Western Snowy Plover Banded Female black black black photo by P. Knapp

Western Snowy Plover Nesting at Bolsa Chica, Orange County, California 2004

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Introduction

In February 1997, the Bolsa Chica lowlands in Orange County, California were acquired into public ownership. This marked the beginning of a multi-agency effort to design, evaluate, and implement a plan for restoring the fish and wildlife habitats of the lowlands which had been cut off from the ocean for a century and an operating oil field for 50 years. Construction of the restoration project began after the 2004 snowy plover breeding season.

The purpose of this investigation is to continue to improve the level of knowledge about the western snowy plover, a federally listed, Threatened species that currently uses Bolsa Chica, and to attempt interim management actions to benefit the reproductive success of this species. This annual study was first initiated in 1997 and is expected to continue at least through completion of construction of the Bolsa Chica restoration project in 2006. This report addresses the 2004 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.

Snowy Plover nest with one chick hatched by J. Fancher

The breeding season of the western snowy plover extends from March 1 through September 15. Generally, three eggs are laid in a nest on the ground which consists of a shallow depression scraped in the substrate. Some nests are lined with plant parts, small pebbles, or shell fragments. Both sexes incubate the eggs for an average of 27 days. Snowy plovers will renest after loss of a clutch or brood. Snowy plover chicks are precocial and leave the nest within hours of hatching in search of food. The tending adult(s) provide danger warnings, thermo-regulation assistance, and guide the chicks to foraging areas, but do not

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 2004 coastal California Snowy Plover breeding season survey estimated 1,904 individuals, found almost equally north and south of the Santa Barbara - San Luis Obispo County line.

Our studies from 1997-2004 have examined the scope, magnitude, and problems of snowy plover breeding activity at Bolsa Chica.

Bolsa Chica Study Area

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

Bolsa Chica Aerial Photo, August 2003 (dark=water, white=flats, brown=vegetation)

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.

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

Study Methods

The study area is demarcated into subareas (cells) by the network of slightly elevated roads constructed for access to the oil wells. These cells were numbered and formed the basis for observer navigation, nest mapping, and data recording. Some areas in the vicinity of our Bolsa Chica study area were not surveyed in this study, although western snowy plovers may have used the habitats for foraging or loafing. Those areas are the ocean beach immediately to the west at Bolsa Chica State Beach, the full tidal area of outer Bolsa Bay. See figure 1. The study area included all the numbered cells, except cells 47 (Fieldstone property) and 64 (the Edwards Thumb), which remain in private ownership.

Retrieval of ME after snowy plover nest has hatched

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

Beginning late-March, observers surveyed for nesting western snowy plovers at least twice a week, sometimes 4 or 5 times a week, until mid- September. The large majority of suitable western snowy plover nesting habitat was visible from the road network. Usually

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

Snowy Plover female by ME covered nest on road edge by J. Fancher

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

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

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

Five still cameras with passive infrared motion detector triggers (*Camtrackers*©), were placed 4-5 meters from selected snowy plover nests. The camera motion sensor was aimed to

detect motion just above the plover nest to avoid causing the camera to fire when the plover adult moved on or to and from the nest. These cameras were thus deployed on a variety of nests throughout the plover breeding season. This camera model must auto-focus before shooting the picture, incurring a delay that sometimes fails to photograph the moving object that caused it to fire. Also, the sensor apparently reacts best with larger objects, such as larger birds or skunks.

Coyote inspects but does not harm snowy plover nest

Results and Discussion

NEST CHRONOLOGIES AND DISTRIBUTION

Winter rainfall preceding the 2004 nesting season was less than usual. The extent of unflooded flats, suitable for snowy plover nesting, was greater in March through May, compared to most previous years. Through April, 28 percent of the total 2004 nests (18/65) had been initiated. Eighteen nest initiations before May 1 is a much greater number than in any previous year (4 nests before May 1 in 2003, 9 in 2002, 4 in 2001, 5 in 2000, 8 in 1999, 6 in 1998, and 3 in 1997). The proportion of total nests initiated in the early 2004 breeding season, March/April, (28%) also exceeded previous years (13% in 2003, 18% in 2002, 7% in 2001, 13% in 2000, 21% in 1999, 18% in 1998, and 10% in 1997). Table 1 provides the cell location, start and end dates, nest fates, chicks and fledglings produced for each nest. Figure 2 depicts the location of nests in the cell map of Bolsa Chica.

In April and May, with extensive dry flats available, in addition to the road tops and tern nesting islands, only four of the first thirty one nests were located on a road top. The south tern island (STI) in the Bolsa Chica Ecological Reserve attracted five of the nest attempts through May. No nests were initiated on STI or a road top after May 31. Table 2 lists the nest and fledgling production distribution by cell. In 2004, cell 11 attracted thirteen nest attempts but nearly half (6) of those nests were lost to predation. The number of fledglings that hatched from nests started in cell 11 was only 11. Cell 4 attracted 9 nests, but 18 fledglings resulted from those nests.

In 2004, the first nest was found March 24. The last nest was started July 21, and the latest nest hatching occurred on August 13 (Table 1, Figure 4). Through most of April, the number of active nests was much larger than average for the preceding seven years, peaking at 16 active nests on April 24. Considering the seven previous breeding seasons of this study, Bolsa Chica had sustained 16 or more active nests only twice and both times in early July. In May 2004, active nests "sank" back down to the 7-year average level, then peaked again at twenty on June 27 (Figure 5).

Snowy plover nests at Bolsa Chica have as varied appearances as the substrates found throughout the lowlands. Some nests area lined with small pebbles, shell fragments, dry plant

parts, while some appear no more than an existing depression or slightly excavated mud bowl. Plates are attached depicting an assortment of snowy plover nest configurations in 2004.

The April peak of nests resulted in an "early" peak of hatching nests in May (Figure 4). The second peak of nest initiations resulted in a second peak of hatching nests in July. This gave the 2004 active nest chronology a unique double hump that is not evident in the seven year average or in any previous individual year at Bolsa Chica.

