OREGON NATURAL HERITAGE INFORMATION CENTER

Institute for Natural Resources

OREGON STATE UNIVERSITY
1322 SE Morrison Street
Portland, Oregon 97214-2423

January 14, 2004

Greetings:

We sent you the 2003 snowy plover monitoring report at the end of December. Unfortunately, we have discovered a couple of errors/omissions. To remedy, please make the following changes to your report:

- Replace the existing Table 1 with the revised Table 1, enclosed (page 25 of report).
- Replace Figure 13 with the correct Table 13, enclosed (page 37 of report).
- Add Figures 10, 11, and 12 (enclosed) after Figure 9 (page 47 of report). This addition will cause the pagination of the appendices to be off. Pages 48 – 52 will become pages 51 – 55.

If you would like a completely new copy of the report, with these problems solved, please email me at Eleanor.gaines@orst.edu. Thank you for your continued interest and support of the snowy plover monitoring work.

Sincerely,

Eleanor

Eleanor Gaines
Zoology Projects Manager

The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast - 2003

David J. Lauten, Kathleen A. Castelein, Brian V. Smithers, K. Charlotte Jandér, Elise Elliott-Smith 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 2003

Submitted to:

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

Oregon Dunes National Recreation Area
855 Highway Ave.
Reedsport, Oregon 97467

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

Oregon Department of Fish and Wildlife
P.O. Box 59
Portland, Oregon 97207

Oregon Department of Parks and Recreation
10965 Cape Arago Highway
Coos Bay, Oregon 97420

The Distribution and Reproductive Success of the Western Snowy Plover Along the Oregon Coast - 2003

David J. Lauten, Kathleen A. Castelein, Brian V. Smithers, K. Charlotte Jandér, Elise Elliott-Smith 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 4 April – 20 September 2003, 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, North Siuslaw, Siltcoos River estuary to the Dunes Overlook and south to Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Beach, and south from the mouth of New River to Floras Lake. Our objectives were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) erect predator exclosures around nests and test a new exclosure design, 4) determine nest success, 5) determine fledgling success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the success of predator management.

We observed an estimated 102-107 adult Snowy Plovers; a minimum of 93 individuals was known to have nested. Indices of abundance indicated that the coastal population of Snowy Plovers has remained relatively stable for the past six years at about 100 birds. Overall Mayfield nest success was 51% (n=91), higher than the 14-year average for the first time in three years. Exclosed nests (n=56) experienced 79% success rate, 11% higher than the 13-year mean of 67.7%. A new mini-exclosure design was not significantly more successful than standard exclosures but did have higher rates of success and contributed to a reduction in egg and adult depredations inside and around exclosures. Unexclosed nests (n=35) had a 23% success rate, higher than the 14-year mean of 17.7%. Nest failures were attributed to unknown depredation (27%), unknown cause (20%), corvid depredation (14%), abandonment (11%), infertility (11%), wind/weather (7%), overwashing (5%), and coyote and raccoon depredation (2% each). We monitored 50 broods, including four from unknown nests, and documented a minimum of 59 fledglings, the highest number of fledglings since monitoring began. Overall brood success was 70%, and fledgling success was 46%, 9% higher than the 14-year average. Brood and fledgling success rates were significantly different at sites with predator management compared to sites without predator management, suggesting predator management positively influenced survival of chicks and overall productivity.

Reaching recovery level populations will require sustained increases in overall productivity, that can be achieved through predator management, habitat improvement and maintenance, and management of recreational activities at all sites.

TABLE OF CONTENTS

ABSTRACT i

INTRODUCTION 1

STUDY AREA 1

METHODS 1

RESULTS 5
- Abundance and Distribution 5
- Nest Activity 6
- Nest Success 7
- Nest Exclosures 8
- Nest Failure 9
- Fledging Success 11
- Captive Reared Plovers 12
- Brood Movements 13
- Activity Patterns on HRA's 14
- 2002 Hatch-Year Returns 14
- Sightings of Snowy Plovers Banded Elsewhere 14

DISCUSSION 15
- Habitat Restoration and Development Projects 18

RECOMMENDATIONS 19
- Signing of Restricted Areas 19
- General Recommendations 20

ACKNOWLEDGMENTS 21

LITERATURE CITED 21

TABLES 1-14 25

FIGURES 1-9 39

APPENDIX A. Study Area 48

APPENDIX B. Site Specific Recommendations .....

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 (Federal Register 1993).

We have completed our 14th year of monitoring the distribution, abundance, and productivity of Snowy Plovers found 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 direct predator control and by placing predator deterrent exclosures around nests as a means of reducing egg depredation, and management of human related disturbances to nesting plovers. The goal of management is increased annual productivity that will lead to increases in the overall breeding population in Oregon and eventually lead to sustainable productivity and stable populations at recovery levels. Based on observations and data gathered since the inception of the project, we continually evaluate, and when necessary, modify our methods. Previous work and results have been summarized in annual reports (Stern et al. 1990, 1991, 2000, Craig et al. 1992, Casler et al. 1993, Hallett et al. 1994, 1995, Estelle et al. 1997, and Castelein et al. 1997, 1998, 2000a, 2000b, 2001, and 2002). We continued with these efforts in 2003; our objectives for the Oregon coastal population this year were to: 1) estimate the size of the adult Snowy Plover population, 2) locate plover nests, 3) erect predator exclosures around nests and test a new exclosure design, 4) determine nest success, 5) determine fledgling success, 6) monitor brood movements, 7) collect general observational data about predators, and 8) evaluate the success of predator management. These results 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, dredge spoil sites, and several habitat restoration/management sites. From north to south, we surveyed and monitored plover activity at Sutton Beach, North Siuslaw, Siltcoos River estuary to the Dunes Overlook and south to Tahkenitch Creek, Tenmile Creek, Coos Bay North Spit, Bandon Beach, and south from the mouth of New River to Floras Lake (Fig. 1). A description of each site occurs in Appendix A.

Methods

In March 2003, pre-breeding season surveys of historical nesting areas were completed. State and Federal agency personnel and various other individuals surveyed sites between Necanicum Spit south to Pistol River. The surveys were implemented in an

attempt to locate any prospecting plovers at locations not known as currently active nesting sites.

Breeding season fieldwork was completed from 4 April to 20 September 2003. Surveys were completed on foot or from an all-terrain vehicle (ATV). For each survey we recorded all plovers and the combination of any banded individual. The amount of time to complete the survey and weather conditions was noted. We also kept notes on any evidence of predators (such as tracks), presence and numbers of predators, and estimated number of corvids recorded on each survey. We surveyed most sites weekly or biweekly, and additional visits were made to check nests, band chicks, or monitor broods.

We located nests using methods described by Page et al. (1985) and Stern et al. (1990). We defined a nest as a nest bowl or scrape with eggs or tangible evidence of eggs in the bowl, i.e. egg shells. We predicted hatching dates by floating eggs (Westerkov 1950) using a floatation schedule developed by staff at Point Reyes Bird Observatory (pers. comm. Gary Page). We defined a successful nest as one that hatched at least one egg. A failed nest was one where we found buried or abandoned eggs, infertile eggs, signs of depredation (e.g. mammalian or avian tracks, eggshell remains not typical of hatched eggs, or nest cup disturbance) or where eggs had disappeared prior to the expected hatch date. In a few instances we found nests with only one egg; often there was no indication of incubation or nest defense and it was uncertain whether the nest was abandoned, or simply had a "dropped" egg. Because it was difficult to make this determination, we considered all one egg clutches as nest attempts, and classified them as abandoned when there was no indication of incubation or nest defense.

Evidence indicates that predators, particularly American Crows (*Corvus brachyrhynchos*), are occasionally able to enter exclosures and depredate the eggs. We have also documented depredation of adult plovers in and around exclosures (Castelein et al. 2000b, 2001, and 2002). We continue to refine management methods in an attempt to reduce risks to both the adults and the eggs associated with exclosed nests. In accordance with procedures used in California, in 2001 we began delaying the placement of exclosures until after 15 May, when peak raptor migration has passed. We continued this practice in 2003 with one exception, with the hope of avoiding depredation of nesting plovers around exclosures by migrating raptors, specifically Merlins (*Falco columbarius*). In past nesting seasons various materials have been added to the standard exclosure design in attempts to prevent predators from entering exclosures (Castelein et al. 2000b, 2001, and 2002). In 2003, we used standard sized exclosures with PVC pipe/cord lock and string tops (designed by Doug George, Point Reyes Bird Observatory, see Castelein et al. 2001 and 2002) and our traditional hand strung method. Partly due to personnel limitations, we did not use any hot wire systems, nor were any other modifications to prevent entry by avian predators used on standard exclosures. Based on conversations we had with other plover biologists and several ideas presented to us, we implemented a new mini-exclosure (ME) design at several sites. The mini-exclosure was designed based on mini-exclosures used in southern California in 2002 for Snowy Plovers by Jack Fancher (USFWS) and by Deborah Melvin (USFWS) in Massachusetts for Piping Plovers (*Charadrius melodus*) over the past several years. We designed a

mini-exclosure that we thought would work best in the local environmental habitats and conditions.

The mini-exclosures were made with 2x4 fencing, each side being four feet long and two feet, eight inches high. In the field, the mini-exclosures were buried eight inches into the sand and spikes were used in the corners to secure the mini-exclosure and prevent a mammal from pushing it over or lifting it up. The mini-exclosures had a "hard" top made of wire, which prevented avian predators from entering the exclosure. To protect the plovers in the event an avian predator attacked them and/or if they flushed inside the exclosure, we designed a double top system. We attached a four-inch mesh netting tautly to the top, and then 2x2 fencing was bubbled over the netting, creating a gap of about one foot between the netting and the "hard" top. We used pig rings to secure the netting and the hard top to the sides of the exclosure. If a plover flushed inside the exclosure, the plover would hit the soft netting and not the hard top, and if an avian predator tried to get in from the top, or landed on the top, the predator would not be able to grab a flushing plover because of the gap between the hard top and the netting. A door was cut into one side of the exclosure so that we could float eggs and band chicks and adults; the door was made of 2x2 fencing and secured shut with wire. Once a mini-exclosure was built, it could easily be moved from one nest to another without having to break it down, reducing the time needed to erect it at a new nest, and reducing the time spent at the nest. We compared the apparent success of mini-exclosures, standard exclosures, and unexclosed nests by Chi-square analysis.

For the second consecutive year, predator management was conducted at Coos Bay North Spit, Bandon Beach State Park and New River. Wildlife Services issued a summary report on the effort and success of predator management (Little et al. 2003). In 2003, Coos Bay North Spit (CBNS) had in an increase in predator management efforts. At CBNS and at New River, the corvidcide DRC-1339 was extensively used on the nesting areas to manage corvids that preyed on eggs. Limited amounts of DRC-1339 were used at Tenmile also. No direct predator management was used from Tahkenitch north to Sutton.

Male Snowy Plovers typically rear their broods until fledging. In order to track the broods we banded the nesting adult male, sometimes the female, and each hatch-year bird with both a USFWS aluminum band and a combination of colored plastic bands. We used an oblong walk-in funnel-trap placed over the nest or chicks to catch adult birds for banding. 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 summer of 2003 by determining the number of uniquely color-banded adult Snowy Plovers observed during the breeding season, and added our estimate of the number of unbanded Snowy Plovers that were also present. We estimated the number of unbanded Snowy Plovers by determining the number of unbanded plovers observed at each site within ten-day intervals during May, June and the first week of July. These time periods,

as determined in past years, represent the periods of maximum nesting effort, maximum breeding population, and are also when there are relatively few movements of plovers between nesting sites. For each 10-day interval we then subtracted the number of adults that were subsequently banded during the breeding season and then selected the 10-day interval that had the highest remaining count of unbanded plovers. This provided us with a minimum estimate of the number of unbanded plovers found at these sites during the breeding season. There are several potential flaws in this method, such as underestimating the number of unbanded plovers because not all plovers are recorded on every survey. Conversely there is potential to overestimate the number of unbanded plovers because plovers can and will move between sites within a 10-day period of time. To assess our estimate we also analyzed our daily observations of all unbanded plovers at each site. We tracked all the dates of observations of unbanded plovers during the breeding season, which permitted us to observe where each unbanded plover was over time, if they had a nest, when they potentially moved from a particular site, and if and when they were subsequently banded. We determined a minimum and maximum number of unbanded plovers using this method and compared it to the previous method.

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. The Mayfield method is used because it describes the probability of nest success on a per day basis, thus eliminating any bias associated with the age of the nest when found; e.g. a nest found on day two of incubation has a different likelihood of hatching than one found on day 27. The strength of the Mayfield method is that the probability of nest success is calculated on a per day basis, and when mortality is assumed to be constant during the incubation period, nest success can be calculated for the entire period. We also calculated an adjusted apparent nest success and 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, in particular, the Mayfield calculations. One egg nests and nests found already depredated 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. For apparent nest success, one egg nests may not have actually been a nest attempt but instead may have just been an egg dropped by a female, and therefore if included in the calculation, would bias the estimate by adding a failure when in fact it may never have been an attempt.

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. Because predator management was not conducted on all sites, we were able to compare the productivity of sites with predator management to sites without predator management. We combined

data from all sites with predator management and compared the combined data from all sites without predator management. We excluded Tenmile from the analysis because it had some limited predator management, so it did not fit into either category. We used Chi-square analysis to compared apparent nest success, brood success, and fledgling success of sites with and without predator management.

We evaluated the activity patterns of plovers on four habitat restoration/management areas: the 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 and Distribution

Pre-breeding March surveys at sites between Necanicum River and Pistol River did not detect any plovers or plover activity outside of known nesting areas.

During the 2003 breeding season, we observed an estimated 102-107 adult Snowy Plovers at breeding sites along the Oregon coast (Table 1). Of 102-107 plovers, 97 were banded. We estimated there were 3 unbanded adult plovers based on the number of unbanded plovers accounted for during the 10-day interval. The alternative evaluation of estimating unbanded plovers determined a minimum of 5 unbanded plovers were present during the breeding season, and 8-10 unbanded plovers were present at the end of the season. For the breeding season, using the latter method of estimating unbanded plovers, we observed 50 banded females, 47 banded males, 2 unbanded females, and 3 unbanded males.

The mean number of plovers recorded at each site in 2003 ranged from zero at Floras Lake to 12.69 at New River (Table 2). Compared to the 2002-nesting season, plover numbers at Sutton decreased from 3.65 to 1.54. At Siltcoos, plover numbers on the south spit declined from 5.37 in 2002 to 3.26 in 2003, but at Overlook, plover numbers increased from 1.90 in 2002 to 5.42 in 2003. At Tahkenitch, plover numbers were relatively similar on the north spit in 2003 compared to 2002 (7.22 in 2002 compared to 6.47 in 2003) but declined on the south spit (2.26 in 2002 compared to 0.43 in 2003). Plover numbers at North Tenmile were stable (2.50 in 2002 compared to 2.52 in 2003) and slightly increased at South Tenmile (5.96 in 2002 compared to 7.41 in 2003). At Coos Bay North Spit, plover numbers were overall relatively stable. There were increases in plover use of both the South Spoil (1.22 in 2002 compared to 3.21in 2003) and the 95HRA (0.36 in 2002 compared to 1.17 in 2003). Bandon Beach had a very slight increase in plover numbers (2.19 in 2002 compared to 2.73 in 2003), and New River increased from 9.79 in 2002 to 12.69 in 2003. No plovers were detected at Floras Lake this year.

Nest Activity

We located 91 nests during the 2003-nesting season (Table 3). There were four additional broods from nests that we did not locate prior to hatching.

Only one nest was found this season at Sutton in the newly created habitat restoration area north of Berry Creek. Although several plovers were noted at North Siuslaw early in the season, no nests were located and there was no evidence of attempted nesting activity.

At Siltcoos, all seven nests that were found were on the south side of the estuary. For the third consecutive year, no nests were on the north side, where habitat was limited. The number of nesting attempts at Siltcoos has declined in each of the past five seasons. All seven nests were within the restricted area of the south spit.

At the Dunes Overlook nine nests were found during the 2003 season, one more nest than in 2002. Eight of the nests were found on the northern section and one nest was found on the southern portion. A male with a brood from a ninth nest that was not found prior to hatching was discovered at North Overlook.

