



Photo by J. Fancher

**Western Snowy Plover Nesting
at Bolsa Chica, Orange County, California
1999 and 2000**

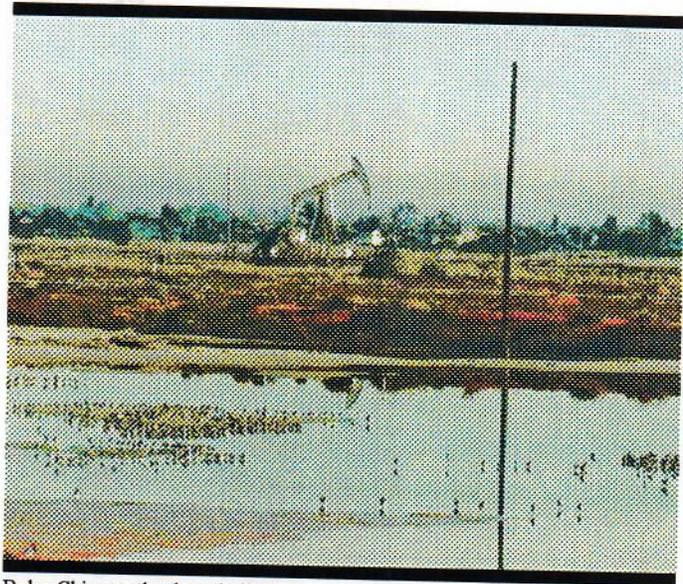
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Fish and Wildlife Service
Carlsbad Office
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Introduction

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. Most of these lowlands are a severely impaired, historically tidal, wetland ecosystem and operating oilfield.



Bolsa Chica wetlands and oilfield

Photo by J. Fancher

The purpose of this investigation was to improve the level of knowledge about the western snowy plover a sensitive species that currently uses Bolsa Chica. This improved knowledge was used to consider and protect the western snowy plover in the formulation of restoration alternatives at Bolsa Chica and during construction of the adopted restoration plan (draft EIR/EIS for the Bolsa Chica Lowlands Restoration Project, July 2000). This study was implemented in 1997 and continued through 2000. The 1997 and 1998 breeding seasons study results were reported previously (Fancher 1998, Fancher *et al.* 1998). The 1999 and 2000 breeding season results are the principal subject of this report.

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 Pacific coast population of the western snowy plover is reproductively isolated from the interior populations. 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 western snowy plover extends along coastal beaches from the southern portion of Washington State to southern Baja California, Mexico. The coastal population of the western snowy plover consists of both resident and migratory birds (Warriner *et al.* 1986). In southern California, some snowy plovers spend the winter in the same areas used for breeding, while other birds relocate to and from other coastal breeding sites (Collier and Powell 2000).

Sand spits, dune backed beaches, sparsely to unvegetated beach strands, open areas around estuaries, and beaches at river mouths are the preferred coastal nesting areas of the

western snowy plover. Other areas used by nesting western snowy plovers include dredge spoil fill, dry salt evaporation ponds, and salt pond levees (Wilson 1980, Page and Stenzel 1981). Nest sites typically occur in flat, open areas with sandy or saline substrates with little or no vegetation (Page and Stenzel 1981). Most western snowy plover breeding adults are site faithful, returning to the same breeding location in subsequent breeding seasons.

The breeding season of the western snowy plover extends from March 1 through September 15. Egg laying begins in mid-March and continues through late-July. Generally, 3 eggs are laid in a nest which consists of a shallow depression scraped in sandy or saline substrates. Some nests are lined with plant parts, small pebbles, or shell fragments. Incubation does not begin until the full clutch is laid and continues for 26-32 days with an average of 27 days before eggs are hatched. Both sexes incubate the eggs. Snowy plovers will renest after loss of a clutch or brood (Warriner *et al.* 1986).



Western snowy plover male adult and chick

Photo by J. Fancher

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 (Warriner *et al.* 1986). Young birds are able to fly within approximately 31 days of hatching.

Double brooding and polygamy have been observed in snowy plovers along coastal California (Warriner *et al.* 1986). If polygamous, snowy plover females may abandon chicks as young as 6 days old to find another mate. This leaves the male as the only adult to care for the brood (Warriner *et al.* 1986). Males attend their young for 29-47 days (Warriner *et al.* 1986). Renesting may occur within the initial nesting area or snowy plovers may move to another nesting site (Warriner *et al.* 1986, Collier and Powell 2000).

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. Page *et al.* (1981) observed western snowy plovers moving between salt pans, tidal flats, and beaches indicating these areas function together in providing habitat for the species.

Human disturbance can interfere with normal western snowy plover behavior. Disturbances to incubating adults can leave nests exposed to extreme temperatures resulting in non-viable eggs. Western snowy plover chicks which are separated from their attending adult as a result of human disturbances or predators may become more susceptible to hypothermia since young chicks are less able to thermoregulate.

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 beachgrass, 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** species on March 5, 1993 (58 Federal Register 12864).

The proposal to designate western snowy plover Critical Habitat was published on March 2, 1995 (60 FR 11768) and the Final Rule designating western snowy plover Critical Habitat was published December 7, 1999 (64 FR 68508). No area of Orange County was designated Critical Habitat for the coastal population of the western snowy plover. Bolsa Chica was not designated for two principle reasons, a) the property had been acquired for habitat conservation and restoration purposes, b) recovery plans for the critically endangered light-footed clapper rail, *Rallus longirostris levipes*, may be in conflict with western snowy plover Critical Habitat designation in restorable diked salt pond areas.

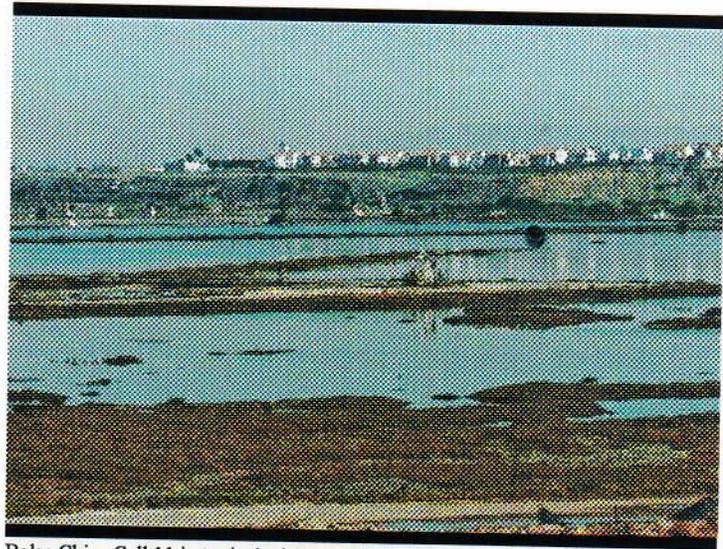
While there were no observations of western snowy plover nesting in Los Angeles County in the last ten years, incidental observations of western snowy plover breeding in Orange County have been noted. For example, a single nest was observed inside the California least tern nesting area at Huntington State Beach in 1993 (Doreen Stadtlander, pers. comm.). Year-round bird counts in 1992-1993 at Bolsa Chica indicated low numbers of nesting western snowy plover and larger numbers of winter migrants (Guthrie *et al.*, 1993). In a single day of observation at Bolsa Chica in June 1995, 8 nesting pairs were estimated (Lee Jones memorandum 1995).

Regular (weekly) surveys specifically for western snowy plover nesting at Bolsa Chica were conducted for the first time in 1996 (Guthrie 1996). That study estimated 33 nest attempts and reported a maximum of 27 individuals in September. In 1997, 30 total nests were identified between April and August with a maximum of 8 nests at any one time (Fancher 1998). In that same year, the breeding population in May was estimated to be 20 males and 14 females, with the total number of western snowy plovers present at Bolsa Chica climbing to nearly 70 individuals in August with the influx of migrants. In 1998, 34 total nests were located, with a peak of 12 nests active at one time in July. The May breeding population was estimated as 16 males and 11 females. In August, the total number of snowy plovers at Bolsa Chica varied between 50 and 85 individuals (Fancher *et al.* 1998).

Bolsa Chica Study Area

Bolsa Chica, while under full tidal influence 100 years ago, is now diked-off from direct tidal influence. The State's Ecological Reserve, adjacent to but not within the study area, is under a muted tidal influence that was restored in 1978. Bolsa Chica is a lowland area between two mesas, the Bolsa Chica Mesa and the Huntington Beach Mesa (Figure 1). An oil field has operated there since the late 1940's. Its soils and groundwater are highly influenced by salt of ocean origin and most of the study area remains below mean sea level.

Today, the approximately 900-acre study area, with its criss-crossing 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 now are not actively disturbed. This has resulted in three general surface conditions within the cells of the study area: 1) thickly vegetated with salt marsh plants, 2) unvegetated flats, and 3) shallow ponds. The vegetated areas (totaling roughly 400 acres) primarily support the perennial salt marsh plant, pickleweed (*Salicornia virginica*). Within the unvegetated areas (also roughly 400 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 dominates, the ponded areas shrink and more unvegetated flats are exposed. A few small areas are covered with water year-round.



Bolsa Chica Cell 11 in typical winter pond condition Photo by J. Fancher

Precipitation in the 1997-1998 rainfall season was much higher than average due to the El Niño weather phenomenon. Thus, in Spring of 1998, all the cells contained extensive ponded water with little unvegetated flat, that is, little suitable nesting area within the cells was available for the snowy plover. In 1999 and 2000, average or below average rainfall had allowed unvegetated flats to be exposed early in the breeding season, although atypically late showers did occur in the spring and early summer of 1999.

Study Methods

The study area was demarcated into relatively discrete subareas (cells) by the network of slightly elevated roads constructed for access to the oil wells in the lowland. These cells were

numbered and formed the basis for observer navigation, nest location, and data recording (Figure 2). Some areas of Bolsa Chica 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 to the west at Bolsa Chica State Beach, the tidal mudflats of outer Bolsa Bay, or the tidal flats or nesting islands of Inner Bolsa Bay within the Bolsa Chica Ecological Reserve. The study area included all the numbered cells, except cells 47 and 64, which are in private ownership. The cells are of uniquely different configuration and area, but the gross area of some of those 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, such as cells 41 through 50. Some cells that were completely or largely covered by water during most of the breeding season, such as cells 3, 5, 30, and 38, were only occasionally checked for nesting plovers.

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. Usually between 8 am and noon, the observer(s) would drive in an automobile slowly along the roads that subdivide Bolsa Chica. Frequent stops were made to examine specific areas through binoculars without exiting the vehicle. In this manner, it was possible to discover most nests within several days of eggs having been laid. The large majority of suitable western snowy plover nesting habitat was visible from the road network. Rarely, the observer would 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 conducted only once or twice per nest. Occasionally, a section of road was closed to most vehicular traffic when a western snowy plover nest was observed on that road.

