

**Final Report**  
**Western Snowy Plover Nesting**  
**at Bolsa Chica, Orange County, California**  
**2007**



photo by P. Knapp

Male snowy plover with newly hatched chick and unhatched egg

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## INTRODUCTION

Bolsa Chica is a coastal lowland area between two mesas, the Bolsa Chica Mesa and the Huntington Beach Mesa in Orange County, California (Figure 1). Bolsa Chica, which a century ago was under full tidal influence, has started to come full circle. Over 100 years ago, Bolsa Chica was diked-off from direct tidal influence but remained below mean sea level, becoming influenced by freshwater and a sump for local drainage. In 1978, restoration began on the State's Ecological Reserve, and muted tidal influence was restored to the Inner Bolsa Bay area. At that time, two small islands, North Tern Island and South Tern Island, were created for nesting California least tern (*Sternula antillarum browni*), a State and Federal endangered species.

In 1997, the Bolsa Chica lowlands were acquired into public ownership. This marked the beginning of a multi-agency effort to design, evaluate, and implement a plan for restoring the fish and wildlife habitats which had been cut off from the ocean for a century and an operating oil field for 50 years. Construction of the restoration project began in Fall 2004 and was completed in August 2006.

By the 2006 breeding season, 3 new nest sites were available for nesting and would augment the pre-existing North and South Tern Islands in Inner Bolsa Bay. The new ocean inlet, referred to as the Full Tidal Basin, was opened after the conclusion of the breeding season, August 24, 2006. The Full Tidal Basin is now subject to water level rise and fall that matches the unequal semi-diurnal tidal range of southern California's ocean waters.

The purpose of this investigation is to continue to improve the level of knowledge about the western snowy plover (*Charadrius alexandrinus nivosus*), a federally listed, threatened species that currently uses Bolsa Chica, and to attempt interim management actions to benefit the reproductive success of this species. In addition, this study will aid in assessing the success of the restoration projects and allow for modifications that would enhance utilization and increase reproductive success of the western snowy plover. This annual study was first initiated in 1997. This report addresses the 2007 snowy plover breeding season at Bolsa Chica.



Snowy Plover family foraging on Bolsa Chica mudflats.  
Photo: P.Knapp

## BACKGROUND AND CURRENT STATUS

The western snowy plover is a sparrow-sized, white and tan colored shorebird with dark patches on either side of the neck, behind the eyes, and on the forehead. The coastal western snowy plover population is defined as those individuals that nest adjacent to or near tidal waters and includes all nesting colonies on the mainland coast, peninsulas, offshore islands, adjacent bays, and estuaries. The breeding range of the coastal population of the western snowy plover extends along coastal beaches from the southern portion of Washington State to southern Baja California, Mexico. The Pacific coast population of the western snowy plover is reproductively isolated from the interior populations.

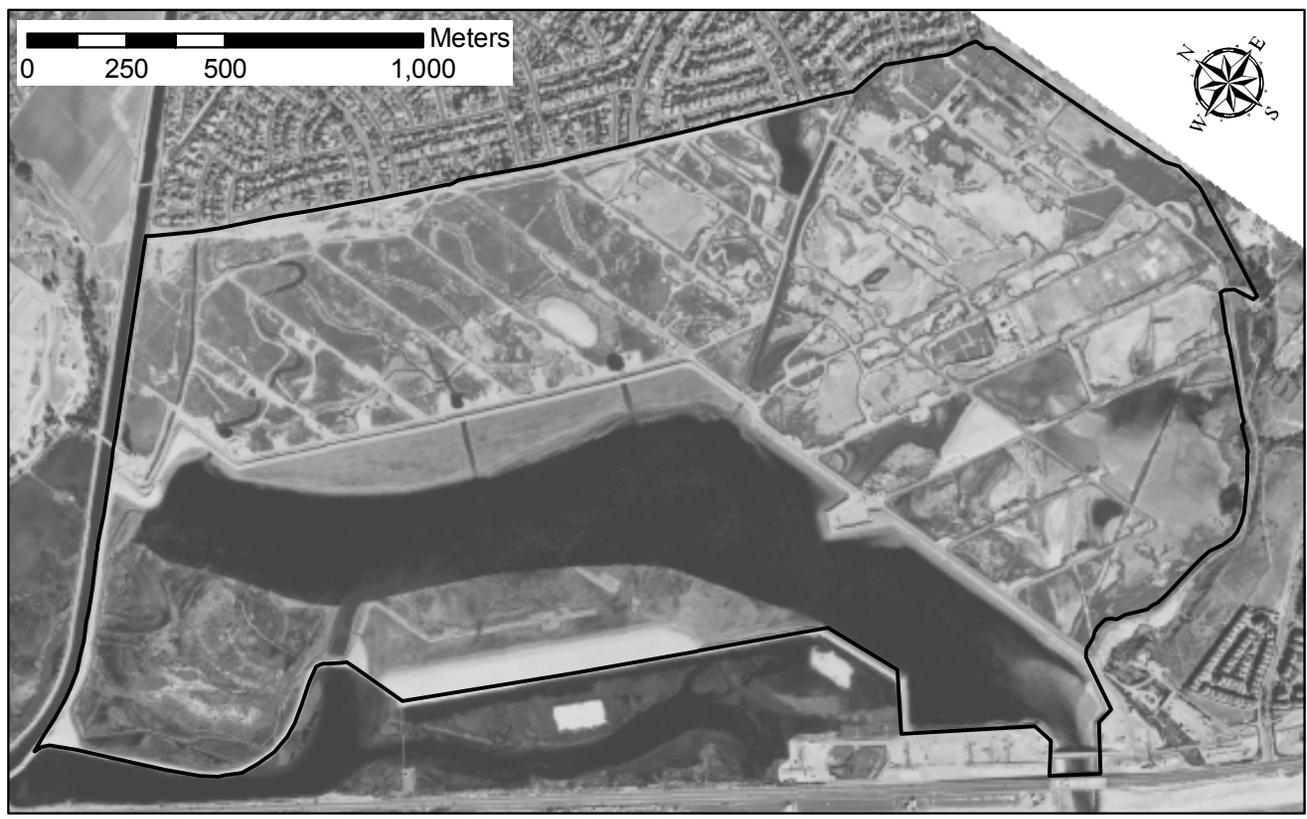
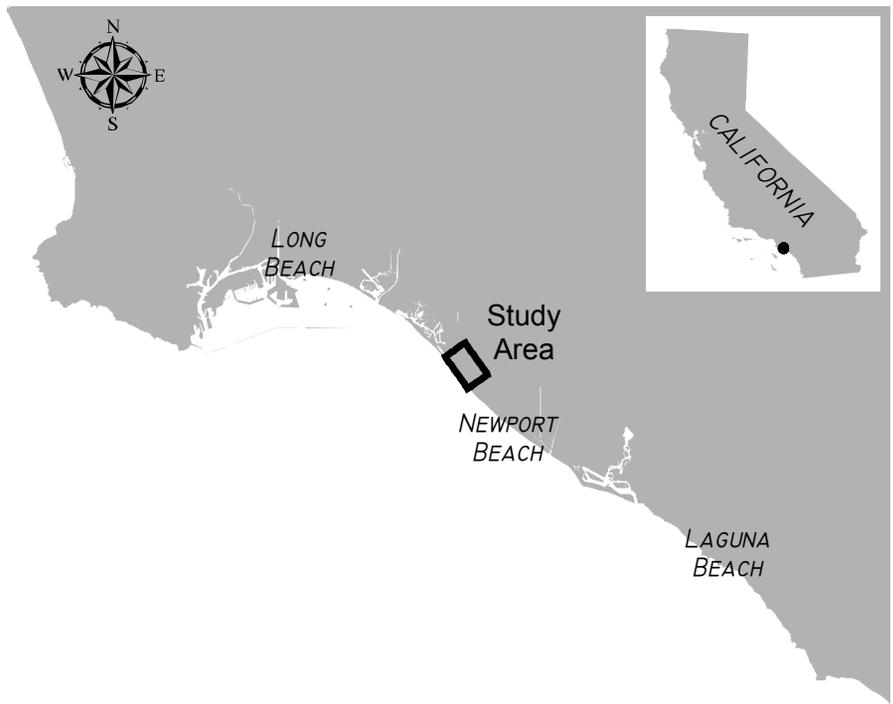


