



Coyote attempt to dig into mini-exclosure Photo by P. Knapp

## **Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 2005**

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## Introduction

In February 1997, the Bolsa Chica lowlands in Orange County, California 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 of the lowlands which had been cut off from the ocean for a century and an operating oil field for 50 years. Construction of the restoration project began after the 2004 snowy plover breeding season.

The purpose of this investigation is to continue to improve the level of knowledge about the western snowy plover, 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 was first initiated in 1997 and is expected to continue at least through completion of construction of the Bolsa Chica restoration project in 2006. This report addresses the 2005 snowy plover breeding season at Bolsa Chica, during Project construction.

## Background and Current Status

The western snowy plover, *Charadrius alexandrinus nivosus*, is a sparrow-sized, white and tan colored shorebird with dark patches on either side of the neck, behind the eyes, and on the forehead. The coastal western snowy plover population is defined as those individuals that nest adjacent to or near tidal waters and includes all nesting colonies on the mainland coast, peninsulas, offshore islands, adjacent bays, and estuaries. The breeding range of the coastal population of the western snowy plover extends along coastal beaches from the southern portion of Washington State to southern Baja California, Mexico. The Pacific coast population of the western snowy plover is reproductively isolated from the interior populations.

The breeding season of the western snowy plover extends from March 1 through September 15. Generally, 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 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 adult(s) provide danger warnings, thermo-regulation assistance, and guide the chicks to foraging areas, but do not



Snowy Plover incubates nest inside ME Photo by P. Knapp

provide food to their chicks. Broods rarely stay in the immediate area of the nest. Young birds are able to fly within approximately 31 days of hatching.

Double brooding and polyandry are the norm. Snowy plover females may leave very young chicks to find another mate. The male typically tends the brood until the chicks fledge. Western snowy plover adults and young forage on invertebrates along intertidal areas, along beaches in wet sand and surf cast kelp, in foredune areas of dry sand above the high tide, on salt pans, and along the edges of salt marshes and salt ponds. The snowy plover is primarily a run and glean type of forager.

Poor reproductive success resulting from human disturbance, predation, and inclement weather, combined with permanent or long-term loss of nesting habitat to urban development and the encroachment of introduced beach grass, has led to the decline in active nesting colonies as well as an overall decline in the breeding and wintering population of the western snowy plover along the Pacific coast of the United States. In southern California, the very large human population and the resultant beach recreation activities by humans have precluded the western snowy plover from breeding on historically used beach strand habitat. As a result of these factors, the Pacific coast population of the western snowy plover was Federally listed as a Threatened with extinction March 5, 1993 (58 Federal Register 12864). The June 2005 coastal California Snowy Plover breeding season survey estimated x,xxx individuals, found almost equally north and south of the Santa Barbara - San Luis Obispo County line.

Our studies from 1997-2005 have examined the scope, magnitude, and problems of snowy plover breeding activity at Bolsa Chica.

### **Bolsa Chica Study Area**

Bolsa Chica is a coastal lowland area between two mesas, the Bolsa Chica Mesa and the Huntington Beach Mesa (Figure 1). While under full tidal influence 106 years ago, Bolsa Chica is now diked-off from direct tidal influence, remains below mean sea level, and is a sump for local drainage. The study area is



Bolsa Chica Lowland Restoration Project contaminant removal and grading

Photo by J. Fancher

adjacent to the State's Ecological Reserve which is under a muted tidal influence that was restored in 1978 and which contains two small islands (NTI - North Tern Island and STI - South Tern Island) created for least tern nesting. There is no public access and 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.

Through the 2004 breeding season, the approximately 900-acre study area, with its crisscrossing pattern of roads and dikes, is artificially subdivided into smaller cells of varying area and configuration. Some cells display the physical features of tidal channels formed a century ago, others have been modified by oil field operations decades ago but are not now actively disturbed. This situation has resulted in three general surface conditions within the cells of the study area: 1) thickly vegetated with salt marsh plants, primarily non-tidal pickleweed, *Salicornia virginica*, 2) unvegetated flats, and 3) shallow ponds. Within the unvegetated areas (roughly 340 acres), the extent of ponded water or exposed flat varies with the seasons and between years. Typically, following winter rains the ponded areas are more extensive, but as evaporation begins to dominate in summer, the ponded areas shrink and more unvegetated flats are exposed. A few small areas are covered with water year-round.

During the 2005 breeding season, the large and complex restoration project was underway. The winter of 2004-5 had ranked second in recorded history of southern California for total precipitation. The earthmoving and nest site construction that

were to be completed before the onset of the 2005 breeding season, were not completed on schedule. Consequently, alternate nesting areas had to be designated and protected from disturbance by construction activities (Rabbit Island/cell 60, part of cell 4, cell 6, an part of cell 1). Also, de-watering using groundwater wells, drainage channels, and continuous pumping reduced the extent of flooding in the construction site and nesting areas of the south end, particularly cells 9-11. During the 2005 breeding season, some cells were completely disrupted by the operation of earthmoving equipment: cells 3, most of 4, 5, 7, 8, 15-18, 43, 44, 51, 58, 59, 61, 62.



ME over nest on temporary dike

photo by J. Fancher

## Study Methods

The study area is demarcated into subareas (cells) by the network of slightly elevated roads constructed for access to the oil wells. These cells were numbered and formed the basis for observer navigation, nest mapping, and data recording. Some areas in the vicinity of our 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, the full tidal area of outer Bolsa Bay. See figure 1. The study area included all the numbered cells, except cells 47 (Fieldstone property) and 64 (the Edwards Thumb), which remain in private ownership.

Each cell is unique in configuration and area. The gross area of some key cells are: cell 4, 30 acres; cell 8, 20 acres; cell 10, 17 acres; and cell 11, 54 acres. Some cells were thickly vegetated with pickleweed and considered unsuitable for western snowy plover nesting (cells 41 through 50). Similarly, areas covered with water during most of the breeding season (cells 3, 5, 30, and 38) are unsuitable for nesting but the margins were regularly checked for nesting plovers.



Snowy Plover nest 12 in cracked clay Cell 9

by J. Fancher

Beginning late-March, observers surveyed for nesting western snowy plovers at least twice a week, sometimes 4 or 5 times a week, until mid- September. The large majority of suitable western snowy plover nesting habitat was visible from the road network. Usually between 8 am and noon, the observer(s) would slowly drive in an automobile along the roads that subdivide Bolsa Chica. Frequent stops were made to examine specific areas adjacent to the road with binoculars or spotting scope without exiting the vehicle. In this manner, it was possible to discover most nests within a few days of eggs having been laid. Most of the time, a nest was evident when an adult was incubating. Other times the adult was foraging or preening near the nest and soon returned to it. Once a nest was discovered, a mini-exclosure (ME, 2-inch x 4-inch welded wire mesh, forming a cube 20 inches on a side) was anchored in place over it and left in place until the nest hatched. A camera was placed near some nests and left in place until the nest hatched. The observer would occasionally exit the vehicle in order to inspect an area not visible from the road or to verify the presence of eggs or chicks in a nest. Close examination of nests was usually conducted only once or twice per nest.

Data collected during this study included the gender of the incubating adult, length of incubation (days), number of eggs in the clutch, condition of the nest (e.g., signs of disturbance), and the fate of each nest (hatched, predated, or abandoned). Observations were also recorded of western snowy plover distribution by cell number, throughout the study area, not just those birds associated with nests.

It was feasible 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. (Banding of chicks has not been done at Bolsa Chica since 1999 and 2000.) Broods were observed 3 - 5 days per week. These regular brood observations were conducted to determine chick survival or fledgling production, as well as to detect movement between cells and use of specific cells for brood rearing.

