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Status and Distribution of the Snowy Plover in Florida

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Photo by Raya Pruner

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Introduction

The snowy plover (*Charadrius alexandrinus*) is a small beach-nesting shorebird that occupies temperate and subtropical zones worldwide. The snowy plover is patchily distributed within North America, where it inhabits coastal beaches, lagoons, interior alkali flats, and mudflats (Page et al. 1995), and is one of the most threatened species of bird in the U.S. (Gorman and Haig 2002, Funk et al. in press). Although the taxonomy is controversial, at least six morphologically distinct subspecies are recognized (O'Brien et al. 2006), two of which occur in North America. The western snowy plover (*C. a. nivosus*) has migratory and non-migratory populations in Texas and Mexico, and along the Pacific Coast of the U.S., as well as migratory populations that breed in the Great Basin and the Great Plains. The Cuban snowy plover (*C. a. tenuirostris*) has migratory and non-migratory populations on the Gulf Coast of the U.S. from Louisiana east to Florida, and in the West Indies (Bennett and Wallace 2001). However, recent genetic research suggests that the geographic boundary between these two subspecies is between Puerto Rico and Florida. Thus, although not yet formally recognized as such, all snowy plovers from the continental U.S. are actually *C. a. nivosus*, and birds from Puerto Rico are *C. a. tenuirostris* (Funk et al. in press). Despite the lack of genetic distinction between the Gulf Coast and other continental U.S. sites, according to Funk et al. (in press), the population in the southeastern U.S. still warrants conservation concern due to insufficient demographic connectivity with other sites in the continental U.S.

Snowy plovers in Florida are restricted to barrier islands and coastal beaches along the Gulf Coast, and function as a demographically independent population (Funk et al. in press). The March-August breeding population in Florida may be partially migratory, with a large portion wintering outside of the state. The breeding population in Florida during 2002 was documented to have 1.5 times the number of individuals documented in the wintering population (Lamonte et al. 2006). Throughout Florida, the snowy plover's breeding habitats are often in conflict with human activity. Additionally, snowy plovers are especially sensitive to disturbance near their nests during the breeding season and will avoid or abandon sites that are frequented by people, thereby leading to mortality of chicks and/or eggs (Gore and Chase 1989, Gore 1996, Lafferty 2001a, Lafferty 2001b, Ruhlen et al. 2003, Colwell et al. 2005).

Gore and Chase surveyed the breeding population of snowy plovers along the Northwest coast of Florida in 1989, with cursory surveys along the Southwest coast. They documented 145 breeding pairs in the Northwest from the east side of the Alabama-Florida state line in Escambia County, east to Alligator Point in Franklin County, and 22 breeding pairs in the Southwest at scattered sites from Three Rooker Bar (also referenced as Horseshoe Key during 1989), Pinellas County, south to Kice Island, Collier County (Gore and Chase 1989). A comprehensive study conducted along the Gulf Coast of Florida during 2002 resulted in the documentation of 153 breeding pairs in the Northwest, and 60 breeding pairs in the Southwest (Lamonte et al. 2006). A wintering count conducted during the 2002 study over the same area calculated a mean of 288.7 snowy plovers (Lamonte et al. 2006). Similarly, a statewide wintering count in 2001, conducted during the International Piping Plover Census detected 311 snowy plovers (Elliott-Smith et al. 2004).

Due to threats posed by beach development and human disturbance, and the consequently low population of *C. a. tenuirostris* in Florida, the snowy plover is listed as Threatened by the Florida Fish and Wildlife Conservation Commission (Florida Administrative Code 68A-27.004). Moreover, the Florida Committee on Rare and Endangered Plants and Animals lists the snowy plover as Endangered (Gore 1996). The snowy plover is also listed as Threatened in Puerto Rico and Kansas, and as Endangered in Alabama and Mississippi (Gorman 2000). *Charadrius a. tenuirostris* is currently considered a Candidate Species by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act.

The overall objective of this study was to re-assess the status and distribution of the snowy plover following the protocol defined in 2002 to further determine long-term population trends in Florida. Specific objectives were to (1) assess the population size and distribution of breeding snowy plovers compared to data collected in 2002, and (2) estimate the nesting success of snowy plovers and compare to 2002. By meeting these objectives, we will be able to provide management and research guidelines to biologists, land managers, landowners, and others in an effort to enhance long-term survival of the snowy plover in Florida. In particular, the information derived from this study will be valuable in enabling the USFWS to better determine whether federal listing and protection of the snowy plover is warranted.

Methods

The 2006 study followed the protocol from the 2002 study to detect any changes in population size and distribution (Lamonte et al. 2006; Appendices 1-4). The 2002 study was modified from the methodologies used by Gore and Chase (1989).

We conducted initial site evaluations of known and potential breeding sites for snowy plovers between 17 February 2006 and 3 March 2006. Locations of known sites were obtained from the 2002 study (Lamonte et al. 2006) and Gore and Chase (1989), as well as from local biologists, land managers, and birdwatchers. During the initial survey of each site, we categorized and recorded site characteristics to determine the location and extent of suitable breeding habitat. Site characteristics included landform, beach width, type and frequency of anthropogenic disturbance, type and presence of predators, and presence and extent of dunes, development, tidal pools, and blowouts/sandflats. Sites assessed as having no suitable habitat were dropped from subsequent surveys. Although site suitability characteristics may be the principal indicators in determining breeding habitat of snowy plovers, several sites that supported breeding snowy plovers had continuous development, an absence of dunes, and high levels of human disturbance. We determined whether sites comprised suitable breeding habitat by the aforementioned characteristics, historical nesting records, and observations of snowy plovers on either initial assessment surveys or subsequent breeding surveys.

We conducted systematic surveys for snowy plovers from 4 March 2006 to 4 August 2006. Following the initial site evaluations, areas with suitable breeding habitat were thoroughly searched for evidence of breeding snowy plovers. Sites that did not have suitable habitat, and for which there were no observations of snowy plovers, were not surveyed for the remainder of the study. Sites that had suitable breeding habitat, but for which there were no observations of snowy plovers, were revisited at intervals of 3 weeks. We visited each site where snowy plovers were observed once every 2 weeks, for a total of 10 survey periods. In a few instances, we conducted multiple site visits within a survey period. In these cases, we tabulated the highest number of plovers observed during a visit in that survey period. We conducted surveys on foot and by all-terrain vehicles (ATV). Sightings of plovers from ATVs were further investigated on foot. Additionally, the number and location of Wilson's plovers (*Charadrius wilsonia*) were recorded to roughly assess their breeding population on the Gulf Coast of Florida. We recorded Wilson's plovers due to their use of similar habitat and known interspecific interactions with snowy plovers, and due to a lack of knowledge of this species in Florida. We also observed and recorded snowy plover interactions with Wilson's plovers observed during the survey.

We recorded the number and location of snowy plovers using a GPS unit (Garmin International Inc.[®]). Once snowy plovers were located, they were closely observed to determine territory establishment and breeding status. We classified each bird or pair of birds in one of the following categories: *nesting pair* (an individual or pair of birds actively defending scrapes with eggs), *family* (adults with unfledged chicks), *territorial pair* (a pair of birds defending an area, but without nests containing eggs), *territorial single* (a single bird defending an area,

but without a nest containing eggs), and *loose bird* (birds not associated with any evidence of nests or territorial behavior).

We searched for nests once we determined snowy plovers were exhibiting breeding behavior, often by waiting for adult birds to return to nests. We assigned an alphanumeric code to nests with eggs and/or chicks, marked the nest with a pin flag and/or flagging at a standard offset distance of 5 meters, and recorded each nest location with the GPS unit. Nests without eggs (i.e. scrapes) were noted for future investigation, but not marked. On the initial visit, we recorded nest contents (i.e. number of eggs and/or chicks), along with habitat characteristics of the nest site. Habitat characteristics included distance to the high tide line, distance to the primary dune line, distance to the nearest vegetation, distance to the nearest structural debris, nest location in relation to the dune line, presence of shell, rock, or plant debris in the nest cup, and visibility of the Gulf of Mexico in relation to the nest. We revisited each nest on subsequent surveys until nest or brood fate was determined, or until the nest cup was empty. If nest failure occurred, we attempted to determine the most probable cause (i.e. trampling, depredation, flooding, etc.).

Certain assumptions were made when determining the fate of nests. We considered a nest to have hatched if a family was present in or around the nesting territory, if we observed family behavior (assuming an approximate incubation period of 27 days; Zonick 1997), or if we observed eggshell fragments in the nest scrape (Mabee 1997). We considered a nest to have been depredated when predator tracks were seen at or around the nest, or when the clutch disappeared too early during the 27-day incubation period to have hatched (Zonick 1997). Hatch dates were evident when we found nests with less than a full clutch (1 or 2 eggs), and during the following survey we discovered empty nest scrapes. We considered nests abandoned if eggs became partially buried or windblown or if no adults could be associated with a nest for consecutive surveys. When the outcome could not be determined at a nest site, the fate was considered unknown.

For comparison of study results between years, we grouped together observations by local geographic areas coinciding with the boundaries established in 1989 by Gore and Chase and modified in 2002 (Lamonte et al. 2006). Direct comparisons of study results between the 2002 and 2006 breeding seasons were possible for geographic areas and/or sites within both the Northwest and Southwest regions. However, due to discrepancies in data collection in the Southwest region during 1989, only data collected in the Northwest could be directly compared between the 1989, 2002, and 2006 breeding seasons. The borders of each geographic area were determined by the presence of suitable habitat, human access, administrative boundaries, and possible bird movement between sites. Figures 1 and 2 depict the local geographic areas for Northwest and Southwest Florida in which we found breeding snowy plovers. Furthermore, we used the number of breeding pairs to indicate population size, based on the assumptions outlined in Gore and Chase (1989). The assumptions were “(1) that all birds attempt to re-nest if their clutch fails, (2) that adults with broods do not attempt to breed again until after chicks fledge (at least 30 days), and (3) that pairs maintaining a territory are attempting to nest” (Gore and Chase 1989). These assumptions were applied to the 2002 and 2006 snowy plover nesting season.

Given these assumptions, we calculated the number of possible breeding pairs during any 28-day period of the breeding season using the number of nesting pairs, territorial pairs, and families observed at each breeding site. We used the number of breeding pairs rather than nest numbers when calculating population totals due to the difficulty in finding well-camouflaged nests, and because the same pair can breed more than once within the season. For each site, we recorded the greatest number of breeding pairs observed during any survey period, and reported this as the estimated number of breeding pairs. High counts at each site were combined to represent the total breeding population in Florida. A population estimate calculated in this manner may tend to overestimate the actual population size. However, due to the 2-week survey intervals, the inconspicuous habits of snowy plovers, and the likelihood that not all nesting pairs were located, our population

estimate likely represents the minimum number of pairs present during the 2006 breeding season. The population estimates were additionally used to calculate the density of breeding snowy plovers within each geographic area. Density was calculated by dividing the maximum numbers of breeding pairs by the linear lengths (km) of surveyed beach.

Data Analysis

We conducted all statistical tests with Statistix 8 software (Analytical Software, 2003). Because the egg/bird count data that were used to detect changes in population from 1989, 2002, and 2006 were comprised of single samples, we used paired t-tests for evaluation. We used a 2-by-2 contingency table to compare the observed difference in proportion of breeding pairs observed between the Northwest and Southwest region between 2002 and 2006. To evaluate the proportion of sites in the Southwest and Northwest region that maintained isolated breeding pairs, the shift in nesting pairs from the western portion to the eastern portion of the Northwest region, and the variability in habitat metrics, we used Chi-square tests. We used a Friedman Two-way Nonparametric ANOVA to compare the distribution of nest locations (i.e. in front of or behind dunes, or in pockets/blowouts).

Due to the high number of nests determined to have an unknown fate, we chose to use the Mayfield method for determining hatching success (Koenen et al. 1996). The Mayfield method determines nest success based on nest failure over the number of days that nests were observed (exposure days). This method corrects for positive biases observed by using proportion estimates for success because hatched clutches last longer and are more likely to be found than destroyed clutches, thereby inflating the hatch rate (Mayfield 1961, 1975). The Mayfield method recognizes that nest losses are not adequately represented in most samples, and that the number of nests lost will vary with the number of nests found and with the time span covered by observations (Mayfield 1961). Our data follow the assumption that mortality will remain constant throughout the incubation period. Nests seen only once were not counted because they did not span any period of time (n=36). If the date a nesting attempt failed was unknown, the date between the last two visits and the known survival period were added to represent exposure days (Klett and Johnson 1982, Mayfield 1961).

Results

Initial Habitat Assessment

We identified 113 sites (compared to 111 sites during the 2002 survey [Lamonte et al., 2006]), encompassing 615.5 km along the Gulf Coast, to incorporate into the 2006 snowy plover study – 60 sites in the Northwest region and 53 sites in the Southwest region (Table 1; Appendix 5). We initially classified 75 sites (66%) as containing suitable breeding snowy plover habitat. Thirty-eight sites (34%) were believed to not contain any suitable breeding snowy plover habitat, but may have contained wintering habitat (Table 2).

We determined site suitability by the type of primary habitat, beach width, disturbance type and frequency, presence of dunes, development, tidal pools, and sand blowouts. The primary habitat of the majority of sites we assessed was sandy beach (n=109) that was usually >5m wide (n=105). We observed predator tracks at 49% (n=55) of sites, with the majority of tracks from canid species and raccoons (*Procyon lotor*). Canid tracks included coyotes (*Canis latrans*) and domestic dogs (*Canis familiaris*). Predators were present at the remaining sites, but tracks were not observed on initial site assessments.

Of the 75 sites classified as containing suitable breeding habitat, 47% (n=35) had tidal pools present for foraging, and 63% (n=47) contained sandflats or blowout areas that are thought to provide essential nesting

locations. Dune habitat, which is thought to be important for providing shelter from predators, was continuous or intermittent at 91% (n=68) of the sites containing suitable breeding habitat.

Beach development was continuous or intermittent at 72 of all evaluated sites (64%) and 82 sites (73%) had high levels of human disturbance occurring >20 times per day (Table 2). Development at sites containing suitable breeding habitat was continuous or intermittent at 38 sites (51%). Fifty-one (68%) of the sites containing suitable breeding habitat had high levels of human disturbance. Sources of human disturbance included vehicular traffic by law enforcement, local land managers, resource managers (i.e. sea turtle surveyors), and recreational beach users (i.e. residents, vacationers, seashell-collectors, and fisherman).

Breeding surveys were conducted at 58 of the 75 sites (77%) containing suitable breeding snowy plover habitat where snowy plovers were observed, covering 295 km of coastline. Breeding pairs of snowy plovers utilized 23 sites in the Northwest region (Figure 1) and 21 sites in the Southwest region (Figure 2). At 8 other sites – Navarre Beach Park (previously called Navarre Beach State Park), Camp Creek, Cape San Blas, Three Rooker Bar South, Fort DeSoto North, Egmont Key, Longboat Key South, and Caxambas Sandbar – we observed snowy plover individuals, but no breeding behavior. Six sites with historic snowy plover nesting (Gore and Chase 1989; J. L. Taylor pers. comm.) were continually surveyed throughout the season, but were not utilized by breeding snowy plovers: St. Andrews State Park/Kiddie Pool, Anclote Key State Park North, Shell Key, Venice Beach, Stump Pass State Park (previously called Charlotte Beach State Park), Sanibel Island West, and Sanibel Island Central. One site, Little Gasparilla Island, was not surveyed during the breeding season due to inaccessibility, although snowy plovers were observed there during the initial site visit. In addition, 8 sites with historic snowy plover nesting were dropped from the survey due to unsuitable habitat conditions and/or high levels of human disturbance: Topsail Hill Preserve State Park, Grayton Beach State Park, Henderson Beach State Recreation Area, St. Joe Beach, Carrabelle Beach, Captiva Island, Fort DeSoto West and the Sunshine Causeway (Lamonte et al. 2006, Gore and Chase 1989).

Breeding Population Size and Distribution

At least 222 breeding pairs of snowy plovers nested or attempted to nest in Florida in 2006 (Table 3). The majority of the breeding population was located in the Northwest region from the east side of the Alabama-Florida state line in Escambia County east to Alligator Point in Franklin County (n=177; 79.7%), whereas breeding pairs were scattered in the Southwest region from North Anclote Bar, Pasco County, south to Kice Island, Collier County (n=45, 20.3%).

The 222 breeding pairs of snowy plovers observed in 2006 represent a 4.2% increase from 2002 (n=213; Lamonte et al. 2006) (Table 4). While there was no significant difference between the number of breeding pairs detected by site between 1989 and 2006 (t=1.14, df=29, $P \geq 0.05$) or between 2002 and 2006 (t=0.48, df=30, $P \geq 0.05$), separating the change by region reveals differences in the breeding population size by year. The 177 breeding pairs observed in the Northwest in 2006 represents a 22.1% increase from 1989 (n=145; Gore and Chase 1989), and a 15.7% increase from 2002 (n=153; Lamonte et al. 2006) (Table 5). In contrast, the 45 breeding pairs observed in the Southwest represent a 25% decrease from 2002 (n=60; Lamonte et al. 2006) (Table 6). Despite the observed difference between the number of breeding pairs in the Northwest and Southwest regions, differences in proportions of breeding pairs between regions between 2002 and 2006 were not significant ($\chi^2=3.70$, df=1, $P \geq 0.05$).

Several sites contained comparatively large numbers of snowy plovers. The highest populated site, St. Joseph State Park, supported $\geq 10\%$ (n=28) of the statewide breeding population. In addition, 8 sites, including Gulf Islands National Seashore/Ft. Pickens (n=12), Eglin Air Force Base West (n=11), Shell Island (n=11),

Tyndall Air Force Base/Crooked Island West (n=17), Tyndall Air Force Base/Crooked Island East (n=14), St. Vincent National Wildlife Refuge (n=11), Little St. George Island (n=16), and St. George Island State Park (n=13), each supported $\geq 5\%$ of the statewide breeding population (Figure 3). Collectively, these 9 sites accounted for over half (59.9%; n=133) of the statewide breeding population.

All sites supporting $\geq 5\%$ of the statewide breeding population occurred in the Northwest region. In contrast to 2002, we found no sites with sizable numbers (≥ 11 breeding pairs) in the Southwest region during the 2006 breeding season (Figure 3). Conversely, the Southwest region supported a majority of sites with isolated breeding pairs. A site with isolated pairs was defined by the presence of 1 or 2 breeding snowy plovers. Fourteen (66.6%) sites in the Southwest region supported isolated breeding pairs, whereas 8 sites (32%) supported isolated breeding pairs in the Northwest region (Figure 3; Table 3). The proportion of sites with isolated pairs was significantly greater in the Southwest region than in the Northwest region in 2002 ($\chi^2=7.50$, $df=1$, $P\leq 0.05$; Lamonte et al. 2006), as well as in 2006 ($\chi^2=4.46$, $df=1$, $P\leq 0.05$). We found 2 new sites supporting isolated breeding pairs in the Northwest region: Perdido Key State Recreation Area and Buck Beach (Tyndall Air Force Base-mainland). Alligator Point-Phipps Preserve supported 1 isolated breeding pair, which had not been recorded since 1991 (Chase 1991).

In the Northwest region, 14 sites exhibited an increase and 7 sites exhibited a decrease in breeding pairs when compared to 2002 (Table 5). Eglin Air Force Base-West was an important nesting area (n=38, 25%) during 1989 (Figure 4). Although nesting habitat was available at this site, during the 2002 breeding season, the number of breeding pairs decreased dramatically to only 4.7% (n=10) of the overall breeding population. We detected a similar number of breeding pairs in 2006 that accounted for 5.0% (n=11) of the overall breeding population. In contrast, the number of breeding pairs at Little St. George Island represented only 2.4% (n=4) of the overall breeding population during 1989, doubled to 3.8% (n=8) during 2002, and again doubled to 7.2% (n=16) during 2006.

The number of breeding pairs dropped from 2002 to 2006 at several geographic areas in the western half of the Northwest region, following the negative trends noted during the 2002 study (Table 5, Figures 4-5): East Pass, Topsail Hill Preserve State Park, Navarre Beach Park, Highway 30A Lakes, and Phillips Inlet. In contrast, 3 sites in the western half exhibited an increase in breeding pairs from 2002 to 2006: Gulf Islands National Seashore-Ft. Pickens, Gulf Islands National Seashore-Santa Rosa, and Eglin Air Force Base-West. Several geographic areas in the eastern half of the Northwest region in which the number of breeding pairs doubled from 1989 in 2002 continued to exhibit positive population trends during 2006: Tyndall Air Force Base/Crooked Island East and West, St. Joseph State Park, St. Vincent National Wildlife Refuge, and Little St. George Island.

When the Northwest region is divided into a western (Escambia, Santa Rosa, Okaloosa, and Walton Counties) and eastern (Bay, Gulf, and Franklin Counties) half, the population trends are more apparent. In 1989, the western half constituted 60% (n=87) of the overall breeding population in the Northwest region (Table 5, Figure 5). The number of breeding pairs in the western half was reduced in 2002 to 29.4% (n=45), and declined further in 2006 to 26.6% (n=47) of the overall breeding population in the Northwest region. By comparison, in 1989 the eastern half of the Northwest region constituted 40% (n=58) of the overall breeding population. The number of breeding pairs in the eastern half increased to 70.6% (n=108) in 2002 and during the 2006 breeding season expanded further, representing 73.4% (n=130) of the overall breeding population in the Northwest region. The population shift identified in 2002 ($\chi^2=28.2$, $df=1$, $P\leq 0.001$; Lamonte et al. 2006) was again significant when compared to 1989 ($\chi^2=36.7$, $df=1$, $P\leq 0.001$).

While the number of sites supporting breeding pairs in 2002 and 2006 in the Southwest region was relatively similar, the location of these sites was highly variable. Therefore, comparing gains and losses by site between years should be viewed cautiously. When grouped by geographic region, changes in breeding pairs were not as apparent (Figure 6). Geographic areas exhibiting increases in the number of breeding pairs observed included North Anclote Bar to south of North Clearwater beach (n=14), Anna Maria Island to south of Siesta Beach (n=6), and Cayo Costa to south of North Captiva (n=7). No sites within these geographic areas, however, displayed any extreme changes. Declines in breeding pairs were observed from Stump Pass State Park to North Gasparilla Island and Sanibel Island to Big Hickory Island. Sanibel Island to Big Hickory Island contained the most drastic decline as a result of declines on Sanibel Central, with 20 pairs recorded in 2002 (Lamonte et al. 2006) and 6 breeding pairs in 2006.

The density of breeding snowy plovers in the Northwest region has not significantly changed since 1989 (Table 7). The overall density in the Northwest during 2006 and 2002 was 0.7 pairs/km. The changes in densities in the Northwest region followed the same trend observed in the change in breeding pairs; sites with high densities were predominately located in the eastern half of the region. Excluding locations that were small in size or were not linearly distributed, the western portion of the Northwest had an average density of 0.5 pairs/km. In contrast, the eastern portion of the Northwest had an average density of 1.0 pairs/km. Five of the key nesting geographic areas, where an increase in density from 1989 and/or 2002 had been observed, maintained densities of ≥ 1 pair/km during the 2006 breeding season: Crooked Island West, Crooked Island East, Palm Point, St. Joseph State Park, and Little St. George Island (Table 7). Gulf Islands National Seashore-Ft. Pickens also maintained a density of ≥ 1 pair/km despite declines noted in 2002.

The overall density observed in the Southwest region during 2006 was 0.4 pairs/km, and 0.9 pairs/km in 2002. No sites displayed a significant increase. However, a relative increase in density, from 0.2 pairs/km in 2002 to 0.4 pairs/km in 2006, was observed at Cayo Costa to south of North Captiva. A drastic decrease in density was observed at Sanibel Island to Big Hickory Island from 1.0 pairs/km in 2002 to 0.3 pairs/km in 2006.

In the Northwest, East Pass and Phillips Inlet/Camp Helen State Park had relatively high densities of breeding pairs in 2006, but not as high as in 1989 or 2002 (Table 7). Four sites in the Southwest region had a density of ≥ 2 pairs/km in 2006: North Anclote Bar, the Bar South of Anclote Key, North Lido Beach, and Keywadin Island (Table 8). All 6 sites were small in size and/or were not linearly distributed, unlike other survey areas. Therefore, a high density calculation may give the misleading impression of a large number of breeding pairs, and comparisons of breeding pair densities that include these 6 sites should be made with caution.

Breeding Chronology

We found the first snowy plover nest of the 2006 breeding season on 8 March at Gulf Islands National Seashore-Perdido Key, in Northwest Florida. In Southwest Florida, the first snowy plover nest was found on 20 March at North Lido Beach. However, the earliest recorded nesting attempt to date was on 17 February 2002 at Sanibel Island East in the Southwest (Lamonte et al. 2006). The earliest documented nesting attempt in the Northwest was on 23 February 2005 at Palm Point (B. Eells pers. comm.).

We observed the first snowy plover family at St. Vincent National Wildlife Refuge on 6 April, 15 days after the nest was initially found on 22 March. Therefore, this nest was initiated around 6 March, given a 27-day incubation period and a 4-day egg-laying period (Page et al. 1985, Warriner et al. 1986). The first family in Southwest Florida was located on 21 April at Sanibel Island East, correlating with the date of nest initiation.

We located several nests during the first half of March. However, the majority of breeding pairs did not begin nesting until around 21 March. These dates coincide with the start of the breeding season determined in 1989 (Gore and Chase) and 2002 (Lamonte et al. 2006).

The number of breeding pairs statewide peaked ($n=161$) between 15-28 April (Survey Period 3), and steadily declined throughout the remainder of the breeding season (Figure 7). A second peak in breeding pairs ($n=139$) occurred between 27 May and 9 June (Survey Period 6). The first peak ($n=135$) in Northwest Florida took place between 15-28 April (Survey Period 3), and a second peak ($n=129$) occurred between 10 June and 23 June (Survey Period 7; Figure 8). The highest peak ($n=26$) in Southwest Florida occurred between 15-28 April (Survey Period 3; Figure 9), and steadily declined without a second peak in nesting. During 2002, the breeding population in Southwest Florida peaked between 15-28 April, and peaked again between 10-23 June (Lamonte et al. 2006). The peak in breeding statewide is more apparent when looking solely at nesting attempts by survey period (Figure 7). Nest totals were highest between 15-28 April (Survey Period 3), then decreased dramatically, with a slight second peak in nesting between 24 June and 7 July (Survey Period 8).

Snowy plover nesting continued in both regions until the third week of July. We documented nesting pairs in Southwest Florida until 18 July (Survey Period 9), and in Northwest Florida until 3 August (Survey Period 10). While the majority of nests in the Northwest had hatched by the third week of July, one nest was still active on 3 August at St. Joseph State Park. Similarly, in 2002, Northwest and Southwest nests were present until 11 July and 16 July, respectively (Lamonte et al. 2006). These dates also correlate with the 1989 study, where Northwest beaches had nesting snowy plovers into early August and Southwest beaches had completed nesting by the beginning of July (Gore and Chase 1989).

Nesting Habitat

We measured habitat features at 274 snowy plover nests statewide (Table 9). Of those nests, 226 were located in the Northwest region and 48 in the Southwest region. Thirty-five broods located during the breeding season did not appear to be associated with any previously documented nests or territories. However, snowy plover broods may move several kilometers from their nesting area (Page et al. 1995, Ruhlen et al. 2003). Thus, we may have located the nests, and if such brood movements occurred afterwards, we would have been unable to determine the nests with which these broods were associated.

Nests located in the Northwest region during 2006 were associated with highly variable features when compared to nests in 2002 ($\chi^2=15.02$, $df=3$, $P\leq 0.01$) (Table 10). Only 22% of nests in 2006 were in close proximity ($<1m$) to vegetation, compared to 73% of nests in 2002. In 2006, the mean distance of nests to the nearest vegetation was 7.7m, compared to 0.98 m in 2002 and 1.4m in 1989. We found 77% of Northwest nests in 2006 lined with shells or debris, compared to 94% and 93% in 2002 and 1989, respectively. Nest locations in 2006 were more similar to locations in 1989 than to locations in 2002, regarding position to landscape features. We found 49% of nests in front of the primary dunes in 2006, compared to 13% in 2002 and 47% in 1989. We found 14% of nests behind primary dunes in 2006, compared to 41% in 2002 and 15% in 1989. We observed 36% of nests in dune pockets or openings in 2006, compared to 45% in 2002 and 38% in 1989. We found 82% of nests located in areas with an unobstructed view of the tideline in 2006, compared to 69% in 2002 and 80% in 1989.

Differences existed in the placement of nests in reference to dunes between the Northwest and Southwest region during 2006 (Table 11). In the Southwest, 71% of nests were in front of the primary dunes, 28% behind primary dunes, and no nests were located in dune pockets or openings. In the Northwest, we found

49% of nests in front of primary dunes, 14% behind primary dunes, and 36% in dune pockets or openings. Despite observed differences, nest placement proportions were not significant in distribution ($P \geq 0.05$).