Upon discovery, most nests were marked with a two-foot long stick stuck in the substrate about 15 feet from the nest to facilitate relocation during subsequent observations. Most of the time, a nest was evident when an adult was incubating. On the rare occasion when an adult would move away from the nest when the vehicle approached on the nearby road, they usually would reoccupy the nest after a few moments. Sometimes the adult was foraging near the nest. In either case, these were opportunities for observation of the number and condition of eggs in the nest scrape with binoculars or spotting scope.

Data collected during this study included the gender of the incubating adult, length of incubation, 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.

To aid in tracking the survival and movements of chicks from hatching to fledging, color banding of chicks began in 1998 and continued in 1999 under Federal migratory bird banding permit #22420 and the Service's permit for recovery and scientific efforts for listed species. Chicks from the same brood were banded with the same color combination. No attempt was made to band adult western snowy plovers. The color combinations used were coordinated with

other west coast plover banding efforts through the Point Reyes Bird Observatory. The color combination unique to Bolsa Chica was coded on the left leg with a yellow plastic band above the Service band with brown tape on it. The numbered migratory bird bands are size 1p, which is a modified size 1a. The color combination used on the right leg was unique to that particular brood. The tape used was automobile pin striping tape. All of the tape and plastic band edges were heat-fused with a battery-powered welding iron.

The draft protocol for banding snowy plover chicks calls for banding as close to hatching as possible. The chicks become increasingly mobile with age quickly making them more difficult to capture for banding. However, we were successful the day after hatching with several broods and banded two other chicks two days after hatching. The bander walks up on the chicks, which usually remain prostrate in the nest or on the salt pan. We went after chicks carefully watching foot placement and using an assistant spotter to ensure no accidental trampling of the young.

Banding was not done in 2000. It was found to be feasible to track and record histories of individual broods since there was dispersion over space and time sufficient to differentiate between broods. Broods were searched for 3 - 7 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.



Male adult snowy plover with banded chicks.

Photo by Peter Knapp

Results and Discussion

NEST CHRONOLOGIES AND DISTRIBUTION

The first 1999 western snowy plover nest observed in our study area was found on March 19th in Cell 19. The first 2000 nest was seen on March 29th in Cell 10. In 1999 and 2000, the latest nests initiated at Bolsa Chica were between July 20th and 30th (Cells 14) which hatched in middle August. In total, 38 nests were identified in 1999 and 39 nests were found in 2000. The locations of the nests found in 2000 and 1999 are shown on Figure 3a and 3b, respectively. In 1999, nine nests were initiated in Cell 4, six in Cell 10, five each in Cells 11 and 19, four in Cell 22, with the one or two each of the other nine nests scattered in other cells. In 2000, twelve nests were initiated in Cell 11, nine in Cell 4, six in Cell 10, three in Cell 36, with the other nine nests scattered in other cells. In 1999 and 2000 combined, Cells 4, 10, and 11 supported 61% of all nests (Cell 4, 18 nests; Cell 11, 17 nests; and Cell 10, 12 nests; totaling 47 of 77 nests) seen at Bolsa Chica.

The number of active nests existing at any one time within the study area fluctuated as nests were initiated, hatched, preyed upon, or abandoned (1999, Figure 4; 2000, Figure 5). The peak number of active nests at any one time was twelve in early July 1999 and ten in late May 2000. From late March through mid-May of both years, the number of active nests was between one and six nests. From late-May to late-June, the number of active nests was between four and twelve nests.



1999 Nest #35. Photo by J. Fancher

EGG, CHICK, AND FLEDGLING PRODUCTION

In 1999, eight nests had been initiated by the end of April, eight more were initiated in May, 14 in June, and eight in July. Twenty seven nests hatched and 11 were predated out of the total 38 nests (Figure 6b). Abandonment of eggs was low in both years (only two eggs in each year). In 2000, five nests were started by the end of April, 12 in May, 18 in June, and six in July. Out of a total of 39 nests attempts in 2000, 20 hatched and 19 were taken by predators (Figure 6a).

Most nests were located within a cell, usually on sandy barren areas that were slightly elevated above ponded water or in salt flat. Most nests were simple scrapes in soft substrate, on open flats, away from most vegetation. The appearance of the substrate within one foot of the nest scrape usually matched very closely the coloration of the snowy plover eggs. The substrate character where the nests were placed was quite variable from moist mud, fine, light-colored sand, dried algae, gravel, and occasionally salt crust over moist mud. Some nests were lined with gravel, some with twigs, and some had no lining.

Nests were not usually placed near surface water, but some nests were initiated where surrounding ground was saturated or very shallow surface water was present. Some nests were found on largely featureless flats without surface water within many tens of yards. Cells that have the highest cumulative totals of nest attempts (Cells 4, 11, and 10) each typically have a portion of the cell that has high surface moisture or a shallow pond.

In 1999, three egg clutches were found in 30 nests, one 2 egg nest, while the other 7 nests were predated before completion of the clutch. Out of a total of 102 eggs laid in 38 nests, 71 eggs survived to hatch (Table 1). Our post-hatching observations of broods indicate at least 23 chicks survived to fledge (0.61 fledglings per nest).



1999 Nest #32 Photo by Fancher

In 2000, three egg clutches were found in 28 nests. Three nests were two egg clutches and the other eight nests were predated before the clutch was complete. Out of a total of 103 eggs laid in 39 nests, 57 eggs survived to hatch (Table 2). Forty two fledglings were estimated in 2000 (1.08 fledglings per nest).

NUMBERS OF MALE, FEMALE, AND JUVENILE SNOWY PLOVERS

In May 1999, the highest number of males observed was 11 and of females was 12 (Figure 7). In May of 2000, the highest number of males observed was 16 and females was 15 (Figure 8). These are assumed to be the "breeding" population of western snowy plovers at Bolsa Chica at the beginning of the 1999 and 2000 season, respectively.

The number of observed juveniles in 1999 increased in middle May to six and stayed at 10-11 in June. The number of observed juveniles climbed abruptly to over 30 in July, with the apparent influx of migrants. In 2000, no juveniles were observed until the end of May, and varied between 13 and 21 in June and July.

The total number of western snowy plover individuals (adults and juveniles) present at Bolsa Chica in March 1999 fluctuated between 20 and 35 then dipped to about 18 in April, increasing to about 25 in May (Figure 9). In 2000, between 18 and 26 individuals were present in March and April, increasing to about 30 in May. Numbers fluctuated between 20 and 40 plovers in June of 1999, but were between 45 and 58 in June of 2000. During July and August of 1999, total plover numbers observed at Bolsa Chica swung between 20 and 85 individuals. In 2000, total numbers of birds were between 45 and 75 in July and August.

CHICK BANDING AND BROOD TRACKING

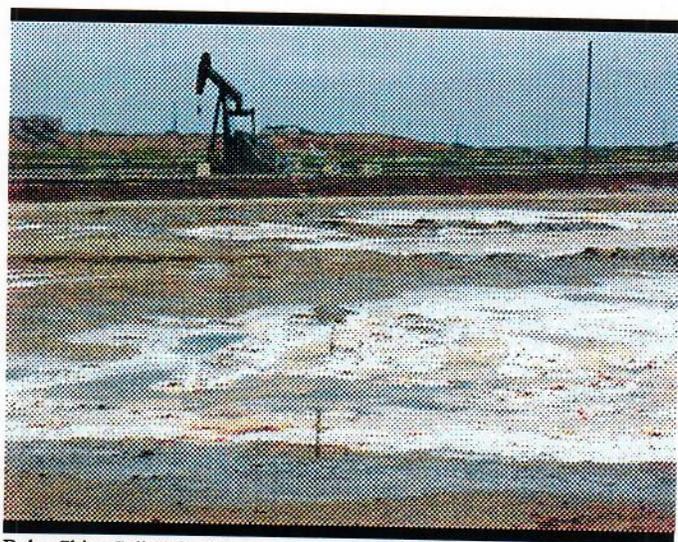
Twenty five plover hatchlings from 10 broods were banded at Bolsa Chica between May 4 and August 18, 1999. We banded 1 - 3 chicks from each of these broods (Table 3). Most of these nests successfully hatched all 3 eggs. We banded 35% of all chicks (25 of 71), and at least one chick from 36% of broods in 1999.

Females did most of the incubation of nests but both male and female western snowy plovers were seen incubating nests. On some occasions, western snowy plover broods and both adults were seen in the general vicinity of the nest for days after hatching. Sometimes, however, the chicks and adults were not seen after hatching as the chicks are highly mobile within days of hatching. Most broods that were seen repeatedly, were accompanied by the male adult. An entire brood can move the length of a cell and into other cells fairly readily. The chicks may also be led to seek cover in the abundant pickleweed vegetation as well, making them harder to observe.

The movements and fate of broods were followed to the maximum extent possible. Banded chicks aided in this but because of age differences and site tenacity, it was also possible

to keep track of most of the unbanded broods. In 1999, of the 15 broods that produced at least one fledgling, six were reared in the cell of their hatching (40%). The broods rarely stayed in the immediate area of the nest scrape, but rather moved to another part of that cell. Nine of the broods moved to an adjacent cell, such as from Cell 10 to 11, but some crossed a couple of roads to move a couple of cells, such as from Cell 59 to 17, 19 to 8, and 22 to 11. Kestrel predation of chicks was more severe in this year and may have driven the tending adult to lead broods away from areas of loss. It is also possible that the search for food caused the tending male to lead them elsewhere.

Of the 19 broods that produced fledglings in 2000, 14 stayed in the cell of their hatching (74%). Of those 5 broods that moved between cells, they went from Cell 10 to 11, Cell 10 to 12, Cell 22 to 11, 36 to 12, and Cell 14 to 8.



Bolsa Chica Cell 22 in July

Photo by J. Fancher

The chick movements observed were often from the nesting cell or road to another cell, where they remained until fledging. In traveling from one cell to another, the chicks had to climb short but steep banks, navigate through and around marsh plants, weeds, and cross roads. Movements across these "obstacles" may have caused some chick mortality, increased exposure to predators, or separated chicks from the tending adult. Few broods were seen to have any association with other adult plovers, juveniles, or other broods prior to fledging. They tend to avoid other broods.

Neither western snowy plover broods nor loafing adults were observed on the oil well access roads. Many of these roads are traveled several times a day by vehicles and that may habituate plovers to avoid the roads. Western snowy plovers were quite tolerant of vehicles moving along those roads while they themselves were foraging, loafing, and incubating within the cell as close as a few tens of feet away. On the other hand, some snowy plovers did move off their nest when approached by a human outside of a vehicle as near as a couple hundred feet.

