

Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 2012



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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 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.

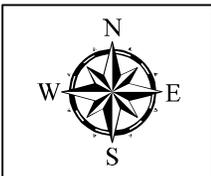
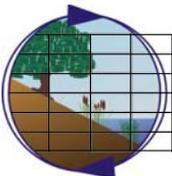
In 1997, the Bolsa Chica lowlands were acquired into public ownership. This marked the beginning of a multi-agency effort to design, evaluate, and implement a plan for restoring the fish and wildlife habitats. These habitats had been cut off from the ocean for a century and have been an operating oil field for over 50 years. Construction of the restoration project began in fall 2004 and was completed in August 2006. By the 2006 breeding season, three 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 on 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 Muted Tidal Basin was opened to tidal influence from the Full Tidal Basin through its water control structures in March 2008.

The purpose of this investigation is to continue to improve the level of knowledge about the western snowy plover (*Charadrius nivosus 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. This annual study will also aid in documenting achievement levels required to meet the goals of the Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (USFWS 2007). 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 document reports on the 2012 snowy plover breeding season at Bolsa Chica.

BACKGROUND

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 recognized breeding season of the western snowy plover normally extends from March 1 through September 15; however, the first nest at Bolsa Chica in 2009 occurred on February 23 and courting behavior has been observed as early as late January. 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.



Site Locator and Vicinity Map
 Bolsa Chica Lowlands Restoration Project
 Orange County, CA

Figure 1

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 typical for this species. Snowy plover females usually leave very young chicks with the male in order 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 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).

BOLSA CHICA STUDY AREA

Snowy plover nesting areas within Bolsa Chica 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), Nest Site 3 (NS3), and the Levee Roads of the Full Tidal Basin (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, Outer Bolsa Bay, Rabbit Island, and Inner Bolsa Bay to the west of West Levee Road with the exception of NTI and STI (Figure 2).

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 the most dominant plant species is pickleweed (*Sarcocornia pacifica*). Portions of the ponds are seasonally inundated with fresh to brackish water that become highly saline as evaporation concentrates the remaining water in diminishing pools over the salt panne. Large portions of Cells 11 and 13 in the Seasonal Ponds were inundated in 2012 and were available for snowy plover nesting for only a portion of the breeding season.

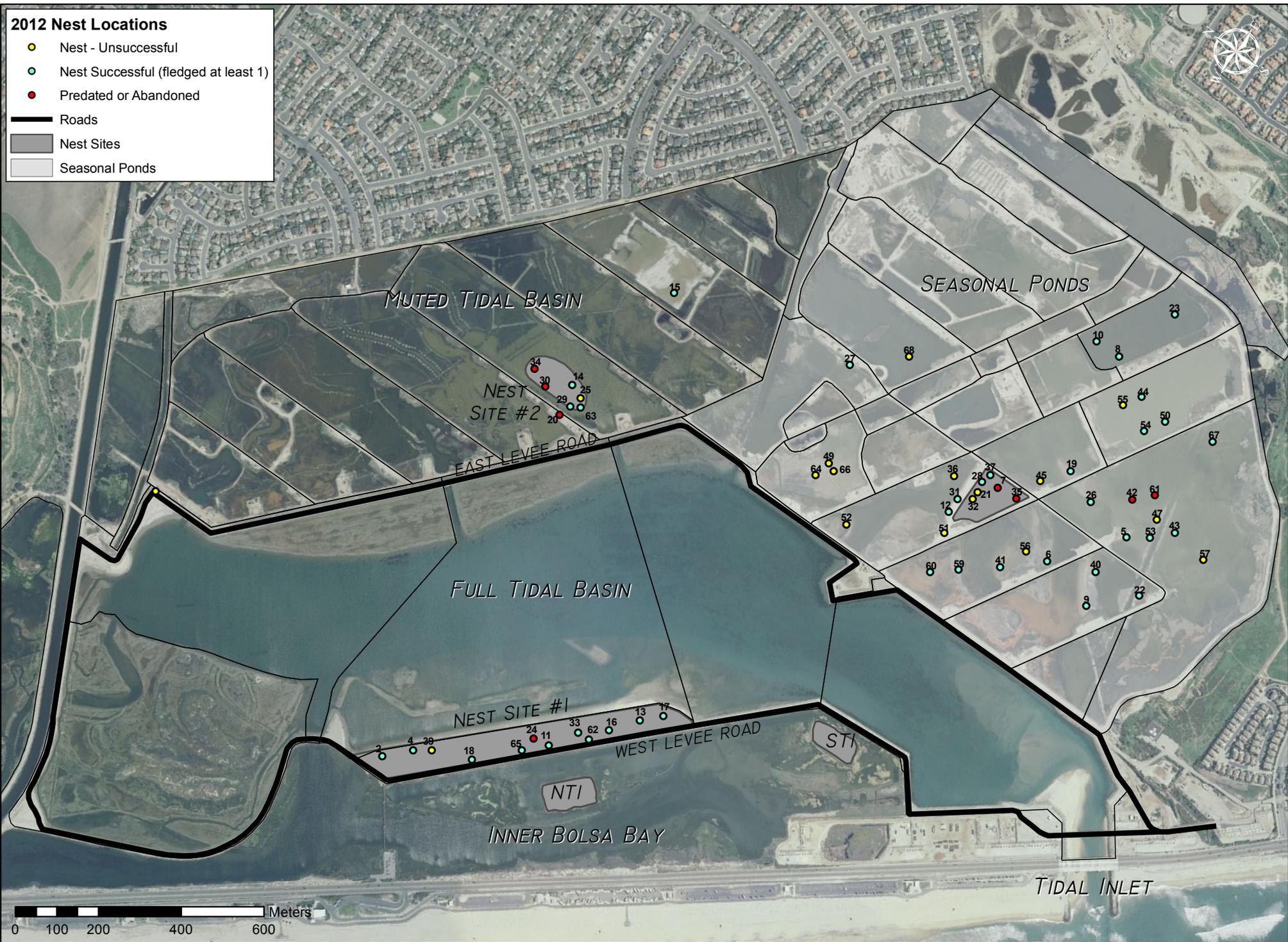


Figure 2. Western Snowy Plover Nesting Sites

The Future Full Tidal Basin lies 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 (Cells 30 and 38). Though these areas are mostly unsuitable for nesting the margins were regularly checked for nesting plovers.