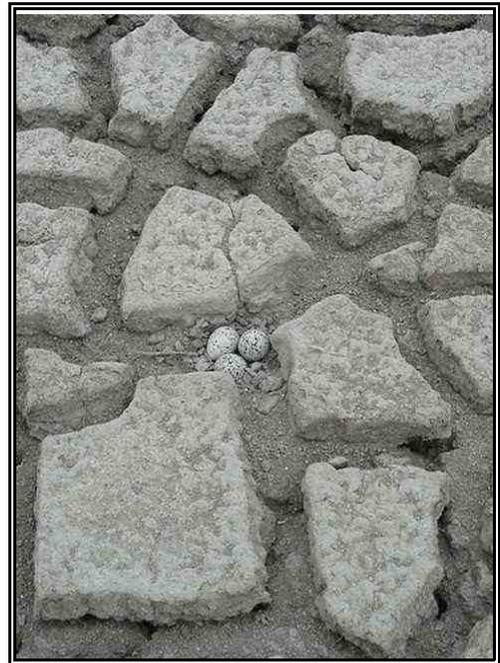
Observations were made of potential predators during our surveys. Predator management actions were then enacted commensurate with the threat to snowy plover breeding activity by that specific predator. Because crows have been a serious, omnipresent predator of snowy plover eggs in previous years at Bolsa Chica, eradication measures were begun in March and continued while plover breeding was continuing. Anchored ME's were usually deployed on every nest from the time it was discovered until hatching. When digging marks, egg loss, or auto-camera evidence indicated visitation by a small mammal predator, drop-door traps would be deployed. If ground squirrels were implicated, commercial poison bait stations were also deployed.

Four still cameras with passive infrared motion detector triggers (*Camtrackers*®), were placed 4-5 meters from selected snowy plover nests. The camera motion sensor was aimed to detect motion just above the plover nest to avoid causing the camera to fire when the plover adult moved on or to and from the nest. These cameras were thus deployed on a variety of nests throughout the plover breeding season. This camera model must auto-focus before shooting the picture, incurring a delay that sometimes fails to photograph the moving object that caused it to fire. Also, the sensor apparently reacts best with larger objects, such as larger birds or skunks.

## Results and Discussion

### NEST CHRONOLOGIES AND DISTRIBUTION

Winter rainfall preceding the 2005 nesting season exceeded the annual total for all but one year. Primarily through vegetation clearing and pumping, several areas suitable for snowy plover nesting were in place and protected from disturbance in March. After that, extensive flooding or rising water levels in nesting cells were not a problem. The earliest nest was found on STI March 19. Through April, 24 percent of the total 2005 nests (12/51) had been initiated. Twelve nest initiations before May 1 is a much greater number than in any previous year (4 nests before May 1 in 2003, 9 in 2002, 4 in 2001, 5 in 2000, 8 in 1999, 6 in 1998, and 3 in 1997), except 2004 with 18 of 65 nests before May 1. The proportion of total nests initiated in the early 2005 breeding season, March/April, (24%) also exceeded previous years (13% in 2003, 18% in 2002, 7% in 2001,



Nest 24 Cell 11

Photo by J. Fancher

13% in 2000, 21% in 1999, 18% in 1998, and 10% in 1997) except 2005 at 28%. Table 1 provides the cell location, start and end dates, nest fates, chicks and fledglings produced for each nest. Figure 2 depicts the location of nests in the cell map of Bolsa Chica.

In April and May, dry flats and nest areas were available and only one nest was initiated on a road top. The STI in the Bolsa Chica Ecological Reserve attracted six nest attempts, all in May, except for the earliest nest found on March 19 on STI. No nests were initiated on STI or a road top after May 31. Table 2 lists the nest and fledgling production distribution by cell. In 2005, cell 11 attracted twelve nest attempts three of those nests were lost to predation. Cells 10, 9, STI, and 4 attracted five to seven nests each, while cells 19, 12, and 33 supported 3-4 nest each.. Only one nest was started in each of 5 other cells. Plates showing examples of weekly nest and brood locations from each month are attached.

In 2005, the first nest was found March 19. The last nest was found August 10 but probably was initiated July 22, and this latest nest hatching occurred on August 19 (Table 1, Figure 4). Through most of

April, the number of active nests was larger than average for the seven years 1997-2003, peaking at 11 active nests on April 24. (In 2004, active nests in April were much higher still than even 2005, peaking at 16 on April 24.) In May 2005, just as in 2004, active nests “sank” back down to the 7-year average level. In 2005, a larger second peak in active nests was reached in late May (22 nests, 28 May; Figure 5). In 2004, the second peak occurred in June. In the 1997-2003 seven year average, there is no first peak, but rather a steady



Nest 7 Cell 10 abandoned when pickleweed grew in and over scrape

ramping up to the sole peak which is on average around June 28. This suggests a trend toward more nests earlier in the nesting season at Bolsa Chica in 2004 and 2005 when compared to the seven years of 1997 and 2003.

## EGG, CHICK, AND FLEDGLING PRODUCTION

Of 51 total nests in 2005, all were judged to be 3-egg clutches (Table 1). Seven of the 51 total nest attempts were lost to predators, two nests were abandoned. Thus, 42 nests survived to

hatch (hatching success rate of 82% or nest failure rate of 18%). At least 153 snowy plover eggs were produced at Bolsa Chica in 2005, 21 eggs were taken by predators and 17 eggs were abandoned or failed to hatch. From those 42 nests that hatched, 115 chicks were produced. Of these 115 total chicks, 75 chicks survived to fledge (65.2% chick survival). Every brood from the 42 nests that hatched produced at least one fledgling.

The total fledgling count was more difficult in 2005 than in past years due to insufficient geographic and temporal separation, defying efforts to maintain brood identity all the way to fledging during the middle part of the season. The initial group of nests, 1 through 18 hatching through early June, produced identifiable broods. These early broods were determined to have produced 15 fledglings due to our ability to follow their development from hatching to fledging. The broods from the middle group of nests, 19 through 37, were much harder to follow due to rarity of banded parents, dense packing of broods, and continual reconfiguration of brood territories or boundaries. Through field observation and comparing actual chicks to expected chicks, we did conclude that of the total of 54 chicks produced in the middle period, many relocated to other cells where they fledged (albeit identity unknown) and only about 10 chicks were lost. Cell 11, while the largest cell in Bolsa Chica (about 54 acres), was also the most crowded with snowy plover broods, with counts of more than 30 total chicks and 10-13 likely broods being common. The total fledgling estimate for the middle group of nests was 44. The broods from the last group of nests, 38 through 51, were also sufficiently identifiable to determine 16 fledglings were produced. (Chick survival of these later nests was actually high, 80%, since only 20 chicks were produced and 16 fledged. This is because seven nests, or 50% of all later nests were lost to egg predation by coyote.)

The April and May nests resulted in an a peak of nests hatching in June (Figure 4). The 18 nests initiated before the end of April produced 54 eggs, 41 chicks, but just 15 fledglings. The 33 nests started after April 30 produced 99 eggs, 74 chicks, and 60 fledglings. Chick survival of the “early” nests was 37% (15 fledglings from 41 chicks), while chick survival of all later nests was 81% (60 fledglings from 74 chicks).

## NUMBERS OF MALE AND FEMALE SNOWY PLOVERS

During the May 30, 2005 breeding season “range-wide population count” the total number of snowy plovers present at Bolsa Chica was 66, plus four chicks (Table 3 and Figure 5). During this count, about twice as many males (41) were seen than in previous years, (between 11 and 20 during 1997-2004). The average number of males at Bolsa Chica from 1997 to 2003 is 16.7 in each year. In 2004 and 2005, the average number of male snowy plovers is 30.5 individuals, an 82% increase over the seven preceding years, Twenty five females were observed during the 2005 count (18 active nests on that date). The number of females during previous window counts at the end of May have ranged between 11 and 19 during 1997-2003, but rose to 25 individuals in each of 2004 and 2005. The average number of female snowy plovers at Bolsa Chica from 1997-2003 at the end of May in each year is 15. In 2004 and 2005, the number of females at Bolsa Chica at the end of May has been 25, a 66% increase over the seven preceding years.

