

photo by Peter Knapp

Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 1998

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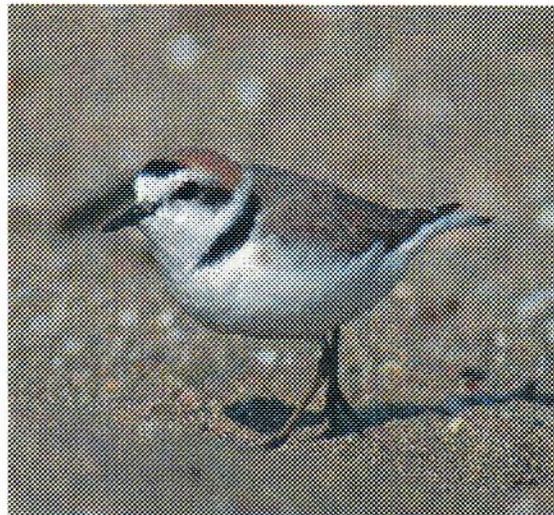
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Introduction

In February 1997, the study area was acquired into public ownership which marked the beginning of a multi-agency effort to design and implement a plan for restoring the fish and wildlife habitats of Bolsa Chica. This study was implemented in 1997 and continued through 1998. The purpose of this investigation was to improve the level of knowledge about a sensitive species that utilizes existing Bolsa Chica and which will be considered and protected in the formulation of restoration alternatives at Bolsa Chica.

Background and Current Status

The western snowy plover, *Charadrius alexandrinus nivosus*, is a small, pale-colored shorebird with dark patches on either side of the upper breast. It is one of two recognized North American subspecies, out of twelve subspecies worldwide. 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.

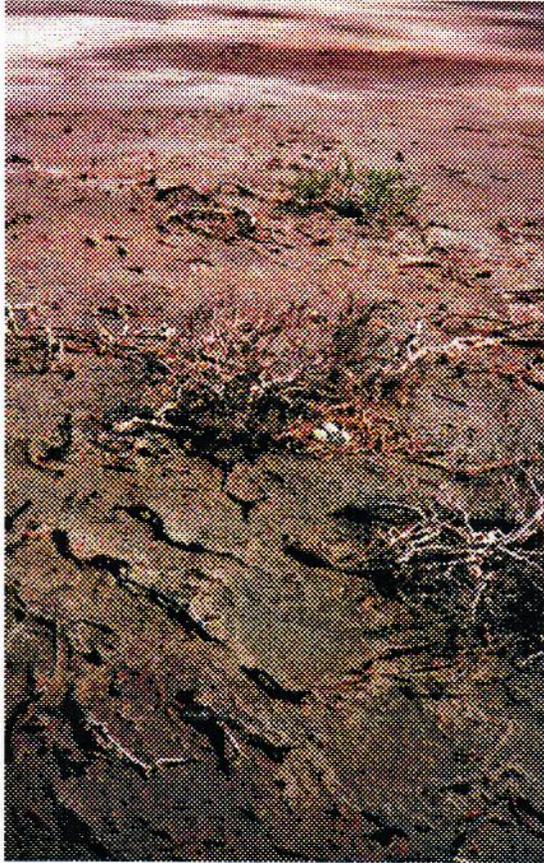


Male Snowy Plover

photo by P. Knapp

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 with some birds wintering in the same areas used for breeding (Warriner *et al.* 1986, Powell and Collier 1994).

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 (Page and Stenzel 1981, Wilson 1980). Other areas utilized 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 (Wilson 1980, Page and Stenzel 1981). The majority of western snowy plover breeding adults are site faithful, returning to the same breeding location in subsequent breeding seasons.



Nest # 23, Cell 10

Photo by J.Fancher

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 (Warriner *et al.* 1986). Both sexes incubate the eggs.

Snowy plover chicks are precocial and leave the nest within hours of hatching in search of food. Broods rarely remain within the nesting territory (Warriner *et al.* 1986). Birds are able to fly within approximately 31 days of hatching. Snowy plovers will renest after loss of a clutch or brood (Wilson 1980, Warriner *et al.* 1986).

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 colony or snowy plovers may move to another nesting site (Warriner *et al.* 1986, Powell and Collier 1994).

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. 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 or blowing sand which buries the 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 unable 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). At this writing, there has been no determination of Critical Habitat for the coastal population of the western snowy plover.

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 (Stadtlander, pers. comm.). 1992-1993 year-round bird counts 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 first conducted 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 of that year 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.

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 principle surface conditions within the cells of the study area, heavily

vegetated with salt marsh plants, unvegetated, and flooded. Many cells (roughly 400 acres) have areas that are always vegetated, primarily with the perennial salt marsh plant, pickleweed (*Salicornia virginica*). Many cells are largely unvegetated and have annually varying extent of ponded water or exposed flat (also roughly 400 acres). A few areas are always covered with water year-round.

Precipitation in the 1997-1998 rainfall season was much higher than average due to the El Niño weather phenomenon. Thus, in March of 1998, all the cells contained extensive ponded water with very little unvegetated flats exposed. Even though some of the roads were under water and water was being pumped out of the lowland, road tops were largely all that was not flooded in April. With the end of the rainy season and pumping, the water levels began to drop slowly and the areas of unflooded salt flats grew larger. By May 1998, some small salt flat areas were exposed but relatively little suitable nesting area was available for the snowy plover at Bolsa Chica. By July 1998, most of the cells had much smaller or no areas of ponded water and very extensive areas of dry pickleweed flats or unvegetated salt flats.

Methods of This Study

The study area was physically delineated into relatively discrete parcels (cells) by the net 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 are likely to 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, 23, 30, and 38, were only occasionally checked for nesting western snowy plover because ponded water is not suitable nesting substrate, either.

Beginning late-March 1998, observers began surveying for nesting western snowy plovers at least twice a week, sometimes 4 or 5 times a week, until mid September 1998. In the morning hours, usually between 8 am and noon, the observer(s) would drive in an automobile slowly along the roads that subdivide Bolsa Chica. Typically, 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 their having been formed. The large majority of suitable western snowy plover nesting habitat was visible from the road net. In a relatively few cases, the observer(s) 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

of nests was conducted only once or twice per nest. Certain sections of roads were closed to most vehicular traffic when a western snowy plover nest was observed on that road.

Upon first discovery or close inspection for the number of eggs, 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 the number and condition of eggs in the nest scrape to be observed 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 some idea of 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.

In order to track the movements of chicks from hatching to fledging, a program of color banding of chicks was initiated. (No attempt was made to band adult western snowy plovers.) The color combinations used were allocated in coordination with other west coast plover banding efforts through the Point Reyes Bird



