

**Western Snowy Plover Nesting
at Bolsa Chica, Orange County, California
2009**



by Peter Knapp* and Bonnie Peterson**

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* California Department of Fish & Game

** Merkel & Associates, Inc.

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 acted as 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 approximates 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 2009 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.

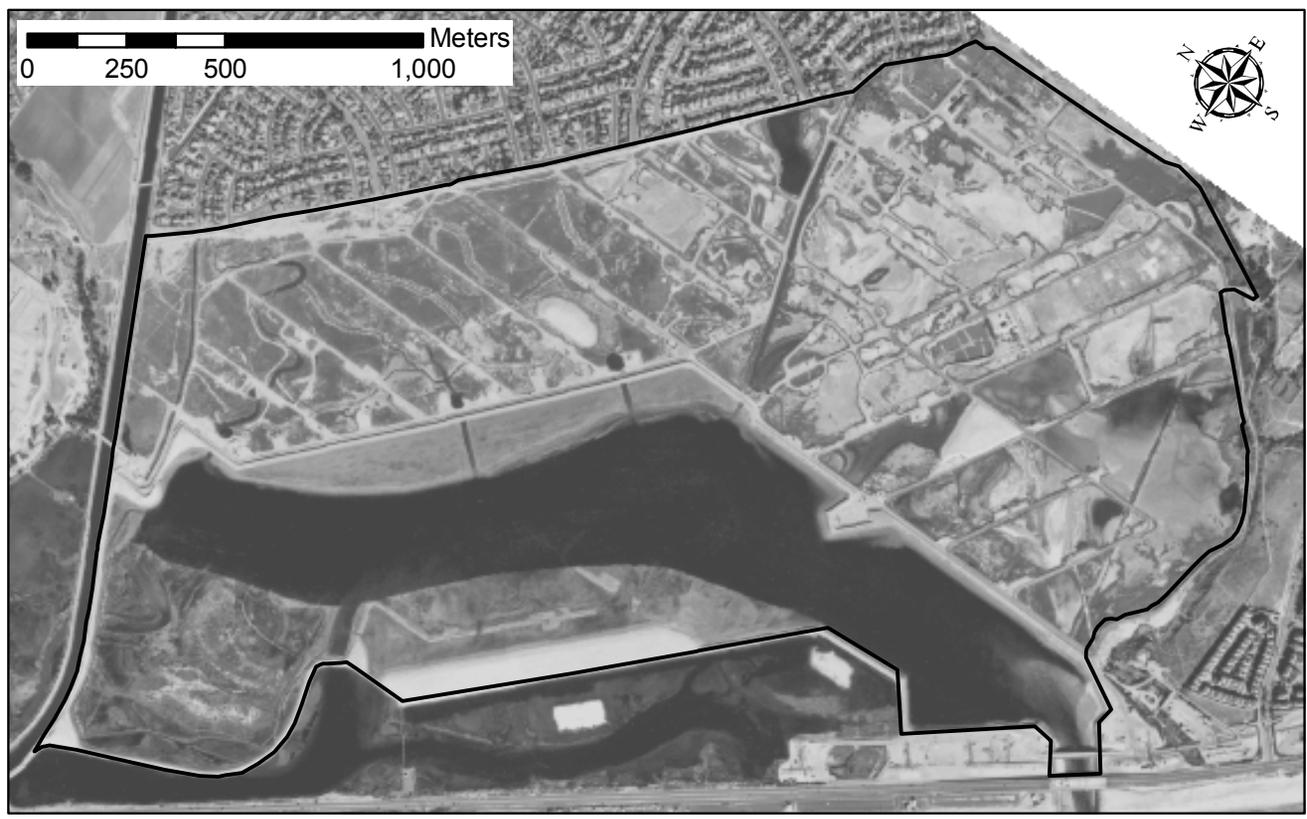
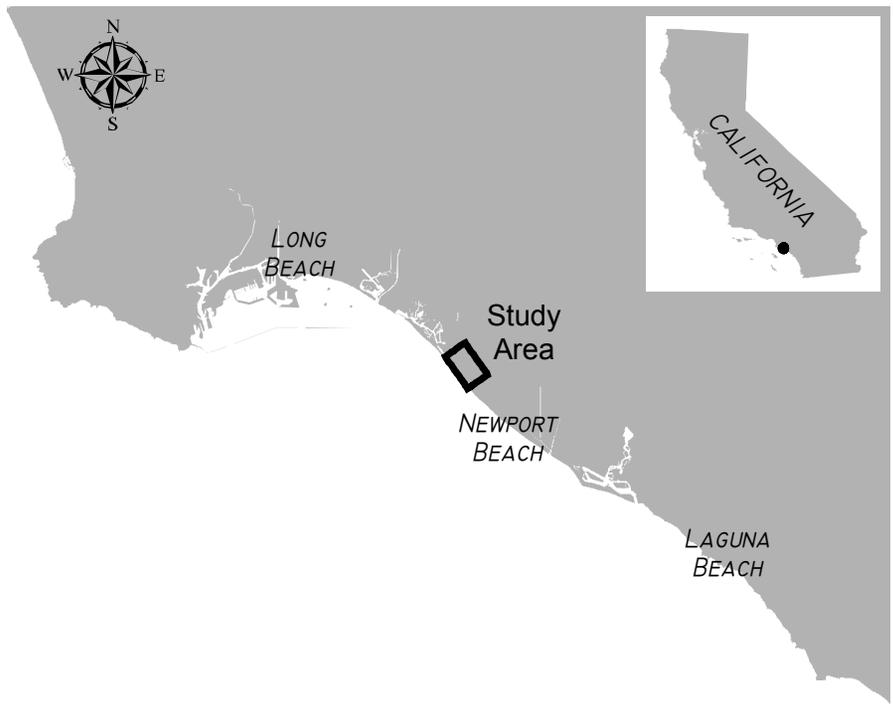


Figure 1. Bolsa Chica Vicinity Map

The recognized breeding season of the western snowy plover normally extends from March 1 through September 15; however, some earlier nesting is known to occur and did occur in 2009. Generally, three 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.