## BROOD TRACKING

Three “nests” were discovered after they had hatched and the location of the “new” brood, when first observed, was inferred to be the location of the nest. Due to the chronological and geographic spacing of each brood, it is usually possible to locate and identify individual broods over the entire several week period before they fledged. Each brood tended to stay together and the males prevented overlap or co-mingling with other broods. However, as in 2004, we observed a few instances of broods combining or chicks being “adopted” into another brood. In 2005, many broods were moved around by the guiding male. In June and July there probably were between 50 and 70 chicks throughout the study area. It was common for just cell 11 to contain 30-40 chicks in 10-14 different broods all jostling each other for brood territory. Tracking of individual broods, in the absence of markings or bands, was very difficult under this circumstance. Snowy plovers readily use the roads of Bolsa Chica that define the cells to cover distances of 1/3 to 3/4 mile. One 3-4 day old brood driven out of cell 4 by a competing male covered about one mile across the construction zone in moving to cell 2, then almost another half mile to cells 10 and 13, over the course of a few days.

## OBSERVATIONS OF BANDED ADULTS

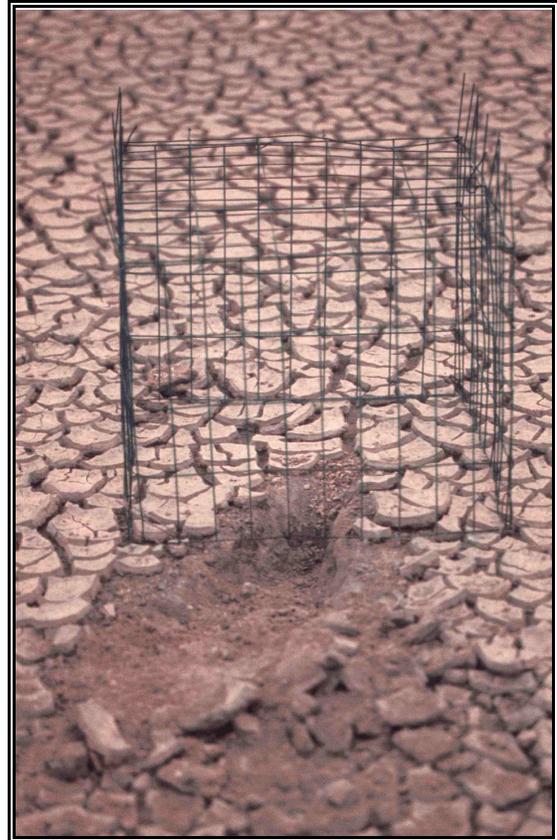
One female (øKKK), hatched at Camp Pendleton in 1999, nested twice at Bolsa Chica in 2000, and three times in 2001, with two surviving nests hatching five chicks. In 2002, øKKK nested twice (nest 20 in cell 11 and nest 32 in cell 14), producing two chicks. In 2003, she nested twice at Bolsa Chica (nest 12, lost to predation on Road STI/3 and hatched nest 21 in cell 9). In 2004, she incubated one nest in cell 11 to hatching in May. She had one known nest at Bolsa Chica in 2005, which was abandoned, probably because pickleweed grew around and over the nest scrape. A male (RBRPink) had two broods at Bolsa Chica in 2004, with 3 chicks fledging. In 2003 he was seen with one brood. This male hatched at Moss Landing in 2001. In 2005, he was seen very frequently but was seen associated with one brood that produced one fledgling. A female (RWKY) banded at Batiquitos Lagoon in 1998, had one successful nest at Bolsa Chica in 2005. Before and after she nested, she was seen to carry her right leg without putting weight on it, as though damaged. We were unable to determine her sighting history between 1998 and 2005, at this writing. A male (WNGY) nested successfully at Bolsa Chica in 2004, and again in 2005. Its prior history is also unknown at this writing.

## PREDATION

In 2005, 13.7% of all nests (7 of 51 nests, Table 2), were lost to predation. Two more nests were abandoned. Nest loss/egg predation was highest in 2001 of all study years in both raw numbers and proportion of total nests. The 2005 breeding season ranked second lowest nest loss after 2003 (Figure 7). The 2005 proportion of nests hatching (82%) exceeded every other year as did fledglings produced per nest (1.47) (Figure 9, Table 3). This low rate of nest loss is attributable to the deployment of MEs. We placed an ME on each nest as soon as the nest had been discovered. One nest was lost to crow predation just two days after our discovery of the nest because placement of the ME was not immediate. The ME design is very effective at preventing crows or ravens from stealing snowy plover eggs.

In late May, a four-pup coyote litter, *Canis latrans*, was seen using a culvert as a den in cell 12 while the adult brought birds (black-necked stilt) to them. A snowy plover nest (#30) was found about 200 feet away, was covered with an ME and auto-camera. This nest was not disturbed although a picture of an investigating adult coyote was taken. In June, we saw several instances of unsuccessful dig marks outside an ME. We took no action against coyote at that time.

Later, in several instances where the snowy plover eggs were stolen, claw marks were evident inside the ME. No ME was bent or shoved out of place. In each instance, the coyote did one of two things. The animal dug enough for the eggs to roll out of the nest scrape closer to the ME edge where the coyote could reach it. Or, the animal learned how to extend its paw through the ME mesh far enough to rake the snowy plover eggs gently out of the scrape. Egg shell fragments were not found inside the ME. The auto-cameras captured several events of coyote, visitation of the nest sites. The auto-camera photos, claw marks, and the frequency of coyote sightings in the Bolsa Chica lowland led to a conclusion that of the seven nests lost to a predator in 2005, all were probably due to coyote.



Coyote took eggs from Nest 45 photo by J. Fancher

Since coyotes have been at Bolsa Chica for the 9 years of this study but never has been know to be a problem for snowy plover nests, we concluded that perhaps pups from the nearby 2005 litter were learning the foraging skills to defeat an ME and steal the eggs underneath. We attempted an ME/egg aversion method in July. Our predator management specialist injected quail eggs with bitter tasting fluids. These were placed under ME's in areas where coyotes were regularly seen (cells 9, 10, 11, 13). Between three and six such aversion ME's were deployed into



Coyote defeats ME over Nest 45

August. There were four instances where a coyote dug or reached into an ME to steal baited eggs. There were known to be as many as 9 coyotes in the south end of Bolsa Chica, so it is

possible we “averted” 4 different coyotes from using the ME to guide in on a tasty egg reward. It is also possible the method was no deterrent and that the coyote attacks on the ME will continue in 2006. It is also possible that expanding the horizontal dimensions of the ME enough that a coyote paw cannot be extended through the mesh to reach the nest scrape (currently about 10 inches from the edge) could reduce losses to coyote. However, if a coyote wants to dig for 3-egg clutch, it appears they will. This aversion methods will be continued in 2006.

Based on the 2004 evidence of ground squirrel theft of snowy plover eggs, direct removal of squirrels and deployment of poisoned bait stations were continued in 2005. No plover nest or egg losses were attributable to ground squirrels in 2005.

Due to the great abundance of crows and their seemingly endless encroachment into the wetland from the surrounding urban area, removal of crows from Bolsa Chica has continued. However, with the success of the MEs, removal of crows has been drastically de-emphasized (Table 6). One snowy plover was lost to crows in 2005 because an ME was not placed on the nest immediately upon discover. Only 15 crows were removed from Bolsa Chica in 2005 (Ross 2005). The detection of West Nile virus (WNV) in Orange County in 2004 and 2005 may have reduced the crow or raven populations around Bolsa Chica. Tests for WNV in crows were positive. Use of the ME virtually eliminates snowy plover egg loss due to crows or ravens so that there can be less emphasis on eradicating egg stealing crows and more predator management effort focused on capturing other chick predators..