The Muted Tidal Basin occupies the northeastern section of Bolsa Chica and is divided into west, central, and east basins. Muted tidal influence was introduced to the west Muted Tidal Basin in March 2008, and later to the central and east basins in March and May 2011, respectively. Due to considerable tidal muting in the Full Tidal Basin, the central and east Muted Tidal Basins were non-tidal in 2012, though water levels were manually adjusted on several occasions for various management purposes. The Muted Tidal Basins are largely inundated, composed of pickleweed, open water, and mudflat, and are generally considered unsuitable for western snowy plover nesting.

NTI and STI are well established, created islands surrounded by the muted tidal waters of 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 elegant tern (*Thalasseus elegans*), royal tern (*Thalasseus maximus*), Caspian tern (*Hydroprogne caspia*), black skimmers (*Rynchops niger*), and occasionally by western snowy plovers.

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. toward the basin. The shoreline of the nest site is now under full tidal influence. In 2012 vegetation covered much of the site including beach evening primrose (*Camissoniopsis cheiranthifolia*), beach sand verbena (*Abronia umbellata* var. *umbellata*), red sand verbena (*Abronia maritima*), saltgrass (*Distichlis spicata*), alkali heath (*Frankenia salina*), pickleweed, coastal deerweed (*Acmispon glaber* var. *glaber*), five-hook bassia (*Bassia hyssopifolia*), hottentot-fig (*Carpobrotus edulis*), crystalline iceplant (*Mesembryanthemum crystallinum*), and slender-leaved iceplant (*Mesembryanthemum nodiflorum*). A huge effort was made during the winter and spring to remove much of the non-native vegetation, mostly by use of herbicide and secondarily by physical or manual removal, but the non-natives still persisted in large patches throughout the site during the 2012 nesting season. The northeastern shoreline is becoming more structured, with pickleweed forming in the intertidal zone. Fences have been installed at both ends of the nest site in order to prevent the public from accessing the site and to limit the access of mammalian predators.

NS2 and NS3 are also created sites in Cell 42 and Cell 14, respectively. NS2 is located in the east Muted Tidal Basin and NS3 is within the Seasonal Ponds. These sites were built up with fill and covered with sand. Both nest sites require some weed control. Some chicks on NS2 forage on the site while others are led from the site by the adult by swimming across surrounding water. Chicks on NS3 tend to leave the site immediately after hatching to seek forage in the surrounding seasonal pond cells.

Public access is not allowed on any of the nest 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

The principal survey effort for western snowy plover in 2012 was undertaken by California Department of Fish & Game (CDFG) staff member Peter Knapp, with assistance from Ross Griswold, a CDFG volunteer, and Gary Keller, a CDFG staff member. Surveys for nesting western snowy plover begin in February. Surveys were conducted at least twice a week, sometimes 6 or 7 times a week, until the end of August. A monitor was on-site daily; however, not all nest sites were surveyed daily. Rather, fieldwork was concentrated on areas of activity, with a goal of covering the Bolsa Chica survey area once every several days.

The accessibility and size of each nesting site dictated survey methods. STI and NS1 were surveyed by vehicle from the West Levee Road prior to arrival of the California least terns and then on foot once nesting was initiated. NTI was used primarily by nesting large terns and black skimmer and, therefore, required minimal monitoring for western snowy plover. Observations of this nesting site were made from the West Levee Road. NS2 was surveyed by vehicle from the East Levee Road using a spotting scope with occasional survey efforts occurring on foot. NS3 was surveyed by vehicle from the north end of the site. The large majority of suitable western snowy plover nesting habitat in the Seasonal Ponds was visible from the road network. Therefore, the observer(s) would slowly drive 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.

During each survey for western snowy plover, observers documented the location of any new nests. NS1, NS2, and NS3 were sectioned by markers, which formed the basis for data recording. NS1 is significantly larger than the other two nest sites; therefore, NS1 was sectioned south to north from A through CC in a regular grid. Each snowy plover nest located during survey efforts was marked with a numbered tongue depressor, mapped for ease of relocation on subsequent visits, and a mini-exclosure (ME) was placed on the nest.

On all sites 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 between 2 and 7 days per week. These regular brood observations were conducted to determine chick survival and fledgling production, as well as to detect movement between cells and use of specific cells for brood rearing.

A Range-wide, Breeding Season Window Survey was conducted at Bolsa Chica in May 2012. The survey was conducted in the same manner as in previous years and in accordance with the guidelines set out in the Snowy Plover Recovery Plan (U.S. Fish and Wildlife Service 2007).

PROTECTION FROM PREDATORS

Once a nest was discovered, a welded wire mini-exclosure (ME) was anchored in place over the top of the nest and left in place until the eggs in the nest hatched. The MEs are 28 inches in width on all four sides and 16 inches in height. These dimensions have proven effective in deterring predation by corvids, gulls, and coyotes (*Canis latrans*). The use of the ME contributes greatly to the low egg predation at Bolsa Chica. Aversion nests, used to deter coyote and corvid nest predation, were not effectively used during the 2012 breeding season.

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 plovers nest in proximity to the least tern, predator management activities on behalf of one species will also benefit the other species. In 2012, predator management was undertaken by Wally Ross of CDFG.

Clay roof tiles are placed on STI, NS1, NS2, and NS3 to provide shelter for young least tern and plover chicks. Adult plovers also use the tiles as a viewing platform for chick movement.

RESULTS AND DISCUSSION

In 2012, the first snowy plover nest was established on March 6 at the cove at the north end of the Full Tidal Basin. There were a total of 68 nests producing 77 fledglings for the season (Table 1).

NUMBERS OF MALE AND FEMALE SNOWY PLOVERS

During May 2012, a Range-wide, Breeding Season Window Survey was conducted. The total number of snowy plovers present at Bolsa Chica was 57 adults: 26 females and 31 males (Table 1). The management goal of the Snowy Plover Recovery Plan for Bolsa Chica is 70 adults.

