

Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 2015



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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 MTB 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 2015 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, there are some exceptions. 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.

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). 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 (FFTB), Cells 14 through 40 and Cell 63), Muted Tidal Basin (MTB, 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, FFTB, and MTB 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 becomes highly saline as evaporation concentrates the remaining water in diminishing pools over the salt panne. Beginning in 2012 ocean water was introduced into Cells 11, 13, 14, and 19 from the Full Tidal Basin in order to provide habitat for the wintering waterfowl and to control encroachment of reed growth in Cell 11. This is now common practice.

The FFTB lies between the Seasonal Ponds and the MTB and consists 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 MTB occupies the northeastern section of Bolsa Chica and is divided into west, central, and east basins. Muted tidal influence was introduced to the west MTB in March 2008, and later to the central and east basins in March and May 2011, respectively. Due to continued tidal muting in the Full Tidal Basin in 2015, the eastern MTB remained non-tidal. Maintenance dredging in late 2014 allowed for modest muted tidal exchange in the central MTB during the nesting season. The west MTB continues to have highly muted tidal exchange for most of the year. In recent years the MTBs have been largely inundated, composed of pickleweed, open water, and mudflat, and until 2014 were rarely used by western snowy plover for nesting. In 2015, nesting occurred in Cells 41, 42, 45, and 46 of the MTBs. The MTBs also provided foraging habitat for juvenile least terns and plover chicks from NS2.



Photo by P. Knapp

Cell 45, in the MTB, had increased snowy plover nesting and foraging in 2015.

NTI and STI are well established, man-made islands surrounded by the muted tidal waters of Inner Bolsa Bay. The surfaces of the islands are dredge spoils with a developed boundary of intertidal or salt tolerant vegetation. STI is a regular breeding area for California least terns but is also used by plovers. 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. In 2015 there was one western snowy plover nest on NTI early in the season, before the terns arrived.

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 extending from the West Levee Road east toward the Full Tidal Basin. The shoreline of the nest site is under tidal influence. The northeastern shoreline is becoming more structured, with pickleweed and suaeda (*Suaeda* sp.) 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. The site has been highly vegetated the past two years and has required extensive vegetation control. The vegetative growth was primarily the native perennial beach sand-verbena (*Abronia umbellata* var. *umbellata*), the native California everlasting (*Gnaphalium californicum*), and five-hook bassia (*Bassia hyssopifolia*), an invasive non-native plant.

NS2 and NS3 are also created sites in Cell 42 and Cell 14, respectively. NS2 is located in the east MTB and NS3 is within the FFTB. 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(s) by swimming across surrounding water and foraging in adjacent cells or in the Seasonal Pond cells. Chicks on NS3 tend to leave the site immediately after hatching to seek forage in the surrounding Seasonal Pond cells. NS3 has a 6-foot high chain link fence surrounding the entire nesting site.

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 2015 was undertaken by California Department of Fish & Wildlife (CDFW) staff member, Peter Knapp, with assistance from Ross Griswold, a CDFW volunteer, and Gary Keller (CDFW). Surveys were conducted daily by one or more individuals beginning in mid-February and continued until mid-September. Each nest was checked daily, from a distance, to ensure that it was still active.

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 also 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 plovers, observers documented the location of any new nests. NS1, NS2, NS3, and STI were sectioned by markers, which formed a grid of squares that were 20 meters on a side, for consistent methodology across the four sites. Data recorded outside of these four sites was done by cell number or road name. Each plover nest located during survey efforts was mapped for ease of relocation on subsequent visits and a numbered 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 daily. 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 Winter Window Survey was conducted at Bolsa Chica on January 23, 2015 to estimate the number of adults present, in accordance with the guidelines set out in the Snowy Plover Recovery Plan (U.S. Fish and Wildlife Service 2007).

Three range-wide, Breeding Season Window Surveys were conducted at Bolsa Chica during the week of May 15, 2015 to estimate the number of adults. Normally only one survey is performed, but three were completed this year based on the request of the Point Blue Conservation Science (formerly the Point Reyes Bird Observatory) for additional data. These surveys were conducted in accordance with the Snowy Plover Recovery Plan. Calculations were also made to estimate the minimum number of adults present at Bolsa Chica during the breeding season. This was based on calculating the highest number of nests (calculated as 2 adults) during the nesting season and combining that with the number of broods (calculated as 1 adult) present at the same time. This was performed on a daily basis.

PROTECTION FROM PREDATORS

Once a nest was discovered, a welded-wire ME was anchored in place over the top of the nest and left in place until the eggs hatched. The MEs are 28 inches in width on all four sides and top, and 16 inches 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 plovers nest in proximity to the least tern, predator management activities on behalf of one species will also benefit the other species. In 2015, predator management was undertaken by Wally Ross of CDFW.