Reproductive Success

We located a total of 274 snowy plover nests during the 2006 breeding season (Figure 10) – 226 nests in the Northwest region (Figure 11) and 48 nests in the Southwest region (Figure 12). We determined the fate of 207 of the 274 nests (78%). The fate of the remaining 67 nests (22%) was unknown.

Using the Mayfield Method (Koenen et al. 1996), we determined the probability of hatching to be 57% for all snowy plover nests found, with a total of 173 families observed throughout the breeding season. Reasons for observed nest failure included depredation ($n=56$), flooding from storms and/or high tide ($n=6$), abandonment ($n=9$), and trampling by people ($n=2$). Depredation represented the largest cause for failure, corresponding to 76.7% of observed nest failure ($n=73$). The main predators observed, based on tracks, included canid species, raccoons, and ghost crabs. It is unclear if ghost crabs are a cause or source of depredation. Despite documented ghost crab depredation on piping plover eggs (Watts and Bradshaw 1995) and chicks (Loegering et al. 1995), there is no strong correlation between low recruitment and high ghost crab abundance (Wolcott and Wolcott 1999). However, in our study, crab burrows were frequently observed within the vicinity of snowy plover nests during the expected hatch dates. Ghost crabs were also observed excavating burrows from previously active snowy plover nests, presumably depredating the eggs in the process. Ghost crabs typically excavate burrows immediately adjacent to potential food, which provides security for extended scavenging (Wolcott and Wolcott 1999). In addition, ghost crabs have been observed directly preying upon snowy plover chicks (B. Eells, pers. comm.). Fish crows were also documented taking eggs through direct observation. Other possible avian predators observed near nest sites included great blue herons, laughing gulls, and blackbird species.

Using the Mayfield Method, we found that snowy plover nests located in the Northwest region had a 70.4% probability of hatching. In contrast, snowy plover nests located in the Southwest region had only a 26.8% probability of hatching. The hatch rate of nests in the western half (Escambia, Santa Rosa, Okaloosa, and Walton Counties) of the Northwest region was 94.2%, with a predation rate of 5.8%. For example, the 15 nests located at Gulf Islands National Seashore-Ft. Pickens had a hatch rate of 100%. The hatch rate of nests in the eastern portion (Bay, Gulf, and Franklin Counties) of the Northwest region was 56.4%, and the predation rate was 38.2%. We found the highest number of nests at St. Joseph State Park ($n=41$). This area constituted 12.6% of the total breeding population in Florida. Despite the high number of nests, it had one of the lowest hatch rates (16.2%) and highest predation rates (79.3%) of all survey sites. The majority of depredated nests at St. Joseph State Park were from coyotes and ghost crabs.

Additional Solitary Ground-Nesting Species

We documented Wilson's plovers at 38 sites statewide during the snowy plover breeding season – 17 in the Northwest region and 21 in the Southwest region (Table 12). We confirmed Wilson's plovers breeding at 22 of the 38 sites. Furthermore, we observed Wilson's plovers in close proximity to breeding snowy plovers at 16 sites, and in many instances the two species interacted in a negative manner. We documented Wilson's plovers initiating breeding roughly 1 month after snowy plovers. The first Wilson's plover nest was found on 10 April 2006 at Crooked Island West in the Northwest region, and on 29 March on Big Marco Pass CWA in the Southwest region.

Discussion

Breeding population size

The slight increase in breeding pairs of snowy plovers in Florida between 2002 and 2006 may be a result of an increased surveying effort in both the Southwest and Northwest regions in 2006 and the variability in detection rates attributable to observer differences, habitat changes, and weather conditions. Given the absence of breeding population estimates prior to 1989, we do not have adequate information to detect long-term trends in the breeding population of snowy plovers. Nevertheless, the continued loss of suitable habitat over the past few decades has undoubtedly already resulted in a subsequent reduction in the number of breeding snowy plovers in Florida (Gore 1996).

Snowy plovers are relatively long-lived shorebirds (Paton 1994) that are slow to reproduce (Warriner et al. 1986). Current banding re-sightings in Florida reveal adult snowy plovers range from at least 2 to 4 years in age. Snowy plovers have high site fidelity (Warriner et al. 1986, Chase 1991, Paton and Edwards 1996) despite documented long-distance site dispersal between breeding seasons (Stenzel et al. 1994, Page et al. 1995). The population of snowy plovers along the Gulf Coast may have been historically connected to other populations in the continental U.S. by fairly high levels of gene flow (Funk et al. in press). However, there have been no documented sources of immigration and/or emigration to and from other geographic areas in North America to the Gulf Coast, and genetic data do not indicate a high level of movement between geographic areas. In fact, only a few dispersers per generation may be necessary to homogenize gene pools between populations (Funk et al. in press). Funk et al. (in press) stress that the few individuals dispersing per generation from interior populations may not be sufficient to recolonize empty patches of habitat in circumstances where isolated populations become extinct. Furthermore, the lack of recolonization of beaches in the western U.S. may be due to adaptive differences between Pacific Coast populations, which use coastal habitat, and interior snowy plovers (Funk et al. in press). These observations may be applicable to populations in the southeastern U.S., which also utilize coastal habitats.

Under these circumstances, snowy plover populations in the southeastern U.S. may be expected to remain stable for a long period of time before showing a steep and precipitous decline. Moreover, habitat degradation and loss can lead to regional extinction. A mean population under 1000 individuals is considered at risk because environmental variation and natural catastrophes could easily reduce numbers to a level from which the population could not recover (Thomas 1990). Species with a low rate of increase have a higher risk of decline because they recover slowly from reductions in density from changes in the environment (Pimm et al. 1988).

Breeding population distribution

The distribution of breeding pairs varied dramatically among geographic areas and sites. This is likely due to breeding habitat variability in a highly stochastic environment, varying in size due to weather patterns, tides, and vegetation (Figures 3, 5). The cause or causes for the dramatic shift in distribution and density observed in the Northwest region is unclear, but may be due to poor reproductive success resulting from human disturbance, inclement weather, predation, or permanent loss of historic nesting habitats.

The shift in distribution is correlated to the pattern of human pressure in the Northwest region: sites with declines in breeding pairs also had an increase in development and/or human disturbance affecting the nesting areas. The avoidance of nesting areas in the Northwest region with high levels of human disturbance was identified by Chase (1991), who observed that snowy plovers did not nest within 1 km of either end of Santa Rosa Island, which they attributed was due to high levels of human disturbance. While the Bay/Walton

county border is a somewhat arbitrary dividing line, it does coincide with the Northwest region's pattern of human development. In both 1990 and 2000, the closest census years to the 1989 and 2002 survey dates, respectively, western counties (Escambia, Santa Rosa, Okaloosa, and Walton) supported approximately 75% of the region's human population (U.S. Census Bureau 2005). As development and tourism expand, human population growth has recently increased in the eastern half of the Northwest region, where the snowy plover is now highly concentrated. From 2000 to 2005, human population growth increased by 9% in Bay County (U.S. Census Bureau 2006). This rate of human population growth may be contributing to a significant disruption of nesting effort and may explain the increase in isolated breeding pairs observed in the Northwest region. Disturbance can decrease the suitability of nesting beaches and motivate birds to seek out isolated locations, thereby explaining low shorebird abundance on beaches with high levels of human use (McCrary and Pierson 2000). However, newly utilized sites available for dispersers are likely to have low carrying capacities, thereby supporting low numbers of breeding pairs.

The shift in distribution may also be due to the concurrent change in habitat suitability due to recent storm activity that altered available nesting microhabitats in the western half of the Northwest region. In 1995, Hurricane Opal made landfall near Pensacola Beach, leveling the dune system and reducing the levels of vegetation. Hurricanes Ivan and Dennis made landfall in the western panhandle in 2004 and 2005, respectively, further altering the available habitat. Interestingly, these same hurricanes are likely responsible for the increases in breeding pairs observed at Gulf Islands National Seashore-Ft. Pickens and Gulf Islands National Seashore-Santa Rosa. The hurricanes destroyed the public access roads at these beaches, and therefore human use was comparatively low during 2006. Nonetheless, without recovery of breeding populations along the western portion of the Northwest region, breeding pairs will continue to concentrate and become overcrowded at the few remaining sites providing ideal habitat.

In Southwest Florida, the breeding population size decreased by 15 pairs from 2002 to 2006, while the Northwest region increased by 12 pairs from 2002 to 2006. The apparent decrease in the Southwest region was caused in part by a loss in breeding pairs on Sanibel Island, likely due to several factors leading to habitat degradation over time. Sanibel Island has expanded by nearly 50% in width at Bowman's Beach at the north end, where the majority of nests were located in 2002. Re-nourishment efforts and hurricanes on adjacent portions of the island have led to accretion, but have also resulted in changes to the quality of the substrate over the past few years (B. Smith pers. comm.). A study on the Atlantic coast documented plummeting shorebird populations after beach re-nourishment projects, largely in response to prey depression and alteration of beach surface substrates (Peterson et al. 2006). It is unknown whether this decline may be attributable to reduced forage base, structural changes to the habitat, or other factors, but does appear to correspond with the physical changes occurring there (B. Smith pers. comm.).

The increase in breeding pairs observed in the Northwest region may be due to movement of snowy plovers from the Southwest region. As most snowy plovers were not banded, movement patterns between breeding sites in the Northwest and Southwest region are unknown. However, we documented movement of a single bird between 4 different sites (traveling 207.83 km round-trip) in the Northwest region in 2006. A banded male was seen at Palm Point (19 April), Crooked Island West (15 May), St. Joseph State Park (3 June), Dog Island (20 June), and returned to Palm Point (5 July) on subsequent occasions. This male was observed on a nest at Palm Point early in the season, but was not documented breeding at any other location. A second banded male also nested at Palm Point early in April, but was observed nesting at St. Joseph State Park later in the season in June. These observations show the potential for snowy plovers to move between sites during the breeding season. Understanding movement within-season among multiple sites is vitally important, as it may enhance management efforts by allowing for the assessment of future nesting and foraging areas (Haig et al. 1998). However, within-season movements are not well studied. Movement of these individual birds may be

the result of emigration in response to habitat quality. It may also be possible that the population in Florida actually represents a population sink and might be supplemented by snowy plovers emigrating from interior breeding areas such as the Great Plains. Gene flow exists between populations in the Great Plains and Texas, as birds appear genetically more closely related to eastern than to western populations of snowy plovers (Gorman 2000, Funk et al. in press). However, movement between populations in the Great Plains and along the Gulf Coast has not been documented and needs further study.

In some geographic areas in the Southwest, the number of breeding pairs and densities of snowy plovers did not change between 2002 and 2006. We believe that isolated breeding pairs in this region move to nearby nesting sites based on yearly and seasonal breeding habitat availability and reachable carrying capacity. Despite lack of data on dispersal in the southeastern U.S., many observations of long-distance dispersal along the Pacific Coast have been documented (Stenzel et al. 1994, Page et al. 1995). Gore attributed this continual movement and sporadic distribution in the Southwest region to the scarcity of undeveloped beach habitat (1996). Continual movement may also be attributed to the high levels of disturbance found at a majority of sites in Southwest Florida

Six snowy plover nesting areas which coincide with historical seabird colony sites designated as Critical Wildlife Areas by the FWC (Chapter 68A-19.005) receive increased protection against human disturbance (Gore 1996). A small portion of publicly-owned beaches are actively managed and include nesting snowy plovers in current management plans. Although impacts to nesting snowy plovers on public and private lands receive some consideration, the majority of coastal residents and visitors, law enforcement personnel, beach workers, and even coastal resource managers are largely unaware of the needs of this species and lack the skills necessary to locate nesting snowy plovers in order to protect them. This leaves snowy plovers vulnerable to disturbance and unintentional take in even the most 'protected' of natural areas.

According to Gore and Chase (1989), most of the suitable snowy plover nesting habitat in Florida has been intensely developed for human use, or is now in public ownership. In fact, all 9 sites that supported >5% of the breeding population of snowy plovers were located on public property. For example, sites owned by the Department of Environmental Protection (i.e. Florida State Parks, State Recreation Areas, National Estuarine Research Reserves) accounted for 38.7% (n=86) of the total breeding pairs in Florida. Sites owned by the Department of Defense (i.e. Eglin Air Force Base, Tyndall Air Force Base) account for 23.9% (n=53) of the total breeding pairs. Sites owned by the U.S. Department of the Interior (i.e. St. Vincent National Wildlife Refuge, Gulf Islands National Seashore) account for 17.1% (n=38) of the total breeding pairs. Gore (1996) assumed the documented trend of breeding on public lands would stabilize the declining trend in available habitat. However, increased recreational pressures and unfavorable management practices applied on those public beaches have rendered many of them unsuitable as nesting habitat. Furthermore, beachfront development has not slowed on privately owned lands that are contiguous and immediately adjacent to publicly-owned beaches, and has increased greatly in Northwest Florida (Lamonte et al. 2006). Breeding habitat at Stump Pass State Park was eliminated by dredging. Maintenance dredging and placement of groins continue to be used to prevent the reformation of that habitat within the park. Breeding habitat at Navarre Beach Park was likely eliminated by beach re-nourishment prior to the start of the nesting season, thereby altering the surface substrate. Breeding habitats at Henderson Beach SRA, Topsail Hill Preserve State Park, and Grayton Beach SRA may have been eliminated by increased development adjacent to the parks, elevated levels of human disturbance, and regular vehicular activity on the beach by law enforcement and beach maintenance crews, thereby preventing access to foraging areas by snowy plovers.

Along with habitat suitability declines on public lands, areas in Walton County (Highway 30A Lakes) and properties administered by the St. Joe Company (i.e. Palm Point/Windmark Beach and Bonfire Beach) that

previously supported the largest areas of undeveloped beachfront with nesting snowy plovers are rapidly being developed. Development of upland coastal properties remains a threat, as construction along the coast usually leads to increased human activity, even when the front dune habitat is not displaced (Gore 1996). High levels of human disturbances may lead to increased predation rates, resulting in increased chick loss and decreased hatching success (Ruhlen et al. 2003, Lord et al. 2000). While the presence of people or dogs are not considered a direct cause for chick loss or nest failure, human activities are an indirect factor that lead to reductions in reproductive success (Lafferty et al. 2006, Colwell et al. 2005, Ruhlen et al. 2003, Lafferty 2001a, Lord et al. 2000).

Breeding Chronology

During 2006, breeding occurred over a 5-month period from early March to early August, coinciding with the established breeding season for snowy plovers in the southeastern U.S. (Gore and Chase 1989, Chase 1991). However, early nests found in mid-February during 2002 and 2006 indicate a 6-month breeding season (B. Eells pers. comm., Lamonte et al. 2006). The breeding season of snowy plovers begins earlier than that of other breeding shorebirds (i.e. Wilson's plovers and American Oystercatchers, *Haematopus palliatus*) and seabirds (i.e. least terns, *Sterna antillarum*, and black skimmers, *Rhynchops niger*) in Florida on which most protection efforts are based. Traditional protection efforts based on the aforementioned species begins 1 April and ends 31 August.

In 2006, there were two peaks in breeding observed statewide: Survey Period 3 (4/15-4/28) and Survey Period 6 (5/27-6/9); Figure 7. The second peak likely represented re-nesting efforts (replacement clutches and second broods). The first peak in breeding pairs occurred 2 weeks earlier than that documented in 2002 (Lamonte et al. 2006). In the Northwest region, this difference may be attributed to an increase in survey effort and/or a lack of storm events which tend to increase the loss of nests and the rate of re-nesting. In the Southwest region, the extreme variation from that observed during 2002, and the multiple peaks and drops in overall pairs during 2006, may be attributed to the irregular numbers observed during the weekly to bi-weekly surveys.

Only one storm in the 2006 hurricane season affected plover nesting in Florida. Tropical Storm Alberto made landfall in the Big Bend area of northern Florida on 13 June, affecting mainly the Southwest region. Alberto caused the flooding of one nest in the Northwest region at St. Joseph State Park. Four nests were flooded in the Southwest, including 1 at the Bar south of Anclote Key and 3 at Sanibel Island East. The loss of these nests and the flooding of many sites may account for the large drop in the breeding population during 10-23 June (Survey Period 7) in the Southwest region of Florida (Figure 8), and contribute to the observed inconsistency noted. Aside from the one flooded nest at St. Joseph State Park, the breeding effort of snowy plovers in the Northwest region was unaffected by storms.

Nesting habitat

In comparing nesting characteristics from the 3 study years, habitat metrics vary exceptionally within the stochastic beach environment. The characteristics we describe may not be adequate for predicting nest sites for snowy plovers or understanding relationships to nest survival. The lack of significant differences of habitat variables between years may be due to our methodologies of using broad categories. We did not test for interrelated factors that might be important in habitat selection for snowy plovers. Snowy plovers may also respond to cues at the landscape level rather than microhabitat characteristics when selecting a nest site.

The most significant change in habitat from 2002 to 2006 was the proximity of nests to vegetation. Although vegetative cover for brood-rearing is considered an integral component influencing nest site selection (Rupert 1997), the importance of the vegetative requirement (i.e. % cover) is unclear for snowy plover populations in the southeastern U.S. Nest survival for snowy plovers along the Gulf Coast of Texas is known to increase with low levels of vegetation (Hood 2006). In our study, the large increase in distance from vegetation was likely the result of an active storm season during 2004 and 2005 that destroyed vegetation and diminished dune systems. However, it was unclear how the differences in vegetation may have affected the documented nest survival rates between study years and/or sites.

Reproductive Success

Our nesting success estimates were based only on nests that we located during the study, and do not represent the entire population. Therefore, all reproductive success data should be interpreted cautiously. Using the Mayfield Method, we believe bias was partially eliminated towards the ability of easily confirming hatched nests over failed nests. However, not all bias was eliminated, as nests not located may have had higher hatch rates due to their secretive locations. Our study documented 35 broods from undiscovered nests. Levels of reproductive success may be affected by levels of predation, nest density, inclement weather, and/or human disturbance.

It was not possible to determine how many pairs re-nested after clutches failed or successfully raised second broods. However, we did observe some snowy plover pairs re-nesting (up to 3 times) after successfully fledging their young or after nest failure. In the majority of cases, snowy plovers were not banded and we used other methods to determine if the same territorial pair was re-nesting. We assumed that a territorial pair was re-nesting if it used the same nest scrape it used previously, or if the nests were found in the same vicinity as previous nests within a given territory. The vicinity of a nesting territory may range from 1 to 300 m, but was typically determined by the previously documented location (i.e. within the same dune pocket, in close proximity to the same palm tree, or other geographic features) and/or distinctively repetitive breeding behavior. We chose to compare re-nesting cautiously because the maintenance of territories between nesting attempts is often variable. A study in California found that adult western snowy plovers often return repeatedly to breeding areas and even nest on occasion in the exact area they had used the previous year (Warriner et al. 1986). In contrast, the same study found that movement of nesting birds also occurred within the breeding season. Breeding adults often moved among sites after nest failure and established new territories for replacement clutches (Warriner et al. 1986).

Ground-nesting birds such as the snowy plover are generally vulnerable to, and their breeding habitats are greatly influenced by, predators in coastal habitats (Page et al. 1983). A wide dispersion of nests may lead to lower levels of predation (Andersson and Wicklund 1978, Page et al. 1983). Although we could not quantify the number of predators present at each site, we could relate hatch rates to nest density by geographic area and/or region (Page et al. 1983). The differences observed in reproductive success from the west to the east in the Northwest region during 2006 may represent a response to nest density at each site. The western portion of the Northwest region had relatively low densities of nesting snowy plovers, but also had comparatively high hatch rates. In contrast, the eastern portion of the Northwest had higher densities and lower hatch rates, in large part due to higher rates of predation, such as at St. Joseph State Park.

Predators may not be active in all breeding sites every year, and population levels may vary annually (Page et al. 1983). The high nest success in the western half of the Northwest region may be due to a decrease in predators as a result of the 2004 and 2005 storm seasons that reduced the dune system and decreased levels of vegetation, as well as increased predator control as part of the USFWS/USDA Threatened and Endangered

Protection Program (D. Teague pers. comm.). 2006 was the first year that depredated snowy plover nests were not documented on Gulf Islands National Seashore, where nests historically were depredated by coyotes, raccoons, gray foxes (*Urocyon cinereoargenteus*), or feral cats (*Felis catus*) (M. Nicholas pers. comm.). The deterioration of the dune system has reduced the diversity of habitat types available/required for many barrier island species (predator and prey species). On the Eglin Air Force Base, there has been a drastic reduction in cover and change in plant community types, which most likely has reduced predator and prey presence (D. Teague pers. comm.), increasing the amount of available nesting habitat for snowy plovers and allowing for an increase in nest success.

High nest density may additionally lead to an increase in territorial behavior between nesting pairs (Page et al. 1983). In addition to high nest failure, chick adoption and abandonment have been documented in California in instances where broods have crossed into other birds' territories, causing territorial birds to attack the intruding young (Warriner et al. 1986, Page et al. 1995). At St. Joseph State Park, we observed one incident of chick abandonment. Although the chick fledged, it was never observed near adult snowy plovers; instead it was always observed alone feeding at a large tidal zone. On another occasion, we observed chick adoption on Little St. George Island. Two 3-egg nests in close proximity hatched around the same date. We observed two families in these nesting territories, one with 2 chicks and one with 4 chicks. This was the second documented instance of chick adoption in Florida: a banded chick on Sanibel Island was observed on more than one occasion with banded chicks from another nest (Lamonte et al. 2006).

Despite posting efforts, the low level of nest success in the Southwest region was due to the frequency of human disturbance near nesting areas. The breeding season for snowy plovers typically corresponds with the season of greatest human beach use along the Gulf Coast. Upon being disturbed by humans, pets, or vehicles, snowy plovers quickly move away from their nests (Gore 1996, Lafferty et al. 2006). Although this behavior is effective in distracting intruders away from the nest, it causes expenditure of time and energy by the adults (Burger 1986, Gore 1996). More importantly, eggs and chicks are exposed to the sun, wind, and predators when adults leave the nest (Gore 1996). These cumulative effects of disturbance may be significant (Lafferty et al. 2006). Furthermore, it has been recognized that human disturbance might adversely affect reproductive success by displacing or lowering site fidelity of breeding shorebirds in areas with recreational disturbance (Morse et al. 2006).

Determination of recruitment was inconclusive due to the inability to accurately relocate chicks after leaving the nest and after fledging. However, we were able to accurately determine recruitment in 15 color-banded snowy plovers that were re-sighted throughout the study. These individuals were banded during a reproductive study completed in 2004 in which both adults and chicks were banded at Crooked Island East, Crooked Island West, and Palm Point in Northwest Florida (K. Lamonte unpublished). Determination of recruitment was also possible for another 5 adult snowy plovers with only an USFWS band. It was believed that these birds were banded as chicks during the 2002 study, but had since lost their color bands.

Determining brood success, fledgling success, and the factors that potentially influence recruitment will facilitate the development of successful management actions to conserve snowy plovers. The hatch rates of snowy plovers on Florida's beaches appeared comparable to snowy plovers and other beach-nesting shorebirds along the west coast. Beach-nesting shorebirds naturally experience high rates of clutch loss due to predation (Page et al. 1983). Furthermore, predator control programs along the west coast have been found to successfully increase hatch rates, but not fledging success (Neuman et al. 2004). Western studies suggest humans may influence habitat quality, in the form of direct mortality to eggs and chicks, chronic disturbance limiting the amount of time adults incubate or brood chicks, or indirect effects such as attracting predators that scavenge garbage left by humans (Colwell et al. 2005), thereby increasing levels of chick loss. The poor

overall reproductive success observed on Florida's coast suggests that management practices should incorporate measures to improve fledging success in addition to management for nesting success.

Additional Solitary Ground Nesting Species

In addition to snowy plovers, we opportunistically recorded breeding status and nest locations, and observed interactions of snowy plovers with Wilson's plovers. Wilson's plover nests were not monitored on a regular basis, therefore breeding or population estimates were inconclusive. There is very little information available on Wilson's plover reproductive success, population trends (Hood 2006), or behavioral interactions with snowy plovers in the southeastern U.S. However, Wilson's plovers and snowy plovers utilize similar habitats, and in many instances during our study the two species were observed interacting in a competitive manner. On many occasions, we observed adult Wilson's plovers and snowy plovers actively defending territories or families against one another, and we regularly observed Wilson's plovers taking over snowy plover territories. In one instance, we observed a Wilson's plover pair with eggs present in a scrape that had been created by a pair of snowy plovers. Moreover, in 2002, an adult Wilson's plover was observed attacking a snowy plover chick (Lamonte et al. 2006).

Intraspecific competition between snowy plover pairs and interspecific competition between snowy plovers and additional ground-nesting species due to territoriality is expected to increase further as the amount of available habitat decreases. A study in California found that plovers nesting too close to other birds resulted in lower nesting success for both species of birds (Page et al. 1983). Furthermore, territorial defense between pairs may allow for the maintenance of low nest density habitats (Page et al. 1983). The concentration of ground-nesting species at fewer locations puts increasing pressure on the remaining habitat, and likely reduces reproductive success for all nesting species utilizing these beaches by increasing nest densities.

Management and Research Recommendations

1. Public education on snowy plovers and other beach-nesting shorebirds and seabirds is essential for adequate protection. Of highest priority is educating both public and private resource managers need to be educated about the needs of this species. Land managers and resource permitting staff need to be made aware of the snowy plover's high degree of imperilment, how routine management activities such as use of vehicles and removal of rack can impact the species, and the need to control disturbance-related impacts. Also of high priority is development of an active and ongoing campaign to educate both residents and visitors along the Gulf Coast of the negative effects that human and pet disturbances can have on the breeding activities of snowy plovers and other beach-obligate species. Specifically, all documented snowy plover nesting beaches should be adequately posted to make all visitors and adjacent residents aware of the birds and their needs. Educational brochures and other outreach material similar to those developed for the western snowy plover (*Charadrius alexandrinus nivosus*) by the California Department of Parks and Recreation should be developed and routinely disseminated to tourists and residents. Law enforcement personnel of all coastal agencies should be educated both in terms of how their behavior may impact the species in the course of their routine duties (i.e. beach driving) as well as in how enforcement of existing rules would benefit the species. Changing human behavior will likely be a challenge, requiring sustained efforts of education, notification, and enforcement (Lafferty 2001a).
2. In addition to educating the staff of resource management agencies, the leadership of those organizations and agencies responsible for management of snowy plover habitat need to be made aware of the conservation requirements and their responsibilities in management of this state-listed

Threatened species. An interagency Snowy Plover Task Force or other cooperative body should be established to identify and address impediments to conservation actions, elevate the profile of the species within the state, and serve as a unifying body to promote conservation of the species.

3. Snowy plovers have been relegated to limited sections of Florida's beaches. These beaches appear to be those which still experience the highest degree of natural processes such as erosion, accretion, washover, inlet formation, inlet movement, and island migration. It is imperative that these remaining refuges be protected not only from development and incompatible recreational practices, but that they retain the functional characteristics which define them as suitable habitat. These refuges need to be protected from actions which interfere with coastal processes.
4. Pets, particularly dogs, are prohibited by law on most public beaches in Florida. However, pets are extremely common on beaches. In fact, there has been a growing trend towards the establishment of dog parks, as well as dog owners that do not abide by existing dog restrictions, and a lack of adequate enforcement of those restrictions. Birds are particularly sensitive to disturbance by dogs. This sensitivity is illustrated by observations that snowy plovers react at twice the approach distance by dogs than by pedestrians (Lafferty 2001a). Although pets do not remove habitat or necessarily kill birds directly, disturbances cause birds to suspend feeding and/or expend energy while in flight, moving on the ground, or maintaining vigilance (Burger 1986, Lafferty 2001a), and may directly result in loss of eggs and chicks due to exposure. Enforcement of regulations that prohibit dogs on beaches, even when leashed, would help protect nesting populations of snowy plovers.
5. Driving vehicles in breeding and foraging habitat may cause destruction of eggs, chicks, and adults, abandonment of nests, and considerable amounts of stress to adults and family groups. Vehicles may also negatively affect reproductive success by restricting access to foraging areas or by causing damage to nesting habitats. Because vehicles move faster than a pedestrian and are further removed from the sights and sounds of the beach, operators are more likely to overlook birds that are disturbed. Most public beaches in Florida are closed to vehicles. However, there is regular and considerable amounts of vehicular traffic by law enforcement, local land managers, resource managers (i.e. turtle surveyors), beach equipment vendors, and garbage trucks. A movement towards minimizing beach driving on Florida's beaches should be taken to limit the level of correlated harassment to snowy plovers and other imperiled species. In areas where beach driving is essential for management, measures need to be taken to ensure that all individuals operating vehicles or equipment on beaches do so in a manner that minimizes impacts on nesting snowy plovers and other beach-nesting species and their habitat.
6. Similar to findings during the 2002 study, nesting by snowy plovers began earlier than for other breeding shorebirds and seabirds (i.e. terns and skimmers) on which most protection efforts are based. During 2006, snowy plovers were found nesting during the first week of March in the northwest, and in mid-March in the southwest of Florida. Nesting protection efforts should be altered to incorporate the 6-month breeding season of the snowy plover, which may begin nesting in Florida as early as mid- to late February, as occurred in 2002 (Lamonte et al. 2006).
7. Due to declines in habitat suitability, continued concentration of snowy plover populations into fewer areas, low population levels, and the consequent vulnerability of birds to further declines, snowy plovers should be monitored at frequent intervals. Snowy plovers should be monitored annually if funding is available. If funding is unavailable, surveys should be conducted at no greater than 4 year intervals. If limited funding is available, snowy plovers should be monitored at sites

with the greatest concentration and/or where disturbance has occurred (i.e. due to hurricane damage, development, high predation, etc.). Breeding and wintering surveys should be conducted following the protocol defined in 2002, which will enable detection of changes in population size and distribution. Sites where declines in breeding pairs have already been documented should be monitored further to determine potential causes for decline. By identifying potential causes for decline, conservation and recovery efforts may be further enhanced.

