

**Western Snowy Plover Nesting
at Bolsa Chica, Orange County, California
2008**



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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 augmented 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 in 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 2008 snowy plover breeding season at Bolsa Chica.

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.

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 reneest 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.

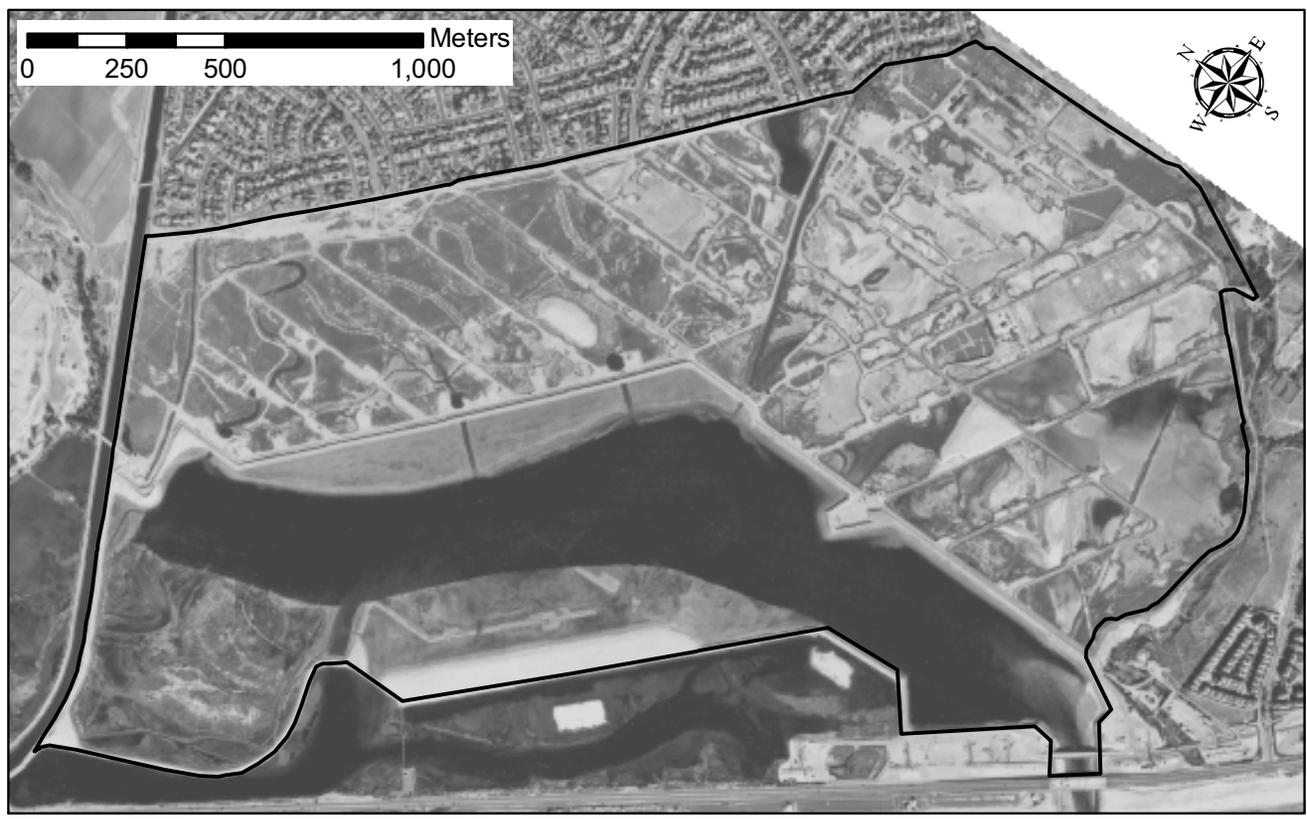
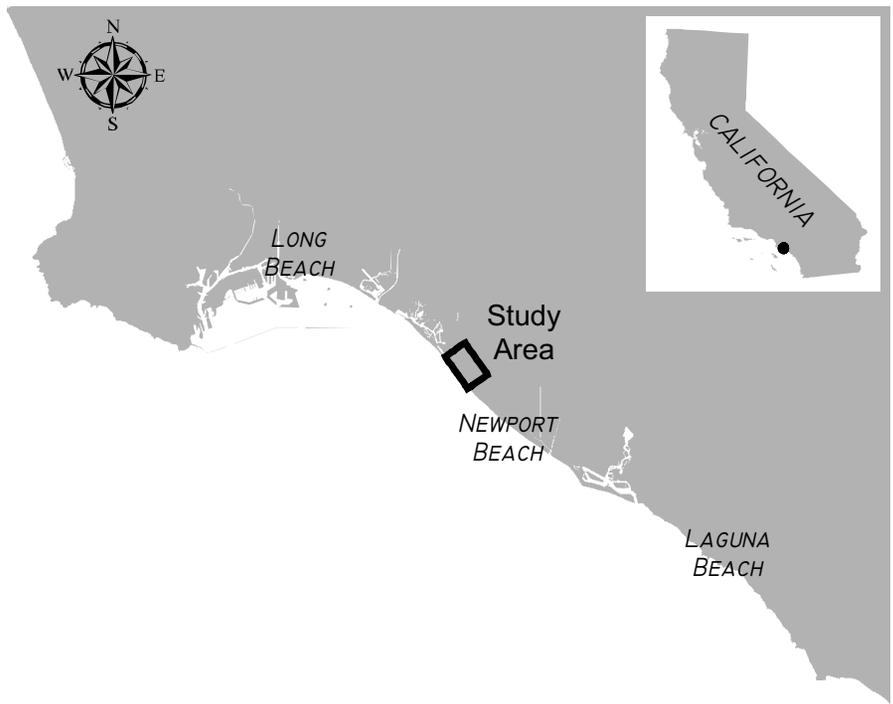