A large number of inoperative cut-off power poles have been left in the Seasonal Ponds over the years and they are commonly used by raptors to view the salt panne within the Season Ponds. During the winter of 2014-2015, twenty-two of these poles were removed by CDFW staff by cutting them down to ground level. This eliminated the perches and reduced raptor activity within those cells.

The resident oil lease holder, CRC, placed NIXALITE on oil wells and other structures that CDFW staff determined to be detrimental to plover breeding success. NIXALITE is a strip of porcupine-like plastic spikes installed to prevent predator perching.

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

RESULTS AND DISCUSSION

In 2015, the first snowy plover nest was established on March 16 in the Seasonal Ponds. The last brood fledged on September 15. There were a total of 92 nests producing 129 fledglings for the season (Table 1). The following sections discuss the details of the nesting season.

NUMBERS OF BREEDING MALE AND FEMALE SNOWY PLOVERS

The range-wide Winter Window Survey conducted in January to estimate the winter population size found 40 adults.

The three Range-wide, Breeding Season Window Surveys conducted in May resulted in a count of 59, 62, and 62 adult snowy plovers at Bolsa Chica. The count of 62 was believed to be the most accurate of the three, with 37 males and 25 females (Table 1).

Table 1. Males and Females based on Breeding Window Survey, Nests, and Fledgling Production 1997-2015.

Year	Females	Males	Total Adults	Total Nests	Fledglings	Total FI/Nest	FI/Male
2015	25	37	62	92	129	1.40	3.49
2014	20 (2unk)	40	62	82	113	1.38	2.83
2013	22	31	53	66	37	0.56	1.19
2012	26	31	57	68	77	1.13	2.48
2011	20 (1unk)	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

FI = fledglings, unk = unknown, nd = not determined

* based on minimum/maximum numbers of fledglings

Calculations were also made to estimate the minimum number of adults present at Bolsa Chica using a different method. This was done by adding the number of nests (calculated as 2 adults) to the number of broods (calculated as 1 adult) present at the same time. Using this method daily from May 26 through June 25 the estimated number of adults ranged between 67 and 76. Therefore the minimum number of adults is reported as 76 (Table 2). The average of this month of surveys was 71 adults. This was the second consecutive year that Bolsa Chica met the management goal of 70 adults identified in the Snowy Plover Recovery Plan. This method consistently provides a higher count than the Breeding Season Window Survey. We believe the minimum number of adult methodology is the more effective method for determining the size of the breeding population.

Table 2: Estimated Minimum Number of Adults, Nests, and Fledgling Production 2012-2015.

Year	Females	Males	Total Adults	Total Nests	Fledglings	Total FI/Nest	FI/Male
2015	31	45	76	92	129	1.40	2.87
2014	31	48	79	82	113	1.38	2.35
2013	26	28	54	66	37	0.56	1.22
2012	28	35	63	68	77	1.13	2.20

NEST SITE SELECTION AND DISTRIBUTION

In 2015, Nests 5, 8, 18, 19, 22, 42, 53, and 70 had identical nest placement as nests in the previous year (Figure 2). These locations were in the Seasonal Ponds where the salt panne substrate seldom changes. Prior to the start of the breeding season, these and other locations were enhanced by Peter Knapp through the dispersal of large-grained sand and shells within a two-foot radius of the previous nest site. This enhancement may have encouraged nest site selection in these previously used locations.

Snowy plovers utilized all available nest sites at Bolsa Chica in 2015 (Figure 2). Seasonal Ponds had 44% of all nests and a record number of nests since recording began in 1997. They also produced 57% of the fledglings from 50% of all nests. All 15 nests in Cell 10 hatched, with 42 chicks and 21 fledglings or 25% of the total fledglings. The MTB had a dramatic increase in nests from 6 in 2014 to 17 in 2015 and produced 22 fledglings or 17% of the total. Cells 21, 41, and 46 were used for the first time. Dry conditions in 2015 may have contributed to increased usage of the MTB. Table 3 presents the nesting information by location for 2015.

Table 3. 2015 Nest, Nest Fate, and Reproductive Success Distribution by Cell.

