

**Western Snowy Plover Nesting
at Bolsa Chica, Orange County, California
2019**



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EXECUTIVE SUMMARY

In 2019, California Department of Fish & Wildlife (CDFW) staff and volunteers continued the annual monitoring and management of western snowy plovers at Bolsa Chica Ecological Reserve (Reserve). Surveys were conducted daily from mid-February to mid-September. Observers documented the location of any new nests, installed welded-wire mini-exlosures (ME) over each nest to protect it from predators, monitored the nests each day, and later followed each brood until fledging. In addition, a range-wide Winter Window Survey and a range-wide Breeding Season Window Survey were conducted. Calculations were also made to estimate the minimum number of adults present at Bolsa Chica during the breeding season for the US Fish and Wildlife Service.

In 2019, the first snowy plover nest was established on March 30 and the last brood fledged on September 5. There was a total of 119 nests, producing 321 eggs, of which 283 hatched chicks, with 112 fledglings produced. There was an overall fledge rate (fledglings/male) of 1.70 for 2019. This continues the high fledge rates of recent years, indicating an increase in the plover population at Bolsa Chica. The continued use of MEs resulted in low rates of egg predation.

The most utilized regions of Bolsa Chica for snowy plover nesting were the Seasonal Ponds and the Muted Tidal Basin, with 41% and 27%, respectively, of all nests. The most successful individual cell was Cell 10 in the Seasonal Ponds, producing 16% of all fledglings. Cell 46 in the Muted Tidal Basin produced 7 nests, with 20 eggs, 20 chicks, and 12 fledglings.

The range-wide Winter Window Survey conducted in January to estimate the winter population size found 26 adults within the Reserve. The range-wide, Breeding Season Window Survey conducted on May 20 resulted in a count of 94 adult snowy plovers in the Reserve. The highest Estimated Minimum Number of Adults was determined to be 109.

Each year, the date of initiation of the tenth nest is recorded. The tenth nest in 2019 was initiated on April 9. This is approximately one week earlier than 2018, which itself was two weeks later than the prior 5-year average of April 1. In addition, the time period that there were 70 or more breeding adults present was 80 days. This was an increase from 2018 (65 days).

There was a high rate of chick loss in 2019 (171 chicks), continuing the high rate of chick loss observed from 2017 through 2019. By comparison, the average chick loss from 2014 through 2016 was 100 chicks. More loss would be expected with the increase in the number of nests in 2017-2019, however the 2014-2016 time period had a higher fledge rate, with over 50% of chicks fledging.

This was the sixth consecutive year that the management goal of 70 adults in the breeding season was surpassed at the Reserve, as specified in the U.S. Fish and Wildlife Recovery Plan for the Pacific Coast Population of the Western Snowy Plover.

A key recommendation for 2020 is to provide predator management. In 2019 there was no predator management because the CDFW employee charged with this task retired. Fledgling success can only be improved through reduction of predators, such as American kestrels, which are believed to be the primary predator of plover chicks. This is essential to improving reproductive success at Bolsa Chica, which provides the best nesting option for snowy plovers within a 60-mile radius. A second recommendation is to recognize that the Muted Tidal Basins now account for over 25% of plover nesting. Impacts to plovers should be carefully considered while developing remedies to the poor functionality of the Muted Tidal Basin.

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.

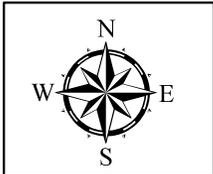
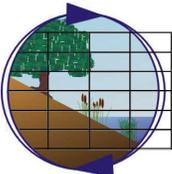
In 1997, the Bolsa Chica lowlands were acquired into public ownership. This marked the beginning of a multi-agency effort to design, evaluate, and implement a plan for restoring the fish and wildlife habitats. These habitats had been cut off from the ocean for a century and have been an operating oil 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 and 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, but the east and central MTBs have never functioned as designed.

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 (U.S. Fish and Wildlife Service 2007). In addition, this study will aid in assessing the long-term effect of the restoration project and identify any 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 2019 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 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.



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 renest after loss of a clutch or brood. Snowy plover chicks are precocial and leave the nest within hours of hatching in search of food. The tending adults 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 28 to 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), the service roads that divide the cells, 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. For the purposes of plover monitoring, Cells 22 and 23 are combined and have been reported in the past as simply Cell 22. The position of nests in either Cell 22 or 23 can be seen on Figure 2 each year. 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, 12, 13, 14, 19, and 22