Western snowy plover foraging was sometimes observed during the nesting or brood surveys. They were usually observed gleaning the surfaces of the substrate. Occasionally, snowy plovers run after, and peck from mid-air, small flying insects found while walking in the unvegetated flats and very shallow surface water or shake one foot in very shallow water to agitate potential prey. They may fly over to forage on the tidal mudflats of Outer Bolsa Chica or

In late summer, snowy plovers would often loaf in groups on the salt flat and very shallow pond areas, sometimes associated with other bird species, particularly semipalmated plovers (*Charadrius semipalmatus*) which appear at Bolsa Chica in large numbers. Thus, during July and August, when snowy plover total numbers begin to increase significantly at Bolsa Chica, larger numbers (10-30) of loafing snowy plovers were seen in Cell 4, as well as in Cells 12 and 8, and sometimes Cells 11 and 17.

OBSERVATIONS OF BANDED ADULTS

Seven banded adult western snowy plovers were seen nesting at Bolsa Chica in 1999 and/or 2000. One female (YKGY) was banded in May of 1997 as a chick, at Camp Pendleton, San Diego County. It had attempted to breed at Camp Pendleton in 1998 before establish the nest at Bolsa Chica in June 1998 (Jill Terp, pers. comm.). This female produced two broods from two nest attempts at Bolsa Chica in 1999. She nested twice at Bolsa Chica in 2000 with one brood produced. A second female (BBKB) observed nesting at Bolsa Chica had been banded as an adult at Chula Vista Wildlife Preserve, San Diego Bay in May 1998 (Jill Terp, pers. comm.). She nested once at Bolsa Chica in June 1998 and twice in 1999 with one brood produced. She was not seen at Bolsa Chica in 2000. One female (RWKY) banded as a chick at Batiquitos Lagoon, San Diego County in 1998, was seen twice at Crystal Cove beach in March and October of 1999, then successfully hatched a brood in July 2000 at Bolsa Chica. A female (OKKK) banded as a chick at Camp Pendleton, San Diego County in 1999, was seen in April 2000 at San Onofre beach, then twice attempted nests at Bolsa Chica in 2000, but both were predated. Another female banded as an adult at Camp Pendleton in 1998 (RBKB) nested there in 1998 and 1999. She nested there again in May 2000 but appeared at Bolsa Chica in June 2000 and produced one brood in July 2000.

A female (YNBR) banded as a chick in 1998 at Bolsa Chica, was seen on the adjacent beach in January and February 1999, made three nest attempts at Bolsa Chica in 1999. She produced two broods, but one nest was predated before hatching. This female was not seen at Bolsa Chica in 2000. A female banded as a chick at Bolsa Chica in 1999 (YNRR) made two nest attempts at Bolsa Chica in 2000; one was ended by predation, the other hatched. A male sibling (YNRR), also banded as a chick at Bolsa Chica in 1999, successfully reared two fledglings at Bolsa Chica in 2000.

Three chicks from one brood were banded in August 18, 1999 at Bolsa Chica with YNWB. One of this brood was lost within days, as explained below. Another of this brood was seen in March 2000 at Bolsa Chica, then the same band code was seen on a bird reported to have nested at Monterey Bay in May 2000 (Gary Page, pers. comm.). One of the YNWB banded birds was seen at Bolsa Chica State Beach in January 2001 (Loren Hays, pers. comm.). A likely explanation of these sightings is that one of the two surviving birds carrying this band code was present in the Bolsa Chica area during the winters of 1999 and 2000 but did not breed, while another of the brood did go Monterey Bay to breed. Alternatively, one banded bird traveled from Bolsa Chica in March 2000 to Monterey in May 2000 and returned to Bolsa Chica in January

2001. Lastly, two juvenile snowy plovers banded elsewhere, one from Pismo Beach (ØRWO/W) and one from Salinas River (BYBA), were seen at Bolsa Chica in July 2000.

Within two days of having been banded as a one-day-old chick (YNWB) in Cell 10, a plover chick was found alive in Cell 2 but with a broken leg. The cause of the injury was unknown, but could have resulted from banding, or from movement across the road between Cells 10 and 2. This chick was recaptured and attempts were made to treat its injuries (leg splinting and force feeding), but it expired a few days later.

Western snowy plover interactions with other nesting bird species at Bolsa Chica, primarily with the black-necked stilt (*Himantopus mexicanus*), were occasionally observed. The black-necked stilt is omnipresent at Bolsa Chica and nests in some of the same places that snowy plovers would nest. It was not uncommon to see adult black-necked stilts briefly chasing western snowy plover adults and chicks, apparently to clear the stilt's territory of the intruders. Interactions with killdeer (*Charadrius vociferus*) were also infrequently noted, when adult snowy plovers would try to drive away the killdeer.

PREDATION

In 1999, 11 of 38 (29%) of snowy plover nests were lost to egg-robbing predators. Five of the destroyed nests (four in Cell 11, one in Cell 4) were where groups of loafing gulls were also regularly present and may have been raided by opportunistic gulls. Of the total 102 snowy plover eggs known to have been produced at Bolsa Chica in 1999, 70% survived to hatch (71 chicks). However, only 23 of those 71 (32%) chicks survived to reach fledgling stage. Although chick mortality from other causes cannot be ruled out, severe chick predation by avian predators is thought to have reduced the fledgling production in 1999 at Bolsa Chica. Thus, in 1999, nest loss was relatively low, with about one third of nests being lost, and chick loss was relatively high, with three fourths of chicks being lost (0.61 fledglings/nest).

In 2000, 19 of 39 (49%) snowy plover nests were lost to egg-robbing predators. Of the total 103 snowy plover eggs produced at Bolsa Chica in 2000, only 50% survived to hatch (51 chicks). Although egg losses to other egg predators (coyote, for example) cannot be ruled out, most of the nest destruction in 2000 was attributed to avian predators. Chick survival in 2000 was high with 42 of 51 (82%) chicks fledging. Unlike 1999, nest loss was high in 2000 with about half of all nests destroyed, but chick survival was good, with less than one fifth of chicks being lost (1.08 fledglings/nest).

Predation of snowy plover chicks and eggs was rarely observed directly during this study. The principle suspect in snowy plover egg loss at Bolsa Chica is the American crow (*Corvus brachyrhynchus*) which is also omnipresent and occasionally very abundant in the Bolsa Chica. Crows were seen foraging in areas of snowy plover nests which, upon closer inspection, were found to have eggs removed and/or shell and yolk remnants. Crows seemed very abundant in the

adjacent urban areas. Flocks of 50-100 crows were regularly seen in the Bolsa Chica lowlands in 2000 and there are almost always between 1-15 crows in the vicinity each day.

American kestrel (*Falco sparverius*) is a major chick predator and frequent, perennial problem for the California least tern which nests on the south island of the Bolsa Chica Ecological Reserve. Western snowy plover chicks are prey for kestrels, as well. Kestrels are quite abundant in the adjacent urban areas and were very frequently observed foraging in Bolsa Chica, especially in 1999.

In a few cases, canid tracks were seen in the vicinity, suggesting a feral dog or coyote (*Canus latrans*) may have been the egg-robbing predator. In most cases, little physical evidence was observed. Individual coyotes are seen regularly within the study area, hunting for ground squirrels along road banks in daytime. In 2000, an active coyote den was noted in the northwest end of Bolsa Chica, Rabbit Island, cell 60.

The common raven (*Corvus corax*) is frequently present in low numbers at Bolsa Chica and will take snowy plover eggs and chicks. The loggerhead shrike (*Lanius ludovicianus*) is also present in low numbers at Bolsa Chica and poses a threat to snowy plover chicks. Northern harriers (*Circus cyaneus*) commonly forage in Bolsa Chica area and may occasionally pose a threat to snowy plover chicks. Peregrine falcon (*Falco peregrinus*), red-tailed hawk (*Buteo jamaicensis*), white-tailed kite (*Elanus caeruleus*), and osprey (*Pandion haliaetus*) transients are common at Bolsa Chica but do not appear to be a problem for snowy plover breeding. Except for the small amount of plover nest destruction possibly caused by loafing gull flocks in 1999, gulls are not considered a significant predator of snowy plovers at Bolsa Chica.

In an effort to reduce predation pressure on the California least tern and western snowy plover breeding at Bolsa Chica, predator management efforts were continued in 1999 and 2000. As noted above, snowy plover chick loss was severe in 1999 due to a very frequent presence of kestrels. In all, 46 kestrels were captured and transported from the area from May to August in 1999 (Ross 1999). Some crows were removed in 1999. Perhaps because of the large number of kestrels removed in 1999, snowy plover chick losses in 2000 were much lower and only 15 kestrels were trapped and transported in that year. However, 91 crows were removed from Bolsa Chica in 2000 when snowy plover egg losses were high (Ross 2000). A crow trap was deployed relatively late in the 2000 breeding seasons but was not functional most of the time.

Loggerhead shrikes cause plover adults to distract the shrike away from chicks, while the chicks lie motionless. Although no plover chick losses to shrikes were directly observed, shrikes are thought to have taken snowy plover chicks in 1999. Five loggerhead shrikes were captured and transported in 1999 and two in 2000. Three ravens were removed from Bolsa Chica in 2000 when a group of 8 began to forage regularly in the vicinity of snowy plover nests. While coyote were regularly observed at Bolsa Chica, and some egg or chick predation may have been attributed to them, no effort was made to capture them.

The nonnative red fox (*Vulpes vulpes*) was once a major problem for ground nesting birds at Bolsa Chica. It has apparently been excluded from Bolsa Chica by a removal program in the early 1990's and the presence of coyote. Feral cats and dogs are very rarely present at Bolsa Chica, perhaps because of the fence around the oil field and/or the presence of coyote. Similarly, few opossums or raccoons are in evidence in the Bolsa Chica lowlands.

1997-2000 SUMMARY

In conclusion, the large majority of the western snowy plover nests at Bolsa Chica were found in the interior areas of cells that are largely unvegetated seasonal pond/salt flats, once the cell dried out enough to expose the salt flat. The road surfaces or shoulder attracted little snowy plover nesting attention in 1997, 1999 and 2000, unlike 1998 when cell water levels were high and eight nests were attempted on road tops. Cells 4, 10, and 11 of Bolsa Chica regularly support most of the western snowy plover nests and brood rearing, with other Cells (such as 8, 19, or 22) sometimes supporting several plover nests (see Figures 3a-e). While nesting activity begins in March and April, the number of nests initiated is lower than during the later months of May and June (see Figures 6a-d). Snowy plover egg and chick losses to predators (primarily crows and kestrels) are important factors in reducing plover reproductive success (Figure 11).

The total numbers of snowy plovers censused at Bolsa Chica during the first half of the breeding season, March through May, fluctuated between around 15 and 35 individuals. In most years, the total number of snowy plovers at Bolsa Chica begins to swell with the influx of migrating plovers in July and August to between 60 and 80 (Figure 9). In the four years, the beginning of the nesting season (defined as first nest) varied between March 17 and April 22, while the conclusion of nesting (defined as no nests incubated) was between July 30 and August 15 (Figure 10).