The number of nests at Tahkenitch remained fairly stable with 14 nests in 2003 and one brood from a nest that was not found prior to hatching. Most nesting occurred on the north spit, where the habitat was extensive. The habitat on the south side was extremely limited from erosion and the southward movement of the creek. Thirteen of the nests found were on the north spit. One nest was discovered on the south spit only several days before hatching, and the brood from an undiscovered nest hatched on the south side. This latter nest however was most likely east of the north spit across the creek and not on the south spit area where habitat had been extensive in previous years.

For the second consecutive year, the 2003-nesting season had the most nests ever found at Tenmile. A total of 16 nests were found. Eleven nests were on the south side, all except one on the habitat management area. One nest was found on the open spit. Five nests were found on the north spit.

At Coos Bay North Spit 23, nests were found in the 2003-nesting season and at least one brood from an undiscovered nest. South Beach had three total nests, one early in the season, and two nests late in the season. There was a fairly large increase in nesting attempts on the South Spoil: nine nests were found this year, nearly doubling the total nesting attempts compared to any of the last five years. On the 94HRA, eight nests were found, and we believe the brood from the undiscovered nest also hatched on the 94HRA. Three nests were located on the 95HRA, all on the area where sand was removed in winter 2003 for the Army Corp jetty project. All three nests were also in the

shell hash that was placed on the 95HRA to enhance nesting habitat. No nests were found this year on the 98EHRA, although at least one brood used the area.

At Bandon Beach, five nests were found during the 2003-nesting season, and one brood from an undiscovered nest. Habitat restoration at the south end of the beach just north of the New River/Twomile Creek mouth was successful at attracting the plovers away from the China Creek overwash area where human disturbance tends to be higher. One nest was located early in the season along the foredune south of the Christian Camp trail but north of the motorized vehicle closure sign. The other four nests were all on the habitat restoration area, and the brood from the undiscovered nest also most likely hatched on the habitat restoration area.

At New River, 16 nests were found this year, similar to the number found in 2002 (14). Five of the nests were found on the extensive habitat restoration area adjacent to Storm Ranch. All five nests were on the northern third of the restored area. Three nests were found in overwashes on private lands; habitat on private lands continues to deteriorate as European beachgrass stabilizes the dunes and sand and vegetation fills in the overwash areas. Eight nests were found on the extensive open spit. Five of the nests were at the very north end of the spit just south of the mouth of New River; these nests are all believed to be on state owned lands. One nest was found west of the Fourmile Road access point, and therefore was on county land. Two other nests were on the middle of the spit in an area where the land ownership boundary is unclear.

There was no plover activity noted at Floras Lake this season despite relatively good habitat at the north end of the beach where Curry County and the BLM restricted recreational activity for plover use. Human disturbance in this area also seemed minimal.

Due to a very wet April, nest initiation in the 2003-nesting season was late. The first nest was initiated 16 April compared to 26 March in 2002. The last nest initiation from a known nest occurred on 19 July, although the brood from the undiscovered nest at Bandon Beach had an approximate initiation date of 26 July. The last successful nest was this same brood from Bandon Beach, which hatched approximately on 23 August. The maximum number of active nests during 10-day intervals was 36 during 10 June-19 June (Fig. 11).

Approximately 90% of the adults (93/102-107) were known to have made a nesting attempt during the 2003 breeding season. This is higher than the mean for 1993-2002 (78%). Of the nesting adults in 2002, 47 were female (45 banded, 2 unbanded), and 46 were male (43 banded, 3 unbanded).

Nest Success

The overall Mayfield nest success in 2003 was 51%, the first time in three years that nest success was higher than the mean of 43% (Table 4) The estimated adjusted Mayfield nest success for all exclosed nests in 2003 was 79%, over ten percentage points higher than the 13-year mean. We erected 24 standard exclosures and 32 mini-

exclosures. For standard exclosures, the adjusted apparent nest success was 74% and the adjusted Mayfield nest success was 72% (Table 5). Nests with mini-exclosures were slightly more successful than nests with standard exclosures (adjusted apparent nest success was 90% and the adjusted Mayfield nest success was 86% for mini-exclosures), but there was no significant difference between the exclosure types ($\chi^2 = 0.3529$, df = 1, $P > 0.05$). Unexclosed nests had an adjusted apparent nest success rate of 11% and an adjusted Mayfield nest success rate of 23%, which is higher than the 13-year mean of 18% and the first time in three years that unexclosed nests were higher than the 13-year mean. Apparent nest success of unexclosed nests was significantly different than either type of exclosed nests ($\chi^2 = 40.687$, df = 1, $P < 0.01$).

The overall annual apparent nest success rate of 51% in 2003 was similar to the 14-year mean of 49% (Table 6 and Figure 12) and higher than 2002 (44%). Overall apparent nests success for exclosed nests was 77%, but for unexclosed nests the overall apparent nest success was only 9%. For 2003, individual site overall apparent nest success was near average or above average (compare Table 6 to Figure 12). The only nest at Sutton Beach hatched. South Siltcoos had the lowest overall apparent nest success rate (29%), mostly due to the failure of unexclosed nests. Overall apparent nest success at North Overlook was 43%, down from 60% in 2002, again due to failure of unexclosed nests. At South Overlook the one nest of the year failed to a corvid entering the standard, string topped exclosure, the only exclosed nest to be raided by corvids in 2003. At North Tahkentich, overall apparent nest success in 2003 was 46%, similar to 2002 (50%). South Tahkentich had just one discovered nest this season, due to poor quantity and quality habitat. The well-hidden nest hatched without being exclosed. At North Tenmile four of five nests hatched in 2003 where in 2002 the three discovered nests did not hatch. Overall apparent nest success at South Tenmile was below its 14-year average (42% in 2003 compared to 59%). At Coos Bay North Spit, South Beach and the habitat restoration areas had overall apparent nest success rates similar to their 14-year mean (67% in 2003 compared to 64% for South Beach and 55% in 2003 compared to 47% for the HRA's). South Spoil had a lower overall apparent nest success rate in 2003 (44%) than the 14-year average (64%). In 2002, one of two nests hatched on the spoil, while in 2003 four of nine hatched, so overall use of the site was higher. Of the five nests that failed, one was infertile and one was a one egg nest, which lowered the apparent nest success rate. At Bandon Beach two of five discovered nests hatched compared to no hatched nests of five in the 2002-nesting season. At New River overall apparent nest success in 2003 was 63%, slightly higher than the 14-year mean of 56%. On the habitat restoration at New River, overall apparent nest success was 80%, while all other lands had a combined overall apparent nest success rate of 55%.

Nest Exclosures

In the 2003 breeding season, we used 24 standard 48-foot perimeter square exclosures and 32 newly designed mini-exclosures (Table 5). All standard exclosures except three had PVC/cord lock stringing on the top. The other three had string tied onto the fencing in the traditional method. No hot wires were used in 2003.

Exclosures were placed around 56 of the 91 nests discovered in 2003 (Table 5). All exclosed nests at North Tenmile, Tahkentich, Overlook, Siltcoos, and Sutton had standard exclosures. All nests at South Tenmile, Coos Bay North Spit, and Bandon Beach were exclosed with mini-exclosures. Of 12 exclosed nests at New River, nine had mini-exclosures and three had standard exclosures. Due to the experimental nature of the mini-exclosures, we decided to erect mini-exclosures only at sites where a more experienced field crew could closely monitor the exclosed nests. The initial implementation of mini-exclosures began slowly at first, and as the success of the mini-exclosures was evaluated, they were used more extensively.

One standard string topped exclosure at South Overlook was entered by corvids and the nest depredated during the 2003-nesting season; the adults were not depredated. At New River on the habitat restoration area, an unknown avian predator entered a standard string topped exclosure a day before the nest hatched. Avian predator tracks were clearly visible in the sand on the inside of the exclosure. However, the eggs were untouched, and the adults were alive and continued incubating until the nest hatched the following day. It was not clear what avian predator entered the exclosure, but it did not appear to be corvid. Why the eggs were not depredated is also unknown.

Since 2000 we have documented a minimum of 21 adult depredations in or near exclosed nests (Castelein et al. 2000, 2001, and 2002). No adult plovers were known to have been depredated inside or near any exclosures during the 2003-breeding season. Only two banded females disappeared during the nesting season and were believed to have been depredated. One female was associated with an unexclosed nest at Coos Bay North Spit. The male continued to incubate the nest, but the nest was infertile and he eventually abandoned the nest. The second female was associated with the first mini-exclosure we erected. The nest was at South Tenmile, and we experimented with a mini-exclosure after the nest had been active for over two weeks. On 2 May we exclosed the nest. By 5 May the female was missing, and the nest was abandoned. We never recorded the female again. We found no evidence around the exclosure that she was depredated inside or nearby the exclosure. We waited until 15 May to erect any more exclosures of either type.

Nest Failure

Exclosed nests in 2003 had an overall 23% failure rate (13 of 56), lower than any of the four previous seasons (34% in 2002, 32% in 2001, 52% in 2000, and 36% in 1999). Standard exclosures had a 29% failure rate (7 of 24) and mini-exclosures had a 19% failure rate (6 of 32). Unexclosed nests continue to experience a very high rate of nest failure: 32 of 35 in 2003, 31 of 33 in 2002, 54 of 54 in 2001, and 21 of 21 in 2000. Overall nest failures were attributed to unknown depredation (27%), unknown cause (20%), corvid depredation (14%), abandonment (11%), infertility (11%), wind/weather (7%), overwashing (5%), and coyote and raccoon depredation (2% each) (Tables 7). For exclosed nests, only one nest failed to a known egg depredation event when a corvid entered a standard exclosure at South Overlook (Table 8). The main cause of nest failure of exclosed nests was infertility (n=5, 36%), followed by wind/weather and unknown

cause (n=3 for each, 23%). One other exclosed nest was overwashed and one was abandoned. The main cause of failure for unexclosed nests was depredation of eggs (total n=19, 63%; unknown predators n=12, 40%; corvids n=5, 17%; coyote and raccoon, n=1 each, 3%). Unknown cause was the second highest individual cause of nest failure of unexclosed nests (n=6, 20%). Four nests were one egg nests and classified as abandoned.

Of the 20 nests that failed due to egg depredation, 12 (60%) were at Dunes Recreation Area (DRA) sites where there was little to no direct predator management. At CBNS, Bandon, and New River, where the avicide DRC-1339 was used extensively, only two nests were known to have failed due to corvids (10% of egg depredations, 33% of known corvid depredations).

Twelve of 20 (60%) egg depredations were due to unknown predators; 67% (8) of these depredations occurred on DRA sites. Only two nests were known to have failed to mammals. One nest was discovered freshly depredated by a raccoon at New River. For the first time, we documented coyote use at CBNS, where we consistently noted tracks on the 95HRA, South Beach, and foredune road. On several occasions we noted coyote tracks inside the fenced 94HRA. One nest on the 95HRA was depredated by the coyotes. There were no documented depredations due to red fox in 2003.

Nine nest failures were classified as unknown cause; three were exclosed and six were not exclosed. Of the six that were not exclosed, four may have been depredated but there was a lack of evidence to be certain of their fate. The other two nests were discovered already failed with the eggs abandoned; the reason why these nests were abandoned was not clear and therefore we classified them as unknown cause. All three exclosed nests had missing eggs and no signs of entry or depredation, nor could the eggs be found buried in the sand. It was unclear what caused the failures, and therefore we classified them as unknown cause.

Two mini-exclosures were vandalized by humans. One nest at Bandon Beach was apparently vandalized while the nest was hatching. We inspected the nest on 5 June and noted that the three eggs were slightly cracked and tapping, indicating that the chicks were beginning the hatching process. Due to scheduling conflicts, we were unable to check the nest until 9 June. On 9 June we found the nest had hatched, as the adult male and two chicks were gone from the nest area. One chick was dead in the nest bowl. The exclosure had been crushed in on one side, and pulled out of the sand. Footprints indicated that two persons walked up to the nest, vandalized it, and walked away to the south after loitering in the area. There were also large dog tracks associated with the human tracks. We were then able to locate the male who was acting broody, and we found one chick and banded it with only a federal band. The brood remained in the area of the HRA and eventually we confirmed two chicks from the brood (one banded and one unbanded). We suspect that the male was harassed into leaving the nest with the first two chicks and the third chick was left behind where it died of exposure.

On 10 June we returned to check nests that were just on the south side of the mouth of New River, within sight of the vandalized nest at Bandon Beach. One nest was exclosed with a standard exclosure and one nest was exclosed with a mini-exclosure. We found both nests failed, with all eggs gone and no evidence of what had caused the failures. Due to some recent rain, all tracks were wiped out in and around the exclosures. We did not note any forced entry of the standard exclosure, or any evidence of vandalism. We did note evidence of vandalism at the mini-exclosure, as one corner was crushed in. We found a piece of eggshell outside the mini-exclosure, but no other evidence. Due to the hard top of the mini-exclosure, it was not possible for any avian predator to have depredated the nest. There was no evidence the nest was overwashed, and neither nest was near the hatching date. All the adults were accounted for. We could not conclusively determine what caused the failure of these nests, so therefore we classified them as unknown cause. However, we suspect that these nests may have been destroyed by humans because of the evidence of vandalism and, aside from a weasel, no known predators could have entered the mini-exclosure and removed and destroyed the eggs.

Fledgling Success

Fifty broods were monitored in 2003, including four broods from undiscovered nests. The increase in nest success resulted in about ten more broods in 2003 compared to the last three years: 40 in 2002, 39 in 2001, and 40 in 2000. Fifty-nine fledglings were confirmed in 2003, the highest since monitoring began in 1990 (Table 9). Overall fledgling success was 46%, the highest it has been since 1995 and nearly ten percentage points higher than the overall average of 37% (Table 10). The overall number of fledglings per brood was 1.18 (59/50) and the overall number of fledglings per male was 1.28 (59/46, Table 11).

The overall brood success rate was 70% (Table 11) compared to 48% in 2002. At Sutton Beach, the one nest hatched, but the brood failed quickly. At Siltcoos, both nests that hatched were successful. At North Overlook, two of the four broods were successful. At Tahkenitch, there were a total of eight broods, six on the north side and two on the south side, but only three total broods were successful (38%, for north 33%, for south 50%). At Tenmile, five of nine broods were successful (56%), but only one of four (25%) was successful one the north side while four of five (80%) were successful on the south side. At CBNS, brood success was 100% (n=13). At Bandon, two of three broods were successful (67%) and at New River only two of ten broods failed (80% brood success rate). Overall brood success rate for sites with predator control (CBNS, Bandon Beach, and New River; 87%) was significantly higher than sites without predator control (Sutton Beach, Siltcoos, and Tahkenitch; 47%; $\chi^2 = 8.579$, df = 1, $P < 0.01$).

The fledgling success rate at Sutton Beach continues to be poor (0% in 2003, Table 11, average 17%, Figure 13). Fledgling success of broods hatched at South Siltcoos was 40%, over ten percentage points higher than the overall average from Siltcoos. However, one of the two successful broods moved shortly after hatching and was actually raised at North Overlook. At North Overlook, fledgling success was slightly

below its average (33% compared to 38%). North Tahkenitch continues to have very poor fledgling success rates (14% in 2003, average = 28%). At North Tenmile, despite four of five nests hatching, fledgling success was only 14%, and the one brood that did fledge crossed the creek to the south side. South Tenmile continues to have very high fledgling success rates: 69% in 2003 and 53% overall. At CBNS, overall fledgling success was also very high (72%). All three individual areas at CBNS had higher than average fledgling success rates in 2003: 58% at South Spoil in 2003 compared to 51% overall, 75% at South Beach in 2003 compared to 55% overall, and 85% on the HRAs compared to 58% overall. At Bandon Beach, fledgling success in 2003 was 33%, higher than the overall average there of 25%. At New River, overall fledgling success in 2003 was 48%, which is considerably higher than the overall average of 25%. Broods that hatched on the HRA had a fledgling success rate of 70%, while broods that hatched on private, state, and county land only had a 33% fledgling success rate. Overall fledgling success for sites with predator control (CBNS, Bandon Beach, and New River; 58%) was significantly higher than overall fledgling success for sites without predator control (Sutton Beach, Siltcoos, Overlook, and Tahkenitch; 33%; $\chi^2 = 12.342$, df = 1, $P < 0.01$)

Sutton Beach, South Siltcoos, North Overlook and Tahkenitch had 15 total broods, but produced only nine total fledglings. At Tahkenitch, where eight nests hatched, only three broods were successful and they produced just four total fledglings. North Tenmile produced just one fledgling despite having four broods, but at South Tenmile only one brood failed of five. The five successful broods at South Tenmile produced nine total fledglings, equal to the total number of fledglings produced at all the sites from Tahkenitch to Sutton. At CBNS, a minimum of 24 fledglings was confirmed, or 41% of the total number of fledglings in 2003. There were a number of unbanded fledglings at CBNS that fledged at about the same time, so we had some difficulty assessing exactly how many fledglings were actually present. It is possible CBNS actually produced more fledglings than we confirmed. Bandon produced four fledglings, the first time since 1994 that more than one chick fledged from this site (Table 9). At New River, the four broods that hatched on the HRA produced seven fledglings, while six broods from all other lands produced five fledglings. The total of 12 fledglings from New River in 2003 is twice as many fledglings compared to each of the last two years, and equals the highest number of fledglings ever produced at this site (Table 9).

