0.42

^a - productivity index = number of fledglings/number of eggs laid

Table 20. Activity patterns of Snowy Plovers on Habitat Restoration Areas along the Oregon Coast, 1994-2009. Note that absence of an activity type indicates we have not documented whether the activity is occurring. The Dunes Overlook and the New River HRA were first created in the winter of 1998-99. The 94HRA, 95HRA, 98HRA, and 98EHRA are all located at Coos Bay North Spit, and each was initially created in the winter of the respective year. The Bandon Beach State Park HRA was created in fall 2001. All areas have been maintained to varying degrees through 2009.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Dunes Overlook						F?,N ,B	F,N, B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B
94HRA	F,N, B	F,B	F,N, B	F,N, B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B
95HRA		R,F, N,B	F,B	N,B	F,N, B	F,B	F,N, B	F?,N ,B	R,F? ,N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B
98HRA							N	F?,N ,B	R?,F ?,N	NA	NA	R	F,B	F,B	F,N, B	R,F, N,B
98EHRA								R?,F ?,N, B	R?,F ?,N, B	F,B	F,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B
Bandon Beach									NA	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B
New River						N	F,N, B	F,N, B	F,N, B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B	R,F, N,B

Type of activity: **R** = roosting, **F** = foraging, **N** = nesting, **B** = brooding, **?** = uncertain, no direct evidence, but activity possibly occurring, **NA** = no activity.