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 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 (Page et al. 1995, Tucker and Powell 1999). 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 in several historically used beach strand areas. 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 1997-2009 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 2 through 13), Future Full Tidal Basin (Cells 14 through 40 and Cell 63), Muted Tidal Basin (Cells 41 through 50 and Cell 66), 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 46 (the Edwards Thumb), which remains in private ownership and a different oil lease.

The Seasonal Ponds, Future Full Tidal Basin, and Muted Tidal Basin 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 salt panne and

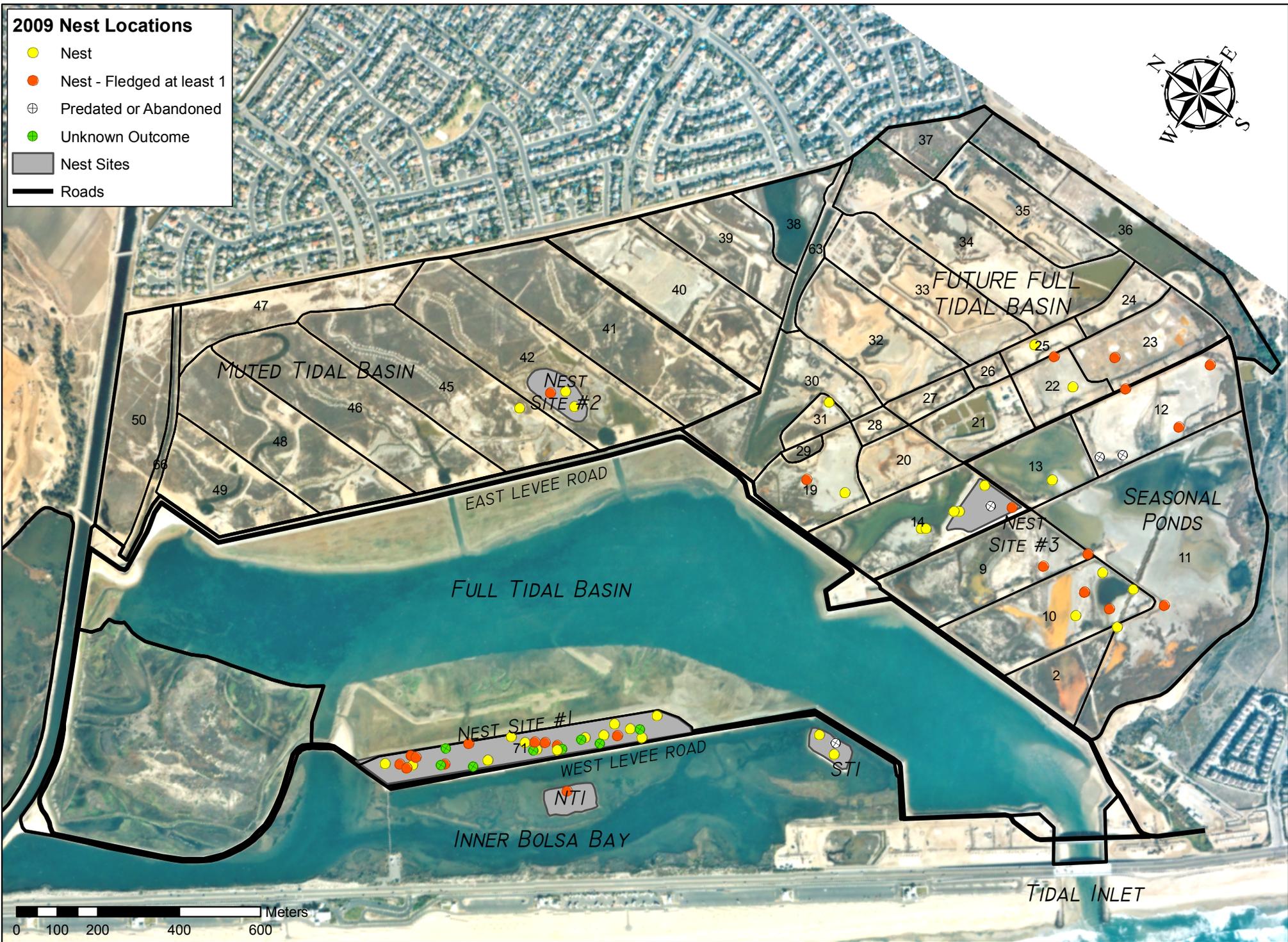


Figure 2. Distribution of Western Snowy Plover Nests in 2009 at Bolsa Chica

the most dominant plant species is pickleweed (*Sarcocornia pacifica*). Portions of the ponds are seasonally inundated with fresh to brackish water that becomes highly saline later as evaporation concentrates the remaining water in diminishing pools over the salt panne. The Future Full Tidal Basin occurs between the Seasonal Ponds and the Muted Tidal Basin and includes Freeman Creek. These zones are very similar to the Seasonal Ponds and consist mainly of salt panne and pickleweed, although there are some areas that retain water year-round. The Muted Tidal Basin occupies the northeastern section of Bolsa Chica. These zones generally contain less salt panne, with broad expanses of pickleweed and are generally considered unsuitable for western snowy plover nesting. Zones 49, 50, 66, and a portion of 48 were exposed to muted tidal influence starting in March 2008. The other zones of the Muted Tidal Basins were inundated by tidal overflow and rainwater for much of the spring and summer, but were not open directly to the Full Tidal Basin. 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. Large portions of Cells 11 and 13 were inundated this year and were not available for snowy plover nesting.

