



Western Snowy Plover incubating nest inside mini-enclosure near oil well photo by J. Fancher

Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 2003

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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. A restoration alternative has now been adopted and permitted. Construction of the restoration project is expected to begin 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 through construction of the Bolsa Chica restoration project. This report addresses the 2003 snowy plover breeding season at Bolsa Chica.

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.



Banded snowy plover female (RBKB)

by P. Knapp

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, thermoregulation assistance, and guide the chicks to foraging areas, but do not provide food to their chicks. Broods rarely stay in the immediate area of the nest. Young birds are able to fly within approximately 31 days of hatching.

Double brooding and polyandry are the 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.

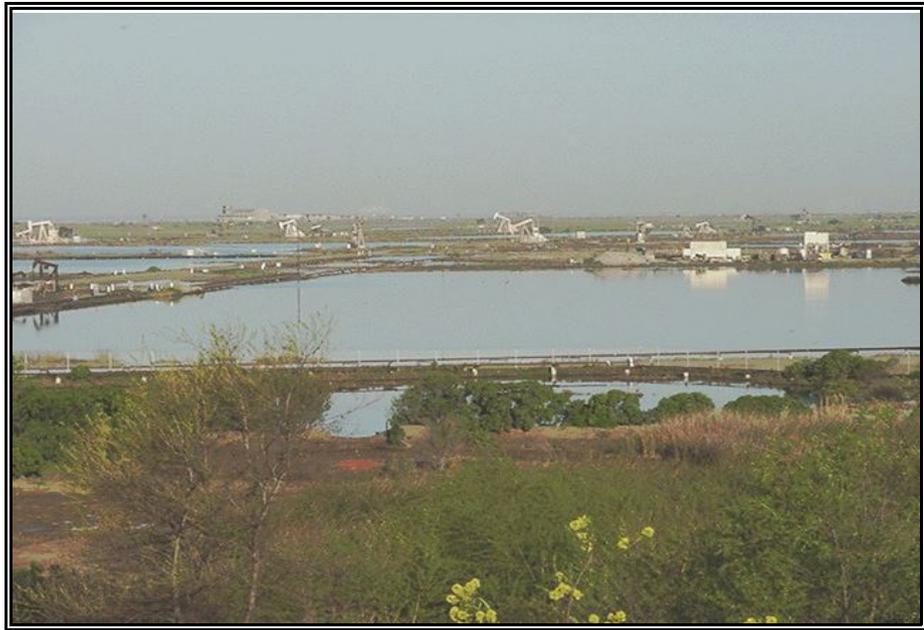
Poor reproductive success resulting from human disturbance, predation, and inclement weather, combined with permanent or long-term loss of nesting habitat to urban development and the encroachment of introduced beach grass, has led to the decline in active nesting colonies as well as an overall decline 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 2002 U.S. breeding season range-wide survey estimated 1,504 individuals. The June 2003 range-wide survey estimated 1529 individuals in coastal California (1444 birds), Oregon (63 birds) and Washington (22 birds).

Our studies from 1997-2003 have examined the scope, magnitude, and problems of snowy plover breeding activity at Bolsa Chica.

Bolsa Chica Study Area

Bolsa Chica is a lowland area between two mesas, the Bolsa Chica Mesa and the Huntington Mesa (Figure 1). While under full tidal influence 105 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 adjacent to the State's Ecological Reserve which is under a muted tidal influence that was restored in 1978 and contains two small islands created for 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.



Bolsa Chica cell 22 looking west in March 2003

by J. Fancher

Today, 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.

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 and the tidal mudflats of outer Bolsa Bay. The study area included all the numbered cells, except cells 47 and 64, which remain in private ownership.

The cells are of different 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.

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-exlosures (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.

The two islands in the Ecological Reserve, originally constructed to provide nesting area for the State and Federal endangered California least tern, *Sterna antillarum browni*, have been used by nesting least tern, other larger terns, and black skimmers. The least tern nesting activity

is typically monitored twice weekly. The observer (Peter Knapp, in 2003) uses a canoe to cross the water barrier and walks back and forth across the island to assess nest distribution and success. Snowy plover nests would be protected with an ME if possible, but least tern nest locations are only marked with a tongue depressor. Other days, observers view those parts of the island that are visible from a distance without disturbing breeding plovers or terns.

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. A crow trap was operated during May. Anchored ME's were deployed on every nest from the time of discovery until hatching, unless debris or immovable objects obstructed the deployment.

Five still cameras, with passive infrared motion detector triggers, were placed 4-5 meters from individual 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.



Mini-exclosure over snowy plover nest with camera by J. Fancher

Results and Discussion

NEST CHRONOLOGIES AND DISTRIBUTION

Although total rainfall during the 2002-2003 rainy season was average, much of it fell in March of 2003, filling the seasonal ponds with water just at the beginning of the snowy plover breeding season. The extent of exposed flats, suitable for snowy plover nesting, was severely reduced in March through May, compared to most previous years. During this time, road tops and the man-made islands for tern nesting were virtually the only dry ground in all of the Bolsa Chica lowlands. (This condition was very similar to the El Niño winter of 1997-1998, that resulted in a flooded Bolsa Chica at the beginning of the 1998 breeding season.)

In April and May, with the road tops and tern nesting islands the only dry ground available in the Bolsa Chica lowland, fifteen of the first eighteen nests were located on a road top or on the south tern island (STI) in the Bolsa Chica Ecological Reserve. STI, which is only a couple of acres in size and had in previous years been used only occasionally by nesting snowy plovers, supported nine snowy plover nests in 2003 (Figure 2). In June and July, as more flats were exposed, only two of fourteen nests were on a road top or the STI (Figure 2, Table 1). In 2003, half of all nests (17 of 32 nests) were on STI or a road top. Cells that in previous years supported half or more of all snowy plover nests, such as cells 4, 10, and 11, only supported two nests in 2003.