Location	Total Nests	Nests Failed	Nests Hatched (# chicks)	Fledglings
Seasonal Ponds	41	0	41 (105)	73
<i>Cell 2</i>	<i>1</i>	<i>0</i>	<i>1 (3)</i>	<i>3</i>
<i>Cell 9</i>	<i>8</i>	<i>0</i>	<i>8 (21)</i>	<i>15</i>
<i>Cell 10</i>	<i>15</i>	<i>0</i>	<i>15 (41)</i>	<i>32</i>
<i>Cell 11</i>	<i>10</i>	<i>0</i>	<i>10 (21)</i>	<i>16</i>
<i>Cell 12</i>	<i>5</i>	<i>0</i>	<i>5 (14)</i>	<i>4</i>
<i>Cell 13</i>	<i>2</i>	<i>0</i>	<i>2 (5)</i>	<i>3</i>
Nest Site 1	9	3	6 (16)	6
Nest Site 2	8	2	6 (16)	9
Nest Site 3	5	1	4 (11)	6
Future Full Tidal Basin	8	1	7 (16)	13
<i>Cell 14</i>	<i>4</i>	<i>1</i>	<i>3 (8)</i>	<i>8</i>
<i>Cell 21</i>	<i>2</i>	<i>0</i>	<i>2 (3)</i>	<i>1</i>
<i>Cell 40</i>	<i>2</i>	<i>0</i>	<i>2 (5)</i>	<i>4</i>
South Tern Island	3	0	3 (7)	0
North Tern Island	1	0	1 (3)	0
Muted Tidal Basin	17	4	13(34)	22
<i>Cell 41</i>	<i>2</i>	<i>0</i>	<i>2 (4)</i>	<i>4</i>
<i>Cell 42</i>	<i>3</i>	<i>2</i>	<i>1 (3)</i>	<i>0</i>
<i>Cell 45</i>	<i>5</i>	<i>1</i>	<i>4 (11)</i>	<i>6</i>
<i>Cell 46</i>	<i>1</i>	<i>0</i>	<i>1 (3)</i>	<i>3</i>
<i>70 Road</i>	<i>1</i>	<i>0</i>	<i>1 (2)</i>	<i>2</i>
<i>80 Road</i>	<i>5</i>	<i>1</i>	<i>4 (11)</i>	<i>7</i>
Total	92	11	81 (208)	129*

* includes bird raised at the Wetlands and Wildlife Care Center.

Appendix 1 provides the cell location, start and end dates, nest fates, and eggs and chicks produced for each nest in 2015. Appendix 2 provides information on historical nest distribution.

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. The two species tolerate the co-location of their nests, with both nesting on STI, NS1, NS2, and NS3 in 2015.

NESTING CHRONOLOGY

In 2015, the first plover nest was initiated March 16. The last nest hatched on August 16. There was an active nest and/or brood for a total of 184 days of the 2015 breeding season at Bolsa Chica. Nest chronology in 2015 is compared to the average of prior years in Figure 3.