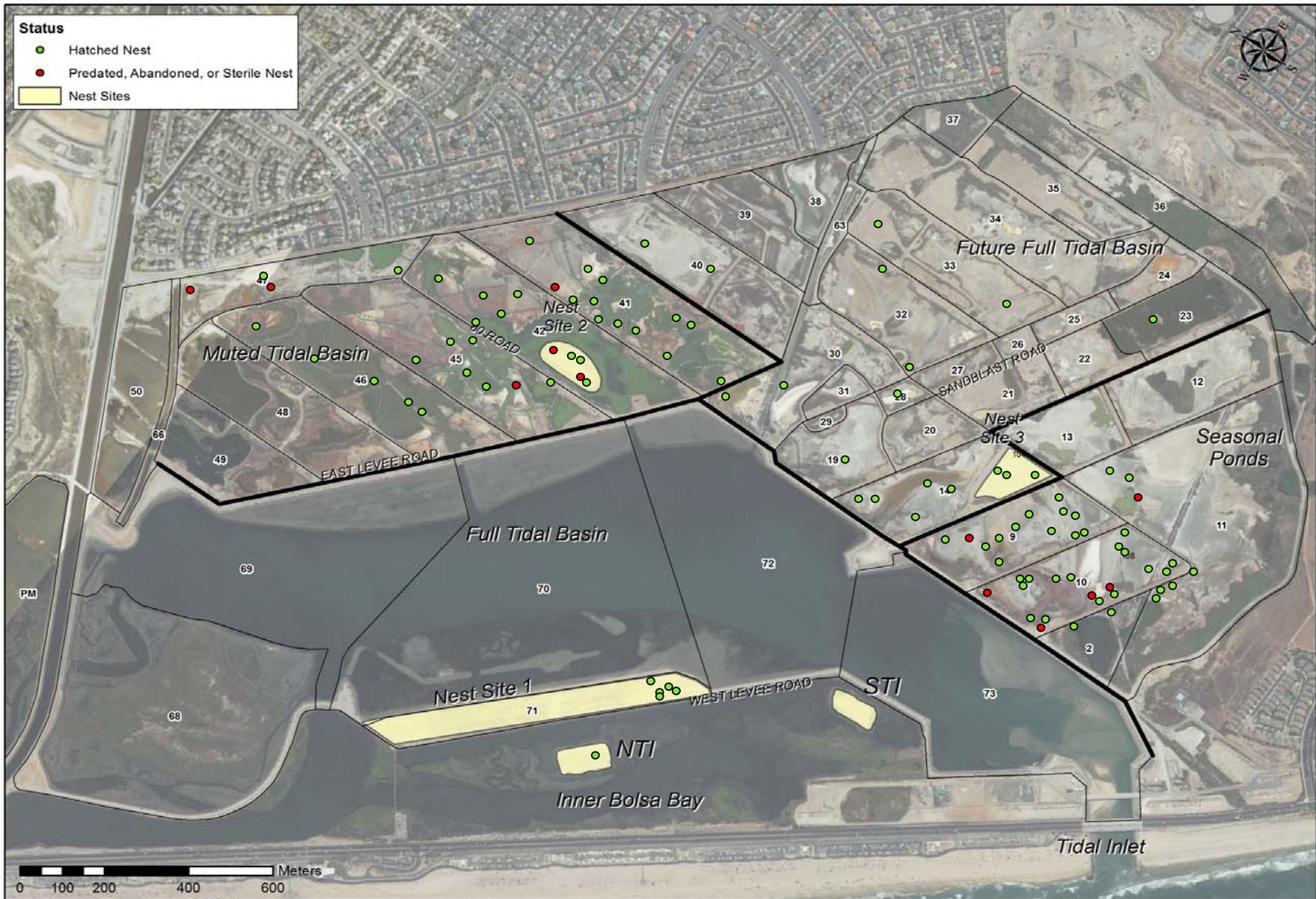


Figure 2. Western Snowy Plover Nest Locations at Bolsa Chica Lowlands, 2019

from the Full Tidal Basin in the late fall 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 some pickleweed, although there is one cell that retains water year-round (Cells 30). Although the FFTB is mostly suboptimal for nesting, this year 21 nests were initiated in the FFTB. The previous high was 29 in 2017.

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 2019, the central and eastern MTBs remained non-tidal. The west MTB continued to have highly muted tidal exchange for most of the year. In past 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 2019, nesting occurred in Cells 40, 41, 42, 45, and 46 of the MTB cells. These cells have steadily gained in use by plovers over the past six years. The MTB cells also provided foraging habitat for juvenile least terns and plover chicks from NS2.

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 2019 the terns and skimmers did not use NTI for nesting, for unknown reasons.

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 four years and has required extensive vegetation control. The vegetative growth is primarily the native perennial beach sand-verbena (*Abronia umbellata* var. *umbellata*), the native California everlasting (*Gnaphalium californicum*), and other invasive non-native plants.

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 from NS2 forage on the site while others more commonly are led from the site by the adult(s) by swimming across surrounding water and foraging in adjacent MTB 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

NESTING SURVEY

The principal survey effort for western snowy plover in 2019 was undertaken by California CDFW staff member, Peter Knapp, with assistance from Ross Griswold, a California Department of Fish and Wildlife (CDFW) volunteer. 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 is typically used primarily by nesting large terns and black skimmer, but in 2019 the large terns did not nest on NTI for unknown reasons. Therefore the site was monitored for western snowy plover from the West Levee Road, and on plover nest was found. 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 ME was placed on the nest.

It was usually possible to follow the movements and determine the fate of chicks of each brood on all sites 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.

Calculations were made for the U.S. Fish and Wildlife Service to estimate the minimum number of adults present at Bolsa Chica each day during the breeding season. This was calculated by taking the number of active nests (calculated as 2 adults) each day and combining that with the number of broods (calculated as 1 adult) present at the same time. This method of estimating adults, referred to in this document as the Estimated Minimum Number of Adults method, is more accurate than the range-wide surveys described below, and has been performed since 2012 at Bolsa Chica.

A range-wide Winter Window Survey was conducted at Bolsa Chica on January 26, 2019 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). A range-wide Breeding Season Window Survey was conducted on May 20, 2019 to estimate the number of adults, also in accordance with the Snowy Plover Recovery Plan. While these methods of estimating the number of adults present are known to considerably underestimate the true number, the surveys are still conducted and presented because they are called for in the Recovery Plan.

The collected data on nest distribution were plotted on a map, nesting summary statistics assembled, and the overall fledge rate determined as fledglings per male. In the past, this report has also presented the metric of fledglings per nest. This has been discontinued as fledglings per male is the metric used in the Recovery Plan and better expresses the reproductive success of the breeding population.

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*). MEs were used on all nests in 2019 except nests 1, 5, 51, and 100, as well as those nests found only as a brood.

Observations were made of potential predators during the surveys. 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 would also benefit the other species. However, predator management actions were not conducted due to the retirement of Wally Ross of CDFW.

Beginning in the winter of 2014-2015, existing cut-off power poles approximately five feet in height were cut off to ground level by CDFW staff to eliminate potential perches for raptors. This effort was completed in the winter of 2017-2018.

For the third year, 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 discourage avian predator perching. In 2017, predators did perch on wells with NIXALITE on a limited basis. In 2018, CRC placed an alternative deterrent called Bird Spiders on wells used by predators for perching. Bird Spiders are a radiating array of wires that bounce and sway in the wind, creating a visual distraction and physical barrier to perching. However these failed to deter both small and large predatory birds due to the large size of the spider arms. Small sized spiders are not commercially available. Further research on deterrence of avian predator perching on oil wells should continue.

To deter predators from perching on structures other than oil wells, and adjacent to nesting and foraging sites, spider-like devices constructed of cork and wire were placed on signs and posts in 2018. These proved very effective in preventing predators from perching on these objects in 2019.

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 an elevated platform for viewing chick movement.

RESULTS AND DISCUSSION

In 2019, the first snowy plover nest was established on March 30 in Cell 41, under pipes that prevented the placement of an ME to protect the nest. The nest was subsequently predated. The last brood fledged on September 5. There was a total of 119 nests producing 112 fledglings for the season (Table 1). The 2019 snowy plover monitoring observed continued high usage of Bolsa Chica by male and females during the breeding season. The following sections discuss the details of the nesting season.

NUMBERS OF BREEDING MALE AND FEMALE SNOWY PLOVERS

The daily estimated minimum number of adults present at Bolsa Chica from April 29 through July 17 ranged between 70 and 109. Therefore, the minimum number of adults is reported as 109 (Table 1). The average of the daily surveys was 94 adults. This was the sixth consecutive year that Bolsa Chica met the management goal of 70 adults in the breeding season, as identified in the Snowy Plover Recovery Plan. This method of estimating the number of adults has consistently provided a higher count than the Breeding Season Window Survey. We believe the Minimum Number of Adults Methodology is the more effective method for determining the size of the breeding population. Because this method has only been employed since 2012, only eight years of data are presented in Table 1. This method will now be continued annually.

Table 1. Males and Females Based on Estimated Minimum Number of Adult Method, Nests, and Fledgling Production per Male 2012-2019.

Year	Females	Males	Total Adults	Total Nests	Fledglings	FI/Male
2019	43	66	109	119	112	1.70
2018	55	66	121	115	115	1.74
2017	51	63	114	127	152	2.41
2016	38	58	96	99	145	2.50
2015	31	45	76	92	129	2.87
2014	31	48	79	82	113	2.35
2013	26	28	54	66	37	1.32
2012	28	35	63	68	77	2.20

The range-wide Winter Window Survey conducted on January 26, 2019 to estimate the winter population size found 26 adults. The range-wide, Breeding Season Window Survey conducted on May 20 resulted in a count of 94 adult snowy plovers at Bolsa Chica (Table 2). As in most prior years, the Breeding Season Window Survey generated an underestimate of adults when compared to the minimum number of adults methodology. However, the Breeding Season Window Survey count is presented in Table 2 for consistency with the Recovery Plan.