Figure 1. Bolsa Chica Vicinity Map

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 1997-2008 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 2). 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 are thickly vegetated with pickleweed and considered unsuitable for western snowy plover nesting (Cells 41 through 50). Similarly, areas 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. Cells 11, 13, and 32, that were commonly utilized in previous years were inundated this year and were not available for snowy plover nesting. This caused greater use of NS1 by the 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. STI is a regular breeding area for least terns but has also has several snowy plover nests per season. NTI has been used primarily by larger terns (elegant, Forrester's, royal, and Caspian) and black skimmers

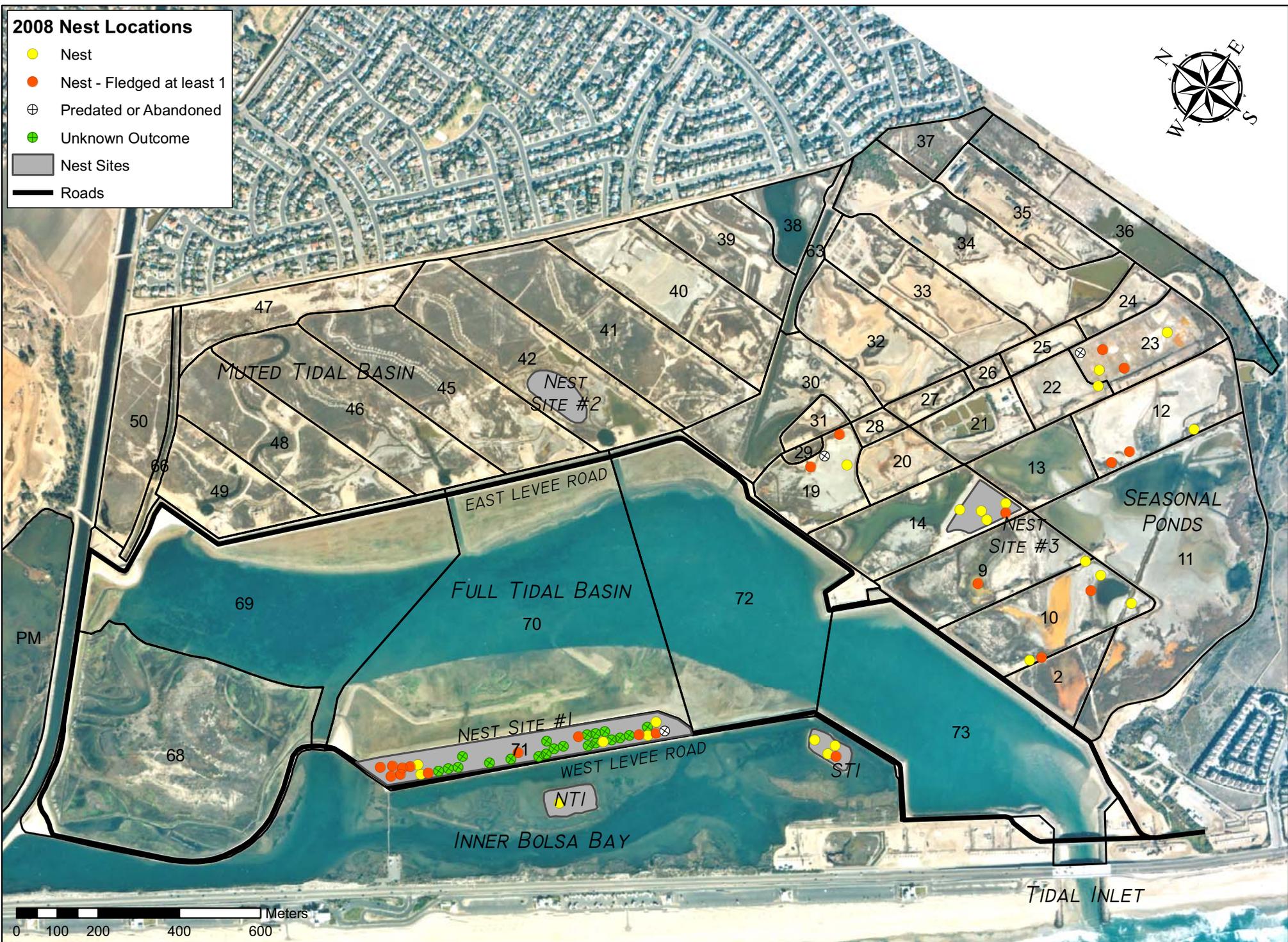


Figure 2. Distribution of Western Snowy Plover Nests in 2008 at Bolsa Chica

(*Rynchops niger*), but after an absence of plover nests for 10 years, at least 1 and probably 2 plover pairs nested on NTI in 2008. One nest was confirmed and subsequently abandoned due to conflict between the plovers and elegant terns (*Thalasseus elegans*).



Snowy plovers at North Tern Island are being kept from their nest by a large flock of elegant terns. The nest pictured was subsequently abandoned with 3 eggs in the nest.

NS1 is a large linear nesting area between Inner Bolsa Bay and the Full Tidal Basin that was built during the creation 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 of the nest site is now under full tidal influence. In 2008, vegetation lightly covered much of the site, including beach evening primrose (*Camissonia cheiranthifolia*), beach sand-verbena (*Abronia umbellata* var. *umbellata*), saltgrass (*Distichlis spicata*), alkali heath (*Frankenia salina*), pickleweed, coastal deerweed (*Lotus scoparius*), five-hook bassia (*Bassia hyssopifolia*) and 3 types of common iceplant (*Mesembryanthemum* sp.). Efforts were made during the winter and spring to remove much of the iceplant but it still persisted in patches throughout the site. The area along the northeastern shoreline lacks vegetation or debris that is normally found in a tidal area. Pickleweed is slowly spreading on this shoreline.

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 rainfall has eroded NS2. 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 or at the foot of the raised nesting site.



Nest Site 1 (NS1) nesting area (left) and shoreline (right) in October 2008 after the breeding season.