Legend

● 2009 Nest Locations

□ Counties

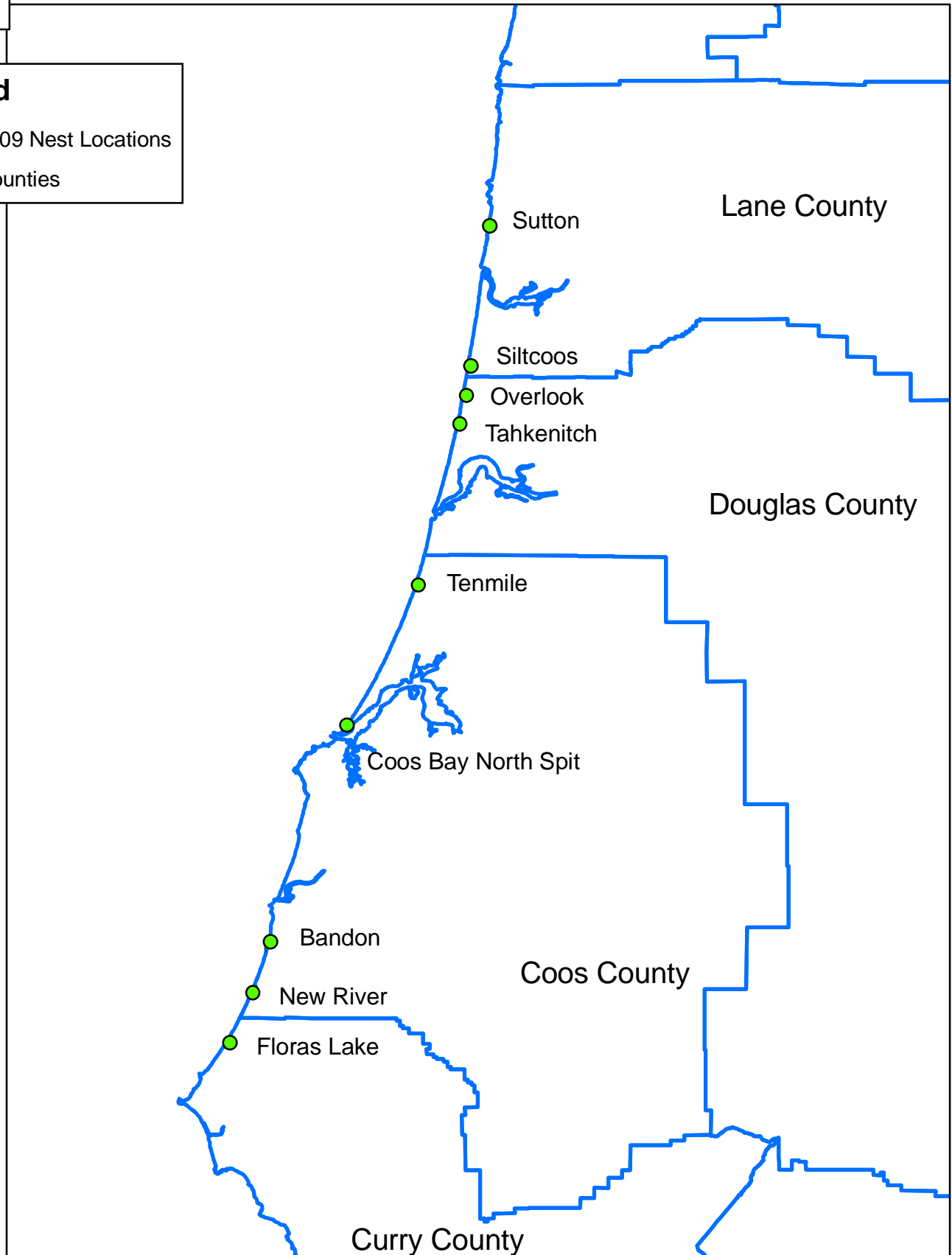


Figure 1. Snowy Plover nesting areas surveyed along the Oregon coast, 2009.

0 12,500 25,000 50,000 Meters



Legend

• 2009 Nests



Figure 2. Snowy Plover nest locations at Siltcoos River, Oregon, 2009.