Table 1. Males, Females, Nests and Fledgling Production 1997-2012.

| Year | Females | Males | Total Adults | Total Nests | Fledglings | Total Fl/Nest | Fl/Male |
|------|------------|-------|--------------|-------------|------------|---------------|------------|
| 2012 | 26 | 31 | 57 | 68 | 77 | 1.13 | 2.48 |
| 2011 | 20 (1 unk) | 28 | 49 | 73 | 62 | 0.85 | 2.21 |
| 2010 | 22 | 23 | 45 | 64 | 63 | 0.98 | 2.74 |
| 2009 | 25 | 22 | 47 | 70 | 42-70* | 0.60-1.00* | 1.91-3.18* |
| 2008 | 22 | 28 | 50 | 67 | 57-109* | 0.85-1.62* | 2.04-3.89* |
| 2007 | 18 | 12 | 30 | 50 | 25 | 0.50 | 2.08 |
| 2006 | 27 | 35 | 62 | 71 | 64 | 0.90 | 1.83 |
| 2005 | 25 | 41 | 66 | 51 | 75 | 1.47 | 1.83 |
| 2004 | 25 | 20 | 45 | 65 | 79 | 1.22 | 3.95 |
| 2003 | 15 | 16 | 31 | 32 | 44 | 1.38 | 2.75 |
| 2002 | 19 | 20 | 39 | 50 | 27 | 0.54 | 1.35 |
| 2001 | 19 | 18 | 37 | 55 | 57 | 1.04 | 3.17 |
| 2000 | 15 | 16 | 31 | 39 | 42 | 1.08 | 2.63 |
| 1999 | 12 | 11 | 32 | 38 | 23 | 0.61 | 2.09 |
| 1998 | 11 | 16 | 27 | 34 | 25 | 0.74 | 1.56 |
| 1997 | 14 | 20 | 34 | 30 | nd | nd | nd |

Fl = fledglings, nd = not determined

* based on minimum/maximum numbers of fledglings

NEST DISTRIBUTION AND CHRONOLOGIES

Snowy plover utilized all available nest sites at Bolsa Chica in 2012 except STI and NTI. Seasonal Ponds had 34% of all nests, NS1 had 16%, Future Full Tidal Basin had 13%, NS3 had 12%, and NS2 had 9% of all nests (Figure 2, Table 2). Cell 45, immediately adjacent to NS2 in the Muted Tidal Basin, was used for nesting this year, as it was in 2009 and 2011. Cell 40, also in the Muted Tidal Basin, was used for the first time in 2012. Cell 30, for the first time this year, had a confirmed nest. Appendix 1 provides the cell location, start and end dates, nest fates, and eggs and chicks produced for each nest in 2012. Appendix 2 provides information on historical nest distribution.

Table 2. 2012 Nest, Nest Fate, and Reproductive Success Distribution by Cell

| Location | Total Nests | Nests Failed | Nests Hatched (# chicks) | Fledglings |
|------------------------------------|-------------|--------------|-----------------------------|------------|
| Seasonal Ponds: | 26 | 2 | 24(66) | 35 |
| Cell 9 | 6 | 0 | 6(17) | 11 |
| Cell 10 | 4 | 0 | 4(12) | 10 |
| Cell 11 | 9 | 2 | 7 (19) | 8 |
| Cell 12 | 4 | 0 | 4(11) | 4 |
| Cell 13 | 3 | 0 | 3(7) | 2 |
| Nest Site 1 | 12 | 1 | 11(33) | 23 |
| Nest Site 2 | 7 | 2 | 5 (14) | 4 |
| Nest Site 3 | 9 | 2 | 7 (19) | 7* |
| Future Full Tidal Basin: | 10 | 0 | 10 (24) | 7 |
| Cell 14 | 2 | 0 | 2 (6) | 0 |
| Cell 19 | 3 | 0 | 3(8) | 0 |
| Cell 22 | 3 | 0 | 3 (8) | 6 |
| Cell 30 | 1 | 0 | 1 (2) | 1 |
| Cell 32 | 1 | 0 | 1 (2) | 1 |
| Road by South Tern Island | 1** | 0 | 1 (1) | 0 |
| Muted Tidal Basin (Cell 40) | 1 | 0 | 1(2) | 1 |
| 80 Road | 1 | 1 | 0 (0) | 0 |
| Full Tidal Basin Cove | 1 | 0 | 1 (2) | 0 |
| Total | 68 | 8 | 60 (161) | 77* |

* includes bird raised at Huntington Beach Huntington Beach Wetlands and Wildlife Care Center.

** nest not found

The State and Federal Endangered California least tern also nests at Bolsa Chica. Snowy plover egg laying typically begins several months before the least tern begins its egg laying. This has been the case at Bolsa Chica as well. The two species tolerate the co-location of their nests. This was apparent in 2012 when they both nested on NS1, NS2, and NS3.

In 2012, the first plover nest was initiated March 6. Snowy plover nesting rose to a peak in early May and again in late June (Figure 3). The last known nests hatched during the first week of August (Figure 3). Fifty-nine (85%) nests survived to hatch. There was an active nest and/or a pre-fledge brood for a total of 175 days of the 2012 breeding season at Bolsa Chica.