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 Wally Ross, Kelly O'Reilly (California Department of Fish & Game (CDFG)), and Bonnie Peterson (Merkel & Associates) surveyed for nesting western snowy plovers a minimum of twice a week, but most often on a daily basis. 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, 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 7 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 and black skimmers and was surveyed from the West Levee Road.

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-May.

NS1 was also partially surveyed on foot as part of least tern surveys from marker CC south to marker M until surveys had to be suspended in July, due to excessive nesting activity by the terns and skimmers. Each nest located on NS1 was marked with numbered tongue depressors, mapped for ease of relocation on subsequent visits, and a mini enclosure was placed over the scrape. 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 although plovers were present and created 3 or 4 scrapes. NS3 was surveyed by vehicle from the north end of the site.

On all sites other than NS1, 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 2 - 7 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. Due to high nesting activity on NS1 in 2008 following broods along such a long narrow reach was difficult. Effort was still made to determine the number of fledglings but it was often difficult to assign them to a specific nest.

A Range-wide, Breeding Season Window Survey was conducted at Bolsa Chica in May 2008. 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



Photo of American crow perched on an active snowy plover nest covered with a mini-exclosure (ME).

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 are 28-inches in width on all four sides and 16-inch in height. These dimensions have proved effective in deterring predation by corvids and coyotes (*Canis latrans*).

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 California 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 2008, predator management was undertaken by Wally Ross under contract to U.S. Fish and Wildlife Service (USFWS).

In 2008, as in past years, 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. 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”, with 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 and the ME contribute greatly to low egg predation in 2008. Chick predation by coyote in 2008 will be discussed in a following section.

NS1 was watered during the winter months, prior to the 2008-breeding season, to aid the germination of existing native plant seeds. Non-natives were removed by hand and with the use of herbicide. These efforts provided additional cover for the young snowy plover chicks. Clay roof tiles were placed on NS1 and NS3 to provide further shelter for young chicks.

RESULTS AND DISCUSSION

NUMBERS OF MALE AND FEMALE SNOWY PLOVERS

During May 2008, a range-wide breeding season window survey was conducted. The total number of snowy plovers present at Bolsa Chica was 50 adults: 22 female and 28 male (Table 1). This is a higher count than in 2007, but has not yet reached the highest counts seen in 2005 (62) and 2006 (65).

Table 1. Males, Females, Nests and Fledgling Production 1997-2008

Year	Females	Males	Total Nests	Fledglings	Total Fledge/Nest	% Chick Survival	Fledge/Male
2008	22	28	67	57-109*	0.85-1.62*	nd	2.0-3.9*
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

* based on minimum/maximum numbers of fledglings

NEST DISTRIBUTION AND CHRONOLOGIES

The distribution of nests indicates that NS1 and the Seasonal Ponds were the preferred plover nesting sites in 2008. NS1 had more than half (55%) of all the nests and the Seasonal Ponds had 30% of the

nests. (Figure 2, Table 2). The most utilized cells were Cell 22 (9%), Cell 10 (4%), Cell 12 (4%), Cell 19 (6%), and several roadways (4%) were utilized for nesting this year. There was one nest on NTI and 4 nests on STI.

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

Distribution of nests on the Seasonal Ponds fluctuates annually (Appendix 2); however, in 2008 many of the cells that were commonly used, such as Cell 13 and Cell 11, were not available for nesting plovers in 2008 due to high water levels. Typically these cells collect water during the winter rains, but later drain out by gravity into Freeman Creek, exposing dry salt panne prior to the breeding season.

In 2008, delayed drainage of the Seasonal Ponds occurred as a result of the inability of Freeman Creek to drain to the Full Tidal Basin, due to reduced tidal prism associated with the flood shoal that had formed in the inlet of the basin. A pump-down of water levels was undertaken in May 2008 to drain water levels; however, it was too late in the nesting season to make these cells available for nesting plovers. Cells 9, 10, 12, 19, and even the roadways were utilized by the snowy plover in order to find dry, suitable nesting areas. Figure 2 shows the location of all nests located in the Bolsa Chica study area.

Table 2. 2008 Nest, Nest Fate, and Reproductive Success Distribution by Cell

Location	Total Nests	Nests Failed	Nests Hatched (# chicks)	Fledglings
Nest Site 1*	37	1	36 (100)	33-83
Seasonal Ponds:	20	2	18 (51)	18
Cell 9	1	0	1 (3)	3
Cell 10	3	0	3 (8)	1
Cell 12	3	0	3 (8)	6
Cell 19	4	1	3 (9)	3
Cell 22	6	1	5 (15)	2
Road	3	0	3 (8)	3
Nest Site 3	5	0	5 (14)	3-5
North Tern Island	1	1	0 (0)	0
South Tern Island	4	1	3 (9)	3
Total	67	5	62 (174)	57-109

*Nests were not monitored on NS1 for the entire season; therefore, nests failed and nests hatched are for known nests (minimum number). The number of fledglings is based on the minimum and maximum number of fledglings for NS1.

The number of nests on NS1 has increased dramatically from 14 nests in 2006, the first year the site was available, to 37 in 2008 (Appendix 2). Reproductive success remained consistent on NS1 with a fledge rate of at least 0.89 (fledge/nest). The increased usage of NS1 has been balanced out by a decreased use of the Seasonal Ponds. The reproductive success in the Seasonal Ponds was very low in 2007 at 0.28, increasing to 0.90 in 2008, even with suboptimal conditions. This would demonstrate that Bolsa Chica has not reached its highest potential for nesting snowy plovers.

The Seasonal Pond Cells, in addition to the nesting areas, are also the primary feeding areas for hatched plovers other than those from STI and NS1. More than one cell maybe used by a brood and often a brood will travel to another cell within one or two days of hatching. As an example, although

there were no nests in Cell 11 this year, at least 6 broods fed in this cell and most of the chicks fledged.

The State and Federal Endangered California least tern also nests at Bolsa Chica. In 2006, they nested on STI and on the newly created NS1 and have continued this nesting pattern through 2008. 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.