Captive Reared Plovers

In 2002, one chick was raised in captivity at the Newport Aquarium (see Castelein et al. 2002). The chick was released at the end of the 2002-nesting season at New River, where it had originated. The bird was banded when released, and was noted several times in the fall at New River and again during the winter survey in January 2003. In spring 2003, the bird was again noted associating with other plovers at New River, and it was determined to be a female. She appeared to be behaving normally, and on 19 May she was found incubating three eggs at the very north end of the New River spit, just south of the mouth of the river. On 28 May the nest was exclosed with a standard exclosure. The female continued to incubate the eggs. On 10 June the nest was found failed, with the eggs gone and no evidence of what caused the failure. The nest was not

overwashed. A nearby nest with a mini-exclosure was also found failed and vandalized by humans. There was no evidence the standard exclosure had been vandalized, but it easily could have been entered without causing any damage to the exclosure. We were unable to conclusively determine what caused the failure, so we categorized it as an unknown cause, however we do suspect that human vandalism may have been a factor. The female remained at New River the rest of the season, but we were not able to find a second nest that was associated with her. She was last noted in September in association with a large flock of plovers on the New River spit.

Another female raised in captivity was also present at New River/Bandon Beach this summer. This female was raised at the Monterey Aquarium in California in 2002 after a nest was abandoned and the eggs brought into the aquarium. She was released banded at Moss Landing Salt Ponds in August 2002, and made a nesting attempt in 2003 at Zmudowski State Park, Monterey Co., CA. On 27 May, we first observed her at New River. We found her incubating a three egg nest at New River on 23 June. On 26 June, we found the nest failed with no evidence as to what caused the failure. She then moved to the north side of the mouth of New River at Bandon Beach, and on 2 July we discovered a new nest that she was incubating on the HRA. The nest hatched on 1 August, but the brood failed quickly. On 21 August she was noted at Morro Bay Sandspit, San Luis Obispo Cty.

Brood Movements

Individual brood movements vary considerably, with some broods staying close to the hatching locations while other broods move long distances. At Siltcoos, one of the successful broods moved to North Overlook within seven days of hatching. The second brood at Siltcoos remained on the south spit. At North Overlook, both successful broods were noted using both the north and south habitat areas. At Tahkenitch, broods on the north spit stayed within the spit area except one brood that crossed the creek to the south side. At North Tenmile, the one successful brood crossed the creek to the south side three days after hatching and remained on the south spit and management area until fledged. The broods at South Tenmile moved between the lagoon side and the ocean side, extensively using the habitat management area, the beach, and the open spit.

At CBNS, many of the broods that hatched on the spoil and HRAs remained on these areas until fledgling, however there was some brood movement between the HRAs and the beach. One brood used the 98EHRA, but in general most broods stayed within the fenced area surrounding the 94HRA and the South Spoil. The one brood from the 95HRA went to the beach quickly after hatching, and spent most of its time at the south end of the beach, including south of the closed area. The brood was noted using the Army Corp project fill area despite some recreational activity nearby. The two broods that hatched on the beach remained on the beach until fledgling, occasionally spending some time on the south end of the 95HRA. Some brood use on the beach was noted as far north as the north end of the 98WHRA. Eventually all fledglings moved to the beach.

At Bandon Beach, the two successful broods stayed on or adjacent to the HRA just north of the mouth of New River. We did not note any movement north of the motor vehicle closure sign. At New River, broods that hatched on the open spit area tended to stay on the open spit, using the entire area from the river to the ocean. Some broods moved south to the north end of private land, where there is higher, more vegetated dunes with overwashes. Two broods from the HRA stayed entirely on the north third of the HRA until fledgling. One brood stayed in this area for about two weeks before slowly moving north along the beach. The brood eventually fledged at the north end of private lands, just south of the open spit. The fourth brood stayed on the HRA for about a week before moving north to the north end of the private land and the south end of the open spit. Some of these movements are up to several miles from the nesting location.

Activity Patterns on HRAs

Table 12 shows the activity patterns of plovers on four habitat restoration areas: the Overlook, the HRAs at CBNS, Bandon Beach HRA, and the New River HRA. We were unable to confirm all types of activity on each site for each year, therefore a missing activity does not necessarily indicate that that behavior is not occurring, rather we have not confidently identified that behavior for that given site and year.

2002 Hatch-Year Returns

Fourteen of the 31 hatch-year 2002 plovers returned to Oregon this year. The return rate was 45%, less than the past four years (56%, 53%, 58%, and 56% respectively) but similar to the average return rate of 48% (Table 13). Of the returning 2002 hatch-year birds, six were females and nine were males (Table 14). All hatch year 2002 returning plovers attempted to nest, and they accounted for 15% of the banded adults.

Sightings of Snowy Plovers Banded Elsewhere

Ten plovers banded in California were observed in Oregon in 2003. Seven were females and three were males. Three of the females originally hatched in Oregon and were subsequently rebanded at coastal nest sites in California. Seven of the plovers, two males and five females, attempted to nest in Oregon; one of these females was originally hatched in Oregon.

Three males and one female were originally banded in Humboldt Co., CA. One male and the female were recorded briefly in July, but did not attempt to nest and were not recorded thereafter. The female was also recorded at Midway Beach, Pacific Co., Washington prior to being recorded in Oregon. The other two males nested in Oregon in 2003. Three other females were banded on the central California coast: one female, documented above, was raised in captivity at Monterey Aquarium, and released at Moss Landing Salt Ponds, Monterey Co. She had one nest at New River and one nest at Bandon Beach. Another female fledged in 2002 from Salinas St. Beach, Monterey Co.;

she nested at N Tahkenitch. The third female was fledged in 2002 from Sunset Beach, Santa Cruz Co.; she nested at N Tenmile.

Discussion

The population of adult plovers along the Oregon coast did not increase in 2003 and has for the past six years remained at about 100 birds (Table 1). Despite very good hatch year return rates (Table 13), overall productivity has not been high enough over the past six years to replace adults lost to breeding season depredations and winter mortality.

April was extremely rainy, resulting in very few nest initiations until the beginning of May (Fig. 11). By mid-May, the number of active nests was approximately ten more than the average and remained at this level until late June. We began to exclose nests about 15 May, and due to the high number of nests initiated in May, we were able to protect a majority of the nests. This, in combination with predator management efforts at the southern sites, helped contribute to an overall nest success rate that was 8% higher than the average and the highest rate since 1999 (Table 4).

Nest success rates for both exclosed and unexclosed nests were higher than the overall average for the first time since 1998 and 1999 respectively (Table 4). Many nests at CBNS, Bandon Beach, and New River were not exclosed immediately as in the past due to lower predation pressure through predator management. This resulted in more days unexclosed with fewer failures, thus unexclosed nests had higher Mayfield nest success rates. Corvids and unknown predators continue to be the main cause of nest failures (41% of failures, Table 7). For unexclosed nests, egg depredations caused the majority of failures (63%, Table 8).

Only one exclosed nest was entered and the eggs were depredated by corvids in 2003 (Table 8). In previous years, egg depredations by corvids of exclosed nests have contributed to lower nest success rates (Castelein et al. 2000, 2001). From South Tenmile to New River, the majority of nests had mini-exclosures (91%); therefore both corvids and any other avian predator were not able to enter the majority of exclosures and cause nest failures. From Sutton Beach to North Tenmile, standard exclosures without hot wires were used. No other predator management activities were completed at those sites. The only exclosure that was entered by corvids was at South Overlook. The lack of egg depredations of exclosed nests contributed to the high nest success rates of exclosed nests.

For the first time in three years, we did not document any adult depredations in or around exclosed nests, which also contributed to the high nest success rates of exclosed nests. Many of the adult depredations that have occurred in past years were at CBNS and New River. We believe several factors contributed to the lack of adult depredations particularly at these sites. Predator management at these sites reduced the number of predators and allowed nests to remain unexclosed for up to three weeks. Unexclosed nests were camouflaged and therefore predators could not target adults as they came and went from the nest, and/or entered or left exclosures. Unexclosed nests reduced the

number of hours an adult was incubating inside an exclosure, reducing the possibility of an adult being attacked inside or around an exclosure. Mini-exclosures prevented entry of avian predators, and therefore it was not possible for an incubating adult to be depredated on a nest. Mini-exclosures were less conspicuous on the landscape, and therefore were potentially more difficult for avian predators to find and target. Mini-exclosures also permitted the adult to exit the exclosure faster by having less distance to travel from the nest to the fence line. Adult plovers, if flushed, may have been outside the exclosure and therefore had no obstacles that would stall them if they needed to fly away quickly. We did not witness any plovers flushing inside a mini-exclosure, and we noted that as we approached mini-exclosures, incubating adults would move outside the exclosure quickly before pausing to assess the incoming potential predator (us).

Evidence in past years at CBNS indicated that a Great Horned Owl (*Bubo virginianus*) was causing depredations of adult plovers particularly around exclosed nests (Castelein et al. 2002). Wildlife Services made attempts to locate and capture the owl(s) both in the late 2002 breeding season and the early 2003 breeding season, however no owls were captured and/or removed, nor was any evidence gathered that the owl(s) was present in 2003. We had recommended that exclosures should not be used at CBNS if the owl(s) was not removed, as we did not want to put more adult plovers at risk (Castelein et al. 2002). This recommendation was based on the standard exclosure design. Standard exclosures were typically erected as soon as nests were discovered, which identified where nests were located and acted as a potential perching place for the owl(s). Due to predator management of corvids, nests were surviving unexclosed for longer periods of time than in the past. In order to monitor nest progression and band adults and chicks, we needed to approach nests. We did not want potential predators to follow our tracks leading up to and around unexclosed nests. Since mini-exclosures prevented avian predators from entering an exclosure, we decided to erect mini-exclosures around nests approximately one to two weeks before hatching. This reduced the number of hours adult plovers were inside an exclosure. We monitored exclosed nests and adults closely to ensure that there was no evidence that adults were disappearing around the mini-exclosed nests. Only one adult female disappeared, and she was associated with an unexclosed nest. There was no evidence of when, where, or what caused the probable depredation.

An additional advantage of using mini-exclosures was once built, we simply moved the mini-exclosure from nest to nest without the need to break the exclosure down. Removal of the mini-exclosure from a completed nest required about five minutes in most cases, and the exclosure was easily carried by two field monitors to a new nest location. Erection of the mini-exclosure around the new nest took approximately 10 minutes compared to 30-60 minutes for a standard exclosure (and an additional 30-60 minutes for adding a hot wire system). This reduced the number of exclosure building hours plover monitors worked in a given week, reduced the time spent around a nest, and therefore reduced the disturbance to the adult plovers. We saw no indication that any plover did not accept the mini-exclosure, and no mini-exclosed nests were abandoned.

Overall, we believe mini-exclosures in conjunction with predator management, were very effective in reducing failures of exclosed nests and preventing adult mortalities in and around exclosed nests.

Overall fledgling success in 2003 was 9% higher than the 14-year mean and the highest since 1995 (Table 10), producing the highest number of fledglings since monitoring began in 1990 (Table 9). The overall number of fledglings produced per male was 1.28 (Table 11), above the target of recovery plan goals. However, brood success, fledgling success, and the number of fledglings per male were considerably different between sites that had predator control and sites that did not have predator control, except for South Tenmile (Table 11). Since monitoring began in 1990, nest success rates for exclosed nests have been generally high (see Stern et al. 1990, 1991, 2000, Craig et al. 1992, Casler et al. 1993, Hallett et al. 1994, 1995, Estelle et al. 1997, and Castelein et al. 1997, 1998, 2000a, 2000b, 2001, and 2002). However, fledgling success and overall productivity has not been as successful as nest success. We believe that predation pressure and recreational pressure, particularly at certain sites, is the cause of poor productivity. In 2003, sites with predator management had significantly higher brood and fledgling success rates, and therefore higher overall productivity. Sites with predator management were responsible for 68% of the fledglings produced in 2003 (Table 11). At CBNS, brood success was 100% and there were 2.40 fledglings produced per male. Reduced numbers of predators through predator control, in combination with little recreational disturbance on the main nesting area, resulted in very high productivity. At New River, where we have identified predators as a main cause of low productivity in past years, fledgling success in 2003 was nearly double the 14 year average (48% compared to 25%, Table 11 and Figure 13). In order to reach recovery goals, all sites need to have adequate fledgling success rates and maintain an average 1.00 fledgling per male ratio. Data indicates that predator management resulted in higher productivity, and we recommend that implementation of direct predator management at all sites to further improve overall productivity.

Plovers continue to respond to habitat management areas (Table 12), and data indicates that these areas contribute to successful productivity and reduced recreational disturbance. Improved habitat restoration at the south end of Bandon Beach attracted plovers, resulting in no nesting attempts near China Creek where recreational activity is high. Productivity of plovers at Bandon Beach went from zero hatched nests of five in 2002 to four hatched nests of six in 2003, with four total fledglings, the highest amount of fledglings at Bandon Beach since 1994 (Table 9). Male plovers kept their broods on or adjacent to the habitat restoration area. At New River, four of five nests on the habitat restoration area hatched, brood success was 100%, and seven fledglings were produced from this area, higher than the total number of fledglings produced from all of New River for the past three years (Table 11 and Table 9). Predator management contributed to the good productivity from these habitat restoration areas. Castelein et al. (2002) suggested that habitat restoration at Sutton Beach would improve plover nesting success at this site by attracting plovers away from the beach where strong winds and recreational activity impact the success of nests. The only nest of the season at Sutton Beach was in the newly created habitat restoration area. Unfortunately the brood did not survive; we

recommend that the habitat area continue to be improved and predator management implemented to decrease the predation pressure on the broods. Habitat restoration is an integral part of plover management, and these areas, once created, need to be improved and maintained to help reach recovery goals.

While data indicates that predator management and habitat restoration are very important for reaching recovery goals, management of recreational activities also continues to be an essential aspect of overall plover management. At Bandon Beach, while the habitat restoration attracted plovers away from the higher recreation activity area, we documented a vandalism event at a hatching nest, and evidence of several groups of campers was found on the habitat restoration area throughout the summer. At New River, visitors from Croft Lake continue to access the beach by passing through the habitat restoration area. Also at New River, recreational activity, particularly dogs off leash, horse riding on dry sand areas and in overwashes, and some illegal vehicle access, continues to occur from Lower Four Mile Road. At Tenmile, we noted an increase in illegal vehicle access of the both spits, and free roaming dogs continue to be an ongoing problem. At Tahkentich, hikers continue to access the nesting area from the trail on the east side of the creek. At Overlook, some violations were noted on the dry sand closure area. At Siltcoos, access of the nesting area via the river and on the north spit continues to be an issue. At Sutton, dogs off leash and violations of the dry sand restricted area, in some cases by horse riders, continues to be a problem. Maintenance of roped and signed areas, and law enforcement of these areas is continually recommended, and continued efforts at outreach and education are essential to improve public awareness and cooperation of plover management and nesting areas.

Habitat Restoration and Development Projects

The USFS began a habitat restoration project at Sutton Beach in the winter of 2002-03. Bulldozers cleared 8.5 acres north of Berry Creek.

At the Overlook, the National Guard bulldozed about 5 additional acres at the south end of the south clearing.