EGG, CHICK, AND FLEDGLING PRODUCTION

Of 65 total nests in 2004, all but three were judged to be 3-egg clutches (Table 1). Twelve of the 65 total nest attempts were lost to predators, one more nest was abandoned. Thus, 52 nests survived to hatch (hatching success rate of 80% or nest failure rate of 20%). At least 191 snowy plover eggs were produced at Bolsa Chica in 2004, 33 eggs were taken by predators and 9 eggs failed to hatch. From those 52 nests that hatched, 149 chicks were produced. Of these 149 total chicks, 79 chicks survived to fledge (53% chick survival). Thirty nine broods produced at least one fledgling. Ten broods had all three chicks survive to fledge, and fourteen broods had no chick survive to fledge.

The 18 nests initiated before the end of April (28% of the total nests) produced 52 eggs, 46 chicks, but only 6 fledglings. The 47 nests started after April 30 produced 102 eggs and 72 fledglings. Chick survival of the first nests was 13%, while chick survival of all later nests was 70%.

NUMBERS OF MALE, FEMALE, AND JUVENILE SNOWY PLOVERS

During most of April and May of 2004, the total number of snowy plovers present at Bolsa Chica was between 25 and 45, although the total climbed to 68 in early May partly due to the presence chicks (Figure 6) . Through mid-May and June the total fluctuated between 40 and 65. This pattern is very similar to previous years, although total number of snowy plovers present during May of 2004 was higher than any previous year. March through mid-May, females fluctuated between 6 and 22, but numbering about 20 in the late April to early May and 24-25 in the June-July nest peak. Males fluctuated between 11 and 23, and was at 20 individuals at the June nest peak. Males seemed to become relatively scarce after late June, although gender identity becomes less and less obvious late in the breeding season.

BROOD TRACKING

Three "nests" were discovered after they had hatched and the location of the "new" brood, when first observed, was inferred to be the location of the nest. Twenty three broods remained in the cell from which they had hatched, while 26 broods relocated at least one time to another cell.

Unlike previous years when we observed that females did virtually all of the incubation of eggs and males did all of the brood rearing, in 2004, 14 of 49 (37%) broods were led mostly

or entirely by females. Due to the chronological and geographic spacing of each brood, it is usually possible to locate and identify individual broods over the entire several week period before they fledged. Each brood tended to stay together and the males prevented overlap or co-mingling with other broods. However, in 2004 we observed some instances of broods combining or chicks being "adopted" into another brood. In one case, two nests located near each other simultaneously hatched six chicks and both broods were found to have been relocated (STI/3 Road to cell 8). One chick was lost and five chicks were tended by one female for three weeks until all five chicks fledged. In another case, two separate broods (of 3 chicks each) were apparently combined when one relocating brood entered the other's territory. This resulted in a 5-chick brood for about 4 days. They separated into a 3-chick brood and a 2-chick brood, both broods moved to separate cells, but one chick was missing. In this same few days, a 3-chick brood in an adjacent cell, became a 4-chick brood. Thus, in the turmoil of relocating and mixing broods, one chick separated from its natal brood and was "adopted" by an unrelated brooding adult. This 4-chick brood was led by a female who successfully reared all four chicks to fledge.

OBSERVATIONS OF BANDED ADULTS

One female (øKKK), hatched at Camp Pendleton in 1999, nested twice at Bolsa Chica in 2000, and three times in 2001, with two surviving nests hatching five chicks. In 2002, øKKK nested twice (nest 20 in cell 11 and nest 32 in cell 14), producing two chicks. In 2003, she nested twice at Bolsa Chica (nest 12, lost to predation on Road STI/3 and hatched nest 21 in cell 9). In 2004, she incubated one nest in cell 11 to hatching in May. She may have incubated a second nest in cell 11 in July but no positive confirmation of her band code was obtained.. Another female (RBKB) nested once unsuccessfully at Bolsa Chica in 2004. 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. She attempted one nest at Bolsa Chica in 2003 which was lost to a predator. A male (RBRPink) had two broods at Bolsa Chica in 2004, with 3 chicks fledging. In 2003 he was seen with one brood. This male hatched at Moss Landing in 2001.

PREDATION

In 2004, 18.5% of all nests (12 of 65 nests, Table 2), were lost to predation. Only one nest was abandoned. 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 categories (Figure 7). The 2004 proportion of nests hatching (80%) and fledglings produced per nest (1.2) was second highest to 2003 (Figure 9).

Striped skunk near predated plover nest with ME

This low rate of nest loss is attributable to the deployment of MEs. We placed an ME on each nest as soon as the nest had been discovered. The ME design is very effective at preventing crows or ravens from stealing snowy plover eggs. It was determined that three nests, not protected by an ME, successfully hatched after the newly hatched broods were discovered.

Disturbance signs were largely absent from most predated plover nests in 2004. That is, the nest scrape and surrounding ground surface was apparently undisturbed, no tracks or egg shell fragments were evident, and there was no bending or lifting of the ME wire. Desultory digging marks were noted on one lost nest outside the ME, apparently made before the suspected ground squirrel, *Spermophilus beechii*, discovered that it is able to pass through the mesh. In another case, faint "rake" marks, as though from a small clawed paw had pulled the nest rim down by reaching through the ME mesh, suggested a skunk with a 9-10 inch reach. Ground squirrel, activity near nest sites before and after plover nest loss was a clue, but a squirrel was confirmed as a egg stealing predator when we placed quail eggs in the just-robbed plover nest scrape. These auto-camera photos and the presence of abundant squirrels and skunk signs led to a conclusion that of the dozen nests lost to a predator, five were probably due to ground squirrel, four were probably due to striped skunk, *Mephitus mephitus*, and three were likely squirrel but could have been skunk.