Black skimmers, elegant, royal (*Thalasseus maximus*), California least, Caspian tern (*Hydroprogne caspia*), and American avocet (*Recurvirostra Americana*) all nested on NS1 in 2008. These species typically nest on NTI. In June 2007, the black skimmers and some of the elegant terns abandoned that nesting site and moved to NS1. The tight colonial style of nesting of the terns and black skimmers did not exclude the snowy plover from any portion of the nesting area. However, it is suspected that 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. Black skimmers are known to be predators of tern chicks (Gochfeld and Burger 1994).

In 2008, the first plover nest was initiated March 17, which is early compared to previous years. Snowy plover nesting rose to its peak by mid-April (Figure 3). Twenty-five (37%) nests had been initiated by May 1, which is a greater number of nests than in all previous years of the study. Half of the nests had been initiated by May 12, 2 weeks earlier than in 2007. The last nest hatched on August 9 with no new nest being initiated after July 16 (Figure 4) which is comparable to past years.

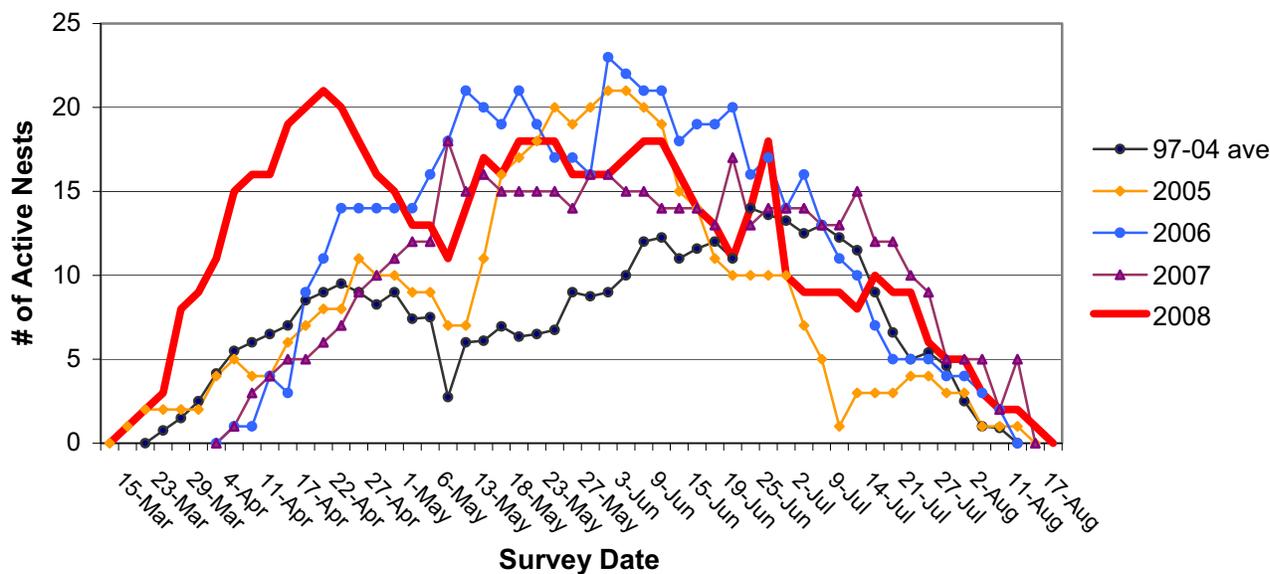


Figure 3. 1997-2008 Bolsa Chica Active Nest Chronology.

EGG, CHICK, AND FLEDGLING PRODUCTION

All 67 nests in 2008 were judged to be complete clutches with the exception of Nest #4 in Cell 22 and Nest #21 on NS1, which were both predated prior to the completion of egg laying and the placement of the ME. Only 4 completed clutches were 2-egg clutches, while 61 were 3-egg clutches (Appendix 1). Three nests were abandoned and appeared to be unrelated to each other. Two were

initiated in mid April, one on NTI and one on STI. The third abandoned nest was initiated in mid-July in Cell 19.

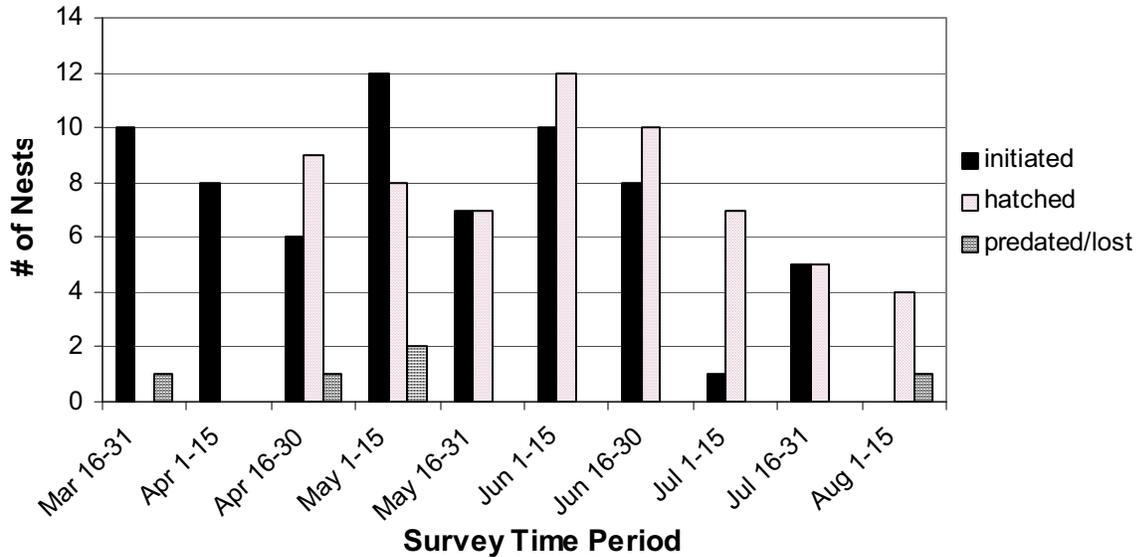


Figure 4. Biweekly Western Snowy Plover Nest Initiation, Hatching, & Loss at Bolsa Chica in 2008.

