

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

CALIFORNIA LEAST TERN FIELD STUDY
1988 BREEDING SEASON¹

by

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ABSTRACT

In 1988 1253 pairs of California Least Terns (*Sterna antillarum browni*) nested at 28 sites in the state. This was an increase of 300 pairs over the 1987 population, and was primarily due to a large contingent of young, first-time breeders. The population returned this year to its 1983 level, indicating recovery from the devastating effects of the El Niño of 1982-83. Productivity was high, with a mean fledgling/pair ratio of 0.9 for the state, as compared with 0.67 in 1987. Predation was the major cause of egg and chick loss. Red fox, American Kestrel, Northern Harrier, American crow and skunks were the predators identified as causing the most serious losses. Close watching of colonies and effective predator control contributed to the success of the breeding season.

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FINAL REPORT TO
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CALIFORNIA LEAST TERN FIELD STUDY
1988 BREEDING SEASON

CONTRACTOR

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INTRODUCTION: A census of the state's breeding population of California Least Terns has been done annually since 1973. It is conducted by monitors who check the colonies on a weekly basis (or more frequently), and make mid-season and final reports. These include date of first nest, chick, and fledgling; number of pairs in first and second nesting waves; clutch size (where obtainable); number of visits; estimated number of fledglings; problems such as predators, and steps taken to alleviate them. At selected sites, research is being conducted on various aspects of Least Tern breeding biology; banding of chicks and color banding of adults are the major research methods.

The colony reports which follow are summaries of the monitors' reports.

COLONY REPORTS:

P.G. & E. PLANT, PITTSBURG (L. Collins)
Breeding pairs: 3

Four nests representing 3 pairs of terns were only marginally productive, with probably a single fledgling from this site.

The suspected predator on 3 failed nests was the Great Blue Heron. The site was monitored on 15 visits between 28 Apr - 4 Aug, terns were present 5 May - 7 July.

ALLIED CHEMICAL CO., PORT CHICAGO (L. Collins)
Breeding pairs: 1

One pair nested; the first egg was seen 14 July, but abandoned after 28 July. There were no indications as to what caused the pair to abandon. There were no further nesting attempts.

NAVAL AIR STATION, ALAMEDA (L. Collins)
Breeding pairs: 58-67

This colony experienced a good season, with 80-87 fledglings produced from 79 nests. There were 58 pairs in the 1st nesting wave, 21 in the 2nd. Thus fledging success was 1.25 - 1.4/pair.

The site was monitored intensively, with 122 visits between 13 Apr and 2 Sep. Vegetation control and cat trapping were begun before the terns arrived.

An electric fence around the site deterred most black-tailed jackrabbits, which were abundant. A trampled nest (one crushed egg, one dead chick) was probably due to a jackrabbit, the first such evidence of damage from this species. Feral cats were a greater problem; after chick predation was documented, an intensive trapping program by ADC dispatched 42 cats between 23 Jun - 26 Aug, all within foraging distance of the colony. There was no further cat

predation. Seven fledglings were killed, 6 by vehicles on the airport, one by an avian predator. Four Northern Harrier young were relocated, but kestrels were not a problem this year. Rainstorms on 16 May and 6 Jun caused flooding of many unhatched nests, but most proceeded to hatch at least one chick. Three nests were successfully elevated (using pebbles and shell) during or after a storm and went on to hatch.

One pair incubated a 2-egg clutch for 60 days before abandoning it (see Venice for similar occurrences).

This was the 4th consecutive year of successful reproduction at this colony, which benefits from intensive monitoring to identify problems, and immediate steps taken to eliminate them.

OAKLAND AIRPORT (L.R. Feeney, L. Collins)
Breeding pairs: 6-7

Total failure of this 7-nest colony was attributed to predation by Northern Harriers. There were 8 harriers in the vicinity of the airport, and they appeared focussed on the tern colony, taking both eggs and chicks. One was trapped and relocated, two were shot. But predation could not be stopped and only one chick survived to age 14 days (and was missing thereafter). The site was abandoned by the terns after 12 July. In this instance, close monitoring (85 visits between 21 Apr and 12 Jul) and early identification of the harrier problem were not effective. Predator assessment in March before the season begins might help in identifying and dealing with problems before they become unsolvable.

BAUMBERG SALT PONDS ((L. Feeney, L. Collins)
Breeding pairs: 0

No nesting was documented, but the ponds were used post-breeding by fledglings and their parents. Monitoring covered the period 2 May - 30 Aug, with 17 visits. There were no terns in evidence until 13 July, when 19 adults and juveniles were seen foraging at ponds 10 & 11. Thereafter terns were present on every visit, with a maximum of 58 fishing in 4 ponds on 10 Aug. This site has been identified as a major foraging site for families in the post-breeding phase, comparable to Harbor Lake in Los Angeles County.