Color banding of a snowy plover chick

photo by P.Knapp

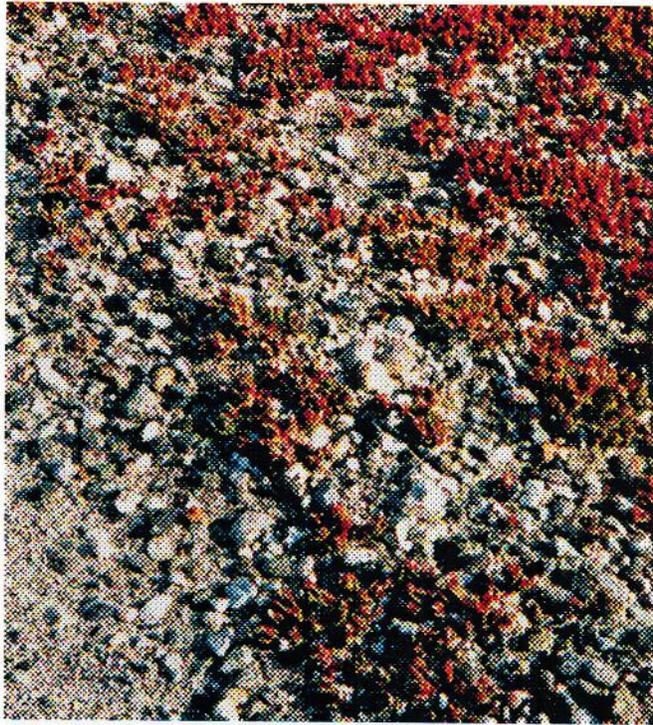
Observatory. The color combination unique to Bolsa was coded on the left leg with a yellow plastic band above the Service band with brown tape on it. The Service bands are size 1p, which is a modified size 1a. The color combination used on the right leg was unique to that particular brood. The tape used 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 making them quickly more difficult to capture and to immobilize adequately for banding. However, we were successful the day after hatching with several broods and banded two chicks, two days after hatching. The bander simply walks up on the chicks, which usually remain hunkered down 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. All broods, banded and unbanded, were searched for 3 - 7 days per week.

Findings of This Study and Discussion

The first 1998 western snowy plover nest observed in our study area was found on April 1st on the road top next to the south nesting island and Cell 3. The latest observed nests initiated at Bolsa Chica were between June 30th and July 7th (Cells 10, 11, and 62) and were hatched or predated by late-July. A single brood of newly hatched chicks was observed in Cell 8 on August 24th, indicating we had not detected the nest which probably had been initiated about August 1st. In total, 34 nests were identified during that time period within the study area. The locations of the nests identified in 1998 are depicted in Figure 3. The largest number of nests within any particular cell or area was seven, in both cell 11 and on the road between the south nesting island and cell 3. Cells 10 had six nests and cell 4 supported a total of five nests during the entire breeding season



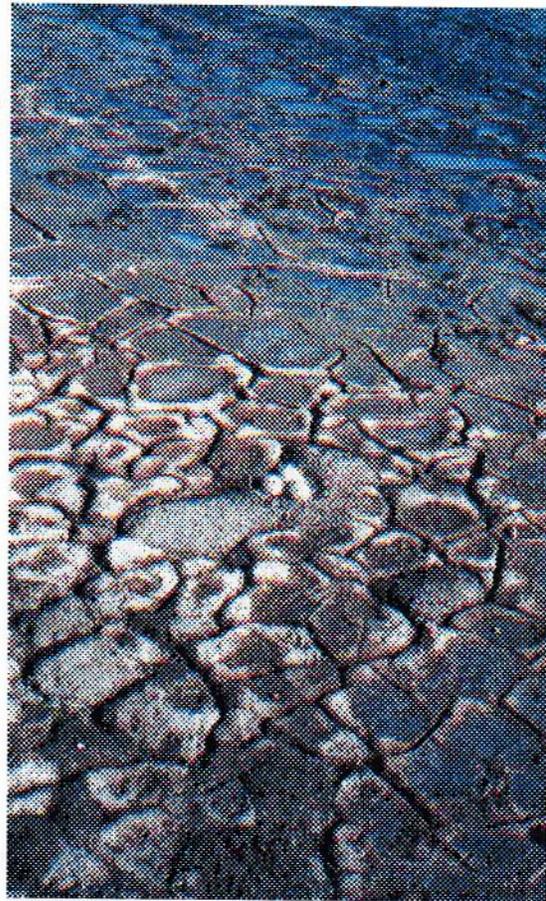
Bolsa Chica road top nest (#15)

photo by J.Fancher

The number of active nests existing at any one time within the study area fluctuated as nests were initiated, hatched, preyed upon, or abandoned (Figure 4). The peak number of active nests at any one time was twelve in early July. From April through mid-May, the number of active nests was between two and five nests. From late-May to late-June, the number of active nests was between six and eight nests. This shift in nest initiations to later in the breeding season at Bolsa Chica is probably due to the high water levels in April that rendered most of Bolsa Chica unsuitable for western snowy plover nesting.

Three nests were initiated in each of the first and second halves of April, two nests were started in the first half of May, seven in the second half of May, seven in the first half of June, ten in the second half of June, and one in the first half of July and August (Figure 5). An estimated 21 nests of the total 34 nests hatched, while 13 failed to be incubated long enough to reach hatching (Figure 6). Abandonment of eggs was relatively low. One nest (#16) was never completed and one egg was abandoned. Nest 26# was completed as a 3 egg nest but was abandoned 6 days later. No new nests were formed between May 8th and May 18th, probably due to heavy rain in that time which also flooded out nest #8.

In early April, one of few areas suitable and available for western snowy plover nesting (e.g. not under water), besides the road between the south nesting island and cell 3, were the nesting islands in the Bolsa Chica Ecological Reserve. Two such islands were created for California least tern nesting. In recent years, other species began nesting at Bolsa Chica in large numbers (elegant tern, *Sterna elegans*; Caspian tern, *Sterna caspia*; black skimmer, *Rynchops niger*; Forster's tern, *Sterna forsteri*), forcing the least tern entirely off of the north island. Our observer(s) did not survey either nesting island. Least tern nesting was monitored by the Department of Fish and Game on the south island and university researchers monitored the nesting birds on the north island. We did, however, observe that the western snowy plover appeared to have established one nest by April 10th on the south island, before the least tern began nesting there. This single nest was incubated into early May and is presumed to have hatched. The number of eggs or chicks from this nest are unknown. Other than this one nest, western snowy plovers were not observed nesting on the south island in 1998, but some parts of the south island are not visible without walking out onto it.



Nest #27, Cell 11

photo by J.Fancher

Most nests were located within a cell, usually on sandy barren areas that were slightly elevated above ponded water or in salt flat. In 1998, 10 nests were located on top of filled dirt or at the top edge of gravel covered roads. One of these nests was at the edge of a turnout area contiguous with a connecting oil well access road between cells 3 and 8. The other nests were located on the top of the road berm between cell 3 and the south nesting island in the Ecological Reserve. 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 did not appear to be placed near areas where surface water was present, although, early in the nesting season when water levels were high, the few suitable nesting areas were all "near" water. Later in the breeding season, as in 1997, when more of the flats were exposed and the extent of surface water reduced, some nests were found placed on largely featureless

flats without surface water within many tens of yards. On the other hand, every snowy plover nesting site at Bolsa Chica is within no more than several thousand feet of ponds or tidal water bodies even by the end of summer when water levels are lowest.

All nests (except the one nest on the south nesting island) were observed closely or frequently enough to confirm the number of eggs present. Three egg clutches were found in 29 nests and five nests were preyed upon or abandoned before the clutch was completed. Out of a total of 94 eggs laid, 67 eggs survived to hatch (Table 2). Our post-hatching observations of broods indicate at least 25 chicks survived to fledge, or 0.73 fledglings per nest attempt.

In May, the highest number of males observed was 16 and of females was 11 (Figure 7). This is assumed to be the "breeding" population of western snowy plovers at Bolsa Chica at the beginning of the 1998 season. We had similarly estimated the 1997 breeding population at Bolsa Chica as 20 males and 14 females (Fancher 1998). These estimates assume that failed nest attempts at Bolsa Chica probably were reinitiated at Bolsa Chica, that females successfully nesting at Bolsa Chica probably attempted subsequent nests at Bolsa Chica, and that breeding western snowy plovers may have arrived from other localities after a failed nesting attempt elsewhere. The few banded western snowy plover adults observed at Bolsa Chica in this study will be discussed below.