Figure 1. Bolsa Chica Vicinity Map

The breeding season of the western snowy plover extends from March 1 through September 15. Generally, 3 eggs are laid in a nest on the ground, which consists of a shallow depression scraped in the substrate. Some nests are lined with plant parts, small pebbles, or shell fragments. Both sexes incubate the eggs for an average of 27 days. Snowy plovers will renest after loss of a clutch or brood. Snowy plover chicks are precocial and leave the nest within hours of hatching in search of food. The tending adult(s) provide danger warnings, thermo-regulation assistance, and guide the chicks to foraging areas, but do not provide food to their chicks. Broods rarely stay in the immediate area of the nest. Young birds are able to fly within approximately 31 days of hatching.

Double brooding and polyandry are the typical. Snowy plover females may leave very young chicks to find another mate. The male typically tends the brood until the chicks fledge. Western snowy plover adults and young forage on invertebrates and insects (Page et al. 1995, Tucker and Powell 1999) along intertidal areas, beaches in wet sand and surf cast kelp, foredune areas of dry sand above the high tide, on salt panne, and edges of salt marshes and salt ponds. The snowy plover is primarily a run and glean type of forager.

Poor reproductive success resulting from human disturbance, predation, and inclement weather, combined with permanent or long-term loss of nesting habitat to urban development and the encroachment of introduced beach grass, has led to the decline in active nesting colonies as well as an overall decline in the breeding and wintering population of the western snowy plover along the Pacific coast of the United States. In southern California, the very large human population and the resultant beach recreation activities by humans have precluded the western snowy plover from breeding on historically used beach strand habitat. As a result of these factors, the Pacific coast population of the western snowy plover was federally listed as Threatened with extinction on March 5, 1993 (Federal Register 1993).

Studies from 1997-2007 have examined the scope, magnitude, and problems of snowy plover breeding activity at Bolsa Chica, before, during and after completion of the restoration project.

### **BOLSA CHICA STUDY AREA**

The study area includes several snowy plover nesting areas within Bolsa Chica. These nesting areas include: Seasonal Ponds (Cells 1 through 37), North Tern Island (NTI), South Tern Island (STI), Nest Site 1 (NS1), Nest Site 2 (NS2), and Nest Site 3 (NS3) (Figure 2). Some areas in the vicinity of the Bolsa Chica study area were not surveyed in this study, although western snowy plovers may have used the habitats for foraging or loafing. Those areas are the ocean beach immediately to the west at Bolsa Chica State Beach and Inner Bolsa Bay to the west of West Levee Road with the exception of NTI and STI (Figure 1). The study area also did not include Cell 64 (the Edwards Thumb), which remains in private ownership and a different oil lease.

The Seasonal Ponds are demarcated into subareas (cells) by the network of slightly elevated roads constructed decades ago for access to the oil wells. These cells were numbered and form the basis for observer navigation, nest mapping, and data recording. Each cell is unique in configuration and area. The approximate areas of some key cells are: Cell 10 (17 acres) and Cell 11 (54 acres). The seasonal ponds are predominantly soil or salt panne and the most dominant plant species is pickleweed (*Sarcocornia pacifica*). Some cells were thickly vegetated with pickleweed and considered unsuitable for western snowy plover nesting (Cells 41 through 50). Similarly, areas

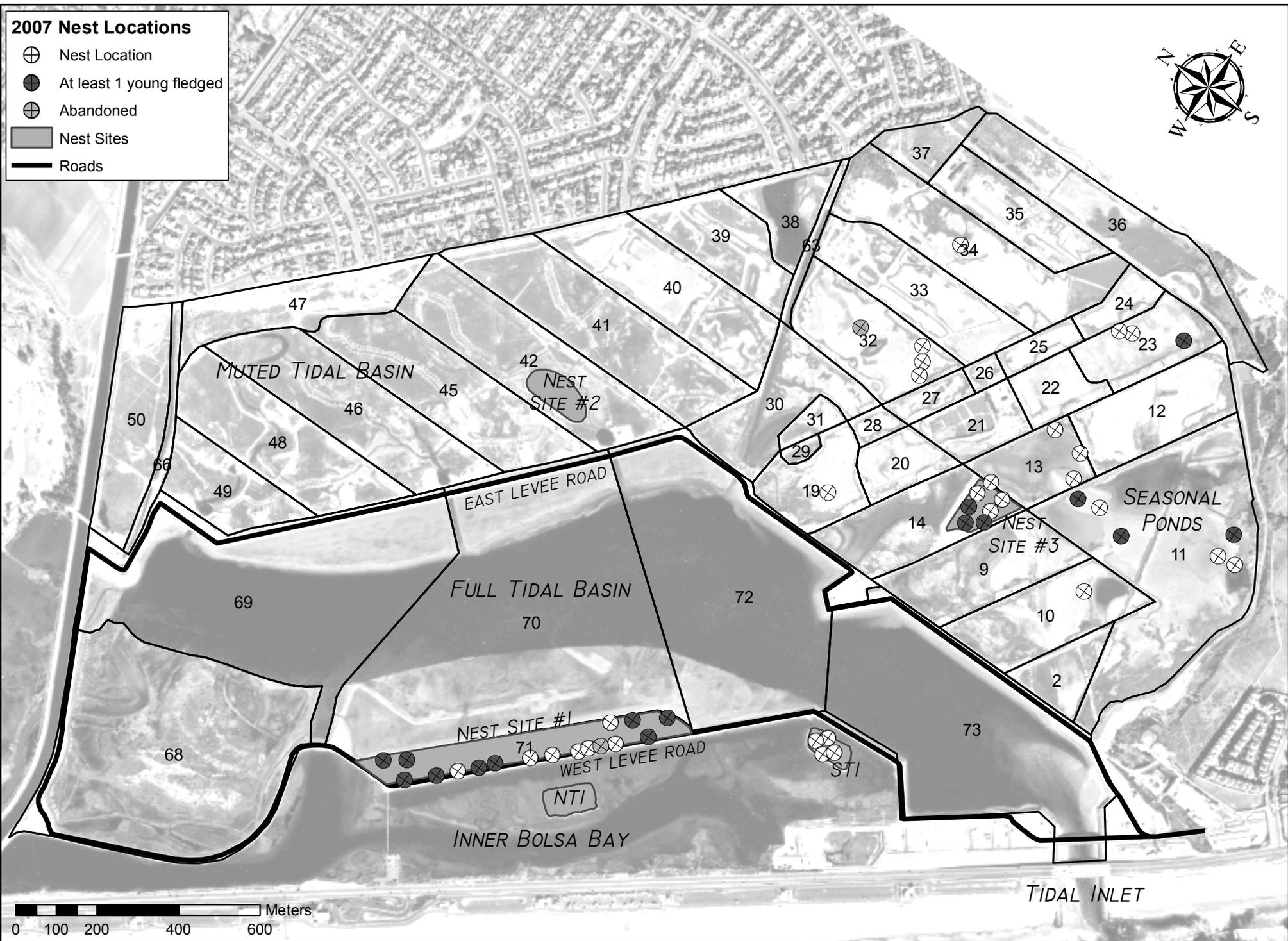


Figure 2. Distribution of Western Snowy Plover Nests in 2007 at Bolsa Chica

inundated by water during most of the breeding season (Cells 30 and 38) are unsuitable for nesting but the margins were regularly checked for nesting plovers.