Acknowledgments

We thank Jill Terp for her review of the draft report. We offer special thanks to Dick Zembal who continued the chick banding effort in 1999 and Wally Ross and Ron Brown who carried out the essential predator management actions.

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1. 1999 Nest Start and End Dates, Number of Eggs, Number Hatched, and Fledglings
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3. Snowy Plovers Banded at Bolsa Chica in 1999

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4. Active Nest Chronology, 1999
5. Active Nest Chronology, 2000
- 6a-d. Nest Initiation, Hatching, Loss by Period 2000-1997
7. Males and Females 1999
8. Males and Females 2000
9. 1997-2000 Total Snowy Plover
10. 1997-2000 Active Nest Chronology
11. 1997-2000 Egg, Chick, and Fledgling Production

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Table 1. 1999 Nest Start and End Dates, Number of Eggs, Number Hatched, and Fledglings

Nest #	Cell #	Start Date ¹	End Date ²	# Eggs	#Hatched	# Fledged
1	19	3/19/99	4/12/99	3	2	0
2	4	4/2/99	5/3/99	3	2	0
3	19	4/8/99	5/9/99	3	3	0
4	6	4/21/99	4/23/99	1	0	0
5	S. Island	4/23/99	5/20/99	3	3	0
6	11	4/27/99	5/3/99	3	0	0
7	4	4/29/99	4/29/99	1	0	0
8	62	4/29/99	5/22/99	3	3	1
9	3/SI Rd	5/4/99	6/6/99	3	2	2
10	19	5/11/99	5/28/99	3	2	0
11	10	5/18/99	6/8/99	3	3	2
12	4	5/18/99	6/10/99	3	3	0
13	10	5/20/99	6/1/99	2	0	0
14	3/SI Rd	5/28/99	6/1/99	1	0	0
15	11	6/3/99	7/5/99	3	3	2
16	S. Island	5/1/99	6/4/99	2	2	0
17	10	6/6/99	7/5/99	3	2	1
18	4	6/6/99	7/6/99	3	3	3
19	22	5/10/99	6/9/99	3	3	1
20	19	6/9/99	7/2/99	3	2	2
21	22	6/10/99	6/17/99	3	3	0
22	4	6/13/99	7/7/99	3	3	1
23	22	6/14/99	6/22/99	1	0	0
24	4	6/16/99	7/13/99	3	3	3
25	22	6/16/99	6/22/99	3	0	0
26	4	6/16/99	7/12/99	3	3	0

Nest #	Cell #	Start Date ¹	End Date ²	# Eggs	#Hatched	# Fledged
27	19	6/18/99	7/6/99	3	0	0
28	10	6/23/99	7/15/99	3	2	1
29	10	6/24/99	7/8/99	2	0	0
30	11	6/29/99	7/27/99	3	3	0
31	4	7/1/99	7/27/99	3	2	1
32	11	7/5/99	7/22/99	2	0	0
33	4	7/8/99	8/3/99	3	3	1
34	59	7/9/99	8/12/99	3	2	0
35	11	7/15/99	7/26/99	3	0	0
36	10	7/20/99	8/16/99	3	3	1
37	17	7/22/99	8/16/99	3	3	1
38	14	7/16/99 ³	8/15/99	3	3	0
Totals				102	71	23

¹ Start Date is the date discovered, irrespective of whether the clutch was complete or not. ² End Date is the date the nest was no longer incubated for whatever reason. ³ estimated start date by backcasting from discovery of a newly hatched brood.

Table 2. 2000 Nest Start and End Dates, Number of Eggs, Number Hatched, and Fledglings

Nest #	Cell #	Start Date ¹	End Date ²	# Eggs	#Hatched	# Fledged
1	10	3/29/00	3/30/00	2	0	0
2	62	3/29/00	4/20/00	3	0	0
3	4	4/12/00	4/26/00	3	0	0
4	9	4/19/00	4/21/00	3	0	0
5	11	4/25/00	5/22/00	3	3	3
6	3/SI Rd	5/8/00	5/11/00	2	0	0
7	11	5/9/00	6/4/00	3	3	2
8	11	5/9/00	5/31/00	3	3	2
9	11	5/9/00	5/22/00	3	0	0
10	10	5/9/00	5/31/00	3	3	2
11	4	5/11/00	6/7/00	3	3	3
12	11	5/18/00	6/12/00	3	3	0
13	4	5/18/00	6/15/00	3	3	3
14	4	5/18/00	6/1/00	3	3	3
15	11	5/25/00	6/22/00	3	0	0
16	11	5/30/00	6/4/00	3	0	0
17	4	5/30/00	6/23/00	3	3	3
18	10	6/3/00	6/12/00	3	0	0
19	4	6/6/00	7/5/00	3	3	2
20	10	6/8/00	6/12/00	2	0	0
21	11	6/13/00	7/5/00	3	0	0
22	4	6/13/00	7/7/00	3	3	2
23	4	6/13/00	7/10/00	3	3	2
24	11	6/20/00	7/14/00	3	0	0
25	11	6/21/00	6/27/00	3	0	0
26	11	6/22/00	6/29/00	1	0	0

Nest #	Cell #	Start Date ^{/1}	End Date ^{/2}	# Eggs	#Hatched	# Fledged
27	10	6/25/00	7/22/00	3	3	2
28	22	6/26/00	7/23/00	2	0	0
29	122	6/27/00	7/18/00	3	3	2
30	36	6/27/00	7/13/00	2	2	1
31	36	6/30/00	7/5/00	1	0	0
32	36	7/6/00	7/14/00	2	0	0
33	11	7/11/00	7/31/00	3	0	0
34	17	6/10/00 ^{/3}	7/13/00	3	3	2
35	4	6/16/00 ^{/3}	7/18/00	2	2	1
36	10	6/16/00 ^{/3}	7/19/00	2	2	2
37	9	7/20/00	8/10/00	1	0	0
38	12	7/10/00 ^{/3}	7/27/00	3	3	3
39	14	7/10/00 ^{/3}	8/10/00	3	3	2
Totals				103	57	42

^{/1} Start Date is the date discovered, irrespective of whether the clutch was complete or not. ^{/2} End Date is the date the nest was no longer incubated for whatever reason. ^{/3} estimated start date by backcasting from discovery of a newly hatched brood.

Table 3. Snowy Plovers Banded at Bolsa Chica in 1999.

DATE	NEST#	CELL#	# CHICKS	BAND #S	COLORS
4 May 99	4	19	3	12101-2	Y/N:G/G
11 May 99	4	19	3	12103-5	Y/N:G/R
22 May 99	8	62	3	12106-8	Y/N:G/W
28 May 99	10	19	1 of 2	12109	Y/N:G/Y
9 June 99	19	22	2 of 3	12110-1	Y/N:R/B
5 July 99	15	11	3	12112-4	Y/N:R/G
7 July 99	18	4	3	12115-7	Y/N:R/R
28 July 99	31	4	2	12118-9	Y/N:R/W
4 Aug 99	33	4	3	12120-2	Y/N:R/Y
18 Aug 99	36	10	3	12123-5	Y/N:W/B

Band colors: Y=yellow; N=brown over Service band; B=blue; G=green; R=red; W=white. Combination sequence of plastic bands=upper left/lower left:upper right/lower right.

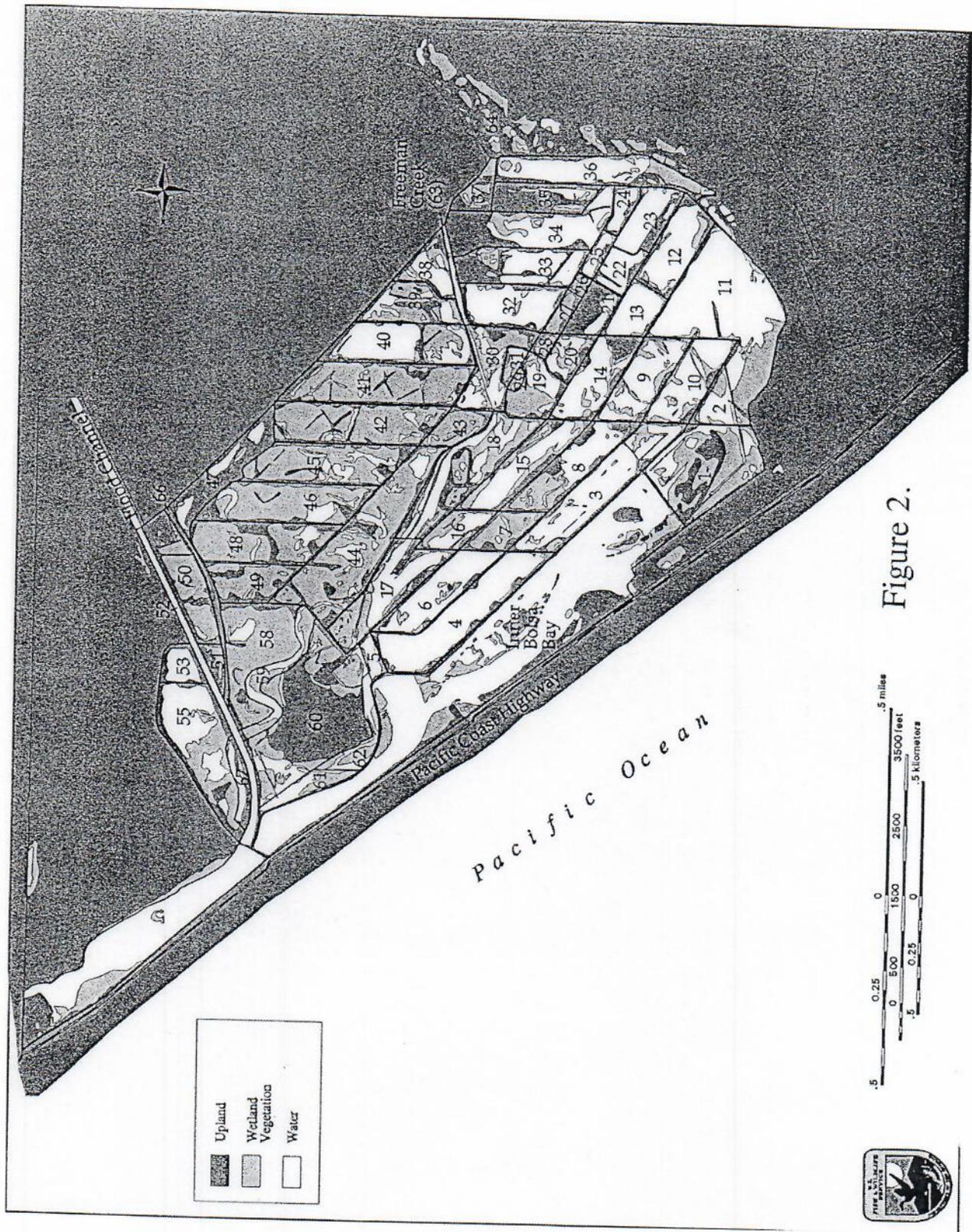


Figure 2.