The abandoned nest on NTI was caused by harassment of the plover pair by elegant terns. The plovers continuously failed to reach the protection of the ME over their eggs and after 2 days abandoned the nest. In 2007, on NS1, 2 plover nests protected by an ME survived to hatch amongst the elegant terns.

The nest abandoned on STI (Nest #19) was incubated by banded female WWYY. Prior to the abandonment of Nest #19, Nest #12 hatched, but the brood was unattended by an adult. The chicks from Nest # 12 gravitated to Nest #19 and, after initially attempting to drive off the chicks, the female (WWYY) began to brood these chicks and to simultaneously incubate her own eggs. It was apparent that she was confused by the situation and the next day after an adult from Nest #12 appeared and brooded its chicks, the female abandoned her Nest #19.

The nest in Cell 19, Nest # 65, was abandoned for unknown reasons. Subsequent examination of eggs revealed semi-developed chicks.

A total of 193 snowy plover eggs were produced at Bolsa Chica in 2008, with 19 eggs abandoned, predated, or failing to hatch. From the 193 total eggs, 174 chicks were produced. Of these 174 total chicks produced in 2008, a minimum of 57 chicks (32.8%) and a maximum of 109 chicks (62.6%) were estimated to have survived to fledge (Table 2). This is the highest number of hatched nests and potentially the highest number of fledglings recorded at Bolsa Chica. Even the minimum number of fledglings is surpassed only by 2004, 2005, and 2006 (Figure 5). Sixty-two nests survived to hatch with a hatching success rate of 92.5%. This is the highest hatching success rate in all years surveyed with the exception of 2007 at 96.0%.

The total fledgling count was difficult to determine in 2008 due to the nesting activity on NS1; black skimmers, elegant terns, royal terns, Caspian terns, and American avocets all nested on NS1 along with the California least tern and the western snowy plover. During July and August, there was so much activity on the nest site that walking the site to locate nests was no longer possible and all human activity on the site was stopped. The total fledgling count for 2008 was estimated to be between 57 and 109. This minimum count is an increase over the results for 2007 and is comparable to the higher counts in previous years.

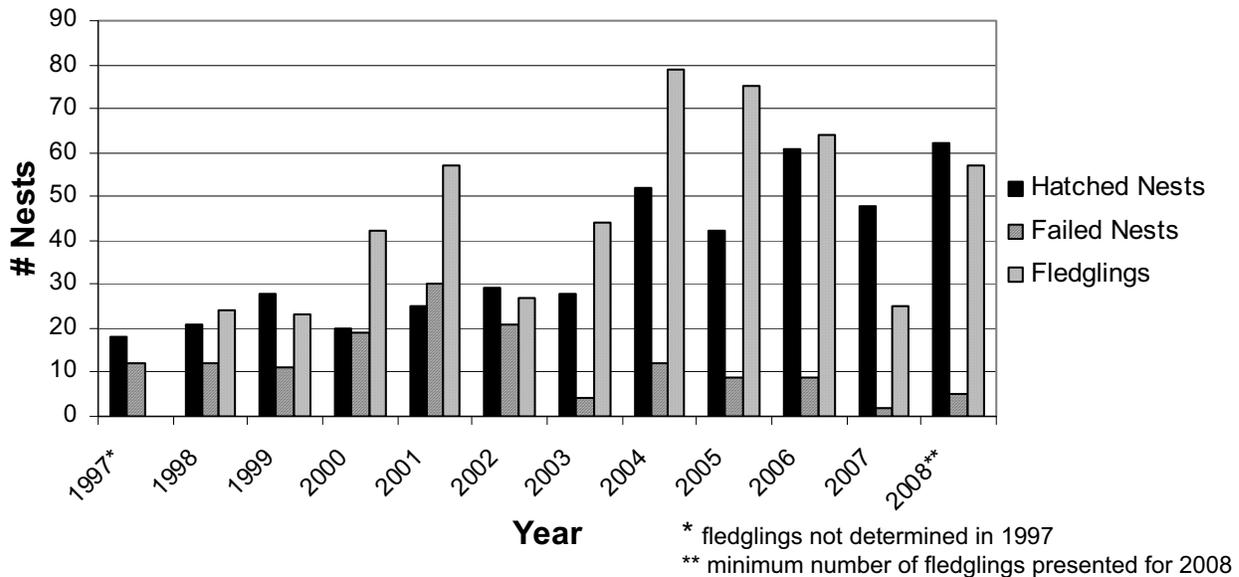


Figure 5. Comparison of Number of Western Snowy Plover Hatched Nests, Failed Nests, and Fledglings 1997-2008 at Bolsa Chica

In 2008, 9 dead eggs were observed, excluding eggs in abandoned nests. With 193 total eggs laid in 2008, 4.7% of total eggs were dead eggs. No laboratory analysis was made of these dead eggs. In the previous 10 years the average percent dead eggs is 4.2% (60/437).

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

BROOD TRACKING

Due to the chronological and geographic spacing of each brood, it is often possible to locate and identify individual broods over the period before they fledge. As generally seen in prior years, in 2008 each brood tended to stay together and the males prevented overlap or co-mingling with other broods. There were confrontations between the males if the broods wondered to close together or tried to take advantage of the same resources (see photo below).

Broods hatched from NS3 relocated within days to other locations to seek food. Snowy plovers readily used the roads of Bolsa Chica to cover distances of 1/3 to 3/4 mile. In the seasonal ponds, broods would move about or change cells readily but could generally be identified. 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

OBSERVATIONS OF BANDED ADULTS

A male (RBRP) hatched at Moss Landing in 2001 and has bred every year at Bolsa Chica since 2003 and in 2008 had 3 nests; two on NS1 (Nests #6 and #50) and one in Cell 10 (Nest #64). He produced 5 fledglings this year. This male has not been seen in the area during the non-breeding seasons. The only winter record was at Pt. Magu in February 2006.