The most likely culprit for snowy plover chick mortality in early 2005 continues to be American kestrel, *Falco sparverius*. Chick predation was significant in the first part of the breeding season. Kestrels were relatively abundant and can do great harm very quickly. Therefore, efforts to remove them from Bolsa Chica during the snowy plover breeding season continued by live-trapping and transporting them considerably inland. Thirteen kestrels were transported away from Bolsa Chica. Loggerhead shrikes, *Lanius ludovicianus*, were far less numerous in 2005 than in previous years. Just one shrike was transported away from Bolsa Chica in 2005.

Red-tailed hawk, *Buteo jamaicensis*, was regularly present in the Bolsa Chica lowland but no known predation of snowy plover was evident. No hawk nest was known to be present in the Bolsa Chica lowland in 2005, as there was in 2002. Consequently, no red-tailed hawk was live-trapped and transported away from Bolsa Chica in 2005.

While Cooper’s hawks, *Accipiter cooperii*, have been present during the snowy plover breeding



Captured Cooper's Hawk

season at Bolsa Chica for years, they had not been indicted as a harmful predator. In 2005, increased abundances of Cooper's hawks in and around the periphery of the wetland and one direct observation of a Cooper's hawk eating a likely snowy plover chick, led us to respond to their presence. Eight Cooper's hawks were live-trapped and transported away from Bolsa Chica in 2005.

No instance of adult snowy plover predation or disease mortality was detected in 2005 at Bolsa Chica.

## SUMMARY

Very high rainfall in 2005 resulted in an abundance of flooded cells just before the breeding season, but pumping water out of the cells exposed adequate flats for snowy plover nesting to begin in March. The highest number of active nests for all our survey years was recorded in June 2005. Adult female numbers were higher than previous years and the number of males was much higher than all previous years. Total nest attempts (51) were third highest of the 9 years of this study at Bolsa Chica. A regression analysis (Figure 8) suggests an improving trend for egg, chick, and fledgling production at Bolsa Chica. Deployment of mini-exlosures (ME) on nearly every nest was very effective at preventing egg losses to crows and ravens. However, coyotes were verified to be egg stealers, defeating the ME six times. No impacts to snowy plover from the heavy construction activities at Bolsa Chica were detected.

The total number of chicks hatched was second highest (115 chicks), behind 2004 (150 chicks). Chick survival to fledge in 2005 (65.2%) ranks third to 2001 (90.5%) and 2000 (82.4%). The major chick predator in 2005 was American kestrel. Despite the early loss of chicks, fledgling production in 2005 (75) was just below the 2004 Bolsa Chica record of 79 fledglings produced in a breeding season.

During March 2005, while pumping water out of the seasonal ponds, cells 9-14, apparently conditions were created that were conducive to pickleweed (*Salicornia virginica*) sprouting. The extent of unvegetated flats at Bolsa Chica has been relatively stable during our years of study and decades before. However, in 2005, pickleweed sprouted and grew in areas that have never supported pickleweed before and which have been utilized by nesting snowy plover. It is too soon to tell if this was a consequence of the record-breaking rainfall of that winter, or of the timing and extent of the pumped draw-down of water during this year of construction. Since the long-term water management system will not be functioning as designed until the season of 2007, preparing the seasonal flats for snowy plover nesting will be considered an interim necessity during construction of the restoration project, including removal of pickleweed from areas where it had never previously grown.

In 2006, three new nest sites totaling about 20 acres will be available at Bolsa Chica, to augment the seasonal flats of the south end plus STI and NTI. Their physiognomy will be flat on top, light-colored sandy surface, minimal vegetation, and gentle slopes down to adjacent seasonal ponds or intertidal salt marsh.

## Acknowledgments

We offer special thanks to Wally Ross and Ron Brown who performed the predator management actions that are so important to snowy plover reproductive success at Bolsa Chica. We also thank Stacie Love for her care and attention to detail in preparing snowy plover nest maps.



Nest 10 Cell 11 under ME on hard sand with gravel and tiled with small stone chips

## Literature Cited

### Tables

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### Plates

Selected maps of 2005 Snowy Plover nests locations over time

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**Table 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2005.**

<u>Nest #</u>	<u>Cell #</u>	<u>date found</u>	<u>date ended</u>	<u>eggs</u>	<u>nest fate</u>	<u>chicks</u>	<u>fledglings</u>
1	STI	3-19	4-10	3	A	-	nests #1-18 <b>15</b>
2	9	3-24	4-29	3	H	2	
3	4	4-3	5-7	3	H	3	
4	9	4-4	5-1	3	H	3	
5	11	4-6	5-7	3	H	2	
6	4	4-16	5-17	3	H	3	
7	10	4-16	5-4	3	A	-	
8	10/2rd	4-20	5-22	3	H	3	
9	4	4-22	5-4	3	H	3	
10	11	4-25	5-26	3	H	3	
11	10	4-26	5-25	3	H	2	
12	9	4-26	5-24	3	H	3	
13	11	5-4	5-28	3	H	3	
14	STI/1rd	5-12	6-7	3	H	1	
15	14	5-15	6-4	3	H	1	
16	STI	5-15	6-11	3	H	3	
17	STI	5-15	6-4	3	H	3	
18	1	5-15	6-4	3	H	3	
19	11	5-17	6-14	3	H	3	nests #19-37 <b>44</b>
20	10	5-17	6-9	3	H	3	
21	4	5-18	6-18	3	H	3	
22	10	5-18	6-9	3	H	3	
23	11	5-23	6-18	3	H	3	
24	11	5-23	6-22	3	H	3	
25	4	5-24	6-11	3	H	3	
26	STI	5-24	6-17	3	H	3	
27	19	5-24	6-13	3	H	3	
28	STI	5-26	6-19	3	H	3	

<u>Nest #</u>	<u>Cell #</u>	<u>date found</u>	<u>date ended</u>	<u>eggs</u>	<u>nest fate</u>	<u>chicks</u>	<u>fledglings</u>
29	STI	5-26	6-19	3	H	3	
30	12	5-26	6-8	3	H	3	
31	19	6-2	6-13	3	H	3	
32	10	6-2	6-30	3	H	3	
33	11	(5-1)	6-2	3	H	3	
34	10	6-5	6-22	3	H	1	
35	19	6-5	6-30	3	H	3	
36	11	6-6	7-4	3	H	2	
37	11	6-7	7-6	3	H	3	
38	10	6-8	7-4	3	P	-	
39	11	6-17	7-7	3	P	-	
40	11	6-18	7-11	3	P	-	
41	9	(5-20)	6-18	3	H	3	
42	11	6-19	7-12	3	P	-	
43	12	6-19	6-20	3	P	-	
44	2	6-21	7-11	3	H	3	
45	9	6-29	7-10	3	P	-	
46	12	6-30	7-24	3	H	3	
47	33	(6-11)	7-10	3	H	2	
48	33	(7-3)	7-31	3	P	-	
49	33	(7-1)	7-29	3	H	3	
50	9	(7-2)	7-30	3	H	3	
51	19	(7-22)	8-19	3	H	3	
<b>2005 Season Totals</b>				<b>153 eggs</b>	<b>7P, 2A 42H 51 Nests</b>	<b>115 chicks</b>	<b>75 fledglings</b>

\*predation photographed, dates in parentheses indicate an inferred nest start date from discovery of a new brood

P = predated; A = abandoned; H - hatched

**Table 2. 2005 Nest and Nest Fate Distribution by Cell**

<u>Location#</u>	<u>total nests</u>	<u># nests lost</u>	<u># nests hatched</u>
cell 11	12	3	9
10	7	2	5
9	6	1	5
STI	6	1	5
4	5	0	5
19	4	0	4
12	3	1	2
33	3	1	2
<u>5 other cells</u>	<u>5</u>	<u>0</u>	<u>5</u>
	51	9	42