45

0 135 270 540 Meters



Legend

- 2009 Nests
- Overlook HRA

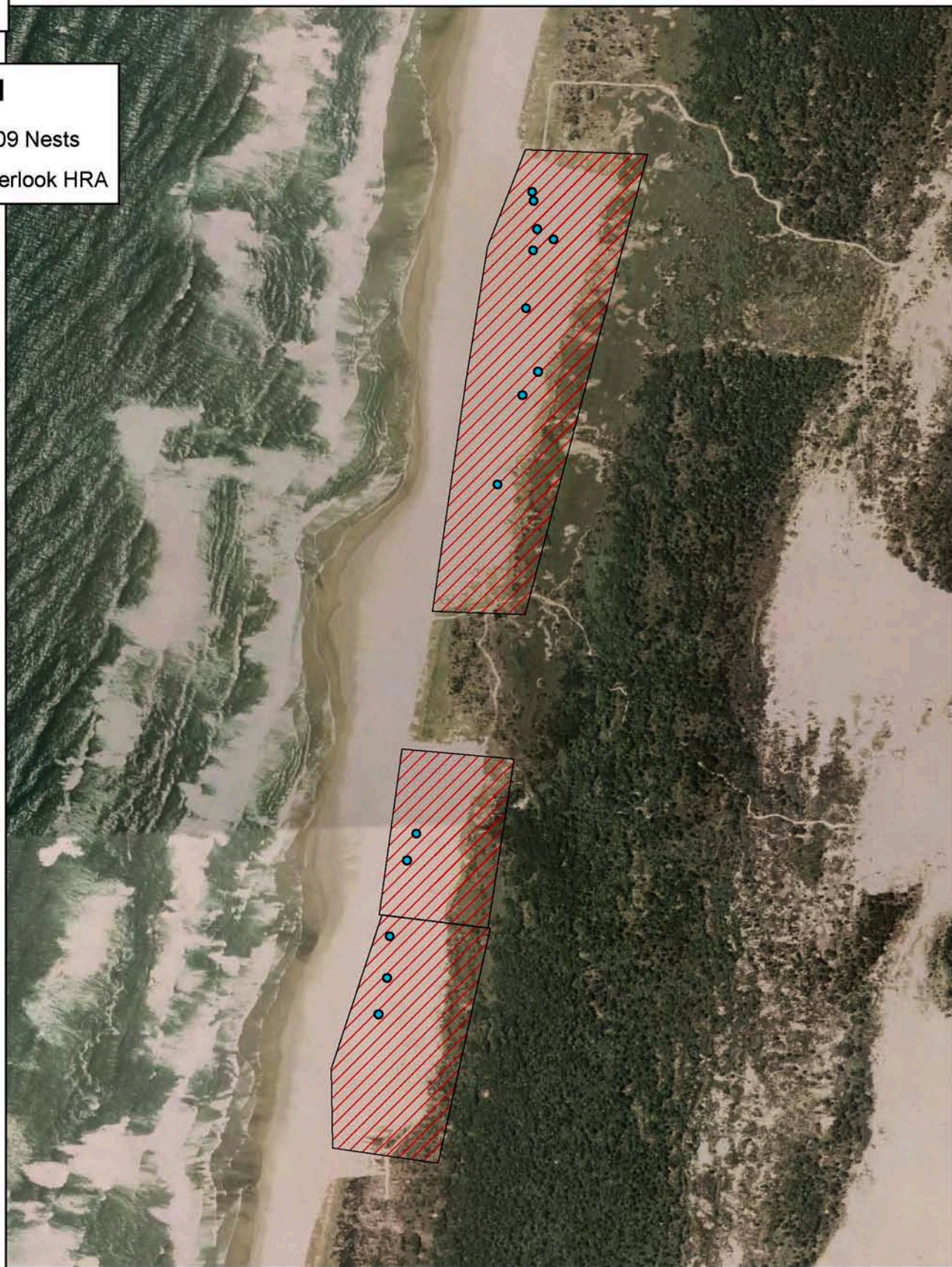


Figure 3. Snowy Plover nest locations at Dunes Overlook, Oregon, 2009.

46

0 155 310 620 Meters



Creek mouth has moved south since photo was taken. All nests are north of the creek mouth.

Legend

• 2009 Nests



Figure 4. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2009.