Table 2. Males, Females, and Adults Based on Breeding Window Survey 1997-2019.

Year	Females	Males	Total Adults
2019	41	53	94
2018	52 (2 unknown)	70	124
2017	46	60	106
2016	29	60	89
2015	25	37	62
2014	20 (2 unknown)	40	62
2013	22	31	53
2012	26	31	57
2011	20 (1 unknown)	28	49
2010	22	23	45
2009	25	22	47
2008	22	28	50
2007	18	12	30
2006	27	35	62
2005	25	41	66
2004	25	20	45
2003	15	16	31
2002	19	20	39
2001	19	18	37
2000	15	16	31
1999	12	11	32
1998	11	16	27
1997	14	20	34

NEST SITE SELECTION AND DISTRIBUTION

Figure 2 presents the distribution of snowy plover nests in 2019. In earlier years, this report has used the term “Successful Nest” on Figure 2, to indicate which nests successfully fledged at least one chick. We no longer use that term, because the eventual fledging or failure to fledge is less related to the location of the nest and more to conditions and events in the areas to which the parents take the brood to forage. Figure 2 now indicates only if the nest hatched at least one egg, or if it failed due to predation, abandonment, or sterility. The nest of chicks that were found only as broods were plotted in the cell in which the chicks were found, though the actual location of the nest is not known. To better understand the factors that lead to successful hatching and fledging, monitoring in 2019 documented plover selection of habitat and foraging sites for raising chicks in relation to their fledging success.

In 2019, snowy plovers utilized all available nest sites typically used at Bolsa Chica (Figure 2). In 2019 the Seasonal Ponds region had 41% of all nests and produced 32% of the total fledglings. As in

the prior year, Cell 10 was the most successful cell, with 14 nests hatching 38 chicks with 16 fledglings, or 14% of all fledglings. The FFTB region continued the reduction in numbers observed in the two years since 2017. Comparing 2017 to 2019: from 29 to 17 nests, 82 to 43 chicks, and 32 to 12 fledglings in 2019.

The man-made nest sites (NS1, NS2, NS3, and STI) had 16 nests, 45 chicks, and 19 fledglings.

Use of the MTB continued to remain much higher than years past, with 35 nests, 84 chicks, and record high fledglings (44).

The 70 Road was used for the first time in 2019.

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 2019.

Table 3 presents the nesting information by location for 2019. The table also reports the number of fledglings by cell, though it should be noted that the fledglings may or may not have hatched from nests in that same cell. The broods frequently move from cells that were suitable for nesting into cells that provide suitable foraging space.

Table 3. 2019 Nests, Nest Fates, Chicks, and Fledglings by Location.

Location	Total Nests	Nests Failed no eggs hatched	Nests Hatched (# of chicks)	Fledglings
Seasonal Ponds	49	6	43 (112)	37
<i>Cell 2</i>	2		2 (6)	0
<i>Cell 9</i>	13	1	12 (31)	9
<i>Cell 10</i>	18	4	14 (38)	16
<i>Cell 11</i>	8	1	7 (18)	7
<i>Cell 12</i>	4	0	4 (9)	0
<i>Cell 13</i>	4	0	4 (10)	5
Nest Site 1	6	0	6 (18)	11
Nest Site 2	7	2	5 (14)	6
Nest Site 3	3	0	3 (8)	1
South Tern Island	1	0	1 (2)	0
Future Full Tidal Basin	17	0	17 (43)	12
<i>Cell 14</i>	5	0	5 (13)	3
<i>Cell 19</i>	1	0	1 (3)	0
<i>Cell 22</i>	1	0	1 (1)	0
<i>Cell 28</i>	1	0	1 (2)	0
<i>Cell 30</i>	2	0	2 (6)	3
<i>Cell 32</i>	3	0	3 (6)	0
<i>Cell 33</i>	2	0	2 (6)	0
<i>Cell 40</i>	2	0	2 (6)	6
Muted Tidal Basin	35	4	31 (84)	44
<i>Cell 41</i>	11	1	10 (27)	9
<i>Cell 42</i>	4	0	4 (11)	7
<i>Cell 45</i>	6	1	5 (13)	6
<i>Cell 46</i>	7	0	7 (19)	12
<i>Cell 47</i>	3	2	1 (3)	1
<i>70 Road</i>	1	0	1 (3)	2
<i>80 Road</i>	3	0	3 (9)	7
Total	119	12	107 (283)	112

Appendix 2 provides the cell location, start dates, nest fates, and eggs and chicks produced for each nest in 2019. Appendix 3 provides information on historical nest distribution.

NESTING CHRONOLOGY

In 2019, the first plover nest was initiated on March 30. The last nest hatched on August 14, and the last brood was seen September 5. There was an active nest and/or brood for a total of 159 days of the 2019 breeding season at Bolsa Chica. Nest chronology in 2019 is compared to the average of the prior 21 years at Bolsa Chica in Figure 3 and to the average of the prior five years, during which the recovery goal of breeding adults was met.

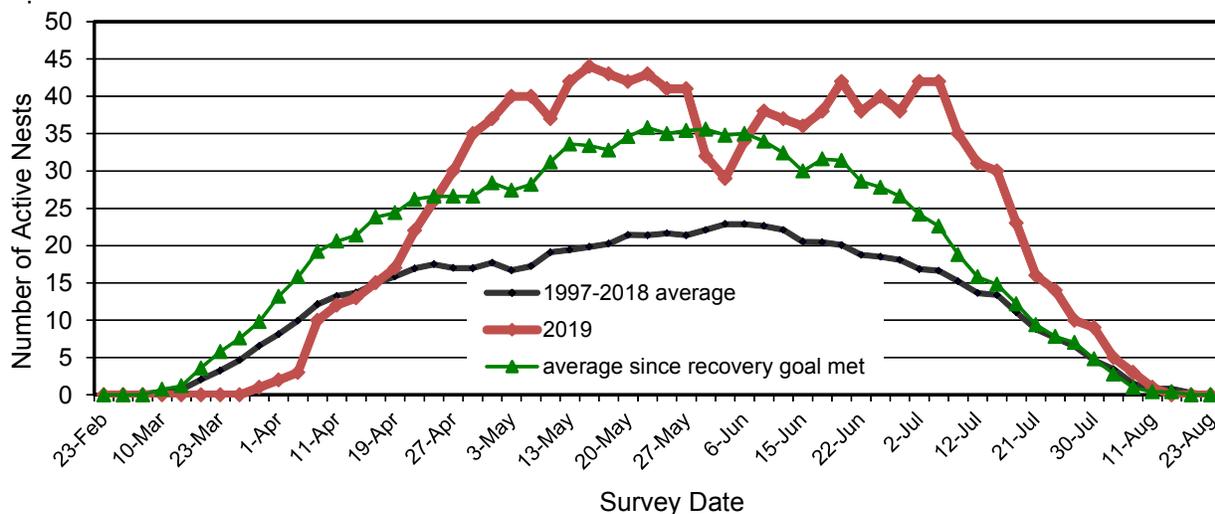


Figure 3. 2019 Western Snowy Plover Active Nest Chronology Compared to 1997 through 2018 Average and Since Recovery Goal Met in 2014 at Bolsa Chica.