BAIR ISLAND (P. Woodin, K. Hobson, D. Gray, T. Hart, R. Lee + volunteers from San Francisco Bay Bird Observatory)
Breeding pairs: 0

The tern nesting habitat on Bair Island has deteriorated over the years, with a heavy growth of pickleweed covering the saltpan where nesting used to occur. After the 1987 nesting season a 28 x 67 m 'platform', 2 m in height and covered with oyster shells was constructed in the hope of attracting Least Terns back to nest there. Despite this

effort, no Least Terns were seen this season (on 6 visits from 17 Apr - 12 Aug).

GUADALUPE DUNES (W.A. Schew, E.P. Schew, J. Dougherty, E. Shannaman)

Breeding pairs: 10-12

There were approximately 9 nests in the dunes in the 1st wave, about 15 in the 2nd wave, mostly apparently renests. The site was visited 7 times from 27 May - 31 Aug, but the area used by the terns is so large it has always been very difficult to assess the colony. It should receive more attention, to know what the problems are and if the terns are at all successful.

SAN ANTONIO CREEK, PURISMA POINT, SANTA YNEZ ESTUARY (M. McElligott)

Breeding pairs: 10

There was only minimal information about these Vandenberg Air Force Base colonies. Seven visits were made between 25 Apr - 26 Aug; an estimated 7 pairs nested at San Antonio Creek, 3 on Purisma Point, none at the Santa Ynez River mouth. There are no data on clutch size, date of first egg or chick or fledgling, or problems encountered during the breeding season. This cluster of colonies has declined since the early 1980's and should be given more attention in 1989 to identify and correct the problems.

SANTA CLARA RIVER (W.A. Schew, K. Pestana, D. Davis and 40 volunteers from Ventura Audubon)

Breeding pairs: 2

Prior to the season, giant reed that had invaded the colony site was cut by hand and a chain link fence was erected by the California Conservation Corps and funded by California Fish & Game. A volunteer-monitor program by Ventura Audubon enlisted the aid of 40 people to police the beach during periods of heavy public use. They logged 60 visits and 150 hr.

Despite this optimization of the site, only two pairs nested. They succeeded in producing 4 fledglings, a very high success rate.

ORMOND BEACH (K. Pestana, S. Teresa)

Breeding pairs: 3-4

Four nests were found, one early in the season, 3 more later on. They hatched and several half-grown chicks were seen in July. No data are available as to fledging success.

This site has always been subject to severe disturbance from human use, with ORVs a special problem. Fencing and more monitoring are needed.

POINT MUGU (M. Klope, S. Teresa)
Breeding pairs: 100

Coverage did not start at Pt. Mugu until 10 June, by which date there were 86 nests. Thereafter it was monitored weekly until 5 Aug. On 29 June a high tide overwashed the outer berm and flooded the beach, causing destruction of all nests still containing eggs. There had already been some hatching, and the chicks were able to retreat to the dunes. Approximately 25 fledglings resulted from the 1st nesting wave.

Renesting began shortly, and by late July, when another (and even higher) tide was due, there were 35 active nests. A group of agency people and volunteers raised 31 nests about 1m, by using sandbags and a sand-filled tire. The terns accepted these elevated nests, as did two Snowy Plovers, and proceeded to incubate as before. The tides of late July again overrode the berm but missed the area where the nests were. Most of these nests hatched, but there are no data available as to the fate of these chicks.

Prior to the '89 season there will be some recontouring of the beach to create some elevated sites for safe nesting.

VENICE (L. Massey, B. Massey, K. Pestana)
Breeding pairs: 165

Terns were courting on the ground on 24 April and the 1st egg was laid on 1 May. By 1 June 135 pairs were nesting. After a week's lull, a 2nd nesting wave began, and 68 more nests were laid in Jun/July, the last one marked on 4 Aug. Approximately 38 pairs in the 2nd wave were renesting after loss of chicks, the other 30 were 2- and 3-yr olds nesting for the first time.