NTI and STI are well-established created islands surrounded by the muted tidal waters 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 California least terns but also has several snowy plover nests per season. NTI has been used primarily by larger terns (elegant, Forester's, royal, and Caspian) and black skimmers (*Rynchops niger*). After an absence of plover nests for 10 years, in 2008, at least one and probably two plover pairs nested on NTI. These nests were abandoned due to conflict between plovers and elegant terns (*Thalasseus elegans*). In 2009, one nest was initiated, but again due to conflict with elegant terns, the nest was abandoned by adults, the eggs were salvaged and given to the Wetlands & Wildlife Care Center of Orange County for captive incubation, hatching, and release of young.



Snowy plover nest surrounded by a large flock of elegant terns

deerweed (*Lotus scoparius*), five-hook bassia (*Bassia hyssopifolia*), and three 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 large patches throughout the site. The area along the northeastern shoreline lacks vegetation or debris that is normally found in a tidal area. Pickleweed is now spreading on this shoreline.

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 2009, vegetation 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



Photo by B. Peterson



Photo by B. Peterson

Nest Site 1 (NS1) nesting area in October 2008 (left) and October 2009 (right) after the breeding season.

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. In 2009, vegetation on both sites increased. On NS2 this occurred naturally. Chicks on NS2 hatched and foraged on the site through fledging. On NS3 seeded sand from the Huntington State Beach tern site was spread early in the season and transplants from NS1 were made. As in past years chicks on NS3 left the site upon hatching to forage in adjacent cells of the Season Pond area.

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

Peter Knapp (the primary surveyor) assisted by Wally Ross and Kelly O'Reilly (each of 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. Surveying begins as soon as there is evidence that the snowy plover is preparing to nest. Normally surveys would begin in mid to late March; however, in 2009 regular surveys commenced in late January when scrapes were observed on NS1. The first snowy plover nest was established on STI on February 23. 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 surveyed on foot as part of least tern surveys. 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 nest. NS2 was surveyed by vehicle from the East Levee Road weekly using a spotting scope and irregularly on foot. 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. 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 2009 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 2009. 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-enclosure (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 proven effective in deterring predation by corvids, gulls, 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 2009, predator management was undertaken by Wally Ross.

In 2009, 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 three 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 2009.

Clay roof tiles were placed on NS1 and NS3 to provide shelter for young chicks.

RESULTS AND DISCUSSION

NUMBERS OF MALE AND FEMALE SNOWY PLOVERS

During May 2009, a range-wide breeding season window survey was conducted. The total number of snowy plovers present at Bolsa Chica was 47 adults: 25 female and 22 male (Table 1). These numbers were used to determine fledgling per male.

Table 1. Males, Females, Nests and Fledgling Production 1997-2009

Year	Females	Males	Total Nests	Fledglings	Total Fledge/Nest	% Chick Survival	Fledge/Male
2009	25	22	70	42-70*	0.60-1.00*	22.8-38.0*	1.9-3.5*
2008	22	28	67	57-109*	0.85-1.62*	29.5-56.5*	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 snowy plover utilized all available nesting sites at Bolsa Chica in 2009; however, the distribution of nests indicates that NS1 and the Seasonal Ponds were, as in past years, the preferred plover nesting sites. NS1 had 46% of all the nests and the Seasonal Ponds had 23% of the nests (Figure 2, Table 2). The most utilized cells in the Seasonal Ponds were Cell 10 (9%) and Cell 12 (7%). NS2 was used by nesting snowy plovers for the first time since 2006. Nests were also established for the first time in Cells 45, 25, and 31. 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 2009 many of the cells that were commonly used, such as Cell 11 and Cell 13, were not entirely available for nesting plovers in 2009 due to high water levels. A pump-down of water levels was undertaken in May 2009 to drain water levels; however, it was too late in the nesting season to make these cells completely available for nesting plovers. Typically these cells collect water during the winter rains, but later drain down somewhat by gravity into Freeman Creek, exposing some dry salt panne prior to the breeding season. Through the season, the available salt panne expands due to evaporation of the pooled water.

Table 2. 2009 Nest, Nest Fate, and Reproductive Success Distribution by Cell

Location	Total Nests	Nests Failed	Nests Hatched (# chicks)	Fledglings*
Seasonal Ponds:	16	0	16 (42)	17
Cell 9	1	0	1 (3)	2
Cell 10	6	0	6 (17)	6
Cell 11	2	0	2 (5)	2
Cell 12	5	0	5 (13)	5
Cell 13	1	0	1 (2)	0
Road	1	0	1 (2)	2
Future Full Tidal Basin:	9	0	9 (23)	4
Cell 14	2	0	2 (6)	0
Cell 19	2	0	2 (4)	2
Cell 22	3	0	3(8)	2
Cell 25	1	0	1 (3)	0
Cell 30	1	0	1 (2)	0
Muted Tidal Basin (Cell 45)	1	0	1 (3)	0
Nest Site 1*	32	0	32 (90)	17-28
Nest Site 2	3	1	2 (5)	1
Nest Site 3	5	1	4 (12)	1
North Tern Island	1	0	1 (3)	2
South Tern Island	3	1	2 (6)	0
Total	70	3	67 (184)	42-70

* Of the minimum number of fledglings 10 were salvaged eggs (7) and chicks (3) raised at Wetlands and Wildlife Care Center.