At Tenmile no habitat was managed in the winter of 2002-03, but the area cleared in the previous winter was still in good condition. USFS is currently working on plans to maintain South Tenmile in winter 2003-04 and eventually improve North Tenmile considerably.

At CBNS in winter 2002-03, the Army Corp needed to make emergency repairs to the north jetty. Army Corp removed a substantial amount of sand from the 95HRA to use as backfill near the north jetty. The removal of sand at the south end of the 95HRA helped to remove a considerable amount of the grass that was well established on this area, and created a relatively wide, flat, and open area. Shell hash was deposited in straight lines on the area, but it was not spread as it has been on the 94HRA. Plovers responded by nesting in the shell hash, but because the shell hash was not evenly spread, it was easier for predators to search the area by concentrating on the shell hash lines. We

would recommend that more shell hash be spread on the area, and distributed more evenly throughout the area. Unfortunately, the project caused an improvement in the foredune road, which we have been recommending for decommissioning to limit recreational activity in the area and improve plover access to the beach. Also, several holes cut in the berm along the foredune in the previous winter to provide travel corridors for the plovers, especially the broods, were filled in and not reopened. We recommend that these holes be reopened to facilitate plover movement between the HRA's. BLM continued the annual disking of the 94, 95/98W and 98E habitat restoration areas; all areas were disked twice. A consensus was made that the areas could be disked just once a winter in the future. Efforts to arrange an agreement to continue to manage the area are currently underway.

Twenty-five acres of habitat were cleared at the south end of Bandon Beach by the Twomile Creek/New River estuary. An additional 30-40 acres are to be restored in winter 2003-04.

In the fall of 2002 at New River, habitat restoration continued along the stretch of beach adjacent to the Storm Ranch boat launch and south. The northern area was cleared for the fifth consecutive year; this area has the best habitat and the highest plover use. No new acreage was added to the restored area but maintenance continues to improve the quality of the habitat and reduce the regrowth of grass. A total of 120 acres and 2.25 linear miles of beach dunes was maintained. The habitat at the south end was not as attractive to plovers as the northern areas, but will continue to be improved in the future. Any removal of beachgrass, even if plovers do not directly use the area, contributes to plover management by reducing predator habitat and increasing the area that predators have to hunt and search for plover nests and broods, thus decreasing the probability of discovering a nest or brood.

Recommendations

Signing of Restricted Areas

Signing and roping for the 2004-nesting season should again be implemented to inform the public of plover nesting habitat. Each season signs and symbolic fencing are erected to 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. Plover monitors can inform the different land agencies managing sites of any obvious maintenance needs at a particular site if problems arise. It is important that the signs are maintained to keep violations to a minimum. To maximize the effectiveness of signs and ropes each site should continue to be evaluated at the end of each nesting season and ways to improve the signing and ropes for the nest season should be considered. The outreach committee is working on improving and creating some new signs.

General Recommendations

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

- Maintain, enhance and expand habitat management areas.
- Continue and expand use of mini-exclosures in conjunction with predator management to reduce the risks to adult plovers, decrease the time spent around individual nests, and decrease disturbance to plovers. Continue to erect predator exclosures around nests after 15 May to reduce attacks by migrating falcons. Ultimately move toward elimination of exclosures at all sites.
- Increase and/or maintain predator management at all sites and explore ways of better understanding the activity patterns and population levels of predators.
- 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.
- 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; including a video about plover biology and management to be used in schools and summer programs.
- 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.
- Consider employing a coastal regional coordinator for plover management to facilitate communication between all federal and state agencies.
- Consider allocation of funding to support further analysis and write up of 14-year data set (1990-2003).

Acknowledgments

We would particularly like to thank Mark Stern of The Nature Conservancy. Mark was key in initiating and coordinating the plover project for the first 13 years of monitoring; his knowledge of plover biology and his insight and guidance has been invaluable to the ONHIC staff, and his continued support, advice, and involvement with data analysis is critical to the success of the project. We would also like to thank John Toman who recently retired from ODFW. John was always friendly and helpful even though he often had limited time due to the large workload he carried; his assistance and advice was always very welcomed and appreciated, and we wish him good fishing and hunting as he enjoys his new time off. Theresa Koloszar of ONHIC provided essential, and much appreciated, administration support. Dylan Little, Mark Boyd, and Stan Thomas of Wildlife Services provided professional expertise with predator management and close cooperation with fieldwork; our field time with them is always a pleasure. Theresa Bolch of BLM spent many hours at CBNS; her time and efforts are greatly appreciated and not overlooked. The following people provided invaluable support and logistical assistance: Charlie Bruce, Stuart Love, and Bill Kinyoun of the Oregon Department of Fish and Wildlife; Madeleine Vander Heyden, Jim Heaney, Kerrie Palermo, Ted Gage, Jake Jakubowski, Chris Church and Larry Mangan of the Coos Bay BLM District; Anne Donnelly, who has put in time for all the agencies associated with the Snowy Plover Working Team; Frank Arnold and staff at Bullard's Beach St. Pk., Michele Michaud, Andy LaTomme and volunteers Ceton (Van) Van Meter and Mary Jean Rivera of the Oregon Parks and Recreation Department; Ed Becker, Margie Pace, Roger Geeting, John Pino, Beaver Bowen, Marlene Dohn of the USFS Dunes National Recreation Area; Cindy Burns, Caroline Herziger, and Bill Helphinstine of the USFS Mapleton Ranger District; Carl Frounfelker of USFW Siuslaw National Forest; Fred Seavey and Liz Kelly of the US Fish and Wildlife Service; Mark Jensen and Dave Williams of Wildlife Services; Ken Popper and Karen Gleason of The Nature Conservancy; 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.; Sue Haig of USGS Forest and Rangeland Ecosystem Science Center, OSU; Gary Page, Lynne Stenzel, and Doug George of Point Reyes Bird Observatory; and Francis Bidstrup of Point Reyes Bird Observatory, our essential contact in California and who provides critical information whenever asked, as well as many enjoyable email moments!

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.

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.

Federal Register. 1993. Determination of Threatened Status for Coast Population of the Western Snowy Plover. Vol. 58, No. 42, pp. 12864-12874.

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.

Little, D.T., and D. Williams. 2003. Integrated Predator Damage Management Report for the Western Snowy Plover (Charadrius alexandrinus nivosus) 2003 Breeding Season at the New River Area of Critical Environmental Concern, Coos Bay North Spit, and Bandon State Natural Area.

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.

Page, G.W., L.E Stenzel, and C.A. Ribic. 1985. Nest site selection and clutch predation in the Snowy Plover in California. Western Birds 12:1-40.

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.

Stern, M.A., D.J. Lauten, K.A. Castelein, K.J. Popper, and J.A. Fukuda. 2000. Impact Assessment of Oil Spilled from the New Carissa On the Western Snowy Plover along

the Oregon coast. Unpublished report submitted to the Coos Bay District BLM, the Oregon Department of Fish and Wildlife, the Dunes National Recreation Area, TMM Co., LTD, and the U.S. Fish and Wildlife Service, Newport. 30pp.

Westerkov, K. 1950. Methods for determining the age of gamebird eggs. J. of Wildlife Management 14:56-67.

Table 1. Population estimates of the Western Snowy Plover on the Oregon Coast, 1990-2003.

YEAR	WINDOW SURVEY	# SNPL BREEDING	# SNPL PRESENT
1990	59	-	-
1991	35	-	-
1992	28	-	-
1993	45	55-61	72
1994	51	67	83
1995	72	94	120
1996	86	110-113	134-137
1997	85	106-110	141
1998	63	75	97
1999	52	77	95-96
2000	NC	89	109[a]
2001	81	79-80	111-113[b]
2002	81	80	99-102[c]
2003	63	93	102-107[d]

[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

Table 1. Population estimates of the Western Snowy Plover on the Oregon Coast, 1990-2003.

YEAR	WINDOW SURVEY	# SNPL BREEDING	# SNPL PRESENT
1990	59	-	-
1991	35	-	-
1992	28	-	-
1993	45	55-61	72
1994	51	67	83
1995	67	94	120
1996	85	110-113	134-137
1997	77	106-110	141
1998	59	75	97
1999	51	77	95-96
2000	NC	89	109[a]
2001	84	79-80	111-113[b]
2002	76	80	99-102[c]
2003	63	93	102-107[d]

[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

Table 2. Distribution and abundance of adult Snowy Plovers along the southern Oregon coast during the 2003 breeding season.

Site Name	Mean (x)	SD	Range	# Surveys (n)[a]	Date of Peak Count	Dates of Surveys
Sutton Beach	1.54	2.13	0-7	22 (26)	14 April	8 April – 28 Aug
North Siuslaw	0.22	0.67	0-2	9 (9)	17 April	8 April – 31 July
Siltcoos:						
North Spit	2.39	4.03	0-14	23 (23)	19 Aug	4 April – 25 Aug
South Spit	3.26	3.01	0-9	27 (36)	29 April	4 April – 25 Aug
Overlook:						
North	5.42	3.29	0-13	31 (46)	26 July	9 April – 28 Aug
South	0.52	0.73	0-2	23 (26)	9,30 April, 9 June	9 April – 28 Aug
Tahkenitch:						
North	6.47	3.29	2-13	30 (58)	18 June	9 April – 27 Aug
South	0.43	0.93	0-4	21 (24)	30 June	9 April – 27 Aug
Tenmile:						
North	2.52	2.05	0-7	29 (37)	1 July, 5 Aug	10 April – 19 Aug
South	7.41	2.67	0-12	32 (42)	21 June	10 April – 19 Sept
Coos Bay N.S.:						
South Beach	5.97	2.96	0-13	32 (38)	20 July	11 April – 14 Sept
South Spoil	3.21	3.39	0-11	24 (36)	5 June	11 April – 21 Aug
HRA '94	6.78	4.33	0-16	23 (40)	24 June	11 April – 21 Aug
HRA '95/'98W	1.17	1.37	0-5	23 (28)	1 July	15 April – 21 Aug
HRA '98E	0.20	0.42	0-1	10 (10)	21 May, 1 July	15 April – 11 Aug
Bandon	2.73	2.27	0-9	30 (41)	21 April	6 April – 20 Sept
New River	12.69	3.06	6-19	26 (54)	14 June	16 April – 15 Sept
Floras Lake	0.00	0.00	0	6 (6)		17 April – 30 June

[a] – first number is total number of complete surveys, number in parenthesis is total number of visits to the site

Table 3. Total number of nests for all sites on the Oregon Coast 1990 – 2003; 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	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total # nests	Total # broods[a]
Necanicum													1	0	1	1
Sutton Beach				2	1	2	6	14	8	3	7	15	3	1	62	1
North Siuslaw													1	0	1	0
Siltcoos:																
North Spit				0	2	4	2	0	1	4	8	0	0	0	21	0
South Spit				1	2	2	1	3	3	17	14	14	10	7	74	0
Overlook																
North										2	8	12	5	8	35	1
South										0	0	3	3	1	7	0
Tahkenitch:																
North Spit				0	0	0	0	0	0	0	4	7	8	13	32	0
South Spit				0	3	9	18	14	6	3	1	6	7	1	68	2
Threemile Creek/ Umpqua River				0	0	0	1	0	0	0	0	0	0	0	1	0
Tenmile:																
North Spit					2	2	1	0	0	0	1	2	3	5	16	1
South Spit	2	0	9	8	5	4	3	2	11	5	5	6	9	11	80	2
Coos Bay North Spit:																
South Beach	0	4	6	3	4	3	3	6	6	0	1	1	2	3	42	9
South Spoil	20	9	4	6	9	12	22	14	5	2	5	3	2	9	122	13
North Spoil	5	1	1	0	0	0									7	0
Habitat Rest. Areas	0				4	3	2	3	7	12	22	13	15	11	92	9
Anad. Spoil															0	1
Menasha, N.Bend	1	0													1	0
Bandon	0	14	8	10	5	9	3	4	1	2	2	6	5	5	74	3
New River	6	6	2	0	6	20	18	25	26	28	17	23	14	16	207	6
Floras Lake/ New River Overwash	2	2	6	11	8	6	9	8	4	0	5	0	1	0	62	3
Total nests	**36**	**36**	**36**	**41**	**51**	**76**	**89**	**93**	**78**	**78**	**100**	**111**	**89**	**91**	**1005**	
Total broods[a]	**2**	**1**	**5**	**7**	**4**	**6**	**11**	**5**	**3**	**1**	**2**	**0**	**1**	**4**		**52**

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

Table 4. Nest Success (Mayfield Method) of Snowy Plovers on the Oregon coast, 1990-2003.

	% Nest Success				
Year	Overall[1]	Exclosed[2]	Unexclosed[2]	(N)[1]	(N)[2]
1990	12	-[3]	13	(36)	(29)
1991	23	77	5	(36)	(33)
1992	54	80	9	(36)	(34)
1993	55	77	16	(41)	(39)
1994	74	75	68	(51)	(47)
1995	43	62	7	(76)	(70)
1996	48	66	7	(89)	(87)
1997	43	52	26	(93)	(87)
1998	50	70	15	(78)	(70)
1999	51	62	40	(78)	(72)
2000	32	46	2	(100)	(91)
2001	26	67	4	(111)	(101)
2002	38	67	13	(89)	(76)
2003	51	79	23	(91)	(79)
mean	42.9 ± 15.7	67.7 ± 10.4	17.7 ± 17.7	(1005)	(917)

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

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

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

Table 5. Apparent and Mayfield Success of Snowy Plover nests on the Oregon Coast, 2003.

	Exclosed Nests[a]	Standard Exclosures[b]	Mini Exclosures[c]	Unexclosed Nests[d]
Total nests	56	24	32	35
Hatched	43	17	26	3
Failed	13	7	6	32
Apparent Nest Success	83%	74%	90%	11%
Mayfield Nest Success	79%	72%	86%	23%

[a] - for exclosed nests, four infertile nests were excluded from Apparent and Mayfield calculations; for Apparent = 43/52, for Mayfield number of failures = 9

[b] - for regular exclosures, one infertile nest was excluded from Apparent and Mayfield calculations; for Apparent = 17/23, for Mayfield number of failures = 6

[c] - for ME's, three infertile nests were excluded from Apparent and Mayfield calculations; for Apparent = 26/29, for Mayfield number of failures = 3

[d] - for unexclosed nests, 8 one-egg/abandoned nests were excluded from Apparent and Mayfield calculations; for Apparent = 3/27, for Mayfield number of failures = 24

Table 6. Nest success of Snowy Plovers on the Oregon Coast, 2003.

		Nests Exclosed		Nests Not Exclosed		Exclosed Nests	Nests Not Exclosed	
Site	**Total #**	**Hatched**	**Failed**	**Hatched**	**Failed**	**App Nest Success**	**App Nest Success**	**Overall Nest Success**
Sutton	1	1	0	0	0	100	0	100
Siltcoos								
North	0	0	0	0	0	0	0	0
South	7	2	1	0	4	67	0	29
Overlook								
North	7	3	0	0	4	100	0	43
South	1	0	1	0	0	0	0	0
Tahkenitch								
North	13	5	3	1	4	63	20	46
South	1	0	0	1	0	0	100	100
Tenmile								
North	5	4	1	0	0	80	0	80
South	12	5	3	0	4	63	0	42
CBNS								
South Beach	3	2	0	0	1	100	0	67
South Spoil	9	3	1	1	4	75	25	44
HRAs	11	6	1	0	4	86	0	55
Bandon	5	2	0	0	3	100	0	40
New River								
HRA	5	4	0	0	1	100	0	80
Other Lands	11	6	2	0	3	75	0	55
Floras Lake	0	0	0	0	0	0	0	0
Totals	91	43	13	3	32	77	9	51

Table 7. Causes of Snowy Plover nest failure at survey sites along the Oregon coast, 2003.