EGGS, CHICKS, AND FLEDGLING PRODUCTION

A total of 321 snowy plover eggs were produced in 2019, with 283 hatching: all in the wild (not at the Wetlands and Wildlife Care Center (WWCC) in Huntington Beach). There were 4 one-egg clutches, 22 two-egg clutches and 93 three-egg clutches. The one- and two-egg clutches were near the end of the breeding season. Of the 38 eggs that did not hatch, 6 were predated, 1 died hatching, and 31 failed to hatch. Of the 31 that failed to hatch, upon examination it was determined that 12 eggs contained embryos. Eleven of these 12 eggs were from complete three-egg clutches.



Of the 119 nests, 7 were found as broods only and the nests not specifically located, but were assigned to the cell where the brood was initially found. Of the remaining 112 nests, four were predated and four failed (no eggs hatched).

Table 4 presents the number of nests, eggs, chicks, and fledglings produced at Bolsa Chica over the past 21 years of monitoring.

Table 4. Nests, Eggs, Hatch Success, and Fledgling Production 1997-2019.

Year	Nests	Eggs	Hatched	Failed to Hatch	Fledglings
2019	119	321	283	38	112
2018	115	320	288	42	115
2017	127	361	340	21	152
2016	99	275	246	29	145
2015	92	244	208	35	129
2014	82	231	211	20	113
2013	66	185	140	45	37
2012	68	193	161	32	77
2011	73	207	164	43	62
2010	64	184	164	20	63
2009	70	201	184	16	42-70*
2008	67	193	174	19	57-109*
2007	50	143	130	13	25
2006	71	198	166	32	64
2005	51	153	115	28	75
2004	65	191	149	42	79
2003	32	92	76	16	44
2002	50	132	75	57	27
2001	55	156	63	93	57
2000	39	103	57	46	42
1999	38	102	71	31	23
1998	34	94	55	39	25
1997	30	79	44	35	ND

ND = not determined

* minimum/maximum number of fledglings

Table 5 presents the total number of broods (one to three chicks each), then breaks them down into those that remained in the wild and fledged at least one chick, those that were raised at the WWCC (all of which fledged at least one chick each year), and those that remained in the wild but failed to fledge at least one chick. These data are available going back to 2010. In 2019, all broods were raised in the wild.

Table 5: Number of Broods 2010-2019 at Bolsa Chica and Raised at the Wetlands and Wildlife Care Center.

Year	Total Broods	Wild Broods that Fledged at Least 1 Chick	WWCC Raised Broods (All Fledged at Least 1 Chick)	Wild Broods that Failed to Fledge at Least 1 Chick
2019	119	60	None at WWCC	59
2018	105	55	6	44
2017	122	74	5	43
2016	91	68	3	20
2015	81	55	7	19
2014	76	55	4	17
2013	50	25	2	23
2012	60	39	0	21
2011	62	28	2	32
2010	58	31	5	22

A total of 112 fledglings, produced from 66 breeding males, results in an overall fledge rate (fledglings/male) of 1.70 for 2019 (Table 1). The Population Viability Analysis for Pacific Coast Western Snowy Plover in Appendix D of the Recovery Plan used a model that suggests that productivity (fledge rate) of at least 1.0 fledglings per breeding male per year should result in a stable population. It goes on to report that productivity of 1.2 or more fledglings per breeding male should increase the population sites at a “moderate pace”. Figure 4 presents the overall fledge rate (fledglings per breeding male), based on the Estimated Minimum Number of Adults since 2012. It shows a fledge rate reflective of an increasing population every year.

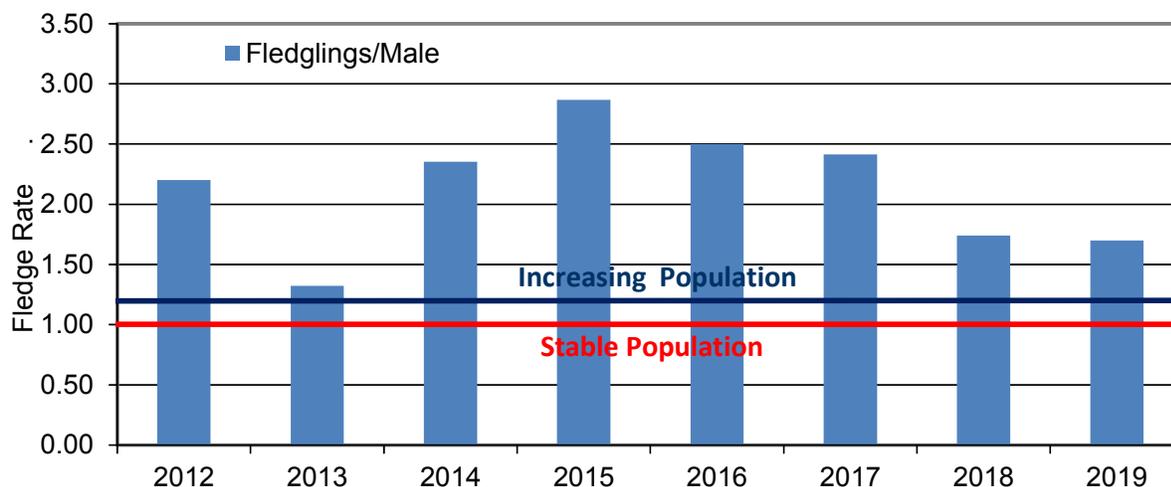


Figure 4. Western Snowy Plover Fledge Rate (Fledglings/Male) 2012-2019 at Bolsa Chica.

A total of 171 chicks failed to fledge in 2019. Of these, 36 died within the first day of hatching and 91 within the first week (Figure 5).

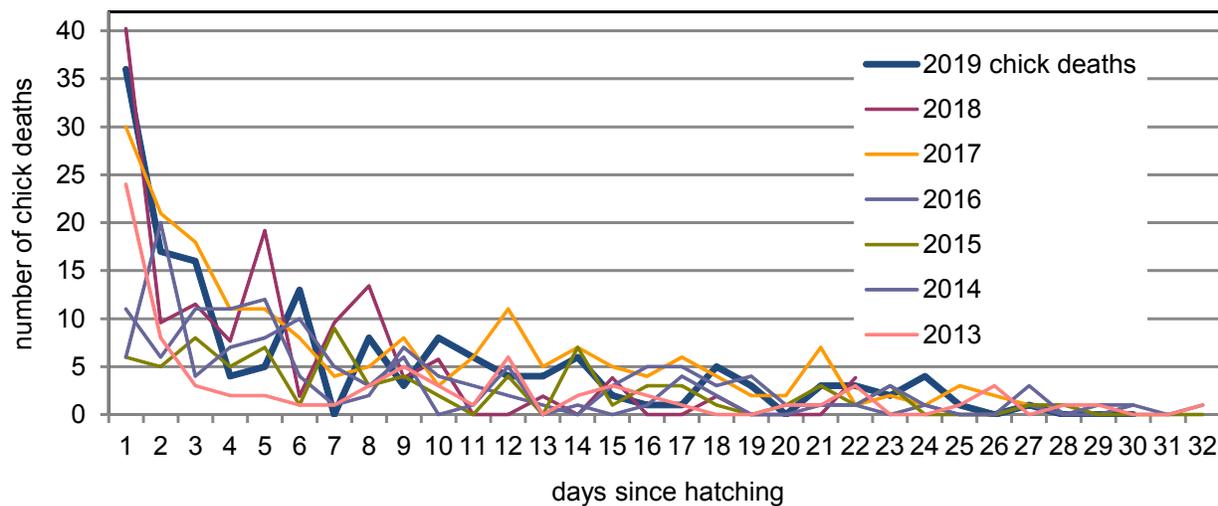


Figure 5. Number of Chick Deaths by Time since Hatching 2013-2019 at Bolsa Chica.