NTI and STI are well-established created islands under muted tidal influence within Inner Bolsa Bay. The surface is dredge spoil with a developed boundary of intertidal or salt tolerant vegetation.

NS1 is a large linear nesting area between Inner Bolsa Bay and the Full Tidal Basin that was recently created during the restoration of the Full Tidal Basin. The surface is dredge spoil that forms a flat surface that extends from the West Levee Rd. towards the basin. The shoreline along the basin is now under full tidal influence. Beach primrose (*Camissonia cheiranthifolia*) is the primary vegetation on this site although there is some alkali heath (*Frankenia salina*), Parish's pickleweed (*Arthrocnemum subterminale*), and iceplant (*Mesembryanthemum* sp.) also found on the nesting site. Beach primrose, a perennial plant, was initiated and grew well on the nest site in 2006 but then died out primarily due to drought and soil conditions. In 2007 the vegetation was very sparse. The area along the shoreline lacks vegetation or debris that is normally found in a tidal area.

NS2 and NS3 are also newly created sites that are within Cell 42 and Cell 14, respectively. NS3 is within the Seasonal Ponds and NS2 is located in the Muted Tidal Basin. These sites were built up with fill and covered with sand. Winds have blown the sand from the surface of NS3 and there is very little live vegetation on either nest site. Foraging areas for snowy plover chicks are not readily available on these nest sites; therefore, they must leave the site immediately upon hatching to find foraging areas in the adjacent cells.

Public access is not allowed on any of the western snowy plover nesting sites. The human presence in the study area is mostly related to the operation of the oil field, consisting of large and small oil service vehicles and small work crews along the roads and well pads.

## STUDY METHODS

Beginning late-March, Peter Knapp (the primary surveyor) assisted by Kelly O'Reilly (California Department of Fish & Game (CDFG)), Loren Hayes (Volunteer), and Bonnie Peterson (Merkel & Associates) surveyed for nesting western snowy plovers at least twice a week, sometimes 4 or 5 times a week, until the beginning of September. Data collected during this study included the gender of the incubating adult, length of incubation (days), number of eggs in the clutch, condition of the nest (e.g. signs of disturbance), and the fate of each nest (hatched, predated, or abandoned). Observations were also recorded of western snowy plover distribution by cell number, throughout the study area, not just those birds associated with nests.

The large majority of suitable western snowy plover nesting habitat in the Seasonal Ponds was visible from the road network. Usually between 8 am and noon, the observer(s) would slowly drive in a motor vehicle along the roads that subdivide this area. Frequent stops were made to examine specific areas adjacent to the road with binoculars or spotting scope without exiting the vehicle. In this manner, it was possible to discover most nests within a few days of eggs having been laid. Most of the time, a nest was evident when an adult was incubating. Other times the adult was foraging or preening near the nest and soon returned to it. The observer would occasionally exit the vehicle in order to inspect an area not visible from the road or to verify the presence of eggs or chicks in a nest. Close examination of nests was usually conducted only once or twice per nest.

STI was surveyed by vehicle from the West Levee Road and on foot as part of the least tern surveys. NTI is used primarily by nesting elegant terns (*Thalasseus elegans*) and black skimmers (*Rynchops niger*).

NS1, NS2, and NS3 are sectioned by markers which form the basis for data recording. NS1 is sectioned south to north from A through CC. NS1 was surveyed by vehicle, in the same manner as the Seasonal Ponds, either from the West Levee Road or the eastern slope of NS1. Due to nesting patterns of least terns, black skimmers, and other terns, vehicle surveys were suspended mid-season other than from the West Levee Road north to Section M. NS1 was also partially surveyed on foot as part of least tern surveys from CC south to M. Each nest located on NS1 was marked with a numbered tongue depressor and mapped for ease of relocation on subsequent visits. NS2 was surveyed by vehicle from the East Levee Road weekly using a spotting scope and once a month on foot. There was no nesting activity on NS2 this season. NS3 was surveyed by vehicle from the north end of the site.

It was usually possible to follow the movements and determine the fate of chicks of each brood since there was dispersion over space and time sufficient to differentiate between broods. In a few cases banded adults identified specific broods, although banding of chicks has not been done at Bolsa Chica since 2000. Broods were observed 3 - 5 days per week. These regular brood observations were conducted to determine chick survival or fledgling production, as well as to detect movement between cells and use of specific cells for brood rearing.

A range-wide, breeding season window survey was conducted at Bolsa Chica in May 2007. The survey was conducted in the same manner as in previous years and in accordance to the guidelines set out in the Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (USFWS 2007).

### **PROTECTION FROM PREDATORS**

Once a nest was discovered, a welded wire mini-exclosure (ME) was anchored in place over the top of the nest and left in place until the eggs in the nest hatched. The MEs used in previous years (2-inch x 4-inch welded wire mesh, forming a cube 20 inches on a side), when centered over the nest, provided a distance of about 10 inches that a coyote (*Canis latrans*) must extend its forelimb through the ME opening to reach the eggs. Since some coyotes have been able to reach the eggs with this dimension, wider MEs (28-inch width on all four sides and 16-inch height) were deployed in 2006 that require a 14-inch reach to rake eggs out of the center of the ME-protected area. All MEs in use during 2007 were of the wider variety.

Observations were made of potential predators during the surveys. Predator management actions were then enacted commensurate with the threat to snowy plover breeding activity by that specific predator. Predator management has been a necessary recovery action for the least tern for decades. In places, such as Bolsa Chica, where snowy plover nests in proximity to the least tern, predator management activities on behalf of one species will also benefit the other species. In 2007, predator management was undertaken by Wally Ross under contract to U. S. Fish and Wildlife Service (USFWS).

Since June 2002, anchored MEs were usually deployed on every nest from the time the nest was discovered until hatching. The American crow (*Corvus brachyrhynchos*) has been a serious, omnipresent predator of snowy plover eggs in previous years at Bolsa Chica. However, loss of snowy plover eggs to crows has been virtually eliminated due to the ME protection. When digging

marks or egg loss evidence indicated visitation by a mammalian predator, drop-door traps were deployed by predator control staff. When ground squirrels were implicated, commercial poison bait stations were also deployed.

In 2007, simulated nest scrapes were constructed using quail eggs injected with bitter tasting, non-lethal contents. This aversion technique has been successfully used in previous years in an attempt to deter coyote depredation of snowy plover eggs. (Several “digging” attempts, some successful at stealing plover eggs, some not, in 2005 suggested that coyotes were possibly cueing in on the MEs and learning to reach through the wire mesh to rake eggs out.) The use of “aversion” nests was intended to teach coyotes to leave ME-covered eggs alone, without harming or removing coyotes. From February 1 through April, these “aversion nests”, 3 baited eggs each, were constructed in areas where snowy plovers had nested in the past. Some nests were covered with an ME and some were not. The use of aversion nests in 2007 contributed to no egg predation in 2007. Chick predation by coyote in 2007 will be discussed in a following section.