Road top between cell 3 and STI with loafing gulls and terns
by J. Fancher

In 2003, the first nest was found March 31. The last nest was started July 15, and the latest nest hatching occurred on August 11 (Table 1, Figure 3 and 4). Through most of April, the number of active nests was 2. In May, active nests went from 4 to 11, then peaked at 12 by the end of the month (Figure 5). A higher peak in July, such as occurred in 2001 and 2002, did not occur in 2003, possibly due to the near absence of renesting which itself was due to the near absence of nest loss.

Four nests were initiated early in the 2003 breeding season, before May 1st (13% of total nest attempts), with 13 nests (41%) initiated in May, 9 (28%) in June, and 6 (19%) in July (Figure 4). The average proportion of Bolsa Chica nest initiations by month over the 6 previous years of this study (246 total nests initiated) are: 14.2% of nests were initiated in March and April, 28.5% in May, 41.1% in June, and 16.2% in July. On average, the peak month for nest

initiations at Bolsa Chica is June, but in 2003 the June peak was weaker than average. Comparing the 2003 season to the 6-year monthly distribution of nests starts, shows a slightly above average number of nests started before May 1, but much higher than average nest starts in May. June 2003 was much below average and July 2003 was slightly above the 6-year average.

EGG, CHICK, AND FLEDGLING PRODUCTION

Out of 32 total nests in 2003, 28 were 3-egg clutches (Table 1). Four of the 32 total nest attempts were lost to predators, twenty eight nests survived to hatch (nest hatch rate of 87.5%, Figure 7), and no nests were abandoned. At least 92 snowy plover eggs were produced at Bolsa Chica in 2003, of which 12 were taken by predators and four failed to hatch. Thus, from those 92 eggs, 76 chicks were produced (Figure 8). Of these 76 total chicks, 44 chicks survived to fledge (58% chick survival or fledge rate, Table 3, Figure 7 & 8). Six broods had all three chicks survive to fledge, and four broods had no chick survive to fledge.

In 2003, with low nest loss, 76 chicks were produced. This was the highest number of chicks produced of all study years (2002-75, 2001-63, 2000-51, 1999-71, 1998-67, 1997-44) for the second lowest number of eggs produced. See Figure 8. Chick survival (44 fledglings produced) in 2003 was only lower than 2001 (Table 3). The number of fledglings produced per nest attempt in 2003 was 1.38 fl/nest, the highest of all study years. Of the 28 nests that hatched in 2003, an average of 1.57 fledglings were produced per hatched nest and chick survival was 58%. This chick survival rate is well above 1998 (37.3%), 1999 (32.4%), and 2002 (36%), while much lower than 2001 (90.5%) or 2000 (82.4%). In 2003, the average number of fledglings produced per adult male was the second highest of any previous year at 2.8 (44 fledglings and 16 males). In 2001, it had been 3.2 fl/male, while the lowest was 1.4 fl/male in 2002.

NUMBERS OF MALE, FEMALE, AND JUVENILE SNOWY PLOVERS

During the winter it is not uncommon to find many more snowy plovers out on the adjacent beaches than within the wetland area. In March 2003, about 20 snowy plovers were seen in the Bolsa Chica wetlands when one nest was initiated. In early April, total birds fluctuated between about 20 and 35, while only between 1-6 were identified as males. The gender of the largest portion of these birds was not determined. In April, when the next three nests were initiated, there were between 2 and 12 females and between 2 and 13 males present (Figure 3). Through May, with active nests climbing from 4 to 12, there were between 7-15 females and 8-16 males. The U.S. range-wide window survey report for Bolsa Chica was May 28 when there were 16 male and 15 female adults, and 12 active nests. This is about the same as 2000 and 10-20% lower than 2001 and 2002.

During most of April and May of 2003, the total number of snowy plovers present at Bolsa Chica was between 20 and 40 (Figure 6). Starting in late June, with the increasing presence of juveniles and migrating plovers, the total number of plovers at Bolsa Chica swells to between 60 and 80 individuals. This pattern is very similar to previous years.

BROOD TRACKING

We again observed that females did virtually all of the observed incubation of eggs and males did most of the brood rearing. (No nocturnal observations were made, however.) Sometimes the male was seen to take over incubation of eggs just prior to the hatching of the clutch. Typically, the male tends to the brood, although in 2003 we observed five instances of the female staying with the brood until the chicks fledged. 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.

In 2003, eight of 13 broods that hatched within a cell were found regularly in brood rearing areas within the same cell. Conversely, five broods that hatched within one cell were moved across a road to another cell. Nine broods hatched on the STI, with five of those broods staying there until fledging. Two STI broods disappeared and were presumed lost to predators on STI but may have been lost while relocating elsewhere. Two STI broods successfully negotiated the water surrounding STI to relocate to other cells. Of six broods hatched from a road top location, four relocated to a cell by moving along and across roads and two were lost to predation or lost while moving away from the nest site. One "road-top" brood (nest #16 hatched June 17) was observed making a move the day after hatching on the road shoulder between cells 12 and 22. Over the course of 70 minutes the two adults guided the 3 toddling chicks along the road bypassing several cells (12, 13, 14, 22 had only narrow fringes not covered by water) a total of about 3500 feet to enter cell 9 from the south. The male with the brood on the road between cells 9 and 11 were harassed by snowy plover males coming out of the south end of cell 9 defending their brood territories. Dense growth of weeds and/or pickleweed along most road banks may also have prevented the brood from entering cell 9 at the earliest opportunity. This incident suggests that the adult probably scouted for suitable brood territory and then guided the brood there. Two "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.