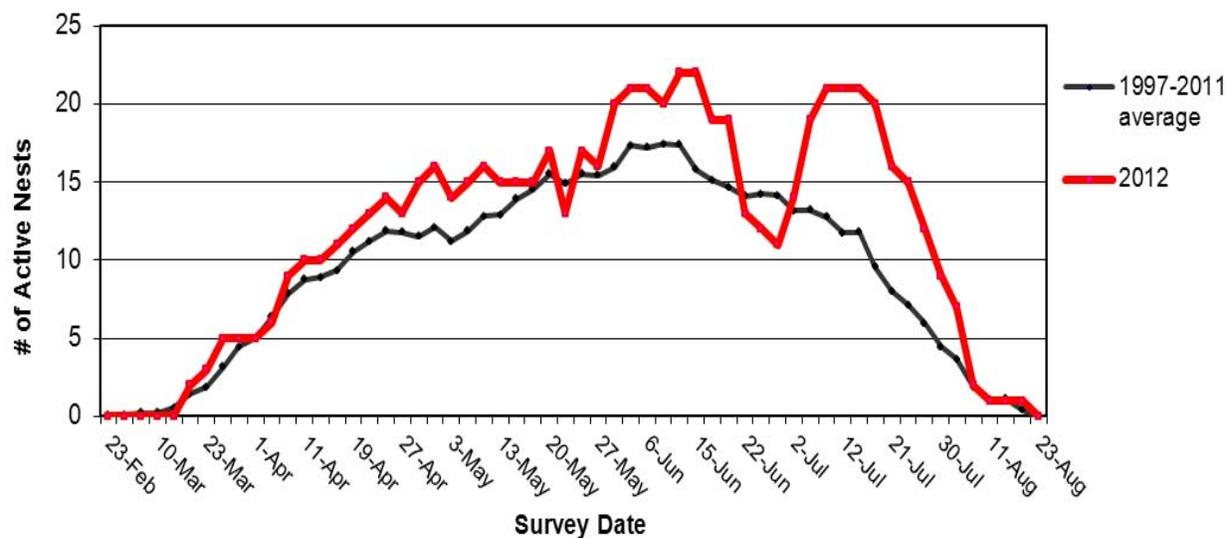


Figure 3. 1997-2012 Bolsa Chica Active Nest Chronology

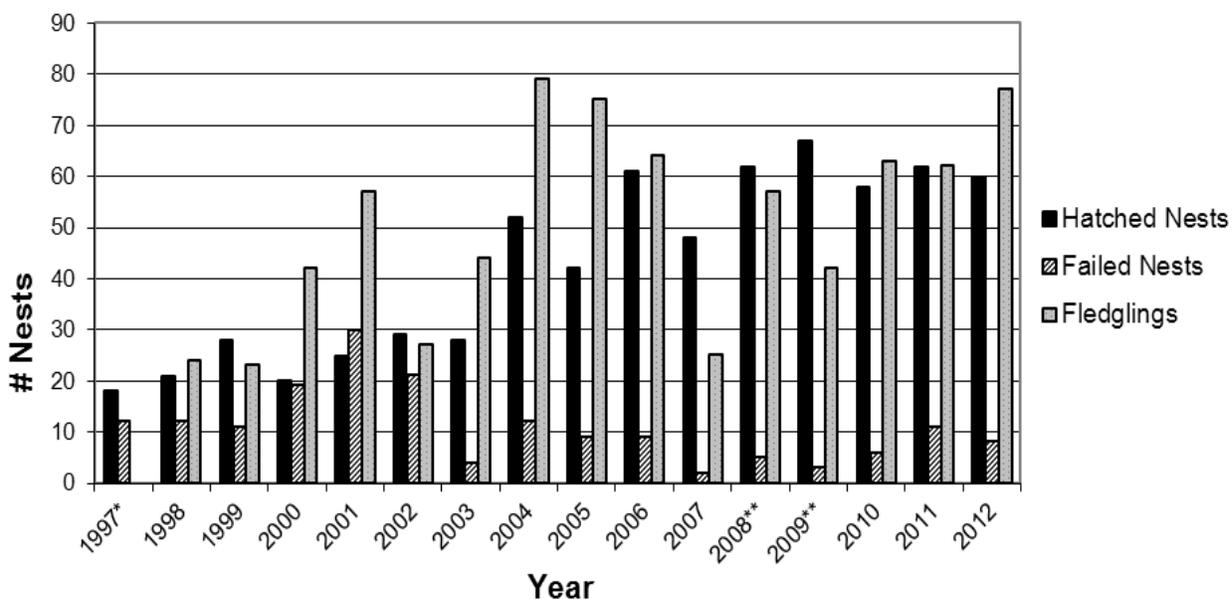
EGGS, CHICKS, AND FLEDGLING PRODUCTION

A total of 193 snowy plover eggs were produced at Bolsa Chica in 2012, with 32 eggs abandoned, predated or failed to hatch, and the remaining eggs producing 161 chicks. Of these 161 total chicks produced in 2012, 77 survived to fledge (Table 2, Figure 4). Of the chicks hatched, 24 (15%) died within the first day of hatching and 41 (25%) died within the first week of hatching. Conversely, of the chicks that perished, 29% died within the first day and 49% died within the first week. The causes of death were unknown.

Of the 68 nests found in 2012, five were found as broods only and the nest were not located including Nest 38 with 2 chicks, Nests 46, 65, and 69 with 3 chicks each, and Nest 58 with 1 chick. The remaining 63 nests were judged to be complete. Nine completed clutches were 2-egg clutches, one clutch was 4 eggs, and 53 were 3-egg clutches (Appendix 1).

Eight nests were abandoned. The cause of abandonment of Nests 1, 20, 24, 30, 34, and 35 is undocumented. Incubation of these nests was 20, 16, 14, 16, 3, and 9 days, respectively. Nest 61 located on Cell 11 was abandoned due to flooding. Cell 11 had dried up and cracked in the area where the nest was located; however, this was followed by ground water seeping up through the ground and filling the cracks with standing water causing the nest to flood. Nest 7 was classified as abandoned when eggs were collected from the nest after an abnormally long incubation period of 44 days. This is the sixth instance of prolonged abnormal incubation periods; in 2009 there were two nests, one nest in 2010, and two nests in 2011.

Only one nest was predated in 2012. In Cell 11 a coyote was able to dig under the ME at Nest 42 and remove the eggs. Additional attempts were made by coyote on Nests 44, 47, 50, 53, 54, 64, and 67, all of which were unsuccessful. Each of these nests successfully hatched full clutches.



* no fledgling data available

** based on the minimum number of fledglings

Figure 4. Comparison of Number of Western Snowy Plover Hatched Nests, Failed Nests, and Fledglings 1997-2012 at Bolsa Chica.

For the second time at Bolsa Chica 28 unhatched eggs were salvaged and given to the Western Foundation of Vertebrate Zoology (WVZ) for analysis of sterility. The results of the analysis are presented in Table 3 on the following page.