The number of observed juveniles seemed to have two peaks, the first in June of about 9 individuals and the second in mid-July of about 15 individuals. It is unknown how long a juvenile will remain in the area of its rearing. Interpretation of these observations is further confounded by the arrival of migrating western snowy plovers, juveniles among them, in late July and early August. A few snowy plover juveniles, banded at Bolsa Chica as chicks, were still being observed out on the ocean beach some weeks after fledging (P. Knapp pers. comm.).

The total number of western snowy plover individuals present at Bolsa Chica fluctuated over time with the lowest numbers occurring in April (Figure 8). The total number of western snowy plovers at Bolsa Chica was under 30 individuals until late May when juveniles first began to augment the group total. The total fluctuated between 25 and 45 individuals from May until mid-July when more juveniles were produced or migrants began to arrive at Bolsa Chica. In late July and mid-August, the total number of snowy plovers at Bolsa Chica was between 50 and 85 individuals, presumably due to the arrival of migrating western snowy plovers.

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.

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. As a result, it became impossible to determine whether any particular chick survived to fledge, or whether any particular female adult left the brood in order to reneest. An estimate of the number of fledglings produced by each nest attempt can be difficult from such incomplete observations.

Twelve western snowy plover hatchlings were banded at Bolsa, 6 - 31 July 1998 under Federal migratory bird banding permit #22420 and the Service's permit for recovery and scientific efforts for listed species. By the time permits were in order and bands in hand, 8 of 18 nests had already hatched and the young were too mobile for easy, safe capture. However, an adequate sample of the chicks was banded to achieve our purpose, to document chick movements and survival to fledging.



Color Banded Snowy Plover Chick photo by P.Knapp

We banded 1 - 3 chicks from each of 6 nests (Table 1). Each of these nests successfully hatched all 3 eggs. We banded 12 of 55 chicks, 22%, and at least one chick from 30% of the 21 broods hatched at Bolsa in 1998 (Table 2). Because of age differences and site tenacity, it was possible to keep track of most of the unbanded broods too. Broods that were hatched from nests on the roads had a strong tendency to move away from the vicinity of the nest quickly and perhaps move further than those from nests in more extensive habitat parcels (Table 2). Two of 12 broods that survived to fledging moved only about 250 feet away from the nest, partly since the retreating pools did not dry to the point of no longer providing adequate food. The movements observed of the chicks were often from the nesting cell or road to another cell, where they remained until fledging. In traveling from one cell to another, the young chicks had to climb short but steep banks, navigate marsh plants, weeds, and roads.

Neither western snowy plover broods or loafing adults were observed on the oil well access roads. Broods that hatched from nests that were located on the road edge moved down into cells, even though such roads had been closed to vehicle traffic. Several broods from the road next to south nesting island and cell 3 moved southerly into cell 1, 10, or 11. Many of the 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 nesting 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.

Few broods were seen to have any association with other adult western snowy plovers

5) foraged in cell 4 on the periphery of other loafing or feeding snowy plovers at the south end of cell 4. No interactions were evident and a discrete distance was maintained from other snowy plovers. The brood from nest #34 (cell 8) stayed in the south end of cell 8 when other snowy plovers were present in other parts of the cell. It was noted that only when the other snowy plovers were absent from the cell would this brood forage in that area. The broods from nests #23 (cell 10) and #24 (cell 10) each fledged from cell 2. During brooding, other snowy plover adults or juveniles were not seen in this cell and brood territories seemed evident for each brood. The brood from nest #24 had used the south end of cell 10 for about 10 days after hatching, were not seen for about 10 days, but were seen to use cell 2 for the balance of the pre-fledging period. Broods from nest #20 and #27, which had hatched from cell 11, moved within this cell, and fledged from it. Distinct brood territories seemed evident for these two broods. The broods remained far from the central area of the cell where other snowy plovers were seen loafing and foraging. Also, the adult male tending the brood from nest #27 was twice seen pecking at the chicks from nest #20, presumably to evict them from its brood territory.

Western snowy plover foraging was sometimes observed for brief periods during the nesting survey or when observing broods. These limited observations suggest that snowy plovers run after, and peck from mid-air, small flying insects found while walking over the unvegetated flats and very shallow surface water of the flats. Western snowy plovers were also observed gleaning the surfaces of the substrate and shaking 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 the ocean beach, but this study did not make regular observations there. The salt flat and pond areas were often the location where snowy plovers would loaf in groups, sometimes associated with other bird species, particularly semipalmated plovers (*Charadrius semipalmatus*) which appeared at Bolsa Chica in large numbers in the late summer. Cells 4, 8, and to a lesser degree cell 11, were most frequently used, and they were used by more loafing snowy plovers than all other cells, particularly in June and July.

Two banded adult western snowy plovers were seen nesting at Bolsa Chica in 1998. 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 (#22) at Bolsa Chica in June (Jill Terp, pers. comm.). This bird was seen at Bolsa Chica until late July but was not seen nesting again. A second female (BBKB) observed at Bolsa Chica was banded as an adult at Chula Vista Wildlife Preserve, San Diego Bay in May 1998 (Jill Terp pers. comm.). It nested once at Bolsa Chica (nest #19) in June. It and its brood were not seen again after the first week of July. A solitary male (KGWS) was seen on May 19th but not after.

Western snowy plover interactions with other nesting bird species at Bolsa Chica were observed, primarily with the black-necked stilt (*Himantopus mexicanus*). The black-necked stilt is omnipresent at Bolsa Chica and nests in many 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 domain of the intruders. Black-

necked stilt nest locations were not marked, therefore it was not possible to determine if black-necked stilts were a significant factor in determining where western snowy plovers nested at Bolsa Chica. Occasional interactions with killdeer (*Charadrius vociferus*) were also noted, particularly when adult snowy plovers would try to drive away the killdeer.

No predation of snowy plovers was directly observed during this study but about 29 percent of nests (10 of 34) were estimated to have been lost to egg robbing predators. In a few cases, canid tracks were seen in the vicinity, suggesting a feral dog or coyote may have been the culprit. In most cases, little physical evidence was observed. Coyotes (*Canus latrans*) were seen regularly during our survey within our study area. As many as five at one time were noted, and two different den sites were suspected, but not investigated. A coyote was seen capturing a black-necked stilt chick.

A most likely suspect in snowy plover egg predation is the American crow which is also omnipresent and occasionally very abundant in the Bolsa Chica. A flock of fifty crows were seen to settle into cell 10 in late May, apparently searching for eggs and chicks of several ground nesting species nesting there, probably including western snowy plovers, American avocet (*Recurvirostra americana*), black-necked stilt, and killdeer. Crows were seen stealing killdeer eggs. 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. 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 likely prey for kestrels as well.

In an effort to reduce predation pressure on the California least tern and western snowy plover breeding at Bolsa Chica, predator management efforts were undertaken. The primary chick predator was the kestrel and 14 were captured and transported from the area from May to August. It was possible to remove only one crow. The loggerhead shrike was seen to cause western snowy plover adults to attempt distracting the shrike away from chicks, and the chicks to lie motionless. Although no snowy plover chick loss to shrike was directly observed, shrikes are thought to have taken snowy plover chicks. No loggerhead shrikes were captured, however. Similarly, coyote were regularly observed at Bolsa Chica, and some egg predation may have been attributed to them, but no effort was made to capture them.