Note: 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 from 27 nests (including those in adjacent Full Tidal Basin) the first year the site was available, to 37 in 2008, and 32 in 2009 (Appendix 2). Reproductive success remained consistent on NS1 with a fledge rate of 0.60-1.00 (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 and 1.06 in 2009, even with suboptimal conditions.

The Seasonal Pond Cells, in addition to the nesting areas, are also the primary feeding areas for hatched plovers other than those from STI, NS1, and NS2. 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 only two nests in Cell 11 in 2009, at least six broods, not hatched from Cell 11, used this cell for foraging 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 2009. 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, royal (*Thalasseus maximus*), California least, Caspian tern (*Hydroprogne caspia*), American avocet (*Recurvirostra Americana*), black-necked stilt (*Himantopus himantopus*), killdeer (*Charadrius vociferus*), and



Terns and black skimmers on NS1.

horned lark (*Eremophila alpestris*) all nested on NS1 in 2009. Black skimmers have nested on NS1 since 2007. Elegant terns did not nest on NS1 in 2009 but used the site as roosting areas especially after their fledglings left NTI. 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).

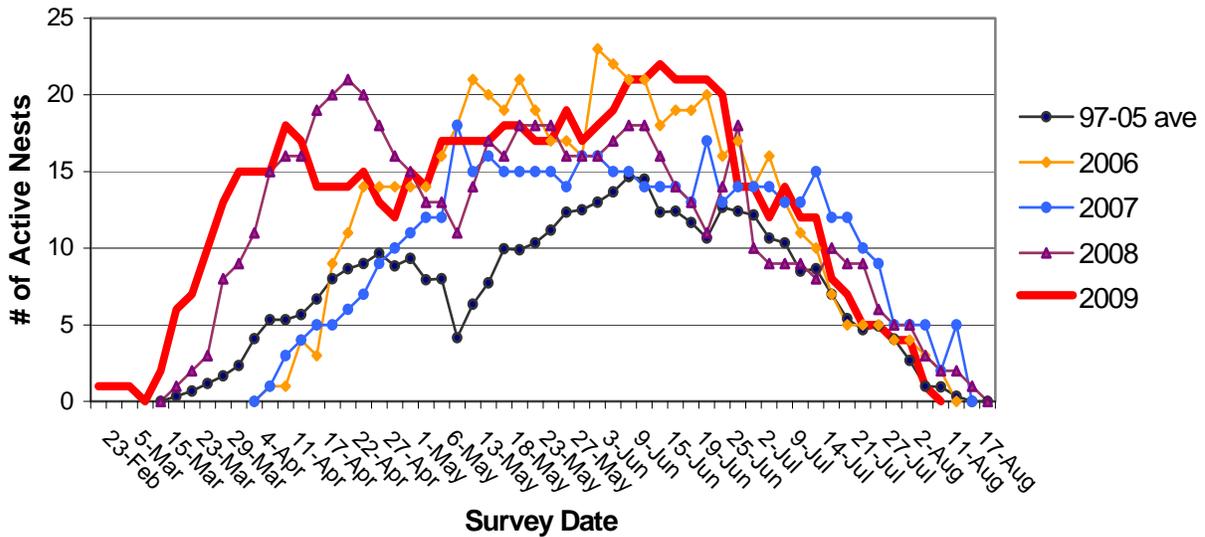


Figure 3. 1997-2009 Bolsa Chica Active Nest Chronology

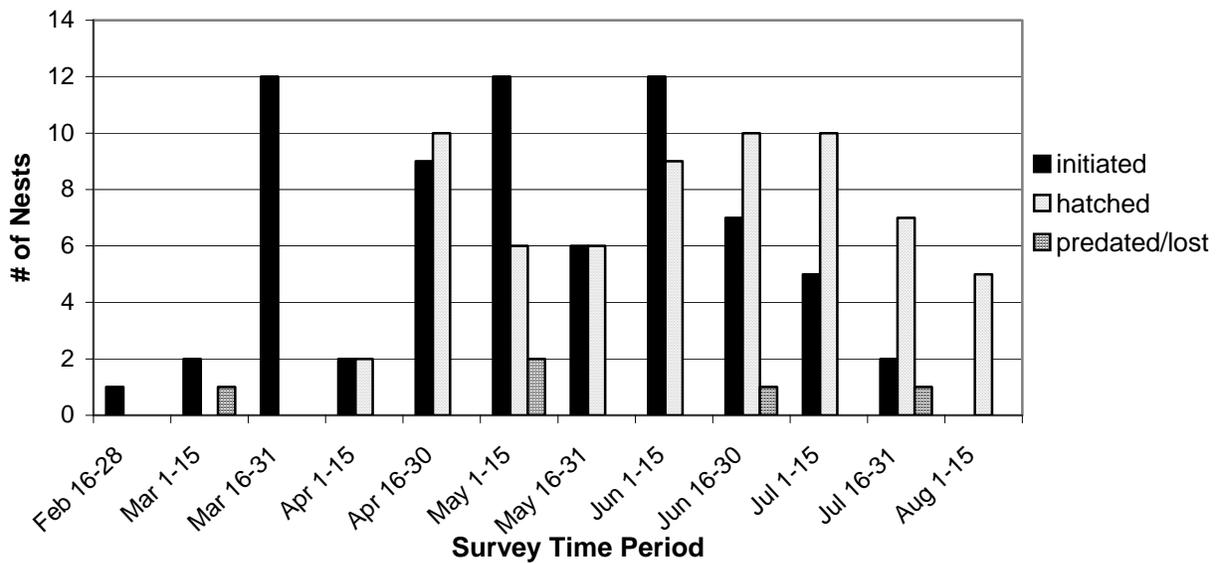


Figure 4. Biweekly Western Snowy Plover Nest Initiation, Hatching, & Loss at Bolsa Chica in 2009