8. It is essential to determine the reproductive success of snowy plovers and other solitary beach-nesting birds (i.e. Wilson's plover, American oystercatcher). It may be useful to look at possible reproductive differences at low- and high-nest density sites, sites with high and low levels of disturbance or development, and sites under different management scenarios. Chronically low reproductive rates have been identified as a major cause for population decline in snowy plovers (Colwell et al. 2005). The determination of quality breeding habitat may be influenced by a combination of factors: predation of eggs and chicks, food availability, and natural disturbance associated with weather and anthropogenic effects (Colwell et al. 2005). Habitat restoration may be inconsequential if fledging success remains low. Understanding beach productivity will help determine if management actions can be implemented to improve productivity at sites with small numbers of breeding pairs and/or with high levels of disturbance.
9. It will be essential to accurately determine depredation levels, and to identify the types of predators that might be influencing nest success and recruitment at various sites. Raccoons, coyotes, and ghost crabs were notable snowy plover nest predators, as evidenced by the frequency of tracks observed around depredated nests. In addition, fish crows and laughing gulls were observed taking snowy plover eggs (R. Pruner pers. obs.) and chicks (B. Eells pers. comm.). Management actions taken to improve reproductive success should coincide with the type of predator and disturbance pressures present at each site. For example, exclosures are only effective with medium to large-sized mammals, or with avian predators (Mabee and Estelle 2000). Nest exclosures are not a means of preserving biological diversity over time, but rather as a site-specific tool for temporarily increasing nest success, while more substantial large-scale/long-term conservation plans are developed (Johnson and Oring 2002). Predator control programs should also be considered at select sites to enhance breeding success of snowy plovers.
10. Human disturbance due to development and increased recreational pressure continue to be of concern. These two factors are the most difficult to control, and create the most permanent impact on the habitat. The impact of recreational pressures should be minimized by protecting areas of snowy plover habitat, and by concentrating human activities away from preferred nesting areas. Depending on the proximity and type of human activity (i.e. walking, running, fishing, dog-walking), shorebirds may respond by spending more time watching the potential human threat (Burger and Gochfeld 1991), than by walking or flushing to undisturbed areas. Furthermore, human disturbance can cause declines in habitat use, and can affect the hatch rates of snowy plovers. Human disturbance on publicly owned beaches is of great concern because the majority of breeding snowy plovers are now concentrated on these sites. In addition, snowy plovers that utilize barrier islands are also prone to high levels of disturbance by humans accessing the islands by boat. Nesting areas with high human impact should be roped off and/or posted against trespass prior to the start of the breeding season. Disturbance rates may fall dramatically following posting and roping around large nesting areas (Lafferty et al. 2006). In addition, minimizing development at the few remaining nesting areas on private lands should be encouraged. Nesting management strategies should be devised for areas where development continues, such as Highway 30A Lakes (Walton County) and

Palm Point (Gulf County), to reduce the impact that will be caused by greater human disturbance, as plovers that have been previously displaced by human activity will rapidly reoccupy protected spaces (Lafferty et al. 2006). Furthermore, movement to and utilization of “new” nesting habitats were only made by small numbers of birds, such as isolated pairs. This may indicate a limited carry capacity at newly utilized nesting sites, suggesting the need for protection and improvement of historic nesting areas.

11. Snowy plovers are comprised of demographically independent populations throughout the U.S. (Funk et al. in press). Therefore, it is essential to understand the movement and winter migration patterns of snowy plovers in the southeastern U.S., particularly because a large portion of snowy plovers breeding within Florida winter outside the state (Lamonte et al. 2006). In addition, birds that breed in the Great Plains may winter in Florida. A statewide banding effort is needed to address these information gaps. Furthermore, information on movement trends in response to human disturbance, as well as understanding the migratory trends of snowy plovers within Florida, will be critical for effective management of the snowy plover.
12. The effects of posting individual snowy plover nests are not well understood. On beaches with heavy recreational use, it is assumed that posting reduces the probability that eggs and newly hatched chicks are crushed by pedestrians or vehicles. Roping may help reduce human disturbance because beach-goers often examine the nesting area without entering the closed area (Lord et al. 2000). However, potential increases in disturbance caused by attracting curious individuals, and the extent to which predators learn to key into this visual queue, are unknown. Ropes preventing human access may not delineate the flush distance, as birds may flush before humans reach the ropes (Lord et al. 2000). This practice is used extensively by well-intentioned managers, but the effectiveness of this management technique urgently needs to be assessed.
13. The habitat characteristics described in our study may not be adequate for predicting nest sites for snowy plovers, or for understanding factors affecting nest survival. It may prove important to assess snowy plover nesting habitat metrics, which have been theorized to affect nesting success (Page et al. 1985, Hood 2006). This will allow for proper management and habitat improvement programs that may benefit snowy plovers and other ground-nesting bird species. There is high potential gain to wildlife to be obtained by creating protected areas, which improve the breeding habitat available (Lafferty et al. 2006). With adequate understanding of habitat metrics, it may be possible to restore and manage for suitable breeding habitat at historical nesting sites in protected areas that have been abandoned by snowy plovers.

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Figure 1. Northwest region geographic areas with breeding sites



Figure 2. Florida's Southwest region geographic areas with breeding sites

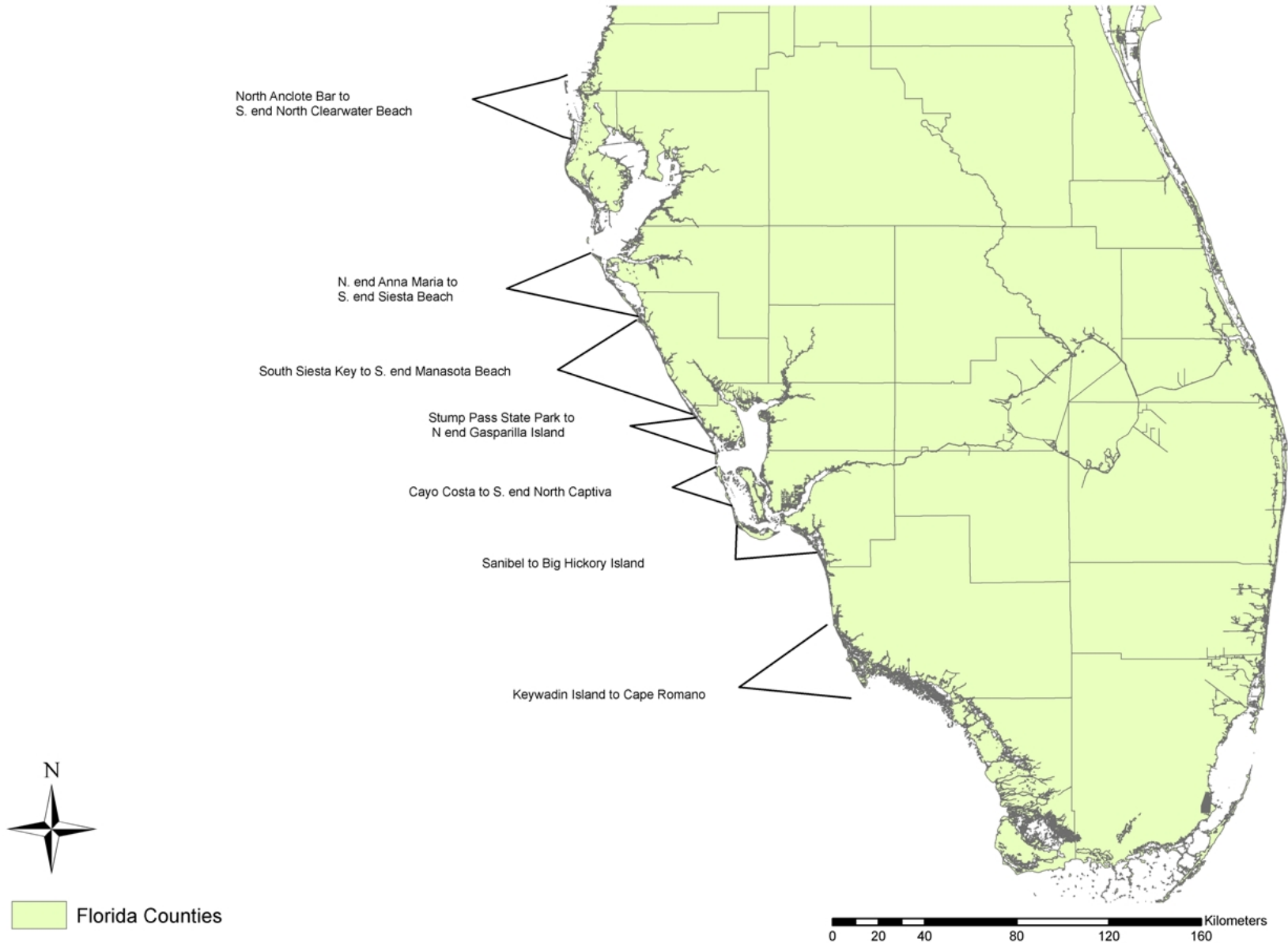
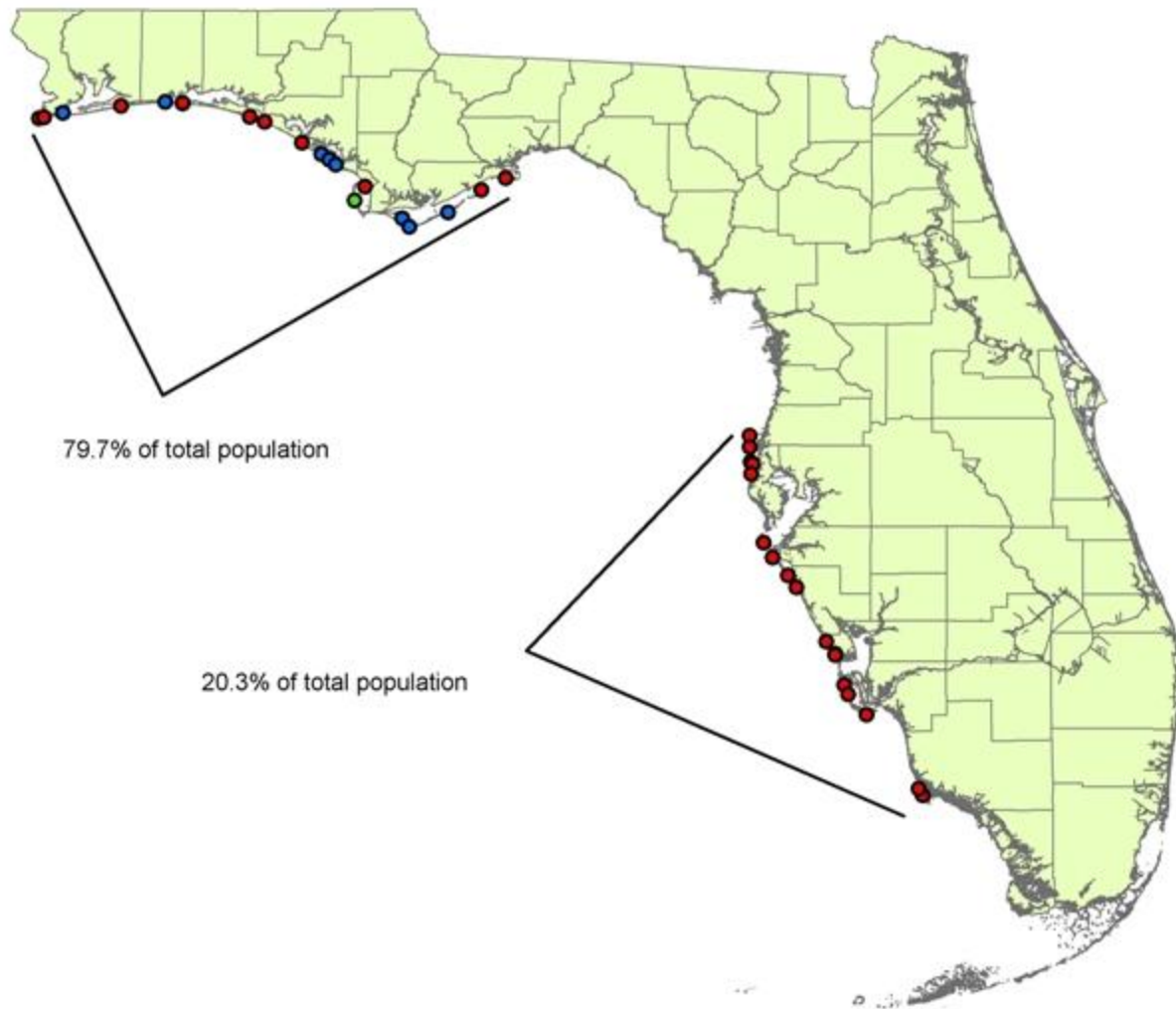
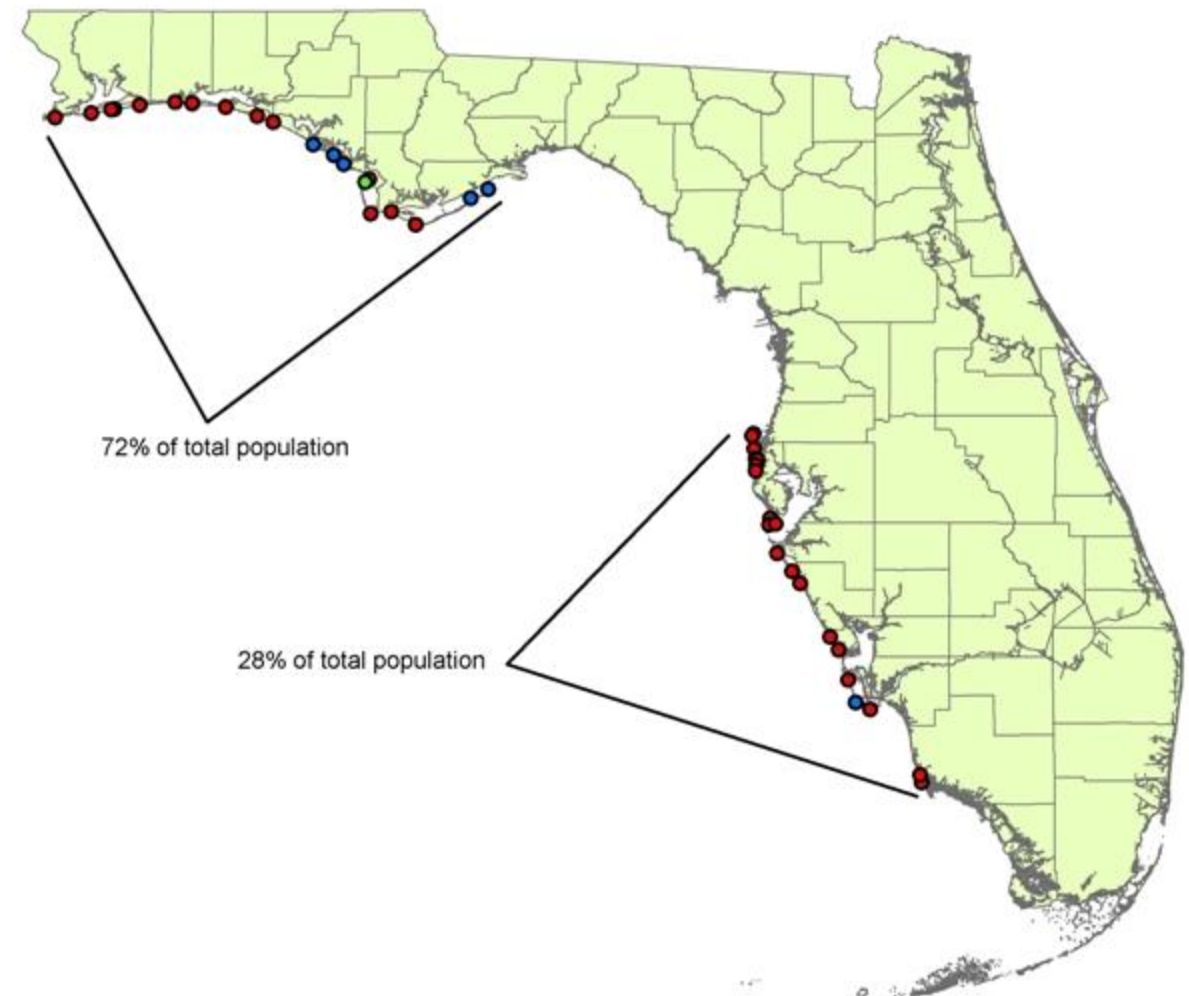


Figure 3. 2002 and 2006 proportion comparisons by site of breeding snowy plovers

2006



2002



Nesting percentage by total Florida population

Percentage

- <5%
- >5%
- >10%

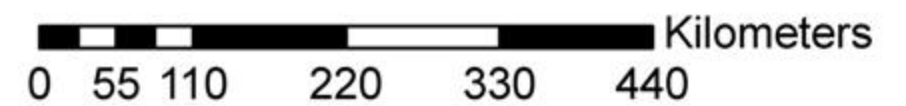


Figure 4. Number of breeding pairs of snowy plovers by site during each survey year in Northwest Florida

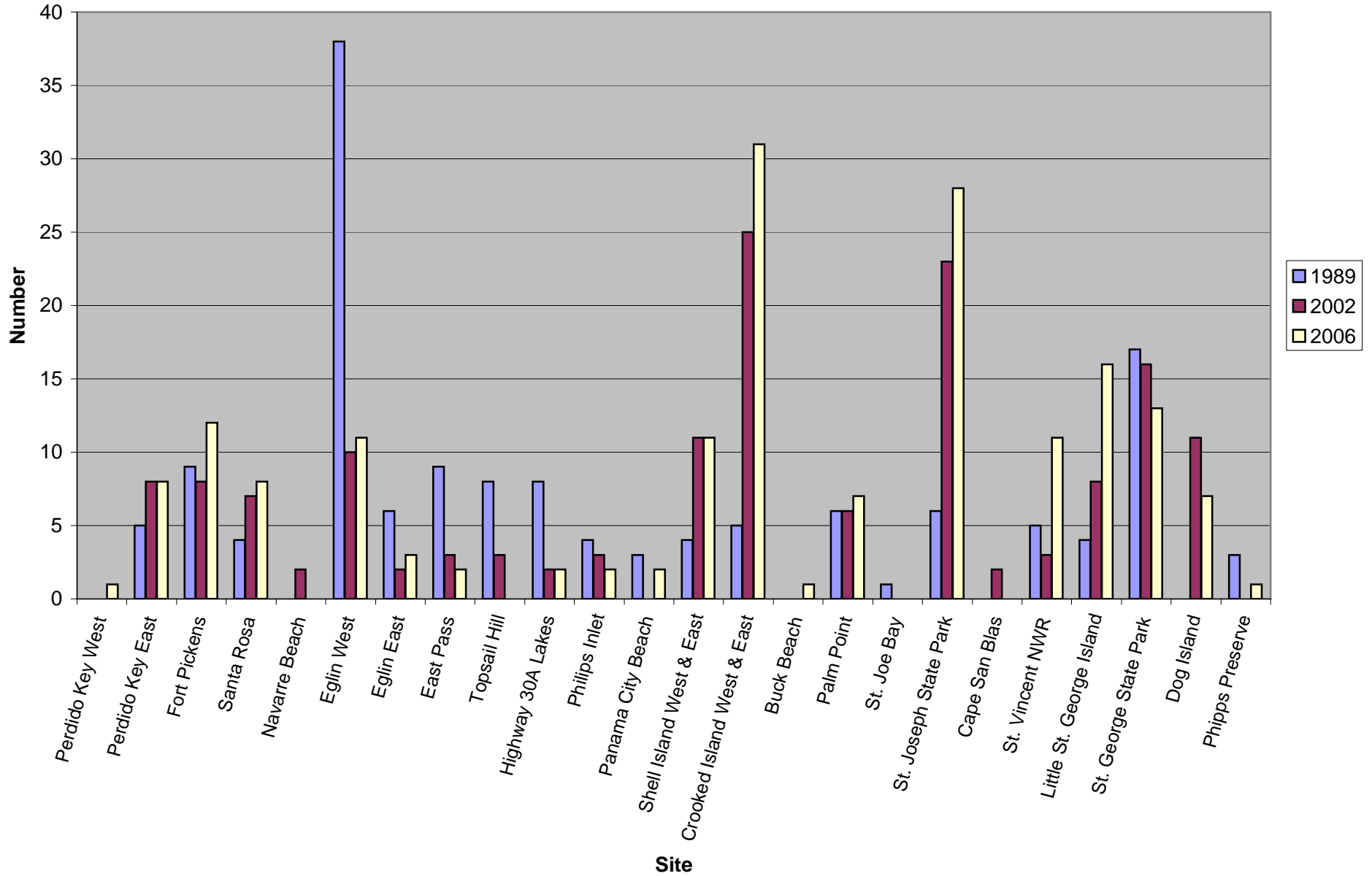
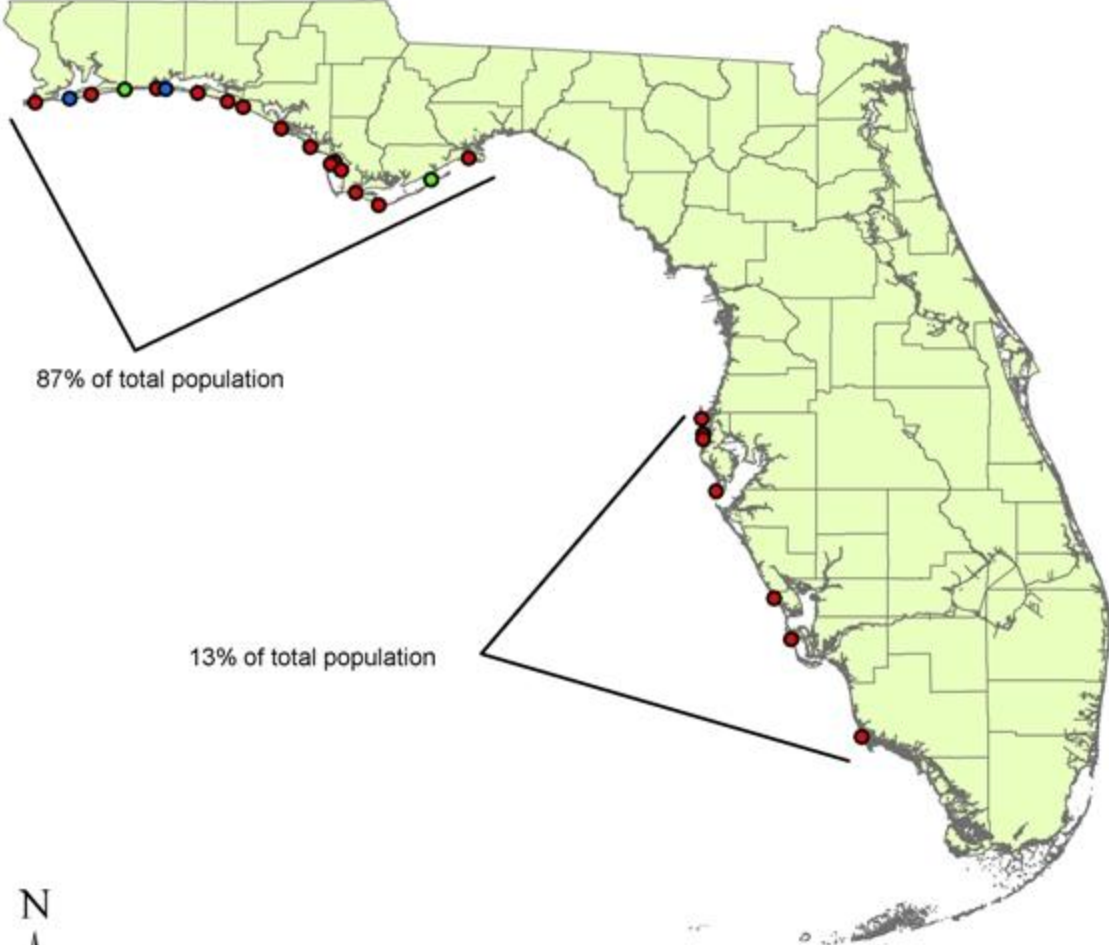
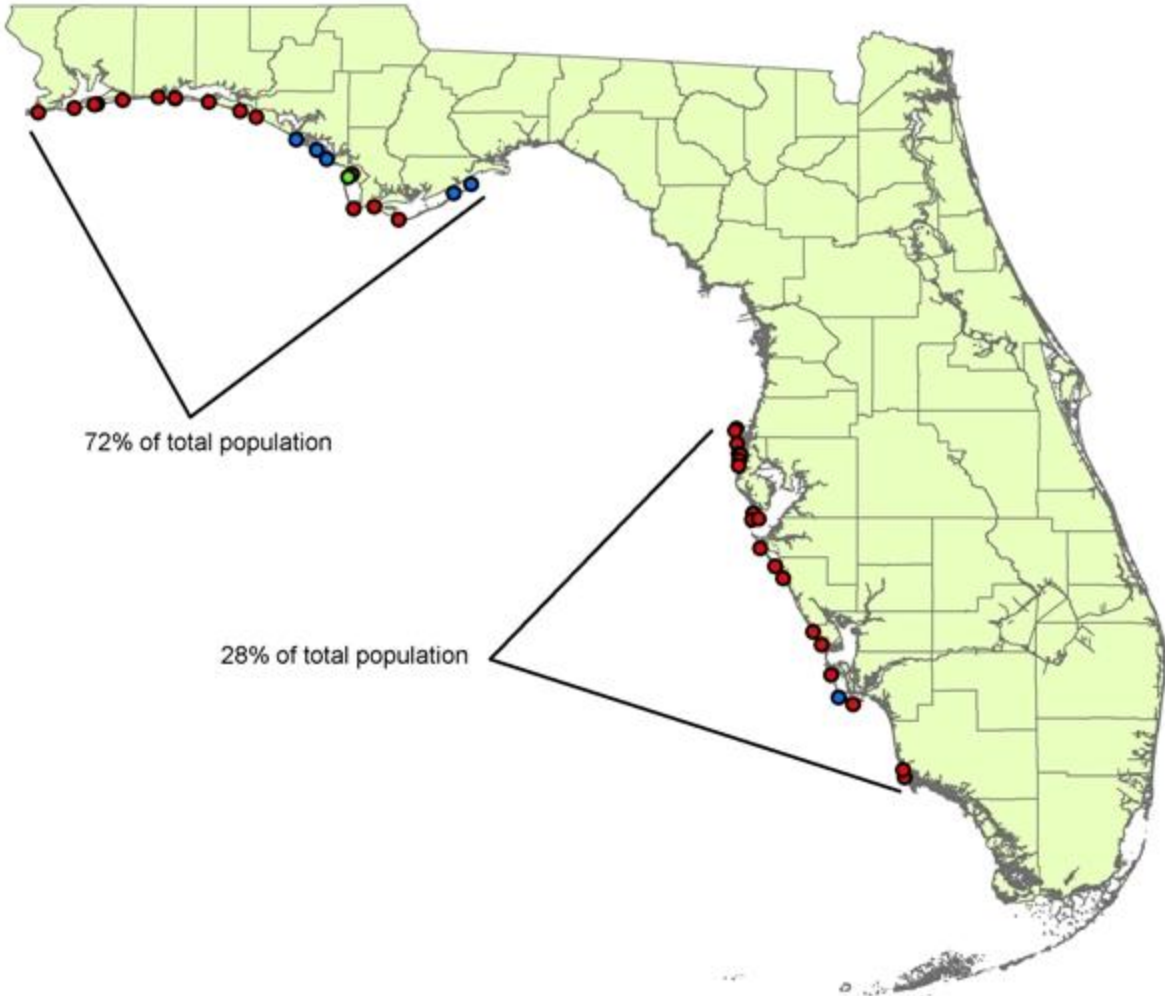