## RESULTS AND DISCUSSION

### NEST DISTRIBUTION AND CHRONOLOGIES

Rainfall in 2007 was below average and both flats and prepared nest sites were available and unflooded throughout the nesting season. The distribution of nests indicates that NS1, the Seasonal Ponds, and NS3 were the preferred nesting sites in 2007, with approximately 54% of all 2007 snowy plover nests located on the newly created NS1 and NS3 (Figure 2, Table 1). There was no nesting activity on NS2 this season. STI attracted 4 nests.

NS1 had 38% (19) of all nests. The Seasonal Ponds also had 38% of the nests but these were well spaced in 7 different cells. The most utilized cells were Cell 11 (12%), Cell 32 (8%), Cell 13 (6%), and Cell 22 (6%). Distribution of nests on the Seasonal Ponds appears to fluctuate annually. For example, Cell 22 had 3 nests in 2007, 12 nests in 2006, and no nests in 2005. NS3 had 8 (16%) nests. Figure 2 shows the location of all nests located in the Bolsa Chica study area.

**Table 1. 2007 Nest, Nest Fate, and Reproductive Success Distribution by Cell**

Location	Total Nests	Nests Failed*	Nests Hatched (# chicks)	Fledglings
Nest Site 1	19	1	18 (50)	17
Nest Site 3	8	0	8 (21)	3
Cell 11	6	0	6 (17)	4
Cell 32	4	1	3 (7)	0
South Tern Island	4	0	4 (11)	0
Cell 13	3	0	3 (8)	0
Cell 22	3	0	3 (9)	1
3 other areas	3	0	3 (7)	0
<b>Total</b>	<b>50</b>	<b>2</b>	<b>48 (130)</b>	<b>25</b>

\*Both nest failures in 2007 were due to nest abandonment.

Appendix 1 provides the cell location, start and end dates, nest fates, eggs and chicks produced for each nest.

The State and Federal Endangered California least tern also nests at Bolsa Chica, usually on STI. In 2006, they nested on STI and on the new NS1. Snowy plover egg-laying typically begins several weeks before the least tern begins its egg-laying. This has been the case at Bolsa Chica. The two species tolerate the co-location of their nests, although inter-specific antagonism between adults and between adults and chicks was occasionally evident.

Black skimmers and elegant terns also nested on NS1 in 2007. Both species typically nest on NTI but the black skimmers and some of the elegant terns abandoned that nesting site in June and moved to NS1. It is unknown if this is a trend or whether the skimmers will return to NTI in subsequent years. The tight colonial style of nesting of the elegant terns and the black skimmers did not exclude the snowy plover from any portion of the nesting area. However, it is unknown whether their presence on NS1 had an effect on the overall reproductive success of the snowy plover once the nests hatched and the chicks left the protection of the ME.



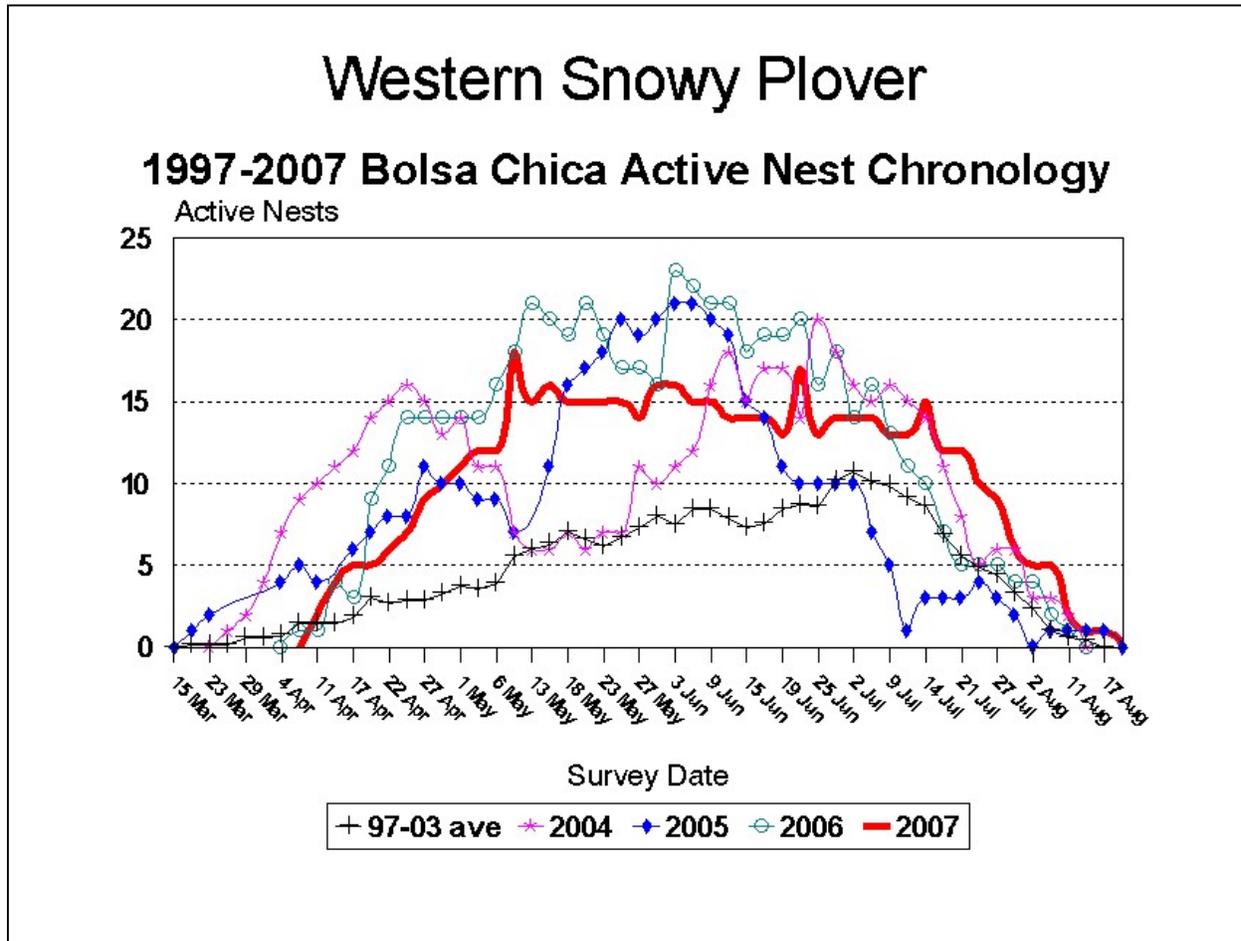
*Elegant terns surrounding an active snowy plover nest protected by an ME.  
Photo: P. Knapp*

In 2007, the first plover nest was initiated April 9, later than in the preceding 10 years of the study (Figure 3). Even with this late start, 10 (20%) nests had been initiated by May 1, which is a greater number of nests in all previous years with the exception of 2004 (18, 27.7%) and 2005 (12, 23.5%). Half of the nests had been initiated by May 28. The active nest chronology in Figure 4 shows a fairly steady nest count from early May until mid-July which is a normal trend at Bolsa Chica with the exception of 2004 when breeding had 2 peaks of nesting. Although the trend was steady, there were fewer nests during the prime nesting period than in the past 2 years, but a greater number than in the 97-03 average. The last nest hatched on August 12, which is comparable or later than in previous years (Figure 3).

### **EGG, CHICK, AND FLEDGLING PRODUCTION**

All 50 nests in 2007 were judged to be completed clutches. Seven completed clutches were 2-egg clutches, while 43 were 3-egg clutches (Appendix 1). None of the 50 total nest attempts were lost to predators, however, 2 complete clutches, one with 3 eggs and one with 2 eggs, failed to hatch. The 2 nests that were abandoned appear to be unrelated to each other. One was located on NS1 and was found on June 8. The second abandoned nest was located on Cell 32 and was found on June 28.