**Table 3. Males, Females, Nests and Fledgling Production 1997-2005**

	<u>Fem</u>	<u>Males</u>	<u>Total Nests</u>	<u>Fledglings</u>	<u>total Fl/nest</u>	<u>% chick survival</u>	<u>Fl/male</u>
2005	25	41	51	75	1.47	65.2	1.8
2004	25	20	65	79	1.22	53.0	4.0
2003	15	16	32	44	1.38	57.9	2.8
2002	19	20	50	27	0.54	36.0	1.4
2001	19	18	55	57	1.04	90.5	3.2
2000	15	16	39	42	1.08	82.4	2.6
1999	12	11	38	23	0.61	32.4	2.1
1998	11	16	34	25	0.74	37.3	1.6
1997	14	20	30	nd	nd	nd	nd

Fl = fledglings, nd = not determined

**Table 4. Bolsa Chica Predator Removal Summary 1997–2005**

	<u>2005</u>	<u>2004</u>	<u>2003</u>	<u>2002</u>	<u>2001</u>	<u>2000</u>	<u>1999</u>	<u>1998</u>	<u>1997</u>
American crow	15	99	118	52	80	91	27	1	2
American kestrel	13	19	5	12	13	15	46	14	2
Loggerhead shrike	1	10	5	3	6	2	5	0	0
Common raven	1	2	4	5	6	3	2	0	0
Coopers hawk	8	-	-	-	-	-	-	-	-
Ring-billed Gull	1	-	-	-	-	-	-	-	-
skunk	-	2	1	-	-	-	-	-	-
coyote	-	-	-	-	-	-	-	-	-
weasel	-	-	-	-	-	-	-	-	-

Figure 1.

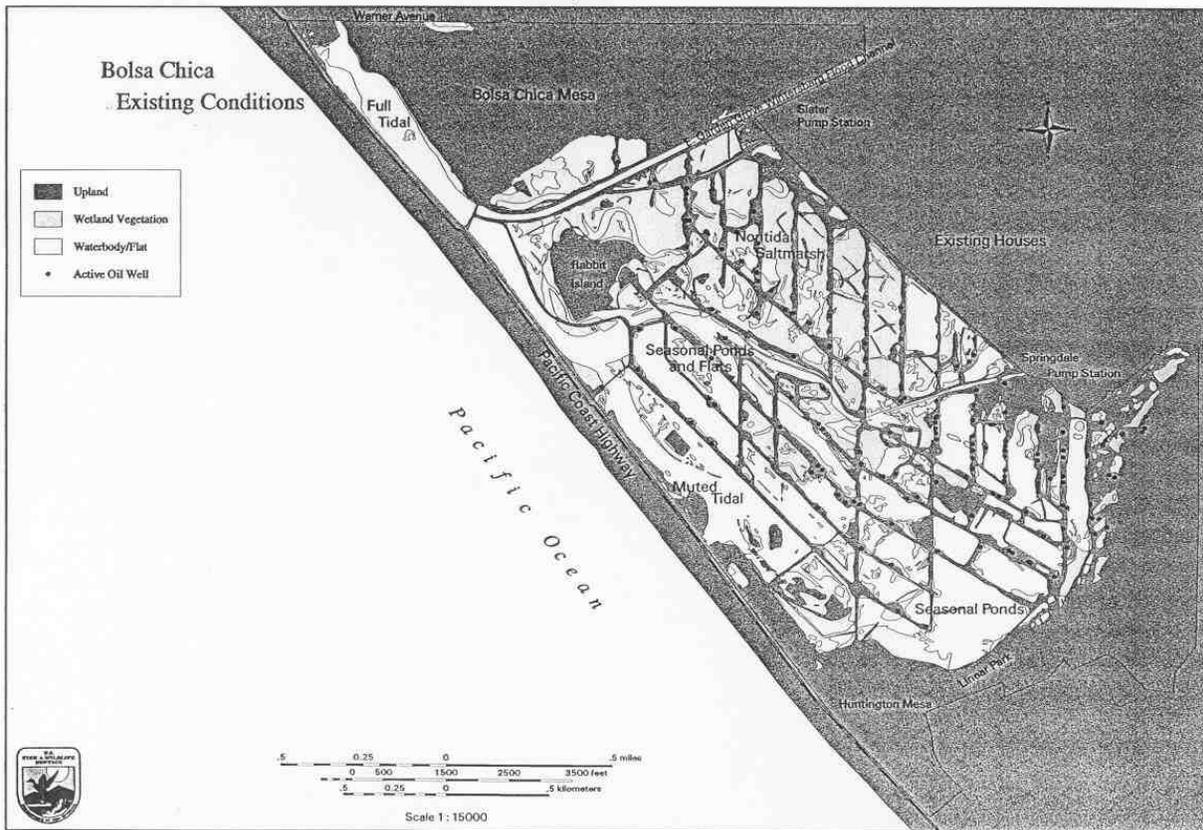
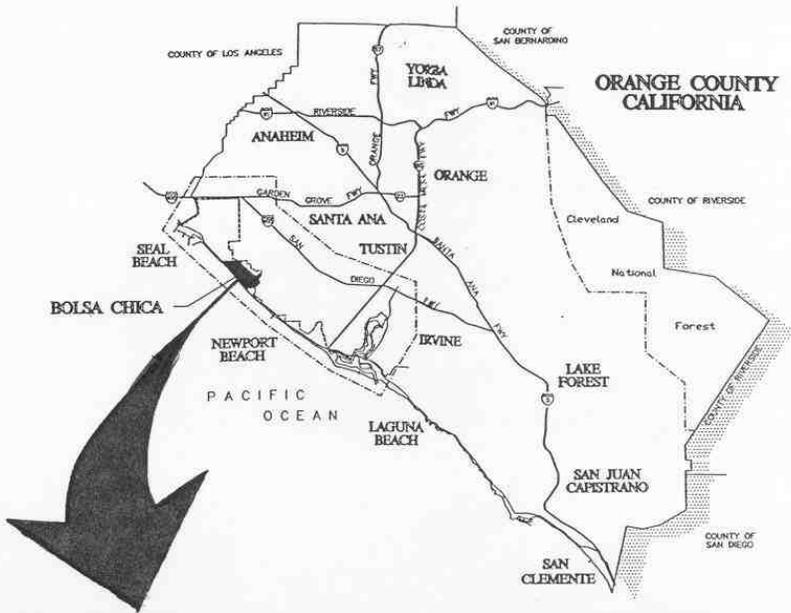