Ground squirrel stealing eggs

Four nests had camera coverage during the predation event but the cameras failed to fire (due to moving object beneath detection cone, or too small, sensor or battery malfunction). It does appear that ground squirrels may be low enough to the ground to evade our camera sensor detection zone which is partially screened so plover motion does not trigger the camera. Based on the photos, digging marks, direct observation, and relatively high abundance of squirrels, we made striped skunk and ground squirrels in areas of active snowy plover nests a target of our predator management efforts. Direct removal and poisoned bait stations for ground squirrels were implemented in mid-June, as was trapping for skunk. No plover nest or egg losses were known after that.

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.

Ninety nine crows were removed from Bolsa Chica in 2004 (Ross 2004). 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. The detection of West Nile virus (WNV) in Orange County in 2004 did not elicit any obvious reduction in the crow or raven populations around Bolsa Chica. Blood from six crows taken from Bolsa Chica was tested for WNV but results were negative. We again activated a modified Australian crow trap in mid-March 2004, located between cells 13 and 14. The crow trap was not effective and was discontinued after just two weeks. Use of the ME virtually eliminates snowy plover egg loss due to crows or ravens so that there may be less emphasis on eradicating crows and more on capturing chick predators.

Loggerhead shrike in trap

The most likely reasons for high snowy plover chick mortality in early 2004 is that American kestrel, *Falco sparverius*, and loggerhead shrike, *Lanius ludovicianus*, had re-occupied forage areas or were more abundant than in previous years. Chick predation was severe in the first part of the breeding season and kestrels are relatively abundant and can do great harm very quickly. Therefore, efforts to remove them from Bolsa Chica during the snowy plover breeding season continued by live-trapping and transporting them considerably inland. Loggerhead shrikes are not abundant, however just a few shrike foraging territories cover large portions of Bolsa Chica's snowy plover breeding areas. Shrikes were repeatedly noted in areas where plover chicks were disappearing. One such predation event was documented when a shrike was seen to kill an adult-sized snowy plover chick and begin flying away with it. Live-trapping and transporting of shrikes from Bolsa Chica during the 2004

Red-tailed hawk picks off new plover chicks

breeding season was continued.

As in 2002, a red-tailed hawk, *Buteo jamaicensis*, was captured on film preying upon newly hatched snowy plover chicks as they moved outside an ME. This is our only 2004 evidence that red-tailed hawk will take plover chicks, suggesting that their presence in the area of imminently hatching plover nests is inimical and they should be live-trapped and transported away. No hawk nest was known to be present in the Bolsa Chica lowland in 2004, as there was in 2002. This hawk was live-trapped and transported away from Bolsa Chica.

Just as the squirrel/skunk removal and deployment of MEs reduced plover egg losses, removal of certain raptors from the lowland greatly improved snowy plover chick survival. The circumstances of 2004, suggest that some predator management efforts, particularly ground squirrel and/or skunk removal should begin in advance of the plover breeding season and that kestrel and shrike captures must begin when plover eggs are about to hatch and continue for as long as plover chicks are present.

One instance of adult snowy plover predation was recorded in 2004. A female in the third week of incubating an ME-protected nest was found partially devoured just outside the ME covering its nest. There were no other signs of disturbance and the camera aimed at the nest did not capture the event. The predator was possibly a barn owl. *Tyto alba*. The plover eggs were not disturbed and the male assumed incubation duties, then successfully brooded two fledglings.

Adult snowy plover killed outside its ME, probably by an owl.

SUMMARY

Below average rainfall in 2004 resulted in an abundance of exposed flats early in the breeding season. Many more early nests then in any previous year resulted in two peaks of nest activity, one in April, the other in late June. Adult female numbers were higher than previous years but numbers of males were similar to 2002, 2001 and 1997. The abundance of both males and females was higher in April and May than in previous years. Total nest attempts (65) were

higher than all previous years and 18% more than the next nearest nest total at Bolsa Chica. Deployment of mini-exclosures (ME) on every nest was very effective at preventing egg losses to crows and ravens. However, ground squirrels were verified to be egg stealers, with loss of between five and eight nests due to ground squirrel. Between 4 and 7 more ME protected nests were probably lost to striped skunk. One incubating female adult snowy plover was found partially devoured just outside the ME covering its eggs.

About twice as many eggs hatched into chicks (149) in 2004 than the next highest prior year of this study at Bolsa Chica (75 in 2002, and 76 in 2003). However, just 53% of chicks survived to fledge which ranks in the middle of prior year's chick survival rates. The major chick predators are American kestrels and loggerhead shrikes, although red-tailed hawk will take plover chicks under some circumstances. Despite the loss of chicks, fledgling production in 2004 (79) was 38.5% higher than the next highest year (57 fledglings in 2001), setting a new record for Bolsa Chica fledglings produced in a breeding season.

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Tables

Figures

Plates

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Table 1. Snowy plover eggs laid, chicks hatched, and fledged at Bolsa Chica, 2004.

Nest #	Cell #	date found	date ended	eggs	nest fate	chicks	fledglings
1	10	3-24	4-26	3	**H**	2	0
2	19	3-27	4-28	3	**H**	3	0
3	18	3-31	4-28	3	**H**	3	0
4	STI/3Rd	4-1	5-4	3	**H**	3	1
5	9	4-2	5-5	3	**H**	3	0
6	1/3Rd	4-3	4-11	2	P	-	-
7	STI	4-4	5-4	3	**H**	3	0
8	4	4-7	5-7	3	**H**	3	3
9	4	4-7	5-8	3	**H**	3	1
10	STI	4-8	5-7	3	**H**	3	0
11	STI	4-8	5-10	3	**H**	3	0
12	11	4-13	5-10	3	**H**	3	1
13	11	4-17	5-10	3	**H**	3	0
14	22	4-19	5-11	3	**H**	3	0
15	3	4-19	5-19	3	**H**	3	0
16	9	4-22	5-4	3	P	-	-
17	14	4-23	5-23	3	**H**	3	0
18	STI/3Rd	5-5	6-7	3	**H**	2	0
19	22	5-7	5-14	3	P	-	-
20	10	5-10	5-31	3	P	-	-
21	11	5-14	5-21	3	P	-	-
22	11	5-17	5-24	3	P	-	-
23	4	5-21	6-9	3	A	-	-
24	18	5-22	6-17	3	**H**	3	0
25	10	5-23	6-2	3	P	-	-
26	11	5-26	6-5	3	P	-	-
27	STI	5-27	6-22	3	**H**	3	3
28	STI	(4-30)	5-27	3	**H**	3	0