With the closure of specific road sections where snowy plover nests had been initiated, disturbance of those vulnerable nests from vehicle traffic was eliminated. Once an Orange County vector control vehicle operator removed the barricade to drive along a closed road section. Luckily, no harm was done to the plover nest there and further problems were averted through ongoing discussions with that agency. Vector Control did conduct multiple helicopter overflights of Bolsa Chica during the snowy plover breeding season to spread mosquito abatement pellets and caused no apparent disturbance or harm to the plovers in so doing.

In 1996, western snowy plover activity was monitored weekly at Bolsa Chica and nest locations were mapped (Guthrie 1996, Figure 9). We also mapped 1997 nest locations (Fancher 1998, Figure 10). It can be seen from these maps that several cells that supported western snowy plover nests in 1998 (Figure 3), had also supported nests in 1996 and 1997, as well. In particular, cells 4, 10, and 11 were most heavily used in all three years.

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 surface, if protected from vehicle traffic will also suffice as a snowy plover nesting habitat if access to forage areas for pre-fledgling chicks is maintained. Particular areas of Bolsa Chica support most of the western snowy plover nests and brood rearing. Chick and egg predation are important factors in reducing reproductive success.

Acknowledgments

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Figures

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Table 1. Snowy plovers banded at Bolsa Chica Wetlands, 1998.

DATE	NEST #	CELL #	# CHICKS	BAND #S	COLORS
6 July	19	4	1	12201	Y/N:B/B
7 July	20	11	1	12202	Y/N:B/G
7 July	19	4	1	12203	Y/N:B/B
8 July	24	10	2	12204-5	Y/N:B/R
11 July	25	4	2	12206-7	Y/N:B/W
12 July	23	10	2	12208-9	Y/N:B/Y
12 July	23	10	1	12210	Y/N:Y/B
31 July	32	5	2	12211-12	Y/N:G/B

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

Table 2. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 1998.

NEST #	CELL #	# EGGS	DATE ¹	#HATCH	DATE	MOVE ²	#FLEDG	DATE
1	3 road	3	4-5	3	5-5	2,200 ft	2	6-5
2	island	1?	4-9	0	5-15			
3	3 road	3	4-20	3	5-15	3,100	2	?
4	4	3	4-21	0	P 4-23	-	-	-
5	10	3	4-23	3	5-20	440	1	6-22
6	22	2	4-20	0	P 5-1	-	-	-
7	10	3	5-8	0	P 5-27	-	-	-
8	14	1	5-8	0	W 5-15	-	-	-
9	9	3	5-19	3	6-3	1,100	2	7-8
10	9	2	5-19	0	P 5-22	-	-	-
11	8 road	3	5-19	3	6-7	3,500	1	7-8
12	3 road	3	6-12	3	6-21	-	-	-
13	3 road	3	5-25	2	6-10	3,100	2	7-9
14	10	3	5-25	0	P 6-6	-	-	-
15	3 road	3	5-29	3	6-22	2,200	-	-
16	4	1	6-2	0	A 6-11	-	-	-
17	10	3	6-2	0	P 6-19	-	-	-
18	11	3	6-11	0	P 6-16	-	-	-
19	4	3	6-12	3	7-6	1,760	-	-
20	11	3	6-11	3	7-6	1,250	3	8-2
21	11	3	6-11	0	P 6-16	-	-	-
22	4	3	6-12	2	7-7	-	-	-
23	10	3	6-16	3	7-11	700+	3	8-12
24	10	3	6-16	3	7-8	700	3	8-11
25	4	3	6-16	3	7-9	250	-	-
26	3 road	3	6-21	0	A 6-30	-	-	-

27	11	3	7-7	2	7-18	250	2	8-21
28	3 road	3	7-7	2	7-18	-	-	-
29	6	3	7-7	2	7-24	-	-	-
30	11	3	6-30	3	7-18	-	-	-
31	10	3	7-7	0	P 7-14	-	-	-
32	5	3	7-7	3	7-30	2,650	2	8-30
33	11	3	7-7	0	P 7-9	-	-	-
34	8?	3?	?	2	8-24	250	2	9-27
TOTALS:		94		55			25+	

P = predated; A = abandoned; W = washed out.

¹ The date shown in this column is the date when the clutch was observed to be completed, rather than the date the first egg was seen.

² The distance shown in this column is the maximum distance that a brood was seen from the location of the nest it hatched from, before fledging.