Two chicks from Nest 31 were orphaned after hatching due to parent desertion and were salvaged by Peter Knapp and taken to the Wetlands and Wildlife Care Center of Orange County (WWCCOC). The third chick from Nest 31 was never found. One of the chicks survived to fledge and was banded and released at Bolsa Chica on July 21. The band combination was YNRR. To aid in the release of the fledgling, a temporary shelter or halfway house was built to provide shelter to the young bird while it familiarized itself with its surroundings. The shelter consisted of a framed wire cage that was open at both ends. It was placed over a small amount of pickleweed to offer the young fledgling some cover while inside the shelter. This shelter was first used in 2010 and appears to have increased the survival of these hand-reared fledglings.

Of the 68 nests at Bolsa Chica in 2012, a total of 77 fledglings were produced. The overall fledge rate was 1.13 fledglings/nest. NS1 was the most successful nesting area with 1.92 fledglings/nest. This is a major increase from 2011 when the fledge rate was to 0.41 fledglings/nest. The number of nests on NS1 has decreased from a high of 37 nests in 2008 to 12 nests in 2012. NS2, which had a record 13 nests in 2011, had 7 nests in 2012. In 2011 NS2 had a fledglings/nest rate of 0.38 and in 2012 it was 0.57. Crowding by other snowy plover broods is believed to have had a negative effect on reproductive success on NS2. This site could possibly support two or at most three broods at one time. NS3 had fledglings/nest rate of 0.67 in 2012. Broods from nests on NS3 left the site and foraged in the Seasonal Ponds. The Seasonal Ponds had a fledge rate of 1.35 fledglings/nest.

Table 3. Results of Analysis by the Western Foundation of Vertebrate Zoology of Abandoned Snowy Plover Eggs.

| Nest # | Clutch size | Eggs hatched | Eggs abandoned (collected) | Notes | Results from WFVZ |
|--------|-------------|--------------|----------------------------|--|--|
| 1 | 3 | 0 | 1 | Normal incubation | Large embryo, rotten shells, very weak |
| 7 | 3 | 0 | 3 | Long incubation, incubated for 44 days | No development, shells weak. |
| 8 | 3 | 2 | 1 | Normal incubation, one egg did not hatch | No development, infertile |
| 20 | 3 | 0 | 3 | Incubated 16 days and abandoned | Large embryos |
| 24 | 3 | 0 | 1 | Abandoned | Large embryos |
| 30 | 3 | 0 | 3 | Incubated for 17 days | 1 large embryo, 2 no development |
| 34 | 3 | 0 | 3 | Abandoned | Two large embryos, one infertile |
| 35 | 3 | 0 | 3 | Abandoned after 10 days, no development | No development |
| 36 | 4 | 1 | 3 | Incubated 26 days | Medium development |
| 49 | 3 | 2 | 1 | Incubated 26 days | Medium development |
| 60 | 3 | 2 | 1 | Incubated 27 days | No development, infertile |
| 61 | 2 | 0 | 2 | Abandoned after 7 days | No development |

BROOD TRACKING

Due to the chronological and geographic spacing of each brood, it is usually possible to locate and identify individual broods over the period before they fledge and it is these observations that are the basis for determining fledgling success. As generally seen in prior years, in 2012 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 wandered too close together or tried to take advantage of the same resources. This was apparent on NS2.

Broods hatched from NS3 relocated within days to locations within the Seasonal Ponds 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. More than one cell may be 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 seven nests that hatched in Cell 11 in 2012, at least 8 broods not hatched from Cell 11 also used this cell for foraging.

Nests 62 and 65 on NS1 hatched three chicks each at about the same time in late July. The brood from Nest 65 was soon observed with only two chicks and the brood from Nest 62 with four chicks. Since there were no other nests or broods on NS1 during this period it appears the fourth chick in brood 62 was adopted from the brood from Nest 65. These broods were normally separated by 800 feet. There were six fledglings from these two broods.

OBSERVATIONS OF BANDED ADULTS

A female, WWYY (assumed lost tape on lower right leg making it WWYS, S=Service band missing yellow tape), was banded as an adult at the South Spit, Humboldt Bay in 2006, had two clutches; one at Nest 13 on NS1 which had two fledges and a second on Nest 64 in Cell 19 that was unsuccessful. This is the fifth year this female has nested at Bolsa Chica.

A female, YNYB, hatched 3 chicks from Nest 47 in Cell 11. This bird was banded as a fledgling at Bolsa Chica after being raised at WWCCOC in 2010.

A male, YNWR, attempted to nest at Bolsa Chica in 2011 and 2012, but a nest was never located. This bird was banded as a fledgling at Bolsa Chica after being raised at WWCCOC in 2010.

A female, YNYW, nested at Bolsa Chica in 2011 and was observed during the winter and early spring but was not observed nesting in 2012.

A female, NBGG, nested at NS1 on Nest 24. This nest was unsuccessful and abandoned. The eggs were fertile and the cause of abandonment is unknown. This female was seen at Bolsa Chica State Beach in the fall of 2012. This bird was banded at Vandenberg Air Force Base in 2011.

PREDATION



Photo by P. Knapp

Last year, in 2011, five nests were predated. This year, 2012, only one nest, Nest 42, was predated, in Cell 11 by a coyote despite being protected by an ME. The coyote was able to dig up the substrate and the eggs rolled from the nest into the dig. The low rate of nest loss and high degree of chick production is normally attributable to the deployment of MEs.

Nest 50 after an unsuccessful coyote attack under the ME. The snowy plover returned to incubate eggs after the attack.



Photo by P. Knapp

One adult was predated at Nest 39 on NS1 and was found deceased inside the ME. Three chicks from this nest, age 1 day, were missing and assumed to have been predated by the same unknown predator. There was no evidence of cause of mortality or identity of predator.



Photo by P. Knapp

Nest 42 predated by coyotes in Cell 11

no snowy plover predation was noted. Black-crowned night heron (*Nycticorax nycticorax*) and Cooper's hawk (*Accipiter cooperii*) were present during all or part of the breeding season but were not suspected predators in 2012.

Eight other nests in the Seasonal Ponds were unsuccessfully attacked by coyote. These include Nests 67, 53, and 47 in Cell 11; Nests 44, 50, 54, and 55 in Cells 12; and Nest 64 in Cell 19. All of the nests were protected by MEs and eventually hatched. See photo of Nest 50 in Cell 12 on previous page.