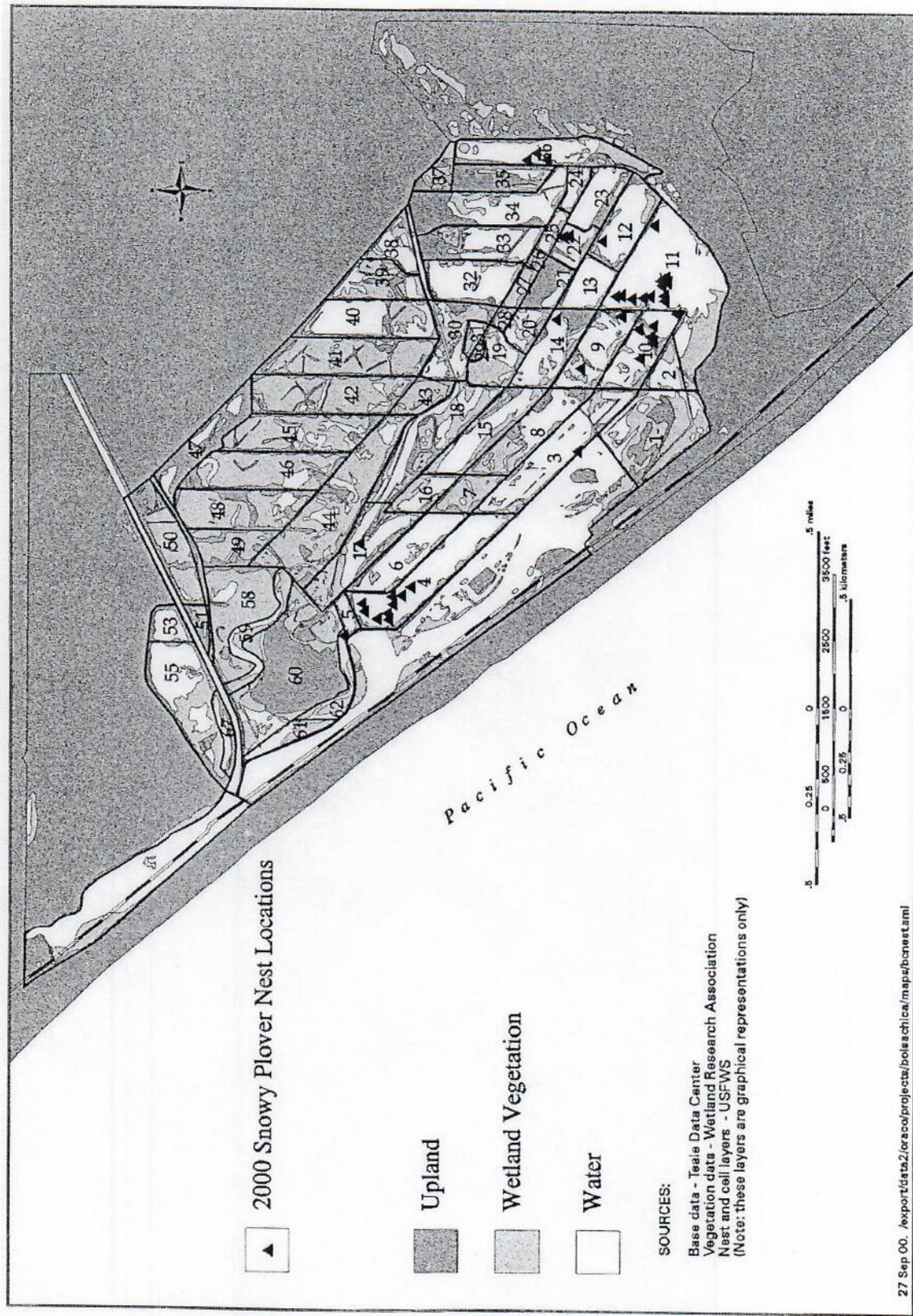


Figure 3a.

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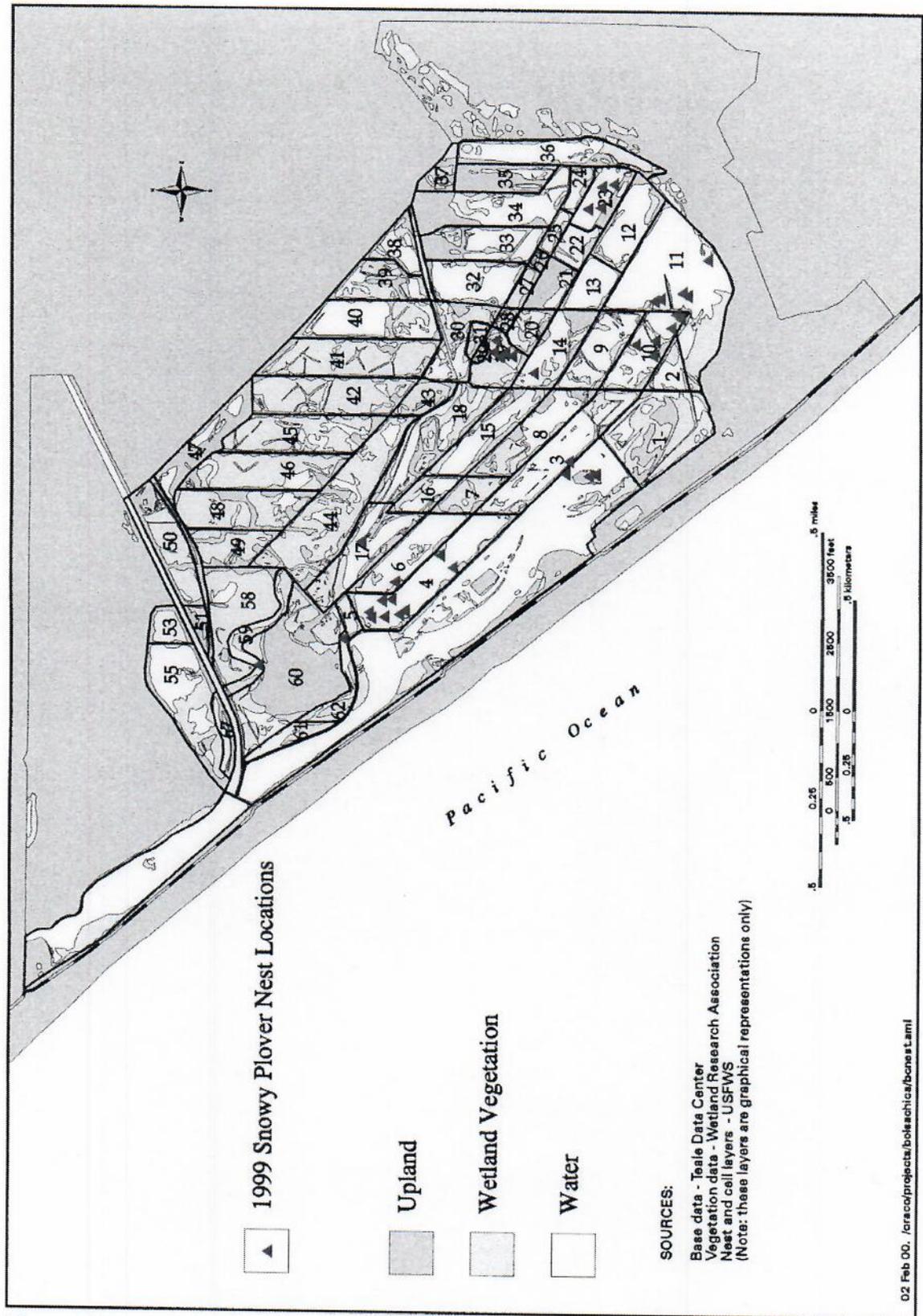


Figure 3b.