OBSERVATIONS OF BANDED ADULTS

Four banded snowy plovers (three females and one male) nested at Bolsa Chica in 2003. 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). A female hatched at Bolsa Chica in 1999 (YNRR♀) nested twice at Bolsa Chica in 2000 and again twice in 2001. YNRR♀ nested once at Bolsa Chica in 2002, but this nest was abandoned. In 2003, she nested successfully one time at Bolsa Chica (nest 3, STI). Another female (RBKB) nested once unsuccessfully on Road 1/3 in 2003. She was banded as an adult at Camp Pendleton in 1998, nested there in 1998 and 1999. She nested there again in 2000, but appeared at Bolsa Chica in June 2000 where she hatched one brood. She was not seen at Bolsa Chica in 2001 and 2002. A male (RBRPink) was found with a new brood in cell 18. This male hatched at Moss

Landing in 2001. A female with a repeated history of nesting at Bolsa Chica from 1998-2002 (YKGY) was not seen in 2003.

Some other banded snowy plovers were seen passing through Bolsa Chica in 2003: RRBW April 9, July 11 and 14, YNGW April 12 (nested at Bolsa in 2002 and 2001), BBWY May 2, GBKB June 12-27, RWKY July 12-17 with slight limp, RROY July 12, OOA0 July 12, øK øg/y-split July 13, øG øy/k-split and øA øy/g-split July 14, r/k-split metal ø ø July 14, øK øg/w-split and øY øy/g-split July 17, BBRW July 30, YGAO July 31, and WOBB August 23.



Skunk patrols past unoccupied ME

PREDATION

In 2003, just 12.5% of all nests (4 of 32 nests, 0 abandoned, Table 2), were lost to predation. Nest loss/egg predation was highest in 2001 of all study years in both raw numbers and proportion of total nests. The 2003 breeding season ranks lowest in these loss-rate categories and highest in nest hatch rate. This low rate of nest loss is attributable to the deployment of MEs. The proportion of nests hatching (87.5%) and fledglings produced per nest (1.32) were higher than all previous years (Figure 7).

Disturbance signs were absent from three of the four predated plover nests, all of which were protected by an ME. Two of these lost nests had no camera trained on them and no physical evidence of the likely predator other than it was a creature that could either enter or reach into the ME to steal the plover eggs. In the other two cases, a camera was aimed at each ME-protected nest that was lost to a predator. In one case, there was no detectable disturbance around or within the ME and the camera did not fire. The predator



Small mammal digging marks around ME by P. Knapp

was either small enough to enter the ME and stay below the motion detection plane of the camera (perhaps a ground squirrel or gopher snake) or the camera malfunctioned.

In the last case, small mammal digging marks in the ground surface around the outside of the ME suggested a skunk was the culprit. However, the camera failed to fire during this episode, probably due to battery failure. Claw marks on the ground inside the ME indicated the adult skunk also reached toward the plover eggs through the mesh of the ME. The skunk did not dislodge or deform the ME, so must have been able to eventually rake the eggs from the nest scrape without breaking them. However, it is also possible that juvenile skunks, arriving after the adult had attempted the digging, entered the ME through the 2" x 3" openings. Due to the detection of a skunk in the area via another camera, and the digging marks at this lost nest, a drop-door trap was deployed nearby and a striped skunk was captured a few days later.

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 (Table 6). As in previous years, crows were removed from Bolsa Chica starting in March. One hundred eighteen crows were removed from Bolsa Chica in 2003 (Ross 2003). However, the tally of crows removed from Bolsa Chica in the last three years, greatly understates the actual problem for nesting snowy plovers. Many crows apparently learn to avoid our removal efforts by moving back and forth between the wetland and safe refuge of the adjacent urban areas. The adjacent urban area may also have such a large “reservoir” of crows to replace the Bolsa Chica intruders that removal is practically ineffectual.



Crows loiter on shed within Bolsa Chica

By P. Knapp

We set up a modified Australian crow trap in late April 2003, located between cells 13 and 14. The crow trap appeared to attract more crows to the area than were ever induced to enter it and its use was discontinued in May.

We placed an ME on each nest as soon as the nest had been discovered. Four nests were not protected by an ME and successfully hatched. Two of these nests were located under curved clay roofing tiles placed on STI as least tern chick shelters and placing an ME was not feasible. Two other successfully hatched nests were identified only after the newly hatched broods were seen. For the most part, no attention by any potential predator was recorded or observed to be given to an ME. We conclude that there is, overall, large nest protection benefit that results from utilizing this ME design at Bolsa Chica.

The most likely reason for high chick mortality in 2003, compared to 2001 and 2000, is the principal snowy plover chick predators, kestrels and shrikes, had re-occupied areas or were more abundant than in previous years. Our 2003 predator management response to kestrels and shrikes (live capture and transport) was no less intense than in the earlier years. We removed five loggerhead shrikes and 5 American kestrels from Bolsa Chica in 2003. Perhaps our response was not sufficiently timely or effective given the large number of small snowy plover chicks that one or two of these birds can take in a relatively short time. For example, on June 27, three juvenile loggerhead shrikes were seen around cell 3. All known snowy plover chicks (23) at that time were within about 0.25 mile radius. Three shrikes were captured the next day. On June 29, additional shrikes were seen, shrike captures attempts were continued, but the traps were ignored. A snowy plover chick was actually observed being killed by a shrike. One more shrike was removed that day. Snowy plover chicks were estimated at about 20 in that area the next day. Thus, apparently, over a period of just a few days, and despite the best efforts to defend the snowy plover chicks from the shrikes, about 13% of snowy plover chicks were lost.

Some nocturnal predation of plover chicks may have resulted from striped skunk activity in the vicinity of nest. Three gull-billed terns, *Sterna nilotica vanrossemei*, were seen at Bolsa Chica in early June but no plover predation was thought likely during their brief visit.