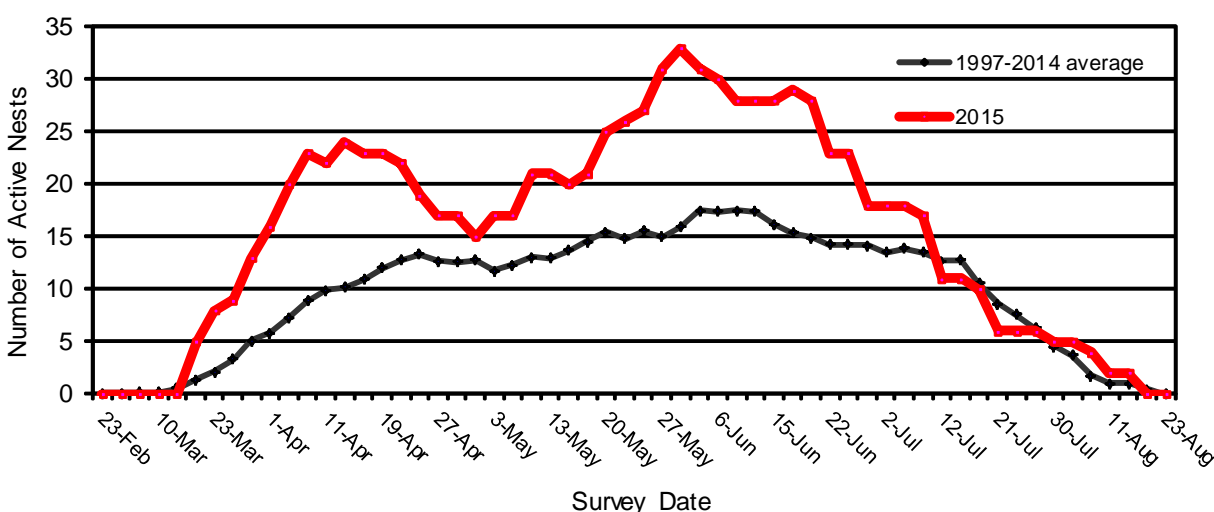
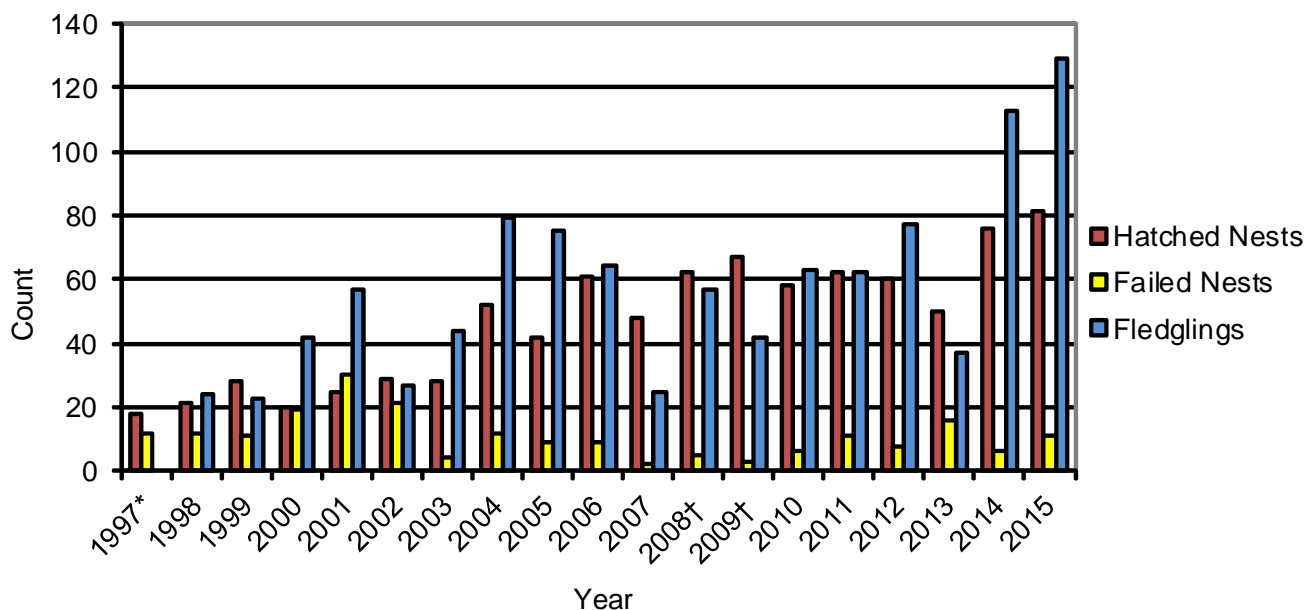


Figure 3. 2015 Active Nest Chronology Compared to 1997 through 2014 Average.

EGGS, CHICKS, AND FLEDGLING PRODUCTION

Of the 92 nests at Bolsa Chica in 2015, 81 hatched, and 11 failed (did not hatch any eggs). A total of 244 snowy plover eggs were produced, with 36 eggs abandoned, predated, or failed to hatch. The remaining eggs produced 208 chicks, of which 129 survived to fledge (Table 3, Figure 4, Appendix 1).

Of the 92 nests, 11 were found as broods only and the nest was not specifically located. The broods were found as two- or three-chick broods and were located throughout Bolsa Chica. Of the remaining 81 nests, five were predated, four were abandoned pre-term, and two abandoned post-term. The 81 nests were judged to be complete clutches with the exception of Nest 64, which was abandoned with only one egg, which was taken to Wetlands and Wildlife Care Center (WWCC) in Huntington Beach for care.



* no fledgling data available

† based on the minimum number of fledglings

Figure 4. Number of Western Snowy Plover Hatched Nests, Failed Nests, and Fledglings 1997-2015 at Bolsa Chica.

Clutch size ranged from one to four; however the one-egg nests were recorded as such due to extenuating circumstances. These were Nest 50, which was found as a brood of one chick and Nest 64 which was found as a single egg abandoned by the adults pre-term. There were 20 two-egg clutches, 66 three-egg clutches, and one nest (Nest 62) was a four-egg clutch. Three nests believed to be complete had an unknown number of eggs. The nest details are provided in Appendix 1.

A total of 129 fledglings, produced from 92 nests, results in an overall fledge rate (fledglings/nest) of 1.40 for 2015 (Table 1). The individual area fledge rates were: NS1: 1.00, NS2: 1.50, NS3: 1.50, MTB: 1.69, FFTB: 1.85, and Seasonal Ponds: 1.79. For comparison, the site-wide fledge rate in 2014 was 1.38.

There was a fledgling/male rate of 3.49 based on the Breeding Season Window Survey (Table 1) and 2.87 based on the minimum number of males estimate (Table 2).

As the age of the chick increased, so did chick survival (Figure 5). Of the chicks hatched, 7 died within the first day of hatching, 12 died within the first two days, and 40 died within the first week of hatching. Among the chicks that perished, 23% died within the first two days, and 51% died within the first week of hatching.