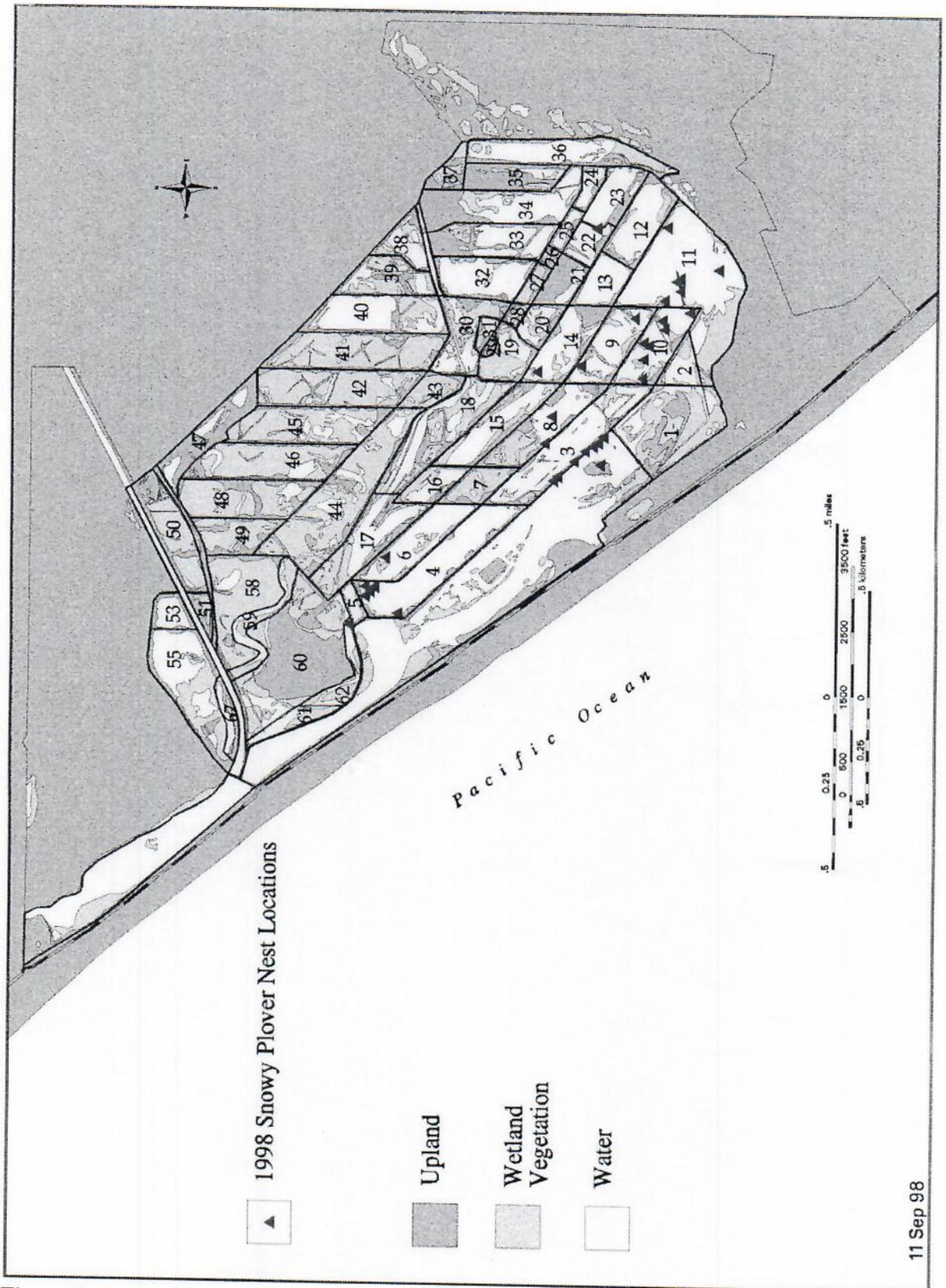


Figure 3c

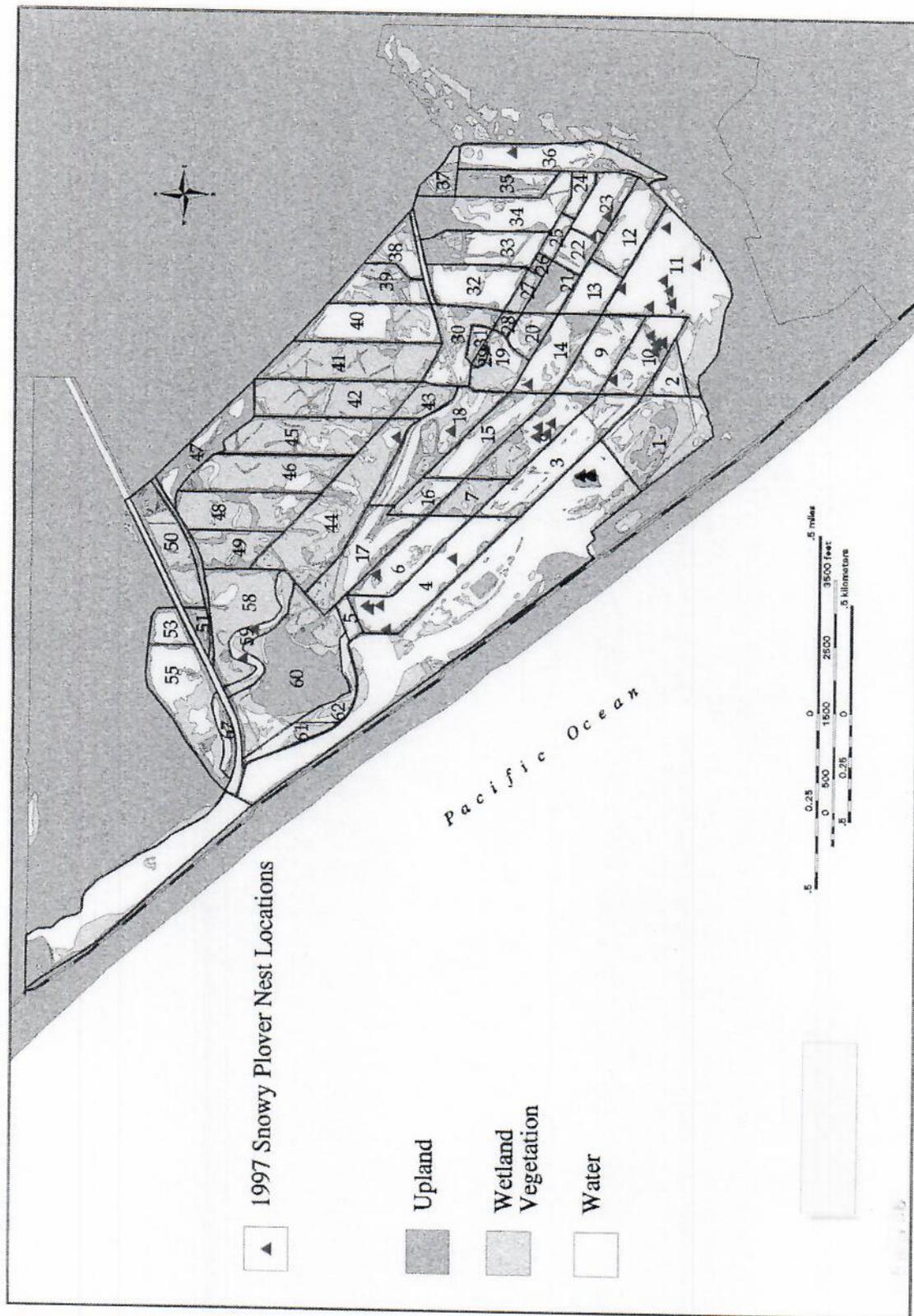


Figure 3d

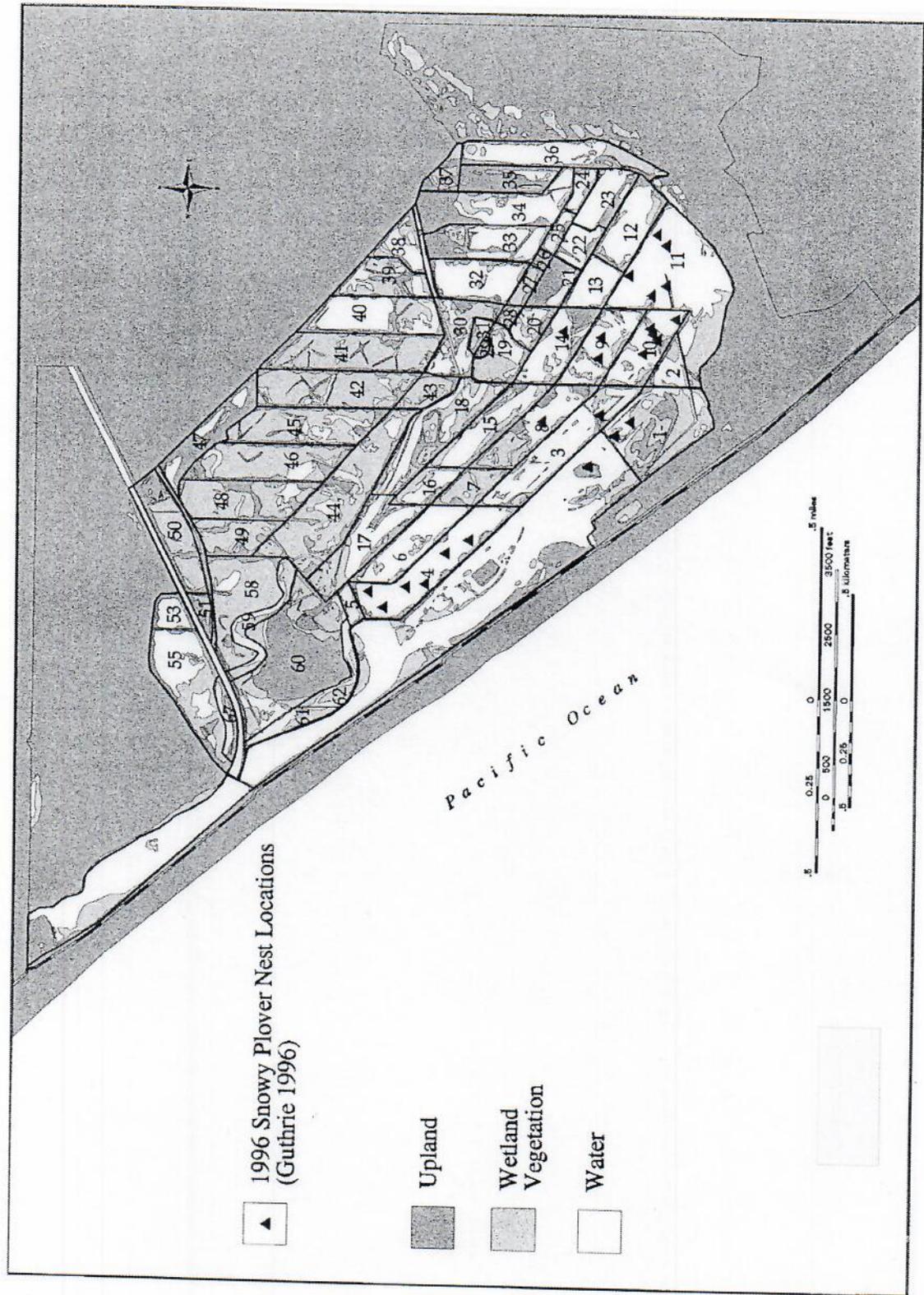


Figure 3e.