Predator management efforts at Bolsa Chica have been increased in the last several years with emphasis on matching the response effort and removal method to the threat to breeding snowy plovers posed by the predator and an appropriate regard for the predator. Consequently, we still have taken no action against large hawks, owls, peregrine falcon, or coyote. (To protect least tern and other breeding terns, a peregrine falcon may occasionally be live-captured at Bolsa Chica and transported away. None were captured at Bolsa Chica in 2002 or 2003.) Crows remain a major problem because of the seemingly endless supply of them entering Bolsa Chica from the adjacent urban area. Continued and increasingly aggressive crow management appears warranted unless the introduction of West Nile Virus into Orange County in late 2003 reduces the indigenous crow population. Kestrels seem to be relatively abundant, regularly present at Bolsa Chica, and can do harm to many small chicks very quickly. Therefore, efforts to remove them from Bolsa Chica during the snowy plover breeding season must continue. Shrikes are not abundant, however a few shrike foraging territories cover large portions of Bolsa Chica snowy plover breeding areas. It is not clear that shrikes can or will capture larger snowy plover chicks, but plovers are greatly agitated by the presence of a shrike and small plover chicks are taken. We conclude that continued live-trapping and transport of shrikes from Bolsa Chica during the breeding season is warranted.

SNOWY PLOVER AND LEAST TERN ON THE SOUTH TERN ISLAND

Breeding snowy plovers shared the STI with breeding least terns during the 2003 breeding season. The least tern is a fish-eating, loosely-colonial ground nesting, water-associated bird that seeks largely unvegetated, light-colored sandy substrates for nesting. An estimated 53 least tern pairs produced about 60 fledglings on STI in 2003. During early May larger terns (especially Caspian and elegant terns) attempting to initiate nests on STI were being hazed away by the nest site monitor. (The high densities and bullying tactics of the larger birds

can exclude least tern and snowy plover. The larger birds settled on the north tern island.) By mid-May, 7 of 9 plover nests had already been initiated and least tern started to initiate nests on STI. By June, when plover nests hatched and brood territories were being defended, between 20-25 least tern nests were interspersed among the 4-5 plover brood territories. One plover nest initiated in late June, successfully hatched but the brood simply disappeared. These plover chicks may have been taken by a predator or expired while in transit to another location.

The plover males defended their brood territories against other plover males and their broods, but ignored the incubating least tern. No signs of antagonism between least tern and snowy plover were noted. Two snowy plover broods that hatched on STI were led across the water to brood territories in other parts of Bolsa Chica. These two broods may have left the island because the tending male could not carve out a brood territory against other aggressive plover males. It is also possible that an unobserved predation threat or disturbance caused those plover broods to be guided off the island, but it appears improbable that the numbers of incubating least tern and fledglings had anything to do with their departure.

SUMMARY

Average, but late winter/early spring rainfall in 2003 resulted in very little exposed flats early in the breeding season. The number of males and females was about the same as 2000 but 10-20% lower than in 2001 and 2002. Total nest attempts were slightly lower than 2000, 1999, and 1998, while much lower than 2001 and 2002. Deployment of mini-exlosures (ME) on nearly every plover nest, to prevent egg loss to crows and ravens, was conducted. The MEs virtually eliminated nest predation. Three ME protected nests were lost to an unknown egg predator that neither left signs nor dislodged the ME. One clutch of 3 eggs in an ME-protected nest was taken by a striped skunk.

More chicks hatched in 2003 than in any prior year of this study at Bolsa Chica. However, only 58% of chicks survived to fledge which ranks only third best behind the 2000 and 2001 seasons. The fledglings to male ratio was high (2.8), as was fledglings per nest (1.38). The chick predators are primarily American kestrels and loggerhead shrikes.

Acknowledgments

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Tables

Table 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2003

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Figure 5. 1997-2003 Active Nest Chronologies

Figure 6. 1997-2003 Total Individuals

Figure 7. 1997-2003 Snowy Plover Nest and Fledgling Production Parameters

Figure 8. Egg, Chick, and Fledgling Production 1997-2003

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U.S. Fish and Wildlife Service, Corps of Engineers, and State Lands Commission. 2001. Final environmental impact report/environmental impact statement for the Bolsa Chica Lowlands Restoration Project. April 2001. Appendices A-H and Volumes I-VI.

Table 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2003.

Nest #	Cell #	date found	date ended	eggs	nest fate	chicks	fledglings
1	STI	3-31	5-6	3	H	2*	0
2	RdSTI/3	4-19	5-21	3	H	3	0
3	STI	4-29	5-29	3	H	3	3
4	Rd12/22	4-30	5-20	3	H	3	1
5	STI	5-7	6-3	3	H	3	3
6	STI	5-7	6-3	3	H	3	2
7	1	5-9	6-5	3	H	2*	1
8	STI	5-12	5-22	3	H	3	2
9	STI	5-12	6-9	2	H	2	2
10	RdSTI/3	5-12	6-13	3	H	3	1
11	10	5-15	6-12	2	H	2	1
12	RdSTI/3	5-16	6-1	3	P	-	-
13	STI	5-17	6-13	3	H	3	2
14	Rd1/3	5-27	6-15	3	P	-	-
15	4	5-28	6-24	3	H	3	2
16	Rd22/12	5-28	6-26	3	H	3	3
17	RdSTI/3	6-1	6-29	3	H	3	2
18	STI	5-29	6-24	3	H	3	0
19	6	6-9	7-11	2	H	2	1
20	9	6-9	7-9	3	H	3	3
21	9	6-11	7-8	3	H	3	3
22	9	6-24	7-21	3	H	3	1
23	STI	6-24	7-17	3	H	3	0
24	3	6-26	7-25	3	H	2*	2
25	3	7-6	7-31	3	H	3	1
26	10	not confirmed	as a nest	-	-	-	-
27	9	7-9	7-15	3	P	-	-
28	9	7-10	8-2	3	H	3	1
29	18	(6-11)	7-9	3	H	3	3
30	RdSTI/3	7-12	8-11	3	H	2*	2
31	19	7-13	8-1	3	H	3	1
32	9	7-15	8-4	3	P	-	-
33	18	(6-19)	7-17	2	H	2	1
2003 Season Totals 32 total nest attempts				92	4P 28H 0A	76	44