At least 143 snowy plover eggs were produced at Bolsa Chica in 2007, with 13 eggs abandoned or failing to hatch. From the 143 total eggs produced, 130 chicks were produced. Of these 130 total chicks produced in 2007, only a maximum of 25 chicks (19.2%) were estimated to have survived to fledge (Table 2). This high degree of chick loss must be considered severe.



**Figure 3. 1997-2007 Bolsa Chica Active Nest Chronology**

Forty-eight nests survived to hatch (hatching success rate of 96% or nest failure rate of 4%). This is the highest hatching success rate since surveys began in 1997 and the lowest fledgling rate since 1999 (Figure 6). These figures represent continued high nest numbers at Bolsa Chica, but a declining fledgling rate (Figure 5).

In 2007, 8 dead eggs were observed, excluding eggs in abandoned nests. With 143 total eggs laid in 2007, 5.6% of total eggs were dead eggs. No analysis was made of these 8 dead eggs to determine whether they were sterile or had exhibited some degree of development before expiration. Including the 2007 breeding season, the ten-year average percent of dead eggs is 4.2% (60/437).

The total fledgling count was more difficult to determine in 2007 than in past years due to insufficient geographic and temporal separation of broods, hampering efforts to maintain brood identity all the way to fledging during the middle part of the season. Most broods were hard to follow due to rarity of banded parents and continual reconfiguration of brood territories or boundaries. Through field observation, we did conclude that a maximum total of 25 chicks were produced in the 2007 breeding season.

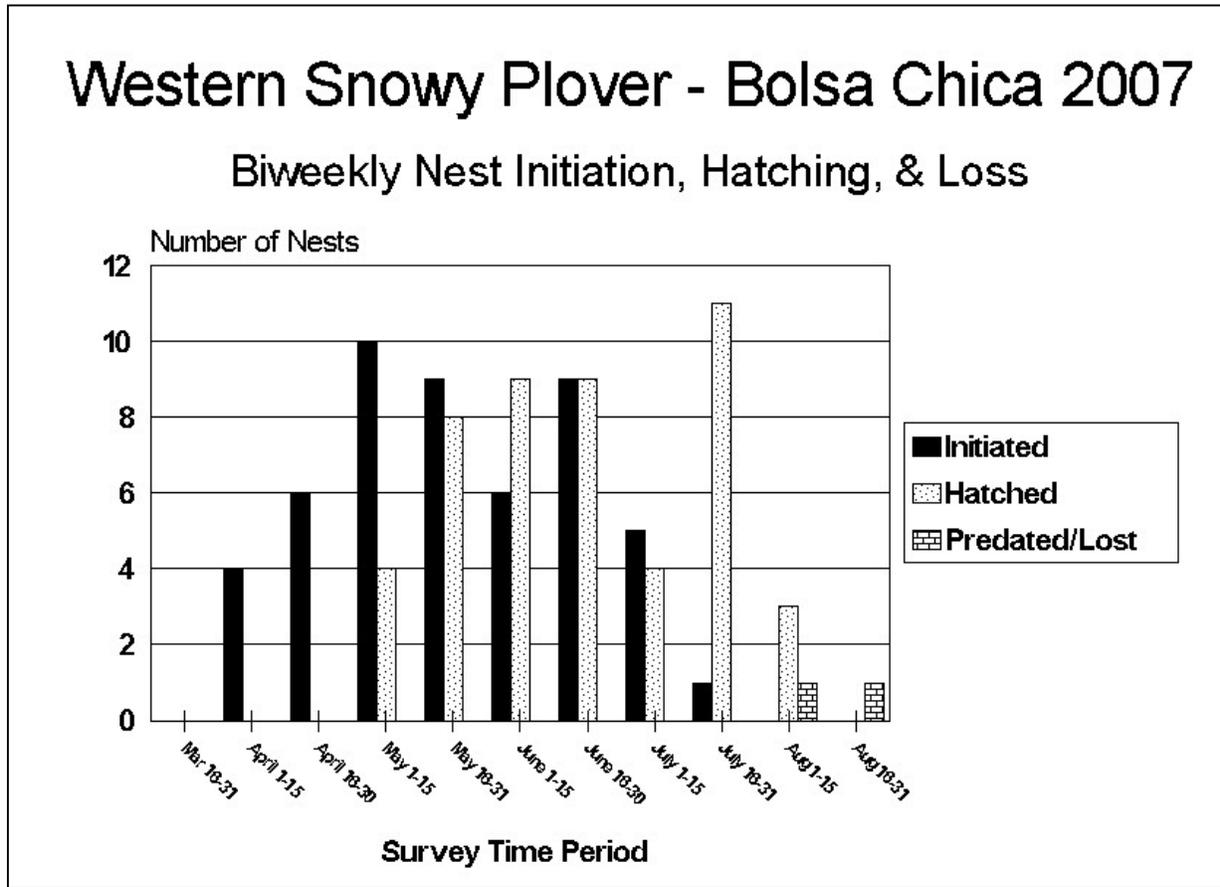
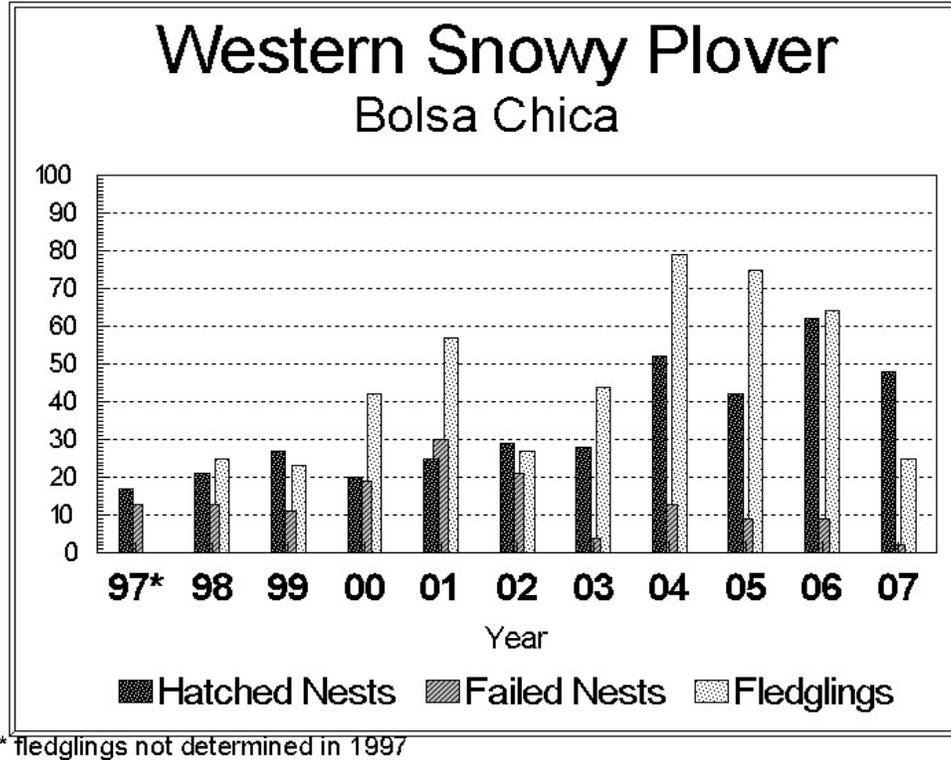