A male (WNGY) has nested at Bolsa Chica every year since 2004. This male was banded at Guadalupe Dunes near Pismo Beach in 2003. He has wintered at Surfside, Orange County and Bolsa Chica State Beach for the past 3 years. In 2008 he had a minimum of 2 nests on NS1 and a third (Nest #65 that was abandoned) in Cell 19.

A female (WWYY) banded as an adult at the South Spit, Humboldt Bay in 2006, nested twice at Bolsa Chica on STI in 2007 and 3 times in 2008 including once on STI (Nest #19), NS1 (Nest #43) and the road between Cells 2 and 10 (Nest #63) in the Seasonal Pond area.



Snowy plover male banded (RBRP) and female banded with USFWS band only.

A female (SKM), banded at Camp Pendleton (year unknown), wintered at Surfside, Orange County in 2007/8 and bred at least once at Bolsa Chica in 2008 (Nest #10).

Three other banded adults nested at Bolsa Chica in 2007 and 2008, but were identified by only a USFWS band. Two were females and the other a male. One of the females nested twice with male (RBRP) on NS1 in 2008.

Two chicks from Nest #6 were hand-reared at the Wetlands and Wildlife Care Center of Orange County and were banded YNYR and YNWW. They were released in Cell 11 in

early June and were seen until late July at Bolsa Chica. YNYR was subsequently seen at Batiquitos Lagoon and later at the Tijuana Estuary. A third chick was successfully hand-reared at the care center and was released on Bolsa Chica State Beach unbanded. The later chick was from Nest #67 and was found unattended 2 days after its siblings hatched and were led away into another cell.

Other banded bird sightings not breeding at Bolsa Chica were as follows: WBRW on March 24; RWRW on April 24 through 26; RAGY and VKRR on July 19; BBVG on August 6; VVVR on August 10; YYGW on August 11; PGVG on August 19; and OYLL on August 27.

PREDATION

In 2008, 2 of the 67 nests were depredated. Nest #4 in Cell 22, with 1 egg, was a probable loss to a corvid. Nest #21 on NS1, with 1 egg, was a probable loss to a gull. Neither nest had an ME placed over it as confirmation of the nest was performed after the eggshell remnants were discovered. Three nests were abandoned. Sixty-two nests hatched. The 2008 proportion of nests hatching, 62 out of 67, was 93%. The low rate of nest loss and high degree of chick production is attributable in 2008 to the following management actions: a) deployment of ME's to deter corvid and coyote predation, b) the use of "aversion" nests to deter predation by coyotes and, c) regular monitoring.

The minimum fledgling estimate per nest (0.85) is slightly below the average (0.95) of the study years. The maximum fledgling estimate per nest (1.62) would exceed the previous high of 1.47 in 2005.

Of the 67 nests, 24 are known to have not fledged chicks. Five of these 24 did not produce chicks (2 depredated and 3 abandoned). Of the 19 known nests producing chicks but not producing fledglings, one brood (Nest #57) was depredated by gulls and one brood (Nest # 25) by coyote. On the remaining 17 broods predation was not observed but the potential predators were: red-tailed hawk (*Buteo jamaicensis*) on STI (2 nests), American kestrel on Seasonal Ponds (12 nests) and black skimmers on NS1 (5 nests). Loggerhead shrikes were not present in 2008.

Red-tailed hawks were regularly present at Bolsa Chica, but no hawk nests were known to be present in 2008. Red-tailed hawks were present continuously on the power poles opposite STI. Although there was no documented take of snowy plover chicks by red-tailed hawks, one took at least one least tern chick from STI from this perch in 2008. These red-tailed hawks were resistant to repeated attempts to trap them and remained present during the entire breeding season. A red-tailed hawk was trapped in the Seasonal Pond area and was relocated.

The gull-billed tern (*Gelochilodon nilotica*) has increased its nesting presence near least tern and snowy plover nesting areas of San Diego County. This tern is a threat to least tern and snowy plover chicks. On 3 occasions gull-billed terns were present during the 2008-breeding season at Bolsa Chica. These sightings were in the Seasonal Pond area (Cells 19 and 11) and NS1. There is no evidence to suggest that either least tern or plover chicks were depredated. The gull-billed tern visits were of no more than 2 or 3 days each.

Chick loss to black skimmers is believed to be significant on NS1. The only other potential predators regularly seen on NS1 were gulls. Other breeding birds on NS1, elegant, royal and Caspian terns, were not probable predators.

Black-crowned night herons, Cooper's hawk, and peregrine falcon present during all or part of the breeding season were not suspected predators in 2008. Management action was taken against black-crowned night herons in the area of STI early in the season based upon 2007 problems with the species.

No instance of predation or disease mortality of adult snowy plovers was detected in 2008.

Table 3. Bolsa Chica Predator Removal Summary 1997-2008

Potential Predator	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997
American Crow	12	10	-	15	99	118	52	80	91	27	1	2
America Kestrel	4	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	-	-
Cooper's Hawk	1	-	-	8	-	-	-	-	-	-	-	-
Peregrine Falcon	-	1	-	-	-	-	-	-	-	-	-	-
Red-tailed Hawk	1	-	-	-	-	-	-	-	-	-	-	-
Gulls	1	7	-	1	-	-	-	-	-	-	-	-
Skunk	-	-	-	-	2	1	-	-	-	-	-	-
Coyote	-	-	-	-	-	-	-	-	-	-	-	-
Weasel	-	-	-	-	-	-	-	-	-	-	-	-
Ground Squirrel	3	unkn*	unkn*	unkn*	unkn*	unkn*	-	-	-	-	-	-

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

MANAGEMENT RECOMMENDATIONS

The 2008 western snowy plover breeding season resulted in excellent nest survival rates. The high nest survival rates are attributable to management actions such as the use of MEs. The fledgling rate (Table 2) was also higher than in 2007, ranging from 57 to 109 fledglings. 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, which nests in the same locations as the western snowy plover, needs 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 corvids and coyotes. Mimic aversion nests, stocked with bitter tasting eggs, appear to have ended egg predation by coyotes, just as bait stations, when required, have deterred ground squirrel depredation. The removal of iceplant has also deterred ground squirrel depredation. These management efforts should continue.