Both an adult peregrine falcon (*Falco peregrinus*) and a merlin (*Falco columbarius*) were observed at Bolsa Chica at the beginning of the season but appear to have migrated away from the area without incident. A juvenile peregrine falcon appeared at Bolsa Chica at the end of the breeding season but

MANAGEMENT RECOMMENDATIONS/ACTION ITEMS

The 2012 western snowy plover breeding season continued the high nest survival rates which have been experienced since the 2002 breeding season. The high nest survival rates are attributable to the use of MEs. 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 recommendations from past years have been implemented with good results. These actions included: 1) placing tiles on the nest sites for the chicks to hide under, both providing protection from predation and a viewing platform for adults; 2) deploying MEs on every snowy plover nest to reduce egg loss due to predation; 3) utilizing drift fences to create dunes and maintain the sand on NS3; and 4) continuing weed management on all manmade nest sites. These management efforts have been effective in the enhancement of nest 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 nest sites.

1. Management of NS1.

NS1 has been plagued with problems that have been difficult to solve. Overcrowding has been a major problem in the past although in the last two years the site has been only lightly used for nesting by large terns. This was due to large-scale predation in 2010 and possibly due to predation or weed overgrowth in 2011. Coyotes predated almost all tern nests in 2012. Coyote predation did not appear to affect plover breeding activity on NS1 in 2012.

During the 2012 fall season vegetation was removed mechanically from large sections of NS1 and refurbished with fresh sand. This should substantially restore the site to unvegetated habitat for the snowy plovers and least terns for the 2013 breeding season.

Coyote predation of least tern eggs and chicks in 2012 on NS1 was the primary cause of an unsuccessful breeding season for the terns. The barriers to coyote entry onto the site include chain link fencing at the north and south ends of the peninsula-like site and water on either side of the site. Planned additions of chain link fencing will hopefully deter some entry, although coyotes are adept swimmers. Further use of aversion nests during the winter of 2012/2013 will hopefully deter coyotes from seeing NS1 as a food source.

2. Management of NS2.

After a record number of 13 nests on NS2 in 2011 with only 0.39 fledglings/nest, there were seven nests with 0.57 fledgling/nest in 2012. Possible confrontations between broods feeding at the base of the site have led to the conclusion that the site may not be capable of successfully supporting more than two or three broods simultaneously.

Weed management is required on this site during the non-breeding season. To this end, a pilot program is planned for the 2012/2013 winter season to treat the site with salt water. This method has been successful at Seal Beach Naval Weapons Station in controlling non-native vegetation. The method was established following a study that incorporated four different non-native vegetation control methods and a control site (Agri Chemical & Supply 2006). Saltwater irrigation treatment was the most effective in terms of controlling non-native plants and providing a suitable nesting area. This method involves pumping salt water into an irrigation system for about six hours or until the ground is saturated. This is repeated the next day. Saltwater irrigation is very effective at killing annual herbaceous plants and not as effective on iceplant and other invasive plants that can tolerate high salt content. This two-day process is done prior to the nesting season each year.

3. Management of NS3.

There were a record 16 snowy plover nests on NS3 in 2011, slightly higher than the 14 recorded in 2010, and decreasing to 9 in 2012. In 2011, coyotes predated five nests, four on a single day and unsuccessful attempts were made on several other nests. In 2012 there were no snowy plover nests predated by coyote on this nest site; however, two nests were abandoned and there were repeated signs that coyote had been visiting the site. The California least tern continues to lose nests on NS3 due to their lack of protection from the coyote during nesting.

Plans are now in place to fence the entire nest site. Fencing can often lead to increased predation by raptors and corvids that are allowed to perch above the nest site and wait for movement that would indicate a nest or chicks. This should not be the case at NS3 due to the elevated nature of the site. The fence would be placed at the bottom of the slope and would not rise above the nesting plateau that is used by both least terns and snowy plover for nesting.

4. Improve water management in the Seasonal Ponds

The Seasonal Ponds are an extremely important foraging and nesting area for the snowy plover. In 2012, 48 of the 77 fledglings (62%) at Bolsa Chica foraged in the Seasonal Ponds. Based upon the recent history of early nest initiations and the fledgling success from those nests it would appear advantageous to have areas within the Seasonal Ponds managed to support earlier nesting. Currently the Seasonal Ponds are inundated with water and are not really available for nesting until at least mid-April. Due to the early nesting it has become even more important to have a flexible management process for balancing the amount of water in these cells. Improving water management at the Seasonal Ponds has been an issue for several years; however, a number of solutions have been implemented to improve the flow of water out of these cells to make them available for snowy plover nesting and foraging. These include repair of culverts between cells and installation of a permanent pump in Freeman Creek (to which the ponds drain) so that excess storm water can be pumped out to the Full Tidal Basin.

From the middle of the 2012 nesting season, apparent increases in the fresh water levels in Cell 11 promoted unusual freshwater marsh vegetation growth. One method to control this growth is provided for in the Bolsa Chica Lowlands Water Management Plan: Seasonal Ponds and Freeman Creek Water Management Unit (M&A 2011). This requires management to introduce salt water into the Seasonal Ponds beginning immediately after the close of the breeding season. This normally would begin in September. In 2012 the first use of this method began in October. The success or failure of this method in inhibiting additional growth will be evaluated in 2013.