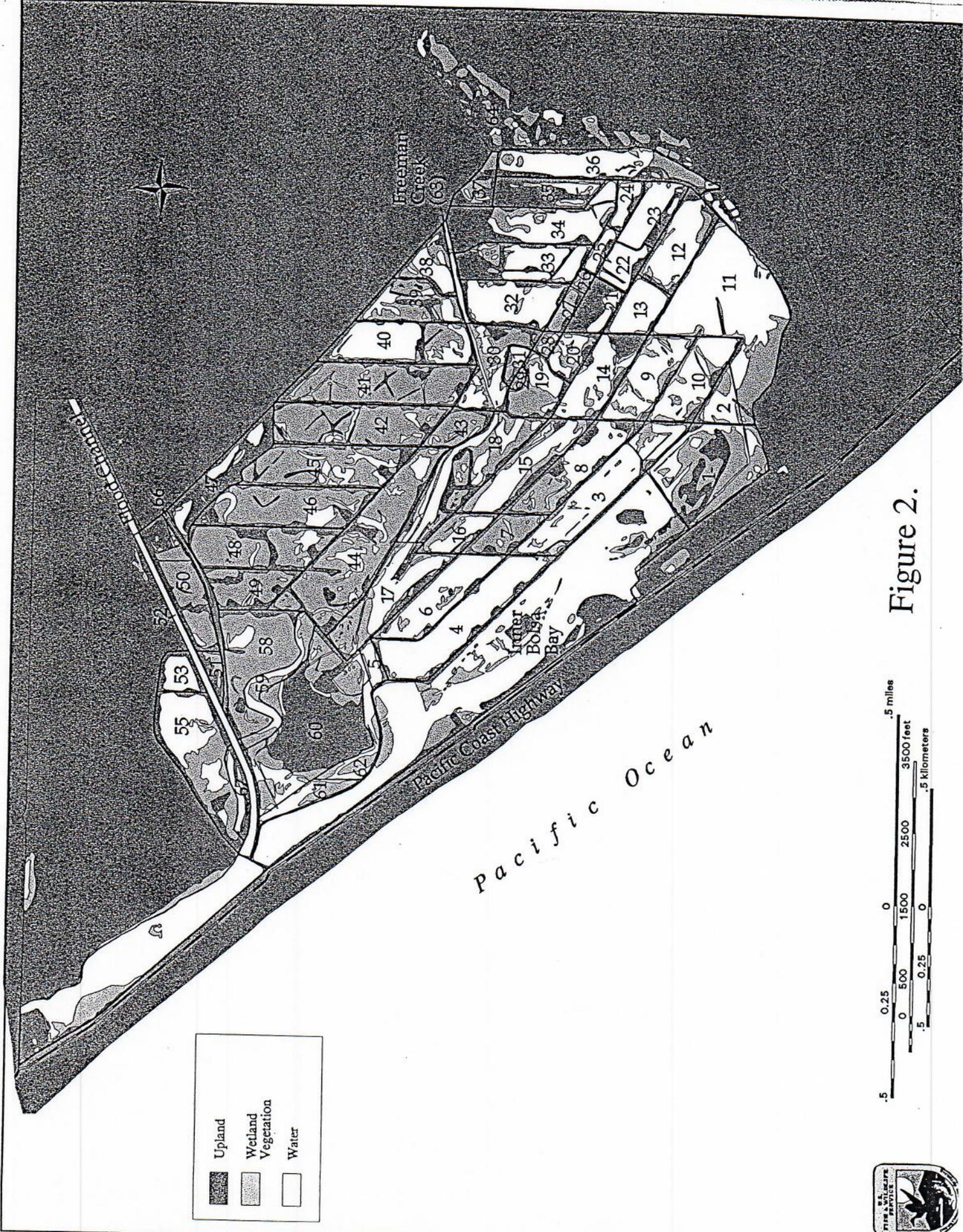
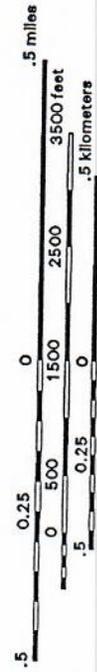
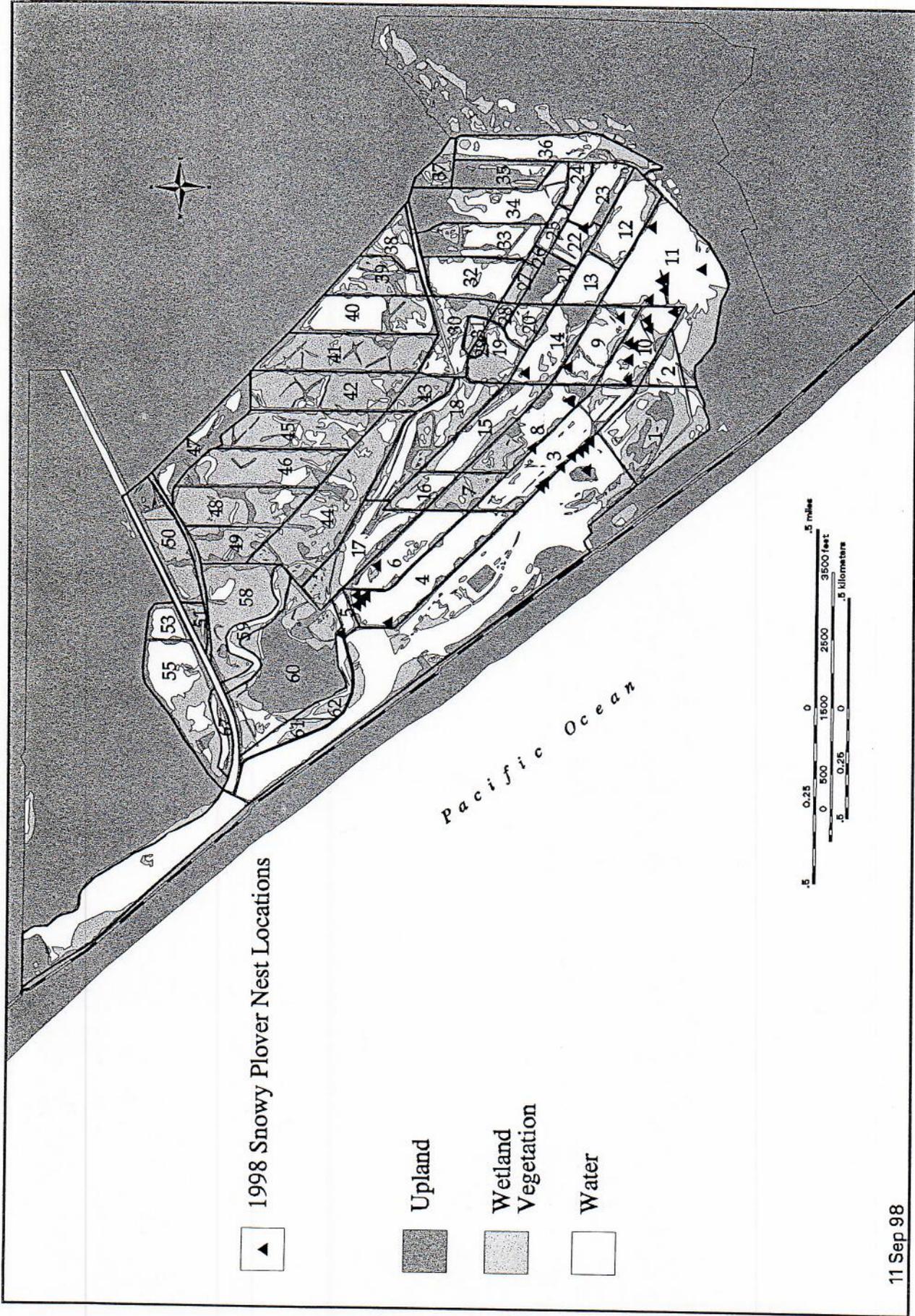


Figure 2.





11 Sep 98

Figure 3.

Western Snowy Plover

Bolsa Chica 1998 Survey

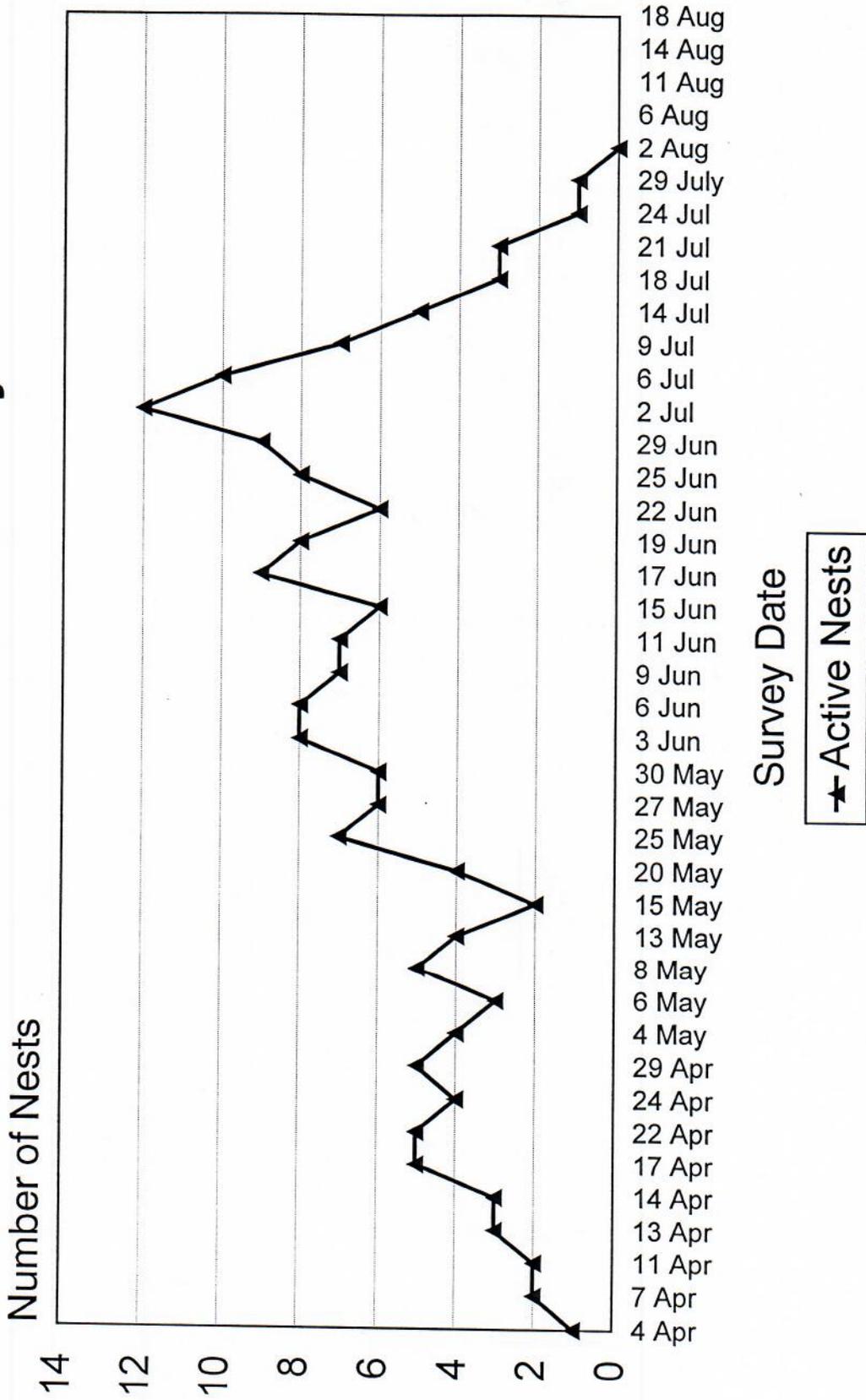


Figure 4.