2. Develop methods to manage overcrowding on NS1.

There are currently 7 species nesting on NS1 including American avocet, California least tern, black skimmer, elegant tern, royal tern, Caspian tern, as well as the western snowy plover. All species, except the snowy plover, are colonial nesters and nest in large groups. This high density nesting probably benefits all species by deterring predators from entering the site. However, mortality increases due to trampling of nests and chicks of the smaller species: California least terns and snowy plovers. Nest trampling has been observed at California least tern nests while snowy plovers have had the protection of the ME covering their nest. Once the eggs hatch the snowy plover chicks are highly mobile, leaving the security of the ME and venturing through the colonial nests to reach the shoreline and risking the possibility of trampling and aggressive behavior from the colonial nesters.

In these overcrowded conditions, monitoring on NS1, in the same manner that has been utilized in the past, may no longer be possible after the elegant terns, Caspian terns, and black skimmers start nesting. In 2008, all nest monitoring on this site had to be halted in July due to the density of birds and the potential threat that any disturbance may cause to nests and chicks.

This problem requires long-term management that would address overcrowding and its effect on listed species, particularly the snowy plover, as well as a review of monitoring methods that can be safely utilized in the future. Management decisions could include: 1) Allowing the terns, skimmers, and plovers to continue nesting and abandon monitoring the listed species for reproductive success in the manner utilized in the past. New methods of estimating success would need to be adopted; 2) Encourage some of the species to utilize NS2 and NS3 (see management recommendation 4. 3) Actively discourage the elegant tern and black skimmer from nesting on NS1 in hopes that they will return to NTI. 4) Continue the use of decoys to attract elegant tern to NTI and acquire black skimmer decoys to attract skimmers to NTI where they have nested in the past.

Observations of interactions between the species would be highly beneficial prior to making these decisions. Although the California least tern and western snowy plover are listed species, the black skimmer is a CDFG Species of Special Concern, and the elegant, royal, and Caspian tern have limited areas for breeding. Utilizing a blind for regular observations, during the nesting season, could give management insight on the negative effects and/or benefits of this high-density nesting.

3. Improve water management in the Seasonal Ponds

A number of cells (*i.e.* Cell 11, 13, and 32) within the Seasonal Ponds were not available in 2008 for nesting due to flooding. These ponds normally flood during the winter but dry out prior to the snowy plover nesting season. In 2008 water was not able to drain into Freeman Creek due to elevated levels in the creek. Cell 11, in particular, has been highly used for snowy plover nesting in the past years but was not available in 2008. This flooding caused the snowy plover to expand into potentially less suitable cells as well as the roadways in order to locate suitable, dry nesting areas. Nesting in the Seasonal Ponds has decreased over the last 3 years, probably due to the creation of NS1 (Appendix

2); therefore, increasing the number of cells available in the Seasonal Ponds would also provide increased potential for nesting opportunities.

Based on conditions in the Full Tidal Basin, it is likely that similar pond basin flooding will recur in future years and that an active water management strategy will be necessary to draw down water in the late winter months. A water management plan must be completed to develop triggers for seasonal water level reduction to accommodate ground-nesting birds on the dry pond basin floors.

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

NS2 has been utilized only one time (2007) for nesting by snowy plovers and no terns have used it. NS3 had 5 snowy plover nests in 2008 with a modest 0.6 fledge rate. No other species have utilized these nest sites. These are both large nesting sites that could be utilized by snowy plover or one or more of the tern species to alleviate the high nesting pressure on NS1. If these sites are to be utilized by snowy plover they require maintenance to make them more attractive. 1) Vegetation, on both sites, is required to help aid in shelter and enhance foraging. This could be accomplished in the same manner as NS1, by watering the site during the winter months to encourage growth on the existing seed bank. 2) NS2 does not appear to be very attractive to the snowy plover. The slopes are very steep and there is no vegetation even along the channel that surrounds the nest site, where the chicks would be required to forage. This channel goes all the way around the nest site. Consideration should be given to enhancing this site for snowy plover nesting or managing it for one or more of the nesting tern species.

5. Develop methods to increase shelter and forage opportunities for snowy plover chicks on NS1.

Recommendations were made in the 2007 snowy plover report on increasing shelter and forage opportunities for snowy plovers on NS1. Many of these recommendations were implemented and probably increased the chicks' survival. These actions included increasing native vegetation by watering the site during the winter months, removing non-natives with herbicides and by hand, and putting out tiles for the chicks to hide under. The tiles provided protection from both predation and trampling.

These measures have enhanced the nest site; however, the snowy plover chicks are more likely to be foraging along the shoreline. Wrack does not appear to be accumulating along the shoreline and efforts to move ocean debris to the area are quickly washed away with the tide. A variety of approaches could be implemented, perhaps initially on a small scale, to determine the best way to enhance the structure and foraging opportunities in this area. Wrack placed along the shoreline could be anchored at the high tide line to prevent it from washing out with the tide. Pickleweed is beginning to grow along the high tide line. This should be encouraged and perhaps enhanced through further plantings. Another possibility is to artificially enhance the structure of the shoreline by permanently anchoring logs or large rocks along a portion of the shoreline. These permanent structures will, quite likely, cause some areas to erode and others to accumulate sand and debris. The benefits of these structures should 1) act as a shelter for chicks to hide; 2) provide a way of retaining some of the natural debris; 3) change the dynamics of broods by providing barriers between established foraging territories.