* one egg abandoned P = predated; A = abandoned; H - hatched (date) = backcast from discovery of brood

Table 2. 2003 Nest and Fledgling Distribution by Cell

<u>Location</u>	<u># total nests</u>	<u># nests lost</u>	<u># nests hatched</u>	<u># fledged</u>
cell STI	9	0	9	14
9	6	2	4	8
RdSTI/3	5	2	3	5
Rd12/22	2	0	2	4
18	2	0	2	4
3	2	0	2	3
<u>other cells</u>	<u>6</u>	<u>0</u>	<u>6</u>	<u>6</u>
	32	4	28	44

STI = South Tern Island RdSTI/3 = road between STI and cell 3 Rd12/22 = road between cells 12 and 22

Table 3. Males, Females, Nests and Fledgling production rates

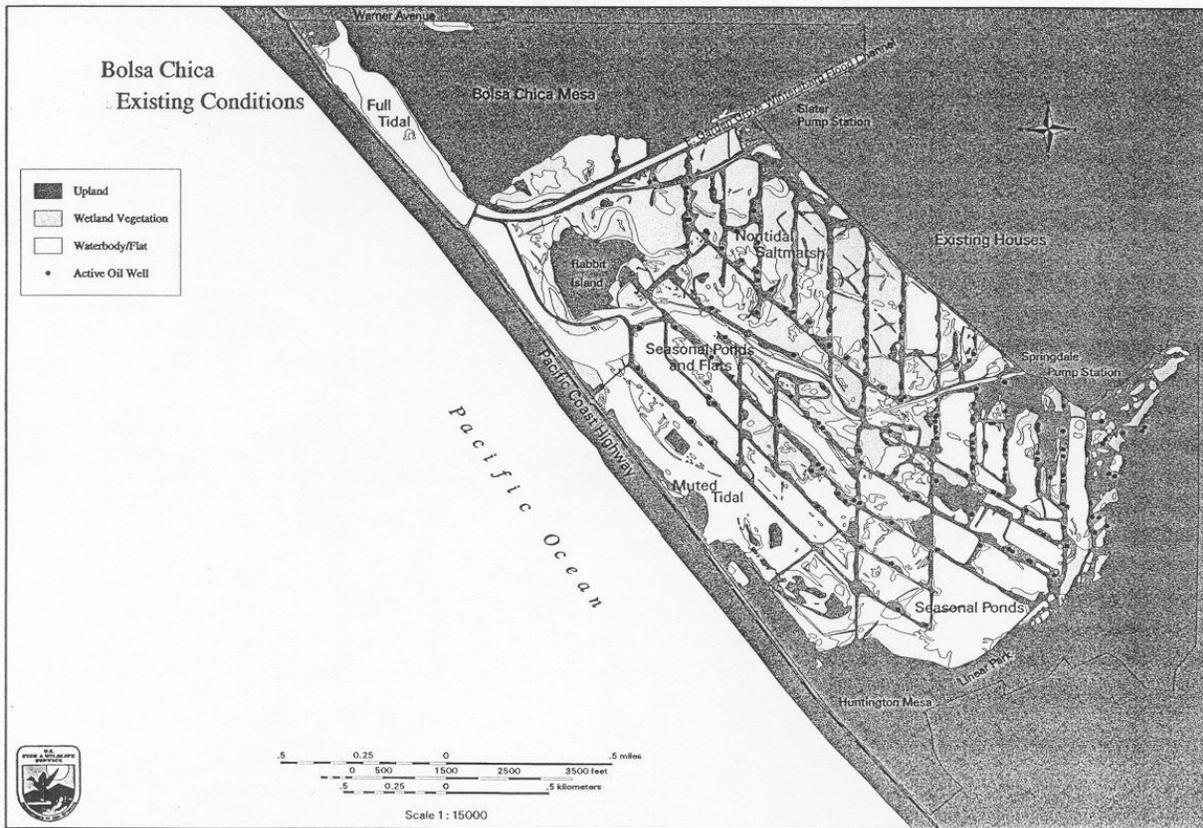
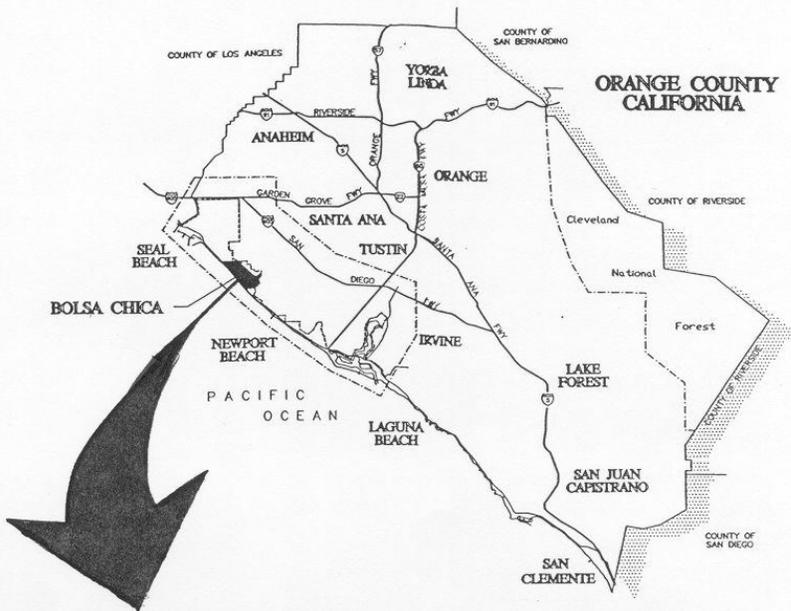
	<u>Fem</u>	<u>Males</u>	<u>Total Nests</u>	<u>Total Chicks</u>	<u>% Nest Hatch</u>	<u>Total Fledglings</u>	<u>Fledglings per nest</u>	<u>% Chick survival</u>	<u>Fledglings per male</u>
2003	15	16	32	76	88	44	1.38	57.9	2.8
2002	19	20	50	75	68	27	0.54	36.0	1.4
2001	19	18	55	63	45	57	1.04	90.5	3.2
2000	15	16	39	51	51	42	1.08	82.4	2.6
1999	12	11	38	71	71	23	0.61	32.4	2.1
1998	11	16	34	67	62	25	0.74	37.3	1.6
1997	14	20	30	44	53	nd	nd	nd	nd