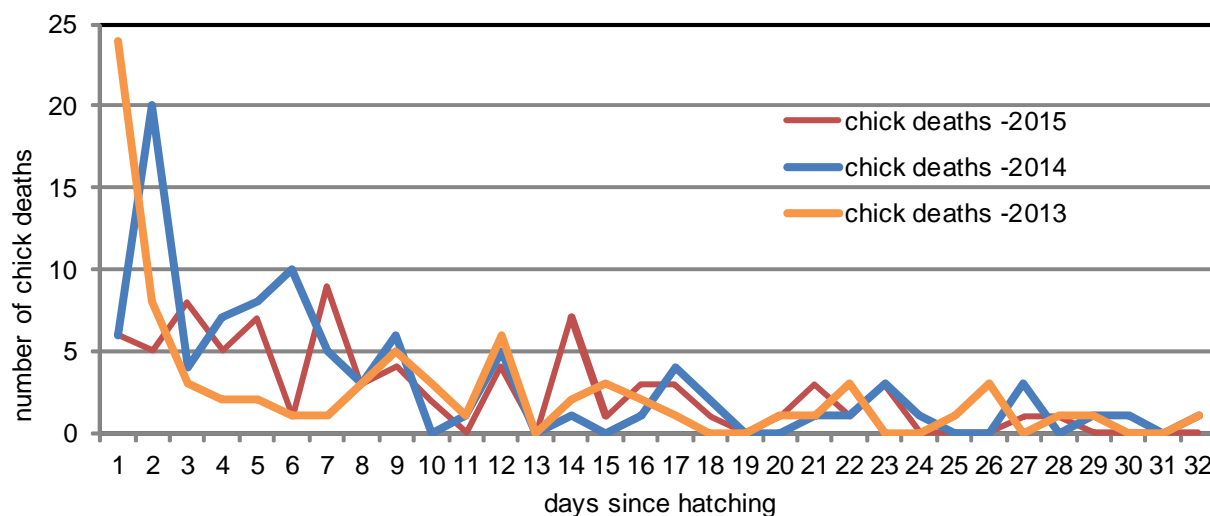


Figure 5. Number of Chick Deaths by Time since Hatching at Bolsa Chica.

Two nests (Nests 4 and 57) with a total of five eggs were incubated for an abnormal length of time and were most likely infertile. This abnormal incubation time span has been seen at Bolsa Chica in prior years beginning in 2009.

EGG SALVAGE

Rainfall from a tropical storm on July 18, 2015 flooded Nest 83, with a clutch of two eggs initiated on July 6 in Cell 11 in the Seasonal Ponds. Both eggs were found floating in four inches of water. It is believed they had been there for at least ten hours. The eggs were collected and taken to WWCC on July 19. Both eggs hatched there on August 1, fledged and were released at Bolsa Chica on September 6, 2015.

Additional rainfall on July 19 flooded nests 84 (2 eggs) and 87 (3 eggs) in Cell 11. The floating eggs were collected and taken to the WWCC on the morning of July 20. The eggs had been floating for at least eight hours prior to collection. The three eggs from Nest 87 all hatched from July 29 to July 30, with one chick fatality. On August 1, one of two eggs from Nest 84 hatched, while the other failed to. The three chicks fledged and were released at Bolsa Chica in mid September 2015.



A flooded mini enclosure in Cell 11.

A total of 14 eggs from seven nests were salvaged and taken to the WWCC for incubation. Eleven of these eggs hatched and the fledglings were released at Bolsa Chica. Two of the eggs failed to hatch and one chick died soon after hatching. Seven of the eggs were from the flooded nests discussed above and 5 of these chicks were released after fledging. Five eggs were from three abandoned nests with all five chicks fledging. Two eggs were taken from a nest where the adult was predated, with both salvaged eggs hatched and the chicks fledged.

To aid in the release of the fledglings, a temporary shelter was built to provide shelter for the young birds while they familiarized themselves with their surroundings. The shelter consisted of a framed wire cage that was open at both ends and measured 60 inches by 30 inches with a height of 19.5 inches. 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 observations suggest it improves the survival of these hand-reared fledglings after release.

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 2015 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 to each other or tried to take advantage of the same resources. This was apparent on NS2. Broods from NS3 relocated within days of hatching to the Seasonal Ponds to forage. 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 be identified. More than one cell may be used by a brood, and often a brood would travel to another cell within one or two days of hatching. Broods from NS2 often left the site to forage in Cell 45 and movement within the MTB was common. It is believed that NS2 will only support two or three broods at a time. This ability to disperse from the nest site to an adjacent cell probably contributed to fledgling success.