Figure 5. 1989 and 2002 proportion comparisons by site of breeding snowy plovers

1989



2002



Nesting percentage by total Florida population

PERCENTAGE

- <5
- >5
- >10



Figure 6. Number of breeding pairs during each survey year in Southwest Florida

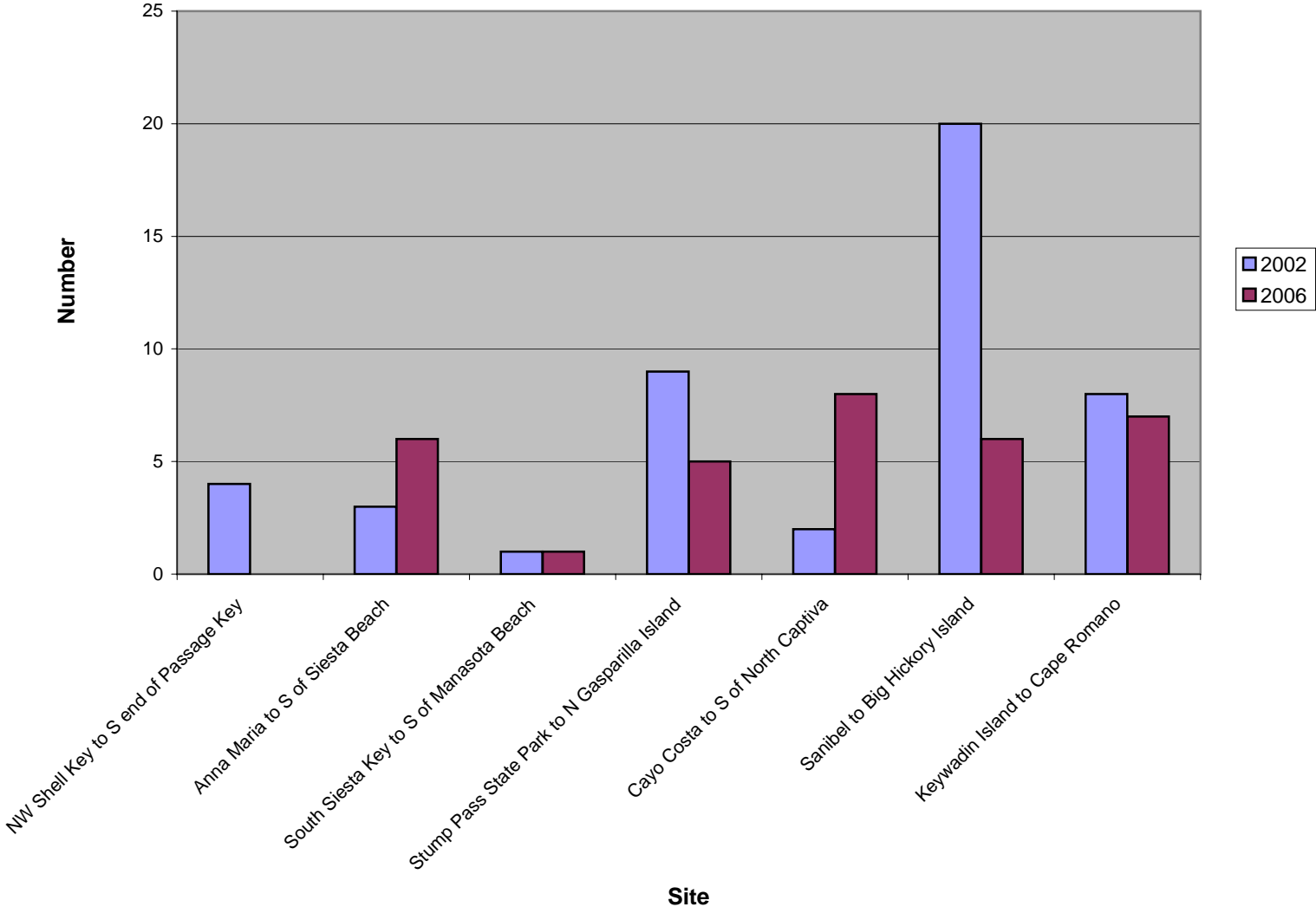


Figure 7. Chronological comparison of the total # of breeding pairs in Florida during the 2006 breeding season

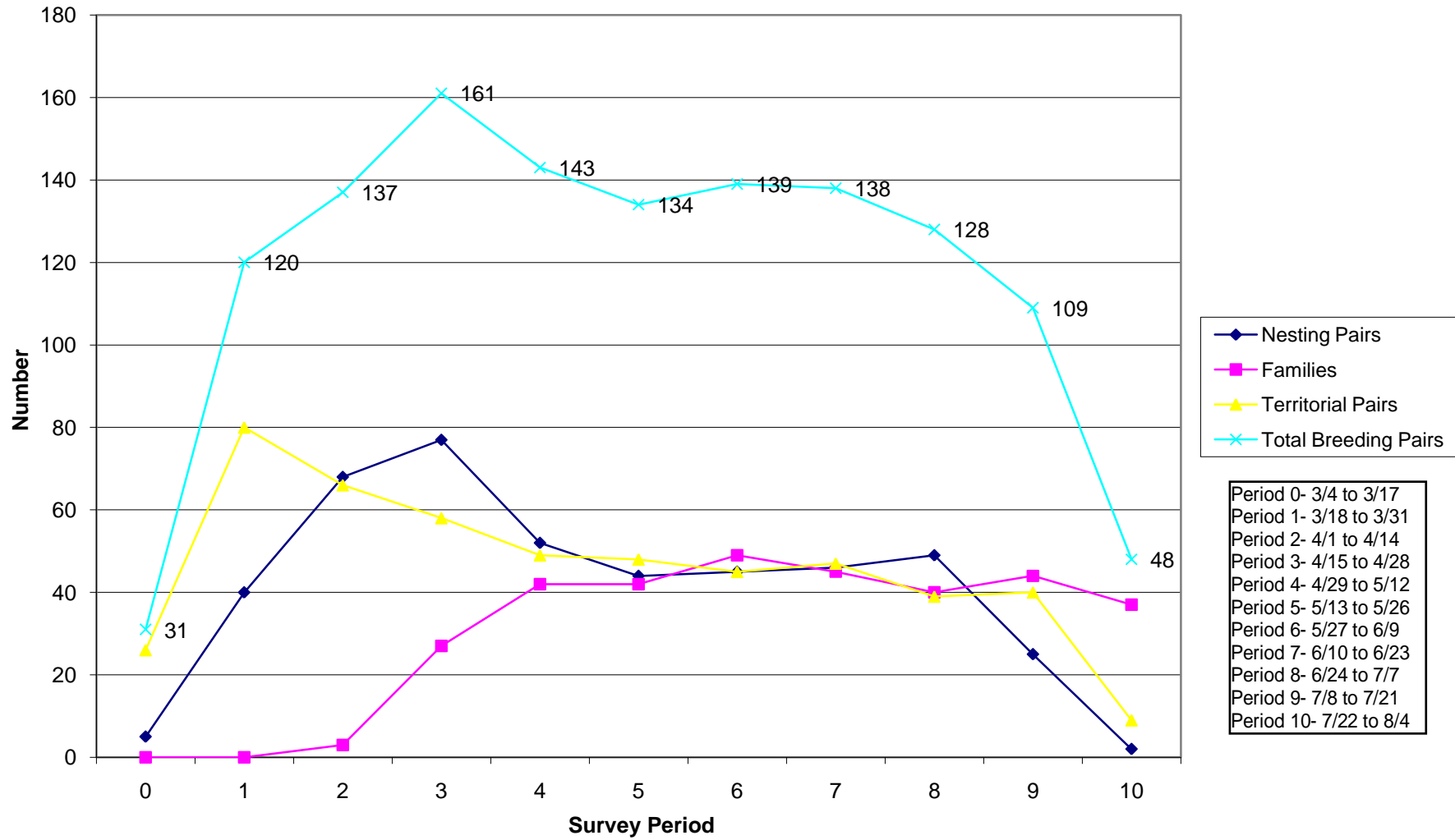


Figure 8. Chronological comparison of the total # of breeding pairs in the Northwest region during the 2006 breeding season

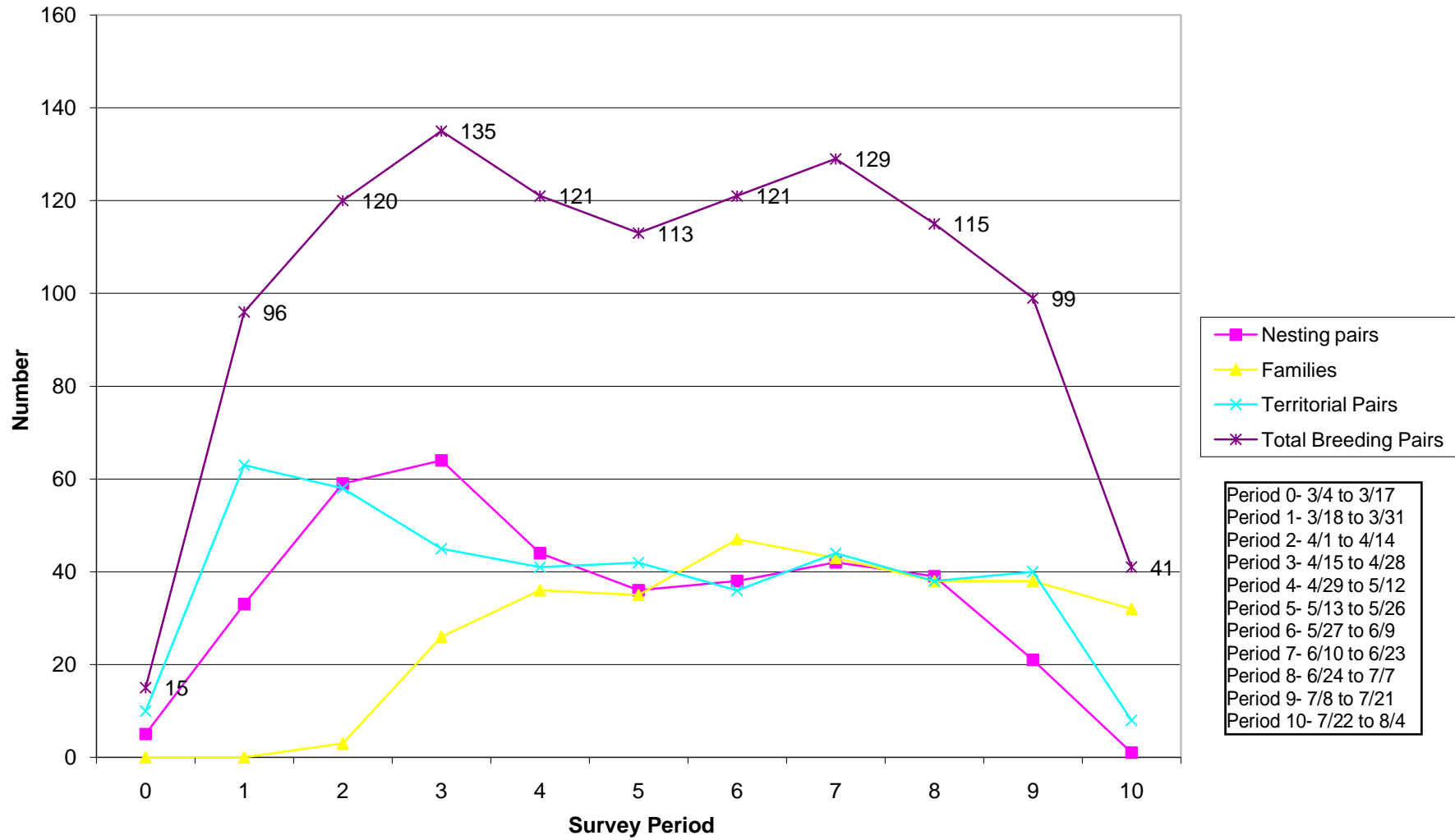


Figure 9. Chronological comparison of the total # of breeding pairs in the Southwest region during the 2006 breeding season

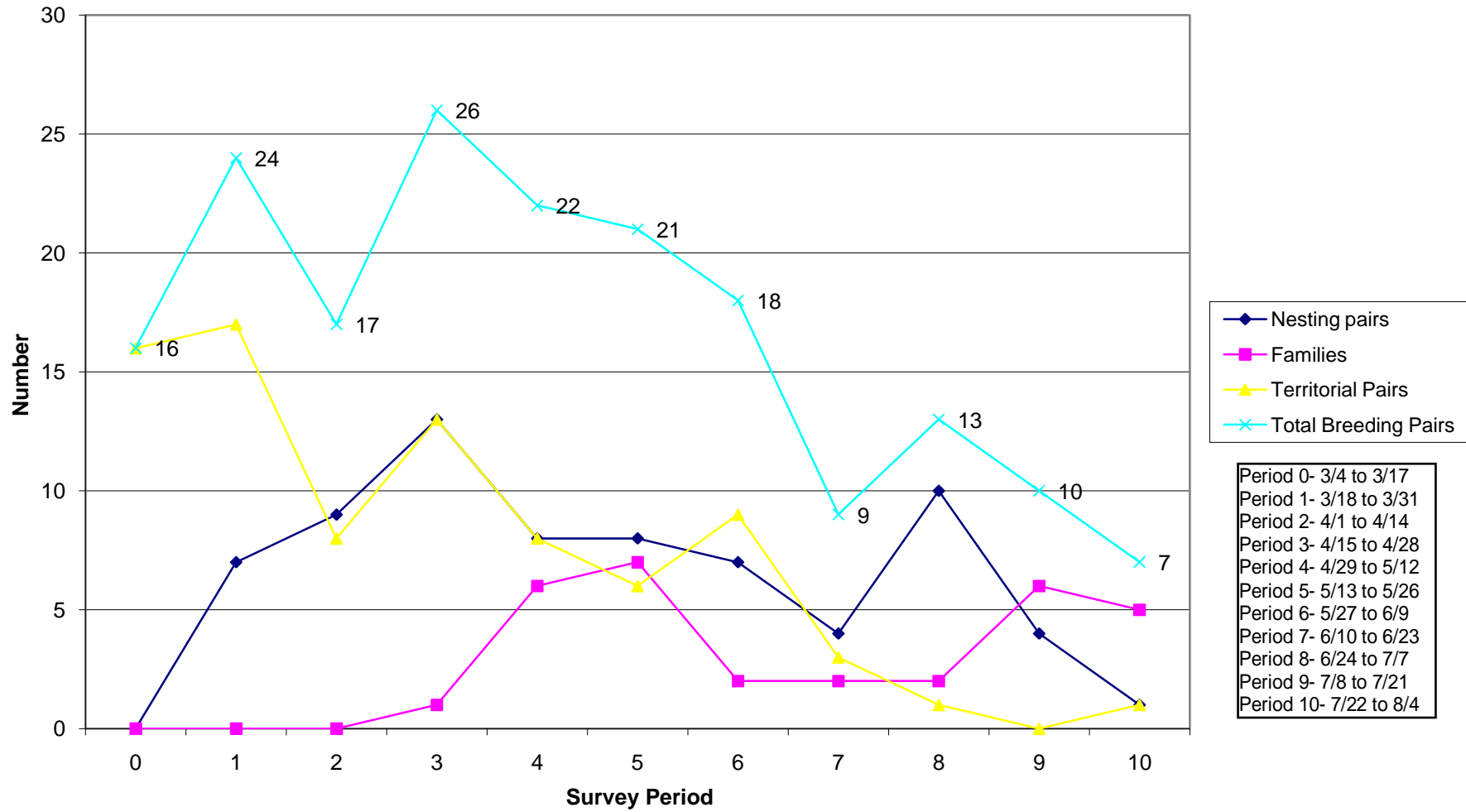


Figure 10. Snowy Plover nests in Florida during the 2066 breeding season

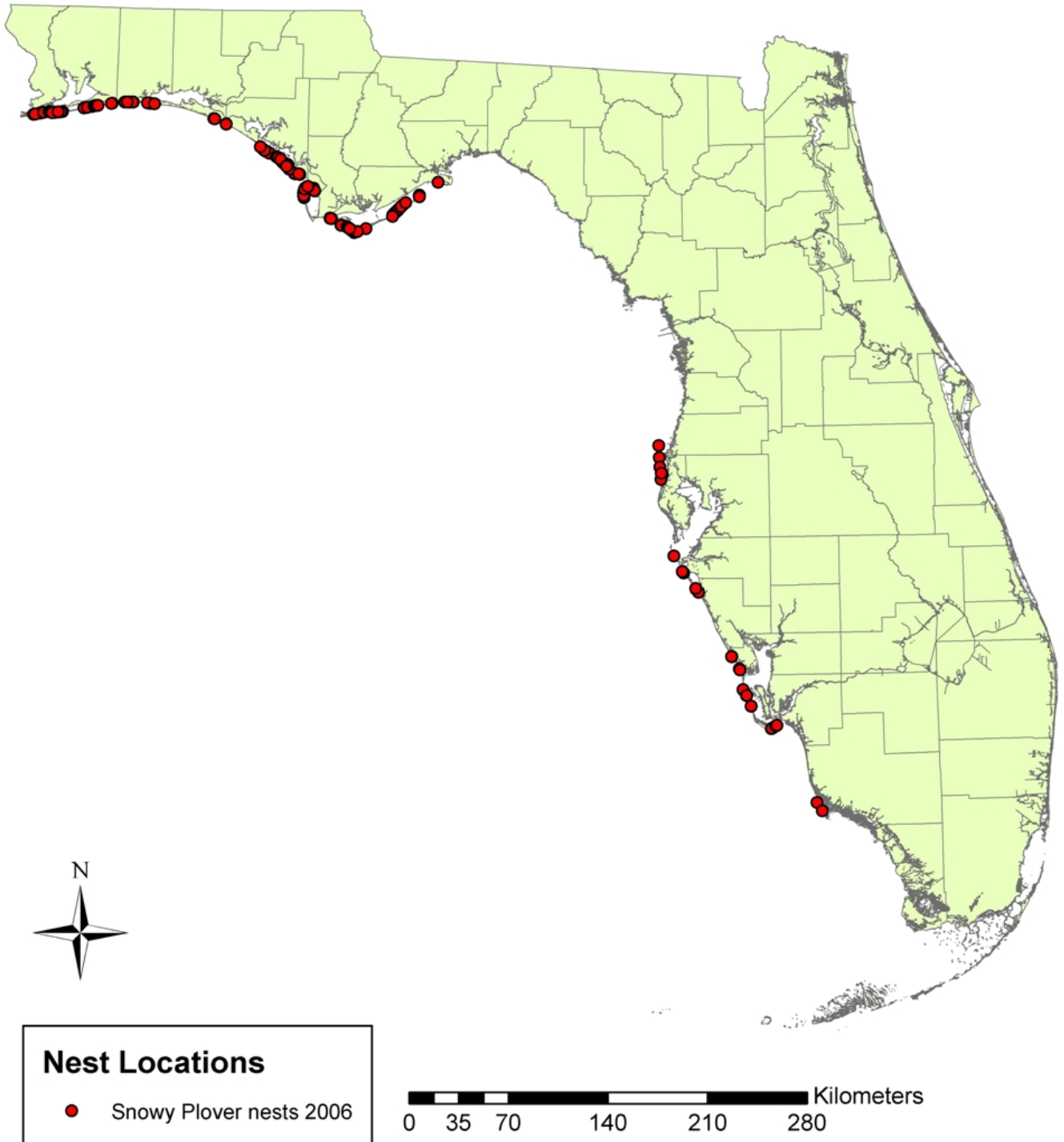


Figure 11. Snowy plover nests in the Northwest region during the 2006 breeding season

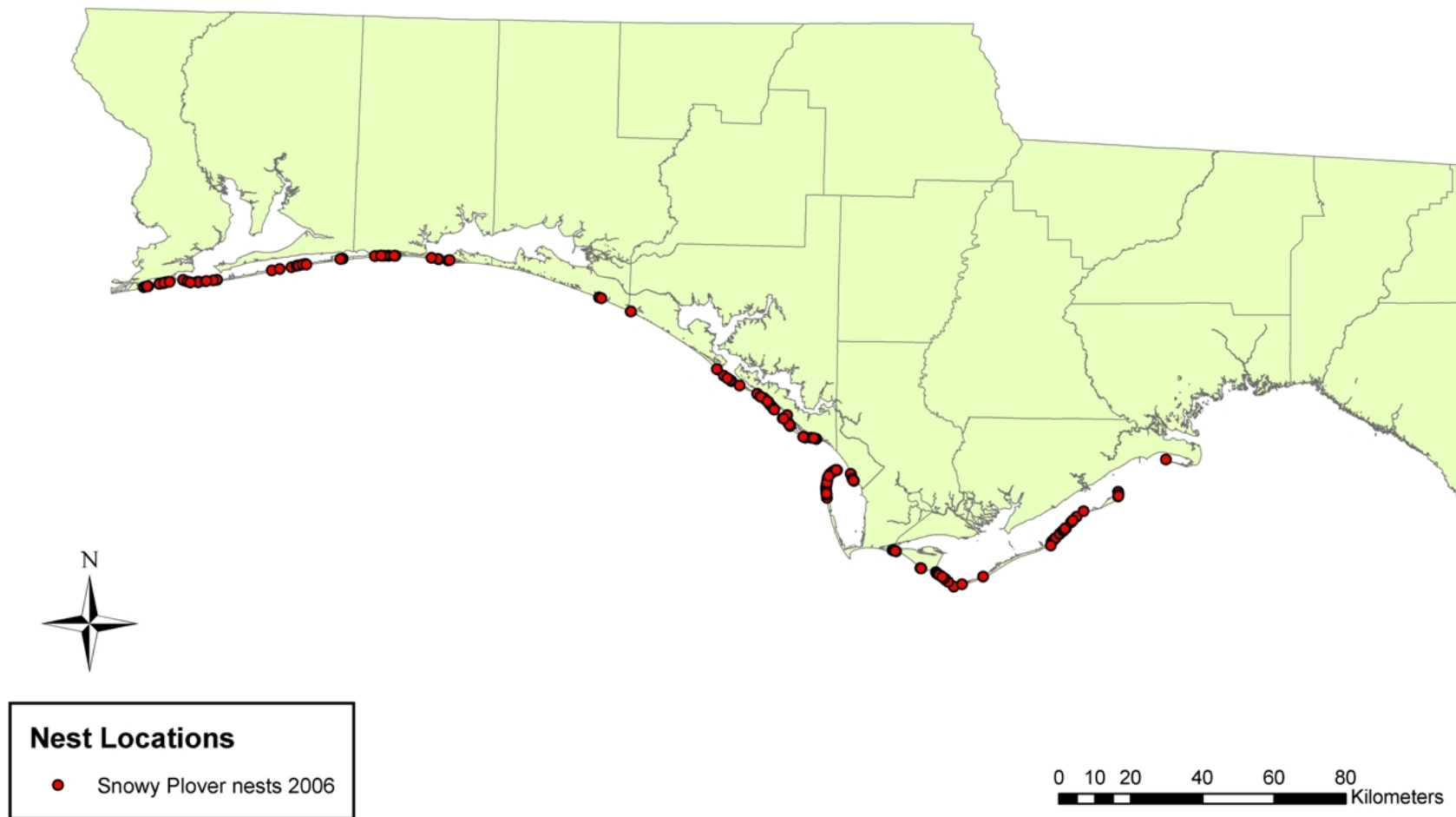


Figure 12. Snowy Plover nests in the Southwest region during the 2006 breeding season

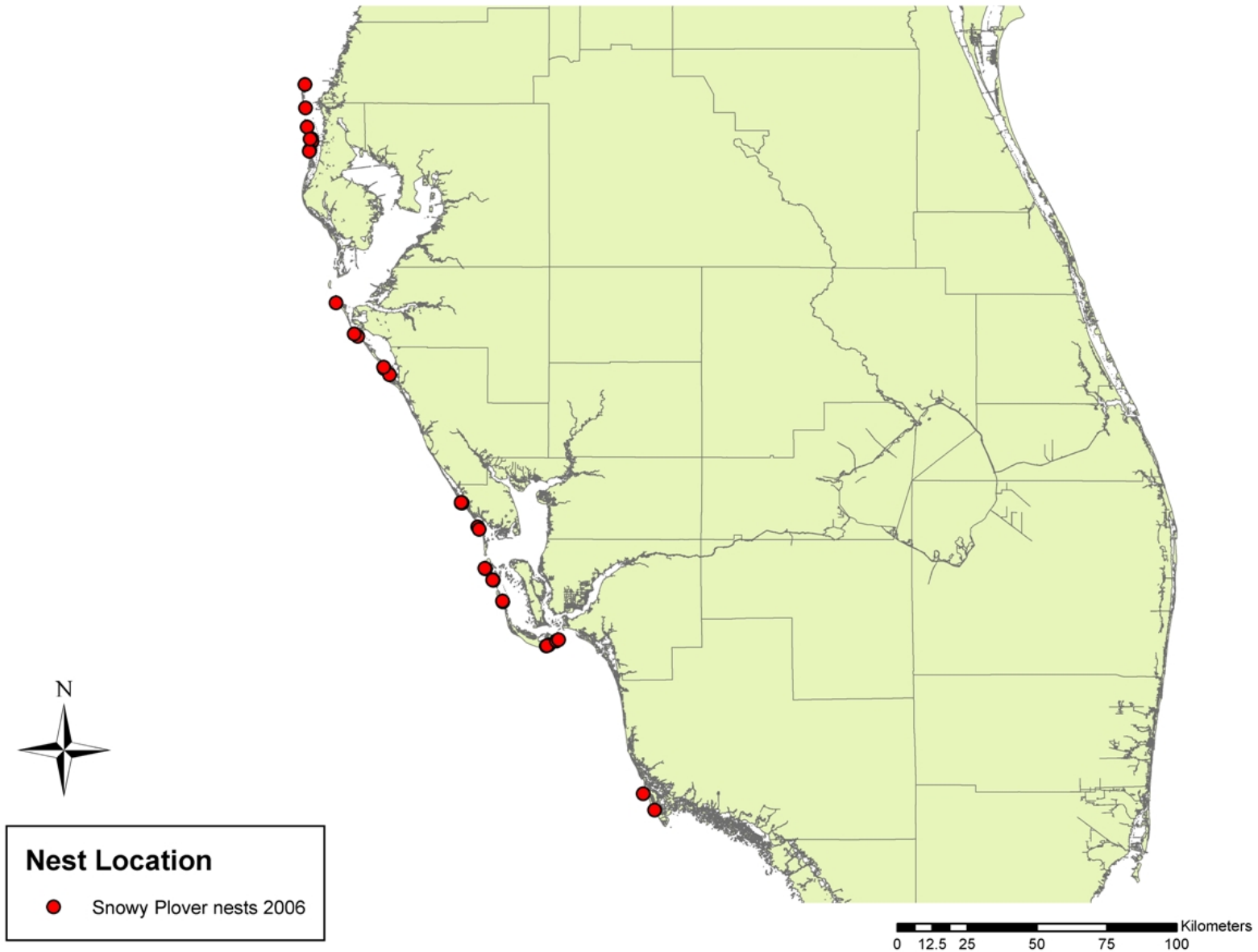


Table 1. Location and description of 113 sites surveyed in 2006 for potential breeding snowy plover habitat.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)
Northwest Florida						
<i>Perdido Key West</i>						
Alabama Beach - Developed	Escambia	30 16.818	87 31.085	30 17.357	87 28.698	4.0
Perdido Key SRA	Escambia	30 17.279	87 28.795	30 17.575	87 27.187	2.6
Johnson Beach - Developed	Escambia	30 17.575	87 27.187	30 17.87	87 25.161	3.3
<i>Perdido Key East</i>						
GINS - Perdido Key	Escambia	30 17.877	87 25.155	30 19.715	87 18.905	10.6
<i>Big Lagoon</i>						
Big Lagoon SRA	Escambia	30 18.781	87 25.504	30 18.506	87 24.165	2.2
<i>Fort Pickens</i>						
GINS - Fort Pickens	Escambia	30 19.66	87 17.937	30 19.507	87 10.899	11.3
<i>Pensacola Beach</i>						
Pensacola Beach	Escambia	30 19.515	87 10.874	30 20.572	87 4.836	9.9
Santa Rosa Parking Areas	Escambia	30 20.572	87 4.836	30 20.858	87 3.119	2.8
<i>Santa Rosa</i>						
UWF Property - Santa Rosa Island	Escambia	30 20.858	87 3.119	30 21.095	87 1.969	1.9
GINS - Santa Rosa	Escambia	30 21.095	87 1.969	30 22.29	86 55.148	11.1
Big Sabine Point	Escambia	30 21.419	87 2.831			*
<i>Navarre Beach</i>						
Santa Rosa Island - Developed	Escambia	30 22.29	86 55.149	30 22.607	86 51.838	5.3
Navarre Beach Park	Santa Rosa, Escambia	30 22.792	86 51.822	30 22.885	86 50.957	1.4
<i>Eglin West</i>						
Eglin AFB - West	Santa Rosa, Okaloosa	30 22.885	86 50.957	30 23.827	86 38.002	20.8
<i>East end of Eglin West to Beasley Park</i>						
Gulfarium and Condos	Okaloosa	30 23.827	86 38.003	30 23.591	86 35.04	4.8
<i>Eglin East</i>						
Eglin AFB - East	Okaloosa	30 23.585	86 35.019	30 23.241	86 31.298	6.0
<i>East Pass</i>						
East Pass	Okaloosa	30 23.272	86 31.530	30 23.137	86 30.886	1.1
<i>Destin to Miramar Beach</i>						
Norriego Point	Okaloosa	30 23.401	86 30.572	30 23.425	86 30.504	0.1
West Henderson - Developed	Okaloosa	30 22.913	86 30.425	30 23.019	86 27.216	5.1
Henderson Beach SRA	Okaloosa	30 23.020	86 27.214	30 22.947	86 25.957	2.0
East Henderson - Developed	Okaloosa	30 22.948	86 25.958	30 22.875	86 25.133	1.3
Miramar Beach	Walton	30 22.875	86 25.133	30 22.131	86 19.646	8.9
<i>Topsail Hill</i>						
Topsail Hill Preserve SP	Walton	30 22.027	86 19.03	30 21.349	86 15.885	5.2
<i>Highway 30A Lakes</i>						
Stallworth Lake Area	Walton	30 21.306	86 15.798	30 20.498	86 13.065	4.6
Stallworth Lake to Big Redfish Lake	Walton	30 20.498	86 13.065	30 20.085	86 11.387	2.8
Grayton Beach SRA	Walton	30 20.012	86 11.181	30 19.297	86 8.784	4.1
Grayton Beach SRA to Eastern Lake	Walton	30 19.298	86 8.784	30 18.335	86 5.745	5.2
Deer Lake SP	Walton	30 18.4	86 5.784	30 17.833	86 4.222	2.7
Camp Creek to Walton County Line	Walton	30 17.499	86 4.135	30 16.148	85 59.332	8.1