In past years there have been instances of prolonged incubation of one or more nests, however, there were no such cases in 2019.

All nest details are provided in Appendix 2.

EGG SALVAGE AND CHICK/ADULT RESCUES

No eggs, chicks, or adults were rescued and taken to the WWCC for care in 2019, however the collection of eggs and chicks abandoned in Nest 74 is detailed in Note 2 of Appendix 1.

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. Movement within some cells can be considerable, with larger cells such as Cell 10 and Cell 11 making up approximately 17 and 54 acres, respectively.

As generally seen in prior years, in 2019 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 disburse from the nest site to an adjacent cell probably contributed to fledgling success.

OBSERVATIONS OF BANDED ADULTS

Five banded plovers were observed breeding in 2019 at Bolsa Chica.

Two adults, yn:bo and yn:ag, both captive reared from salvaged eggs from Bolsa Chica at WWCC in 2018 nested at Bolsa Chica in 2019. The female, yn:bo, had Nest 23 in Cell 11, with two chicks and no fledglings, and the male, yn:ag, had a nest on NS2 with two chicks and no fledglings.

A female, pn:wk, nested once in 2019 in Cell 40, with three chicks, all of which fledged from Cell 41. She was banded at Coronado in 2018.

A male, Kl:yk nest in Cell 13 with one chick that did not fledge. He was banded at Camp Pendleton in 2018.

A male that is called rr:kk (because the color combination has never been acknowledged) had a nest believed to have been in Cell 10 and fledged two birds. This male has previously nested at Bolsa Chica and was in the photograph on the cover of the 2016 Bolsa Chica Western Snowy Plover nesting report.

A male, yn:wr, now banded as x:wr, was banded at the WWCC in 2010 and was present for the full breeding season. However, he could not be documented with a specific nest of chicks. This male has been observed nesting in previous years and has returned to Bolsa Chica every year since.

A male, s:oo (formerly ysa:oo), banded as an adult in December 2013 in Mexico, had nested at Bolsa Chica for the prior five years. In 2016 it suffered a left leg injury, was captured, and taken to the WWCC where it was rehabilitated and re-released to Bolsa Chica, and nested successfully. In 2019 he was seen early in the breeding season, but not thereafter.

Other banded plovers seen at Bolsa Chica in 2019 were yn:or, yn:ro, vg:wy, Rl:br, yk:kg, and O:Fg.ba.

PREDATION

There was no predator management at Bolsa Chica in 2019, as the CDFW employee Wally Ross retired after the 2018 season. Therefore there were no predator control measures taken other than the use of MEs. The continued use of the ME over all active nests contributed to the low rate of egg predation at Bolsa Chica. Four nests identified as breeding birds failed to have an ME placed in a timely manner and all four were predated. One of these four, Nest 1, could not be protected by an ME due to its location. Deployment of the MEs at the other three unprotected nests was delayed. Of the 119 nests recorded, 108 had MEs in place and resulted in all eggs remaining safe. There were seven broods found as a brood that had survived without ME protection.

Predation of plover chicks was for the most part undocumented, but were assumed to be from American kestrels. Two instances of predation were documented. One brood from ME-protected Nest 66 had just hatched and the chicks were taken by a coyote. At Nest 70, on STI, a loggerhead shrike took two of three hatching chicks.

In past years coyote had unsuccessfully attempted to predate plover eggs protected by MEs by digging under the ME. In 2019 there were attempts made on various nests (less than 10) all of which were unsuccessful (see Appendix 1 for detailed notes). There were two intense periods of predation. The first was between June 1 and June 3, when eight broods suffered loss of the entire brood of from

one to three chicks. These losses were concentrated in the Seasonal Ponds cells. No unusual predator sightings were recorded. The second instance centered around August 11 and was primarily in Cell 41 in the MTB area. It is assumed that one or more predators, most likely American kestrel. Seven broods were lost around this date.

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 on nearly 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. Resume predator control

Prior to 2019 a great deal of effort went into protecting the plovers through active predator control, with varying success. The loss of 188 chicks in 2017 indicated that consideration must be given to changes in predator management or development of other means to deter predators. Again in 2018 the loss of 177 chicks emphasized the continuing need for additional predator management or innovative techniques to protect chicks. The loss of 171 chicks in 2019 with the absence of Wally Ross and any other predator management again demonstrates that without some form of predator management in 2020 there is limited hope for improvement in chick fledgling results.

2. Consider protection of snowy plover nests and chicks in the Muted Tidal Basin

The Muted Tidal Basin has been gaining in importance as nesting and foraging habitat for snowy plovers over the past 10 years. Nesting has expanded from 1 nest in the Muted Tidal Basin in 2009 to 36 nests in 2018, and 31 nests in 2019 (Appendix 3). This region contributes to the increasing nesting by plovers at Bolsa Chica, supporting more than one quarter of all nests in 2019. Efforts are under way to remedy the hydrologic failures of the Full Tidal Basin/ Muted Tidal Basin functionality, so that they will perform more closely to their designed hydrology. It is important that this exploration of options take into account likely impacts to plover nesting and foraging. Inundating these areas with even muted daily tidal flow would preclude nesting by most of those plovers.

3. 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. Recent years of drought, through 2016, resulted in drier conditions in the Seasonal Ponds, suitable for early nesting. Though the drought has ended, the greater inundation did not impact plover nesting. However it is still important to have a flexible management process for balancing the amount of water in the Seasonal Ponds to make them available for snowy plover nesting and foraging.

Although culvert repairs and the Freeman Creek pump have improved the drainage of water from the Seasonal Ponds after inundation, they are not enough to drain key cells enough for optimal plover nesting and brood rearing. The additional removal of water must be done with a portable pump, which requires a pit be present for the pump intake to be placed in. It has been previously recommended that pits be dug to facilitate the removal of ponded water in key cells in fall months, particularly in priority Cells 9, 10, 11, and 14.

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 calls for the introduction of salt water into the Seasonal Ponds beginning immediately after the close of the breeding season. This has been done annually in September. This has been effecting in stopping the spread of freshwater. It is recommended that this practice continue annually.

4. Enhance potential nesting areas

Beginning in 2014, several locations within the Seasonal Ponds were enhanced at the start of the breeding season 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 believed that this enhancement may have encouraged repeat use of nest sites within the same year and in the following years. It is not possible to know if the sites are being used repeatedly by the same individuals because most of the plovers are not banded. The recommendation is to continue the enhancement of these areas each year and expand the method to other areas as deemed appropriate by the substrate present.