OBSERVATIONS OF BANDED ADULTS

A limited number of banded birds were observed breeding this year at Bolsa Chica.

A male, YN:WR, was present from early April thru mid-May, but was not identified with a specific nest. Further observations of this male led to the speculation that he may have been infertile. This male also attempted to nest at Bolsa Chica each year from 2011 to 2014, but a nest was never located. This bird was banded as a fledgling at Bolsa Chica after being raised at WWCC in 2010.

Male YN:WB, raised at WWCC and released at Bolsa Chica in 2013, nested successfully in 2014 and again successfully in 2015 (Nest 41), fledging three chicks.

Captive reared male YN:YR, released at Bolsa Chica in 2008, nested successfully in 2014 and had two nests in 2015 (34 and 84). Nest 34 fledged three chicks. Nest 84 fledged one chick.

A male YSA:OO banded as an adult in December 2013 in Mexico nested successfully at Bolsa Chica in 2014 and again in 2015. He partnered with GA:OY in 2015 (Nest 33) and produced three fledglings. The female GA:OY nested a second time with an unidentifiable male (Nest 65) and produced two fledglings.

Three banded birds that nested early in the season at Batiquitos Lagoon in Carlsbad, CA were seen subsequently at Bolsa Chica in 2015. NP:YR nested successfully in Cell 45 (Nest 60) and produced three fledglings. NP:BY attempted to find a mate unsuccessfully in June and left after a week of territorial calling. NP:OY was seen with no indication of a nesting attempt.

Thirteen other banded plovers were sighted during the breeding season, but only for a day or two.

PREDATION

Several methods were utilized to avoid predation of nests, chicks, and even adults. The use of the ME over all active nests contributes greatly to the low egg predation at Bolsa Chica. Other methods have met with limited success including aversion nests and fencing around several of the nest sites (NS1 and NS3). Aversion nests were not used in 2015.

One adult loss was documented from Nest 3 in Cell 41. The predator was believed to be a mammal.

In 2015 five nests were predated, none of which was protected by a ME. One nest was on NS1 and documented as a raven take. The other four nests were in the MTB and believed to be taken by ravens.

An owl is believed likely to have taken two plover chicks from STI. Photos taken as part of a least tern research project document the presence of a great horned owl on STI. An American kestrel took one chick from a brood in Cell 45. All other losses are undocumented as to whether they were due from natural causes or predation.

MANAGEMENT RECOMMENDATIONS/ACTION ITEMS

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 (28 inches square and 16 inches high) on every snowy plover nest to reduce egg loss due to predation; and 3) continuing weed management on all manmade nest sites through manual removal of non-native plants and the use of herbicide. These management efforts have been effective in the enhancement of nest sites and improving reproductive success of the snowy plover and should continue. Additional management recommendations are provided below. The endangered California least tern, which nests in the same locations as the western snowy plover, needs to be considered in all management efforts. 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.

1. Improve water management in the Seasonal Ponds

The Seasonal Ponds are an extremely important foraging and nesting area for the snowy plover. 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 in winter and spring 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.

Since at least 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. The salt water did stop the spread of freshwater and did impact some standing growth. Use of channels to let the salt water inundate standing growth of freshwater marsh is recommended.

2. Enhance potential nesting areas



Shell fragments spread to encourage nesting.

At the start of the breeding season several locations within the Seasonal Ponds were enhanced by spreading a combination of large-grained sands and small shell fragments in areas that had previously been selected by snowy plovers as suitable nesting areas. It is thought that this enhancement may have encouraged nest site selection. The recommendation is to continue the enhancement of these areas each year and expand the method to other areas.

3. Determine the individual(s) responsible for sterile egg production

There have been one or two nests per year for at least five years that have been incubated for extended periods of time. For several years these eggs had been collected and sent to the Western Foundation for Vertebrate Zoology for analysis. The results have found the eggs are sterile and have not developed. It is unknown if this is due to one or more snowy plovers. In the event that individual nests are incubated for an abnormal length of time, the adults associated with the nest should be trapped and banded. This will identify adults that may suffer from infertility. From a management perspective there is little that can be done to prevent an infertile bird from nesting but we could encourage this individual to remain on the nest rather than have multiple nests. However, by banding the individuals involved it would aid us in determining if this is more than one adult. If more than one adult is involved we may want to try to determine the source of the problem. In 2015, the two nests affected (Nest 4 and 57), were not sent for analysis, but were assumed to be infertile.

4. Continued monitoring

It is recommended that monitoring continue annually with the same intensity that has occurred in the past in order to maintain this quality of management within the nest sites.