Western Snowy Plover

Bolsa Chica 1999 Survey

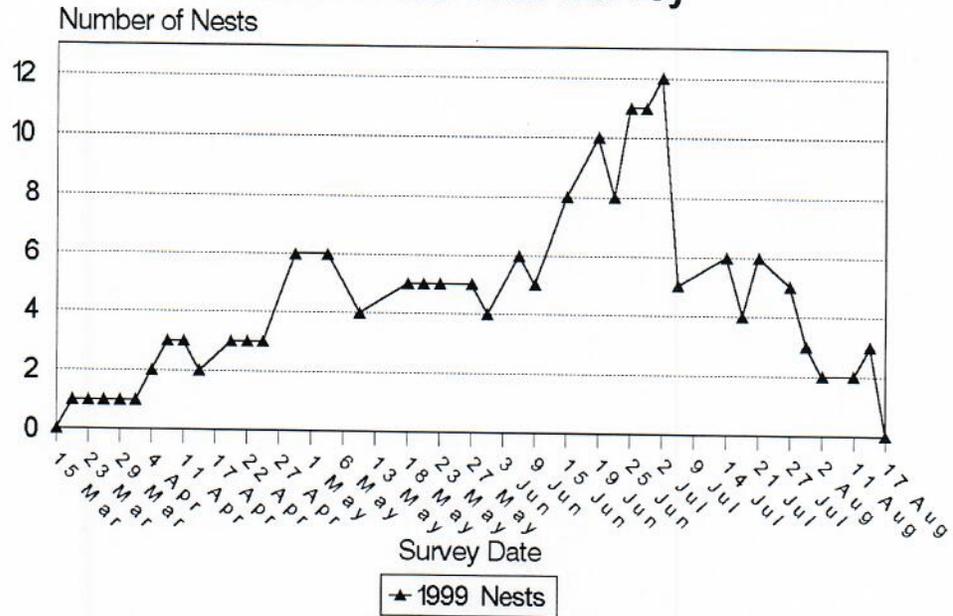


Figure 4. Active Nest Chronology 1999

Western Snowy Plover

Bolsa Chica 2000 Survey

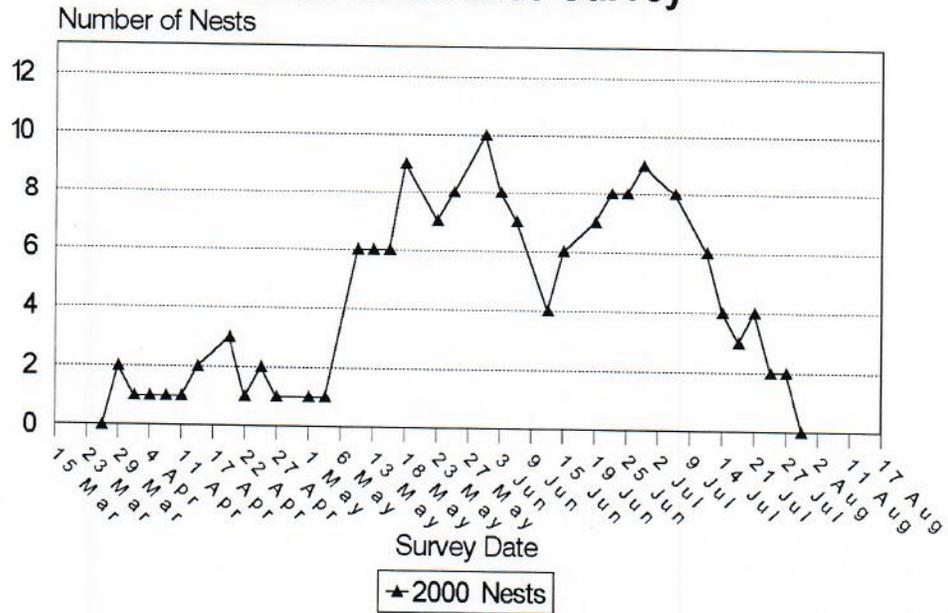


Figure 5. Active Nest Chronology 2000

Western Snowy Plover - Bolsa Chica 2000

Nest Initiation, Hatching, & Loss Dates

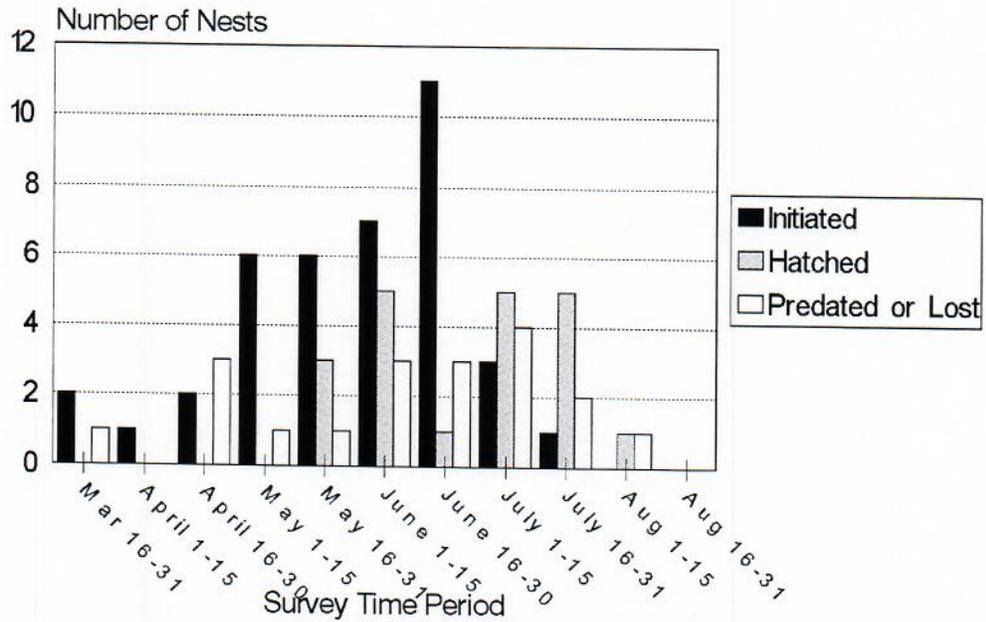


Figure 6a. 2000 Nest Initiation, Hatching, and Loss Dates

Western Snowy Plover - Bolsa Chica 1999

Nest Initiation, Hatching, & Loss Dates

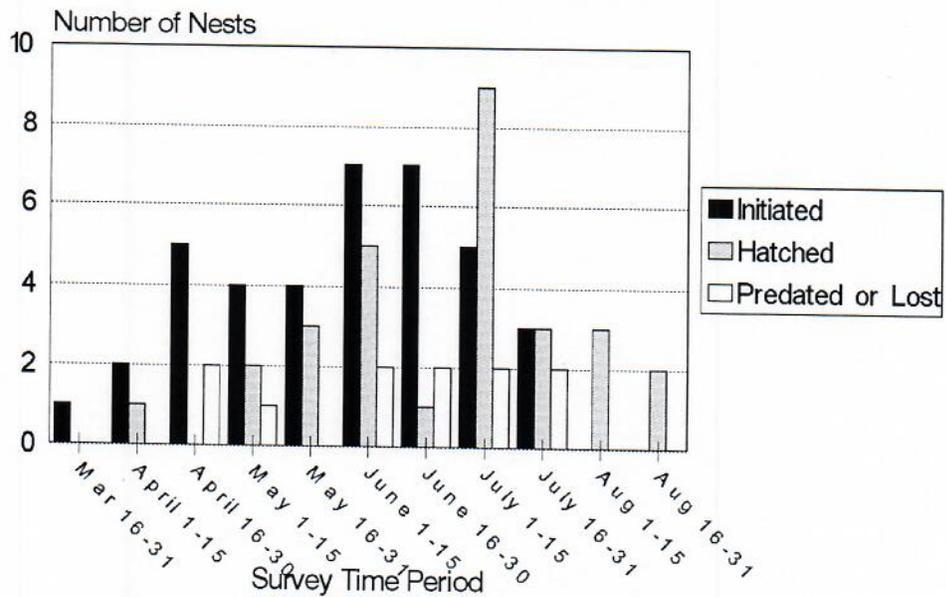


Figure 6b. 1999 Nest Initiation, Hatching, and Loss Dates

Western Snowy Plover - Bolsa Chica 1998

Nest Initiation, Hatching, & Loss Dates

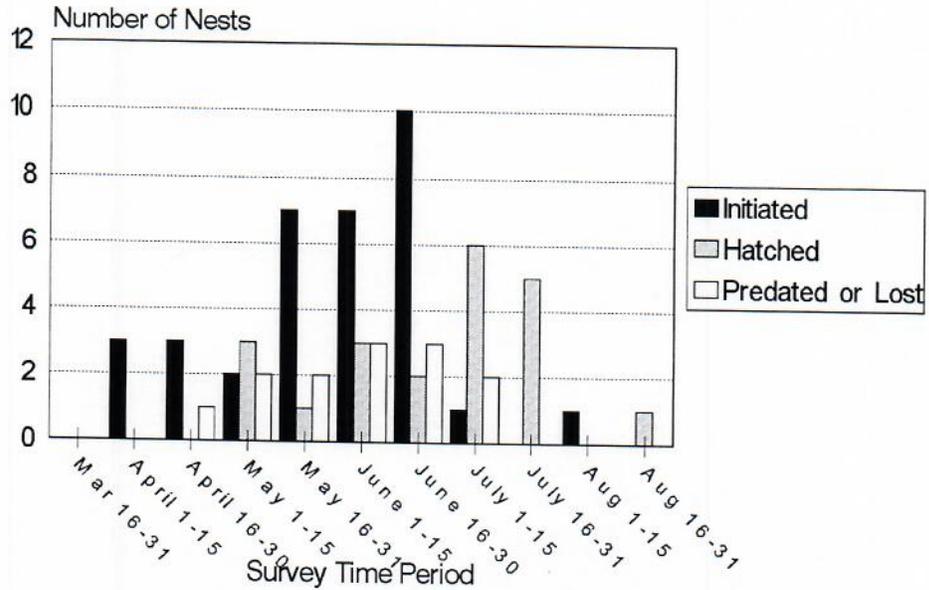


Figure 6c. 1998 Nest Initiation, Hatching, and Loss Dates

Western Snowy Plover - Bolsa Chica 1997