Table 1. Continued

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)
Northwest Florida continued						
<i>Philips Inlet</i>						
Philips Inlet/Camp Helen SP	Bay	30 16.165	85 59.750	30 15.909	85 59.130	1.1
<i>Panama City Beach</i>						
Panama City Beach - Developed	Bay	30 16.045	85 59.51	30 7.994	85 44.783	27.9
St. Andrews SP - Gulf Front	Bay	30 7.955	85 44.7	30 7.258	85 43.592	2.2
St. Andrews SP - Kiddie Pool	Bay	30 7.258	85 43.592	30 7.82	85 43.264	1.2
St. Andrews SP - Grand Lagoon	Bay	30 7.82	85 43.264	30 7.94	85 43.734	0.8
<i>Shell Island West & East</i>						
Shell Island	Bay	30 7.117	85 43.74	30 3.517	85 37.182	12.5
<i>Crooked Island West</i>						
Tyndall AFB - Crooked Island West	Bay	30 3.517	85 37.182	30 01.330	85 34.059	6.5
Tyndall AFB- Hurricane Island	Bay	30 1.343	85 33.87	30 0.285	85 32.295	3.2
<i>Buck Beach</i>						
Buck Beach	Bay	30 1.195	85 32.410	29 59.584	85 30.417	4.4
<i>Crooked Island East</i>						
Tyndall AFB - Crooked Island East	Bay	29 59.566	85 31.660	29 57.998	85 25.838	9.8
<i>Mexico Beach</i>						
Mexico Beach - Developed	Bay, Gulf	29 57.033	85 25.813	29 53.579	85 21.585	9.3
<i>Palm Point</i>						
Palm Point	Gulf	29 53.579	85 21.585	29 51.033	85 20.224	5.2
Windmark Beach	Gulf	29 51.028	85 20.222	29 50.734	85 19.701	1.0
<i>St. Joe Bay</i>						
St. Joe Beach	Gulf	29 50.173	85 19.011	29 50.734	85 19.701	1.5
<i>St. Joe Peninsula</i>						
St. Joe Peninsula - Developed	Gulf	29 40.817	85 21.973	29 45.559	85 24.181	9.5
<i>St. Joseph State Park</i>						
St. Joseph SP	Gulf	29 45.561	85 24.181	29 52.514	85 23.167	13.0
<i>Cape San Blas</i>						
Cape San Blas	Gulf	29 39.969	85 21.042	29 41.000	85 18.417	4.6
Indian Pass	Gulf	29 41.000	85 18.417	29 40.986	85 13.339	8.2
<i>Mainland Shoreline from St. Vincent to Alligator Point</i>						
Yent Bayou	Franklin	29 47.316	84 45.726	29 47.621	84 44.938	1.4
Carrabelle Beach	Franklin	29 49.829	84 40.512	29 49.638	84 41.746	2.0
Turkey Point	Franklin	29 54.615	84 29.627	29 54.922	84 29.127	1.0
<i>St. Vincent NWR</i>						
St. Vincent NWR	Franklin	29 40.864	85 13.019	29 38.488	85 5.676	12.6
<i>Little St. George Island</i>						
Little St. George Island	Franklin	29 37.624	85 5.558	29 36.791	84 57.516	14.9
<i>St. George Island - West end</i>						
St. George Island - Developed	Franklin	29 36.829	84 57.496	29 40.977	84 47.808	17.4
<i>St. George State Park</i>						
St. George Island SP	Franklin	29 40.971	84 47.806	29 46.25	84 41.784	13.8
<i>Dog Island</i>						
Dog Island	Franklin	29 47.12	84 40.274	29 49.667	84 34.827	10.0

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)
Northwest Florida continued						
<i>Lanark Reef</i>						
Lanark Reef	Franklin	29 50.500	84 37.677	29 53.167	84 32.516	9.7
<i>Phipps Preserve</i>						
Alligator Point - Phipps Preserve	Franklin	29 54.299	84 25.433	29 55.07	84 26.447	2.2
<i>Bald Point</i>						
Alligator Point - Developed	Franklin	29 54.173	84 25.38	29 53.623	84 22.661	4.5
Bald Point SP	Franklin	29 56.858	84 20.49	29 54.808	84 20.192	3.8
Bald Point - Developed	Franklin	29 54.808	84 20.192	29 53.724	84 22.106	3.6
Southwest Florida						
<i>North Anclote Bar to south end of North Clearwater Beach</i>						
North Anclote Bar	Pasco	28 13.511	82 50.491	28 14.004	82 50.284	1.0
Anclote Key SP North	Pasco	28 12.791	82 51.057	28 10.574	82 51.008	4.1
Anclote Key SP South	Pinellas	28 10.312	82 50.986	28 9.877	82 50.730	0.9
Bar south of Anclote Key	Pinellas	28 9.424	82 50.338	28 9.484	82 50.451	0.2
Three Rooker Bar North	Pinellas	28 8.593	82 49.300	28 7.612	82 50.246	2.4
Three Rooker Bar South	Pinellas	28 7.268	82 50.357	28 6.403	82 49.888	1.8
Honeymoon Island SRA North	Pinellas	28 5.742	82 50.02	28 3.655	82 49.775	3.9
Honeymoon Island SRA South	Pinellas	28 3.665	82 49.775	28 3.33	82 48.911	1.5
Caledesi SP/Dunedin Pass	Pinellas	28 2.924	82 49.006	28 1.176	82 49.621	3.4
North Clearwater Beach	Pinellas	28 1.175	82 49.645	27 59.089	82 49.734	3.9
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>						
Clearwater Beach	Pinellas	27 59.089	82 49.734	27 58.247	82 49.896	1.6
Bellair/Madeira/Indian Rocks Beach	Pinellas	27 46.985	82 47.043	27 57.862	82 49.875	20.7
Treasure Island	Pinellas	27 44.320	82 45.388	27 46.838	82 47.005	5.4
St. Petersburg Beach / Pass-a-Grille Beach	Pinellas	27 40.996	82 44.33	27 44.265	82 45.288	6.3
<i>Northwest end of Shell Key to south end of Passage Key</i>						
Shell Key	Pinellas	27 40.452	82 43.941	27 38.983	82 44.247	2.8
Fort DeSoto North	Pinellas	27 38.945	82 44.579	27 37.798	82 44.44	2.1
Fort DeSoto West	Pinellas	27 37.798	82 44.44	27 36.795	82 44.239	1.9
Fort DeSoto South	Pinellas	27 36.692	82 44.081	27 38.206	82 41.927	4.5
Egmont Key	Hillsborough	27 36.126	82 45.727	27 34.589	82 45.496	2.9
<i>North end of Anna Maria Island to south end of Siesta Beach</i>						
Anna Maria Island	Manatee	27 32.279	82 44.748	27 26.664	82 41.435	11.8
Longboat Key North	Manatee	27 26.525	82 41.336	27 23.37	82 38.56	7.4
Longboat Key South	Sarasota	27 23.37	82 38.56	27 19.695	82 35.342	8.6
North Lido Beach	Sarasota	27 19.518	82 35.296	27 18.929	82 34.876	1.3
South Lido Beach	Sarasota	27 18.929	82 34.876	27 17.768	82 33.975	2.6
<i>South of Siesta Key to south end of Manasota Key</i>						
Siesta Key	Sarasota	27 16.511	82 34.109	27 14.791	82 32.145	4.6
Turtle Beach	Sarasota	27 14.127	82 31.555	27 12.482	82 30.7	3.4
Casey Key	Sarasota	27 12.482	82 30.7	27 6.801	82 28.116	11.4
Venice Beach	Sarasota	27 3.696	82 26.735	27 6.683	82 27.967	5.9
Manasota Key	Sarasota	27 03.696	82 26.735	26 54.59	82 21.144	19.3

Table 1. Continued.

Region, Geographic Area, and Site	County	Latitude 1	Longitude 1	Latitude 2	Longitude 2	Size (km)
Southwest Region continued						
<i>Stump Pass State Park to north end Gasparilla Island</i>						
Stump Pass SP (Charlotte Beach)	Charlotte	26 54.59	82 21.144	26 53.823	82 20.439	1.8
Don Pedro Island	Charlotte	26 53.686	82 20.412	26 50.39	82 18.045	7.3
Little Gasparilla Island	Charlotte	26 50.39	82 18.045	26 48.948	82 16.89	3.3
Gasparilla North	Charlotte	26 48.594	82 17.038	26 45.54	82 15.915	6.0
<i>Gasparilla South</i>						
Gasparilla South SP	Lee	26 44.28	82 15.835	26 43.039	82 15.639	2.3
<i>Cayo Costa to south end of North Captiva Island</i>						
Cayo Costa SP	Lee	26 42.264	82 15.324	26 36.848	82 13.42	10.5
North Captiva Island	Lee	26 36.245	82 13.423	26 33.319	82 11.972	5.9
<i>Captiva Island</i>						
Captiva Island	Lee	26 33.084	82 12.05	26 28.961	82 10.98	7.9
<i>Sanibel Island to Big Hickory Island</i>						
Sanibel Island West	Lee	26 28.959	82 10.994	26 28.113	82 10.325	1.9
Sanibel Island Central	Lee	26 28.113	82 10.325	26 25.325	82 4.805	10.5
Sanibel Island East	Lee	26 25.325	82 4.805	26 27.147	82 0.847	7.4
Fort Myers Beach	Lee	26 27.971	81 58.014	26 24.965	81 54.281	8.3
Little Estero Island	Lee	26 24.965	81 54.281	26 24.269	81 52.976	2.5
Lovers Key North SP	Lee	26 23.91	81 53.166	26 23.163	81 52.517	1.8
Lovers Key South SP	Lee	26 23.163	81 52.517	26 22.755	81 52.19	0.9
Big Hickory Island	Lee	26 22.699	81 52.066	26 22.342	81 51.87	0.7
<i>Bonita Beach to Naples</i>						
Bonita Beach	Lee	26 21.963	81 51.759	26 19.924	81 50.782	4.1
Barefoot Beach	Collier	26 19.924	81 50.782	26 17.360	81 49.843	5.0
<i>Keywadin Island to Cape Romano</i>						
Keywadin Island	Collier	25 59.480	81 45.070			0.5
Big Marco Pass CWA	Collier	25 57.921	81 44.941	25 56.528	81 44.404	2.7
Caxambas Sandbar	Collier	25 54.295	81 43.211	25 54.297	81 47.628	7.4
Kice Island	Collier	25 53.868	81 42.85			0.5
Cape Romano	Collier	25 50.323	81 40.155	25 50.812	81 39.763	1.1
Cape Romano Large Sandbar	Collier	25 50.812	81 39.763			*
Statewide Total						615.5

*Site is too small to have meaningful linear distance calculated.

SRA- State Recreation Area
 UWF- University of West Florida
 GINS- Gulf Islands National Seashore
 SP- State Park
 AFB- Air Force Base
 NWR- National Wildlife Refuge
 CWA- Critical Wildlife Area

Table 2. Initial assessment of 113 sites for potential wintering and breeding snowy plover habitat.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Development^	Extent of Dune System^	Disturbance Frequency	Extent of Habitat*
Northwest Florida						
<i>Perdido Key West</i>						
Alabama Beach - Developed	N	N	C	A	>20	N
Perdido Key SRA	Y	Y	I	I	>20	I
Johnson Beach - Developed	N	N	C	A	>20	N
<i>Perdido Key East</i>						
GINS - Perdido Key	Y	Y	I	C	5-20	C
<i>Big Lagoon</i>						
Big Lagoon SRA	Y	N	I	A	<5	I
<i>Fort Pickens</i>						
GINS - Fort Pickens	Y	Y	A	I	5-20	C
<i>Pensacola Beach</i>						
Pensacola Beach	N	N	C	A	>20	N
Santa Rosa Parking Areas	Y	Y	I	I	>20	I
<i>Santa Rosa</i>						
UWF Property - Santa Rosa Island	Y	Y	A	I	>20	C
GINS - Santa Rosa	Y	Y	A	I	<5	C
Big Sabine Point	Y	N	A	A	5-20	I
<i>Navarre Beach</i>						
Santa Rosa Island - Developed	N	N	C	A	>20	N
Navarre Beach Park	Y	Y	I	I	>20	C
<i>Eglin West</i>						
Eglin AFB - West	Y	Y	I	I	5-20	C
<i>East end of Eglin West to Beasley Park</i>						
Gulfarium and Condos	N	N	C	A	>20	N
<i>Eglin East</i>						
Eglin AFB - East	Y	Y	I	C	>20	I
<i>East Pass</i>						
East Pass	Y	Y	A	I	>20	I
<i>Destin to Miramar Beach</i>						
Norriego Point	Y	N	I	A	>20	I
West Henderson - Developed	N	N	C	A	>20	N
Henderson Beach SRA	Y	Y	I	C	>20	I
East Henderson - Developed	N	N	C	A	>20	N
Miramar Beach	N	N	C	A	>20	N

^C=Continuous, I=Intermittent, A=Absent

*N=None; I=Intermittent; C=Continuous

Table 2. Continued.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Development[^]	Extent of Dune System[^]	Disturbance Frequency	Extent of Habitat[*]
Northwest Florida continued						
<i>Topsail Hill</i>						
Topsail Hill Preserve SP	Y	Y	A	C	>20	C
<i>Highway 30A Lakes</i>						
Stallworth Lake Area	N	N	C	A	>20	N
Stallworth Lake to Big Redfish Lake	N	N	C	A	>20	N
Grayton Beach SRA	Y	Y	I	C	>20	I
Grayton Beach SRA to Eastern Lake	N	N	C	A	>20	N
Deer Lake SP	Y	Y	I	I	>20	I
Camp Creek to Walton County Line	Y	Y	C	I	>20	I
<i>Philips Inlet</i>						
Philips Inlet/Camp Helen SP	Y	Y	I	A	>20	I
<i>Panama City Beach</i>						
Panama City Beach - Developed	N	N	C	A	>20	N
St. Andrews SP - Gulf Front	Y	Y	A	C	>20	C
St. Andrews SP - Kiddie Pool	Y	N	A	I	>20	I
St. Andrews SP - Grand Lagoon	Y	N	A	A	>20	I
<i>Shell Island West & East</i>						
Shell Island	Y	Y	I	C	>20	C
<i>Crooked Island West</i>						
Tyndall AFB - Crooked Island West	Y	Y	A	C	5-20	C
Hurricane Island	Y	Y	A	I	5-20	I
<i>Buck Beach</i>						
Buck Beach	Y	Y	A	I	5-20	I
<i>Crooked Island East</i>						
Tyndall AFB - Crooked Island East	Y	Y	A	C	>20	I
<i>Mexico Beach</i>						
Mexico Beach - Developed	Y	N	C	I	>20	I
<i>Palm Point</i>						
Palm Point	Y	Y	I	C	>20	I
Windmark Beach	Y	N	I	A	>20	I
<i>St. Joe Bay</i>						
St. Joe Beach	Y	N	I	A	5-20	I
<i>St. Joe Peninsula</i>						
St. Joe Peninsula - Developed	Y	N	C	I	>20	I

[^]C=Continuous, I=Intermittent, A=Absent

^{*}N=None; I=Intermittent; C=Continuous

Table 2. Continued.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Development[^]	Extent of Dune System[^]	Disturbance Frequency	Extent of Habitat[*]
Northwest Florida continued						
<i>St. Joseph State Park</i>						
St. Joseph SP	Y	Y	A	C	5-20	C
<i>Cape San Blas</i>						
Cape San Blas	Y	Y	I	I	>20	C
Indian Pass	Y	N	C	I	>20	I
<i>Mainland Shoreline from St. Vincent to Alligator Point</i>						
Yent Bayou	Y	N	I	A	<5	I
Carrabelle Beach	Y	N	C	A	>20	I
Turkey Point	Y	N	A	A	<5	I
<i>St. Vincent NWR</i>						
St. Vincent NWR	Y	Y	A	I	<5	I
<i>Little St. George Island</i>						
Little St. George Island	Y	Y	A	C	5-20	C
<i>St. George Island - West end</i>						
St. George Island - Developed	N	N	C	I	>20	N
<i>St. George State Park</i>						
St. George Island SP	Y	Y	A	C	5-20	C
<i>Dog Island</i>						
Dog Island	Y	Y	I	I	5-20	I
<i>Lanark Reef</i>						
Lanark Reef	Y	Y	A	A	<5	I
<i>Phipps Preserve</i>						
Alligator Point - Phipps Preserve	Y	Y	A	I	5-20	C
<i>Bald Point</i>						
Alligator Point - Developed	N	N	C	A	>20	N
Bald Point SP	Y	Y	I	I	5-20	I
Bald Point - Developed	N	N	C	A	>20	N
Southwest Florida						
<i>North Anclote Bar to south end of North Clearwater Beach</i>						
North Anclote Bar	Y	Y	A	C	5-20	C
Anclote Key SP North	Y	Y	A	I	>20	C
Anclote Key SP South	Y	Y	A	I	>20	C
Bar south of Anclote Key	Y	Y	A	C	5-20	C

[^]C=Continuous, I=Intermittent, A=Absent

^{*}N=None; I=Intermittent; C=Continuous

Table 2. Continued.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Development [^]	Extent of Dune System [^]	Disturbance Frequency	Extent of Habitat*
Southwest Florida continued						
Three Rooker Bar North	Y	Y	A	I	>20	I
Three Rooker Bar South	Y	Y	A	I	>20	I
Honeymoon Island SRA North	Y	Y	A	I	>20	C
Honeymoon Island SRA South	Y	Y	I	I	>20	I
Caledesi SP/Dunedin Pass	Y	Y	A	I	>20	I
North Clearwater Beach	Y	Y	I	I	>20	C
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>						
Clearwater Beach	N	N	C	I	>20	I
Bellair/Madeira/Indian Rocks Beach	N	N	C	I	>20	I
Treasure Island	N	N	C	I	>20	I
St. Petersburg/Pass-a-Grille Beach	N	N	C	I	>20	N
<i>Northwest end of Shell Key to south end of Passage Key</i>						
Shell Key	Y	Y	A	C	>20	C
Fort DeSoto North	Y	Y	A	I	>20	I
Fort DeSoto West	N	Y	I	I	>20	I
Fort DeSoto South	N	N	I	I	>20	I
Egmont Key	N	N	A	I	<5	I
<i>North end of Anna Maria Island to south end of Siesta Beach</i>						
Anna Maria Island	Y	Y	I	I	>20	I
Longboat Key North	Y	Y	C	I	>20	I
Longboat Key South	Y	Y	I	I	>20	I
North Lido Beach	Y	Y	I	I	>20	C
South Lido Beach	Y	Y	I	I	>20	I
<i>South Siesta Key to south end of Manasota Key</i>						
Siesta Key	Y	Y	C	I	>20	I
Turtle Beach	N	N	C	A	>20	I
Casey Key	N	N	I	I	>20	I
Venice Beach	N	Y	I	I	>20	I
Manasota Key	N	N	I	I	>20	I
<i>Stump Pass State Park to Gasparilla North</i>						
Stump Pass SP (Charlotte Beach)	Y	Y	A	I	>20	C
Don Pedro Island	Y	Y	I	C	>20	C
Little Gasparilla Island	Y	Y	I	I	>20	I
Gasparilla North	Y	Y	I	I	>20	I

[^]C=Continuous, I=Intermittent, A=Absent

*N=None; I=Intermittent; C=Continuous

Table 2. Continued.

Region, Geographic Area, and Site	Potential Wintering Habitat?	Potential Breeding Habitat?	Extent of Develop ment^	Extent of Dune System^	Disturbance Frequency	Extent of Habitat*
Southwest Florida continued						
<i>Gasparilla South</i>						
Gasparilla South SP	Y	Y	I	I	>20	I
<i>Cayo Costa to south end of North Captiva Island</i>						
Cayo Costa SP	Y	Y	A	I	5-20	I
North Captiva Island	Y	Y	I	I	>20	I
<i>Captiva Island</i>						
Captiva Island	Y	Y	I	I	>20	I
<i>Sanibel Island to Big Hickory Island</i>						
Sanibel Island West	Y	Y	I	C	>20	C
Sanibel Island Central	Y	Y	I	I	>20	I
Sanibel Island East	Y	Y	C	I	>20	I
Fort Myers Beach	Y	Y	C	I	>20	C
Little Estero Island	Y	Y	I	I	>20	I
Lovers Key North SP	Y	Y	A	C	>20	I
Lovers Key South SP	Y	Y	A	I	>20	I
Big Hickory Island	Y	Y	I	I	>20	I
<i>Bonita Beach to Naples</i>						
Bonita Beach	N	N	C	A	>20	I
Barefoot Beach	N	N	I	I	>20	I
<i>Keywadin Island to Cape Romano</i>						
Keywadin Island	Y	Y	A	I	5-20	C
Big Marco Pass CWA	Y	Y	A	I	5-20	C
Caxambas Sandbar	Y	Y	A	A	<5	C
Kice Island	Y	Y	A	A	<5	C
Cape Romano	Y	Y	A	A	5-20	C
Cape Romano Large Sandbar	Y	Y	A	A	5-20	C

^C=Continuous, I=Intermittent, A=Absent

*N=None; I=Intermittent; C=Continuous

Table 3. Highest number of possible snowy plover breeding pairs per site per survey period, 4 March 2006 to 4 August 2006.

Region, Geographic Area, and Site	Survey Period						Highest # of Possible Breeding Pairs
	AA 3/04/06 to 3/17/06	A 3/18/06 to 4/14/06	B 4/15/06 to 5/12/06	C 5/13/06 to 6/9/06	D 6/10/06 to 7/7/06	E 7/8/06 to 8/4/06	
Northwest Florida							
<i>Perdido Key West</i>							
Alabama Beach - Developed	#	^	^	^	^	^	
Perdido Key SRA	#	0	*	*	1	0	1
Johnson Beach - Developed	#	^	^	^	^	^	
<i>Perdido Key East</i>							
GINs - Perdido Key	1	7	7	7	8	5	8
<i>Big Lagoon</i>							
Big Lagoon SRA	#	^	^	^	^	^	
<i>Fort Pickens</i>							
GINs - Fort Pickens	1	9	12	10	11	6	12
<i>Pensacola Beach</i>							
Pensacola Beach	#	^	^	^	^	^	
Santa Rosa Parking Areas	#	^	^	^	^	^	
<i>Santa Rosa</i>							
UWF Property- Santa Rosa Island	#	1	0	0	0	0	1
GINs - Santa Rosa	#	3	6	7	6	6	7
Big Sabine Point	#	^	^	^	^	^	
<i>Navarre Beach</i>							
Santa Rosa Island - Developed	#	^	^	^	^	^	
Navarre Beach Park	1	3	4	4	4	0	4
<i>Eglin West</i>							
Eglin AFB - West	1	7	3	7	5	1	7
<i>East end of Eglin West to Beasley Park</i>							
Gulfarium and Condos	#	^	^	^	^	^	
<i>Eglin East</i>							
Eglin AFB - East	#	4	3	4	4	0	4
<i>East Pass</i>							
East Pass	#	1	1	1	1	0	1
<i>Destin to Miramar Beach</i>							
Norriego Point	#	^	^	^	^	^	
West Henderson - Developed	#	^	^	^	^	^	
Henderson Beach SRA	#	0	^	^	^	^	
East Henderson - Developed	#	^	^	^	^	^	
Miramar Beach	#	^	^	^	^	^	
<i>Topsail Hill</i>							
Topsail Hill Preserve SP	#	0	0	0	^	^	

Table 3. Continued.

Region, Geographic Area, and Site	Survey Period						Highest # of Possible Breeding Pairs
	AA 3/04/06 to 3/17/06	A 3/18/06 to 4/14/06	B 4/15/06 to 5/12/06	C 5/13/06 to 6/9/06	D 6/10/06 to 7/7/06	E 7/8/06 to 8/4/06	
Northwest Florida continued							
<i>Highway 30A Lakes</i>							
Stallworth Lake Area	#	^	^	^	^	^	
Stallworth Lake to Big Redfish Lake	#	^	^	^	^	^	
Grayton Beach SRA	#	0	0	0	^	^	
Grayton Beach SRA to Eastern Lake	#	^	^	^	^	^	
Deer Lake SP	#	2	2	2	2	2	2
Camp Creek to Walton County Line	#	0	0	0	0	0	
<i>Philips Inlet</i>							
Philips Inlet/Camp Helen SP	#	2	2	2	2	2	2
<i>Panama City Beach</i>							
Panama City Beach - Developed	#	^	^	^	^	^	
St. Andrews SP - Gulf Front	#	1	2	2	1	0	2
St. Andrews SP - Kiddie Pool	#	0	0	0	0	0	
St. Andrews SP - Grand Lagoon	#	0	0	0	0	0	
<i>Shell Island West & East</i>							
Shell Island	#	8	8	9	11	10	11
<i>Crooked Island West</i>							
Tyndall AFB - Crooked Island West	#	9	12	12	8	6	12
Tyndall AFB - Hurricane Island	*	*	*	5	4	2	5
<i>Buck Beach</i>							
Tyndall AFB - Buck Beach	*	*	*	1	1	0	1
<i>Crooked Island East</i>							
Tyndall AFB - Crooked Island East	7	8	12	14	14	7	14
<i>Mexico Beach</i>							
Mexico Beach - Developed	#	^	^	^	^	^	
<i>Palm Point</i>							
Palm Point	#	7	6	4	3	3	7
Windmark Beach	#	^	^	^	^	^	
<i>St. Joe Bay</i>							
St. Joe Beach	#	^	^	^	^	^	
<i>St. Joe Peninsula</i>							
St. Joe Peninsula - Developed	#	^	^	^	^	^	
<i>St. Joseph State Park</i>							
St. Joseph SP	#	26	28	27	21	19	28
<i>Cape San Blas</i>							
Cape San Blas	#	0	0	0	^	^	
Indian Pass	#	^	^	^	^	^	

Table 3. Continued.

Region, Geographic Area, and Site	Survey Period						Highest # of Possible Breeding Pairs
	AA 3/04/06 to 3/17/06	A 3/18/06 to 4/14/06	B 4/15/06 to 5/12/06	C 5/13/06 to 6/9/06	D 6/10/06 to 7/7/06	E 7/8/06 to 8/4/06	
Northwest Florida continued							
<i>Mainland Shoreline from St. Vincent to Alligator Point</i>							
Yent Bayou	#	^	^	^	^	^	
Carrabelle Beach	#	^	^	^	^	^	
Turkey Point	#	^	^	^	^	^	
<i>St. Vincent NWR</i>							
St. Vincent NWR	#	9	10	11	11	8	11
<i>Little St. George Island</i>							
Little St. George Island	2	11	16	14	16	11	16
<i>St. George Island - West end</i>							
St. George Island - Developed	#	^	^	^	^	^	
<i>St. George State Park</i>							
St. George Island SP	#	13	13	11	13	7	13
<i>Dog Island</i>							
Dog Island	1	7	7	5	7	4	7
<i>Lanark Reef</i>							
Lanark Reef	#	^	^	^	^	^	
<i>Phipps Preserve</i>							
Alligator Point - Phipps Preserve	1	1	1	0	*	0	1
<i>Bald Point</i>							
Alligator Point - Developed	#	^	^	^	^	^	
Bald Point SP	#	^	^	^	^	^	
Bald Point - Developed	#	^	^	^	^	^	
Region Total	15	139	155	159	154	99	177
Southwest Florida							
<i>North Anclote Bar to south end of North Clearwater Beach</i>							
North Anclote Bar	1	2	2	1	1	1	2
Anclote Key SP North	#	0	0	0	*	0	
Anclote Key SP South	#	1	1	0	0	0	1
Bar South of Anclote Key	#	*	*	1	*	*	1
Three Rooker Bar North	#	0	*	*	*	*	
Three Rooker Bar South	#	0	0	0	0	0	
Honeymoon Island SRA North	1	0	2	2	1	0	2
Honeymoon Island SRA South	#	0	0	*	1	1	1
Caledesi SP/Dunedin Pass	4	3	3	2	0	1	4
North Clearwater Beach	#	1	1	0	0	0	1

Table 3. Continued.