5. Increase protection of nests and chicks in the Seasonal Ponds

The mini-exclosure has been used successfully for many years to protect snowy plover nests from predators. Although this was a major step forward it is still critical to provide some protection to the mobile chicks after they have hatched. A great deal of effort has gone into protecting these young birds such as active predator control and exclusion fencing. These and other methods have had varying success but management of this species requires development of additional ideas to protect the plover chicks.

A large number of inoperative power poles had been left in the Seasonal Ponds over the years and they were commonly used by raptors to view the salt panne within the Seasonal Ponds. During the winter of 2014-2015, twenty-two of the cut-off power poles were cut down to ground level. The remaining poles will be eliminated in winter of 2015-2016.

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Appendix 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2015

<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	CELL 10	3/16/15	3/21/15	3	2H/1NV	2	2	3 eggs taken to WWCC; NV = non viable egg failed to hatch; 2 fledglings released into Cell 20, 20 May 2015
2	NS1	3/22/15	4/23/15	3	H	3	0	
3	CELL 41	3/22/15	4/10/15	3	2H/1DH	2	2	Adult predated by cat or skunk; 3 eggs taken to WWCC; DH = died hatching
4	NS3	3/22/15	5/17/15	2	2NV	0	0	
5	CELL 13	3/23/15	4/26/15	3	H	3	1	
6	NS1	3/25/15	4/21/15	3	H	3	0	
7	NS2	3/25/15	4/15/15	3	H	3	0	
8	CELL 9	3/25/15	4/22/15	3	H	3	2	
9	80 RD	3/31/15	4/24/15	2	H	2	0	
10	NS2	4/1/15	4/27/15	3	H	3	2	
11	NS1	4/1/15	4/28/15	3	H	3	2	
12	NS3	4/2/15	4/30/15	3	H	3	3	
13	CELL 12	4/3/15	4/30/15	3	H	3	1	
14	CELL 11	4/4/15	5/4/15	3	H	3	2	
15	CELL 10	4/7/15	5/9/15	3	H	3	3	
16	CELL 9	4/8/15	5/8/15	3	H	3	3	
17	NS1	4/8/15	5/11/15	3	2H/1NV	2	1	
18	CELL 11	4/9/15	5/4/15	3	H	3	0	
19	CELL 10	4/9/15	4/30/15	3	2H/1NV	2	2	
20	NS3	4/9/15	5/12/15	3	H	3	0	
21	CELL 9	4/10/15	5/12/15	3	H	3	0	
22	NTI	4/10/15	5/1/15	3	H	3	0	
23	CELL 12	4/13/15	5/8/15	3	H	3	0	
24	NS2	4/19/15	5/15/15	3	A	0	0	
25	NS3	4/23/15	4/23/15	3	H	3	3	
26	NS1	4/24/15	5/13/15	3	A	0	0	
27	STI	4/28/15	5/29/15	3	H	3	0	
28	NS3	4/30/15	5/23/15	3	2H/1NV	2	0	

Western Snowy Plover Nesting at Bolsa Chica, 2015

<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>
29	80 RD	5/3/15	6/1/15	2	H	3	1	
30	CELL 21	5/4/15	6/2/15	2	1H/1NV	1	0	
31	70 RD	5/6/15	6/3/15	2	H	2	2	
32	NS2	5/6/15	6/2/15	3	2H/1NV	2	0	
33	CELL 10	5/8/15	6/4/15	3	H	3	3	
34	CELL 12	5/8/15	6/4/15	3	H	3	3	
35	NS1	5/12/15	5/23/15	3	A	0	0	
36	NS1	5/12/15	5/13/15	3	P	0	0	
37	NS2	5/14/15	6/9/15	3	H	3	2	
38	NS2	5/14/15	6/9/15	3	H	3	3	
39	CELL 10	5/17/15	6/11/15	3	H	3	2	
40	CELL 10	5/17/15	6/15/15	3	H	3	2	
41	80 RD	5/18/15	6/13/15	3	H	3	3	
42	CELL 10	5/18/15	6/11/15	3	H	3	3	
43	NS2	5/21/15	6/16/15	3	2H/1NV	2	2	
44	CELL 2	5/24/15	6/7/15	3	H	3	3	
45	CELL 45	5/25/15	6/18/15	3	H	3	1	
46	CELL 12	5/25/15	6/24/15	2	H	2	0	
47	CELL 45	5/26/15	6/21/15	3	H	3	1	
48	CELL 46	5/28/15	6/8/15	3	H	3	3	
49	NS1	5/30/15	6/26/15	2	H	2	1	
50	CELL 11	5/31/15	5/31/15	1	H	1	1	
51	CELL 10	5/31/15	6/26/15	3	H	3	2	
52	CELL 9	6/1/15	6/25/15	2	H	2	2	
53	CELL 9	6/2/15	6/18/15	3	H	3	2	
54	CELL 11	6/2/15	6/28/15	3	H	3	3	
55	CELL 12	6/3/15	7/2/15	3	H	3	0	
56	CELL 21	6/4/15	6/21/15	2	H	2	1	
57	CELL 14	6/4/15	7/30/15	2	2NV	0	0	
58	W. Levee Rd	6/4/15	7/1/15	3	2H/1NV	2	0	Reported in Table 3 as STI