47

0 110 220 440 Meters



Legend

• 2009 Nests

▨ Tenmile HRA

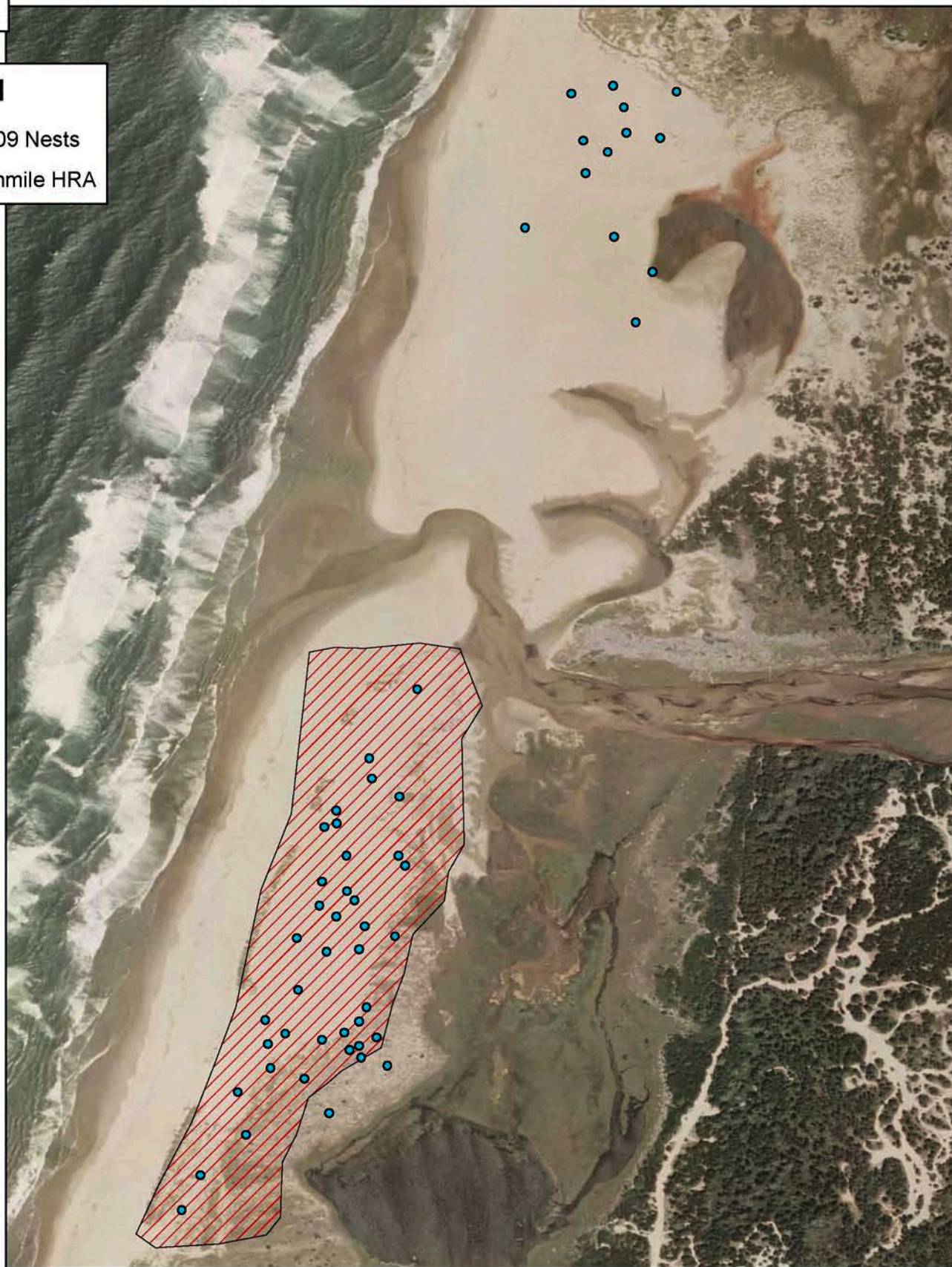


Figure 5. Snowy Plover nest locations at Tenmile Creek, Oregon, 2009.

48

0

115

230

460 Meters





Legend

• 2009 Nests

▨ CBNS HRA



Figure 6. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2009.