Nest Initiation, Hatching, & Loss Dates

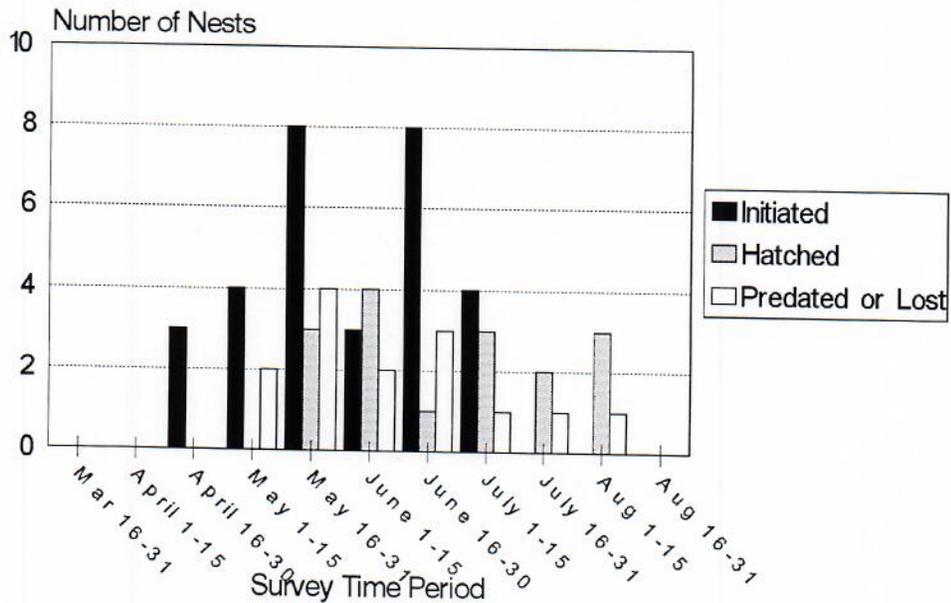


Figure 6d. 1997 Nest Initiation, Hatching, and Loss Dates

Western Snowy Plover

Bolsa Chica 1999 Survey

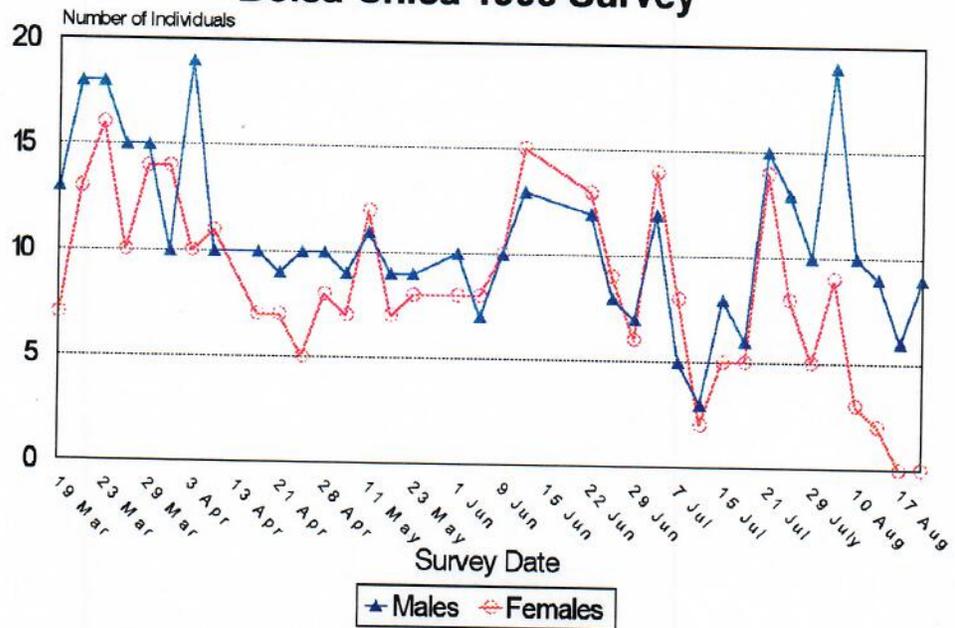


Figure 7. 1999 Males and Females

Western Snowy Plover

Bolsa Chica 2000 Survey

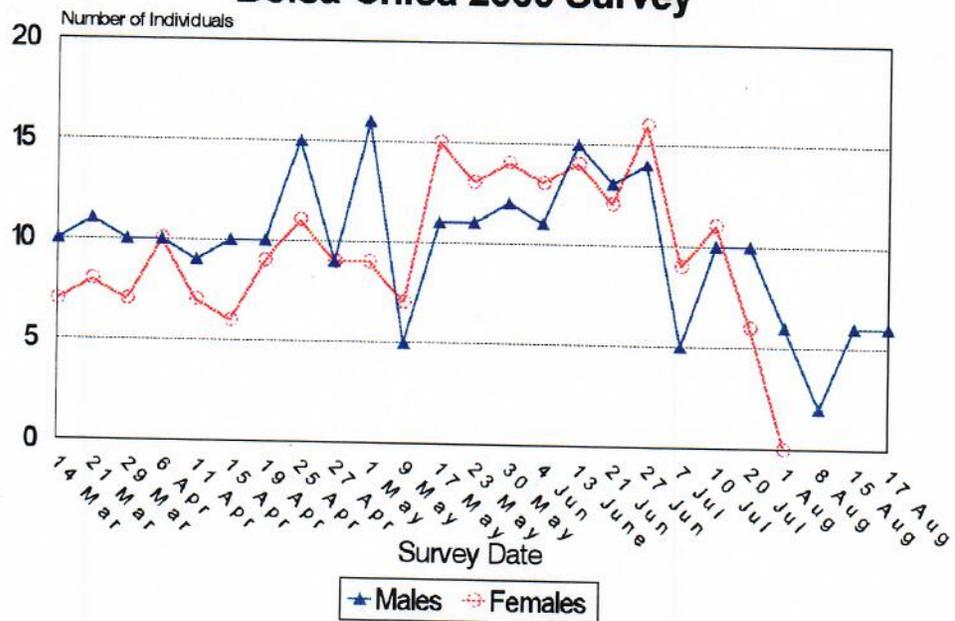


Figure 8. 2000 Males and Females

Western Snowy Plover

Bolsa Chica 1997-2000 Total Individuals

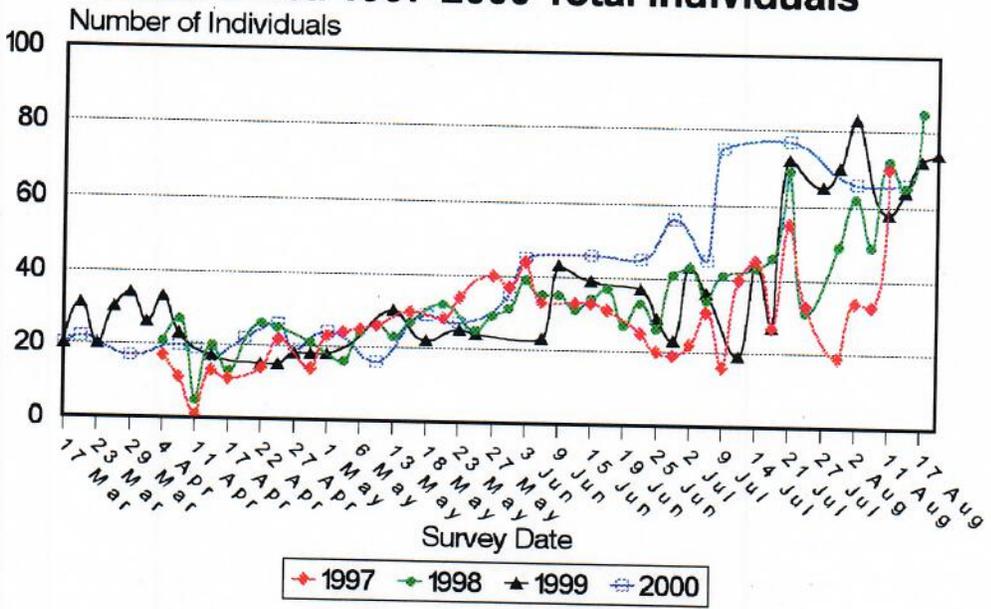


Figure 9. 1997-2000 Total Individuals

Western Snowy Plover

1997-2000 Bolsa Chica Active Nest Chronology

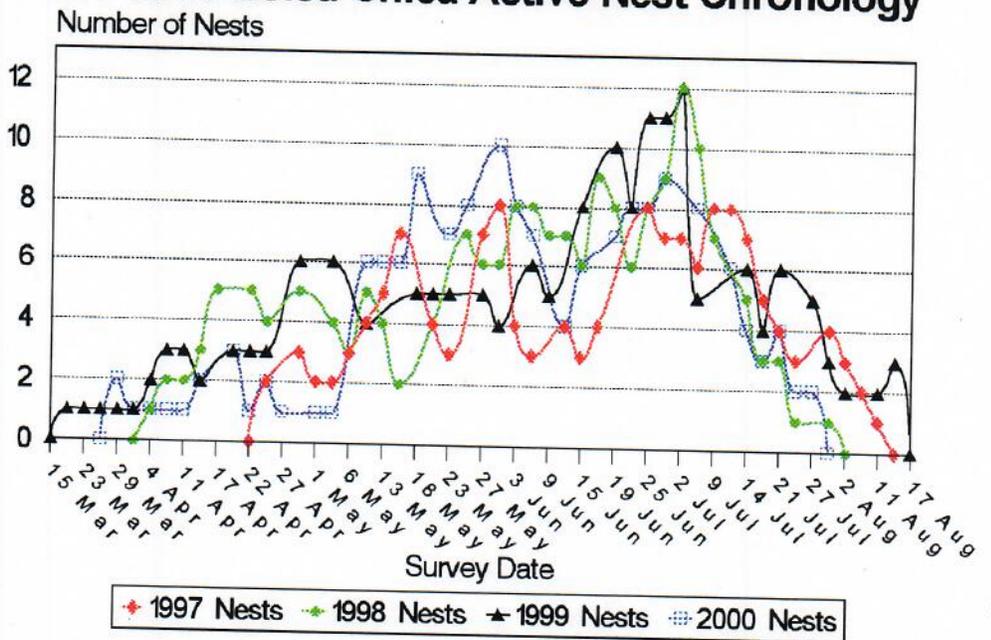


Figure 10. 1997-2000 Active Nest Chronology

Bolsa Chica

Western Snowy Plover Egg, Chick, and Fledgling Production

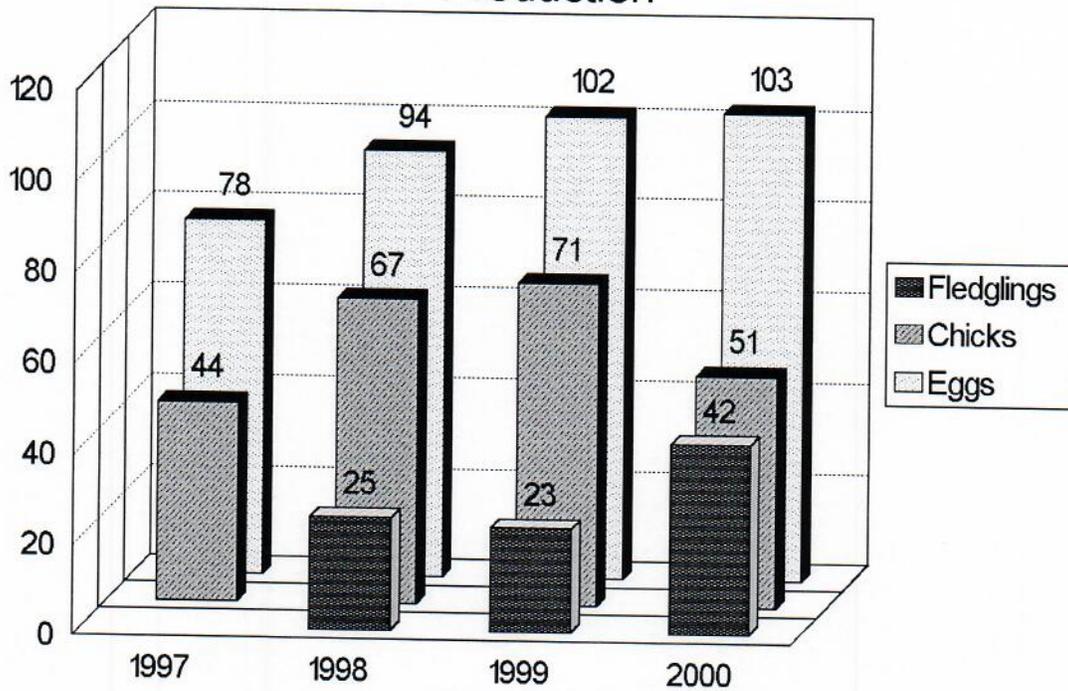


Figure 11. Egg, Chick, and Fledgling Production