F1 = fledglings nd = not determined

Table 4. Bolsa Chica Predator Removal Summary

	<u>2003</u>	<u>2002</u>	<u>2001</u>	<u>2000</u>	<u>1999</u>	<u>1998</u>	<u>1997</u>
American crow	118	52	80	91	27	1	2
American kestrel	5	12	13	15	46	14	2
Loggerhead shrike	5	3	6	2	5	0	0
Common raven	4	5	6	3	2	0	0
skunk	1	-	-	-	-	-	-
coyote	-	-	-	-	-	-	-
weasel	-	-	-	-	-	-	-

Figure 1.



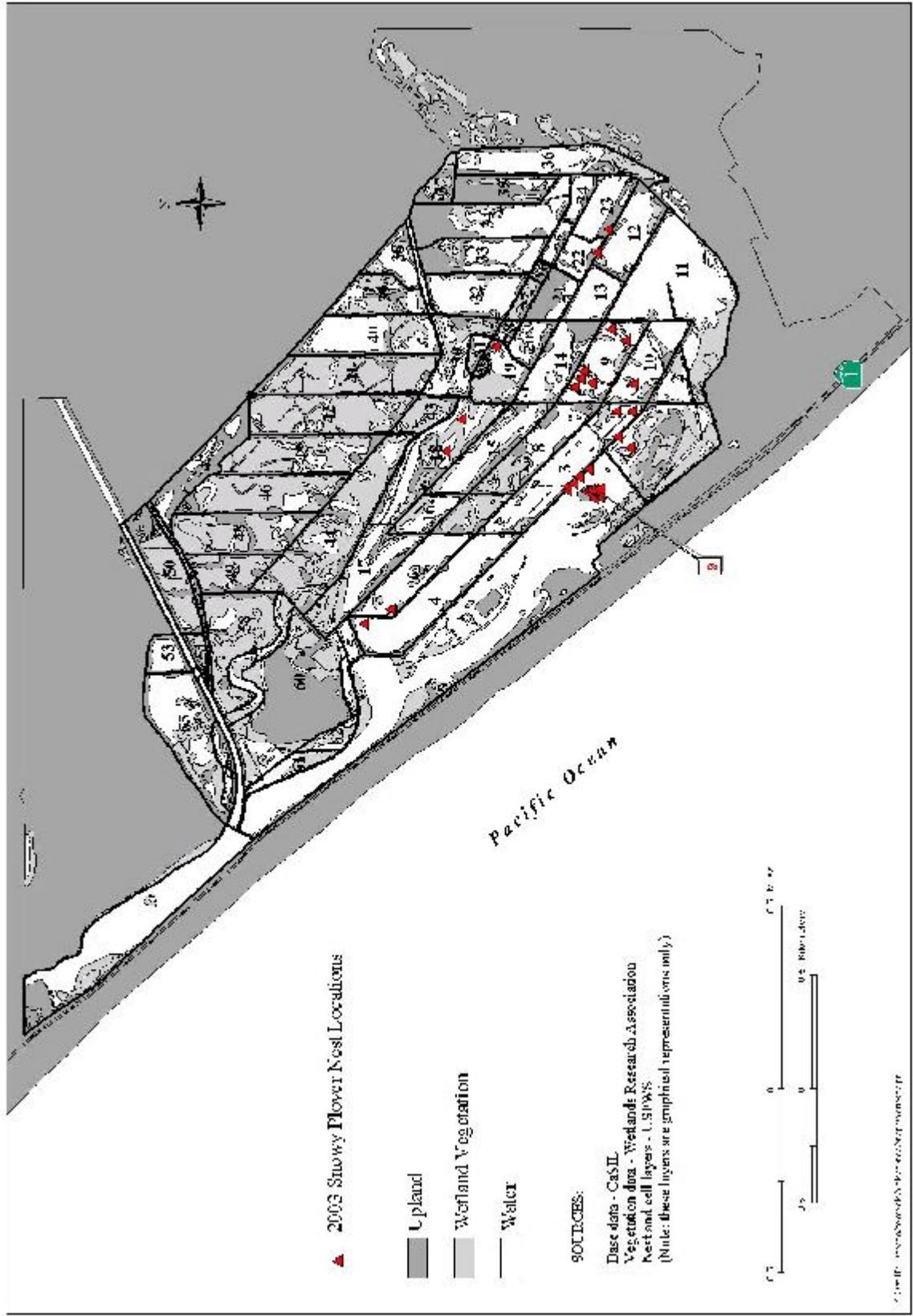


Figure 2 2003 Snowy Plover Nest Locations at Bolsa Chica

Western Snowy Plover

Bolsa Chica 2003 Survey

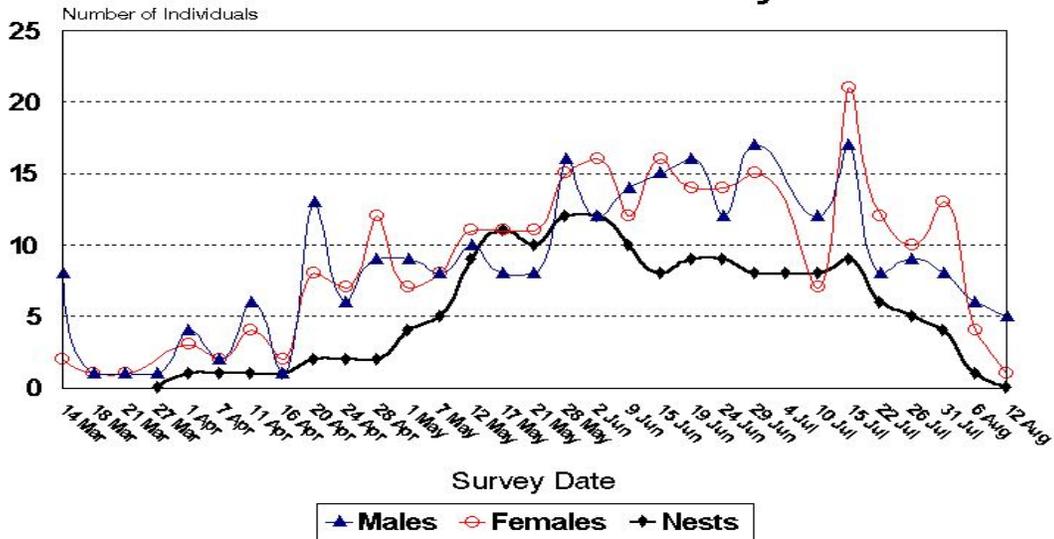


Figure 3 Active nest and breeding adult chronology at Bolsa Chica 2003

Western Snowy Plover - Bolsa Chica 2003

Nest Initiation, Hatching, & Loss Dates

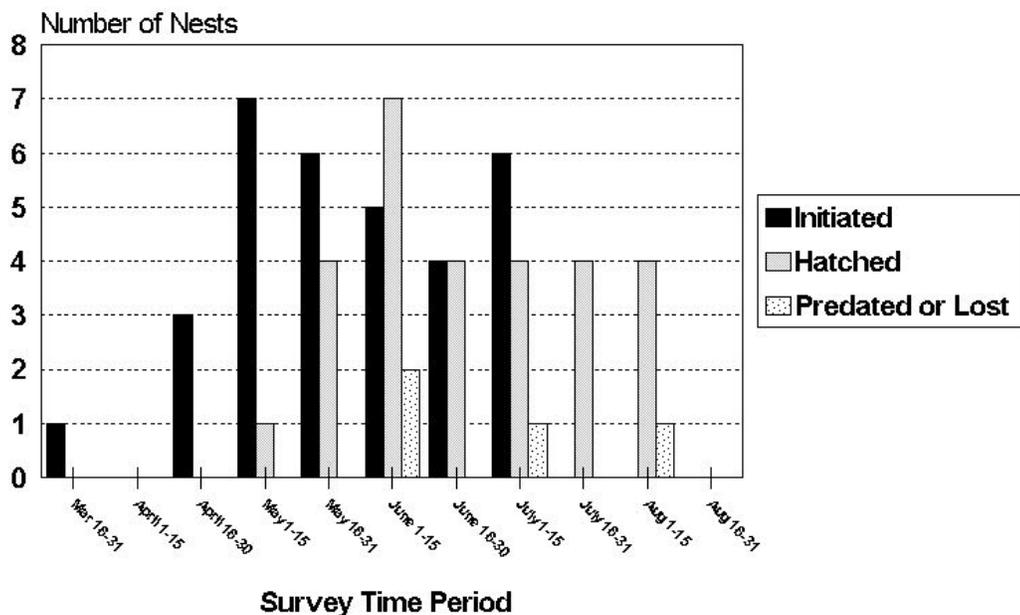