Nest #	Cell #	date found	date ended	eggs	nest fate	chicks	fledglings
29	9	5-27	6-12	3	**H**	3	1
30	STI/3Rd	5-27	6-22	3	**H**	3	2
31	STI/3Rd	5-27	6-22	3	**H**	3	3
32	10	6-1	6-21	3	**H**	3	2
33	4	6-1	6-30	3	**H**	3	3
34	10	6-4	6-29	3	**H**	3	2
35	11	6-5	6-28	3	**H**	3	3
36	10	6-6	6-28	3	**H**	3	1
37	11	6-7	7-5	3	**H**	3	1
38	11	6-7	6-15	3	P	-	-
39	4	6-9	7-7	3	**H**	2	2
40	11	6-9	6-15	3	P	-	-
41	10	6-9	7-7	3	**H**	3	2
42	11	6-10	6-15	3	P	-	-
43	4	6-11	7-10	3	**H**	3	2
44	10	6-12	6-12	1	P	-	-
45	18	6-12	7-5	2	**H**	2	2
46	4	6-16	7-16	3	**H**	3	2
47	13	6-16	7-13	3	**H**	3	4
48	10	6-16	7-13	3	**H**	1	1
49	6	6-23	7-20	3	**H**	3	3
50	10	6-23	7-20	3	**H**	3	2
51	4	6-23	7-20	3	**H**	3	3
52	9	6-23	7-19	3	**H**	3	3
53	59	(6-1)	6-29	3	**H**	3	1
54	11	6-25	7-20	3	**H**	3	3
55	4	6-26	7-25	3	**H**	3	2
56	10	6-28	7-21	3	**H**	3	3
57	11	7-3	7-18	3	**H**	3	2

Nest #	Cell #	date found	date ended	eggs	nest fate	chicks	fledglings
58	10	7-3	7-31	3	**H**	3	3
59	11	7-3	7-18	3	**H**	3	1
60	22	7-8	8-1	3	**H**	3	2
61	9	7-13	8-8	3	**H**	3	1
62	12	7-19	8-11	3	**H**	2	1
63	12	7-20	8-13	3	**H**	3	2
64	22	7-21	8-1	3	**H**	3	2
65	30	(6-22)	7-21	3	**H**	3	3
2004 Season Totals				**191 eggs**	**12P 52H 1A**	**149 chicks**	**79 fledglings**

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

P = predated; A = abandoned; H - hatched

Table 2. 2004 Nest and Fledgling Distribution by Cell

Location	# total nests	# nests lost	# nests hatched	# fledged*
cell 11	13	6	7	11
10	12	3	9	16
4	9	1	8	18
9	5	1	4	5
STI	5	0	5	3
STI/3 Rd	4	0	4	6
22	4	1	3	4
10 other cells	13	1	12	16
	65	13	52	79

*number of chicks hatched from this cell that survived to fledge. Many had relocated to another cell by the time they fledged, however.

Table 3. Males, Females, Nests and Fledgling Production

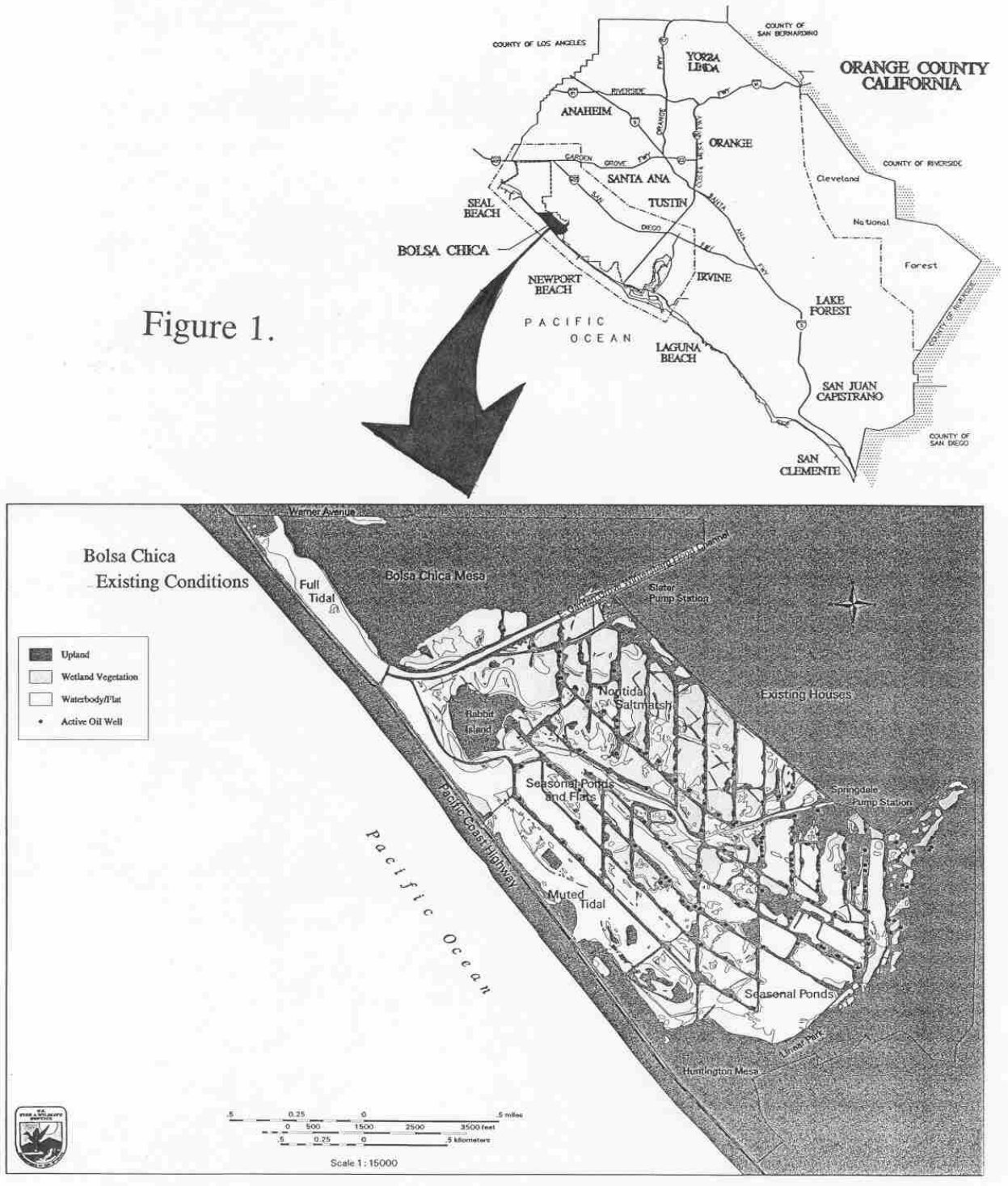
	Fem	Males	Total Nests	Fledglings	total Fl/nest	% chick survival	Fl/male
2004	25	20	65	79	1.22	53.0	4.0
2003	15	16	32	44	1.38	57.9	2.8
2002	19	20	50	27	0.54	36.0	1.4
2001	19	18	55	57	1.04	90.5	3.2
2000	15	16	39	42	1.08	82.4	2.6
1999	12	11	38	23	0.61	32.4	2.1
1998	11	16	34	25	0.74	37.3	1.6
1997	14	20	30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