49

0 240 480 960 Meters



Legend

- 2009 Nests
- ▨ Bandon HRA

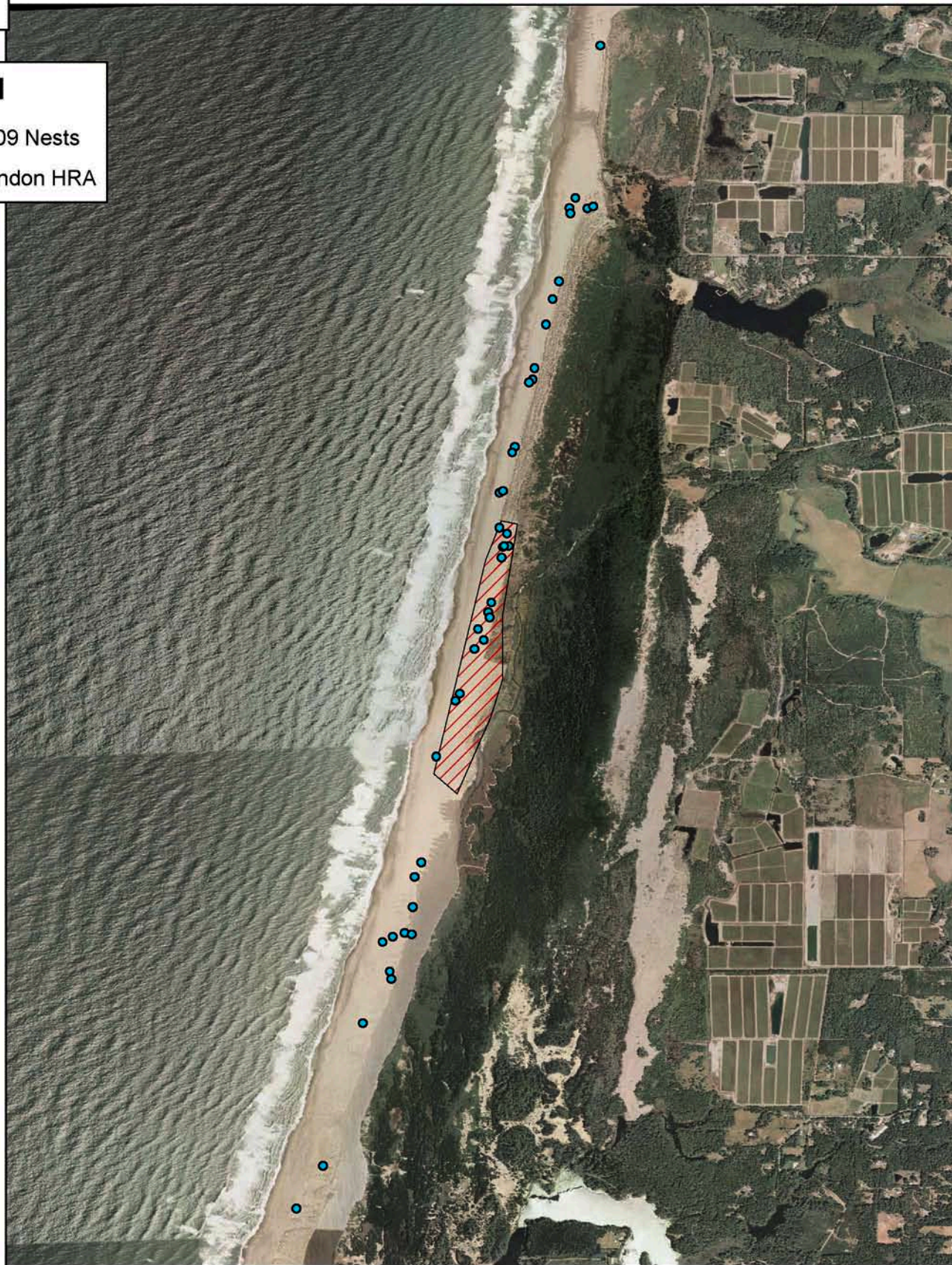


Figure 7. Snowy Plover nest locations at Bandon/
New River, Oregon, 2009.

50

0 455 910 1,820 Meters



Legend


- 2009 Nests
-  New River HRA



Figure 8. Snowy Plover nest locations at New River, Oregon, 2009.