Western Snowy Plover - Bolsa Chica 1998

Nest Initiation, Hatching, & Loss Dates

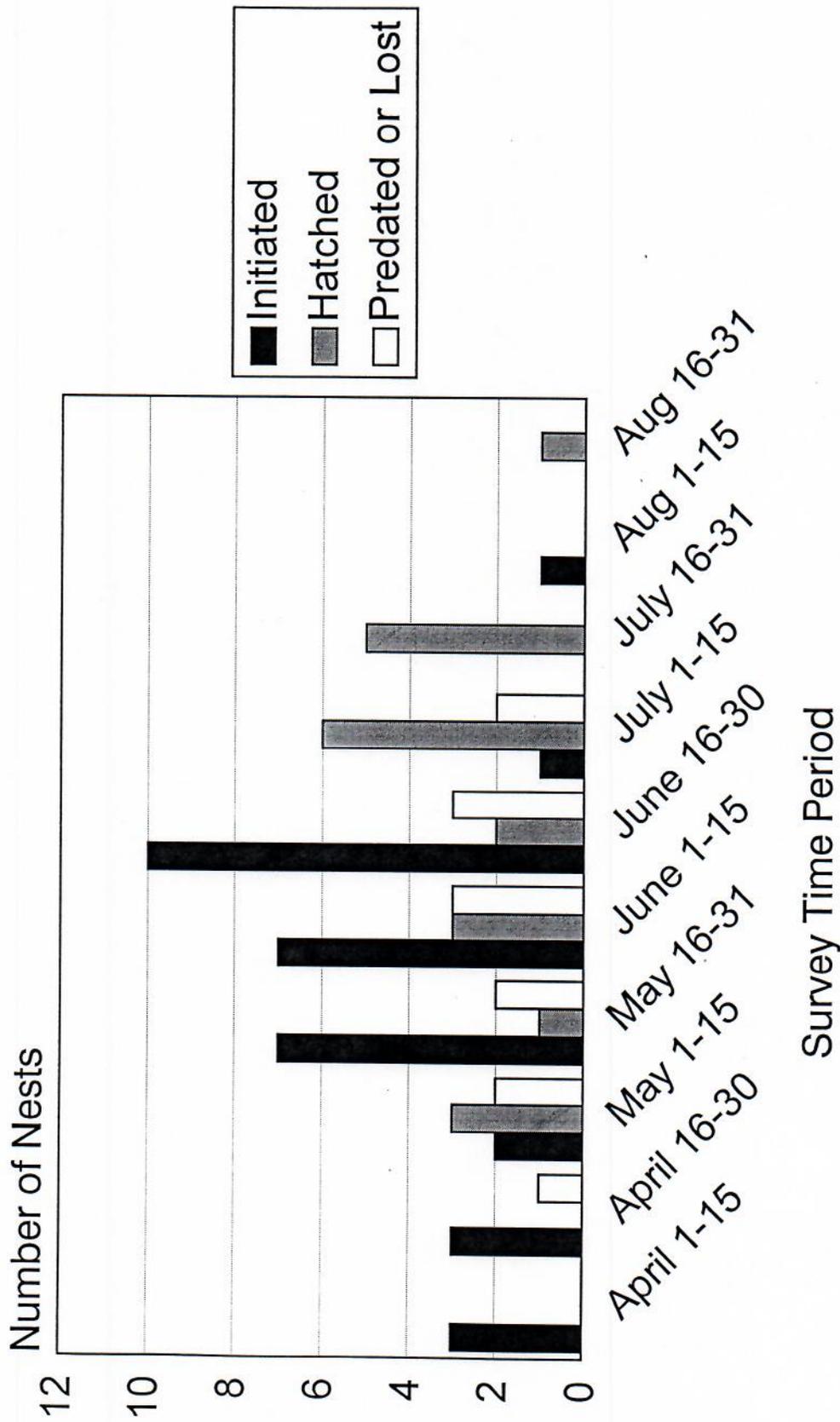


Figure 5.

1998 Snowy Plover Nest Timeline

Note	4/5 1998	4/12 1998	4/19 1998	4/26 1998	5/3 1998	5/10 1998	5/17 1998	5/24 1998	5/31 1998	6/7 1998	6/14 1998	6/21 1998	6/28 1998	7/5 1998	7/12 1998	7/19 1998	7/26 1998	8/2 1998	8/9 1998	8/16 1998	8/23 1998		
Nest #1 - rd cell 3/SI																							
Nest #2 - S. Nesting I.																							
Nest #3 - rd cell 3/SI																							
Nest #5 - cell 10																							
Nest #4 - cell 4																							
Nest #6 - cell 22																							
Nest #8 - cell 14																							
Nest #7 - cell 10																							
Nest #10 - cell 9																							
Nest #9 - cell 9																							
Nest #11 - rd cell 3/8																							
Nest #14 - cell 10																							
Nest #12 - rd cell 3/SI																							
Nest #13 - rd cell 3/SI																							
Nest #15 - rd cell 3/SI																							
Nest #16 - cell 4																							
Nest #18 - cell 11																							
Nest #17 - cell 10																							
Nest #19 - cell 4																							
Nest #21 - cell 11																							
Nest #20 - cell 11																							
Nest #22 - cell 4																							
Nest #23 - cell 10																							
Nest #25 - cell 4																							
Nest #24 - cell 10																							
Nest #26 - road cell 3/SI																							
Nest #27 - cell 11																							
Nest #28 - rd cell 3/SI																							
Nest #29 - cell 6																							
Nest #31 - cell 10																							
Nest #30 - cell 11																							
Nest #32 - cell 62																							
Nest #33 - cell 11																							
Nest #34 - cell 8																							

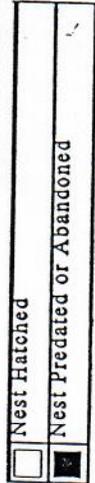


Figure 6.