Fl = fledglings, nd = not determined

Table 4. Bolsa Chica Predator Removal Summary

	2004	2003	2002	2001	2000	1999	1998	1997
American crow	99	118	52	80	91	27	1	2
American kestrel	19	5	12	13	15	46	14	2
Loggerhead shrike	10	5	3	6	2	5	0	0
Common raven	2	4	5	6	3	2	0	0
skunk	2	1	-	-	-	-	-	-
coyote	-	-	-	-	-	-	-	-
weasel	-	-	-	-	-	-	-	-

Figure 1.


ORANGE COUNTY
CALIFORNIA
COUNTY OF LOS ANGELES
COUNTY OF SAN BERNARDINO
COUNTY OF RIVERSIDE
YORBA LINDA
ANAHEIM
ORANGE
SANTA ANA
TUSTIN
SEAL BEACH
BOLSA CHICA
NEWPORT BEACH
IRVINE
LAKE FOREST
LAGUNA BEACH
SAN JUAN CAPISTRANO
SAN CLEMENTE
PACIFIC OCEAN
Cleveland
National
Forest
Bolsa Chica
Existing Conditions
Upland
Wetland Vegetation
Waterbody/Flat
Active Oil Well
Warner Avenue
Bolsa Chica Mesa
Full Tidal
Slater Pump Station
Nontidal Saltmarsh
Existing Houses
Rabbit Island
Seasonal Ponds and Flats
Springdale Pump Station
Pacific Coast Highway
Muted Tidal
Pacific Ocean
Seasonal Ponds
Huntington Mesa
Scale 1 : 15000