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, 2008

<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	3-17	4-22	3	H	3	0
2	NS1 BB2	3-21	4-18	3	H	3	3
3	NS1 V1	3-26	4-28	3	2H1A	2	--
4	22	3-28	3-28	1	P	0	0
5	NS1 H1	3-28	4-25	3	H	3	1
6	NS1 E1	3-28	4-28	3	H	3	3
7	22	3-28	5-02	3	H	3	1
8	NS1 Z2	3-28	4-30	3	H	3	1
9	NS1 O1	3-29	4-25	3	H	3	--
10	NS1 L2	3-30	4-23	3	2H1A	2	1
11	NS1 I1	4-02	5-01	3	2H1A	2	--
12	STI K3/4	4-02	4-29	3	H	3	0
13	NS3 6D	4-05	5-07	3	H	3	3
14	NS1 K1	4-05	5-12	3	H	3	--
15	10	4-07	5-12	3	H	3	1
16	NS3 5C	4-08	5-06	3	H	3	0
17	NS1 V2	4-10	5-06	3	H	3	--
18	NS1 F2	4-15	5-18	2	H	2	--
19	STI	4-17	5-06	2	A	0	0
20	NTI	4-17	5-04	3	A	0	0
21	NS1 D1	4-18	4-19	1	P	0	0
22	22	4-18	5-17	3	H	3	0
23	NS1AA2	4-21	5-15	3	H	3	2
24	NS1 W1	4-21	5-17	3	2H 1A	2	--
25	NS3 3C	4-23	5-25	3	H/P	3	0
26	NS1 M1	5-01	6-08	3	H	3	--

<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	10	5-05	6-07	3	2H1A	2	0
28	NS1H1/2	5-07	5-22	3	H	3	--
29	STI	5-07	6-08	3	H	3	3
30	22	5-12	6-10	3	H	3	0
31	NS1 J2	5-12	6-04	3	2H1A	2	--
32	NS1 R1	5-12	5-26	3	H	3	--
33	NS1 O2	5-13	5-26	3	H	3	--
34	NS1 Q2	5-13	6-01	3	H	3	1
35	NS1 J1	5-14	6-03	3	H	3	--
36	NS1 T1	5-14	6-10	3	H	3	--
37	RD 9/10	5-14	6-14	3	2H1A	2	0
38	RD 10/2	5-17	6-17	3	H	3	3
39	NS1J1/2	5-19	6-19	3	H	3	--
40	NS1M1	5-19	6-19	3	2H1A	2	--
41	9	5-20	6-15	3	H	3	3
42	12	5-20	6-16	3	H	3	3
43	NS1 X1	5-21	6-13	3	H	3	2
44	NS1 Y2	5-26	6-24	3	H	3	2
45	NS3 B3	6-1	6-29	3	2H1A	2	--
46	12	6-2	6-30	3	H	3	3
47	NS1 W1	6-5	7-01	3	H	3	--
48	NS1 H1	6-5	6-30	3	H	3	--
49	NS1 O1	6-5	7-01	3	H	3	--
50	NS1 G1	6-7	6-30	3	H	3	0
51	NS1AA2	6-7	7-2	3	H	3	1
52	NS1 E2	6-8	7-9	3	H	3	0
53	22	6-12	7-12	3	H	3	0

<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>
54	NS1 Y1	6-12	6-29	3	H	3	0
55	NS3	6-25	7-19	3	H	3	0
56	10	6-25	7-15	3	H	3	0
57	NS1 Y2	6-25	7-15	3	H	3	0
58	NS1AA2	6-25	6-30	3	H	3	1
59	NS1 J1	6-26	7-25	3	H	3	0
60	NS1 K1	6-26	7-25	3	2H1A	2	--
61	19	6-28	7-25	3	H	3	0
62	12	6-28	7-27	2	H	2	0
63	RD10/2	7-13	8-2	3	H	3	0
64	19	7-16	8-9	3	H	3	1
65	19	7-16	8-15	2	A	0	0
66	19	7-16	8-6	3	H	3	2
67	22	7-16	8-2	3	H	3	1
2008 Season Totals				193 eggs	2P, 3A, 62H 67 Nests	174 chicks	45++ fledglings

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.

Appendix 2. Distribution of Western Snowy Plover Nests at Bolsa Chica for 1997 through 2008.

Distribution of nests

Year	Total # Nests	Cell 1	Cell 3	Cell 4	Cell 5	Cell 6	Cell 8	Cell 59	Cell 44	Cell 62	FTB	NTI	NS1	NS2	NS3	Total
1997	31			5		1	4	3	1							14
1998	34		7	5	1	1	2									16
1999	38		2	9		1		1		1						14
2000	39		1	9						1						11
2001	55	1	1	11		4	1			1						19
2002	50			8		3	1	1		1						14
2003	32	1	8	1		1										11
2004	65		6	9		1		1								17
2005	51	1		5												6
2006	71										13		15	2	8	38
2007	50												19		8	27
2008	67											1	37		5	43

Cells that were no longer available after 2005
 Cells only available after 2005

Year	Cell 2	Cell 9	Cell 10	Cell 11	Cell 12	Cell 13	Cell 14	Cell 17	Cell 18	Cell 19	Cell 22	Cell 30	Cell 32	Cell 33	Cell 34	Cell 36	STI	Total
1997			4	7			1		1		2						2	17
1998		2	7	6			1				1						1	18
1999			6	5			1	1		5	4						2	24
2000		2	6	12	1		1	1			1					3	1	28
2001	1	8	11	9						5							2	36
2002	1	2	1	10		3	3	5			10					1		36
2003		6	1		2				2	1							9	21
2004		5	12	13	2	1	1		3	1	4	1					5	48
2005	1	6	8	12	3		1			4				3			7	45
2006			2	6	5						13		2	1			4	33
2007			1	6		3				1	3		4		1		4	23
2008		2	5		3					4	6						4	24