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, 2012

| <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> | <u>comments</u> |
|---------------|---------------|-------------------|-------------------|-------------|------------------|---------------|-------------------|--|
| 1 | FTB Cove | 3-06 | 4-06 | 3 | A | 0 | 0 | eggs abandoned; large embryos (WFVZ) |
| 2 | NS1 BB2 | 3-19 | 4-23 | 3 | H | 3 | 3 | |
| 4 | NS1 Y2 | 3-27 | 4-29 | 3 | H | 3 | 2 | |
| 5 | CELL 11 | 3-30 | 5-04 | 3 | H | 3 | 3 | |
| 6 | CELL 9 | 4-03 | 5-05 | 3 | H | 3 | 1 | |
| 7 | NS3 B3 | 4-05 | 5-27 | 3 | S | 0 | 0 | incubated 44 days; no development, shells weak (WFVZ) |
| 8 | CELL 22 | 4-06 | 4-30 | 3 | 2H1A | 2 | 2 | Collected 1 egg; infertile (WFVZ) |
| 9 | CELL 10 | 4-06 | 5-10 | 3 | H | 3 | 2 | |
| 10 | CELL 22 | 4-07 | 5-08 | 3 | H | 3 | 2 | |
| 11 | NS1 L1 | 4-09 | 5-12 | 3 | H | 3 | 2 | |
| 12 | NS3 G | 4-10 | 5-08 | 3 | H | 3 | 1 | |
| 13 | NS1 F1 | 4-10 | 5-14 | 3 | H | 3 | 2 | Female was WW:YS |
| 14 | NS2 C2 | 4-15 | 5-17 | 3 | H | 3 | 1 | |
| 15 | CELL 40 | 4-15 | 5-16 | 2 | H | 2 | 1 | |
| 16 | NS1 H1 | 4-17 | 5-04 | 3 | H | 3 | 1 | Female was YN:RY |
| 17 | NS1 C2 | 4-17 | 5-11 | 3 | H | 3 | 2 | |
| 18 | NS1 T1 | 4-20 | 5-18 | 3 | H | 3 | 2 | |
| 19 | CELL 13 | 4-22 | 5-22 | 2 | H | 2 | 2 | |
| 20 | 80 ROAD | 4-23 | 5-18 | 3 | A | 0 | 0 | Collected 3 eggs after abandoned; 3 large embryos (WFVZ) |
| 21 | NS3 C1 | 4-24 | 6-05 | 3 | H | 3 | 0 | 1 dead chick and 1 dead chick in egg |
| 22 | CELL 10 | 4-28 | 5-28 | 3 | H | 3 | 3 | |
| 23 | CELL 22 | 5-01 | 6-03 | 3 | H | 3 | 2 | |
| 24 | NS1 M2 | 5-03 | 6-06 | 3 | A | 0 | 0 | Collected 3 eggs after abandoned; two large embryos, one infertile |
| 25 | NS2 | 5-04 | 5-31 | 3 | H | 3 | 0 | |
| 26 | CELL 11 | 5-04 | 5-25 | 3 | H | 3 | 2 | |
| 27 | CELL 30 | 5-05 | 5-09 | 3 | 2H1A | 2 | 1 | Collected 1 egg |

| <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> | <u>comments</u> |
|---------------|---------------|-------------------|-------------------|-------------|------------------|---------------|-------------------|---|
| 28 | NS3 B1 | 5-07 | 5-30 | 3 | H | 3 | 2 | |
| 29 | NS2 A1 | 5-09 | 6-06 | 3 | H | 3 | 2 | |
| 30 | NS2 D1 | 5-06 | 5-31 | 3 | A | 0 | 0 | Collected 3 eggs after abandoned; one large embryo, 2 infertile (WFVZ) |
| 31 | NS3 F | 5-09 | 6-06 | 3 | H | 3 | 1 | 2 chicks died, one fledged |
| 32 | NS3 D2 | 5-09 | 6-05 | 3 | H | 3 | 0 | 2 dead chicks |
| 33 | NS1 J2 | 5-09 | 5-19 | 3 | H | 3 | 3 | |
| 34 | NS2 G1 | 5-16 | 5-31 | 3 | A | 0 | 0 | Collected 3 eggs after abandoned; two large embryos, one infertile (WFVZ) |
| 35 | NS3 B6 | 5-17 | 5-31 | 3 | A | 0 | 0 | Collected 3 eggs after abandoned; no development |
| 36 | NS3 | 5-20 | 6-20 | 4 | 1H3A | 1 | 0 | Collected 3 eggs after abandoned; medium development |
| 37 | NS3 A6 | 5-24 | 6-19 | 3 | H | 3 | 3 | |
| 38 | CELL 13? | 5-24 | 5-24 | 2 | H | 2 | 0 | Found brood in Cell 13; nest location unknown |
| 39 | NS1 Y2 | 5-22 | 6-22 | 3 | H | 3 | 0 | |
| 40 | CELL 10 | 6-04 | 6-23 | 3 | H | 3 | 2 | |
| 41 | CELL 9 | 6-04 | 6-29 | 3 | H | 3 | 3 | |
| 42 | CELL 11 | 6-04 | 7-02 | 2 | P | 0 | 0 | Coyote dug under ME and removed eggs |
| 43 | CELL 11 | 6-04 | 6-25 | 3 | H | 3 | 1 | |
| 44 | CELL 12 | 6-04 | 6-25 | 3 | H | 3 | 1 | |
| 45 | CELL 13 | 6-05 | 6-23 | 3 | H | 3 | 0 | |
| 46 | CELL 9 | 6-06 | 6-06 | 3 | H | 3 | 3 | Found brood in Cell 9; Nest location unknown |
| 47 | CELL 11 | 6-05 | 7-04 | 3 | H | 3 | 0 | Male was YN:YB |
| 48 | CELL 10 | 6-07 | 6-16 | 3 | 2H1A | 2 | 0 | |
| 49 | CELL 19 | 6-07 | 7-02 | 3 | H | 3 | 2 | Collected 1 egg; medium development (WFVZ) |
| 50 | CELL 12 | 6-07 | 7-06 | 2 | H | 2 | 2 | |
| 51 | CELL 14 | 6-08 | 7-05 | 3 | H | 3 | 0 | |
| 52 | CELL 14 | 6-08 | 7-07 | 3 | H | 3 | 0 | |
| 53 | CELL 11 | 6-08 | 7-12 | 2 | H | 2 | 1 | |
| 54 | CELL 12 | 6-12 | 7-12 | 3 | H | 3 | 1 | |