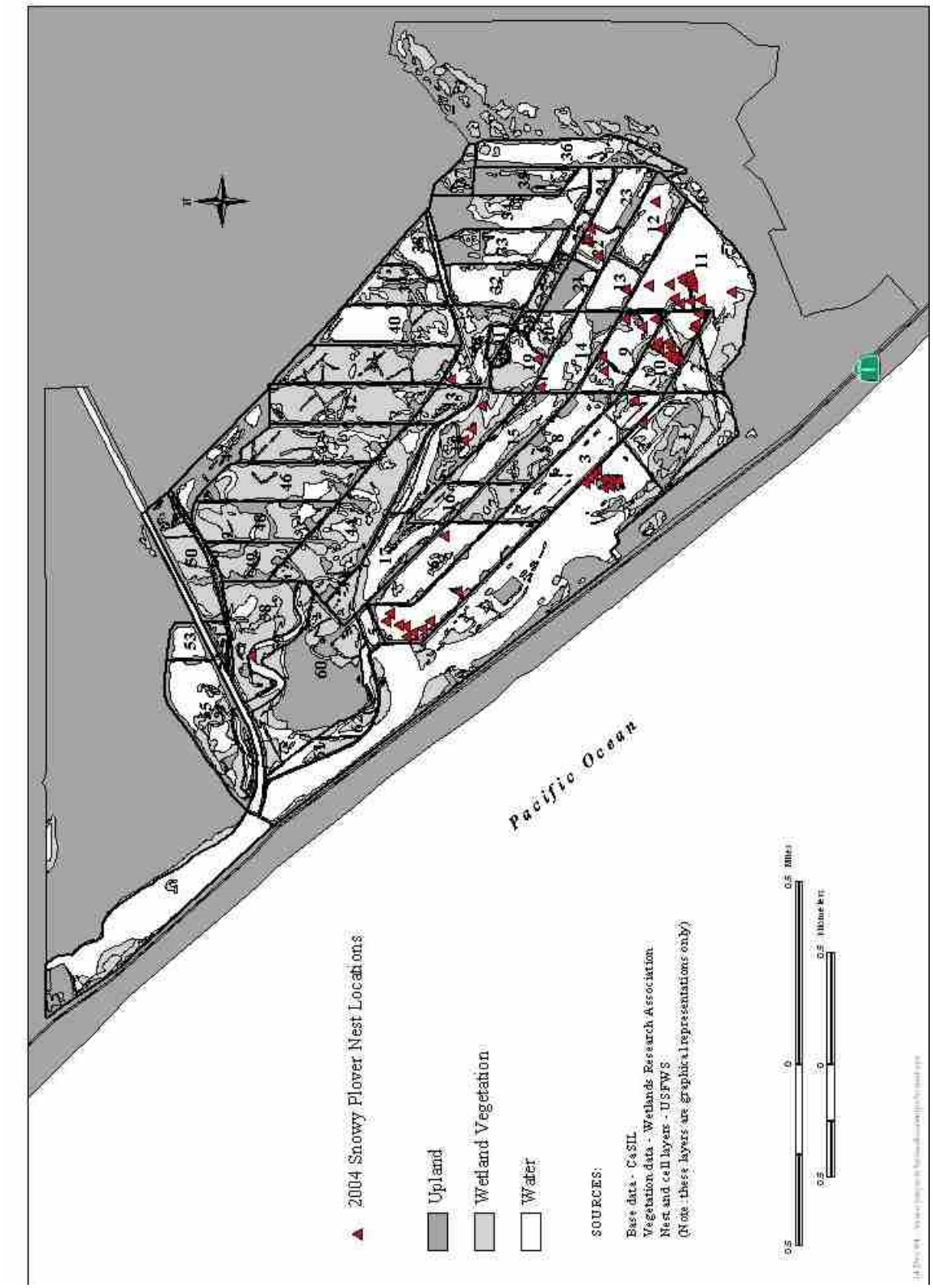


Figure 2. Snowy Plover Nest Locations 2004

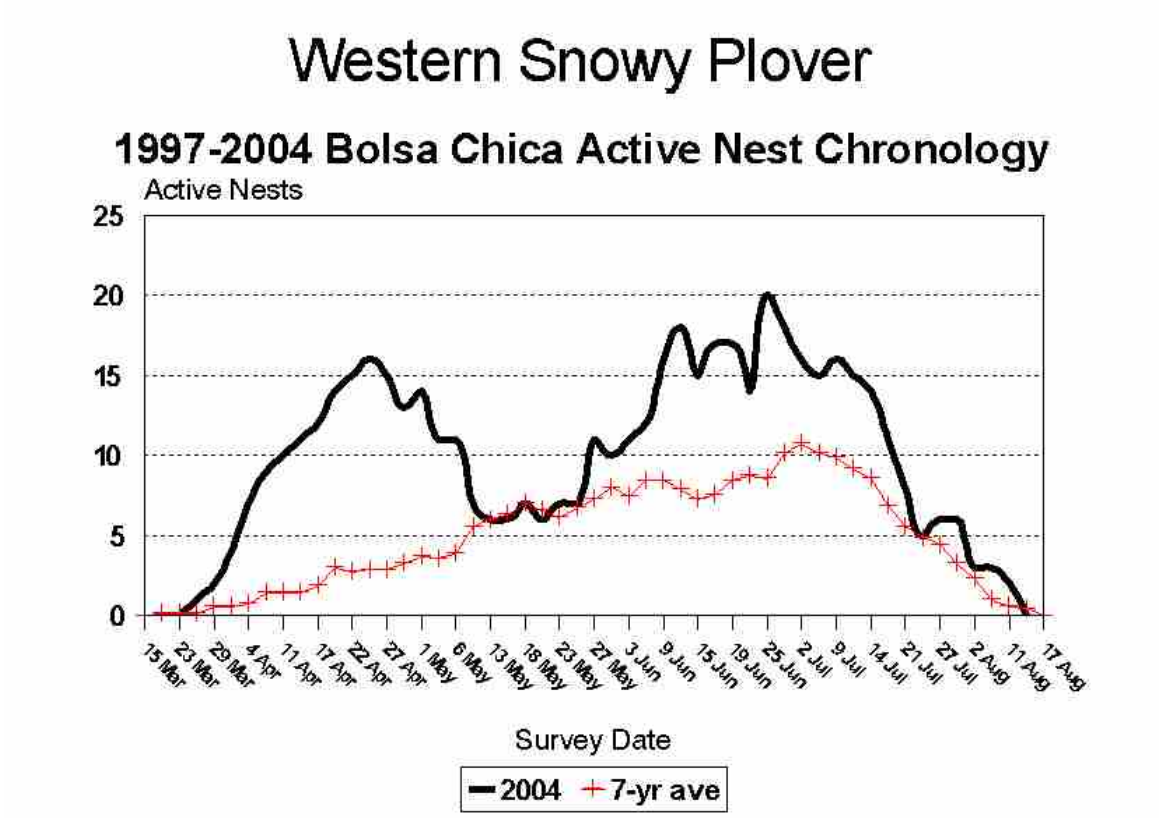


Figure 3

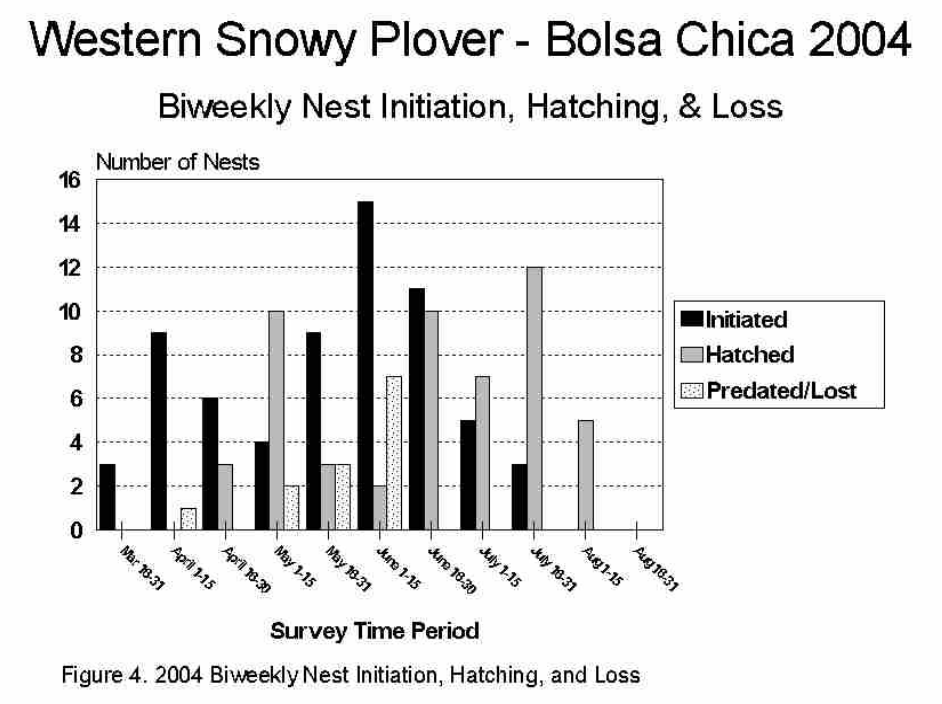


Figure 4. 2004 Biweekly Nest Initiation, Hatching, and Loss