Region, Geographic Area, and Site	Survey Period						Highest # of Possible Breeding Pairs
	AA 3/04/06 to 3/17/06	A 3/18/06 to 4/14/06	B 4/15/06 to 5/12/06	C 5/13/06 to 6/9/06	D 6/10/06 to 7/7/06	T 7/8/06 to 8/4/06	
<i>Clearwater Beach to south end of Pass-a-Grille Beach</i>							
Clearwater Beach	#	^	^	^	^	^	
Bellair/Madeira/Indian Rocks Beach	#	^	^	^	^	^	
Treasure Island	#	^	^	^	^	^	
St. Petersburg Beach/Pass-a-Grille Beach	#	^	^	^	^	^	
<i>North end of Shell Key to south end of Passage Key</i>							
Shell Key	#	0	^	^	^	^	
Fort DeSoto North	#	0	0	0	*	*	
Fort DeSoto West	#	^	^	^	^	^	
Fort Desoto South	#	0	^	^	^	^	
Egmont Key	#	^	^	^	^	^	
<i>North end of Anna Maria Island to south end of Siesta Beach</i>							
Anna Maria Island	#	*	*	0	1	0	1
Longboat Key North	#	1	0	0	1	1	1
Longboat Key South	#	0	*	*	0	0	
North Lido Beach	2	3	1	2	1	1	3
South Lido Beach	1	1	1	0	0	0	1
<i>South Siesta Key to south end of Manasota Key</i>							
Siesta Key	#	0	1	1	0	1	1
Turtle Beach	#	^	^	^	^	^	
Casey Key	#	^	^	^	^	^	
Venice Beach	#	*	*	0	0	0	
Manasota Key	#	^	^	^	^	^	
<i>Stump Pass State Park to Gasparilla North</i>							
Stump Pass SP (Charlotte Beach)	#	^	^	^	^	^	
Don Pedro Island	1	1	0	2	3	2	3
Little Gasparilla Island	#	0	/	/	/	/	
Gasparilla North	2	2	2	0	0	1	2
<i>Gasparilla South</i>							
Gasparilla South SP	#	^	^	^	^	^	
<i>Cayo Costa to south end of North Captiva</i>							
Cayo Costa SP	1	3	5	4	1	1	5
North Captiva Island	1	3	1	0	1	0	3
<i>Captiva Island</i>							
Captiva Island	#	0	^	^	^	^	
<i>Sanibel Island to Big Hickory Island</i>							
Sanibel Island West	#	0	^	^	^	^	

Table 3. Continued.

Region, Geographic Area, and Site	Survey Period						Highest # of Possible Breeding Pairs
	AA 3/04/06 to 3/17/06	A 3/18/06 to 4/14/06	B 4/15/06 to 5/12/06	C 5/13/06 to 6/9/06	D 6/10/06 to 7/7/06	E 7/8/06 to 8/4/06	
Southwest Florida continued							
Sanibel Island Central	#	0	^	^	^	^	
Sanibel Island East	2	5	5	5	3	1	5
Fort Myers Beach	#	^	^	^	^	^	
Little Estero Island	#	1	1	0	0	0	1
Lovers Key North SP	#	0	^	^	^	^	
Lovers Key South SP	#	^	^	^	^	^	
Big Hickory Island	#	^	^	^	^	^	
<i>Bonita Beach to Naples</i>							
Bonita Beach	#	^	^	^	^	^	
Barefoot Beach	#	^	^	^	^	^	
<i>Keywadin Island to Cape Romano</i>							
Keywadin Island	#	0	*	*	1	*	1
Big Marco Pass CWA	#	3	4	2	*	*	4
Caxambas Sandbar	#	0	0	*	0	*	
Kice Island	*	*	2	*	0	*	2
Cape Romano	#	0	0	*	0	^	
Cape Romano Large Sandbar	#	0	*	*	*	*	
Region Total	16	30	32	22	15	11	45
STATEWIDE TOTAL	31	169	187	181	169	110	222

Site Assessments

*Not Surveyed

^Not Suitable Habitat - dropped from survey

/ Not able to access survey site

Table 4. Total number of snowy plover breeding pairs observed, difference, and % change in 2006, 2002, and 1989*.

Change by Region	Survey Year		Difference	% Change
	2006	2002		
Northwest Florida	177	153	24	15.7
Southwest Florida	45	60	-15	-25.0
Statewide Total	222	213	9	4.2

Change in the Northwest Region	Breeding Pairs		Difference	% Change
	2006	2002		
2006-1989	177	145	32	22.1
2002-1989	153	145	8	5.5

*Due to the discrepancies in data collection in the Southwest region during 1989, only data collected in the Northwest could be directly compared.

Table 5. Change in the number of breeding pairs per geographic region in Northwest Florida from 2006, 2002, and 1989.

Northwest Florida Region and Geographic Area	Survey Year			2006-2002		2006-1989		2002-1989	
	2006	2002	1989	Difference	% Change	Difference	% Change	Difference	% Change
Northwest Florida									
<i>Perdido Key West</i>	1	0*	0	1		1			
<i>Perdido Key East</i>	8	8	5	0	0	3	60	3	60.0
<i>Big Lagoon</i>	*	*	*						
<i>Fort Pickens</i>	12	8	9	4	50	3	33.333333	-1	-11.1
<i>Pensacola Beach</i>	*	0*	0						
<i>Santa Rosa</i>	8	7	4	1	14.3	4	100	3	75.0
<i>Navarre Beach</i>	0	2^	0	0		0		2	
<i>Eglin West</i>	11	10	38	1	10	-27	-71.1	-28	-73.7
<i>East end of Eglin West to Beasley Park</i>	*	0*	0						
<i>Eglin East</i>	3	2	6	1	50	-3	-50.0	-4	-66.7
<i>East Pass</i>	2	3	9	-1	-33.3	-7	-77.8	-6	-66.7
<i>Destin to Miramar Beach</i>	*	0*	0						
<i>Topsail Hill</i>	0	3	8	-3	-100	-8	-100	-5	-62.5
<i>Highway 30A Lakes</i>	2	2	8	0	0	-6	-75	-6	-75.0
<i>Philips Inlet</i>	2	3	4	-1	-33.3	-2	-50	-1	-25.0
<i>Panama City Beach</i>	2	0*	3	2	200	-1	-33.3		
<i>Shell Island West & East</i>	11	11	4	0	0.0	7	175.0	7	175.0
<i>Crooked Island West & East</i>	31	25	5	6	24.0	26	520.0	20	400.0
<i>Buck Beach</i>	1	*	*	1		1			
<i>Mexico Beach</i>	*	0*	0						
<i>Palm Point</i>	7	6	6	1	16.7	1	16.7	0	0.0
<i>St. Joe Bay</i>	*	*	1						
<i>St. Joe Peninsula</i>	*	*	*						
<i>St. Joseph State Park</i>	28	23	6	5	21.7	22	366.7	17	283.3
<i>Cape San Blas</i>	0	2	0	-2	-100.0	0		2	
<i>Mainland Shoreline St. Vincent to Alligator Point</i>	*	*	0						
<i>St. Vincent NWR</i>	11	3	5	8	266.7	6	120.0	-2	-40.0
<i>Little St. George Island</i>	16	8	4	8	100.0	12	300.0	4	100.0
<i>St. George Island - West end</i>	*	*	0						
<i>St. George State Park</i>	13	16	17	-3	-18.8	-4	-23.5	-1	-5.9
<i>Dog Island</i>	7	11	0	-4	-36.4	7		11	
<i>Lanark Reef</i>	*	*	*						
<i>Phipps Preserve</i>	1	0	3	1	100.0	-2	-66.7	-3	-100.0
<i>Bald Point</i>	*	*	0						
Region Total	177	153	145	24	15.7	20	13.8	8	5.5

*Area dropped from survey or not surveyed.

^Survey limited to public lands within the geographic area.

Table 6. Comparison of Southwest region sites with breeding snowy plovers in 2006 and 2002.

Region, Geographic Area	Survey Year		2006-2002	
	2006	2002	Difference	% Change
Southwest Florida				
<i>North Anclote Bar to S of North Clearwater</i>	12	13	-1	-7.7
<i>Clearwater Beach to S of Pass-a-Grille Beach</i>	0	0	0	0.0
<i>NW Shell Key to S end of Passage Key</i>	0	4	-4	-100.0
<i>Anna Maria to S of Siesta Beach</i>	6	3	3	100.0
<i>South Siesta Key to S of Manasota Beach</i>	1	1	0	0.0
<i>Stump Pass State Park to N Gasparilla Island</i>	5	9	-4	-44.4
<i>Gasparilla South to N of Cayo Costa</i>	0	0	0	0.0
<i>Cayo Costa to S of North Captiva</i>	8	2	6	300.0
<i>Captiva to N of Sanibel</i>	0	0	0	0.0
<i>Sanibel to Big Hickory Island</i>	6	20	-14	-70.0
<i>Bonita Beach to Naples</i>	0	0	0	0.0
<i>Keywadin Island to Cape Romano</i>	7	8	-1	-12.5
Region Total	45	60	-15	-25.0

Table 7. Density of snowy plover breeding pairs in Northwest Florida by site for 2006, 2002, and 1989.

Region and Geographic Area	2006 Number of Breeding Pairs	2002 Number of Breeding Pairs	Length of Nesting Beach (km)	2006 Density (pairs/km)	2002 Density** (pairs/km)	1989 Density*** (pairs/km)
Northwest Florida						
<i>Perdido Key West</i>	1	*	2.6	0.4	*	*
<i>Perdido Key East</i>	8	8	10.6	0.8	0.8	0.7
<i>Fort Pickens</i>	12	8	11.3	1.1	0.7	0.8
<i>Santa Rosa</i>	8	7	11.1	0.7	0.5	0.2
<i>Navarre Beach Park</i>	*	2	1.4	*	0.3	*
<i>Eglin West</i>	11	10	20.8	0.5	0.5	1.8
<i>Eglin East</i>	3	2	6.0	0.5	0.0	1.0
<i>East Pass</i>	2	3	1.1	1.8	0.4	9.0
<i>Topsail Hill</i>	*	3	5.2	*	0.5	1.3
<i>Highway 30A Lakes^</i>	2	2	27.5	0.1	0.1	0.3
<i>Philips Inlet/Camp Helen</i>	2	3	1.1	1.8	2.7	5.0
<i>Panama City Beach^</i>	2	*	32.1	0.1	*	*
<i>Shell Island</i>	11	11	12.5	0.9	0.9	0.3
<i>Crooked Island West</i>	17	12	9.7	1.8	1.2	0.2^
<i>Buck Beach</i>	1	*	4.4	0.2	*	*
<i>Crooked Island East</i>	14	13	9.8	1.4	1.3	0.2^
<i>Palm Point</i>	7	6	5.2	1.3	1.2	1.9
<i>St. Joseph State Park</i>	28	23	13.0	2.2	1.7	0.4
<i>Cape San Blas</i>	*	2	4.6	*	0.2	0.3
<i>St. Vincent NWR</i>	11	3	12.6	0.9	0.2	0.3
<i>Little St. George Island</i>	16	8	14.9	1.1	0.5	0.3
<i>St. George State Park</i>	13	16	13.8	0.9	1.2	1.2
<i>Dog Island</i>	7	11	10.0	0.7	1.0	*
<i>Alligator Point- Phipps Preserve</i>	1	*	2.2	0.5	*	1.6
Region Total	177	153	243.5	0.7	0.7	0.6

*No breeding pairs recorded.

**Data reproduced from Lamonte et al. 2006.

***Data reproduced from Gore and Chase, 1989.

^For each geographic area, nesting only occurred at one site: Deer Lake State Park and St. Andrews State Park.

^^Density based on 5 pairs found at Crooked Island East and West combined (21.4 km).

Table 8. Number and density of snowy plover breeding pairs in southwest Florida by site in 2006 and 2002**

Region, Geographic Area, and Site	2006 Number of Breeding Pairs	2002 Number of Breeding Pairs	Length of Beach (km)	2006 Density (pairs/km)	2002 Density (pairs/km)
Southwest Florida					
<i>North Anclote Bar to south end of North Clearwater Beach</i>					
North Anclote Bar	2	2	1	2.0	1.7
Anclote Key SP North	*	2	4.1	*	0.4
Anclote Key SP South	1	*	0.9	1.1	*
Bar South of Anclote Key	1	*	0.2	5.0	*
Three Rooker Bar	*	1	4.2	*	0.4
Honeymoon Island SRA North	2	1	3.9	0.5	1.7
Honeymoon Island SRA South	1	1	1.5	0.7	0.2
Caledesi State Park/Dunedin Pass	4	4	3.4	1.2	1.1
North Clearwater Beach	2	2	3.9	0.5	0.8
Sum of Totals and Mean Density	13	13	23.1	0.6	0.7
<i>Northwest end of Shell Key to Fort DeSoto</i>					
Shell Key	*	1	2.8	*	0.3
Fort DeSoto North	*	1	2.1	*	0.5
Fort DeSoto West	*	2	1.9	*	1.1
Sum of Totals and Mean Density	0	4	6.8	0.0	0.6
<i>Anna Maria Island to Siesta Beach</i>					
Anna Maria Island	1	*	11.8	0.1	*
Longboat Key North	1	1	7.4	0.1	0.1
North Lido Beach	3	2	1.3	2.3	2.0
South Lido Beach	1	*	2.6	0.4	*
Sum of Totals and Mean Density	6	3	23.1	0.3	0.3
<i>South Siesta Key to Manasota Key</i>					
Siesta Key	1	1	4.5	0.2	0.2
Sum of Totals and Mean Density	1	1	4.5	0.2	0.2

Table 8. continued

Region, Geographic Area, and Site	2006 Number of Breeding Pairs	2002 Number of Breeding Pairs	Length of Beach (km)	2006 Density (pairs/km)	2002 Density (pairs/km)
<i>Stump Pass State Park to Gasparilla North</i>					
Charlotte Beach SRA	*	3	1.8	*	1.1
Don Pedro Island	3	3	7.3	0.4	0.4
Gasparilla North	2	3	6	0.3	0.5
Sum of Totals and Mean Density	5	9	15.1	0.3	0.6
<i>Cayo Costa</i>					
Cayo Costa	4	2	10.5	0.4	0.2
North Captiva Island	3	*	5.9	0.5	*
Sum of Totals and Mean Density	7	2	16.4	0.4	0.2
<i>Sanibel Island to Big Hickory Island</i>					
Sanibel Island Central	*	13	10.5	*	1.3
Sanibel Island East	5	6	7.4	0.7	0.8
Little Estero Island	1	1	2.5	0.4	0.4
Sum of Totals and Mean Density	6	20	20.4	0.3	1.0
<i>Keywadin Island to Cape Ramano</i>					
Keywadin Island	1	3	0.5	2.0	1.8
Big Marco Pass CWA	4	5	2.7	1.5	2.9
Kice Island	2	*	0.5		
Sum of Totals and Mean Density	7	8	3.7	1.9	2.4
SUM OF REGIONAL TOTALS AND MEAN DENSITY	44	60	113.1	0.4	0.9

* No breeding pairs recorded

** Data reproduced from Lamonte et al. 2006.

Table 9. Characteristics of 274 snowy plover nests documented in Florida in 2006

Variable Measured	Range	Mean	Number of Nests	% of total nests
Distance (m) to:				
High tide line	1-275	63.8		
Primary dune line	0-92.3	15.8		
Nearest vegetation	0-67	7.1		
Nearest debris	0-28	1.4		
Type of vegetation near nest:				
Grass			175	64
Forb			83	31
Other			18	7
Nest <1m from vegetation			65	24
Nest <1m from debris			178	65
Nest <1m from vegetation and debris			33	12
Nest <1m from either vegetation or debris			190	70
Nest lined with shell			210	77
Nest location				
In front of primary dune			145	53
Behind primary dune			46	17
In dune pocket opening			118	43
Other (flat - no dunes)			0	0
Nest located with water in view			214	79

Table 10. Characteristics of Northwest region Snowy Plover nests documented in 2006, 2002 and 1989[^].

Variable Measured	Range			Mean			Number of Nests			% of total nests		
	2006	2002	1989	2006	2002	1989	2006	2002	1989	2006	2002	1989
Distance (m) to:												
High tide line	3-275	6.4-200	0-250	70.9	59.8	61.5						
Primary dune line	0-92.3	1.5-200	0-60	15.8	33.7	10.5						
Nearest vegetation	0-67	0-18	0-22	7.7	0.98	1.4						
Nearest debris	0-28	0-23.5	*	1.5	2.64	*						
Nearest building	*	0-13,080	150-10,000									
Nearest public access	*	0-9475	50-10,000									
Type of vegetation near nest:												
Grass							157	56	35	69	44	41
Forb							67	56	26	30	44	31
Other							2	15	*	0.9	12	*
None within 1m							N/A	0	24	N/A	0	28
Nest <1m from vegetation							50	92	*	22	73	*
Nest <1m from debris							134	63	*	59	50	*
Nest <1m from vegetation and debris							19	44	*	8	35	*
Nest <1m from either vegetation or debris							145	111	85	64	87	100
Nest lined with shell							173	118	79	77	94	93
Nest location												
In front of primary dune							112	17	40	49	13	47
Behind primary dune							32	52	13	14	41	15
In dune pocket opening							82	57	32	36	45	38
Other (flat - no dunes)							0	0	*	0	0	*
Nest located with water in view							186	88	68	82	69	80

[^]Data reproduced here from Gore and Chase 1989.

*Characteristic not recorded during survey year.

Table 11. Characteristics of 226 Northwest region and 48 Southwest region Snowy Plover nests documented in 2006.

Variable Measured	Range		Mean		Number of Nests		% of total nests	
	NW	SW	NW	SW	NW	SW	NW	SW
Distance (m) to:								
High tide line	3-275	1-150	70.9	29.2				
Primary dune line	0-92.3	0-45	15.8	10.4				
Nearest vegetation	0-67	0-30	7.7	4.3				
Nearest debris	0-28	0-1.2	1.5	0.17				
Type of vegetation near nest:								
Grass					157	18	69	39
Forb					67	16	30	35
Other					2	16	0.9	35
Nest <1m from vegetation					50	15	22	33
Nest <1m from debris					134	44	59	96
Nest <1m from vegetation and debris					19	14	8	30
Nest <1m from either vegetation or debris					145	45	64	98
Nest lined with shell					173	37	77	80
Nest location								
In front of primary dune					112	33	49	71
Behind primary dune					32	13	14	28
In dune pocket opening					82	0	36	0
Other (flat - no dunes)					0	0	0	0
Nest located with water in view					186	28	82	61

Table 12. Sites utilized by Snowy Plovers and Wilson's Plovers, 17 February 2006 through 4 August 2006

Region, Site	Wilson's Plovers Observed	Wilson's Plovers Breeding	Wilson's Plover/Snowy Plover Interaction
Northwest Florida			
GINS - Perdido Key	X		
GINS - Ft. Pickens	X		
UWF - Santa Rosa	X	X	X
GINS - Santa Rosa	X	X	X
Shell Island	X	X	X
Tyndall AFB - Crooked Island West	X	X	X
Tyndall AFB - Hurricane Island	X	X	X
Buck Beach	X	X	X
Tyndall AFB - Crooked Island East	X	X	X
Palm Point	X		
St. Joseph Peninsula SP	X		X
Cape San Blas	X	X	X
Little St. George Island	X	X	X
St. George Island SP	X	X	X
Dog Island	X	X	X
Lanark Reef	X		
Alligator Point - Phipps Preserve	X	X	X
Southwest Florida			
North Anclote Bar	X	X	X
Anclote Key SP North	X	X	
Anclote Key SP South	X		
Three Rooker Bar South	X		
Honeymoon Island SRA North	X	X	
Honeymoon Island SRA South	X		
Caledesi State Park/Dunedin Pass	X	X	
North Clearwater Beach	X	X	X
Shell Key	X		
Fort DeSoto North	X		
Anna Maria Island	X		
North Lido Beach	X		
Don Pedro Island	X	X	
Little Gasparilla Island	X		
Gasparilla North	X	X	X
Cayo Costa	X	X	
North Captiva Island	X	X	
Sanibel Central	X		
Little Estero	X	X	
Keywadin Island	X		
Big Marco Pass CWA	X		

Appendix 1. 2006 Snowy plover survey site form.

Site Form

Site Name _____

Site Number _____

Date _____ Observer(s) _____ County _____

Directions/Access: _____

Lat/Lon: _____
 1 _____ / _____
 2 _____ / _____
 3 _____ / _____
 4 _____ / _____

Location: _____
 1 _____
 2 _____
 3 _____
 4 _____

Land form: Mainland Barrier Island Peninsula other:

Suitability Factors:

Beach width: <5m wide >5m wide

Primary habitat: seawall/riprap sandy beach/interdune mudflat other:

Disturbance : beach raking vehicles/ATV pets pedestrians

Dist. Frequency: <5 times/day 5-20 times/day >20 times/day

Predator tracks? YES NO Type _____

Habitat within 150m of high tide line:

	CONTINUOUS	INTERMITTENT	ABSENT
DUNES			
DEVELOPMENT			
TIDAL POOL			
BLOWOUT/SANDFLAT			

Potential habitat present: Breeding Wintering None

Is suitable habitat: CONTINUOUS or INTERMITTENT

NOTES: _____

Appendix 2. 2006 snowy plover survey territory survey form.

Appendix 3. 2006 snowy plover survey nest form.

Nest Form

Site Name _____ Site # _____ Territory # _____

Observer(s) _____

Nest # _____ Latitude _____ Longitude _____

Nest Contents:

Date	# of eggs	# of chicks	Comments

Nest Characteristics:

Distance to high tide line _____

Nest in view of Gulf? Yes No

Elevation above high tide line _____

Distance to 1° dune line _____

Nest location: Behind In front In dune pocket
 1° dune 1° dune or opening

Distance to nearest vegetation _____

Type of vegetation: Grass Forb Tree Other

Distance to nearest structural debris _____

Type of structural debris _____

Nest lined with shell or debris? Yes No

Location of nearest building _____ _____

Location of nearest public access _____ _____

Notes: _____

Appendix 4. 2006 snowy plover survey Wilson's plover observation form.

Appendix 5. 2006 snowy plover survey site summaries.

Perdido Key West - Includes *Alabama Beach*, *Perdido Key State Recreation Area (SRA)*, and *Johnson Beach* in Escambia County (9.9 km).

Alabama Beach (4.0 km) is located between the Alabama-Florida state line and Perdido Key SRA. The site was highly developed with houses and condos built continuously along the gulf front. Dunes, tidal pools and blowout/sandflats were absent. Potential breeding snowy plover habitat did not exist.

Perdido Key SRA (2.6 km) is located between Alabama Beach and Johnson Beach; administered by the Florida Department of Environmental Protection (DEP) – Florida Park Service. Nesting was limited as boardwalk access points were positioned periodically from the parking lot to the beach front with high levels of human disturbance. Potential breeding habitat was intermittent and nesting was only possible in front of the primary dunes. The area behind the dunes was densely vegetated and directly adjacent to the parking lot and Perdido Key Drive. At least 1 pair attempted to nest here within a posted least tern colony. This pair may have moved over from Gulf Islands National Seashore (GINS)-Perdido Key as no snowy plovers were present here early in the season. With posting efforts keeping visitors away from the dune front, this area might continue to support nesting snowy plovers.

Johnson Beach (3.3 km) is located between Perdido Key SRA and GINS - Perdido Key. This area was highly developed with houses and condos built continuously along the gulf front. Dunes, tidal pools and blowout/sandflats were absent. Potential breeding snowy plover habitat did not exist.

Perdido Key East - Includes *GINS - Perdido Key* in Escambia County (10.6 km); administered by the Department of the Interior (DOI) - National Park Service. This site is located directly to the east of Johnson Beach. The beach was moderately wide, with low primary and secondary dunes. Human use was high at the west end of the gulf side near the parking lot. Human use was medium to high along the 4-km stretch of road from the western boundary east into the Seashore. Boardwalks are placed periodically along the road for access to the bay and gulf sides, distributing human disturbance throughout and allowing visitors to walk through the dunes to access the gulf side. The area between the road end and eastern tip had low human use. Most access to these areas was limited to an occasional recreational boater landing on the bayside, or the occasional hiker from the parking lot at the west end. The eastern tip was not conducive for breeding due to high boat use/human activity and the steep beach wall caused by wave action. At least 8 pairs bred here, representing 3.6% of the total breeding population in Florida. Most nesting occurred in open areas behind the primary dunes on the bay side, or between primary and secondary dunes in the interior of the beach. We found 13 nests, with a hatch rate of 87%. One nest was documented as depredated by an unknown source. Park employees posted nests as they were located, thereby augmenting nest success. However, posting the eastern tip prior to the nesting season, where human disturbance was the highest, will enhance nesting at this site. This area was used heavily by snowy plovers in 2002, but not during 2006. Posting of brood foraging areas should also be considered.

Big Lagoon - Includes *Big Lagoon State Recreation Area* in Escambia County (2.2 km); administered by the DEP - Florida Park Service. This site is designated as a critical habitat unit for piping plovers. The beach width was <5 m wide and the primary habitat consisted of wetland vegetation. Potential wintering/feeding habitat was located at the tip of peninsula during low tide. Breeding snowy plover habitat did not exist, but the area may be essential as a foraging stop-over point for snowy plovers and other shorebirds.

Ft. Pickens - Includes *GINS - Ft. Pickens* is located at the western end of Santa Rosa Island in Escambia County (11.3 km); administered by the DOI - National Park Service. This area consisted of moderate to wide beaches, with frequent openings between low dunes. Dunes and tidal pools were intermittent, while sand flats were continuous. Hurricane Opal (1995), followed by Hurricanes Ivan (2004) and Dennis (2005), wiped out the dunes and flattened the eastern 6 km of the area. The paved road running through the center of the island was closed to vehicular traffic due to damage by Hurricanes Ivan (2004) and Dennis (2005). Human use was low to medium at the site, and limited to hiking, biking, and boating. However, in previous years, paved roads and boardwalks distributed throughout the park allowed for access and disturbance along the entire beach. At least

12 pairs bred here, representing 5.4% of the total breeding population in Florida. We found most nests in front of the primary dunes or in dune openings, with a few on the bay side behind primary dunes. Many nests were in close proximity to the damaged road system on both the bay and gulf sides. Upon reconstruction of the road system, posting of nesting areas and critical brood foraging areas may be necessary prior to the nesting season. Monitoring of nesting areas and posting the perimeter of all located nests should continue. We found 15 nests, with a hatch rate of 100%. No nests were depredated to our knowledge. We observed a total of 21 families, 7 of which emerged from undiscovered nests. Most families congregated at a large washout area on the bayside toward the eastern portion of the site, moving many kilometers from their nesting territories.

Pensacola Beach - Includes *Pensacola Beach* and *Santa Rosa Parking Areas* in Escambia County (12.7 km).

Pensacola Beach is located between GINS-Ft. Pickens and the Santa Rosa Parking Areas (9.9 km).

This area is highly developed. Potential breeding snowy plover habitat did not exist.

Santa Rosa Parking Areas are located between Pensacola Beach and the University of West Florida (UWF)-Santa Rosa (2.8 km). The area consisted of intermittent dunes and some development including parking lots and a large hotel on the edge of the area with high levels of human disturbance. Potential breeding snowy plover habitat did not exist.

Santa Rosa - Includes *University of West Florida (UWF) - Santa Rosa property*, *GINS - Santa Rosa*, and *GINS - Big Sabine Point* in Escambia County (13.0 km).

UWF - Santa Rosa is located from the eastern edge of the Santa Rosa Parking Areas to the western edge of GINS - Santa Rosa (1.9 km); administered by the University of West Florida. The area consisted of very wide beaches with low to high dunes in places and intermittent blowouts/sandflats. A paved road runs through the center of the site, with parking available on both sides of the road, allowing for high levels of human disturbance. At least 1 pair nested on the north side of the road (the bay side), and foraging typically occurred on the tidal flats on the bayside. Posting of nesting and brood foraging areas should be implemented to counter the high levels of human disturbance.