Legend

• 2009 Nests

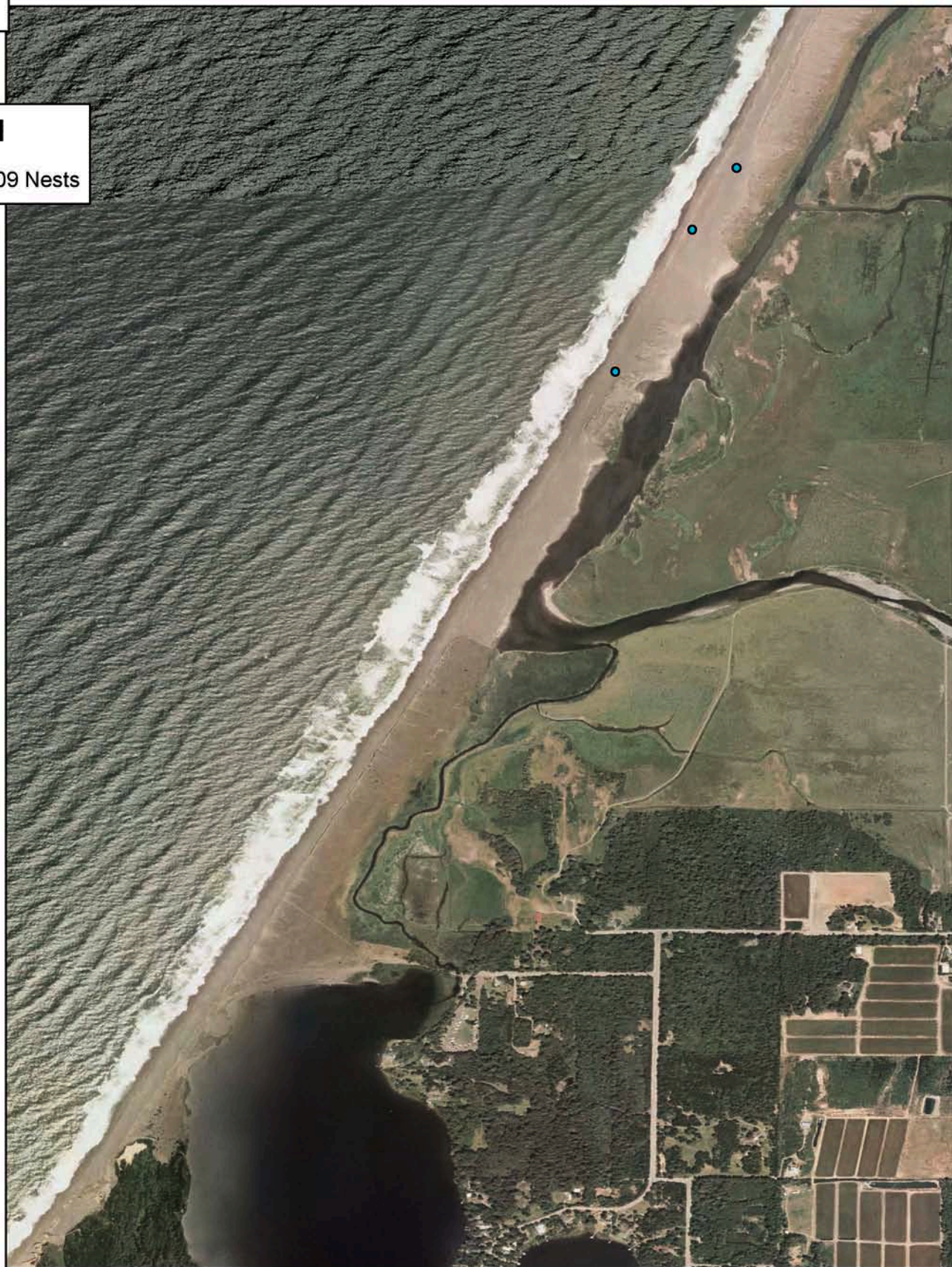


Figure 9. Snowy Plover nest locations at Floras Lake, Oregon, 2009.

52

0 262.5 525 1,050 Meters

Figure 10. Number of active Snowy Plover nests within 10-day intervals on the Oregon coast, 2009. Dashed lines represent ± 2 standard deviations.