In 2009, the first plover nest was initiated February 23, almost a full month prior to previous years. Snowy plover nesting rose with the initial peak occurring prior to mid-April and at least 10 days prior to the initial peak in 2008 (Figure 3). The last nests hatched early in August, about a week or more earlier than in previous years (Figure 4). Even with the early start in nesting, the season were comparable to 2008, with 26 (37%) nests had been initiated by May 1 and half of the nests had been initiated by May 12.

EGG, CHICK, AND FLEDGLING PRODUCTION

All 70 nests in 2009 were judged to be complete clutches. Nine completed clutches were 2-egg clutches, while 61 were 3-egg clutches (Appendix 1).



Banded fledgling released from Wetlands and Wildlife Care Center. Note the discoloration on the chest.

Seven nests were abandoned and appeared to be unrelated to each other (Nests #1, 18, 27, 46, 47, 48, and 52). Nest #1 was probably abandoned due to presence of a peregrine falcon (*Falco peregrinus*) on STI. Nest #18 on NTI was abandoned due to elegant tern harassment of adult plovers attempting to reach their nest to incubate eggs. Nest #47 in Cell 10, nest #48 in Cell 11, and nest #52 in NS2 were abandoned for unknown reasons.

The eggs from nests #18, 47, and 48 were collected after determination that abandonment had occurred and were given to the Wetlands and Wildlife Care Center of

Orange County for possible salvage (Table 3). Eight of the nine eggs hatched at the care center and were raised to fledging, banded, and subsequently released in the seasonal pond area of Bolsa Chica. In addition to the nine eggs, three abandoned chicks from Nest # 11 on NS1 were given to the care center for salvage. They were raised at the care center, fledged, were banded and subsequently released in the Bolsa Chica area (Table 3). Two other nests (#27 and 46) contained non-viable eggs that were incubated by the respective females for unusual periods. Nest #27 from May through July 21 and Nest #64 from June 3 through August 30. This behavior is unexplained and has not been seen before at Bolsa Chica.

Table 3. Western Snowy Plovers Banded at the Wetlands and Wildlife Care Center of Orange County

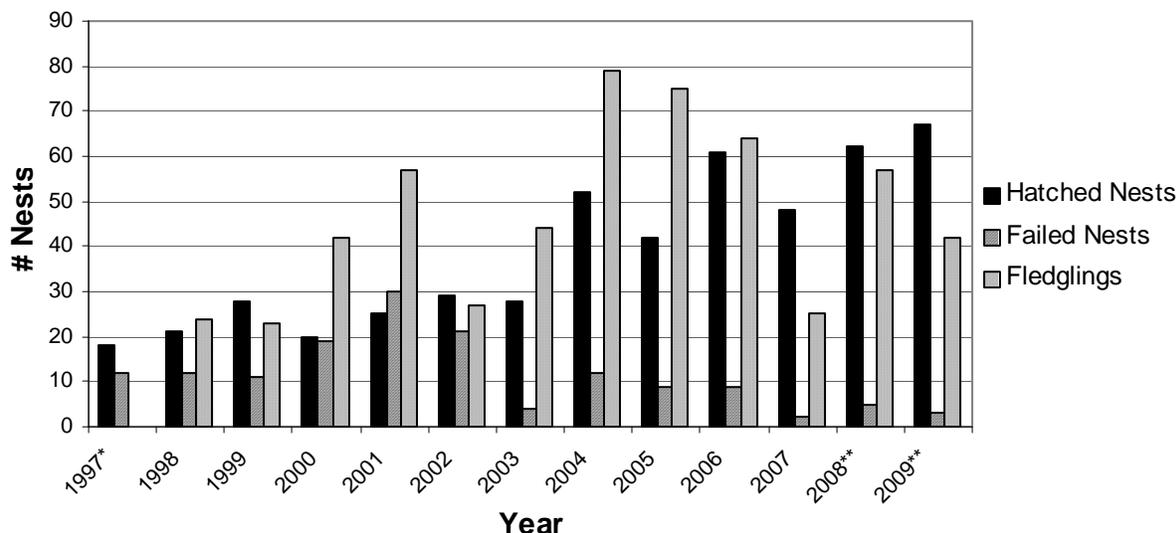
Band Combination	Nest #	Arrived As	Date Banded	Date Released	Last Observed	Comment
YNRW	11	chick	5/20/2009	6/19/2009	7/17/2009	
YNY Y	11	chick	5/20/2009	6/19/2009	7/13/2009	
YNWB	11	chick	5/20/2009	6/19/2009	6/19/2009	
YNBW	18	egg	5/20/2009	6/19/2009	6/19/2009	
YNBB	18	egg	5/20/2009	6/19/2009	7/28/2009	
YNR Y	18	egg	5/20/2009	--	--	euthanized
YNBG	47	egg	7/17/2009	8/8/2009	8/25/2009	
YNBR	47	egg	7/17/2009	8/8/2009	10/15/2009	
YNBY	47	egg	7/17/2009	--	--	predated
YNGB	48	egg	7/17/2009	8/8/2009	8/25/2009	
YNYW	48	egg	7/17/2009	8/8/2009	10/29/2009	
	48	egg	--	--	--	did not hatch