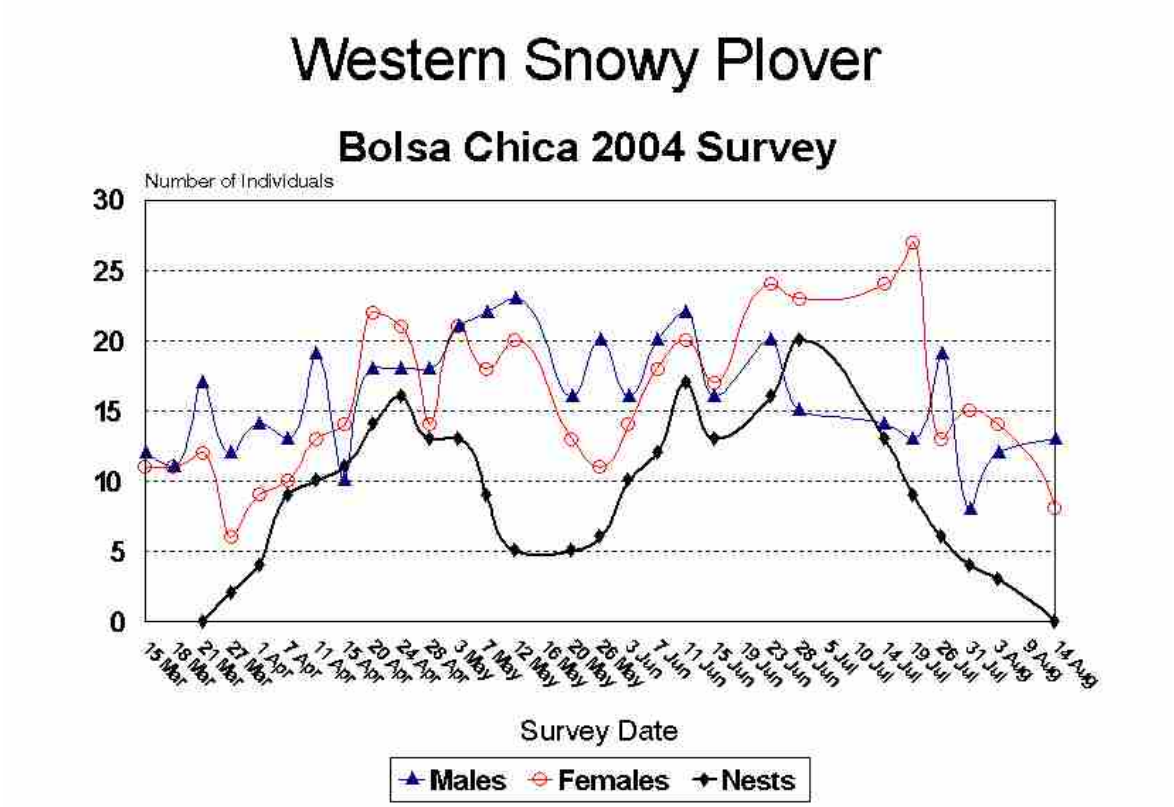


Figure 5

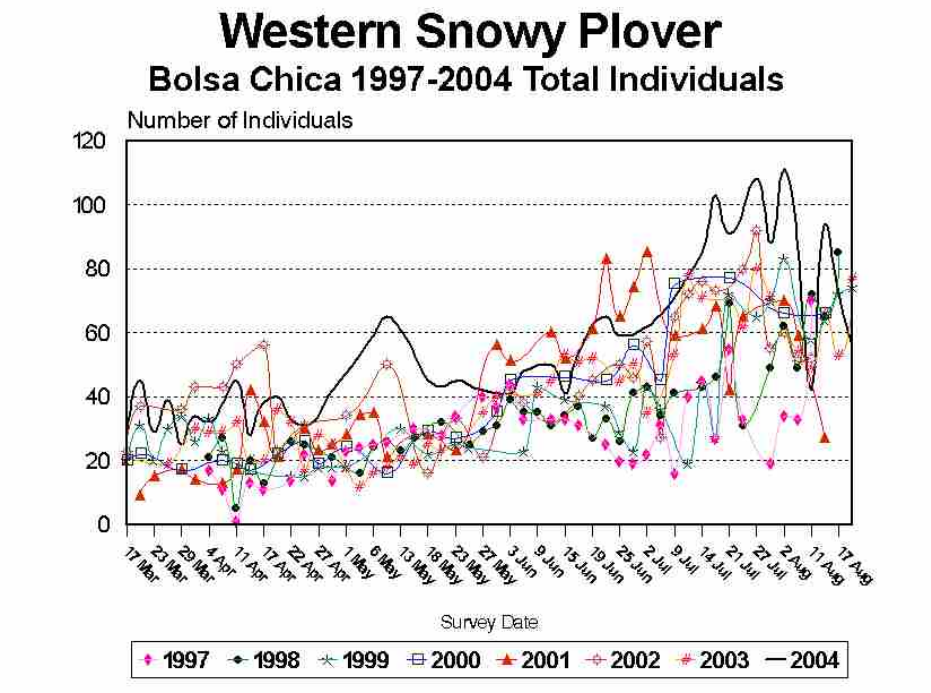


Figure 6

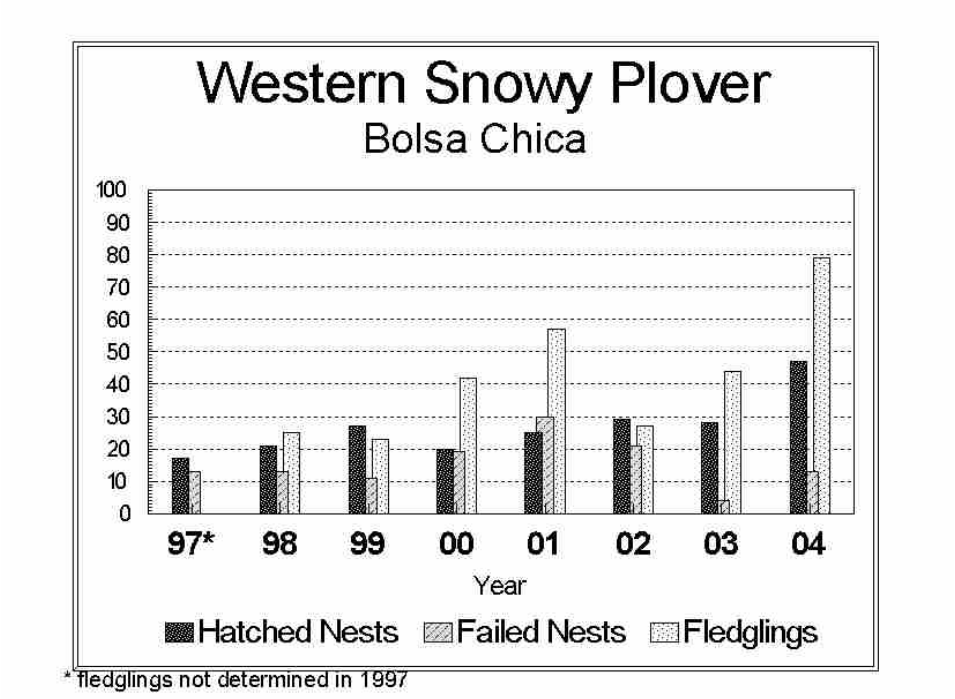


Figure 7

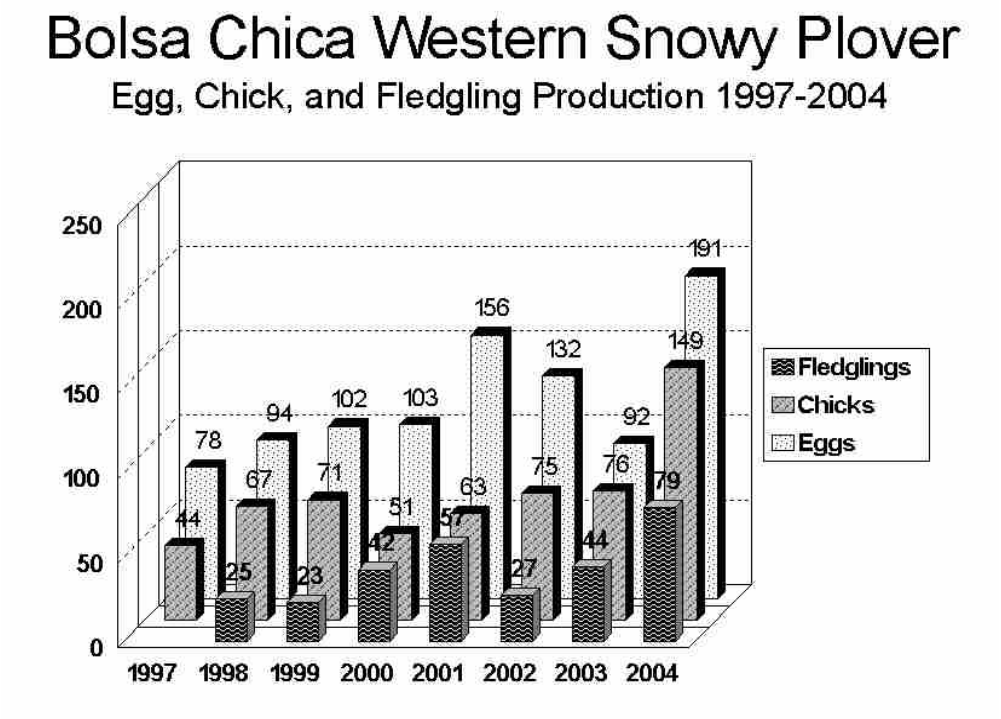


Figure 8

Nest 18, Cell STI/3 Rd

Nest 29, Cell 9