Figure 4. 2003 Nest Initiation, Hatching, and Loss Dates

Figure 5

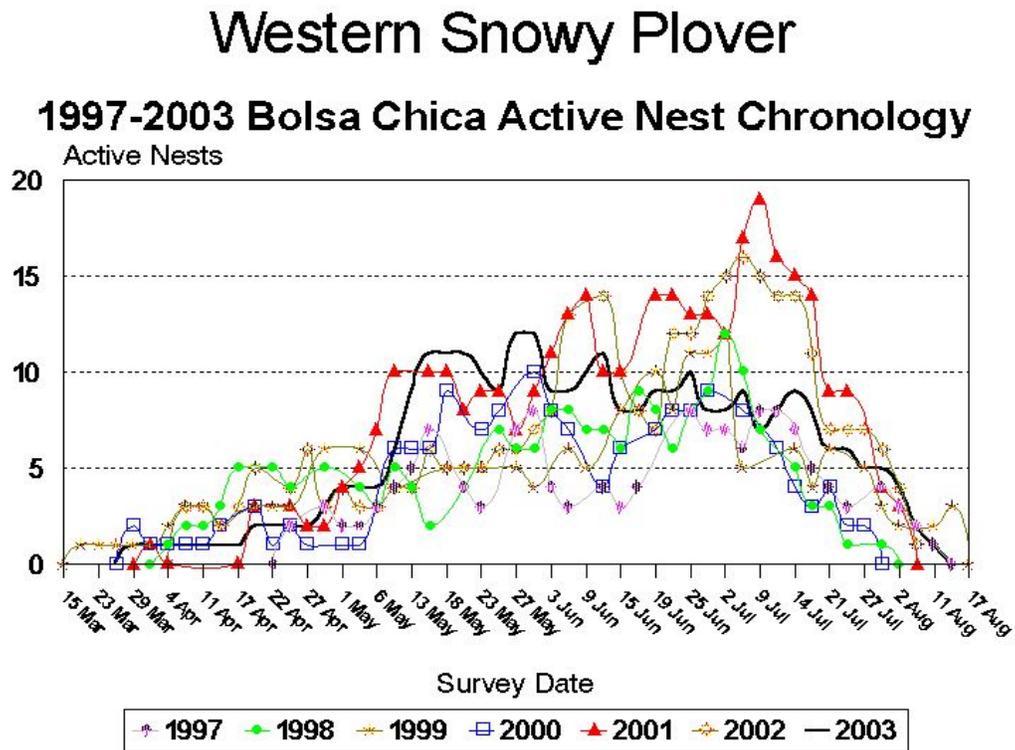


Figure 6

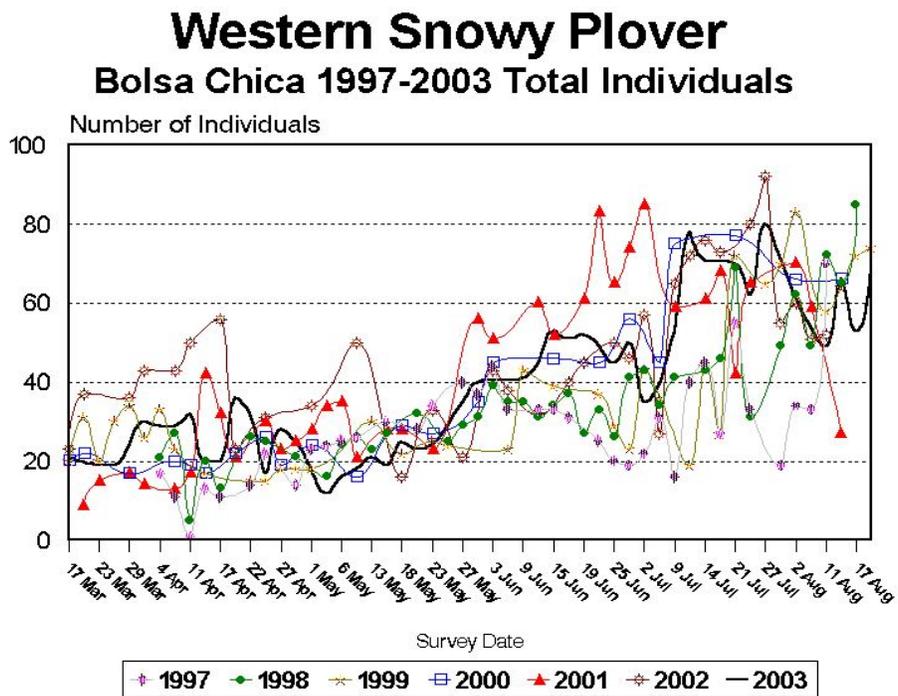
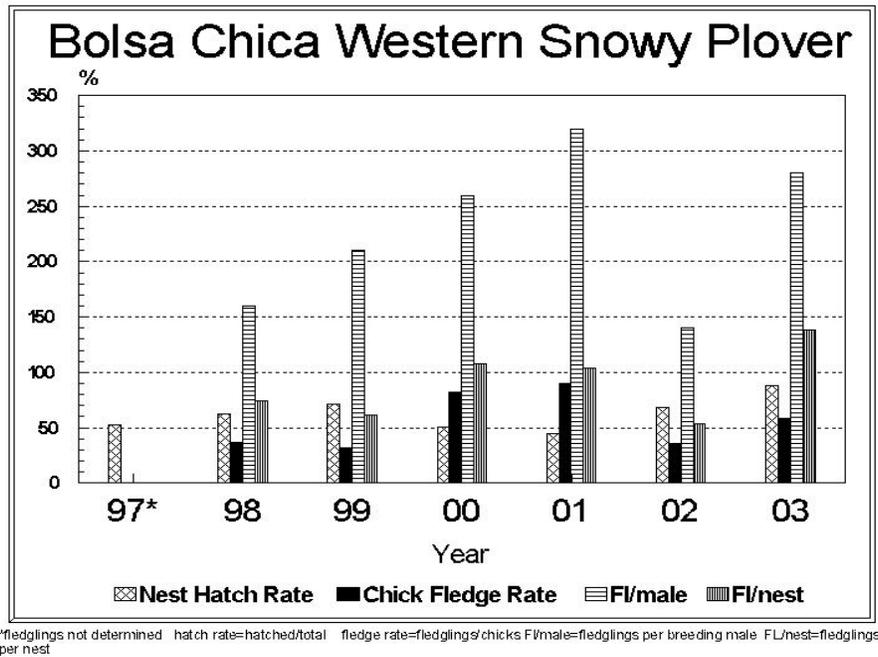


Figure 7 1997-2003 Snowy Plover Nest and Fledgling Production Parameters



Bolsa Chica Western Snowy Plover Egg, Chick, and Fledgling Production 1997-2003

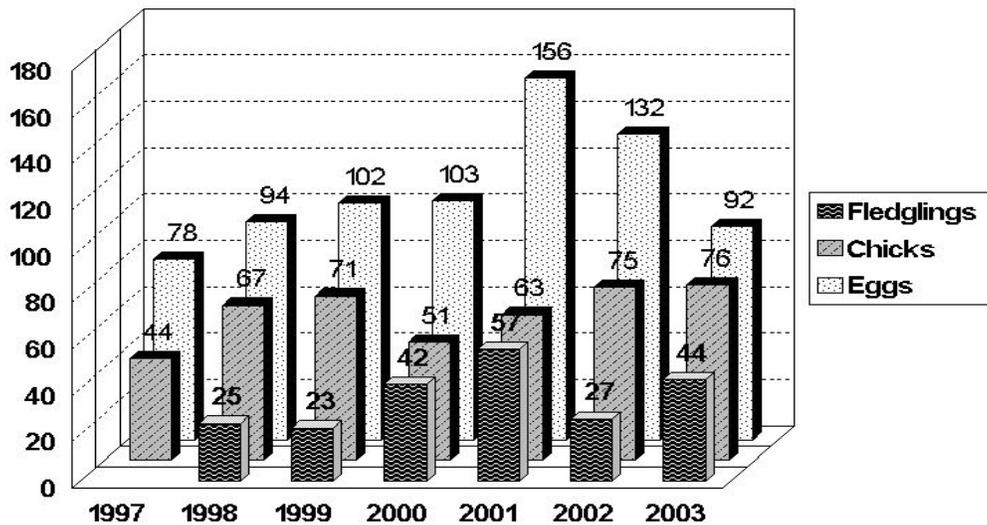


Figure 8