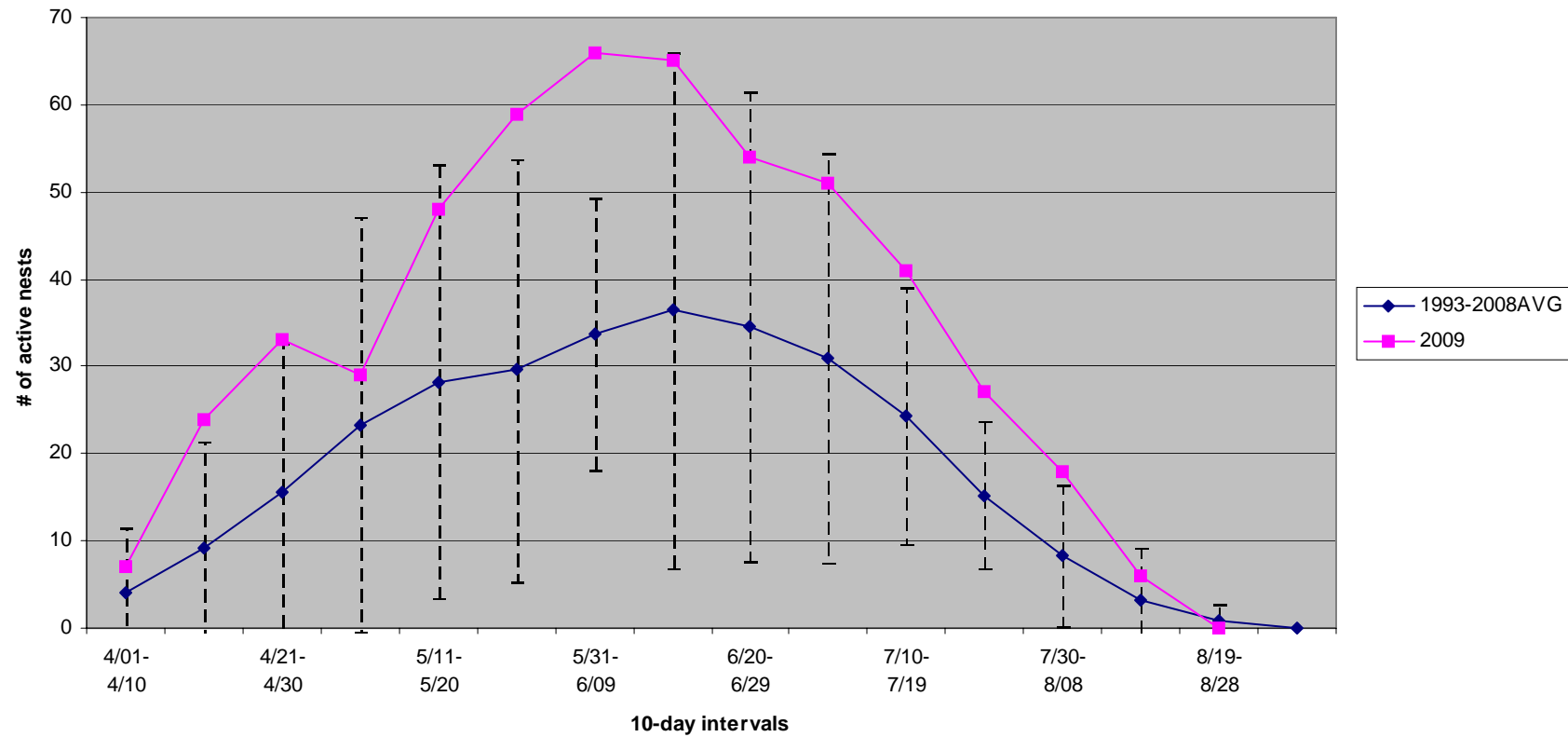
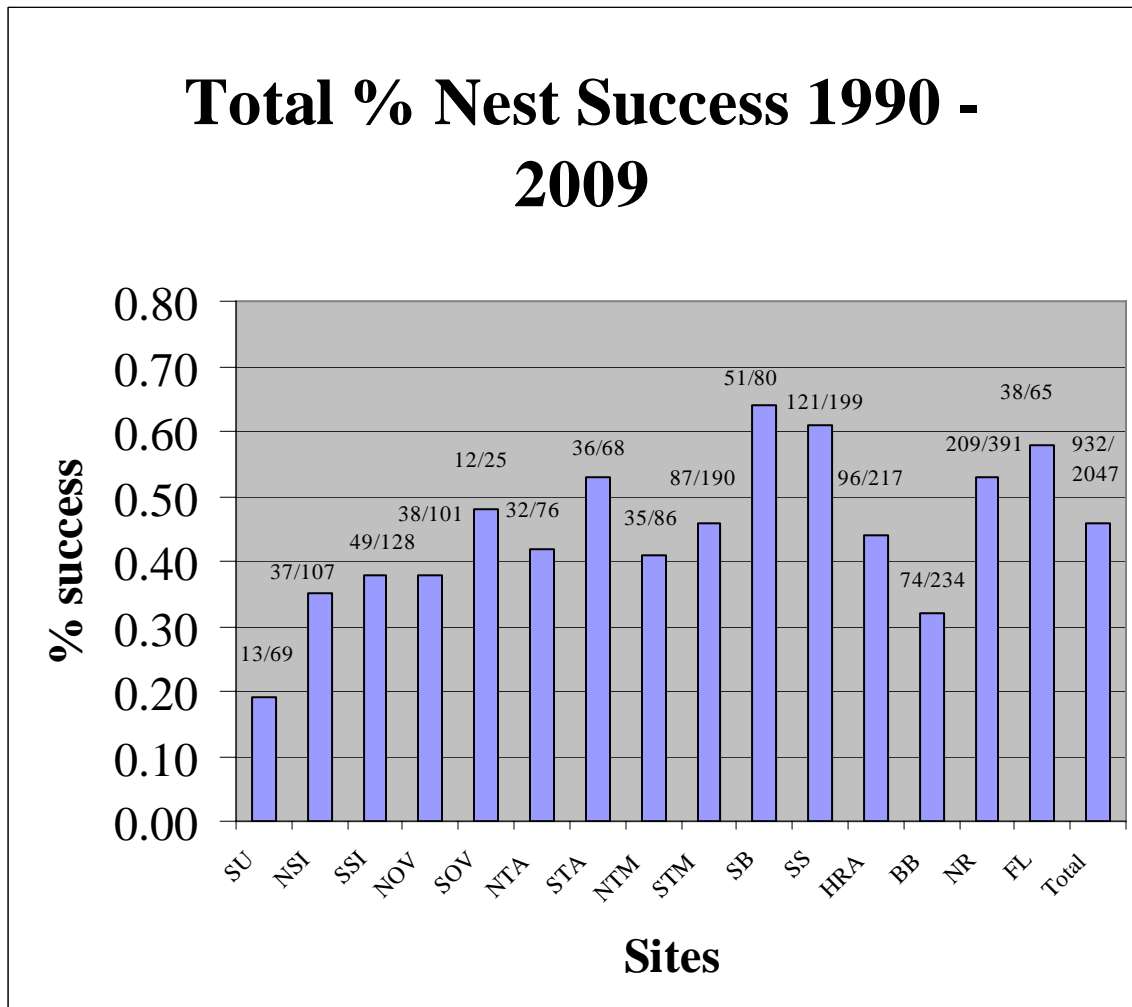