Figure 4. Biweekly Nest Initiation, Hatching, & Loss

Table 2. Males, Females, Nests and Fledgling Production 1997-2007

Year	Females	Males	Total Nests	Fledglings	Total Fledge/Nest	% Chick Survival	Fl/Male
2007	18	12	50	25	0.50	19.2	2.1
2006	27	35	71	64	0.90	38.5	1.8
2005	25	41	51	75	1.47	65.2	1.8
2004	25	20	65	79	1.22	53.0	4.0
2003	15	16	32	44	1.38	57.9	2.8
2002	19	20	50	27	0.54	36.0	1.4
2001	19	18	55	57	1.04	90.5	3.2
2000	15	16	39	42	1.08	85.4	2.6
1999	12	11	38	23	0.61	32.4	2.1
1998	11	16	34	25	0.74	37.3	1.6
1997	14	20	30	nd	nd	nd	nd

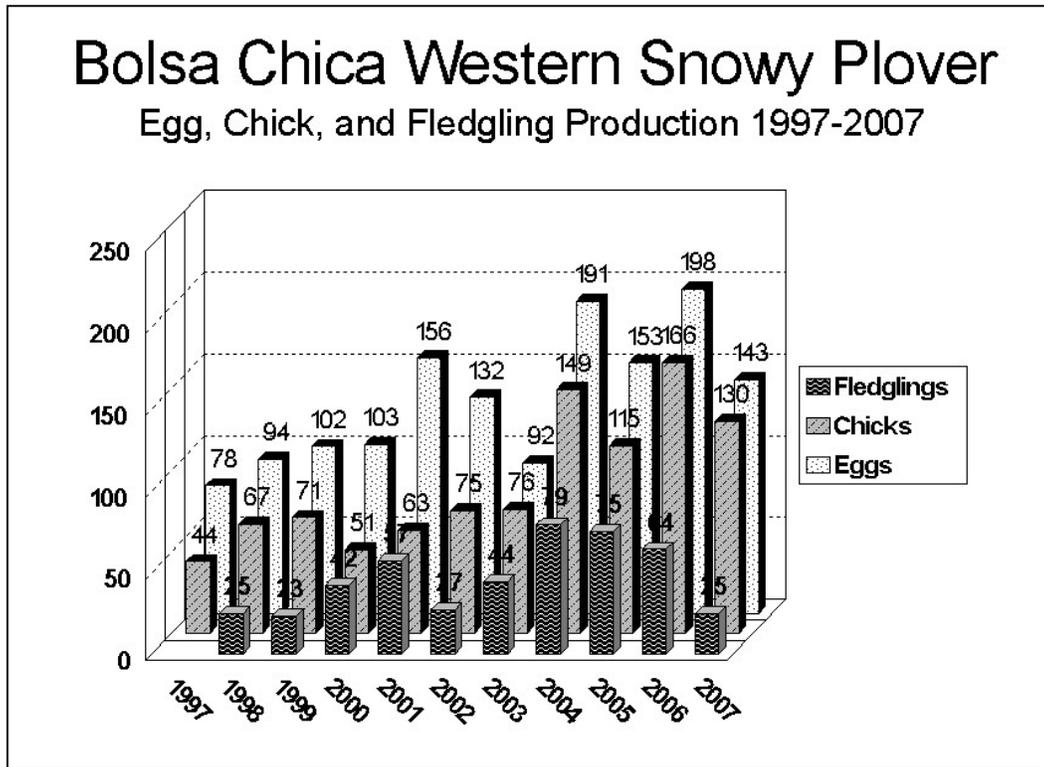
Fl = fledglings, nd = not determined



**Figure 5. Comparison of Number of Hatched Nests, Failed Nests, and Fledglings 1997-2007.**

Several factors may have contributed to the low production of fledglings in 2007. The most likely cause would be predation on chicks, discussed more below. Of 21 chicks produced on NS3, all moved off the nest site top to other locations. And of 50 chicks produced on NS1 only 2 were known to have left the site. Food shortages that may have caused chick loss in 2006, especially on NS1, were not evident in 2007. In the 2007 breeding season, NS1 received full tidal influence, which should have increased the prey base of insects and invertebrates. Currently, no method of assessing the adequacy of the prey base for snowy plover chick survival has been developed for Bolsa Chica. Brood movement out of an area is a symptom of a problem. However, broods may be relocating because the adult is evading a potential predator, been the loser in a brood territory dispute, or because there is no food available for chicks. A disease that causes chick death but not illness in adults seems improbable.

In this study, when one or more eggs of a clutch hatch, days are allowed to pass before any egg(s) that may have been abandoned are collected. No apparently abandoned eggs have been seen to hatch.



**Figure 6. Egg, Chick, and Fledgling Production 1997-2007.**

#### NUMBERS OF MALE AND FEMALE SNOWY PLOVERS

During May 2007, a range-wide breeding season window survey was conducted. The total number of snowy plovers present at Bolsa Chica was 30 adults (Table 2). This was the lowest total since 1999 and the third lowest during the study period.

#### BROOD TRACKING

Due to the chronological and geographic spacing of each brood, it was possible to locate and identify individual broods over the entire several-week period before they fledged. Each brood tended to stay together and the males prevented overlap or co-mingling with other broods. In 2007, as in previous years, many broods were moved around by the guiding male. Broods hatched from NS 3 and from Cell 22 relocated within days to other locations. Snowy plovers readily use the roads of Bolsa Chica to cover distances of 1/3 to 3/4 mile. In June and July, area counts of snowy plover chicks indicated very low numbers compared to the expected number, especially around NS1. Broods on NS1 were not tracked on a regular basis to avoid possible disturbance of other nesting birds on the site (least, elegant, royal, and caspian terns, and black skimmers).



*Territorial dispute between two male Snowy Plovers.*

*Photo: P. Knapp*

### **OBSERVATIONS OF BANDED ADULTS**

A male (RBRP) hatched at Moss Landing in 2001 was seen with one brood at Bolsa Chica in 2003. He had two broods at Bolsa Chica in 2004. In 2005, he was seen very frequently and was associated with one brood that produced one fledgling. In 2006, this male was again seen frequently and was associated with one unsuccessful brood on NS1. In 2007, he was identified with nest 8 and 42 with one successful fledgling from NS1. He was not seen after July.

A male (WNGY) nested successfully at Bolsa Chica in 2004, 2005, and 2006. This male was banded at Guadalupe Dunes near Pismo Beach in 2003. He was seen on NS1 in 2007 but not identified with a specific nest. This bird has wintered at Surfside, Orange County the past 2 winters.

A female (WWYY) banded as an adult at the South Spit, Humboldt Bay in 2006, nested twice at Bolsa Chica on STI. Six chicks were hatched but none left the island or fledged.

Three other banded adults nested at Bolsa Chica in 2007, but were identified by only a USFWS band. Two were females nesting on NS1 and the other a male nesting on NS3.

### **PREDATION**

In 2007, none of the 50 nests were lost to predation. Two nests were abandoned. The 2007 proportion of nests hatching, 48 out of 50 (96%) exceeded every other year of the study. However, the number of fledglings produced (25), was the lowest since 1999. The low rate of nest loss and high degree of chick production is attributable to the following management actions: a) deployment of larger MEs to deter crow and common raven (*Corvus corax*) predation; b) The use of “aversion” nests to deter predation by coyotes; and c) the use of bait stations to deter predation by ground squirrel.

Fledglings per nest (0.50) ranked the lowest out of the 10 years of fledgling estimates (Table 2). One hundred five chicks were most likely lost to predation. Of this loss, the only documented take was by American kestrel (*Falco sparverius*), one on NS1 and the other in the Seasonal Pond area. The most likely culprit of snowy plover chick mortality in 2007 continues to be kestrels. They were relatively abundant and can do great harm very quickly. Therefore, efforts to remove them from Bolsa Chica during the snowy plover breeding season continued by capturing and transporting them considerably inland. Six kestrels were transported away from Bolsa Chica (Table 3). A moderate lapse in attentiveness toward kestrels is apparently sufficient opportunity for just one or two kestrels to radically deplete the snowy plover chick production at Bolsa Chica, as appears to have happened in June 2007. Loggerhead shrikes (*Lanius ludovicianus*) never numerous in the lowland were not present in 2007.