A total of 201 snowy plover eggs were produced at Bolsa Chica in 2009, with 17 eggs abandoned or failing to hatch, the remaining eggs produced 184 chicks. Of these 184 total chicks produced in 2009, a minimum of 42 chicks (23%) and a maximum of 70 chicks (38%) were estimated to have survived to fledge (Table 2). This is the highest number of hatched nests recorded at Bolsa Chica. The number of estimated fledglings seems to be dropping compared to previous years; however, this is based on minimum numbers of fledglings for the past two years (Figure 5). Sixty-six nests survived to hatch with a hatching success rate of 94.3%. 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 both 2008 and 2009 due to the nesting activity on NS1; black skimmer, royal tern, Caspian tern, American avocet, black-necked stilt, and horned lark all nested on NS1 along with the California least tern and the western snowy plover. Although, the site was surveyed on a weekly basis it was difficult to track hatching nests and chick activity due to the large number of nesting birds on the site. The total fledgling count for 2009 was estimated to be between 42 and 70.

In 2009, ten dead eggs were observed, including the eggs in two abandoned nests that were incubated for almost two months. With 201 total eggs laid in 2009, 5.0% of total eggs were dead eggs. No laboratory analysis was made of these dead eggs.

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.



** based on the minimum number of fledglings

Figure 5. Comparison of Number of Western Snowy Plover Hatched Nests, Failed Nests, and Fledglings 1997-2009 at Bolsa Chica

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 2009 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.

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 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, royal, and Caspian terns, and black skimmers).

OBSERVATIONS OF BANDED ADULTS

A male, identified by banding color code (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 three years. In 2009 he had at least one nest on NS1 (Nest #31).

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 three times in 2008. In 2009, this female nested at least once on NS1 (Nest #32).

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 2009 (Nest #10). A male (SKM) also from Camp Pendleton nested a least once at Bolsa Chica in 2009.

Other banded bird sightings not breeding at Bolsa Chica were as follows: RWRW on April 7-12, SYK on May 28, and PGYB on August 14. In previous years more banded birds were sighted as migrants in July and August.

PREDATION

In 2009, no nests were depredated. The low rate of nest loss and high degree of chick production was attributable in 2009 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. Nest #1 on STI was probably abandoned due to the presence of a peregrine falcon roosting on STI.

Of the 70 nests, 35 are known to have not fledged chicks. Four of these 35 did not produce chicks due to abandonment. One brood (Nest #9) was depredated by gulls and two broods (Nest #20 and 21) were depredated by squirrels shortly after hatching. A gull-billed tern (*Gelochilodon nilotica*) was also observed depredating chicks and is estimated to have taken a minimum of 18 plover chicks.



Photo by P. Knapp



Photo by S. Smith

Gull-billed tern with snowy plover chick (above). Two gull-billed terns with adult snowy plover and brood nearby (left).

The gull-billed tern has increased its nesting presence near least tern and snowy plover nesting areas of San Diego County. This tern forages on insects, lizards, crabs, and young birds and is a threat to least tern and snowy plover chicks. In 2009, the first gull-billed tern sighting was on March 26. Subsequent sightings were made throughout April and infrequently in May and June. The last sighting was on June 27. The gull-billed terns did not nest at Bolsa Chica in 2009 and at times during May and June were not seen. Sightings were in the Seasonal Pond area and NS1. It is estimated that at least 18 plover chicks, one of which was observed, were attributable to the gull-billed tern. Most sightings were of two birds but one time three birds were present on NS1.

American kestrels (*Falco sparverius*) were often present in the seasonal pond area and loss of plover chicks may be attributable to these birds.

Red-tailed hawks (*Buteo jamaicensis*) were regularly present at Bolsa Chica, but no hawk nests were known to be present in 2009. 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 hawk, 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. One red-tailed hawk was trapped in the Seasonal Pond area and was relocated.

Table 3. Bolsa Chica Predator Removal Summary over 10-year period 1999-2009

Potential Predator	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999
Gull-billed Tern	-	-									
American Crow	6	12	10	-	15	99	118	52	80	91	10
American Kestrel	5	4	4	6	13	19	5	12	13	15	11
Loggerhead Shrike	-	-	-	4	1	10	5	3	6	2	5
Common Raven	5	-	4	2	1	2	4	5	6	3	2
Cooper's Hawk	-	1	-	-	8	-	-	-	-	-	-
Peregrine Falcon	-	-	1	-	-	-	-	-	-	-	-
Red-tailed Hawk	1	1	-	-	-	-	-	-	-	-	-
Gulls	-	1	7	-	1	-	-	-	-	-	-
Skunk	-	-	-	-	-	2	1	-	-	-	-
Virginia Opossum	1	-	-	-	-	-	-	-	-	-	-
Ground Squirrel	4	3	unkn*	unkn*	unkn*	unkn*	unkn*	-	-	-	-
Brown Rat	1	-	-	-	-	-	-	-	-	-	-

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

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 including elegant, royal, and Caspian terns were not probable predators.

Black-crowned night heron (*Nycticorax nycticorax*), Cooper's hawk (*Accipiter cooperii*), and peregrine falcon were present during all or part of the breeding season but were not suspected predators in 2009.

No instance of predation or disease mortality of adult snowy plovers was detected in 2009.

MANAGEMENT RECOMMENDATIONS

The western snowy plover breeding season resulted in high nest survival rates in 2009. The high nest survival rates are attributable to management actions such as the use of MEs. The fledgling rate (Table 1), however, was low to moderate, ranging from 42 to 70 fledglings (0.6 – 1.00 fledglings/nest). Therefore, management recommendations focus on maintaining existing management actions that have worked in the past as well as taking additional steps focused 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.