Site Name	Total Nests	# Fail	Depredation				Other				
			Egg Depredation								
			Corvid	Unk	Raccoon	Coyote	Overwashing	Wind/ Weather	Infertile	Abandon[a]	Unk cause
Sutton	1										
Siltcoos:											
North											
South	7	5		1			1	1		1	1
Overlook											
North	7	4	3	1							
South	1	1	1								
Tahkenitch											
North	13	7		3				1	2	1	
South	1										
Tenmile:											
North	5	1					1				
South	12	7		3				1	1		2
Coos Bay North Spit:											
South Beach	3	1									1
South Spoil	9	4	1	1					1		1
HRAs	11	5		1		1			1	2	
Bandon	5	3	1	1							1
New River	16	6		1	1					1	3
TOTALS	**91**	**44**	**6**	**12**	**1**	**1**	**2**	**3**	**5**	**5**	**9**

[a] – includes 4 one-egg nests that never completed the clutch

Table 8. Cause of failure for Snowy Plover nests protected by predator exclosures and nests unprotected by predator exclosures along the Oregon coast, 2003.

Cause of Failure		Exclosed	Unexclosed	Totals
Egg Depredation	Corvid	1	5	6
	Unknown	0	12	12
	Raccoon	0	1	1
	Coyote	0	1	1
Other	Overwashing	1	1	2
	Wind/Weather	3	0	3
	Infertile	5	0	5
	Abandoned[a]	1	4	5
	Unknown Cause	3	6	9
Totals		14	30	44

[a] – includes 4 one-egg nests (clutches never completed)

Table 9. Total number of young fledged for all sites on the Oregon Coast 1990-2003; includes fledglings from broods from undiscovered nests.

Site Name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	TOTALS
Necanicum											1	0	0	0	1
Sutton							0	1	1	0	3	0	0	0	5
North Siuslaw													0	0	0
Siltcoos:															
North Spit					0		0	0	2	4	0	0	0	0	6
South Spit					1	2	0	0	4	2	7	0	0	2	18
Overlook															
North										3	5	1	2	3	14
South										0	0	1	0	0	1
Tahkenitch															
North					0	0	0	0	0	0	2	4	1	2	9
South					1	12	8	7	1	1	3	4	5	2	44
Tenmile:															
North Spit					0	1	0	0	0	0	0	0	3	1	5
South Spit			14	7	3	3	4	4	3	7	5	4	3	9	66
Coos Bay North Spit:															
South Spoil	3	2	4	13	17	17	22	8	6	5	3	4	2	7	113
South Beach		11	9	2	6	2	2	7	2	0	0	1	1	3	46
HRAs					7	2	1	1	1	23	6	6	8	14	69
Bandon		1	1	3	5	0	1	0	1	1	0	1	0	4	18
New River Spit			3	0	7	12	8	9	11	8	5	6	6	12	87
Floras Lake/ New River Overwash	0	2	2	11	9	6	1	3	0	0	3	0	0	0	37
TOTALS	**3**	**16**	**33**	**36**	**56**	**57**	**47**	**40**	**32**	**54**	**43**	**32**	**31**	**59**	**539**

Table 10. Overall Mayfield nest success, fledgling success and total number of fledglings on the Oregon Coast, 1990 – 2003.

Year	% Nest Success[a]	% Fledgling Success[b]	# Fledglings[c]
1990	12	11	3
1991	23	45	16
1992	54	41	33
1993	55	42	36
1994	74	50	56
1995	43	50	57
1996	48	32	47
1997	43	30	41
1998	50	26	32
1999	51	43	53
2000	32	41	43
2001[d]	26	34	32
2002	38	29	31
2003	51	46	59
	Mean = 42.9±15.7	Overall = 37	Total = 539

a – Overall Mayfield Success from Table 4
b – does not include fledglings from broods from undiscovered nests
c – total number of fledglings including from broods from undiscovered nests
d – number of fledglings and % fledgling success slightly modified based on 2002 sightings

Table 11. Fledgling success, brood success, and number of fledglings per male for Snowy Plovers on the Oregon Coast, 2003.

Site Name	Total # Broods*	% Brood Success*	Total # Eggs Hatched	Min. # Fledged: From Known Nests	Min. # Fledged: From Undiscovered Nests	% Fledgling Success**	# of Breeding Males[a]	# of Fledglings/ Male
Sutton	1	0	2	0	0	0	1	0.00
Siltcoos:								
North Siltcoos	0	0	0	0	0	0	0	0.00
South Siltcoos	2	100	5	2	0	40	4	0.50
Overlook								
North Overlook	4	50	9	3	0	33	4	0.75
South Overlook	0	0	0	0	0	0	1	0.00
Tahkenitch								
North Tahkenitch	6	33	14	2	0	14	9	0.22
South Tahkenitch	2	50	3	0	2	0	2	1.00
Tenmile:								
North Spit	4	25	7	1	0	14	3	0.33
South Spit	5	80	13	9	0	69	4	2.25
Coos Bay N. Spit							All areas	All areas
South Spoil	4	100	12	7	0	58	combined:	combined:
South Beach	2	100	4	3	0	75	10	2.40
HRA	7	100	13	11	3	85		
Bandon	3	67	6	2	2	33	5	0.80
New River							All areas	All areas
HRA	4	100	10	7	0	70	combined:	combined:
Other lands	6	67	15	5	0	33	10	1.20
Floras Lake/New River Overwash	0	0	0	0	0	0	0	0
TOTALS**	**50**	**70**	**113**	**52**	**7**	**46**	**46[b]**	**1.28**
TOTAL FLEDGED				**59**				

% 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

Table 12. Activity patterns of Snowy Plovers on Habitat Restoration Areas along the Oregon Coast, 1994-2003. 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 and significantly improved in fall 2002.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Dunes Overlook						F?,N,B	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
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
98HRA							N	F?,N,B	R?,F?,N	NA
98EHRA								R?,F?,N,B	R?,F?,N,B	F,B
Bandon Beach									NA	R,F,N,B
New River						N	F,N,B	F,N,B	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.

* - there is known winter use of the 94HRA; this is the only area with documented winter use

Figure 13. Percent fledgling success of Snowy Plovers at each nesting site along the Oregon coast, 1990 – 2003. Above each bar is the number of fledglings over the number of hatched eggs.

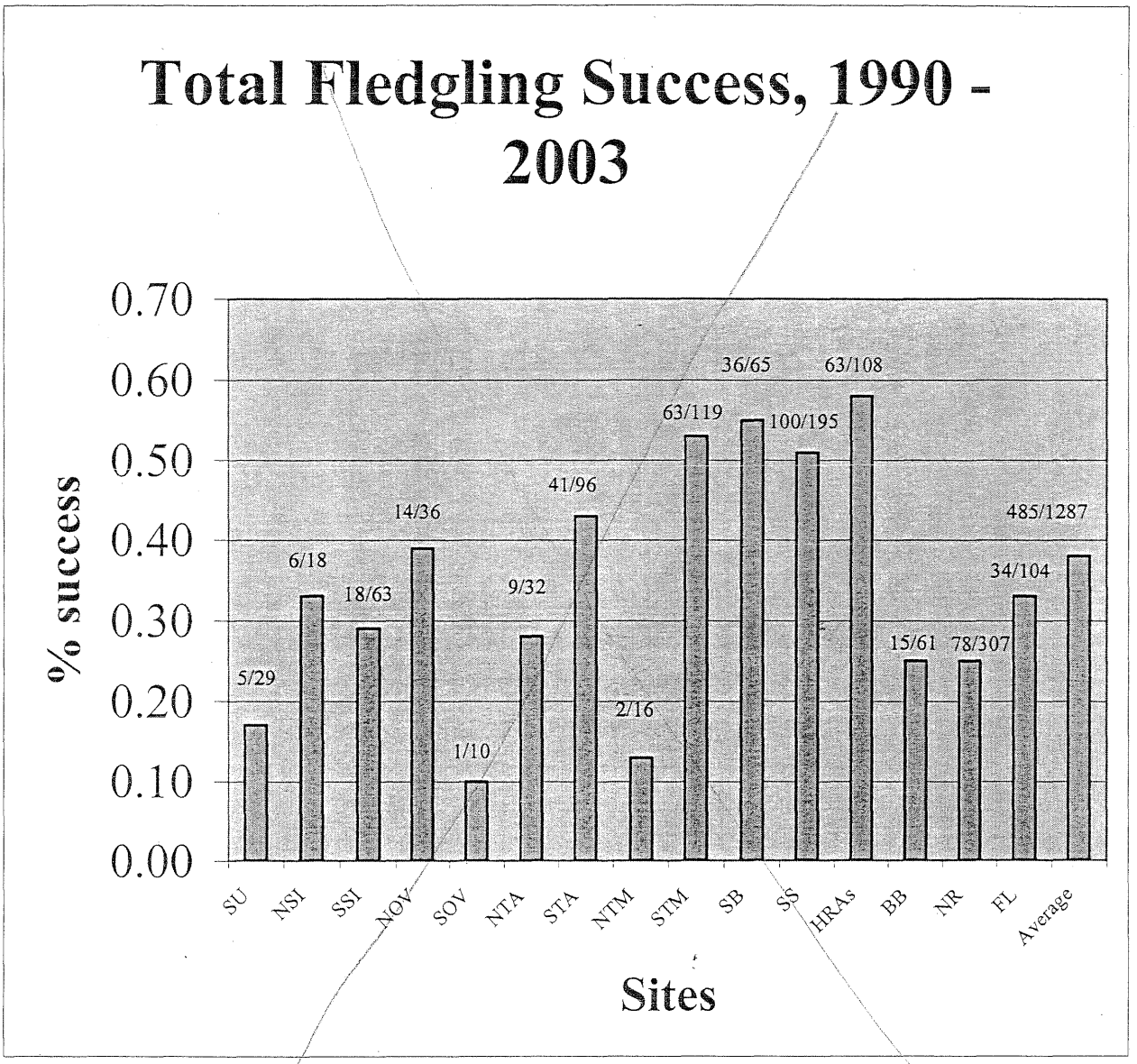


Table 13. Number of Snowy Plover fledglings, number of previous year fledglings returning, return rate, number nesting, and percent nesting in first year of return along the Oregon coast, 1990 - 2003.

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
2003	59	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 = 48.0%
SD = 12.56%
Average percent of returning HY birds that nest in first season = 63.67%
SD = 19.77%

Table 14. 2002 hatch year Snowy Plovers that returned to the Oregon coast in 2003.

Chick Combos	New Combo	Sex	2002 Banding Location	2003 Location(s)	2003 Nest
B/R/B:R	BR:LR	M	N Overlook	NTA, NOV, SOV	Yes
B/W/B:G	LB:RL	M	S Tenmile	NTA	Yes
GL:G		M	S Tenmile	NSI, SSI, NOV	Yes
GL:R		M	94HRA	SB, SS, 94HRA, 95HRA	Yes
GL:R	RG:RY	F	94HRA	SB, SS, 94HRA	Yes
L:G		M	Unknown	SSI, NOV, NTA, STA	Yes
L:Y		M	Unknown	BB, NR	Yes
L:Y, L/G/L:Y	RG:GR	F	South Spoil	NTM, STM	Yes
R/G/R:G	BR:WB	M	N Tahkenitch	NTM, STM	Yes
RL:R	RG:RB	F	S Tahkenitch	BB, NR	Yes
RL:R	RG:RB	M	S Tahkenitch	STM	Yes
RL:R		F	S Tahkenitch	BB, NR	Yes
WL:G	BL:YW	F	New River	NSI, SSI, NOV	Yes
Y/G/Y:G		M	94HRA	SB, SS, 94HRA, 95HRA	Yes

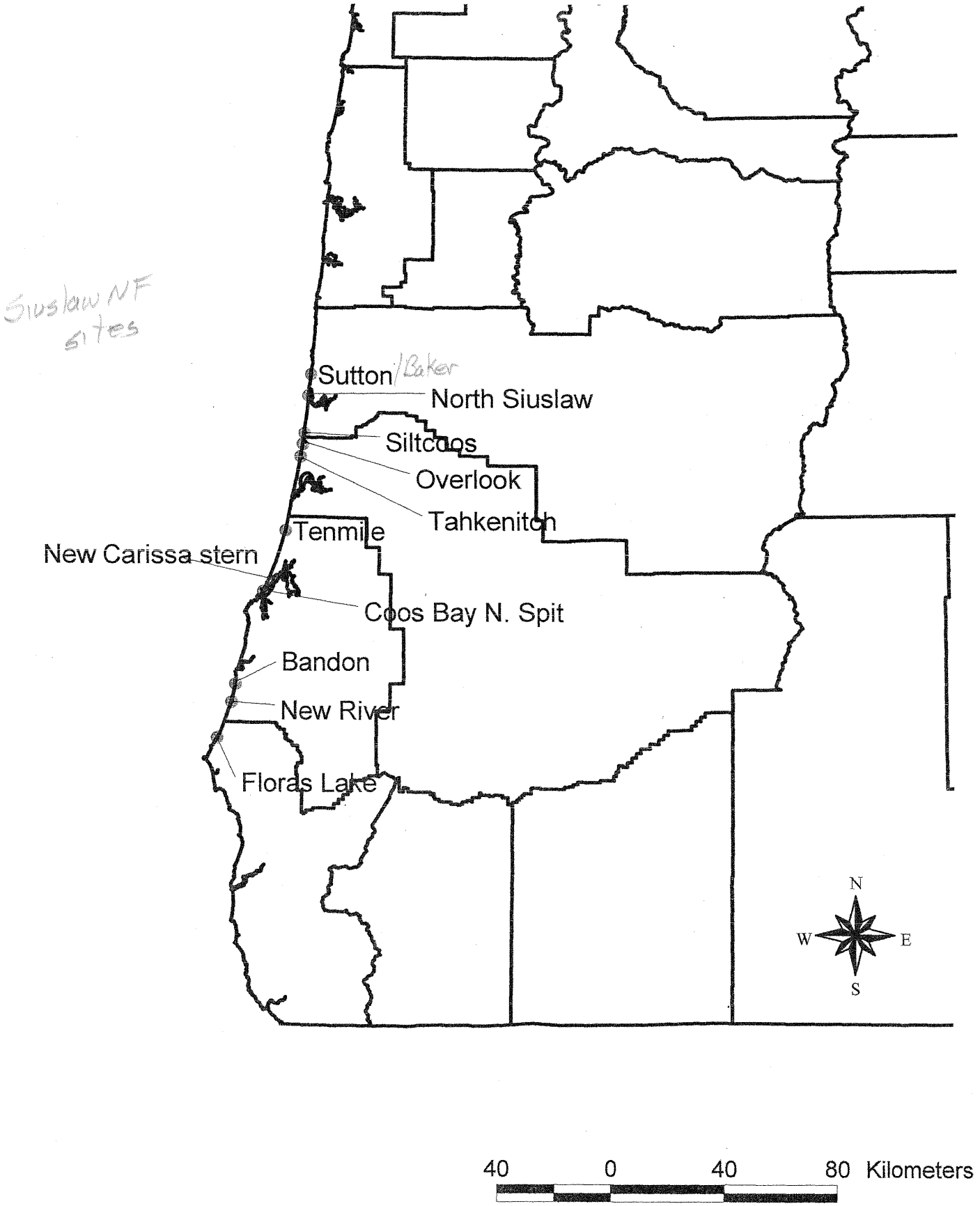


Figure 1. Snowy Plover nesting areas surveyed on the Oregon Coast in 2003.

Figure 2. Snowy Plover nest locations at Sutton and Baker Beaches and North Siuslaw, Oregon, 2003.