5. Continue monitoring

One of the key factors in the increasing success of nesting western snowy plovers at Bolsa Chica appears to be the intense monitoring and management employed to protect and track the nesting birds. It is recommended that monitoring continue annually with the same intensity in order to maintain the progress the plovers have made at Bolsa Chica, as the species attempts recovery range-wide.

Monitoring in 2017 included commencement of identifying brood movements, as called for in the Recovery Plan: Paragraph 4.4.1 "*Identify western snowy plover brood habitat and map brood home ranges... Brood movements should be mapped and distances quantified to identify how large an area must be protected for broods*". Efforts continue to map distances traveled by newly hatched broods.

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Appendix 1. Field observations and details by Peter Knapp, 2019.

Field observations and details by Western Snowy Plover observer Peter Knapp, 2019.

1) Least tern and snowy plover interaction, June 2019

I first saw a pair of least terns preparing a scrape on NS1. As they moved away from the scrape a snowy plover took possession of the scrape. The least terns reacted by attempting to scare the plover away, but as they did, the other plover's partner joined the challenge and shortly the terns flew off. The female plover again took possession of the scrape. The area available to both species for nesting was huge, but both chose this small space. The next day I returned and the plover was in possession of the scrape and I witnessed the male come to the scrape and scrape a bit before they mated. Two days later there were two eggs in the scrape and this became nest 86 of the 2019 season.

2) Nest 74 chick salvage, July 2019

On July 15 I visited western snowy plover Nest 74 at BCER to determine if the nest was being attended by an adult. For the past two weeks I had not seen an adult at the nest. A number of times due to the absence of an adult I positioned the three eggs such that on a return visit I could determine if an adult was attending the nest at night. At least once during this two week period I found the eggs in a incubating arrangement rather than an arrangement I used to see if the eggs were being incubated. But the last two times covering 5 days there was no indication that an adult had been present.

On this visit I found that one chick had hatched and was laying close to the mini-exclosure used to protect the nest. There were no sightings of an adult in the area. The chick appeared to be in poor condition, but movement of its legs was evident and it was calling. I placed the chick in a container and transported it to Vicki Anderson at Songbird and Care Education Center. I simultaneously contacted Cheryl Eggar. After leaving the chick in what I believed to be good hands I returned to BCER and returned to Nest 74 to check on the remaining two eggs and I found another egg to have hatched with a tiny attachment to the egg shell. I secured the chick and the third egg that had a pip hole in the shell. I could feel movement in the shell. I transported the second chick and pipping egg to Vicki Anderson at her residence. Cheryl Eggar had by this time arrived at Vicki's. Cheryl agreed to contact International Bird Rescue to give them early information that we might be transporting 1, 2, or 3 snowy plover chicks to them as Vicki does not have rearing capability.

A little history of the nest follows. It was found on June 10 as a one egg nest and a mini-exclosure was placed over the nest. The complete clutch of three eggs began incubation about June 15 and continued thru July 2. After this date no bird was sighted attending the nest and it was checked daily. When it appeared that the nest was abandoned after no sightings for four days I rotated the eggs to determine if in the evening the eggs were being incubated as described above. After July 9 there was no indication that eggs were attended at anytime.

Once the chicks were stabilized the intent was to transfer them to International Bird Rescue. Both chicks brought to the center failed to survive 24 hours, as did the hatching chick.

3) Loggerhead shrike predation, July 2019

Today July 6, I observed a predatory move by a loggerhead shrike against snowy plover nest 70 on South Tern Island. I noticed first the adults not within the MiniExclosure. In about a minute I suspected that a predator was somewhere within striking distance. The female plover performed its distraction display and that is when I noticed the loggerhead shrike sitting on the exclosure. At this point I could not determine if the eggs had hatched and the shrike was after newly hatched chicks or was it somehow sensing that the eggs were about to hatch. The shrike flew off and the male

cautiously entered the enclosure and appeared to be incubating eggs. I left to proceed to Nest Site 1. I returned in about 20 minutes only to find that the loggerhead shrike was again perched on the enclosure, but after a minute or two it again flew off. The male again resumed incubating and I left at this point. On the following day there was one chick alive, and two other eggs were missing and assumed to have hatched and taken by the shrike.

4) Plover acclimation to vehicles at Bolsa Chica, 2019

A number of plover nests have been created on gravel roads at Bolsa. Once established, vehicles routinely, on a limited basis, drove by the nest without any disturbance to the plovers. I believe this is partially indicative of the dedication of plovers to their eggs, familiarity with oil company vehicles traveling the roads and prior experience. A number of these nests have been established in areas previously used in prior years, but with plovers not banded, it can not be determined if this behavior is by the same adults. The vehicles pass slowly within 5 feet of the nest and at times within a tire width from the Mini-enclosure encasing the plover and scrape. In 2019 all of these nests hatched successfully.

5) Predation by coyote, 2019

On June 26 I found that the ME on Nest 66 had been dislodged from the nest and that the area surrounding the ME had been disturbed. This was extremely unusual as the ME was designed to be anchored in the ground and in this case bolts with washers were used due to the substrate being a former well pad. Observations of previous coyote attempts to secure eggs within a ME indicated that the coyote attempted to reach the eggs, sometimes from all sides of the ME. The claw marks could clearly be seen with these unsuccessful attempts. In this instance there was no indication that the coyote depredated the eggs and in my analysis I felt that the eggs had hatched and that the coyote (s) was after chicks. Based upon the date the nest was found with 3 eggs and the depredation date, it was reasonable that the eggs had hatched. Nests within close distance were not disturbed. Normally once hatched, the chicks remain under the ME for only a short time before foraging for food. With the number of MEs utilized during the breeding season attempts by coyotes to depredate eggs is very unusual. Further, historical observations of coyote walking past MEs with eggs indicated that they are not tempted to attempt depredation of eggs except in rare cases.

6) Intervention for plover injured by leg band, 2019

This is a record of the activities surrounding the capture and release of a snowy plover at BCER. The capture was occasioned due to an injury to the plover when a plastic band on the left leg of the bird slipped down the foot and prohibited the toes to spread in a normal manner thereby causing the plover to hop continuously. The following is a list of the people involved:

Peter Knapp, CDFW

Ross Griswold, CDFW volunteer

Travis Wooten, Institute for Conservation Research, San Diego Zoo Global

Rachel Smith, Institute for Conservation Research, San Diego Zoo Global

Doug George, Point Blue,

Vicki Anderson, Songbird Care and Education

The plover was observed for a number of days with a only a yellow band on the left leg and white over red on the right leg. Normally there would have been two bands, one an aluminum service band below the yellow band on the left leg. Without a service band identification of the bird is impossible. But based upon previous behavior of a bird banded in 2010 and it's annual appearance at BCER and behavior each year, there is a high likelihood that the birds are one and the same. The original

banding of a 2010 plover was yellow over a brown taped service band on the left leg and white over red on the right leg. The 2010 plover was the only BCER plover with this combination.

After observing the bird acting normal using both legs, I observed it using its right leg to hop along while foraging and holding its left leg up against its body. After this behavior was seen repeatedly it was evident that the yellow band had slipped down and was prohibiting the bird from opening its toes. Previously a similar situation had occurred at BCER and I determined that an effort be made to capture the plover. The previous situation had been resolved successfully using a leg-hold noose trap for capture.