Figure 11. Total percent nest success for Snowy Plovers along the Oregon coast, 1990-2009. Above each bar is the total number of nests that hatched over the total number of nests.



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 north and south areas cleared of beachgrass, beginning in 1998, directly west of the Oregon Dunes Overlook off of Hwy 101.

Tahkenitch Creek to the Umpqua River, Douglas Co. (Figure 4) - Tahkenitch North Spit - the spit and beach on the north side of Tahkenitch Creek; there was no habitat on the south side of Tahkenitch Creek due to erosion and the movement of the mouth of the creek.

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

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

Bandon Beach, Coos Co. (Figure 7): the beach between China Creek and the location of the New River/Two-mile Creek mouth, including the large habitat restoration area north of the mouth of Two-mile Creek.

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

Floras Lake, Curry Co. (Figure 9) – the beach and overwash areas west of the confluence of Floras Creek and the beginning of New River, north to Hansen Beach.

The following additional areas were either surveyed in early spring or the breeding window survey: Fort Stevens, Necanicum Spit, Nehalem Spit, Bayocean Spit, Netarts Spit, Sand Lake Spit, Nestucca River Spit, Whiskey Run to the Coquille River, 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 - 2007.

Sutton:

- Continue to manage the nesting areas behind the foredune; 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.
- Continue roping and signing of dry sand from Sutton Creek to north of Berry Creek.
- Continue to sign the backside of the foredune in order to minimize pedestrian crossing of dry sand.
- Place signs on the south side of Sutton Creek notifying people that if they cross the creek dogs must be on leash at all times.

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.
- Continue to prohibit dogs on the spits and near the estuary during nesting season.
- Continue the use of campground plover hosts/volunteers to educate people and keep them out of 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.
- Evaluate plover use along the foredune south of Waxmyrtle trail access to the Carter Lake trail area, and determine the status of this area as plover habitat and whether this area should be signed and/or roped.

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.

- Continue to restrict all dogs to leashes adjacent to the Overlook nesting areas. It should be noted that many hikers with dogs are compliant while on-trail but often unleash their animals upon reaching the beach, therefore additional signing for clarification is highly recommended.

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.
- Continue to restrict dogs to leashes adjacent to closure areas.

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.
- 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.

Coos Bay North Spit:

- Continue predator management of the area for corvids, feral cats, and skunks; monitor the coyote population and remove coyotes if warranted.
- 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.
- Clearly sign all entrance points on the spit that the beach is street legal vehicles only.
- The seasonal reroute of the foredune road continues to benefit plovers by reducing recreational activity, and thus disturbance, near the nesting area, and permits brood movements between the HRA's without any chance of harm from vehicle use. A permanent reroute of the foredune road would be ideal.

Bandon:

- Continue predator management to control fox and corvid populations.
- Continue to improve and maintain the habitat restoration area north of Twomile Creek. Improve habitat along the foredune to increase available nesting habitat for plovers.
- Sign and rope the entire beach from China Creek overwash to the habitat management area near to the mouth of Twomile Creek/New River before the nesting season.
- Maintain enforcement of restricted areas and leash laws for dogs. Monitor hiker use from Bandon to Blacklock Point, and check the beach and HRA on weekends for illegal camping activity.

New River:

- Continue predator management to control fox 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 dogs on leash rules. Consider use of an interpretive specialist to help monitor recreational activities in the area and explain the management efforts in the area.
- Continue to close the gate at the Storm Ranch for 15 April- 15 September.

Floras Lake:

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