Many of these recommendations from past years have been implemented with good results. These actions include: 1) removing non-native plant cover with herbicides and by hand on all the man-made nest sites, keeping the area clear for nesting; 2) placing tiles on the nest sites for the chicks to hide under, providing protection from both predation and trampling; 3) deploying MEs on every snowy plover nest to prevent egg loss due to predation and trampling; 4) focusing predator monitoring and management on known nest and chick predators. These management efforts have been effective in the enhancement of nesting sites and improving reproductive success of the snowy plover and should continue. It is also recommended that monitoring continue with the same intensity that has occurred in the past in order to maintain this quality of management within the nesting sites.

There are also a number of management issues that are still unresolved although some effort has been made to improve or change the situation. These issues include an on-going problem of overcrowding on NS1, water management in the Seasonal Ponds, and the need to develop methods to increase usage of NS2 and NS3. These management issues are discussed in detail below.

1. Develop methods to manage overcrowding on NS1.

There are currently eight species nesting on NS1 including American avocet, California least tern, black skimmer, royal tern, Caspian tern, black-necked stilt, killdeer, horned lark, as well as the western snowy plover. In the later part of the breeding season large number of elegant terns used NS1 for roosting but did not nest there in 2009. The terns and skimmers 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 of California least tern and snowy plover nests and chicks increases due to trampling by these larger species. 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 nesting sites to reach the shoreline, risking the possibility of trampling and aggressive behavior from the colonial nesters.

This problem of overcrowding is unresolved, although a number of options have been discussed. One of these options included encouraging the terns and skimmers to return to NTI, where they nested exclusively until 2007. This option of getting these species to return to the island is becoming less appealing due to the large number of birds and the small size of the island. Opportunities should be sought to increase the size of NTI. There may be some opportunity for this kind of expansion when and if future dredging efforts occur in the Full Tidal Basin.

NS1 is also designed as a long linear nesting site with very little natural protection for the young plover chicks. These chicks are restricted to NS1 until they can fly due to the lack of suitable adjacent habitat. Some enhancement efforts have been made or have occurred naturally on NS1 that have improved the structure of the foraging areas. Large logs have been secured along the high tide line to try to enhance the structure of the shoreline. This has been implemented on a small scale to determine if it is a viable and useful enhancement effort. It is expected that during the high winter tides that some areas around the logs will erode and others will accumulate sand and debris. Some naturally occurring enhancement has also occurred over time. There is vegetation accumulating above the high tide line that was utilized this year by foraging chicks. Pickleweed is also starting to recruit along and just below the high tide line. It is expected that these areas will prove to provide further shelter and structure to the area but may need to be managed to provide open access to water at multiple locations, as the vegetation matures to a dense structure.

2. Improve water management in the Seasonal Ponds

A number of cells or large portions of cells within the Seasonal Ponds were not available in 2008 and 2009 for nesting due to flooding. These ponds frequently flood during the winter but dry out prior to the snowy plover nesting season. In 2008 and 2009 water was not able to drain into Freeman Creek due to elevated levels in the creek and the closed condition of the storm water release flap gates. A large portion of Cell 11, in particular, has been highly used for snowy plover nesting in the past years but was largely unavailable in 2008 and 2009. This flooding caused the snowy plover to expand into potentially less suitable cells as well as roadways in order to locate suitable, dry nesting areas. Nesting in the Seasonal Ponds has decreased over the last 4 years, probably due to the creation of NS1; therefore, increasing the number of cells available in the Seasonal Ponds would also provide increased potential for nesting opportunities. Based on changing conditions in the Full Tidal Basin and Muted Tidal Basin, it is likely that similar pond basin flooding will continue to occur in future years. Pumping of selected cells has occurred in both 2008 and 2009 to alleviate the conditions and increase nesting areas for the plovers. A Water Management Plan is currently being drafted that will include provisions to seasonally reduce water levels in the Seasonal Ponds and provide additional plover nesting and foraging habitat as a management element.

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

NS2 had one snowy plover nest in 2006 and three nests in 2009. NS3 had five snowy plover nests in 2008 with a low 0.2 fledge rate (1 fledge/5 nests). One California least tern nested on NS3 in 2009. No other species have utilized these nest sites. Efforts have been made on NS3 to retain the sand by placing fabric fencing in areas. Sand dunes have formed allowing for more structure on the site and allowing native dune plants to take root. This successful effort could also be utilized elsewhere. Vegetation on both sites is required to provide shelter, enhance foraging, and retain sand on the nest sites. This could be accomplished by watering the sites during the winter months to encourage growth from the existing seed bank. An opportunity may also exist for recontouring the surface of

the nest sites such that they pond water during the winter and dry to a salt crust during the summer months. This should be explored as a means to foster desired habitat conditions.

With several issues yet to be resolved, Bolsa Chica has also been presented with a new challenge with the arrival of the gull-billed tern. This CDF&G species of special concern is a known predator of the western snowy plover and the California least tern and has been an on-going problem in San Diego County where they have recently expanded their nesting range to south San Diego Bay. Predator management is complex for this rare species; therefore, alternative efforts to protect the snowy plover and least tern chicks in San Diego County should be followed and their successes should be emulated at Bolsa Chica.

4. Develop methods to increase knowledge of causes of plover chick mortality.

Identifiable causes of mortality in plover chicks have been, for the most part, limited to specific depredation events. This has left potential causes of mortality unknown. In 2009 after eliminating fledged chicks and known depredation, approximately 100 chick deaths were unaccounted for. Depredation by American kestrels, corvids, gulls and unknown predators are the assumed cause.