| <u>Nest #</u> | <u>Cell #</u> | <u>date found</u> | <u>date ended</u> | <u>eggs</u> | <u>nest fate</u> | <u>chicks</u> | <u>fledglings</u> | <u>comments</u> |
|---------------------------|---------------|-------------------|-------------------|---------------------|---|-----------------------|--------------------------|--|
| 55 | CELL 12 | 6-16 | 7-11 | 3 | H | 3 | 0 | |
| 56 | CELL 9 | 6-17 | 7-03 | 3 | H | 3 | 0 | |
| 57 | CELL 11 | 6-23 | 7-20 | 2 | H | 2 | 0 | |
| 58 | ROAD by STI | 6-24 | 6-24 | 1 | H | 1 | 0 | Found brood on road; nest location unknown |
| 59 | CELL 9 | 6-25 | 7-05 | 3 | H | 3 | 2 | |
| 60 | CELL 9 | 6-25 | 7-22 | 3 | 2H1A | 2 | 2 | Collected 1 egg; infertile (WFVZ) |
| 61 | CELL 11 | 6-26 | 7-04 | 2 | A | 0 | 0 | Water flooded nest; collected 2 eggs after abandoned; no development |
| 62 | NS1 J1 | 6-26 | 7-23 | 3 | H | 3 | 3 | |
| 63 | NS2 | 6-26 | 7-20 | 2 | H | 2 | 1 | |
| 64 | CELL 19 | 6-29 | 7-29 | 3 | H | 3 | 0 | Female was WW:YS |
| 65 | NS1 N1 | 6-30 | 6-30 | 3 | H | 3 | 0 | Found brood on NS1; nest location unknown: Female was YN:RY |
| 66 | CELL 19 | 7-05 | 8-02 | 3 | H | 3 | 0 | |
| 67 | CELL 11 | 7-06 | 7-29 | 3 | H | 3 | 1 | |
| 68 | CELL 32 | 7-07 | 8-03 | 2 | H | 2 | 0 | |
| 69 | NS2 | 7-18 | 7-18 | 3 | H | 3 | 0 | Found brood on NS2; nest location unknown |
| 2012 Season Totals | | | | 193 eggs | 59H, 7A, 1S, 1P 68 Nests | 161 chicks | 77 fledglings | |

P = predated; A = abandoned; H – hatched, A/H – abandoned eggs that were salvaged and hatched at WWCCOC, S = sterile eggs.

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

WFVZ= Western Foundation of Vertebrate Zoology; PK=Peter Knapp; WWCCOC = Wetlands and Wildlife Care Center of Orange County

Appendix 2. Distribution of Western Snowy Plover Nests at Bolsa Chica for 1997 through 2012.

Distribution of nests throughout Bolsa Chica

| Year | Total # Nests | Cells eliminated during restoration | Seasonal Ponds | FFTB | MTB | NTI | NS1 | NS2 | NS3 | STI | Other |
|-------------|----------------------|--|-----------------------|-------------|------------|------------|------------|------------|------------|------------|--------------|
| 1997 | 31 | 14 | 11 | 4 | | | | | | 2 | |
| 1998 | 34 | 16 | 15 | 2 | | | | | | 1 | |
| 1999 | 38 | 14 | 11 | 11 | | | | | | 2 | |
| 2000 | 39 | 11 | 21 | 6 | | | | | | 1 | |
| 2001 | 55 | 19 | 29 | 5 | | | | | | 2 | |
| 2002 | 50 | 14 | 17 | 19 | | | | | | | |
| 2003 | 32 | 11 | 9 | 3 | | | | | | 9 | |
| 2004 | 65 | 17 | 33 | 10 | | | | | | 5 | |
| 2005 | 51 | 6 | 30 | 8 | | | | | | 7 | |
| 2006 | 71 | 13 | 13 | 16 | | | 16 | 1 | 8 | 4 | |
| 2007 | 50 | | 10 | 9 | | | 19 | | 8 | 4 | |
| 2008 | 67 | | 10 | 10 | | | 37 | | 5 | 4 | 1 |
| 2009 | 70 | | 16 | 9 | 1 | 1 | 32 | 3 | 5 | 3 | |
| 2010 | 64 | | 11 | 4 | | 1 | 26 | 4 | 14 | 2 | 2 |
| 2011 | 73 | | 19 | 7 | 1 | 1 | 12 | 13 | 16 | 3 | 1 |
| 2012 | 68 | | 26 | 11 | | | 12 | 7 | 9 | | 3 |

Distribution of Nests by Cell

| 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 40 | Cell 45 |
|-------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 1997 | | | 4 | 7 | | | 1 | | 1 | | 2 | | | | | | | | | |
| 1998 | | 2 | 7 | 6 | | | 1 | | | | 1 | | | | | | | | | |
| 1999 | | | 6 | 5 | | | 1 | 1 | | 5 | 4 | | | | | | | | | |
| 2000 | | 2 | 6 | 12 | 1 | | 1 | 1 | | | 1 | | | | | | | 3 | | |
| 2001 | 1 | 8 | 11 | 9 | | | | | | 5 | | | | | | | | | | |
| 2002 | 1 | 2 | 1 | 10 | | 3 | 3 | 5 | | | 10 | | | | | | | 1 | | |
| 2003 | | 6 | 1 | | 2 | | | | 2 | 1 | | | | | | | | | | |
| 2004 | | 5 | 12 | 13 | 2 | 1 | 1 | | 3 | 1 | 4 | | 1 | | | | | | | |
| 2005 | 1 | 6 | 8 | 12 | 3 | | 1 | | | 4 | | | | | | 3 | | | | |
| 2006 | | | 2 | 6 | 5 | | | | | | 13 | | | | 2 | 1 | | | | |
| 2007 | | | 1 | 6 | | 3 | | | | 1 | 3 | | | | 4 | | 1 | | | |
| 2008 | | 2 | 5 | | 3 | | | | | 4 | 6 | | | | | | | | | |
| 2009 | | 2 | 6 | 2 | 5 | 1 | 2 | | | 2 | 3 | 1 | | 1 | | | | | | 1 |
| 2010 | | 2 | 5 | 3 | 1 | | 3 | | | | 1 | | | | | | | | | |
| 2011 | | 9 | 3 | 3 | 1 | 3 | 3 | | | 1 | 2 | | | | 1 | | | | | 1 |
| 2012 | | 6 | 4 | 9 | 4 | 3 | 2 | | | 3 | 3 | | 1 | | 1 | | | | 1 | |