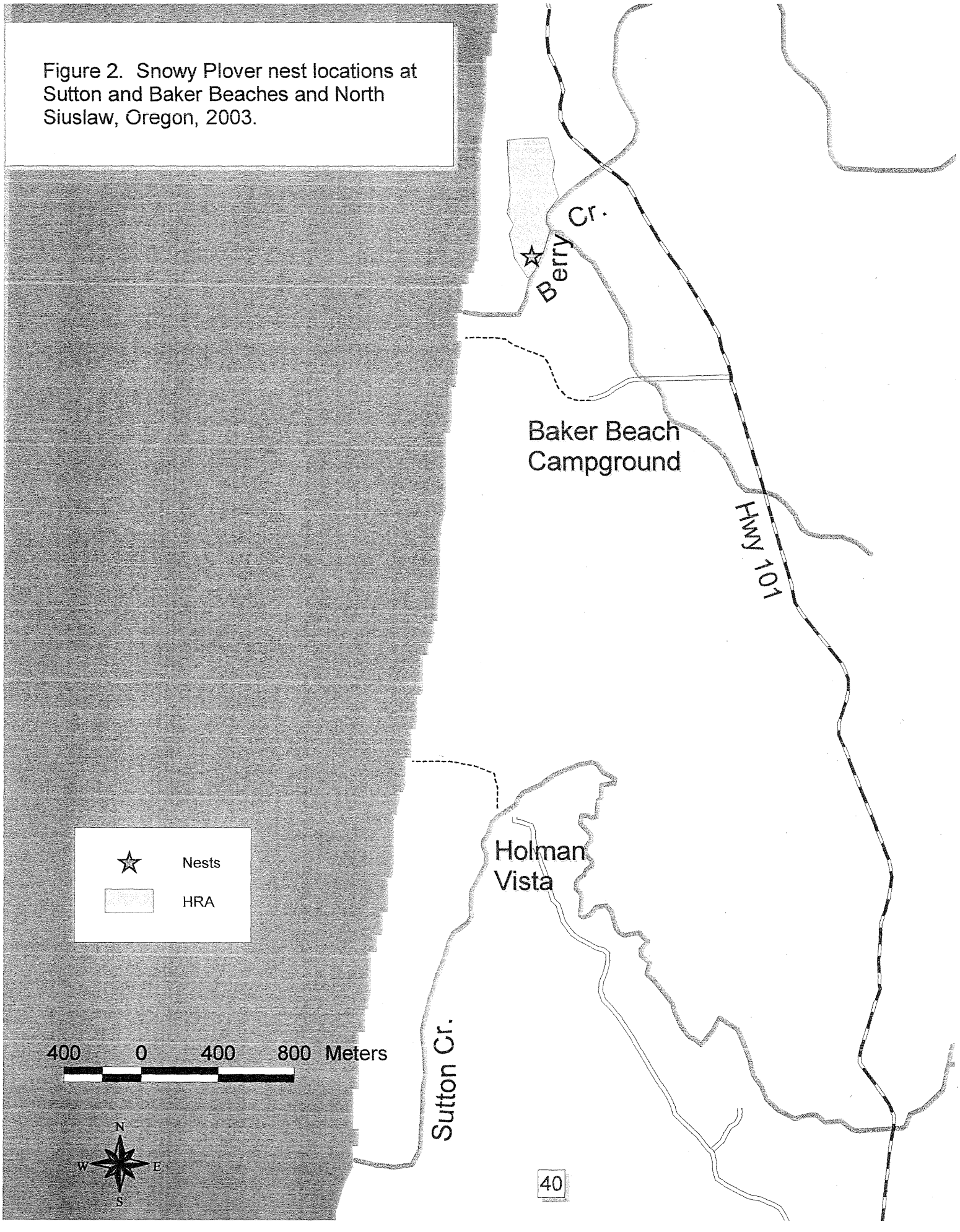


Figure 3. Snowy Plover nest locations at Siltcoos River, Oregon, 2003.

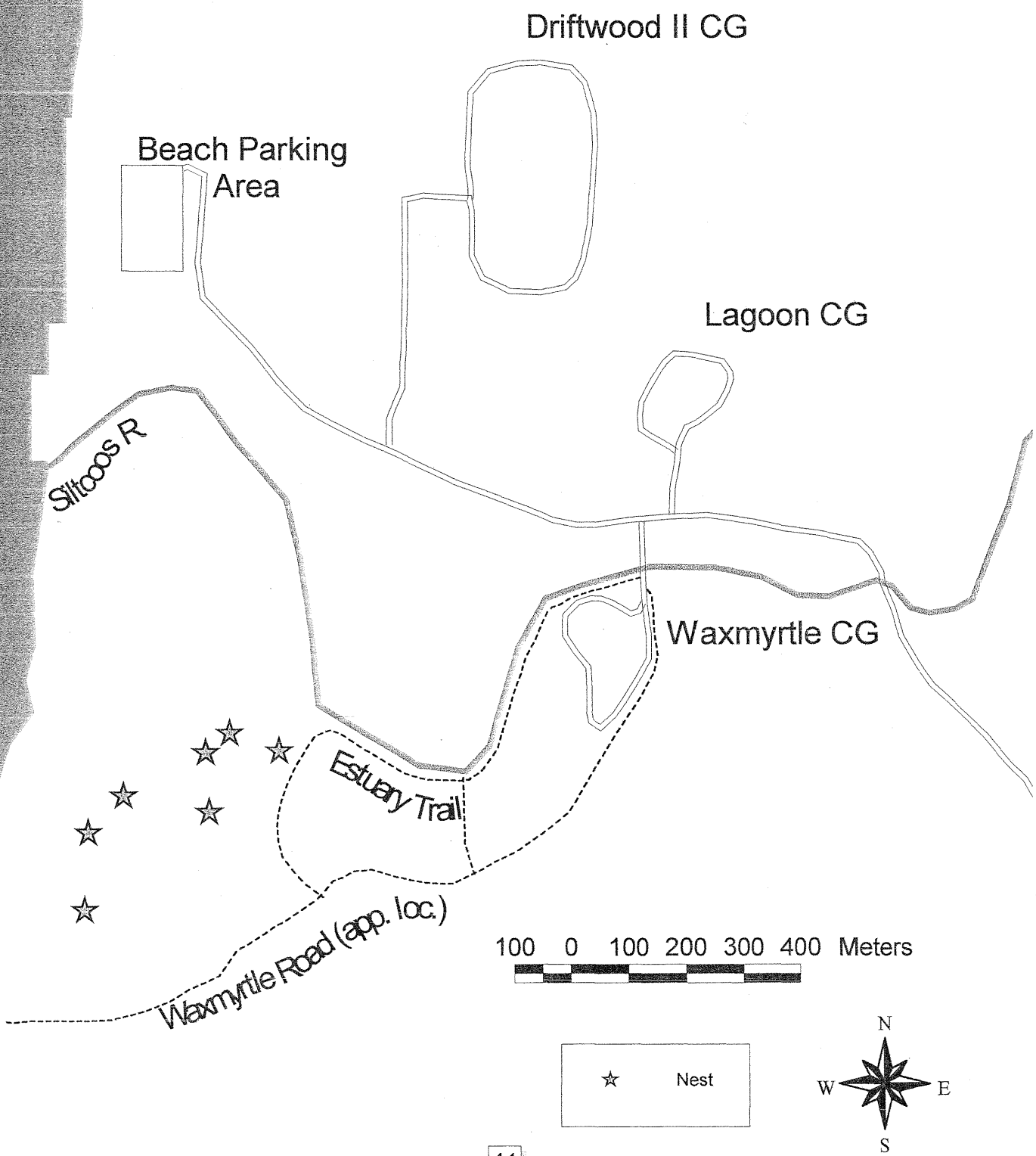


Figure 4. Snowy Plover nest locations at the Overlook Clearing, Oregon, 2003.

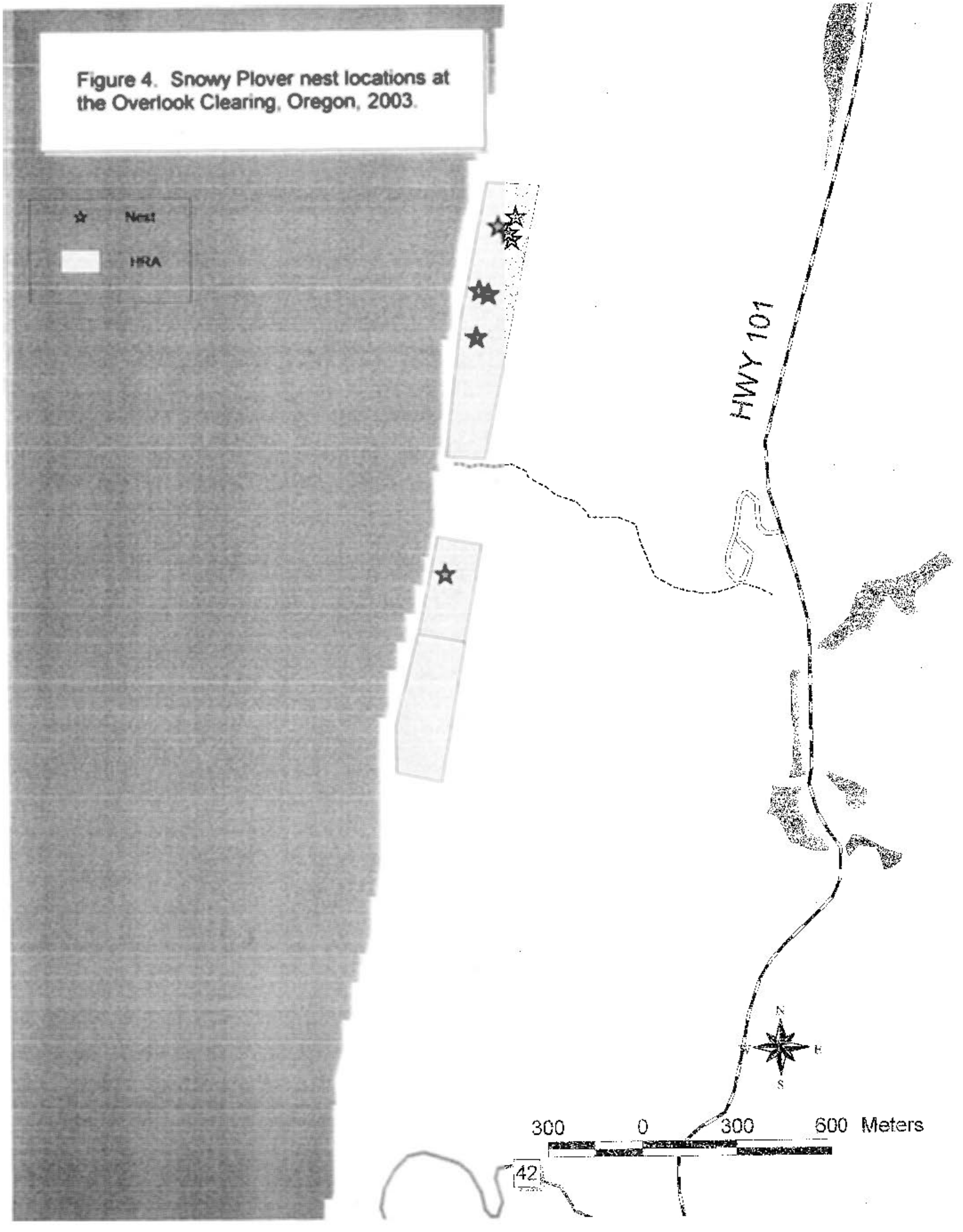


Figure 5. Snowy Plover nest locations at Tahkenitch Creek, Oregon, 2003.

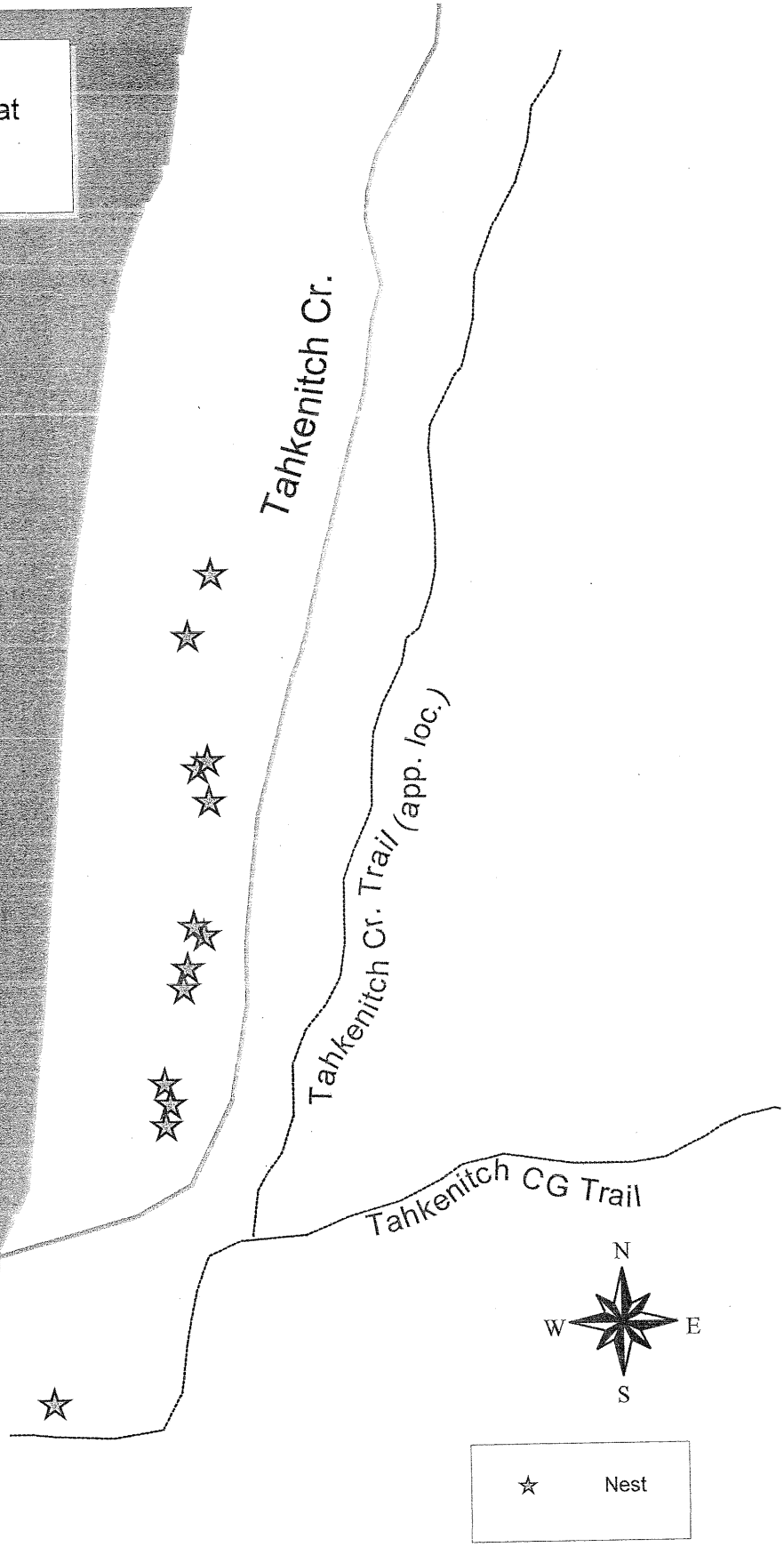
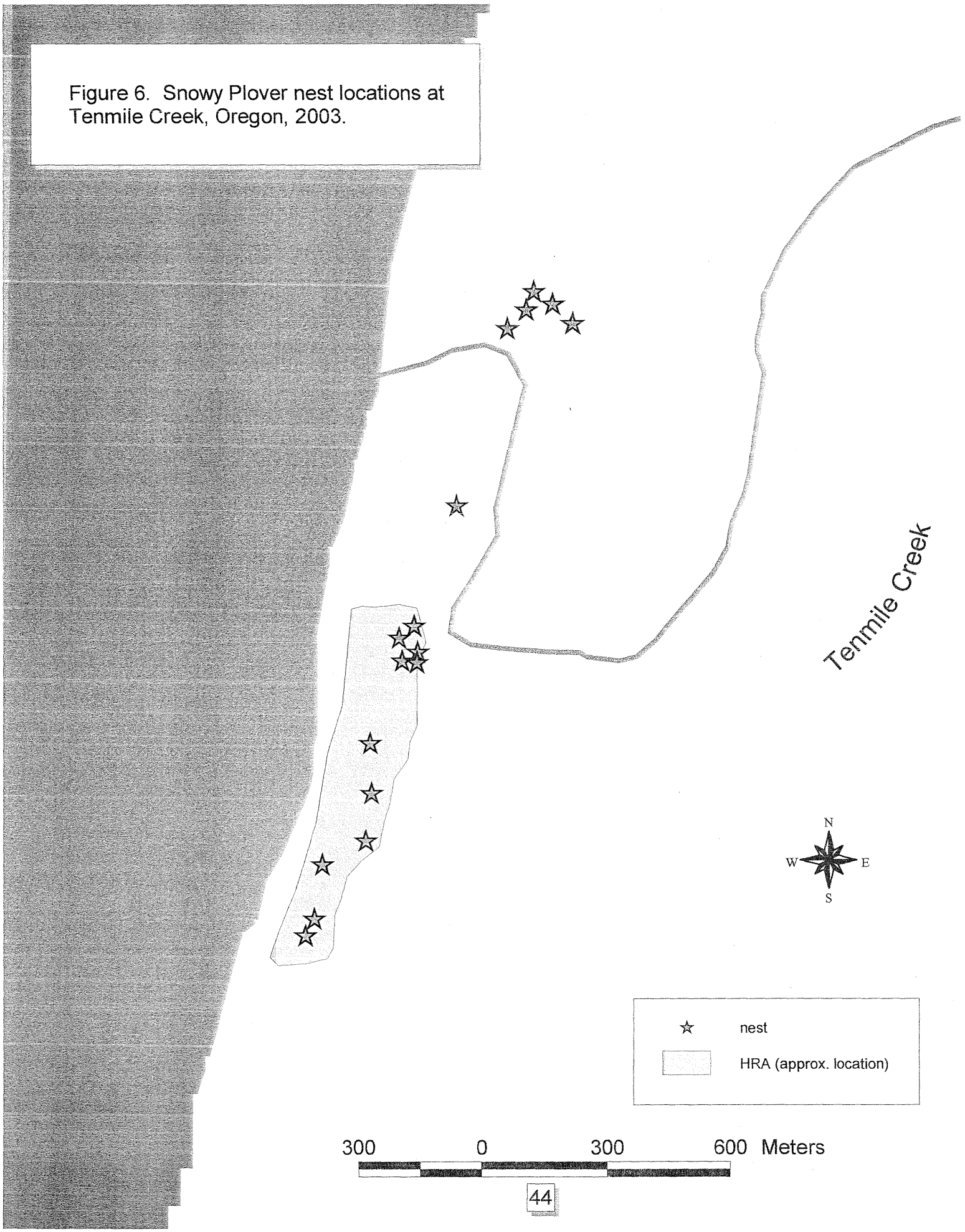


Figure 6. Snowy Plover nest locations at Tenmile Creek, Oregon, 2003.