Other chick predation was potentially caused by raven, coyote, black-crowned night heron (*Nycticorax nycticorax*), and black skimmers. The probable loss to ravens was 2 broods from Cell 22 that moved to Cell 13 to feed. This coincided with regular raven visits to Cell 13 to feed upon coyote scraps. Coyotes and 4 pups utilized the culvert between Cells 12 and 13 as a den in 2007. Raven loss was estimated at 6 chicks. The loss to coyotes is estimated at one brood of 3 chicks which hatched coincident with coyote/pup activity on NS3. Coyote tracks substantiate the probable loss. The loss to black-crowned night heron is probable on ST1 and possibly on NS1. Chick losses were both to least tern and plover chicks. Heron tracks indicated widespread hunting coincident with chick production and loss of broods 1, 12, 30, and 39: a loss of 13 chicks. The probable loss of chicks to black skimmers was on NS1: broods 24 through 28 were lost for a total of 13 chicks. Breeding black skimmers dominated the areas of NS1 between sections O to W, which coincided with broods 24 through 28.



Coyote pups had tried to gain access to Snowy Plover eggs protected by a ME. Photo: P.Knapp

Red-tailed hawk (*Buteo jamaicensis*) was regularly present in the Bolsa Chica lowland but no known predation of snowy plover was evident. No hawk nest was known to be present in the Bolsa Chica lowland in 2007, as there had been in 2002. One red-tailed hawk was live-trapped and transported away from Bolsa Chica in 2007 due to its continued presence on power poles opposite the STI.

While Cooper's hawks (*Accipiter cooperii*) have been present during the snowy plover breeding season at Bolsa Chica for years, they had not been identified as a harmful predator. In 2005, increased abundances of Cooper's hawks in and around the periphery of the wetland, and one direct observation of a Cooper's hawk eating a likely snowy plover chick, led to a response to their presence. However, in 2007 no action was taken against Cooper's hawks, although they were present at the perimeter of the lowlands.

One peregrine falcon (*Falco peregrinus*) was present at Bolsa Chica at the beginning of the breeding season. To reduce the likelihood that the presence of the falcon would cause the colonial nesting seabirds to abandon their nesting efforts at Bolsa Chica, it was live captured and relocated to

Northern California. This male individual returned to Bolsa Chica in October and was regularly seen with an adult female at NS1.

Burrowing owls (*Athene cunicularia*) were present in the Bolsa Chica lowland in late winter for the last several years. These transient birds typically left the area in early spring and had no adverse affect upon seabird or snowy plover nesting at Bolsa Chica. In the winter of 2006-07, five individuals were noted in the lowland area. This rare and declining bird could establish a breeding presence at Bolsa Chica, to its benefit, but it could also severely harm the reproductive success of other State and Federally listed species. In that eventuality, thoughtful management actions may need to be considered.

The gull-billed tern (*Gelochilodon nilotica*), another rare and declining species, has increased its nesting presence near least tern and snowy plover nesting areas of San Diego County in the last few years. This tern sometimes preys upon least tern and snowy plover chicks. Gull-billed terns have been occasionally observed at Bolsa Chica in recent years, but not in 2007. Should they return and pose a significant threat to the reproductive success of the least tern and/or snowy plover, thoughtful management actions may need to be considered.

The elegant tern and black skimmer nesting at Bolsa Chica, because of their potentially large numbers, extreme density of nests, dense flocking/loafing behavior, “bullying” temperament, and/or dense groups of chicks, can interfere with successful breeding by least tern or snowy plover. The existing NTI seems perfectly suited to the elegant tern nesting although competition for nesting space appears likely. Use of decoys, as done in 2007, to attract elegant terns to NTI, hazing, and/or the use of chick fences to prevent elegant tern chicks from trampling the nests of other birds can potentially be used to reduce conflicts should they arise.

No instance of predation on or disease mortality of adult snowy plovers was detected in 2007.

**Table 3. Bolsa Chica Predator Removal Summary 1997-2007**

Potential Predator	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997
American Crow	10	-	15	99	118	52	80	91	27	1	2
America Kestrel	4	6	13	19	5	12	13	15	46	14	2
Loggerhead Shrike	-	4	1	10	5	3	6	2	5	-	-
Common Raven	4	2	1	2	4	5	6	3	2	-	-
Coopers Hawk	-	-	8	-	-	-	-	-	-	-	-
Peregrine Falcon	1	-	-	-	-	-	-	-	-	-	-
Gulls	7	-	1	-	-	-	-	-	-	-	-
Skunk	-	-	-	2	1	-	-	-	-	-	-
Coyote	-	-	-	-	-	-	-	-	-	-	-
Weasel	-	-	-	-	-	-	-	-	-	-	-
Ground Squirrel*	unk	unk	unk	unk	unk	-	-	-	-	-	-

\* bait stations used, therefore the number removed is unknown (unk).

## **MANAGEMENT RECOMMENDATIONS**

The 2007 western snowy plover breeding season resulted in excellent nest survival rates, with no known nest predation. The high nest survival rates are attributable to management actions such as the use of MEs. However, the fledgling rate was extremely low at only 19.6%. Therefore, management recommendations focus on maintaining existing management actions as well as taking additional steps that focus on improving fledgling success. The endangered California least tern, that nests in the same locations as the western snowy plover, need to be considered in all management efforts. The following five recommendations are proposed for upcoming nesting seasons:

- 1. Continue utilizing the MEs and taking other preventive measures to protect nests from predation.**

The deployment of MEs on every nest has been very effective at preventing egg loss to crows and ravens. Mimic aversion nests, stocked with bitter tasting eggs, appear to have ended egg predation by coyotes, just as bait stations have deterred ground squirrel depredation. These management efforts should continue.

- 2. Develop methods to decrease predation of snowy plover chicks.**

Loss of chicks this season (at least 105 chicks) is due in part to chick predation. Field evidence linked five predators to the loss of approximately 35 of these chicks: black-crowned night heron (13 chicks), black skimmer (up to 11 chicks), common raven (6 chicks), coyote (3 chicks), and American kestrel (2+ chicks). The lack of adequate shelter on the newly constructed nest sites could also be compounding this problem.

While management efforts have successfully deterred the predation of nests, it is much more difficult to offer the same protection to highly mobile chicks. It is anticipated that snowy plovers will continue to benefit to some degree from the annual predator control efforts undertaken for the protection of the California least tern.

However, further protection, in the form of shelter, may make the small chicks less of a target to predators. The snowy plover chicks tend to stop moving and crouch down in a depression or beside an object if they feel threatened or if an adult gives a warning call. Because of their coloration, they can be very difficult to locate if crouched in a sheltered area. An increase in the number of plants and/or ocean debris in foraging areas may be sufficient to provide adequate shelter.

At NS1, there is currently no plant cover along the shoreline and very little debris. There is potential that adequate shelter could develop naturally along the shoreline in the form of wrack, brought in as drift kelp by the tide. Drought conditions may have caused the beach primrose that occurred on the top of NS1 to die out during the nesting season. If so, there is potential for this plant to return to that area provided there is adequate rainfall during the winter.