Figure 2 2005 Bolsa Chica Snowy Plover Nest Map

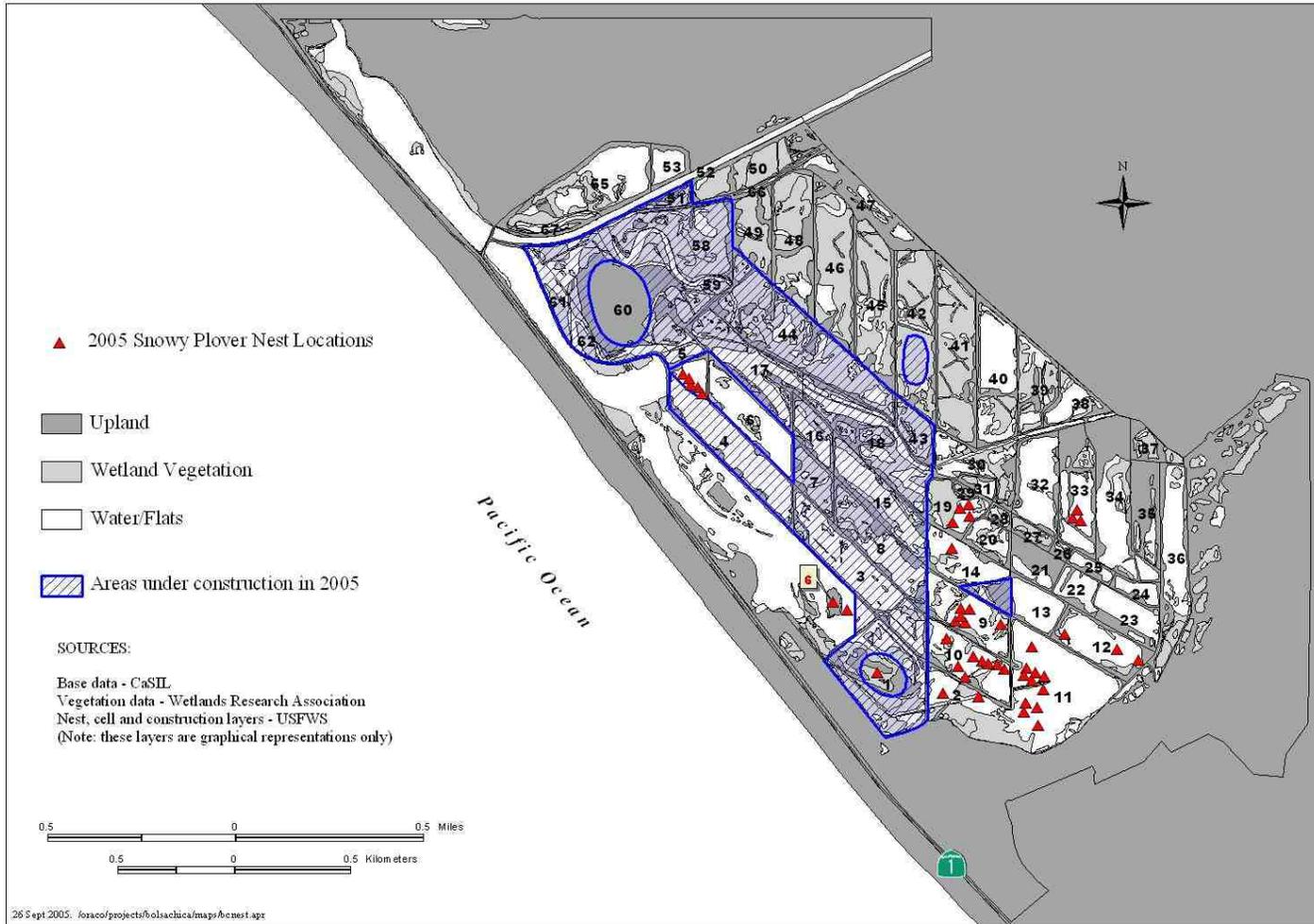
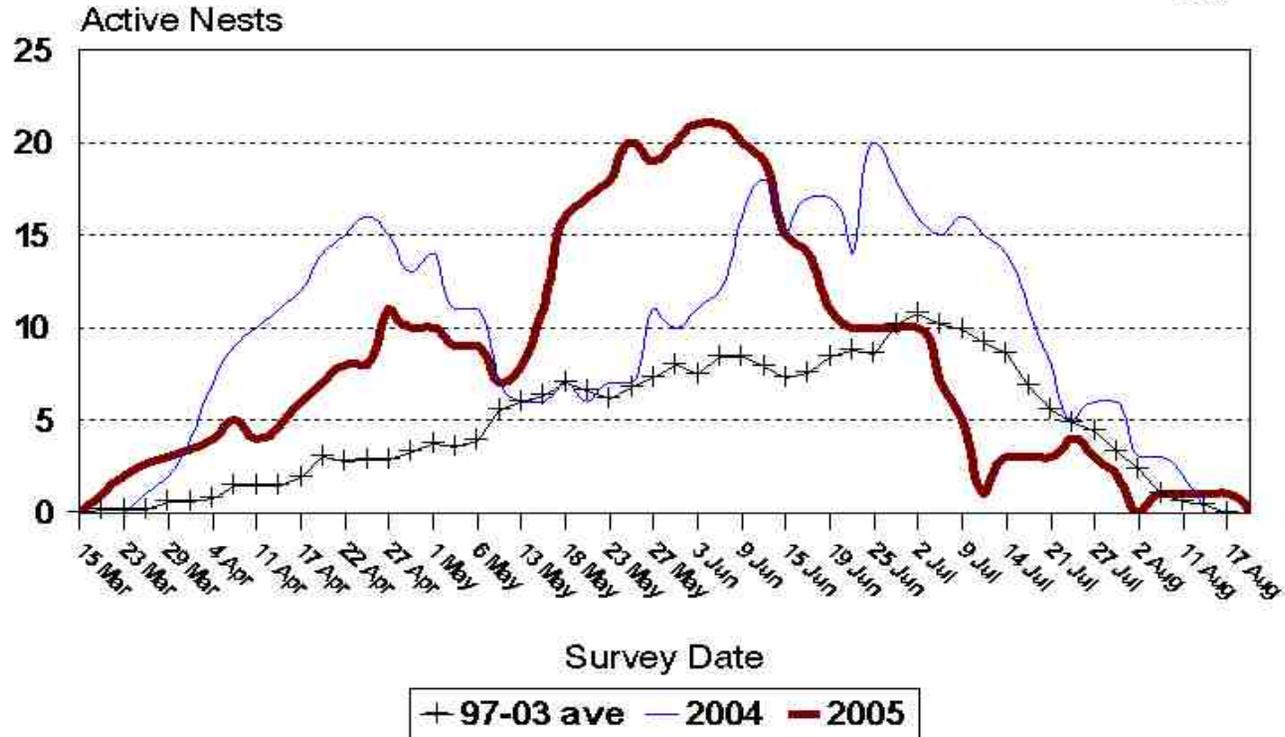


Figure 3

# Western Snowy Plover

## 1997-2005 Bolsa Chica Active Nest Chronology



# Western Snowy Plover - Bolsa Chica 2005

## Biweekly Nest Initiation, Hatching, & Loss

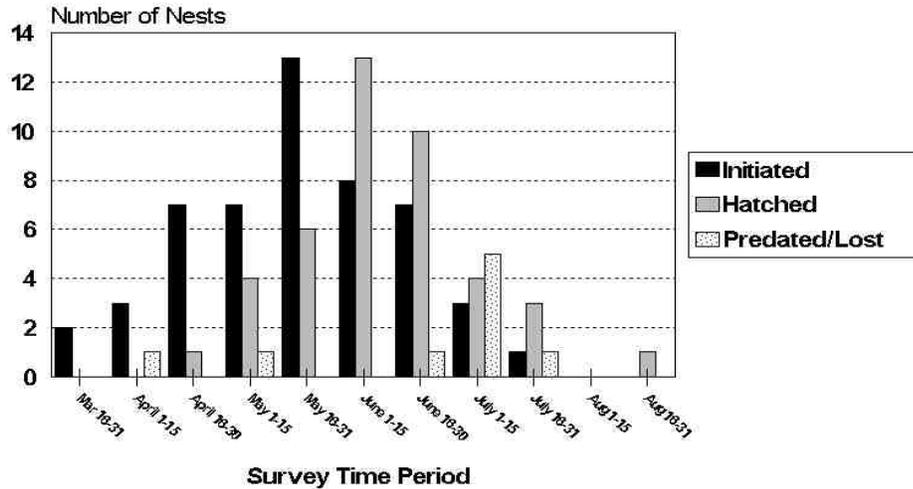
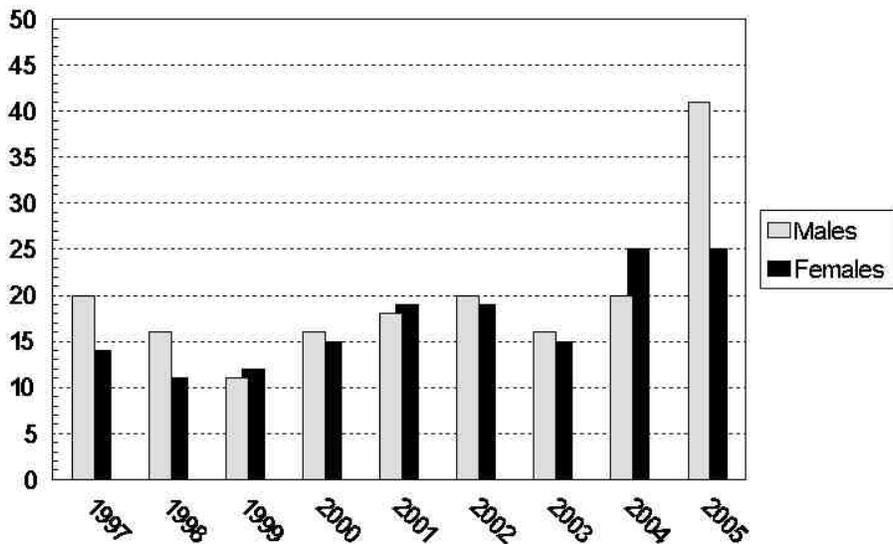