An “eyes on the colony” volunteer effort will be initiated in 2010 to monitor the north end of NS1 from the public viewing area. This will hopefully identify causes of brood loss for both the least tern and snowy plover, contributing to a better understanding of what is occurring at least at the north end of NS1.

Use of a blind to study the interaction of the various species nesting on NS1 will also contribute to identification of potential interaction conflicts. This activity would be undertaken in the area used by black skimmers and larger tern species, most likely in the central and southern sections of NS1.

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, 2009

<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	2-23	3-08	3	A	0	0
2	NS1 Y2	3-12	4-16	3	H	3	0
3	NS1 N1	3-14	4-15	3	H	3	0
4	NS1 G1	3-16	--	3	H	3	0
5	NS1 D1	3-16	4-23	3	H	3	0
6	NS1 BB2	3-17	4-11	3	H	3	0
7	NS1 I1	3-18	4-17	3	H	3	0
8	NS1 Z1	3-23	4-19	3	H	3	0
9	NS1 P3	3-24	4-27	3	H	3	0
10	NS3 6D	3-25	4-26	3	H	3	1
11	NS1 V1	3-25	5-01	3	H*	3	3
12	NS3 A2/3	3-27	4-28	3	H	3	0
13	NS1 F2	3-29	4-26	3	H	3	0
14	NS3 6A	3-29	4-26	3	H	3	0
15	CELL 10	3-31	5-03	3	H	3	1
16	NS1 L1	4-01	5-04	3	H	3	--
17	NS1 E2	4-11	5-11	3	H	3	--
18	NTI	4-16	5-10	3	H*	3	2
19	NS1 Z2	4-16	5-11	3	H	3	1
20	CELL 12	4-18	5-12	2	H	2	0
21	CELL 12	4-20	5-15	3	H	3	0
22	NS2	4-24	5-27	3	2H1A	2	1
23	STI H4	4-23	5-26	3	H	3	0
24	CELL 10	4-28	5-28	3	H	3	0
25	NS1 V3	4-29	6-02	3	H	3	--
26	NS1 K1	4-30	5-21	3	2H1A	2	--
27	NS3 B4	5-01	7-21	3	A	0	0
28	NS1 E1	5-01	5-28	3	H	3	0
29	CELL 22	5-04	5-28	3	H	3	1
30	CELL 11	5-06	6-03	3	H	3	0
31	NS1 R1	5-06	--	3	H	3	0
32	NS1 V1	5-06	6-02	3	H	3	--
33	CELL 19	5-11	6-05	3	2H1A	2	2
34	NS1 N1	5-06	6-02	3	H	3	--
35	CELL 9	5-12	6-07	3	H	3	2
36	NS1 T1	5-12	6-16	3	H	3	--
37	NS1 D1	5-12	6-22	2	H	2	--
38	NS1 Z1	5-14	--	3	H	3	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>
39	CELL 25	5-18	6-15	3	H	3	0
40	CELL 12	5-27	6-27	3	H	3	1
41	CELL 12	5-29	6-24	3	H	3	3
42	STI	5-27	6-26	3	H	3	0
43	NS2	5-28	--	3	H	3	0
44	NS1 H1	5-26	--	3	H	3	--
45	NS1 I-J1	6-3	--	3	H	3	--
46	NS1 L1	6-3	--	2	A	0	0
47	CELL 10	6-1	6-26	3	H*	3	3
48	CELL 11	6-4	7-09	3	H*	2	2
49	CELL 10	6-4	--	2	H	2	0
50	RD9/10	6-5	7-03	2	H	2	2
51	NS1 Y3	6-5	6-26	3	H	3	2
52	NS2	6-6	6-20	3	A	0	0
53	CELL 22	6-07	6-30	3	H	3	1
54	NS1 B2	6-07	7-08	3	H	3	0
55	CELL 14	6-09	7-05	3	H	3	0
56	NS3	6-15	7-17	3	H	3	0
57	CELL 10	6-22	7-17	3	H	3	2
58	CELL 14	6-22	7-17	3	H	3	0
59	NS1 Y2	6-23	7-09	3	H	3	3
60	NS1 O2	6-16	7-07	3	H	3	0
61	CELL 45	6-25	7-20	3	H	3	0
62	NS1 T/S3	6-26	7-17	2	H	2	2
63	CELL 19	6-30	7-21	2	H	2	0
64	CELL 30	7-08	8-02	2	H	2	0
65	CELL 13	7-08	7-28	3	2H1A	2	0
66	CELL 22	7-08	8-6	2	H	2	0
67	CELL 10	7-09	--	3	H	3	0
68	CELL 12	7-09	8-03	3	2H1A	2	1
69	NS1	7-26	--	3	H	3	2
70	NS1	7-26	--	3	H	3	1
2009 Season Totals				201 eggs	3A, 67H 70 Nests	184 chicks	42++ fledglings

P = predated; A = abandoned; H = hatched, -- = data unknown

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

*chicks or eggs (see Table 3) were abandoned but salvaged and sent to the Wetlands and Wildlife Care Center of Orange County and subsequently released after fledging.

Appendix 2. Distribution of Western Snowy Plover Nests at Bolsa Chica for 1997 through 2009.

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	1	8	37
2007	50												19		8	27
2008	67											1	37		5	43
2009	70											1	32	3	5	41

Cells that were no longer available
 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 25	Cell 30	Cell 31	Cell 32	Cell 33	Cell 34	Cell 36	Cell 45	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
2009		2	6	2	5	1	2			2	3	1		1					1	3	29