Western Snowy Plover Nesting at Bolsa Chica, 2015

<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>
59	CELL 42	6/5/15	6/13/15	UNK	P	0	0	# eggs unknown
60	80 RD	6/5/15	6/20/15	3	H	3	3	
61	CELL 40	6/8/15	6/8/15	3	H	3	2	
62	CELL 11	6/9/15	6/27/15	4	3H/1NV	3	3	
63	CELL 10	6/10/15	7/10/15	3	H	3	2	
64	CELL 11	6/11/15	6/16/15	1	A/H	1	1	Collected 1 egg to WWCC; hatched there 16 June 2015; released 30 August
65	CELL 9	6/12/15	7/10/15	3	H	3	2	
66	CELL 41	6/12/15	7/10/15	2	H	2	2	
67	STI	6/14/15	7/11/15	2	H	2	0	
68	CELL 13	6/17/15	6/17/15	2	H	2	2	
69	CELL 42	6/17/15	7/28/15	2	F	0	0	
70	CELL 10	6/18/15	7/16/15	3	H	3	2	
71	CELL 14	6/19/15	7/15/15	3	H	3	3	
72	CELL 40	6/20/15	7/17/15	3	2H/1NV	2	2	
73	CELL 9	6/20/15	7/17/15	2	1H/1NV	1	1	
74	CELL 10	6/20/15	7/19/15	3	2H/1NV	2	1	
75	CELL 10	6/20/15	6/20/15	3	H	3	3	
76	CELL 9	6/20/15	6/20/15	3	H	3	3	
77	CELL 14	6/25/15	7/25/15	2	H	2	2	
78	CELL 10	6/26/15	7/19/15	3	H	3	0	
79	CELL 42	6/26/15	6/26/15	3	H	3	0	
80	NS2	6/27/15	6/30/15	UNK	P	0	0	
81	80 RD	6/28/15	7/12/15	2	P	0	0	
82	CELL 45	7/2/15	7/12/15	UNK	P	0	0	
83	CELL 11	7/5/15	7/19/15	2	F	2	2	2 eggs taken to WWCC; 2 fledglings released on 6 September
84	CELL 11	7/5/15	7/20/15	2	F	1	1	2 eggs taken to WWCC and released 6 September; other egg failed to hatch
85	CELL 45	7/9/15	7/9/15	3	H	3	3	
86	NS1	7/11/15	7/15/15	3	H	3	2	
87	CELL 11	7/19/15	7/20/15	3	F	3	2	3 eggs taken to WWCC
88	CELL 11	7/25/15	8/4/15	3	A	1	1	2 eggs taken to WWCC; 1H/1 failed to hatch; 1 fledgling

<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>
								released 20 September
89	CELL 10	8/1/15	8/1/15	2	H	2	2	
90	CELL 45	8/11/15	8/11/15	2	H	2	1	
91	CELL 14	8/15/15	8/15/15	3	H	3	3	
92	CELL 10	8/27/15	8/27/15	3	H	3	3	
2015 Season Totals				244 eggs		208 chicks	129 fledglings	

UNK= unknown, P = predated; A = abandoned; H = hatched, F = flooded, NV = not viable, WWCC = Wetlands and Wildlife Care Center

Appendix 2. Distribution of Western Snowy Plover Nests at Bolsa Chica for 1997 through 2015.

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
2013	66		28	5	2		16	4	8	1	2
2014	82		38	8	5		9	13	7	1	1
2015	92		41	8	17	1	9	8	5	3	

Year	Cell 2	Cell 9	Cell 10	Cell 11	Cell 12	Cell 13	Cell 14	Cell 19	Cell 21	Cell 22	Cell 25	Cell 30	Cell 31	Cell 32	Cell 33	Cell 34	Cell 36	Cell 40	Cell 41	Cell 42	Cell 45	Cell 46
1997			4	7			1			2												
1998		2	7	6			1			1												
1999			6	5			1	5		4												
2000		2	6	12	1		1			1							3					
2001	1	8	11	9				5														
2002	1	2	1	10		3	3			10							1					
2003		6	1		2			1														
2004		5	12	13	2	1	1	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				
2013		5	10	8	3	2	2	2		1								1			1	
2014		12	9	11	2	4	5	1		1		1								2	3	
2015	1	8	15	10	5	2	4		2									2	2	3	5	1