Figure 4. 2005 Biweekly Nest Initiation, Hatching, and Loss

Figure 5 Male and Female Snowy Plovers in late May

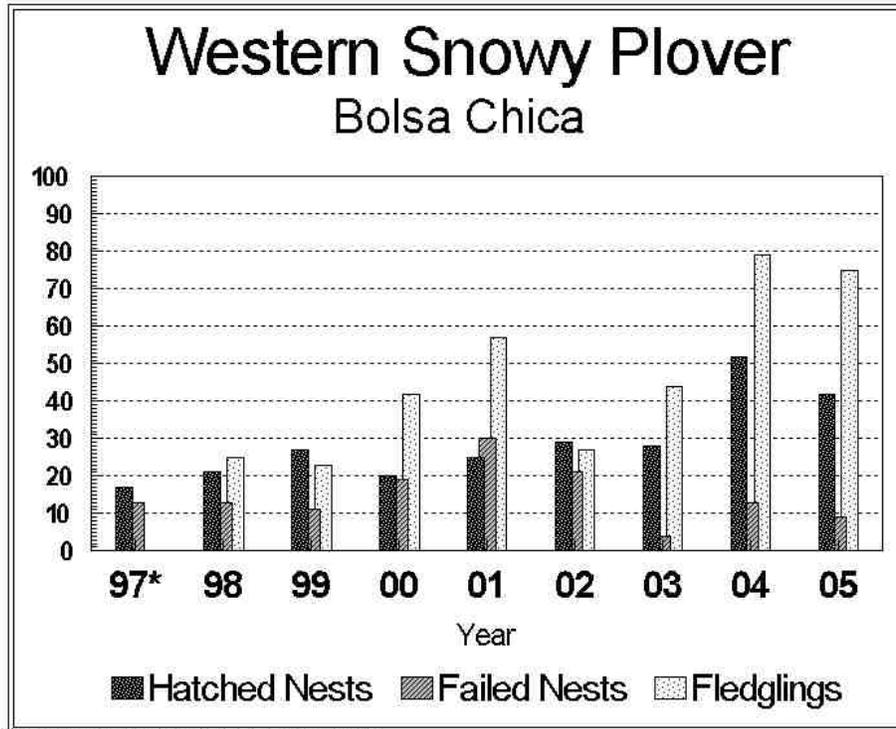
# Western Snowy Plover

## Bolsa Chica - Males and Females



during range-wide window counts, end of May

Figure 6. Nest Fates and Fledglings Produced 1997-2005



\* fledglings not determined in 1997

Figure 7.

### Bolsa Chica Western Snowy Plover Egg, Chick, and Fledgling Production 1997-2005

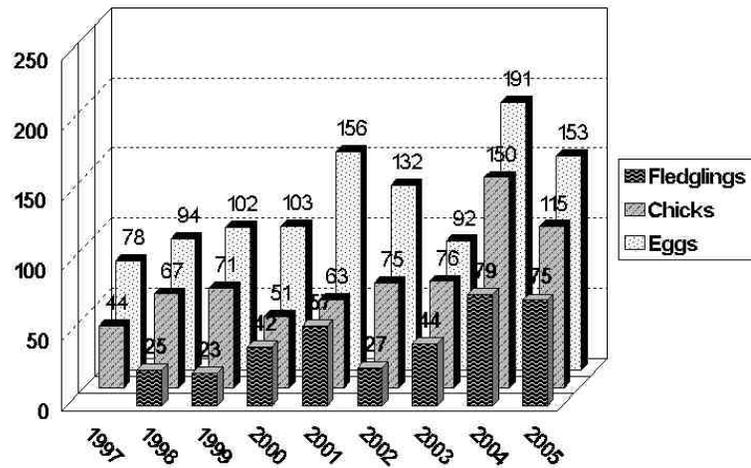
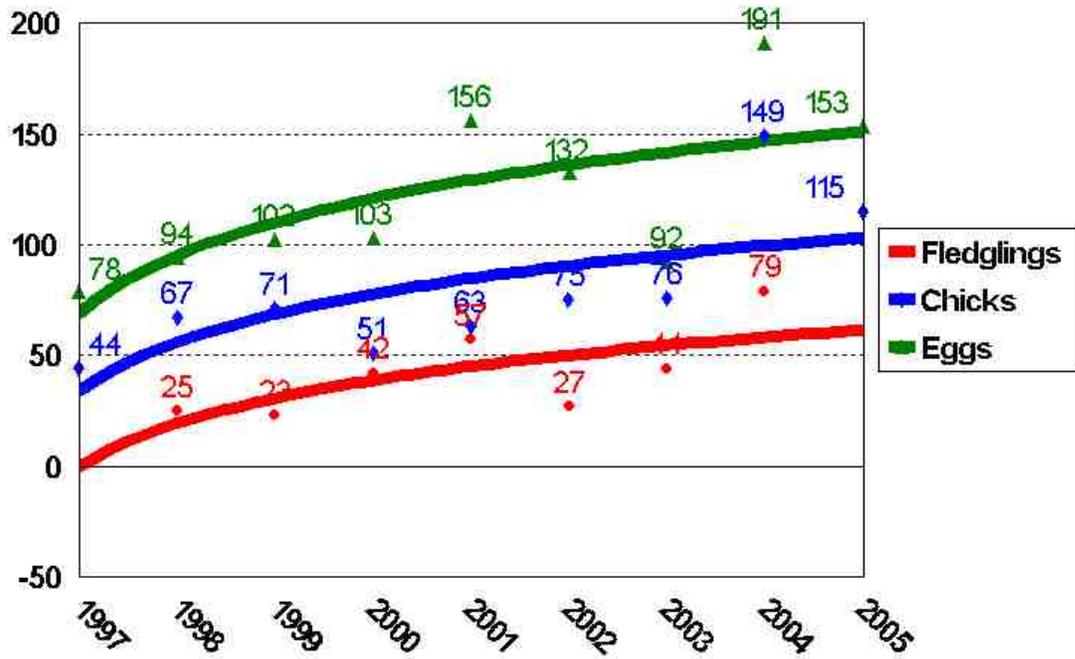