Small amounts of shelter could be provided at NS1 by: 1) allowing wrack to naturally accumulate on the shore, 2) planting small amounts of pickleweed and placing natural material such as driftwood and other ocean debris along the shoreline, and 3) conducting limited reseeded of the nest area. These shortfalls should be implemented during the winter season in preparation of the 2008 breeding season.

Nesting black skimmers have the potential to be a problem in 2008, as they were in 2007. If the black skimmers continue to nest in the same areas as snowy plovers, chick fencing or construction fencing could be installed as a potential barrier between the skimmer nesting area and the snowy plover and least tern nests. This would protect the least tern eggs and chicks as well as snowy plover chicks once they leave the protection of the ME. The barrier would need to be installed after the black skimmers start nesting because they do not have a pre-determined nesting area and should be installed so as to not block access to the beach area where the plovers forage. This solution should be considered, but approached with caution. There are no data available on whether the fencing will work to protect plovers from skimmers or what effects it may have on the nesting skimmers. The effect of fencing on snowy plovers is well known. They have nested in fenced tern colonies for many years with little consequence except when it prevents them from accessing beach areas where they can forage.

### **3. Develop methods to increase forage opportunities for snowy plover chicks.**

Increasing food supplies will allow the snowy plover broods to maintain smaller territories and be adequately nourished. Food availability may improve over time, although steps should be considered to improve this situation prior to the 2008 breeding season. Importing decaying seaweed or other ocean debris will likely attract shoreflies (*Scatella stagnalis*) and other invertebrates, increasing the amount of available forage for snowy plover chicks.

### **4. Increase usage and reproductive success on NS2 and NS3.**

NS2 was not used by nesting snowy plovers or terns during the 2007-breeding season; therefore, it is unknown whether enhancement would increase reproductive success. This nest site is surrounded by water, which may offer some protection, but like NS3, offers very little in the way of shelter and foraging sites. NS3 was utilized this year and had very low fledgling success (14%). This was probably due to the lack of foraging areas within the immediate area. Chicks are burning valuable resources before they reach adequate foraging grounds.

Decoys could be utilized to attract terns and plovers to these nesting sites but this would not be recommended until we can be assured that we have created safe nesting and foraging areas for these species, rather than a population sink. Management of these nesting sites should include sparsely vegetating the upper surface of the islands to offer some shelter and to anchor the sandy surface of the site. Alternatives for foraging areas need to be assessed. On NS2 the water acts as a barrier to movement for foraging; therefore there needs to be adequate shelter and forage within that barrier. On NS 3, the chicks normally travel long distances, immediately after they have hatched, to reach shelter and foraging areas within the seasonal pond area. The plover adults do not feed the chicks; they guide the chicks to areas where they can forage on their own. Currently, the chicks are traveling across the top of the nest site, down the unvegetated slope, across a road, and then must find an area where the pickleweed is either absent or sparse enough for them to pass through to the salt panne. Any methods developed that would decrease the distance chicks are required to travel (i.e. allow the sand to cover the road to the east of NS3 giving direct access to Cell 13) would also increase the potential for survival. Careful consideration should be given to management options for these two nesting sites.

**5. Reduce sand export from created nesting sites.**

The surface sand has been reduced on the nesting sites due to blowing winds that export the sand into the adjacent waterways, roadways, and cells. This is particularly evident on NS3 where much of the surface sand has been displaced to the base of the hill and along the roadway between Cell 13 and 14. Installing drift fences along portions of the nesting sites would catch the blowing sand prior leaving the nesting sites and would act to create small dunes. Caution should be taken to ensure that the drift fences are not blocking beach or other foraging areas during the snowy plover breeding season.

Ongoing and adaptive management actions are essential to improving western snowy plover reproductive success at Bolsa Chica, which provides the best nesting option for snowy plovers within a 60-mile radius.

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**Appendix 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2007**

<u>Nest #</u>	<u>Cell #</u>	<u>date found</u>	<u>date ended</u>	<u>eggs</u>	<u>nest fate</u>	<u>chicks</u>	<u>fledglings</u>
1	STI	4-9	5-15	3	<b>H</b>	3	0
2	NS3	4-10	5-12	3	<b>H</b>	3	0
3	22	4-13	5-17	3	<b>H</b>	3	0
4	NS1Z2	4-14	5-18	3	<b>2H1A</b>	2	2
5	NS1I1	4-17	5-13	3	<b>H</b>	3	0
6	34	4-22	5-13	2	<b>H</b>	2	0
7	NS3	4-24	5-20	3	<b>H</b>	3	1
8	NS1C2	4-26	5-27	3	<b>H</b>	3	1
9	13	4-27	5-29	3	<b>H</b>	3	0
10	NS1F2	4-29	5-28	2	<b>H</b>	2	2
11	NS3	5-1	5-29	3	<b>H</b>	3	0
12	STI	5-2	5-30	3	<b>H</b>	3	0
13	NS1M1	5-7	6-3	3	<b>H</b>	3	0
14	NS1K1	5-7	6-7	3	<b>H</b>	3	0
15	11	5-7	6-8	3	<b>H</b>	3	1
16	NS1Y1	5-7	6-3	3	<b>H</b>	3	3
17	NS1E1	5-8	6-6	3	<b>H</b>	3	2
18	NS3	5-9	6-6	2	<b>H</b>	2	0
19	NS3	5-14	6-8	3	<b>H</b>	3	0
20	STI	5-15	6-9	3	<b>2H1A</b>	2	0
21	NS1Z3	5-17	6-11	3	<b>H</b>	3	2
22	22	5-19	6-18	3	<b>H</b>	3	1
23	NS3	5-28	6-24	3	<b>H</b>	3	1
24	NS1U1	5-28	6-25	3	<b>2H 1A</b>	2	0
25	NS1T1	5-28	6-25	3	<b>H</b>	3	0
26	NS1O1	5-28	6-25	3	<b>H</b>	3	1

<u>Nest #</u>	<u>Cell #</u>	<u>date found</u>	<u>date ended</u>	<u>eggs</u>	<u>nest fate</u>	<u>chicks</u>	<u>fledglings</u>
27	NS1V2	5-30	6-25	3	H	3	0
28	NS1Q1	5-30	6-25	3	H	3	0
29	NS3	5-31	6-26	3	H	3	1
30	11	6-1	6-21	3	H	3	1
31	11	6-7	7-11	3	H	3	2
32	NS1I1	6-8	8-16	3	3A	0	0
33	NS3	6-8	7-4	3	1H2A	1	0
34	22	6-9	7-2	3	H	3	0
35	11	6-9	7-9	3	H	3	0
36	19	6-21	7-17	3	H	3	0
37	NS1K1	6-21	7-16	3	H	3	0
38	13	6-21	7-23	3	H	3	0
39	STI	6-21	7-18	3	H	3	0
40	NS1O1	6-25	7-23	3	H	3	1
41	NS1AA2	6-26	7-19	3	H	3	3
42	32	6-28	8-7	2	2A	0	0
43	11	6-28	7-28	3	2H1A	2	0
44	11	6-28	7-27	3	H	3	0
45	13	7-2	7-28	3	2H1A	2	0
46	10	7-4	8-3	2	H	2	0
47	NS1H1	7-12	8-7	2	H	2	0
48	32	7-13	8-12	3	2H1A	2	0
49	32	7-13	7-29	2	H	2	0
50	32	7-23	7-25	3	H	3	0
<b>2007 Season Totals</b>				<b>143 eggs</b>	<b>0P, 2A, 48H 50 Nests</b>	<b>130 chicks</b>	<b>25 fledglings</b>

P = predated; A = abandoned; H = hatched

Note: In the Nest Fate column, **2H1A** means the nest hatched but only two eggs produced chicks, one egg was abandoned.