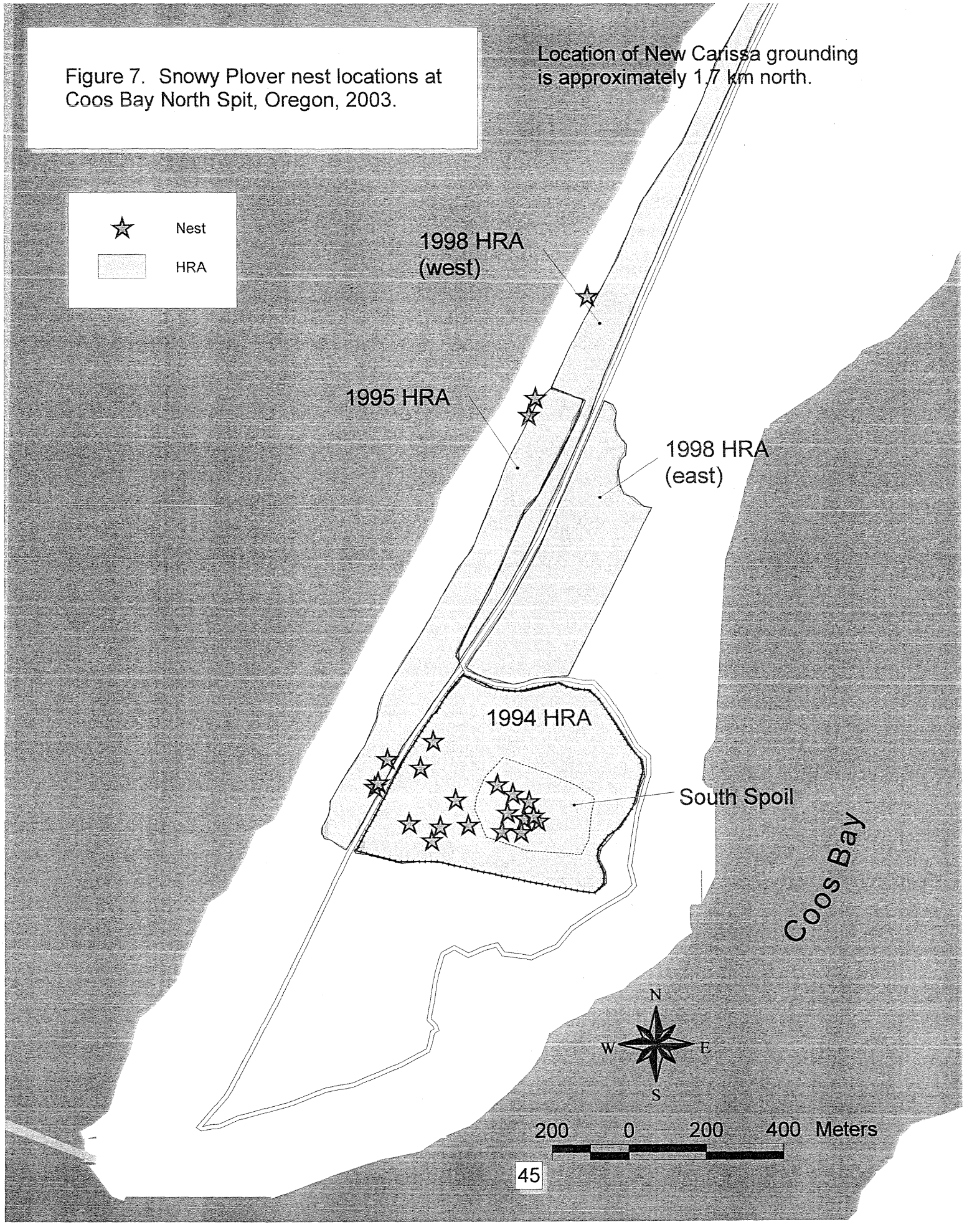


Figure 7. Snowy Plover nest locations at Coos Bay North Spit, Oregon, 2003.

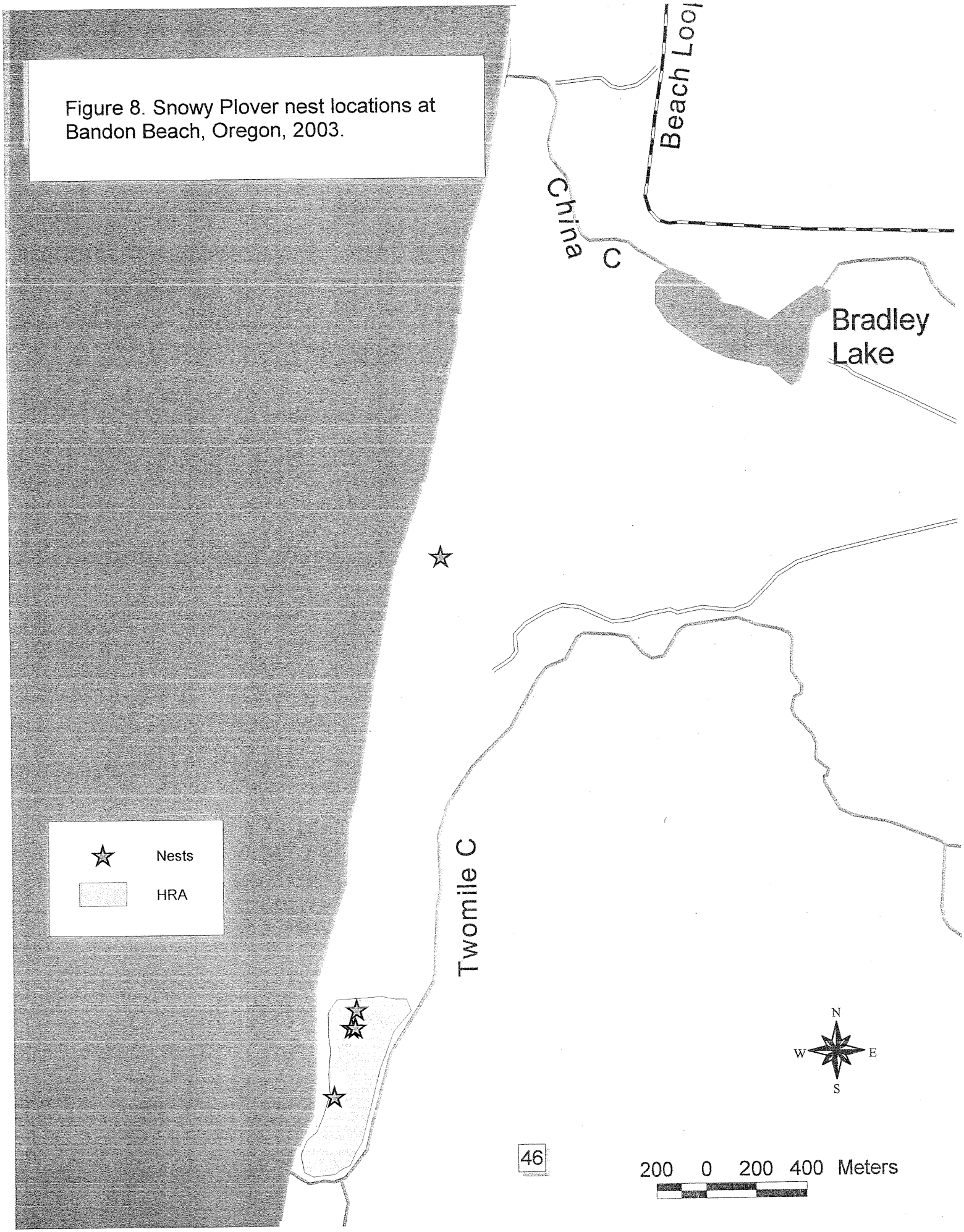


Figure 8. Snowy Plover nest locations at Bandon Beach, Oregon, 2003.

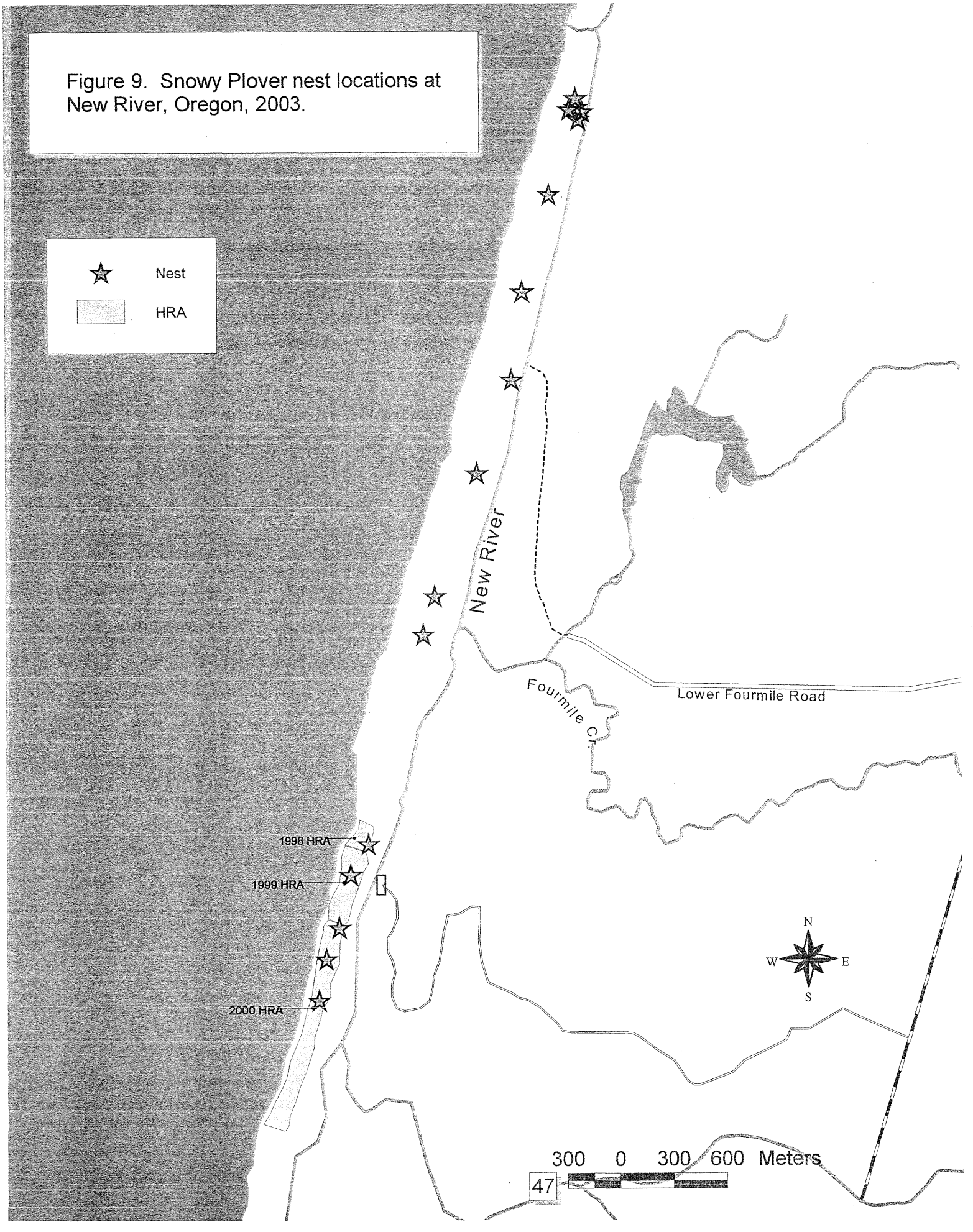


Figure 9. Snowy Plover nest locations at New River, Oregon, 2003.

Figure 10. Number of active Snowy Plover nests within 10 day intervals on the Oregon coast, 2003. Dashed lines represent +/- 2 standard deviations.

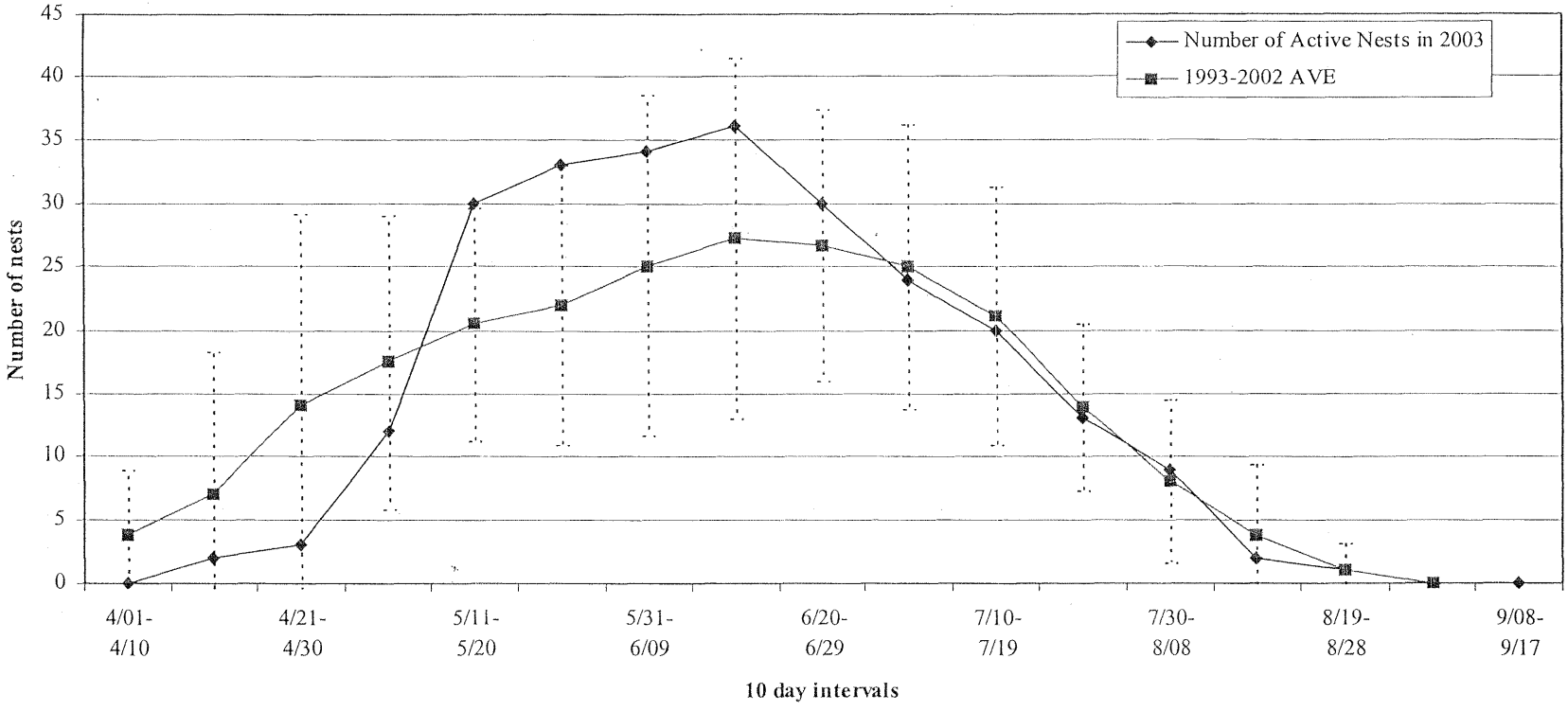


Figure 11. Total percent nest success for Snowy Plovers along the Oregon coast, 1990 – 2003. Above each bar is the total number of nests that hatched over the total number of nests.