I contacted Doug George who had previously loaned us a leg hold noose trap and arranged to borrow his trap. Once in hand I contacted Travis Wooten for advice and he volunteered along with Rachel Smith to come up to BCER and assist with the attempted capture of the plover. Rachel had her own leg hold noose traps (2).

The plover cooperated by showing up at his regular time and behaving normally for him. The area was his territory and he defended against any other plovers that attempted to forage on his territory. Since Rachel had more experience using the traps she elected to attempt on her own to entice the plover to cross the traps. This was in lieu of attempting to herd the plover across the traps with multiple herders. A number of close encounters were unsuccessful as each time another plover entered the area the subject bird attacked the intruder and flew with it for a distance before returning to its territory. After more than 2 hours the plover left the area appearing to fly to Nest Site 3, a nesting area for plovers that may have indicated that he had a nest on the site. The bird assumed to be the banded bird from 2010 had previously nested there. He returned after about an hour and Rachel resumed her efforts to entice the plover across the traps unsuccessfully. As we were imagining that we would be unsuccessful, she had the idea to use her phone with plover calls playing to attract the bird. The noose traps were arranged so that the bird would have to cross one of the traps in order to approach the calls. This was successful in attracting the bird as was his habit in driving off any other plover from his territory.

Once trapped, Rachel and Travis examined the leg with the problem band. The band was not loose and did not slide. There was a small split in the band that allowed Rachel with her fingernails to widen the split so that Travis was able to use reverse band pliers to open the band further and slip it off of the birds foot. There was no evidence of tape on the band. There was a small amount of swelling and I determined that the bird should be cared for and observed at least overnight. Ross Griswold delivered the bird to Vicki Anderson. The following day after concluding with Vicki that the bird was in good shape I collected the bird and returned it to the same area where it was captured. Since then I have observed it foraging naturally in the same area (its territory).

If we had been unsuccessful, the next day were going to attempt to use a plover decoy to attract the plover to a triangular configured leg hold noose trap in the suspicion that the plover would attempt to drive the intruder away from its territory.

7) Mini-exclosure placement, May 2019

On 4 May 2019 I placed MEs on 3 snowy plover nests. Nest 26 on NS1 had one egg, Nest 27 in cell 10 had two eggs, and Nest 28 in cell 42 had three eggs. Prior to placement of the MEs an adult was attending the nests either incubating nest 28, or tossing material, nests 26 and 27. Within no more than 90 seconds the bird in each instance was back on the nest after placement of the ME. This response of the plovers was common to prior ME placements over the past ten years.

8) Predation attempts by coyote and raven, April 2019

On April 19 2019 the following attempted predatory events were documented.

At 8:00AM a pair of coyotes were crossing Cell 9 and as one of the coyotes saw the ME on Nest 11 and the plover eggs inside, it circled the ME but made no attempt to get inside the ME and joined its companion and left the cell. In the afternoon Gary Keller (CDFW) called me to advise me a raven was attempting to get the eggs under Nest 8 in Cell 19. The bird on top of the ME attempted to get its bill through the 2x4" opening unsuccessfully. After other attempts it flew away.

Appendix 2. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2019.

Nest #	Date Found	Cell/Location	Grid#	# Eggs	Nest Fate	# Chicks	# Fledged	Bands	Substrate	Comments
1	30-Mar-19	41		3	3P	0	0		Cement	No ME on Nest under pipes well 73I
2	1-Apr-19	41		3	H	3	0		Gravel	Well pad 71E
3	5-Apr-19	11		3	H	3	2		Wet sub	Coyote track
4	5-Apr-19	10		3	H	3	2		Small stones	
5	8-Apr-19	10		2	2P	0	0		Concrete	No ME on Nest. One discolored egg left in nest
6	9-Apr-19	NS1	31B	3	H	3	2		Hard panne	
7	10-Apr-19	NS3	5B	3	H	3	1		Sand	
8	10-Apr-19	19		3	H	3	0		Salt panne	
9	10-Apr-19	10		3	H	3	2		Salt panne	
10	12-Apr-19	70 rd		3	H	3	2		Mixed	Edge of road
11	15-Apr-19	9		2	H	2	1		Salt panne	
12	20-Apr-19	10		3	H	3	0		Old well pad	
13	23-Apr-19	9		3	H	3	2		Salt panne	
14	24-Apr-19	46		2	H	2	2		Salt panne	
15	25-Apr-19	32		3	H	3	0		Old well pad	
16	25-Apr-19	40		3	H	3	3	pn:wk	Salt panne	
17	25-Apr-19	13		3	H	3	2		Salt panne	
18	25-Apr-19	47		3	H	3	1		Old well pad	
19	26-Apr-19	10		3	H	3	2		Salt panne	
20	26-Apr-19	10		3	H	3	1		Salt panne	
21	27-Apr-19	10		3	H	3	1		Salt panne	
22	27-Apr-19	NS2	1B	3	H	3	3		Salt panne	
23	1-May-19	11		2	H	2	0	yn:bo	Gravel	
24	2-May-19	2		3	H	3	0		Gravel	
25	2-May-19	14		3	H	2	2		Salt panne	
26	4-May-19	NS1	31A	3	H	3	2		Sand/Salt panne	
27	4-May-19	10		2	H	1	1		Salt panne	Two discolored eggs, one failed to hatch.
28	4-May-19	42		3	H	3	3		Salt panne	
29	5-May-19	NS3	2C	3	H	3	0		Salt panne	
30	6-May-19	11		3	H	3	0		Salt panne	3 Viable eggs abandoned (embryos present)
31	7-May-19	42		3	H	3	2		Salt panne	
32	7-May-19	10		3	H	3	0		Salt panne	3 Viable eggs abandoned (embryos present)
33	9-May-19	14		3	H	3	1		Salt panne	Found as a brood
34	9-May-19	45		3	H	3	3		Salt panne	3 Viable eggs abandoned (embryos present)
35	8-May-19	41		3	H	3	3		Salt panne	