GINS - Santa Rosa is located between UWF - Santa Rosa and Santa Rosa Island - Developed (11.1 km); administered by DOI - National Park Service. The area consisted of very wide beaches, with varying heights of secondary and tertiary dunes north of the road. Most of the primary dunes on the gulf side were flattened by Hurricanes Opal (1995), Ivan (2004), and Dennis (2005). A paved road ran through the center of the island to Navarre Beach, but was damaged by past hurricanes, and closed to the public. Sections of the road remained intact, while other sections were completely ruined. There was an abundance of asphalt debris spread on the beach. Some of the large asphalt pieces were bulldozed into large piles by NPS staff prior to the breeding season. Human use was low at the site due to the lack of accessibility. At least 7 pairs bred here, constituting 3.2% of the total breeding population in Florida. We found 7 nests and confirmed that 6 hatched. No nests were depredated to our knowledge. Many nests occurred in close proximity to the damaged road. Upon reconstruction of the road system, posting of nesting areas may be necessary prior to the nesting season. Continued monitoring of nesting areas and posting of newly utilized nesting locations should continue. We observed a total of 11 families, 5 of which emerged from undiscovered nests. Most snowy plover families were observed feeding on the bay side towards the eastern end. Posting of critical foraging areas will also be essential upon construction.

GINS - Big Sabine Point is located between GINS - Santa Rosa and Santa Rosa Island - Developed; administered by DOI - National Park Service. This site is designated as a critical habitat for piping plovers. The area had narrow beaches with moderate to high levels of human disturbance. Snowy plover breeding habitat was not present. However, the area contains a large mudflat that provides foraging habitat and serves as an important wintering habitat, as well as providing a stop-over point. Posting efforts should be considered to lessen the effects of high human disturbance to foraging birds.

Navarre Beach - Includes *Santa Rosa Island - Developed* and *Navarre Beach Park* in Escambia and Santa Rosa Counties (6.7 km).

Santa Rosa Island - Developed is located between GINS - Santa Rosa and Navarre Beach Park (5.3 km). The area was highly developed with stilt houses built along the gulf front. Potential breeding snowy plover habitat did not exist.

Navarre Beach Park is located between Santa Rosa Island – Developed and Eglin West (1.4 km); administered by Santa Rosa County. This site was under DEP management, but was handed back over to Santa Rosa County in 2005. The area was wide with low sporadic dunes (< 1 m). Human use in the area was moderate and mainly limited to the gulf side. The few pavilions located at the west end of the park were damaged by Hurricane Ivan (2004) and Hurricane Dennis (2005) and closed to the public. Although nesting is known from this area (Lamonte et al., 2006), we did not locate any nests during this survey. The reason for the loss of nesting at this site is unclear. However, dredging projects prior to the nesting season may have altered the surface substrate. Posting efforts prior to the breeding season and habitat restoration might allow snowy plovers to return to this historic nesting area.

Eglin West - Eglin Air Force Base (AFB) - West is located between Navarre Beach Park and Fort Walton Beach in Santa Rosa and Okaloosa Counties (20.8 km); administered by Eglin AFB. This area consisted of very wide beaches with low dunes. Secondary and tertiary dunes on the bay side were higher than the primary dunes near the gulf side. Primary dunes were diminished due to Hurricane Opal (1994) and Hurricane Dennis (2005). Tidal pools and blowout/sandflats were intermittent. Development included a damaged paved road through the center of the island leading from Navarre Beach to Fort Walton Beach. Access to the road was limited to Air Force employees and construction workers. A few Air Force buildings were located along the beach, with road access points from the main road. Besides occasional Air Force use of the area, public use was low. Access to the beach was limited to pedestrians from either the western boundary of Fort Walton Beach or western boundary of Navarre Beach Park. Human disturbance was limited to 1 km from either boundary. Although human use was relatively low, the majority of disturbance was from vehicular activity from Law Enforcement and turtle surveyors. At least 11 pairs bred here, constituting 5.0% of the total breeding population in Florida. Nine nests were found and 2 were confirmed hatched. Seven nests had unknown fates and no nests were depredated to our knowledge. A total of 4 families were observed, 2 of which emerged from undiscovered nests late in the breeding season. In 1989 (Gore and Chase), this site was documented as supporting the highest number of nesting snowy plovers in Florida. The reason for the decrease in snowy plover numbers is unclear. However, measures to improve habitat, as well as posting efforts in areas receiving high levels of human disturbance, should be taken.

East end of Eglin West to Beasley Park - Includes ***Gulfarium and condos (aka Fort Walton Beach)*** in Okaloosa County (4.8 km). This area is located from the eastern boundary of Eglin AFB-West to the western boundary of Eglin AFB-East. This area has continuous development, and dunes, tidal pools, and blowout/sandflats are absent. Breeding snowy plover habitat did not exist.

Eglin East - Includes ***Eglin AFB - East*** in Okaloosa County (6.0 km); administered by Eglin AFB. Eglin AFB - East is located from the eastern boundary of Fort Walton Beach to the western boundary of East Pass. The area consisted of a narrow beach on the eastern half, and a medium-width beach on the western half. The narrow portion had steep primary dunes, with dense vegetation behind the dunes. The western portion of the beach was much wider, with large openings and low primary dunes. Access points were dispersed along the beach and were available to pedestrians who parked their cars along U.S. Highway 98. A higher level of disturbance at the western end was due to construction of an officer's club. Although human use was relatively low, the majority of disturbance was from vehicular activity from Law Enforcement and the Turtle Patrol, with ATV tracks well above the high tide line. Nesting signs for endangered species were placed in areas in front of the primary dunes on the narrow portion and in open blowout areas between dunes in the wider portion. However, the actual areas where plovers nested did not correlate with the designated spots that were posted before the nesting season began. At least 3 pairs bred here, constituting 1.4% of the total breeding population in Florida. Most nesting occurred in dune pockets on the wider portion of beach. Four nests were located, 3 were confirmed hatched, and none were depredated to our knowledge. A total of 3 families were observed. Least

terns were also observed nesting in the wide portion of the beach. Broods were often observed foraging at East Pass, where they were subjected to high levels of human disturbance. Nesting and brood foraging areas should be protected and monitored.

East Pass - Includes *East Pass* in Okaloosa County (1.1 km); administered by Eglin AFB. East Pass is located from the eastern boundary of Eglin East to the eastern tip of Santa Rosa Island. The area consists of high (2-7m) dunes surrounded by sparse vegetation (20-50 m wide), and by a wide (100-200 m) sandy beach on the gulf side and a sandy flat on the East Pass side. Fresh and brackish water and feeding areas were available along the edge of the Pass. Human use in the area was extremely high on the East Pass side. People accessed the area from both the parking lot adjacent to the Pass and from recreational boats anchored along the edge. Nesting signs with ropes were posted around the entire perimeter of the high dune system prior to nesting season. However, people often ignored the signs and climbed over the high dune system or wide slope area to the west of the high dunes to access the gulf side. At least 2 pairs bred here. Two nests were located and confirmed hatched. A small colony of least terns and black skimmers nested in front of the high dune system and behind the bird-nesting signs. Continued posting and enforcement of nesting and foraging areas will be necessary to retain East Pass as a nesting area.

Destin to Miramar Beach - Includes *Norriego Point*, *West Henderson - Developed*, *Henderson Beach SRA*, and *East Henderson - Developed* in Okaloosa County and *Miramar Beach* in Walton County (17.4 km).

Norriego Point (0.1 km) is a short stretch of beach across the waterway from East Pass. Dunes, tidal pools, and blowouts/sandflats were absent, while development was intermittent. Human use in the area was very high, with pedestrians and anchored boats. Potential breeding snowy plover habitat did not exist.

West Henderson - Developed (5.1 km) is located from the eastern edge of Norriego Point to the western boundary of Henderson SRA. It is a highly developed beach, with no snowy plover breeding habitat.

Henderson Beach SRA (2.0 km) is located from the eastern boundary of West Henderson-Developed to the western boundary of East Henderson-Developed; administered by the DEP- Florida Park Service. The area has continuous primary dunes, while tidal pools and blowout/sandflats are absent. Development was intermittent and included pavilions behind the dunes. The area behind the dunes was densely vegetated, with no breeding habitat. Human use of the area was high, as there were highly developed areas on both sides of the park. No snowy plovers were seen during initial surveys and the area was subsequently dropped from the survey. Posting of potential nesting areas may allow snowy plovers to return to this historic nesting area.

East Henderson - Developed (1.3 km) is located from the eastern boundary of Henderson SRA to the western boundary of Miramar Beach. The beach is highly developed, with no snowy plover breeding habitat.

Miramar Beach (8.9 km) is located from the eastern boundary of East Henderson – Developed to the western boundary of Topsail Hill Preserve SP. The area is highly developed, with no snowy plover breeding habitat.

Topsail Hill - Includes *Topsail Hill Preserve State Park* in Walton County (5.2 km); administered by the DEP, Florida Park Service. This area is located from the eastern boundary of Miramar Beach to the western boundary of the Highway 30A Lakes. Dunes are continuous, development and tidal pools are absent, and blowouts/sandflats are intermittent. Human use and vehicular traffic by Law Enforcement and turtle surveyors were high, with tracks well above the high tide line. The area was classified as having continuous breeding habitat. However, no snowy plovers were seen during the first 3 survey periods, and the area was dropped from the survey despite documented nesting during 2002. Posting, monitoring, and enforcement of nesting areas should be implemented to encourage snowy plovers to return to this historic nesting area.

Highway 30A Lakes - Includes *Stallworth Lake Area*, *Stallworth Lake to Big Redfish Lake*, *Grayton Beach SRA*, *Grayton Beach SRA to Eastern Lake*, *Deer Lake SP*, and *Camp Creek to Walton County Line* in Walton County (27.5 km).

Stallworth Lake Area is located from the eastern boundary of Topsail Hill Preserve SP to the western boundary of Stallworth Lake (4.6 km). The area is highly developed, with no snowy plover breeding habitat.

Stallworth Lake to Big Redfish Lake is located from the eastern boundary of Stallworth Lake Area to the western boundary of Grayton Beach SRA (2.8 km). The area is highly developed, with no snowy plover breeding habitat.

Grayton Beach SRA is located from the eastern boundary of the Big Redfish Lake area to the western boundary of Grayton Beach SRA (4.1 km); administered by the DEP- Florida Park Service. Dunes were continuous, while tidal pools were absent and blowout/sandflats intermittent. There was some development between the eastern and western sections of the park. Human use in the area was high due to development adjacent to the park. Disturbance from vehicular traffic from Law Enforcement, turtle surveyors, and other beach maintenance vehicles was high. The snowy plover breeding habitat was considered intermittent. Although Grayton Beach SRA is a historic nesting area for snowy plovers (Gore and Chase 1989), no snowy plovers were seen during the initial 3 survey periods of this survey, and the area was thereafter dropped. By implementing posting practices to lessen the effects of disturbance of both vehicular traffic and human use, snowy plovers may return to this area for nesting.

Grayton Beach SRA to Eastern Lake is located from the eastern boundary of Grayton Beach SRA to the western boundary of Deer Lake SP (5.2 km). The area is highly developed with no snowy plover breeding habitat.

Deer Lake SP is located from the eastern boundary of Eastern Lake to the western boundary of Camp Creek (2.7 km); administered by the DEP- Florida Park Service. Dunes, tidal pools, and blowouts/sandflats were intermittent. Development was absent in the park, but existed around the edges. Human use in the area was high. At least 2 pairs bred here. Four nests were located, 3 confirmed hatched, and no nests were depredated to our knowledge. Both pairs nested twice during the season. A total of 3 families were observed foraging near the tidal area created from Deer Lake. Posting of nesting areas and foraging areas prior to the breeding season should be implemented to counter the effects of the increased development adjacent to the park.

Camp Creek to Walton County Line is located from the eastern boundary of Deer Lake State Park to the western boundary of Philips Inlet/Camp Helen SP (8.1 km). Most of the area is highly developed and does not contain suitable breeding habitat. However, the western portion directly adjacent to Deer Lake SP contained some suitable habitat consisting of a few dunes in front of condos and a wide sandflat area. This portion of the area was surveyed throughout the survey, and although this area is a historic nesting area for snowy plovers (Gore and Chase 1989), no breeding was observed. With posting efforts in conjunction with Deer Lake SP prior to the nesting area, it might be possible for snowy plovers to return to this historic nesting area.

Philips Inlet - Includes **Philips Inlet/Camp Helen SP** in Bay County (1.1 km); administered by the DEP- Florida Park Service. The area is located from the eastern boundary of Camp Creek to Walton County Line to the western boundary of Panama City Beach-Developed. An inlet from a freshwater lake opens and closes naturally throughout the year and provides an excellent tidal area for foraging shorebirds. Dunes are intermittent and very low (1-2 m high) on the east side of the inlet. At least 2 pairs bred here, 3 nests were located, all of which hatched and occurred in dune pockets on the east side of the inlet, and 3 families were observed. Nesting and brood foraging areas should be posted prior to the breeding season due to increased development in adjacent areas.

Panama City Beach - Includes **Panama City Beach-Developed; St. Andrews SP - Gulf Front, St. Andrews SP - Kiddie Pool**, and **St. Andrews SP - Grand Lagoon** in Bay County (32.1 km).

Panama City Beach – Developed is located from the eastern boundary of Philips Inlet/Camp Helen SP to the western boundary of St. Andrew's S P-Gulf Front (27.9 km). The area is highly developed and no snowy plover breeding habitat exists.

St. Andrews SP - Gulf Front is located from the eastern boundary of Panama City Beach-Developed to the south end of the Kiddie Pool (2.2 km); administered by the DEP- Florida Park Service. The area had continuous dunes and intermittent tidal pools and blowout/sandflats. Human use in the area was very high, but people stayed out of the breeding habitat in front of and behind the dunes due to bird nesting signs. At least 2 pairs bred here, with 3 documented nests and 2 confirmed hatched. All 3 nests were found in front of the

primary dune line behind the bird nesting signs. One nest was depredated by an unknown source. A total of 2 families were observed foraging at the tideline. Posting of nesting and brood foraging areas should continue.

St. Andrews SP - Kiddie Pool is located from the eastern boundary of St. Andrews SP - Gulf Front to the sandy point on the northern tip along the canal (1.2 km). A seawall was created by a dredging project in prior to the breeding season. There was no breeding habitat available, despite documented nesting in previous years (Gore and Chase 1989). Posting and/or habitat restoration should be implemented to promote nesting.

St. Andrews SP - Grand Lagoon is located from the sandy point at the end of the Kiddie Pool section to the Boat Ramp on the canal side (0.8 km). The beach was less than 5 m wide, and no dunes, tidal pools or blowouts/sandflats existed. The majority of available habitat was densely vegetated. No snowy plover breeding habitat existed.

Shell Island West and East - Includes **Shell Island West and East**, located immediately south of St. Andrew Bay, Bay County (12.5 km). The western portion of Shell Island is administered by the DEP - Florida State Parks as part of St. Andrews SP, and the eastern portion is administered by the Tyndall Air Force Base (AFB) and is designated as a Critical Wildlife Area. The western half of Shell Island contained narrow beaches, sparse vegetation, and intermittent dunes, and people and pets intensively used this area during the summer months. Cruise vessels accessed the island at 2 boardwalks on the bay side of the western half. However, recreational boaters were not limited to access points. People typically walked through the dunes to access the gulf side. The eastern end contained wide beaches with areas containing shell microhabitats, sparse vegetation, an open interdune area with many small pockets of nesting habitat among continuous low dunes, and limited public access. The dune pockets provided nesting habitat for both snowy plovers and Wilson's plovers. The eastern boarder was somewhat arbitrary, as Crooked Island West and Shell Island are connected by a sandflat created through accretion of sand through beach renourishment efforts on Panama City Beach. We located 11 pairs and 9 nests on Shell Island West and East, representing 5.0% of the total breeding population in Florida. Two of the 11 pairs attempted to nest all season in the western portion, as evidenced by the presence of nest scrapes in the same location near public access points, but failed to successfully lay eggs. Only 7 of the 9 nests had determinable fates. Of these 7 nests, unknown sources depredated 2 nests in unposted areas and 5 hatched in posted areas. A total of 7 families were observed, 2 of which emerged from undiscovered nests. Three small least tern colonies also nested at washout areas on Shell Island during the month of May, 2 on DEP property and 1 at the washover area between Shell and Crooked Island West. One was flooded and the 2 others were depredated by unknown sources. All nesting areas within DEP properties should be posted and maintained throughout the breeding season. Some areas were posted in 2006 prior to the nesting season, but did not correlate to where nests were actually located. The washover area between Shell Island and Crooked Island West should also be posted as recreational boaters typically anchored their boats here. Continued posting and maintenance of nesting and foraging areas might improve nesting by providing protection against human and pet disturbance.

Crooked Island West - Includes **Crooked Island West** and **Hurricane Island**; administered by Tyndall AFB.

Crooked Island West is located to the east of Shell Island, Bay County. The size of Crooked Island West was reduced from 10 km to 6.4 km, as it was divided into 2 separate islands during the past storm seasons. Crooked Island West is designated as a Critical Wildlife Area. The beaches were wide, with frequent pockets within a sparsely vegetated low dune system, freshwater and tidal pools were dispersed intermittently, allowing for foraging areas, and human disturbance was limited to the few available public access points. The dune system provided ideal nesting habitat for both snowy plovers and Wilson's plovers. At least 12 pairs attempted to breed here, and 13 nests were located, representing 5.4% of the total breeding population in Florida. Only 10 of the 13 nests had determinable fates. Although predators appeared abundant, coyotes presumably depredated only 1 nest, as evidenced by tracks, whereas another 3 nests that disappeared before the estimated hatch dates were possibly depredated, although predator tracks absent. Nine nests successfully hatched, some of which were located in posted areas. A total of 10 families were observed, 1 of which emerged from an undiscovered nest. Three pairs attempted to nest at the eastern point of the area early in the nesting season, but abandoned their attempts due to disturbance by recreational boaters during the months of June and July. Least Terns also attempted to nest at the eastern end, but failed to successfully lay eggs due to high levels of human disturbance

from recreational boaters. Posting efforts should be implemented for nesting and brood foraging areas where disturbance is high, particularly at the eastern tip.

Hurricane Island is located to the east of Crooked Island West, Bay County (3.6 km), and is designated as a Critical Wildlife Area. Early in the season, Hurricane Island contained 2 separate islands, but the 2 became connected by a sandbar in early June. The western half had narrow beaches surrounding a large forested area. Two large tidal zones provided foraging areas used by snowy plovers, Wilson's plovers, and American oystercatchers during the breeding season. No breeding snowy plovers nested on this portion of the island. The eastern half contained a small, sparsely vegetated dune system with small pockets containing shell debris, and occasional tidal pools providing foraging areas. The dune pockets and washover areas containing shell microhabitats provided ideal nesting areas for snowy plovers, Wilson's plovers, least terns, and American oystercatchers. Five pairs of snowy plovers attempted to breed here, with only 2 located nests. Few nests were located, as Hurricane Island was not surveyed until late in the season. Four pairs already had families on the initial visit. Only 2 pairs nested later in the season, as human disturbance by recreational boaters increased during Memorial Day weekend and the months of June and July. On Memorial Day alone, there were 57 boats using the 3.6 km of Hurricane Island. Both nests hatched and there were no observed predation events of snowy plover nests. However, in the month of June, a coyote swam across the channel from Crooked Island West and predated a least tern colony containing over 30 nests. This area should be posted (nesting and foraging areas) and closed to recreational access prior to the breeding season as a Critical Wildlife Area.

Buck Beach - Includes **Buck Beach**, located on the mainland along U.S. Highway 98 between the barrier islands of Crooked Island West and East, Bay County (4.4 km), administered by Tyndall AFB and designated as a Florida Critical Wildlife Area. Buck Beach had narrow beaches that contained densely vegetated low dunes, but lacked shell debris. Two large tidal pools provided excellent foraging areas, and human access was limited to one access point that was closed during the weekdays. One snowy plover pair and 1 Wilson's plover pair nested here. The nest was located in front of primary dunes on raised sand, with debris from surrounding sand pines. One brood was successfully fledged during the breeding season. No further evidence of breeding was found, possibly due to increased use of beaches in June and July on the weekends. No predation was observed, although predators appeared abundant, as both raccoon and coyote tracks were observed throughout the season. Although this area contained limited breeding habitat, it provided an essential foraging area for birds from Crooked Island West/East.

Crooked Island East - Includes **Crooked Island East** and **Bonfire Beach**, located between Buck Beach to the west and Mexico Beach to the east, Bay County (9.8 km). Crooked Island East is the western portion, is administered by Tyndall AFB, and is designated as a Critical Wildlife Area. Bonfire Beach is the eastern portion and is administered by The St. Joe Company, with Mexico Beach to the east, Bay County (9.8 km.) These two sites were surveyed as a single unit. The beaches were wide, with frequent pockets within a sparsely vegetated low dune system, and freshwater and tidal pools were dispersed intermittently, which were used as foraging areas. The dune system provided ideal nesting habitat for both snowy plovers and Wilson's plovers. Human and pet disturbance was greatest on the eastern portion of the area, with 2 beach access points adjacent to Mexico Beach. Although the western portion does not have any established public access points, recreational boaters regularly landed at the western tip. At least 14 pairs attempted to breed here, and 21 nests were located, representing 6.3% of the total breeding population in Florida. Thirteen of the 21 nests had determinable fates. Eight of 13 (62%) of these nests successfully hatched in posted areas, 1 was trampled by people at the western point, and 4 of 13 (31%) were depredated. Of the depredated nests, 2 were by unknown sources, 1 was by a coyote, and 1 was by a fish crow. A total of 9 families were observed, one of which emerged from an undiscovered nest. The western point, which contained large washout areas with large open sand flats, shell microhabitat, and expansive tidal pools, provided the best nesting and brood foraging habitat for snowy plovers, Wilson's plovers, least terns, and American oystercatchers. Despite posting efforts, all least tern and American oystercatcher nests were depredated, trampled, abandoned, or flooded during Tropical Storm Alberto. The western point should be posted and enforced against trespass due to the numerous species attempting to nest in the area. Posting efforts of nesting and foraging areas should be implemented at Mexico Beach and Bonfire Beach public access points prior the breeding season.

Mexico Beach - Includes *Mexico Beach*; the developed portion between Crooked Island East to Palm Point, Bay and Gulf Counties (9.3 km). The beach was relatively narrow, had intermittent dunes, and was continuously developed. This site was frequented by people from various beach access points and the beach was raked on a regular basis. There was no potential habitat and no plovers were observed on the initial survey. If beach raking is limited and dune pockets are posted, this area might support nesting snowy plovers.

Palm Point - Includes *Palm Point* and *Windmark Beach*, both are administered by the St. Joe Company, Gulf County (5.2 km).

Palm Point is located from the eastern edge of Mexico Beach to the western edge of Windmark Beach (5.0 km). The beach was very narrow (<35 m wide), with low continuous dunes, intermittent development, and areas of high human disturbance. Beach access points were scattered throughout, but there were 3 areas of intensive disturbance. The access point at the east end from the U.S. Highway 98 near Windmark had intensive disturbance from both humans and their pets. Many dogs were observed without leashes and interacting with snowy plover families. A second access point, towards the middle of the beach, is near a development area with vacation homes directly behind the low dune system with beach front access. A third access point is at the west end adjacent to Mexico Beach. People and pets walk directly over the arbitrary line dividing Palm Point and Windmark Beach. Despite the narrow beaches and high levels of disturbance, at least 7 pairs attempted to breed here and 8 nests were located, representing 3.2% of the total breeding population in Florida. Most of the nesting occurred in and around the easternmost public beach access point, primarily in front of beach front houses. Six of the 8 nests had determinable fates. Three of these 6 (50%) nests hatched in posted areas, whereas another 3 of 6 (50%) nests were depredated. Only 3 pairs continued to nest throughout the season due to the high levels of human and pet disturbance. The remaining 4 pairs may have re-nested at St. Joseph State Park for the remainder of the season, as one of the banded individuals was observed with a nest at both locations. Posting of nesting and foraging areas should continue, preferably prior to the nesting season.

Windmark Beach is located from the eastern edge of Palm Point to the western edge of St. Joe Beach (1.0 km). The beach was very narrow, less than 5 m wide, dunes were absent, and development was continuous. There was no potential breeding habitat, and no snowy plovers were observed during the initial survey.

St. Joe Bay - Includes *St. Joe Beach*, a developed beach located along St. Joe Bay (1.5 km). It is located from the eastern edge of Windmark Beach to Highland View before Port St. Joe Bridge, Gulf County. The beach is very narrow (<5 m wide), highly vegetated, and continuously developed. Highland View is an area of dredge spoil and represents the only area on St. Joe beach with potential habitat. However, due to recreation activities such as beach driving, nesting did not occur. No snowy plovers were observed during the nesting season. Highland View could support snowy plovers if vehicular traffic is limited and mid-beach areas are posted prior to the nesting season.

St. Joe Peninsula – Includes *St. Joe Peninsula*, the developed area of the peninsula, located between Cape San Blas to the east and St. Joseph SP to the West, Gulf County (9.5 km). The beaches were relatively narrow, had intermittent dunes, and were continuously developed with beach front homes. There were small pockets of potential habitat, but due to high levels of human and pet disturbance, breeding did not occur. There were no snowy plovers observed during the initial survey.

St. Joseph SP - Includes *St. Joseph SP*; administered by the DEP- Florida State Parks and located from the tip of St. Joe Peninsula to the eastern park boundary, Gulf County (13.0 km). The easternmost beaches were narrow to moderately wide, containing isolated areas of shell microhabitat, with small pockets of nesting habitat among continuous steep vegetated dunes (2-10 m high). Public access was localized towards the eastern park boundary, as only the first 3 km had boardwalks for beach access. The western tip of the peninsula had wide beaches, an abundance of shell microhabitat, large tidal pools for foraging, and a sparsely vegetated dune system directly behind the nesting areas. Public access on the tip was not limited, as recreational boaters could land at any location, particularly on holidays and during the months of June and July. At least 28 pairs

attempted to breed, with a total of 41 nests located, representing 12.6% of the total breeding population in Florida. A substantial amount of nesting occurred at the tip of the peninsula, where 13 of the 41 (32%) total nests were observed. Only 30 of the 41 nests had determinable fates. Although there were numerous nesting attempts, success was very low, in particular because 20 the 30 (67%) nests with a determinable fate were depredated. Predator tracks observed at nests were from coyotes and ghost crabs. Although large flocks of laughing gulls were observed loafing near nesting areas, tracks were never seen around nests. Of the 20 depredated nests, 9 were by coyotes, 3 from an unknown source, possibly avian, and 8 by ghost crabs. Only 7 of the 30 (23%) determinable nests successfully hatched. In addition, 1 nest was abandoned where human disturbance was high, 1 nest was trampled where recreational boaters land, and 1 was flooded by Tropical Storm Alberto. A total of 8 families were observed, one of which emerged from an undiscovered nest. Towards the end of the season, a few least terns and 1 pair of black skimmers attempted to nest at the tip of the peninsula. Despite posting efforts, these nests were not successful and were depredated by an unknown source. Posting efforts of nesting and foraging areas should continue, particularly at the western point, where the number of nesting attempts was highest.

Cape San Blas - Includes *Cape San Blas* and *Indian Pass*; administered in part by Gulf County and Eglin AFB, Gulf County (12.8 km).

Cape San Blas is located between St. Joseph Peninsula to the west and Indian Pass to the east (4.6 km). The western portion of Cape San Blas is administered by Gulf County and the eastern portion by the Eglin AFB. This area appeared to contain good habitat, comprised of wide beaches with frequent pockets within a vegetated low dune system, and freshwater and tidal pools for foraging. However, vehicles were allowed to drive on the beaches during daylight hours under a Gulf County ordinance. Human and pet disturbance was high from individuals coming from Salinas Park or anywhere along County Highway 30E. Due to the high disturbance, territorial snowy plovers were not observed, even though 2 nests were located during the 2002 nesting season (Lamonte et al, 2006). Two Wilson's plover nests were located during the 2006 breeding season within the Eglin AFB managed portion. Protection efforts of nesting areas should continue, with posting of nesting areas and limiting of vehicular traffic during the breeding season.

Indian Pass is located to the west of Cape San Blas (8.2 km). The beaches were relatively wide, had intermittent dunes, and were continuously developed with beach front homes. Due to continuous development and presence of beach driving, human disturbance was high. One pair of snowy plovers was observed here in February, but disappeared soon after the tourism season began. As there were no snowy plovers observed on subsequent surveys, this site was dropped.

Mainland Shoreline from St. Vincent to Alligator Point - The mainland shoreline includes *Yent Bayou*, *Carrabelle Beach*, and *Turkey Point*, following the shoreline to the east tip of Alligator Point in Alligator Harbor, Franklin County (99.4 km). The mainland shoreline includes the bayside of the barrier islands and contains suitable habitat at only 3 small beach areas.

Yent Bayou is located along U.S. Highway 98 next to Royal Bluff (1.4 km).