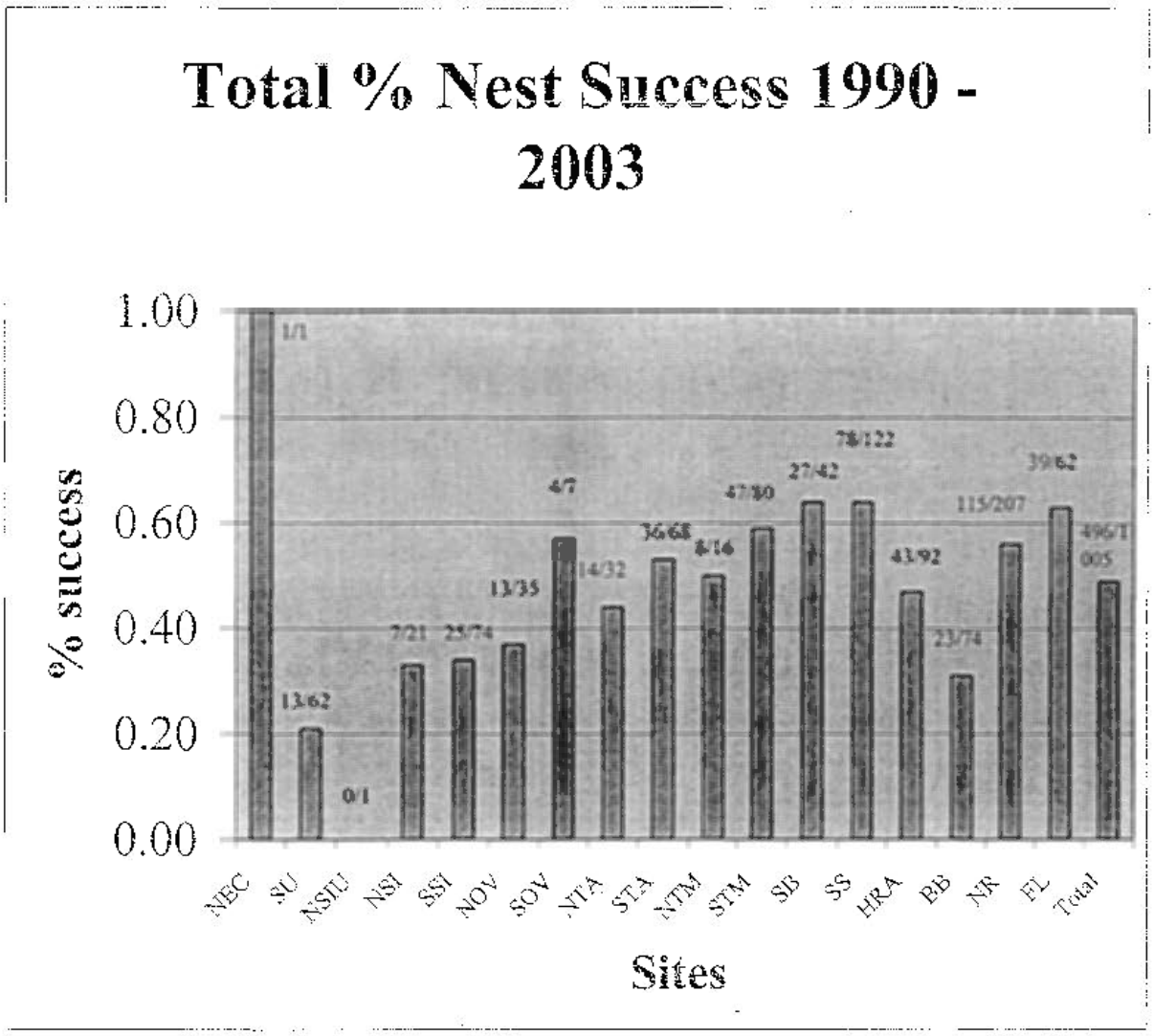
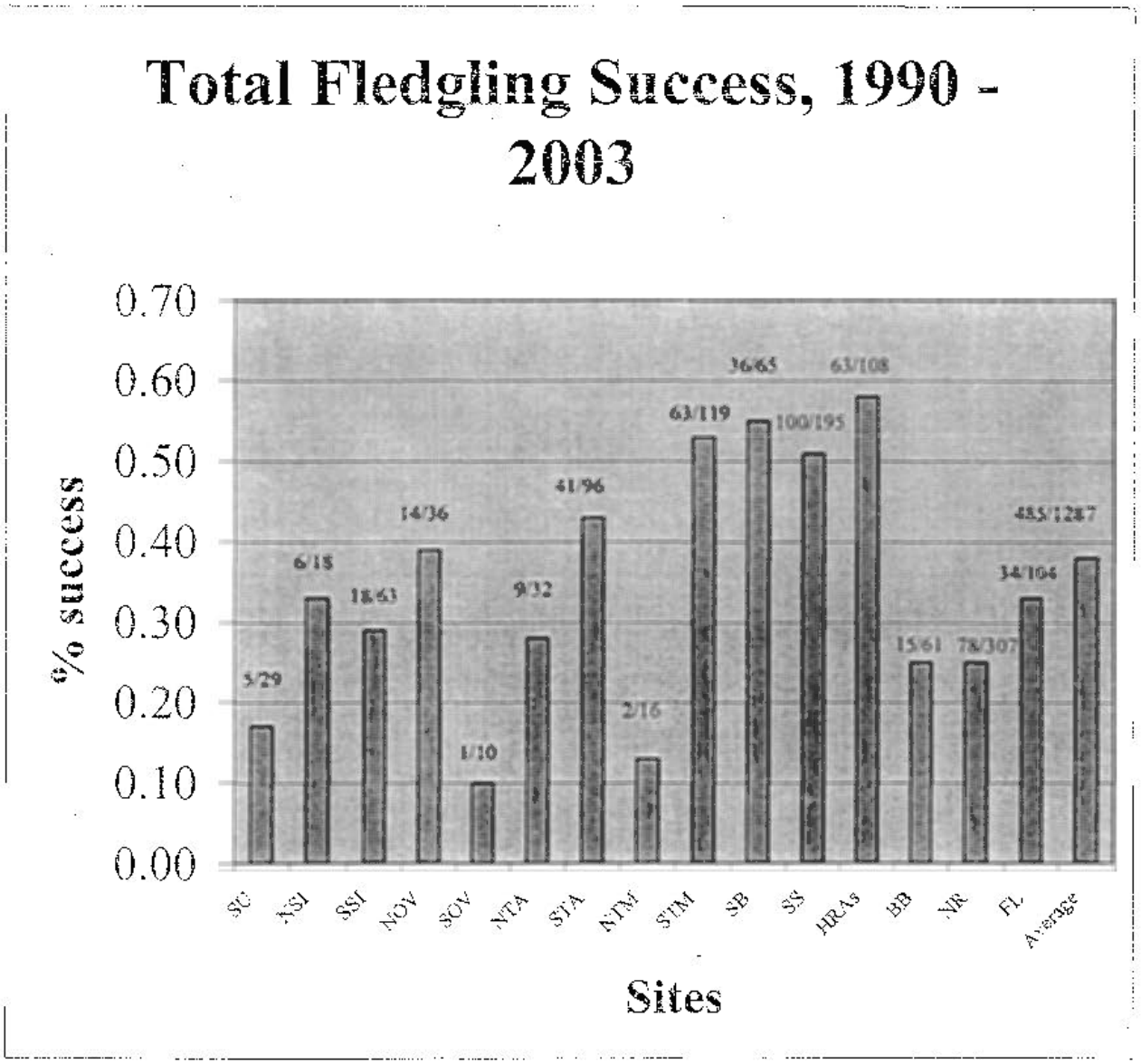


Figure 12. Percent fledgling success of Snowy Plovers at each nesting site along the Oregon coast, 1990 - 2003. Above each bar is the number of fledglings over the number of hatched eggs.



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.

North Siuslaw, Lane Co.: the beach north of the north jetty of the Siuslaw River north to the mouth of Sutton Creek.

Siltcoos: North Siltcoos, Lane Co. - 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 the Waxmyrtle trail beach entrance.

Dunes Overlook Clearing, Douglas Co.: the area 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.: Tahkenitch North Spit - the spit and beach on the north side of Tahkenitch Creek; Tahkenitch South Spit - the spit and beach between Tahkenitch Creek and the south end of the vehicle closure; North of Threemile Creek. - the beach from the south end of the vehicle closure to Threemile Creek; and South of Threemile Creek. - the beach between Threemile Creek and the Umpqua River.

Tenmile: North Tenmile, Coos and Douglas Cos. - 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: South Beach - the beach between the north jetty and the F.A.A. towers; South Spoil/HRA - the south dredge spoil and adjacent habitat restoration areas (HRA); and Bayside - the bay south of the South Spoil.

Bandon Beach, Coos Co: the beach between China Creek and New River mouth, the sand spits and overwash areas near the mouth of Twomile Creek.

New River Spit, Coos and Curry Cos.: the beach and sand spit on the south side of the mouth of New River, 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/New River Overwash, Curry Co.: the beach west of Floras Lake north to the two overwash areas near the confluence of Floras Creek and Floras Lake outflow.

In addition, the beach between the overwash areas of Floras Lake/New River Overwash and New River Spit was surveyed periodically. The following additional areas were surveyed in early spring to determine whether potential prospecting plovers were present and some were checked for the summer window survey: Necanicum Spit, Bayocean Spit, Sand Lake Spit, Nestucca River Spit, South Beach Newport, Whiskey Creek to Coquille River, Blacklock Point to Sixes River, Elk River Spit, Euchre River Spit, and Pistol River Spit.

APPENDIX B. Recommendations for Management of Recreational Activities and Habitat Restoration for sites with Snowy Plovers along the Oregon Coast - 2003.

Necanicum:

- Continue to monitor this site early in the nesting season to determine plovers presence and potential nesting activity.
- Consider signs and ropes if plovers are noted at the site early in the season.
- Work with the local community to manage recreational activities, especially off leash dogs.
- Evaluate the level of predator activity to determine whether predator management tools are necessary if nesting is occurring.

Sutton:

- Continue to expand, improve and manage a nesting area behind the foredune.
- Implement predator management to reduce predation pressure on broods, particularly corvids. Determine the extent of canine predator activity in the area and implement management measures to reduce and/or eliminate canine predator activity.
- Continue roping and signing of dry sand from Sutton Creek to north of Berry Creek.
- Have the necessary materials in place at the initiation of the nesting season to reduce confusion to the public and achieve greater compliance.
- 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:

- Implement predator management to reduce the number of corvids using the nesting area. Evaluate canine predators use of the area and implement management techniques if necessary.
- Continue to close the Estuary Trail, which benefits nesting Snowy Plovers. Adequately sign the river to inform users of the Siltcoos Canoe Trail 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.
- 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.

Overlook:

- Implement predator management to control corvid use of the area.
- Continue to rope and sign both north and south closures for Snowy Plover nesting habitat by 15 March, which is the onset of the nesting season.
- Continue to improve and enlarge the restoration area, especially to the south towards Tahkenitch. Restoration work should be scheduled after the Snowy Plover nesting season is completed, acknowledging in advance that broods may remain in the area as late as mid-September.
- Additional interpretive signing is recommended 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 on both spits. Create more habitat on the south spit which has become very limited and overgrown.
- Implement predator management to control corvid use of the area. Determine the presence of other predators in the area and control those predators if necessary.
- Continue to rope and sign all suitable habitat.
- Block off the old trail that people use to access the south spit from the Tahkenitch Creek Trail, and put up new trail signs.
- Continue to restrict dogs to leashes adjacent to closure areas.
- Continue to extend appropriate signing on both riverbanks, to prevent hikers from walking up the closed estuary.

Tenmile North and South Spits:

- Implement predator management to control corvid use of the area and canine predator use of the area. Eliminate the free roaming dog use of the area.
- Continue to maintain and improve the south side for nesting; create and maintain a large habitat restoration area 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, particularly corvids. Evaluate avian predator use of the area and remove avian predators if necessary. Evaluate coyote use of the area and remove coyotes that are hunting on the nesting areas. Evaluate elk use of the area and attempt to control elk access of the nesting areas.
- Continue to improve and maintain the habitat restoration areas. Continue to spread shell hash to improve nesting substrate. Continue to maintain the fence, and remove accumulated sand and grass.
- Reopen the gaps in the berm along the 95HRA to facilitate brood movement from the 94HRA to the 95HRA and to the beach. Create 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, and inform all law enforcement agencies of the regulations on the beach.
- Permanently reroute the foredune road around the 94HRA and 98 HRA's to reduce disturbance to the plovers, especially during the nesting season. The seasonal reroute of the 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.

Bandon:

- Continue predator management to control fox, corvid, raccoon, and skunk populations.
- Continue to improve and maintain the habitat restoration area north of Twomile Creek.
- Sign and rope around the China Creek overwash, the entrance point to the Christian Camp, and south of the trailhead early in the season. Consider removal of ropes and signs if plovers do not use the area.
- Sign the habitat management area near to the mouth of Twomile Creek/New River before the nesting season.
- State Parks should continue to work with the administration of the Christian Camp and hire a recreational monitor to help explain the wet and dry sand restrictions to the public.
- All law enforcement agencies should again be informed as to the status of the vehicle regulations on the beach.

- Maintain enforcement of restricted areas and leash laws for dogs. Monitor hiker use from Bandon to Blacklock Point, and check the HRA on weekends for illegal camping activity.
- Develop maps of the area to explain what type of recreational activities are allowed.

New River:

- Continue predator management to control fox, corvid, raccoon, and skunk populations.
- Continue to improve and maintain the habitat restoration area.
- Continue to place interpretive signs on the east side of the river on the county land at the end of Lower Fourmile Road to inform the public of plover activity.
- Coordinate with State Parks to determine property boundary lines, and sign the area to inform the public of nesting plovers. Determine if the area has a dry sand restriction and post and sign area to inform public. Determine if dogs are permitted off leash in area, and consider whether dog restrictions should be implemented. Consider use of an interpretive specialist to help monitor recreational activities in the area and explain the management efforts in the area.
- Work with the county to reduce the ATV riding in the area. Encourage continuing cooperation of county, state and federal law enforcement officers to monitor vehicle use of the area.
- Consider roping and signing a trail through the open spit to permit people to access the beach without disturbing nesting plovers.
- Determine if hikers need a designated primitive camping area.
- Continue to close the gate at the Storm Ranch for 15 April- 15 September.

Floras Lake:

- Continue to implement an adaptive management approach between the BLM and Curry Co. Engage local private landowners to cooperate with plover management in the area north of the county land.
- Continue the seasonal restrictions and use of ropes and signs as determined by the cooperative management agreement. It is important to have all the ropes, signs and fences in place early in the nesting season.
- Prompt replacement of signs, rope and posts should continue to notify people that the area is being monitored. Signs need to clearly state that dogs must be on leashes at all times on the beach regardless of whether or not they are outside of the restricted zone.
- Continue to hire an on-site interpretive specialist, to contact the public, monitor the beach, and present slide shows.
- Continue strict law enforcement at Floras Lake to improve compliance by the public. It is important for the BLM to maintain a high profile at Floras Lake to notify the public the site is being monitored, especially since the new bridge was constructed.