Western Snowy Plover

Bolsa Chica 1998 Survey

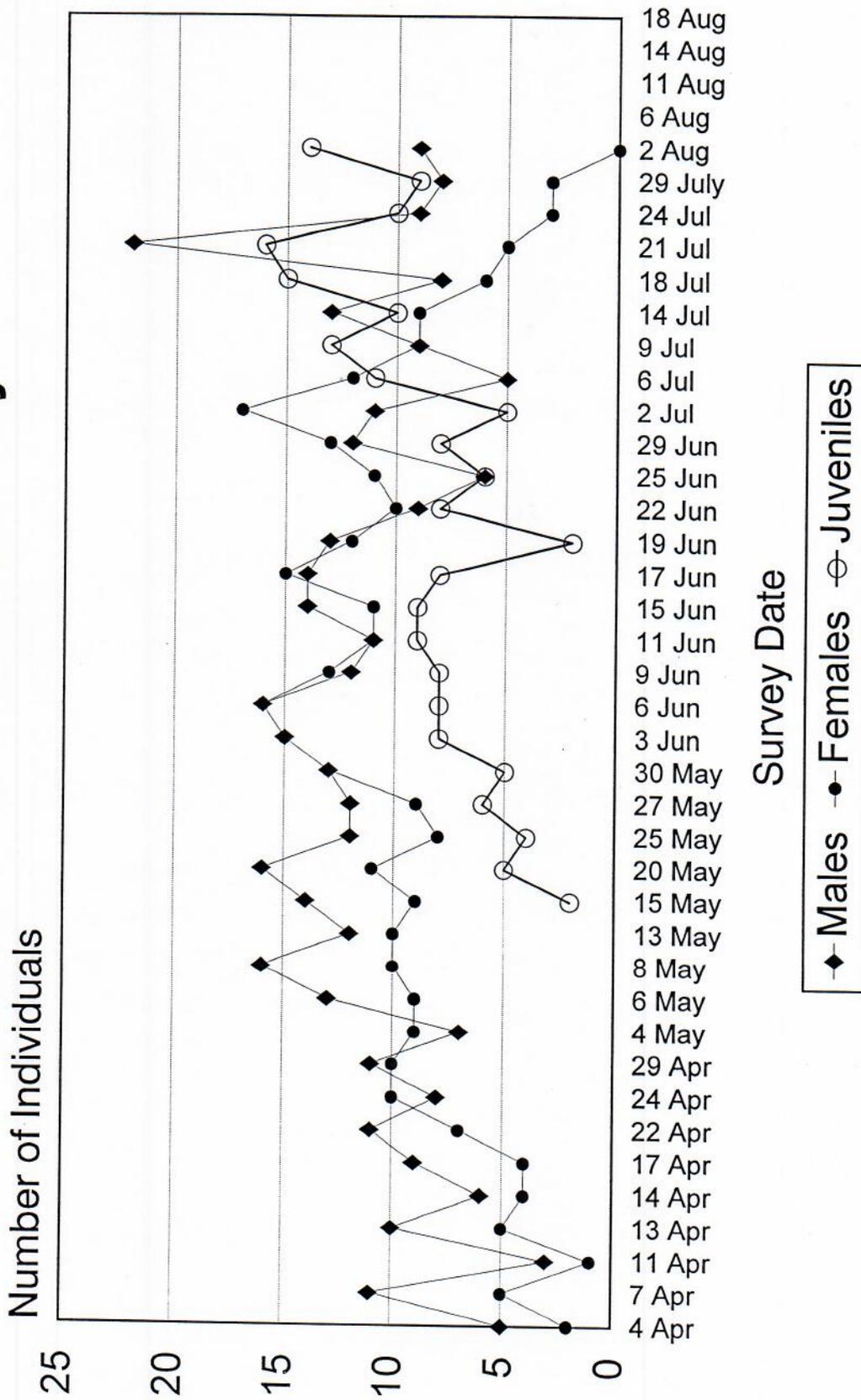


Figure 7.

Western Snowy Plover

Bolsa Chica 1998 Survey

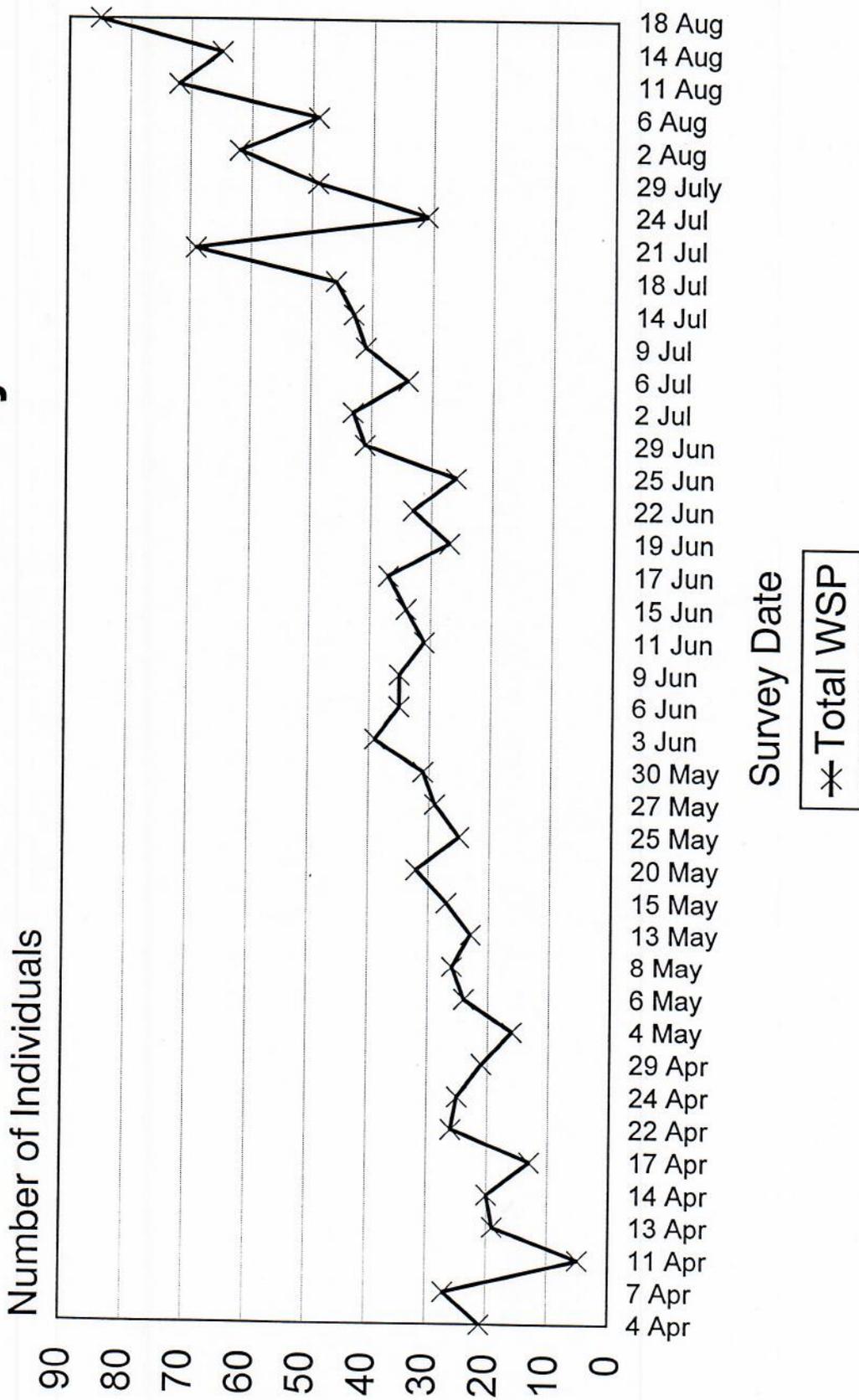


Figure 8.