Nest 30, Cell STI/3 Rd

Nest 31, Cell STI/3 Rd

Nest 32, Cell 10

Nest 33, Cell 4

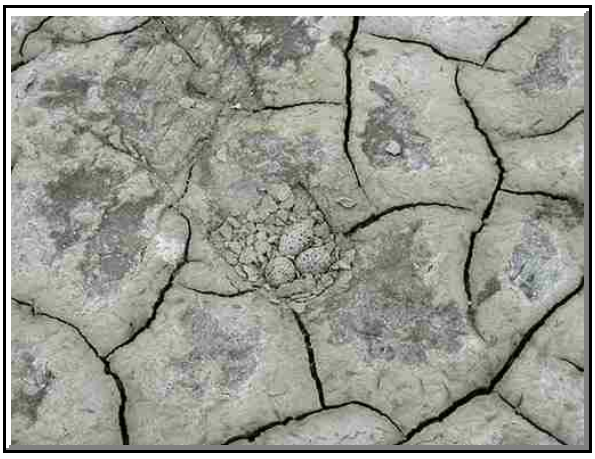
Nest 39, Cell 4

Nest 40, Cell 11

Nest 45, Cell 18

Nest 52, Cell 9

Nest 56, Cell 10



Nest 57, Cell 11

Nest 58, Cell 10

Nest 60, Cell 22