Figure 8. 1997-2005 Production Trend: eggs, chicks, fledglings

## Bolsa Chica Western Snowy Plover 1997-2005 Production Trend\*: Eggs, Chicks, and Fledglings



\* log regression

Plates

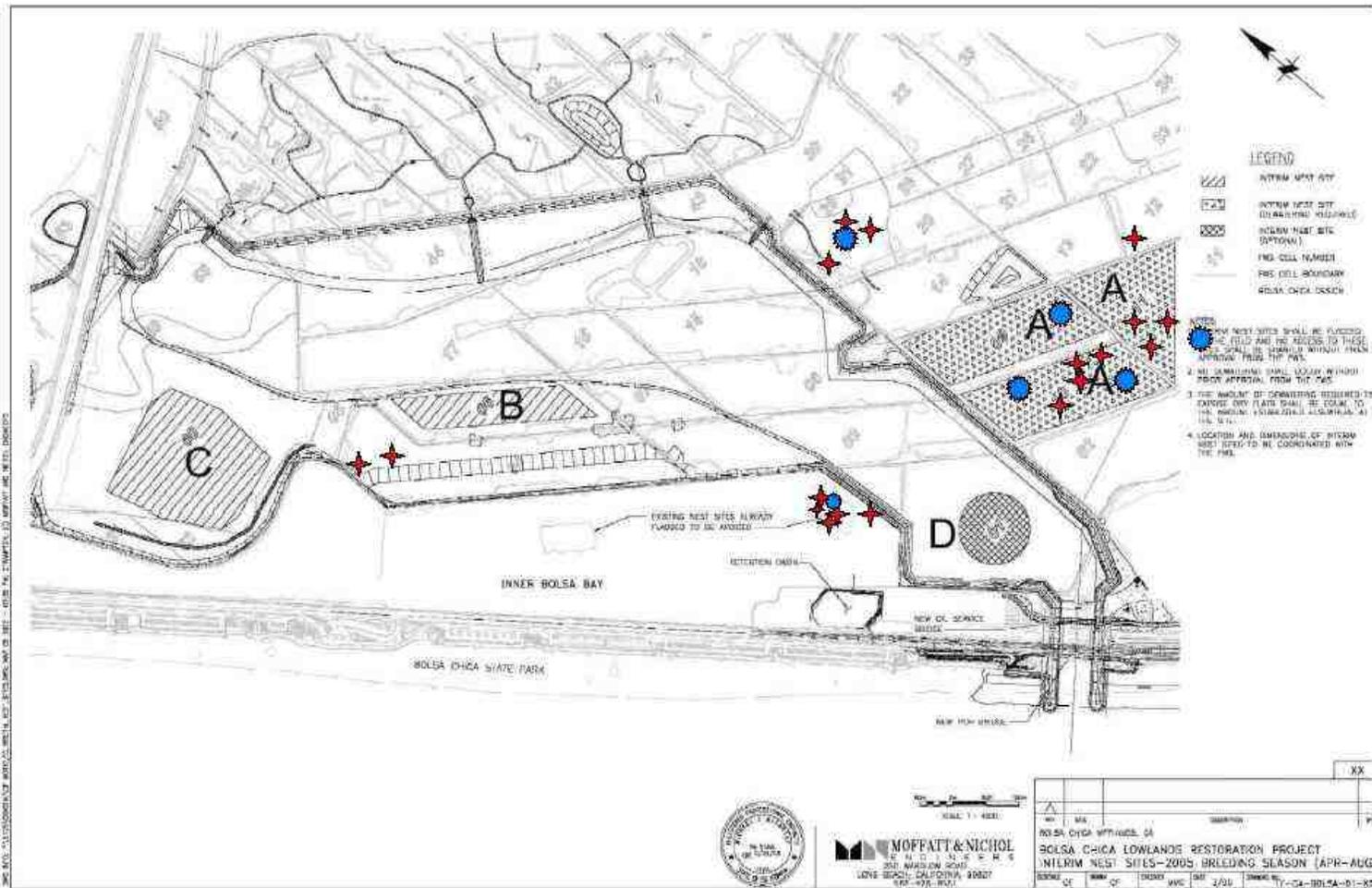
nest and brood locations

May 15, 2005

June 5, 2005

July 17, 2005

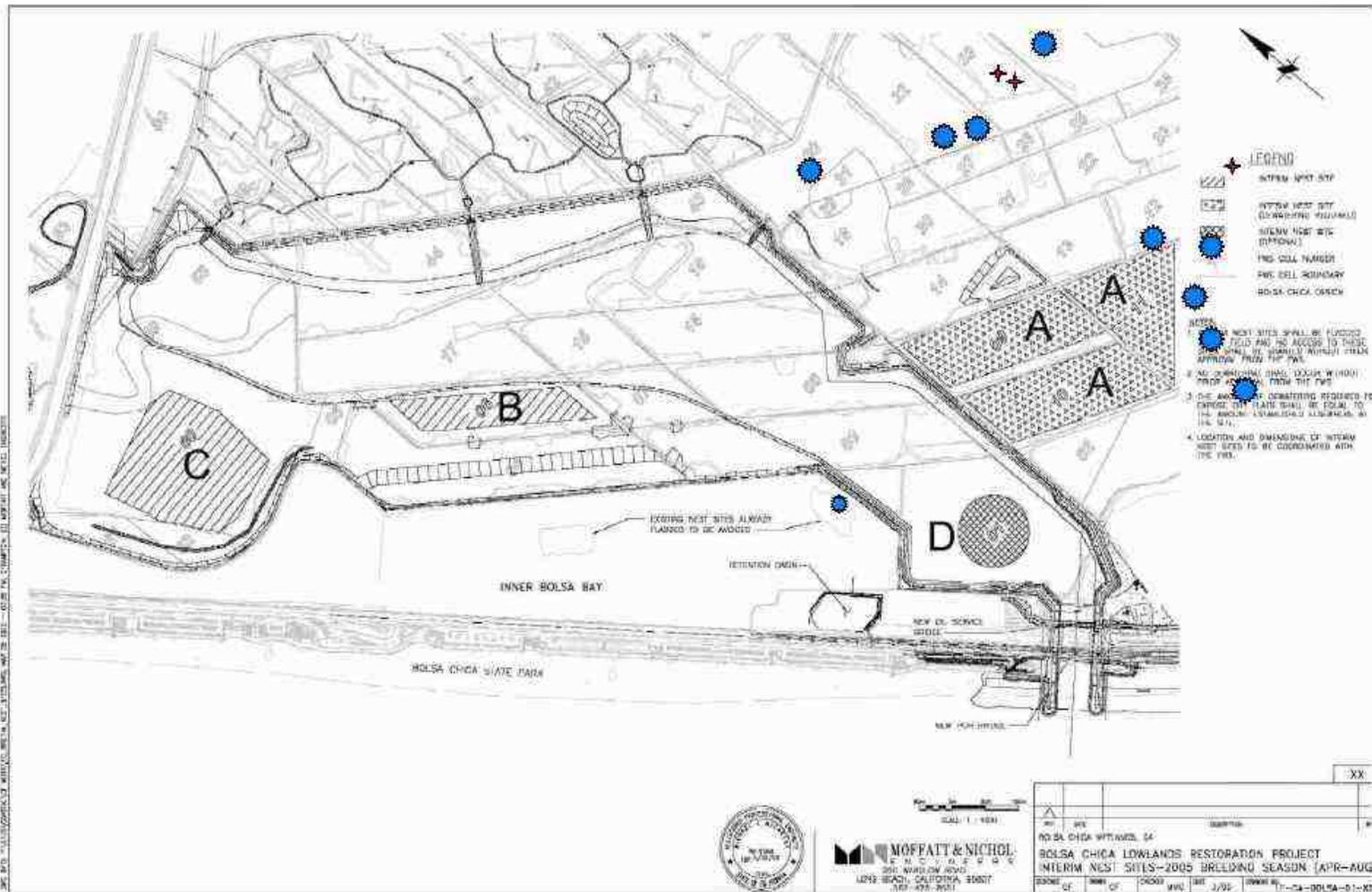




◆ Snowy plover nest location

● Snowy plover brood location

June 5, 2005



★ Snowy plover nest location

● Snowy plover brood location

July 17, 2005