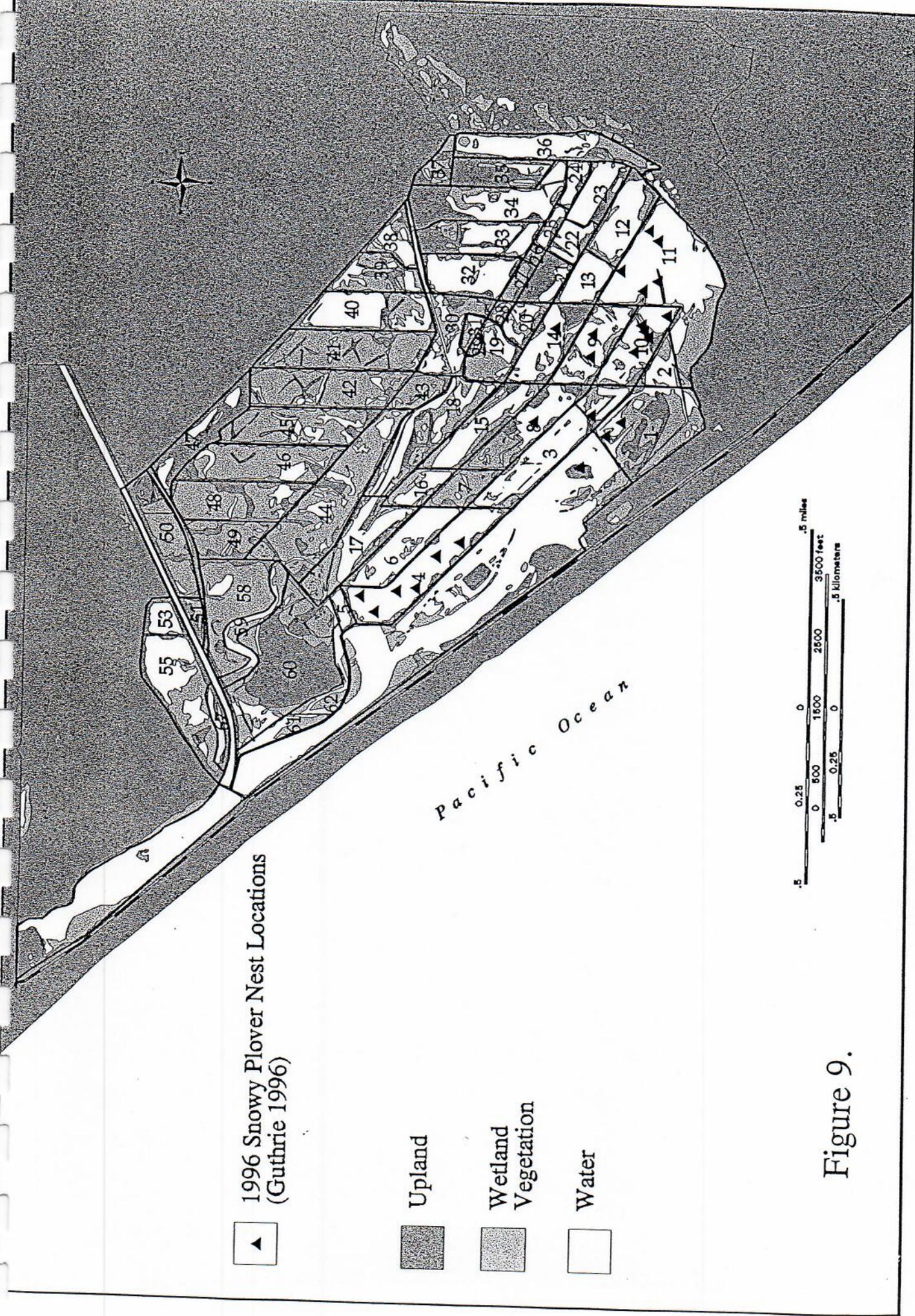
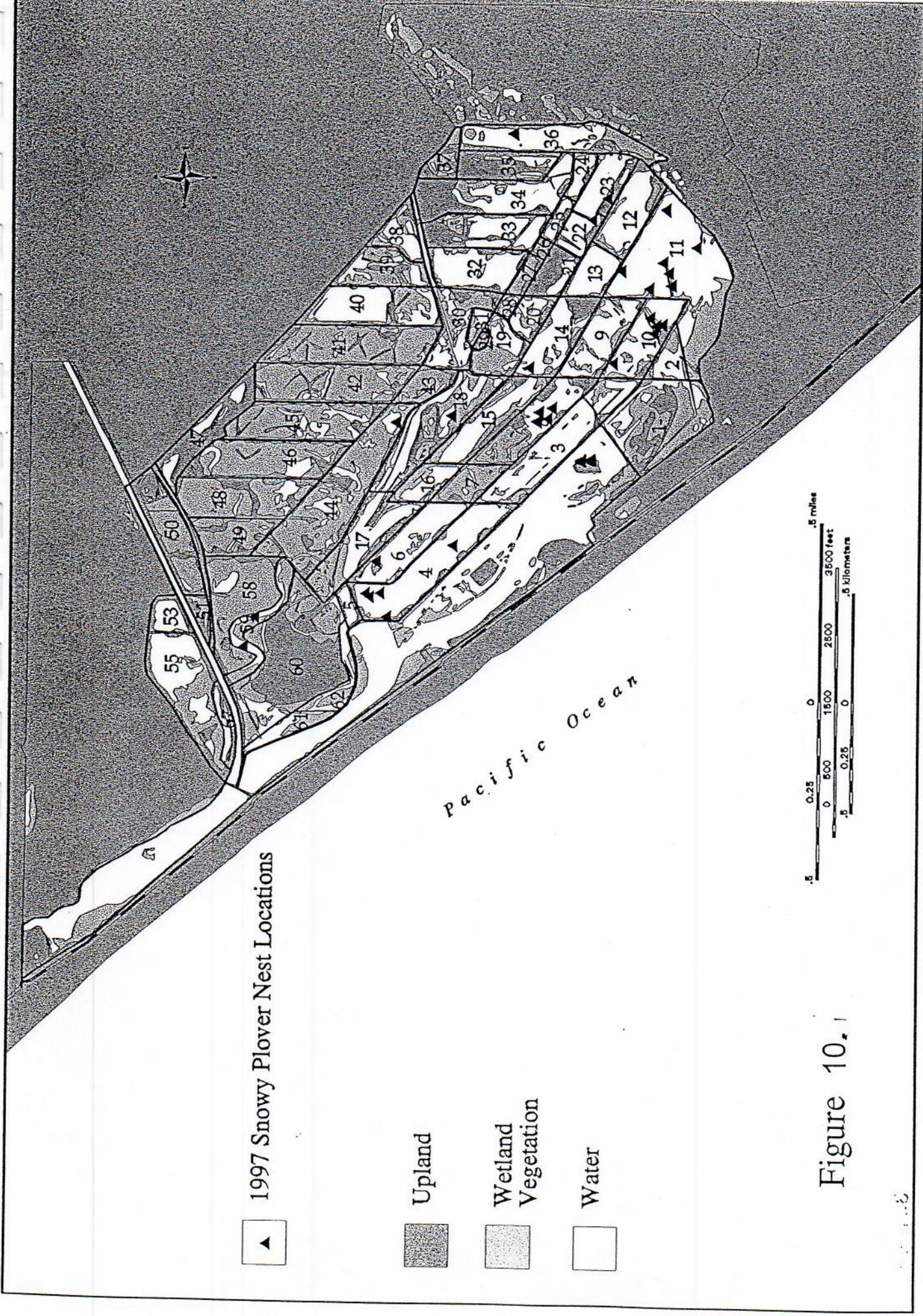


Figure 9.



▲ 1997 Snowy Plover Nest Locations

■ Upland

■ Wetland

□ Water

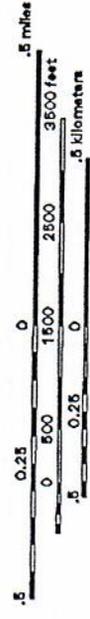


Figure 10.1