Western Snowy Plover Nesting at Bolsa Chica, 2019

Nest #	Date Found	Cell/Location	Grid#	# Eggs	Nest Fate	# Chicks	# Fledged	Bands	Substrate	Comments
36	7-May-19	NS2	F1	3	3A	0	0		Salt panne	
37	7-May-19	NS2	D2	3	H	3	3		Salt panne	
38	10-May-19	47		3	3A	0	0		Salt panne	3 eggs abandoned, cause unknown
39	10-May-19	9		3	H	3	0		Salt panne	
40	11-May-19	47		3	3A	0	0		Salt panne	3 eggs abandoned, cause unknown
41	12-May-19	33		3	H	3	0		Salt panne	
42	12-May-19	12		3	H	3	0		Salt panne	
43	15-May-19	14		2	H	2	0		Salt panne	
44	16-May-19	9		3	H	3	1		Salt panne	
45	16-May-19	80 RD		2	H	2	2		Gravel	
46	18-May-19	14		3	H	3	0		Salt panne	
47	18-May-19	10		3	H	3	2		Salt panne	Found as a brood in cell 10
48	18-May-19	40		3	H	3	3		Salt panne	
49	18-May-19	9		3	H	3	2		Salt panne	
50	21-May-19	30		3	H	3	2		Salt panne	
51	21-May-19	10		Unkn	P	0	0		Salt panne	No ME on Nest.
52	21-May-19	14		3	H	3	0		Salt panne	
53	22-May-19	80 RD		3	H	3	2		Gravel	
54	23-May-19	12		3	H	1	0		Salt panne	
55	23-May-19	10		3	H	3	0		Salt panne	
56	23-May-19	10		2	H	2	0		Salt panne	
57	24-May-19	32		2	H	2	0		Salt panne	Found as a hatching nest
58	25-May-19	41		3	H	2	1		Salt panne	
59	27-May-19	41		3	H	3	0		Salt panne	
60	27-May-19	45		3	3A	0	0		Salt panne	
61	27-May-19	80 Rd		3	H	3	3		Gravel	
62	27-May-19	13		3	H	3	0		Unkn	
63	28-May-19	32		1	H	1	0		Salt panne	Found as single chick and male adult
64	29-May-19	33		3	H	3	0		Salt panne	Found as just hatched brood
65	30-May-19	11		3	H	3	1		Salt panne'	
66	1-Jun-19	10		3	H	3	0		Salt panne	Former well pad. Coyote defeated ME Chicks
67	1-Jun-19	NS1	Unkn	3	H	3	2		Salt panne	Found as just hatched brood
68	5-Jun-19	11		3	H	2	1		Salt panne	
69	5-Jun-19	12		3	H	3	1		Salt panne	
70	6-Jun-19	STI		3	H	3	1		Salt panne	Loggerhead shrike took 2 chicks while hatching
71	9-Jul-19	41		3	H	2	2		Salt panne	
72	8-Jun-19	2/10/Rd		3	H	3	0		Salt panne	
73	9-Jun-19	45		2	H	2	2		Salt panne	
74	10-Jun-19	9		3	H	2	0		Salt panne	2 Chicks hatched, 1 chick died hatching
75	10-Jun-19	9		3	H	3	1		Salt panne	

Western Snowy Plover Nesting at Bolsa Chica, 2019

Nest #	Date Found	Cell/Location	Grid#	# Eggs	Nest Fate	# Chicks	# Fledged	Bands	Substrate	Comments
76	10-Jun-19	11		2	H	2	0		Salt panne	
77	11-Jun-19	11		3	H	3	3		Salt panne	
78	11-Jun-19	41		3	H	3	3		Salt panne	
79	11-Jun-19	NS1	30D	3	H	3	3		Salt panne	
80	11-Jun-19	46		3	H	3	0		Salt panne	Found as hatched brood from cell 46 to 45
81	12-Jun-19	41		3	H	3	0		Salt panne	
82	12-Jun-19	42		3	H	2	2		Salt panne	2Hatched 1abandoned egg
83	12-Jun-19	46		3	H	3	2		Salt panne	
84	14-Jun-19	NS2	E2	3	H	3	0		Salt panne	
85	14-Jun-19	NS2	F1	3	3A	0	0		Salt panne	3 abandoned: 1 non-viable, 2 viable (embryos present)
86	14-Jun-19	NS1	32A	3	H	3	1		Salt panne	
87	18-Jun-19	30		3	H	3	1		Salt panne	
88	20-Jun-19	9		3	H	3	1		Salt panne	
89	20-Jun-19	9		3	H	3	1		Salt panne	
90	20-Jun-19	10		2	H	2	2		Salt panne	
91	21-Jun-19	9		2	H	2	0		Salt panne	
92	22-Jun-19	46		3	H	3	3		Salt panne	
93	20-Jun-19	46		3	H	3	1		Salt panne	
94	23-Jun-19	45		3	H	3	0		Salt panne	
95	24-Jun-19	46		3	H	3	2		Salt panne	
96	24-Jun-19	10		3	H	3	2		Salt panne	
97	5-Jul-19	13		2	H	1	0	Kl:yk	Salt panne	1 Hatched 1abandoned
98	25-Jun-19	NS1	31A	3	H	3	1		salt panne	
99	26-Jun-19	45		3	H	3	1		Salt panne	
100	18-Jun-19	NS2	1A	3	H	3	0		Salt panne	
101	30-Jun-19	41		2	H	2	0		Salt panne	
102	30-Jun-19	22		2	H	1	0		Salt panne	1Hatched, 1 viable egg abandoned (embryo present)
103	1-Jul-19	11		1	1A	0	0		Salt panne	
104	4-Jul-19	45		2	H	2	0		Salt panne	
105	5-Jul-19	9		1	1A	0	0		Salt panne	
106	6-Jul-19	41		2	H	2	0		Salt panne	
107	6-Jul-19	12		2	H	2	0		Salt panne	
108	6-Jul-19	NS3	1C	2	H	2	0		Salt panne	
109	6-Jul-19	NTI		2	H	2	0		Salt panne	
110	7-Jul-19	10		2	2P	0	0		Salt panne	
111	7-Jul-19	46		3	H	3	2		Salt panne	
112	8-Jul-19	9		3	H	3	0		Salt panne	
113	10-Jul-19	28		3	H	2	0		Salt panne	2 eggs hatched, 1 abandoned
114	10-Jul-19	42		2	H	2	0		Salt panne	
115	11-Jul-19	10		1	1A	0	0		Salt panne	

Western Snowy Plover Nesting at Bolsa Chica, 2019

Nest #	Date Found	Cell/Location	Grid#	# Eggs	Nest Fate	# Chicks	# Fledged	Bands	Substrate	Comments
116	17-Jul-19	41		3	H	3	0		Salt panne	
117	25-Jul-19	9		2	H	1	0		Salt panne	
118	14-Aug-19	13		3	H	3	3		Salt panne	Found in cell 13 as new hatch
119	21-Jul-19	NS2		2	H	2	0	yn:ag	Salt panne	
			TOTALS	321		283	112			

Appendix 3. Distribution of Western Snowy Plover Nests at Bolsa Chica for 1997 through 2019.

Number of nests by area at 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	
2016	99		46	12	20		7	3	9	2	
2017	127		55	29	26		3	5	8	1	
2018	115		40	21	36		7	7	2	1	
2019	119		49	17	31	1	6	7	3	1	4

Number of nests by cell at Bolsa Chica

Year	Cell 2	Cell 9	Cell 10	Cell 11	Cell 12	Cell 13	Cell 14	Cell 19	Cell 21	Cell 22/23	Cell 25	Cell 30	Cell 31	Cell 32	Cell 33	Cell 34	Cell 35	Cell 36	Cell 40	Cell 41	Cell 42	Cell 45	Cell 46	Cell 47	Cell 48.	80 Rd.
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				1
2015	1	8	15	10	5	2	4		2										2	2	3	5	1			5
2016	1	12	15	13	3		6			1										5	2	6	2	1		4
2017		12	21	16	2	4	6	3	1	2	1	2	1	3	2	2	1	0	2	8	5	9	3	0	1	1
2018	3	7	18	7	1	4	5	2	1	5	1		1	3	1	1		1	1	7	6	9	5	5	1	3
2019	2	13	18	8	4	4	5	1	1	1		2		3	2				2	11	4	6	7	3	3	1

Additionally, in 2019, there was a snowy plover nest located on the 70 Road for the first time.