Carrabelle Beach is located near the town of Carrabelle, along U.S. Highway 98 at the Carrabelle Beach Picnic Area (2.0 km).

Turkey Point is located along U.S. Highway 98 near St. Teresa (1.0 km). The beaches are all relatively narrow, with low vegetated intermittent dunes, and had many public access points. No snowy plovers were observed during the breeding season, as the beaches received high human and pet use. Development projects by the St. Joe Company at Turkey Point created additional disturbance during the 2006 breeding season.

St. Vincent National Wildlife Refuge (NWR) - Includes *St. Vincent NWR*; administered by the DOI - U.S. Fish and Wildlife Service and is located to the east of St. Joe Peninsula and to the west of Little St. George Island, Franklin County (12.6 km). The western and eastern edges of the island had wide beaches with large blowout areas, intermittent vegetated low dunes, numerous freshwater and tidal pools for foraging, and isolated public access. Most of the breeding snowy plovers, least terns, and American oystercatchers were observed within a 2-km radius of either end. The middle of the island does not support nesting snowy plovers, but was important for brood foraging. The beach ranges from narrow to relatively wide, small tidal pools are numerous

for foraging, low dunes are present in places with a thick forest directly behind, and human disturbance is low due to no developed access points. Although suitable habitat appears to be present, snowy plovers were not observed nesting in this part of the beach, perhaps due to the higher presence of predators in the adjacent forested areas. Public access is only provided by personal boats or the occasional refuge tour. Recreational boaters typically accessed only the western tip of the island. A substantial amount of nesting occurred at the western end of the island in and around posted nesting areas, where 12 of the 16 (75%) total nests were observed. Twelve pairs collectively attempted to breed on most of St. Vincent, with a total of 16 nests located, representing 5.0% of the total breeding population in Florida. Thirteen of 16 (87%) nests hatched. Despite the high presence of predators, only 2 of 16 nests (13%) were depredated, both by ghost crabs. Tracks from red wolves, feral pigs, and raccoons were observed in abundance at St. Vincent, but none were seen in close proximity to snowy plover nests. Least terns also attempted to nest in 2 locations along the eastern tip of the island. All least tern nests were assumed to have been depredated by raccoons due to the presence of tracks around nests. Posting of nesting and foraging areas should continue at the western tip and should be implemented at the eastern tip where snowy plovers, American oystercatchers and least terns nested.

Little St. George Island – Includes *Little St. George Island*; administered by the DEP through the Apalachicola National Estuarine Research Reserve and is located between St. Vincent NWR to the west and St. George Island to the east, Franklin County (14.9 km). The beaches were narrow to wide, becoming wider to the east, with an intermittent low dune system, numerous large flat open dune pockets, freshwater and tidal pools for foraging, and low levels of human disturbance. The beaches were also covered in large quantities of shell debris from the 2005 storm season, providing ideal nesting habitat throughout. Human disturbance from recreational boaters was highest at the eastern end, nearest the developed west end of St. George Island. Although there was no apparent difference in habitat on Little St. George Island, a substantial amount of nesting occurred on the western portion of the island, where 18 of the 21 (86%) total nests were observed. On the other hand, least terns and American oystercatchers were more abundant on the eastern portion of the island. Sixteen pairs attempted to breed on Little St. George, with a total of 21 nests located, representing 7.2% of the total breeding population in Florida. Sixteen of the 21 nests had determinable fates. Fourteen of these 16 (88%) nests hatched. Despite the high presence of predators, only 1 of 16 nests (6%) was depredated. One 3-egg nest that was located near a service road was also abandoned for unknown reasons. A total of 17 families were observed, three of which emerged at the beginning of the breeding season from undiscovered nests. Tidal pools for brood foraging were frequent through the site. At least 5 pairs of American oystercatchers attempted to nest, and 2 broods made it to fledging. Two pairs of Wilson's plovers also nested in the open dune pockets, and broods made it to fledging. One colony (30-50 nests) of least terns and one pair of black skimmers attempted to nest on 2 occasions. However, raccoons depredated all nests during both occasions.

St. George Island - West End - Includes *St. George Island - West End*; located to the east of Little St. George and borders the St. George SP western Boundary, Franklin County (17.4 km). The beaches were wide, had intermittent dunes, an absence of tidal pools, and continuous development with beach front homes, shops, and hotels. Due to high levels of human, pet, and vehicular activity on the beach fronts, there was no potential breeding habitat. There were no snowy plovers observed during the initial survey.

St. George State Park - Includes *St. George State Park*; administered by the DEP - Florida State Parks and is located between the western park boundary and to the west of Dog Island, Franklin County (13.8 km). The beaches were wide, becoming wider to the east, with an open interdune area with many small pockets of nesting habitat among continuous dunes, numerous bay and gulf side tidal pools for foraging, and low levels of human disturbance on the western end. The beaches were also covered in large quantities of shell debris from the 2005 storm season, providing ideal nesting habitat throughout. The dune system and shell debris provided ideal nesting habitat for snowy plovers and Wilson's plovers, least terns, and American oystercatchers. Human disturbance was localized at the west end due to the lack of access throughout the park. The majority of park development, including the public road, was destroyed during the 2005 storm season. For the 2006 breeding system, most of the state park was closed to the public. At least 13 pairs attempted to breed at St. George State Park, with a total of 20 nests located, representing 5.9% of the total breeding population in Florida. Only 15 of

the 20 nests had determinable fates. Eleven of these 15 (73%) nests were confirmed hatched, and 2 of 15 (13%) were depredated by a coyote and ghost crabs, as evidenced by predator tracks around the nests. The 5 other nests with unknown fates were possibly depredated by avian sources, as the eggs disappeared, but no predator tracks were located in the vicinity of the nests. Two nests were also abandoned for unknown reasons. At least 6 American oystercatchers attempted to nest, but only 1 brood made it to fledging, and all others were depredated. Two large colonies of least terns (>50 nesting adults) attempted to nest, but were depredated by laughing gulls. With posting of nesting areas and continued predator control, this area might support additional nesting snowy plovers. Upon reconstruction of the park access road, posting efforts will be essential in maintaining current nesting areas.

Dog Island - Includes *Dog Island*; has fragmented ownership, as portions of the western and the eastern tip are administered by the Nature Conservancy, and the rest of the island is privately owned. Dog Island is a barrier island and is located to the east of St. George SP and to the west of Lanark Reef, Franklin County (10.0 km). Most of the snowy plover nesting occurred on the eastern tip, where the beaches were relatively wide, had continuous low dunes, tidal pools for foraging, and a lack of development. Nesting also occurred on the western tip, where beaches were relatively narrow, had intermittent low vegetated dunes (1-2m), tidal pools for foraging, and vacation homes. Two washover areas, referred to as the 1st and 2nd narrows, in the middle of the island also had potential habitat, beaches were narrow, dunes were absent, and there were a few vacation homes. The rest of the island was either highly vegetated or developed and thus lacked suitable nesting habitat. Human disturbance was not limited at any point, but was highest in the middle developed portion and at the eastern tip, as recreational boaters could access all of the island's beaches despite posting attempts to keep trespassers out. Dog Island provided nesting habitat for snowy plovers, Wilson's plovers, least terns, black skimmers, and American oystercatchers. At least 7 pairs of snowy plovers attempted to nest on Dog Island, with a total of 10 nests located, representing 3.2% of the total breeding population in Florida. Nine of which had determinable fates. Five of these 9 (56%) nests were confirmed hatched in posted areas, whereas another 4 of 9 (44%) nests were depredated. Raccoons probably depredated 1 nest and possibly 3 others that disappeared before the estimated hatch date where predator tracks did not appear. Black skimmers and least terns nested in posted nesting areas at the narrows. Despite some human disturbance and presence of predators, many black skimmer and least tern nests were successful and many broods fledged. Continued posting and enforcement of nesting and foraging areas should be implemented to improve the nesting habitat quality. Predator control for raccoons should be considered, as they were numerous and could impact nesting success.

Lanark Reef - Includes *Lanark Reef*; a barrier island located to the east of Dog Island, Franklin County (9.7 km). The beaches were narrow, with small vegetated pockets that might represent potential breeding habitat. Dunes were absent, had frequent tidal pools for foraging, and there was low human disturbance. Snowy plovers are known to winter here, but no snowy plovers were observed during the initial survey. Birds may not nest here due to the frequency of tidal washouts. However, this site probably functions as an important stopover area.

Phipps Preserve - Includes *Alligator Point - Phipps Preserve*; administered by the Nature Conservancy and is located from the tip of Alligator Point to the eastern boundary at the developed beach (2.2 km). This is the easternmost breeding site in Northwest Florida. The habitat contained wide beaches and low dunes with small pocket openings and tidal pools for foraging. The dune pockets provided ideal nesting habitat for snowy plovers, Wilson's plovers, and American oystercatchers. However, due to unauthorized entry by recreational boaters, snowy plovers abandoned these nesting areas early in the breeding season. At least 1 pair of snowy plovers nested, with 1 nest located in front of the dunes. The fate of this nest was unknown, as the nest and the pair of snowy plovers disappeared over a two-week interval. Despite posting efforts to close the beaches, human and pet impact was high. Two pairs of American oystercatchers made 2 attempts to nest and both disappeared prior to hatching. Eight pairs of Wilson's Plovers nested, which were more successful due to their strategy of nesting in the vegetated low dunes. Earlier posting and enforcement will be necessary to maintain this site as a nesting area.

Bald Point - Includes *Alligator Point developed beach*, *Bald Point developed beach*, and *Bald Point State Park*, Franklin County (11.1 km).

Alligator Point - developed beach is located to the east of Phipps Preserve and to the west of Bald Point developed beach (4.5 km). The beaches were very narrow, and had continuous development and high levels of human and pet disturbance. There was no potential habitat and no snowy plovers were observed during the initial survey.

Bald Point - developed beach is located to the east of Alligator Point and to the west of Bald Point SP (3.6 km). The beaches were narrow, with small pockets of sand blowouts, and had continuous development and high levels of human and pet disturbance. Suitable habitat occurred at one isolated blowout area, but no snowy plovers were observed due to high disturbance levels.

Bald Point SP is administered by the DEP - Florida State Parks and is located to the east of Bald Point developed beach (3.8 km). The beaches were narrow, with intermittent low vegetated dunes, sand blowout areas, and development. The disturbance frequency was moderate from people and pets. There were areas of intermittent suitable habitat, yet no snowy plovers were observed here throughout the breeding season.

Alligator Point Franklin County East and south to Tarpon Springs - This region was not surveyed for breeding snowy plovers. It was considered to have very little suitable habitat. Much of the region along the coast was marshy and contained few beaches. Snowy plovers might use this region to stopover when moving from Northwest Florida to Southwest Florida. However, it is unlikely that snowy plovers breed in this area in significant numbers.

North Anclote Bar to south end of North Clearwater Beach - Includes *North Anclote Bar*, *Anclote Key SP*, *Three Rooker Bar*, *Honeymoon Island*, *Caladesi Island SP* and *North Clearwater* beach in Pasco and Pinellas Counties (23.1 km). These sites typically had long stretches of narrow beach with the north and/or south ends providing suitable habitat for breeding snowy plovers. Between all the sites, there were at least 13 breeding pairs. Florida state park personnel protected breeding areas by roping areas off beginning in April. Nests that were found to be outside a roped area were notified to state park management and subsequently roped off.

North Anclote bar is the northernmost island off Tarpon Springs (1.0 km). There was no development, dunes were small and intermittent, and the south end had a sandflat. Human use of this site was by boat only and was moderate to high. The site is small and it doesn't take many people to disturb the area. At least 2 pairs attempted to nest here. We found 1 nest and confirmed it hatched. We observed another family from an undiscovered nest for a total of 2 families.

Anclote Key SP is located just south of North Anclote Bar about ¼ mile and is administered by the DEP- Florida State Parks (5.2 km). Three sites are included here, *Anclote Key SP North* and *South*, and *Bar south of Anclote Key*. Plovers were observed once on the north end and sporadically on the south end. At least 1 pair of breeding birds was documented at Anclote Key SP South although no nests were located. These areas were not roped off and disturbance from visitors probably precluded snowy plovers from breeding at this site. One snowy plover pair was observed nesting at the Bar south of Anclote Key in a colony of least terns. This small sandbar was roped off but tropical storm Alberto wiped out any active nests.

Three Rooker Bar is about a mile south of Anclote Key. It is separated into 2 small islands (North and South) which compromise a total length of (4.2 km). There was no development and recreational use varied from light to heavy. Suitable habitat on the north and south ends were capable of supporting a few pairs of plovers. No pairs were observed during our surveys.

Honeymoon Island SP is administered by the DEP- Florida State Parks and is located outside Dunedin and close to Three Rooker Bar. Honeymoon Island was divided into 2 sites, a north and south end, divided by rocks and a seawall and comprises a total length of (5.4 km). Development was minimal but recreational use was typically high, especially at the south end. Habitat on the north end supported 2 snowy plover pairs and 1 nest was observed. This nest was washed out by high tides. At least 1 pair nested at the south end, with 1 located nest. This nest hatched 1 chick.

Caladesi SP is administered by the DEP- Florida State Parks and is located just across from Honeymoon Island. It is accessible by ferry at Honeymoon Island or by walking from North Clearwater Beach. The beach

length comprises (3.4 km) and has suitable habitat mainly at the north end, although plovers were found to be throughout the site. There was no development and recreational use was light to moderate. The north end of Caladesi was roped off supporting beach nesting birds. Caladesi supported at least 4 pairs and 3 nests were found but none were successful. Two nests were depredated and 1 was abandoned.

North Clearwater Beach is immediately adjacent to Caladesi and runs (3.9 km) before becoming Clearwater Beach. Suitable habitat was located at the far north end at Dunedin pass adjacent to Caladesi. The northern part of North Clearwater Beach was undeveloped and received light to moderate use. The southern end was highly developed and received moderate to high recreational use. One breeding pair was found at Dunedin pass where it successfully hatched a nest just south of the Caladesi boundary.

Clearwater Beach to south end of Pass-a-Grille Beach - Includes *Clearwater Beach*, *Indian Rocks Beach*, *Treasure Island*, and *St. Petersburg Beach / Pass-a-Grille Beach* in Pinellas County (34.0 km).

Clearwater Beach is located just south of North Clearwater Beach and runs (1.6 km) to Clearwater Pass. The beach was highly developed and there was no breeding snowy plover habitat.

Bellair/Madeira/Indian Rocks Beach is located between Clearwater Pass and Johns Pass and is (20.7 km) long. The beach was highly developed and there was no breeding snowy plover habitat.

Treasure Island is located between Johns Pass and Blind Pass (5.4 km). The beach was highly developed and there was no breeding snowy plover habitat.

St. Petersburg Beach / Pass-a-Grille Beach is located between Blind Pass and Pass-a-Grille Pass (6.3 km). The beach was highly developed and contained no snowy plover breeding habitat.

Northwest end of Shell Key to south end of Passage Key - Includes *Shell Key*, *Fort Desoto*, and *Egmont Key* in Pinellas, Hillsborough, and Manatee Counties (14.1 km).

Shell Key is located between Pass-a-Grille Beach and Fort Desoto (2.8 km). The beach was fairly narrow with an undeveloped dune system and had no development. Recreational use was light to moderate but fairly high at the northeast end of the key. No snowy plovers were seen on the first 3 visits and the site was dropped subsequently thereafter.

Fort Desoto North is located between Fort Desoto West and Shell Key (2.1 km). The beach was wide in some spots, a fairly developed dune system with no development. Recreational use was moderate to heavy. A pair of snowy plovers was observed but no evidence of breeding. The site was dropped after 4 surveys due to no breeding snowy plovers observed.

Fort Desoto West is located between Fort Desoto North and Fort Desoto East (1.9 km). The beach was narrow, moderately developed, highly utilized and contained no snowy plover breeding habitat.

Fort Desoto East is located between Tampa Bay and Fort Desoto West (4.5 km). The beach was very narrow, moderately developed and contained no snowy plover breeding habitat.

Egmont Key is a small island in the mouth of Tampa Bay between Fort Desoto and Passage Key. It had about 2.9 km of beach facing the gulf. The island had a narrow beach, little development and did not contain suitable habitat. The site was dropped from the survey after not observing any plovers on the initial visit.

North end Anna Maria Island to south end of Siesta Beach - Includes *Anna Maria Island*, *Longboat Key*, *Lido Beach*, and *Siesta Key* in Manatee and Sarasota Counties (36.3 km). These islands had patches of suitable habitat in otherwise, long stretches of developed, highly used beaches. Several areas were roped off prior to the breeding season to protect nesting colonies. Any plover nest found outside a roped area was immediately posted. Since habitat is discontinuous on these barrier islands, snowy plovers were very likely to move between patches of suitable habitat. Although not proven, it is likely the pair on South Lido beach is the same pair that successfully bred on Siesta beach. This geographic region is not likely to support a high number of snowy plovers. However, this region is surrounded by long stretches of unsuitable breeding habitat and could provide an important link between the northern most and southern most geographic regions.

Anna Maria Island is located between Tampa Bay and Lido Key (11.8 km). Much of the island was highly developed, heavily used, and had unsuitable habitat. At the northern end the beach was wide, lightly used, and had suitable breeding habitat supporting at least 1 snowy plover pair. The area was roped off in April. One nest was found inside the roped are but was unsuccessful due to predation.

Longboat Key is located between Anna Maria Island and Lido Key (16.0 km) and is divided into 2 sites, North and South. Much of the beach was highly developed with a slightly developed dune system in some areas. Recreational use was light to heavy depending on the area. Suitable habitat was found towards the north and south ends. At least 1 breeding pair nested on Longboat Key with 2 nesting attempts. Both were located towards the north end. The first attempt was unsuccessful due to predation, but the second nest successfully hatched.

Lido Beach is located between Longboat Key and Siesta Key (3.9 km) and is divided into 2 sites, North and South. Most of Lido Key was highly developed with high recreational use and no suitable breeding habitat. The southern tip and northern end of Lido Key contained suitable breeding habitat with wider beaches, little development, and a more developed dune system. One pair nested at the south end but quickly abandoned due to high disturbance. At the northern end, 3 pairs nested producing 3 nests, 2 of which were successful.

Siesta Key included the north end from Big Sarasota Pass south to Turtle Beach (4.6 km). Siesta beach was highly developed and received moderate to high recreational use. The beach was also relatively flat and can be flooded at high tides or after a moderate downpour. A wide beach area with some dunes contained suitable breeding habitat and supported 1 breeding pair. One family was observed late in the breeding season from an undiscovered nest.

South Siesta Key to south end of Manasota Beach - Includes **Turtle Beach**, **Casey Key**, **Venice Beach**, and **Manasota Key** in Sarasota and Charlotte Counties (39.9 km).

Turtle Beach is located between Siesta Key and Midnight Pass on Casey Key (3.4 km). Midnight Pass is closed and Casey and Siesta Keys are connected. This beach doesn't have a lot of development but was very narrow and heavily used. There was no suitable breeding habitat.

Casey Key is located between Turtle Beach and Venice Beach (11.4 km). The beach was lightly developed, moderately used but was narrow in almost all spots. It contains no suitable breeding habitat.

Venice Beach is located between Casey Key and Manasota Key (5.9 km). This beach was highly developed and moderately to highly used. Most of the beach was wide, contained some small dunes and was capable of supporting snowy plovers. However, beach nourishment was recently completed and left a steep escarpment that discouraged snowy plovers to breed in this habitat.

Manasota Key is located between Venice Beach and Stump Pass State Park (19.3 km). This beach was highly developed, narrow and contained no suitable breeding habitat for snowy plovers.

Stump Pass SP to north end Gasparilla Island - Includes **Stump Pass SP Don Pedro Island**, **Little Gasparilla Island**, and the north end of **Gasparilla Island** in Charlotte County (18.4 km).

Stump Pass SP is administered by the DEP- Florida State Park and is located between Manasota Key and Stump Pass (1.8 km). The south tip of the state park recently underwent land management and did not provide any suitable breeding habitat for snowy plovers. It may provide breeding habitat in the future. The rest of the state park was moderately used and had a narrow beach unsuitable for breeding snowy plovers.

Don Pedro Island is located between Stump Pass SP and Little Gasparilla Island (7.3 km). Palm Island Resort occupies most of this site, particularly the north end, managed in conjunction with Charlotte County. There was a large buffer between the beach and the resort containing a large lagoon and a wide dune system. Available breeding habitat for shorebirds was roped off prior to the breeding season. Access to the island was by boat or car ferry which limited recreational use. Predators may be more a concern. The beach was wide in spots and suitable habitat was found in front of and behind the lagoon. This area supported 3 breeding pairs of snowy plovers. There were 6 nesting attempts with only 1 nest being successful producing 2 fledglings. All other nests were depredated.

Little Gasparilla Island is located between Don Pedro Island and Gasparilla Pass (3.3 km). The pass between Don Pedro and Little Gasparilla had closed and is continuous. Little Gasparilla was moderately developed with houses, lightly to moderately used in spots, and narrow. At the south end there was a sandflat that had a wide beach and some suitable breeding habitat capable of supporting a snowy plover pair. An undiscovered nest was successful producing 2 chicks at the south end.

Gasparilla North is located between Gasparilla Pass and Gasparilla South (6.0 km). This beach is private, not easily accessible, and received light to moderate use. However, the suitable habitat was in a small

area and in a couple patches at the north end. The area was not roped off and even light use of the beaches can disrupt breeding plovers. At least 2 pairs of snowy plovers attempted to nest with 2 nests located. Both nests were unsuccessful. One family was observed later in the season from an undiscovered nest. To support breeding plovers and other nesting shorebirds this area may need to be roped off prior to nesting season in February or March.

Gasparilla Island South - Includes *Gasparilla Island South SP*; located from the end of the breeding area at the north end of Gasparilla Island to the lighthouse at Boca Grande Pass (2.3 km) in Lee County. The south end is administered by the DEP- Florida State Parks. Beaches were narrow, interspersed with seawalls, heavily used, and did not contain any suitable habitat. This region did not contain any snowy plovers.

Cayo Costa to south end of North Captiva Island - Includes *Cayo Costa* and *North Captiva* in Lee County (16.5 km).

Cayo Costa SP is located between Gasparilla Pass and Captiva Pass (10.5 km). Cayo Costa SP is an undeveloped barrier island state park administered by the DEP- Florida State Parks. Recreational use was relatively light due to limited access. Suitable breeding habitat was found in two separate areas and were posted and roped off prior to the nesting season. These breeding areas had a wide beach compared to the rest of the island where the beach was narrow and lined with trees. This site supported at least 5 pairs of breeding snowy plovers; 3 pairs at the north breeding area and 2 pairs at the south breeding area. Over the course of the breeding season 6 nests were located with 2 hatching. Predators were a major problem with large populations of raccoons, crows, and feral pigs likely affecting nest success.

North Captiva is located between Captiva Pass and Redfish Pass (5.9 km). Development was moderate at the north end but most of the island was undeveloped. The beach is fairly wide in spots but snowy plovers are not known to breed here. In August 2004, Hurricane Charley blew through the middle of North Captiva cutting a pass that created a sand flat on either side. Both sides of the pass had suitable habitat with the north side having a larger area. This newly created habitat supported 3 pairs of breeding plovers. The area was accessible by boat only or by walking from the north end of North Captiva. Visitor use was typically light but the area was popular with boaters. Because the suitable habitat was small and not roped off, even light use (1-2 boats) could disrupt breeding shorebirds in a short amount of time. Breeding snowy plovers attempted two nests, both unsuccessfully. Management should minimize disturbance by posting and roping the area before the breeding season.

Captiva Island

Includes *Captiva Island* and is located between Redfish Pass and Sanibel Island in Lee County (7.9 km). There have been no historical records of snowy plovers breeding on Captiva and no snowy plovers were observed. Captiva was moderately developed, received moderate use, was regularly raked, and did not contain any suitable habitat.

Sanibel Island to Big Hickory Island - Includes *Sanibel Island*, *Fort Myers Beach*, *Little Estero Island*, *Lovers Key*, and *Big Hickory Island* in Lee County (34.1 km).

Sanibel Island is located between Captiva Island and San Carlos Bay (19.8 km), is administered by the Sanibel-Captiva Conservation Foundation, and is divided into 3 sites, West, Central, and East. Sanibel Island is considered the most important breeding area for snowy plovers in the Southwest region of Florida, having the largest percentage of the Southwest breeding snowy plover population. Development on Sanibel was typically moderate to high but low at the north end of the island. A heavily vegetated dune buffer of about 50-100 m separated the development and the beach in most areas. Beach width was widest at the north end of island due to recent beach nourishment. Visitor use was high in the early part of the breeding season but declined as the summer progressed. Visitor use tended to be higher at the east and south end of the island where development was more concentrated. A full time technician monitored Sanibel Island everyday for nesting snowy plovers. Once a nest was found, posts and ropes were immediately put up to protect the nest. Over the course of the season, 6-8 breeding pairs of snowy plovers were observed. All the nests occurred on Sanibel East with at least 5 breeding pairs documented. The northern and western half of Sanibel Island was surveyed regularly, but no

breeding pairs were observed. Approximately 15 nests were located, 5 of which were confirmed hatched. At least 5 young fledged during the season. Three nests were depredated and 6 failed by either abandonment or flooding.

Fort Myers Beach is located south of Sanibel Island (8.3 km). Fort Myers beach was continuously developed with high levels of human disturbance. Small areas of suitable habitat were present, but the remainder of the beaches were heavily used and raked periodically. No snowy plovers were observed here.

Little Estero Island is located between San Carlos Bay and Lovers Key (2.5 km) and is directly adjacent to Fort Meyers Beach where it is heavily developed and receives high visitor use. The only suitable habitat was south of the Holiday Inn at the south end of Estero. There is an established Critical Wildlife Area and the area was posted and roped before the start of the breeding season. The habitat was able to support 1 pair of breeding snowy plovers. One pair was observed at the beginning of the nesting season but no known nesting attempts were recorded.

Lovers Key SP is located between Estero Island and Big Hickory Island (2.7 km) and is divided into 2 sites, North and South. Lovers Key SP is administered by the DEP - Florida State Parks and had recently undergone habitat management for nesting shorebirds. Development was minimal, moderate visitor use, and the beach was narrow at the north and south ends. Although no snowy plovers were recorded on surveys, this area has potential for nesting snowy plovers. It may be able to support a few breeding pairs if management and beach restoration of nesting areas continues.

Big Hickory Island is located between Lovers Key SP and Bonita Beach (0.7 km). Big Hickory Island is under private ownership and can be heavily used by people. The beaches were narrow and contained no suitable breeding habitat.

Bonita Beach to Naples - Includes **Bonita Beach**, **Barefoot Beach**, and **Naples Beach** in Collier County (9.1 km).

Bonita beach is located between Big Hickory Island and Barefoot Beach (4.1 km). This beach was highly developed, received high recreational use and had no suitable breeding habitat.

Barefoot Beach is located between Naples Beach and Bonita Beach (5.0 km). This beach was lightly developed, received high visitor use. The beaches were narrow and contained no suitable breeding habitat.

Keywadin Island to Cape Romano - Includes **Keywadin Island**, **Caxambas Sandbar**, **Big Marco Pass Critical Wildlife Area**, **Kice Island**, **Cape Romano**, and **Cape Romano Large Sandbar** in Collier County (12.2 km).

Keywadin Island is located between Naples Beach and Caxambas Sandbar (0.5 km). The south end of Keywadin Island is owned and administered by the DEP staff from Rookery Bay National Estuarine Research Reserve, who roped off and closed areas for nesting shorebirds in mid-April. Public use was high on the south end of the island. Keywadin Island is only able to support a low number of snowy plovers. At least 1 breeding pair was documented, with 1 located nest.

Big Marco Pass Critical Wildlife Area is a 4-km long barrier beach managed by FWC located between Caxambas Sandbar and Kice Island (2.7 km). Nesting areas were posted from mid-April to mid-August, which decreased human disturbance to nesting birds. Four breeding pairs were observed during surveys the season, however only one nest was located and was confirmed hatched.

Caxambas Sandbar is located between Keywadin Island and Big Marco Pass Critical Wildlife Area (7.4 km). This Sandbar is designated as a Critical Wildlife Area and is managed by the FWC. There was no development, minimal visitor use and the entire sandbar was posted in mid-April. No snowy plovers were observed nesting at this site.

Kice Island is located between Big Marco Pass Critical Wildlife Area and Cape Romano (0.5 km). This island was undeveloped and had suitable breeding habitat at the north end. Two pairs of snowy plovers nested on a small stretch of beach at the north end and nests were posted and roped when found. This was the first record of documented nesting on Kice Island.

Cape Romano is located between Kice Island and Cape Romano Large Sandbar (1.1 km). This beach contained a small amount of marginal breeding habitat for snowy plovers. But no snowy plovers were observed breeding at this site.

Cape Romano Large Sandbar is located south of Cape Romano (0.1 km). This site was undeveloped and no snowy plovers were observed.