The nesting site was enlarged and a new fence installed before the season. The fence was 6' (1.8m) high and cantilevered outward at the top at a 45° angle. Disturbance and predation previously caused by people, cats and dogs was virtually eliminated. There was no protection from aerial predators, however, and a male American Kestrel found the colony when the 1st-wave chicks were within a few days of fledging, and took a minimum of 30 chicks and one adult during the week of 9 - 16 Jun. After intensive trapping efforts failed, the roosting site was found by K. Pestana in Playa del Rey. The bird was shot on 17 June and there was no further kestrel predation. In late June and July there was evidence of Great Horned Owl predation, and in the 1st week of August a group of crows apparently destroyed the remaining nests, both eggs and chicks. As of 8 Aug the flock of roosting terns that had been regularly seen in July on Venice beach had relocated to Playa del Rey. Crows were walking around in the sanctuary on that date.

Despite avian predation, fledgling production was high, with at least 192 juveniles tallied in multiple evening counts in July, a ratio of 1.16/pr.

The enclosure was enlarged 50' (15m) in both directions when the new fence was constructed in early April 1988; the new measurements are 350 x 500' (108 x 154m). The terns expanded their use of the area accordingly; 36 pairs nested in the added space.

There was an unhatched egg at 29 nests, and at two nests both eggs in the clutch failed to hatch. The parents incubated these duds for 10 and 11 wks before finally abandoning them. Fourteen unhatched eggs were collected for pesticide analysis.

Venice was monitored every other day from 1 May - 24 June, then 2-4 times/week until 8 Aug, when the site was found deserted. On alternate days a researcher was observing and trapping adults from a blind, thus the colony was under observation virtually every day. All nests were marked, clutch size noted, hatching recorded, chicks banded (mostly at the nest), renesting documented. Once a week starting the 2nd week in June the chicks were herded into one corner of the sanctuary by a banding crew for weight and wing measurements.

TERMINAL ISLAND (K. Keane, K. Pestana, V. Lopez)
Breeding pairs: 4-6

The regular presence of a flock of American Crows was apparently responsible for abandonment of the site this year. This was the 3rd season that crows have been a formidable problem at Terminal Island. Crows harassed courting terns, of which there were very few, and only 4 - 6 pairs tried to nest. Two nests were found in mid-May, both were destroyed almost immediately by crows. There may have been several more that were eaten before they were noticed. The terns left the site and apparently relocated at Anaheim Bay and Venice (color banded adults were seen nesting in both places). Abandonment by the colony, which numbered 79 pairs in 1986 and 40 in 1987, has resulted in crowding of adjacent sites, as there are no other viable options for relocating in the Los Angeles-Long Beach area.

Intensive efforts to get rid of the crows were unavailing. If this site is to function successfully, a crow eradication program must be carried out before the 1989 season.

COSTA del SOL (W.A. Schew)

No evidence of Least Terns at this site; heavy construction underway. This site is no longer a viable nesting area.

ANAHEIM BAY (M. Silbernagle, J. Wiley, J. Johnson, P. Jones)
Breeding pairs: 75-90

The 1st eggs were laid 27 April, and by 16 May there were 62 nests and the colony looked promising. However, a red fox invaded through the electric fence that night and destroyed 44 nests. Renesting followed, but a 2nd fox incursion on 7 June accounted for two more nests. The 1st chick hatched 25 May, and on 15 June the 1st fledgling was seen.

There were 115 nests throughout the season, but many were presumed to be renesting, and the total number of pairs was estimated at 75-90. About 60-71 fledglings were produced at the site. The 2nd wave was difficult to analyze because of all the renesting, and because the vegetation on the island grew so profusely.

In addition to fox predation, a Peregrine Falcon took a chick on 23 June, and was seen at the colony on 5 occasions. Also a skunk entered through the electric fence in mid-July but did not do any damage as nesting was about over.

Better protection from mammalian predators is needed and is planned before next season.

BOLSA CHICA (W.A. Schew, E. Burkett, M. Bounds, C.T. Collins)
Breeding pairs: 89-94

North Island Nine pairs nested in the 1st wave in May, raising 7 fledglings. As the season progressed, increasing numbers of Elegant, Caspian and Forster's Terns nested on the island, apparently displacing the Least Terns, and there was no 2nd wave.

South Island Egg-laying began at the same time as on North Island (6 May) and continued throughout the season, with 149 documented nesting attempts (47-50 in the 1st wave, 70 in the 2nd wave). The estimated number of pairs was 80-85. The colony produced 55-60 fledglings, a below-optimum ratio of 0.68/pr.

Predation by red foxes occurred on at least 3 occasions, and was responsible for most nest (egg) loss, although skunks were also implicated. Seventy-five nests were known to have been lost to predation. Trapping of foxes began 5 Feb, but was not pursued with vigor until 1 May. Ten red foxes were taken between 5 Feb and 24 Aug. Four kestrels were trapped and removed from the area during the season. Additionally, a Peregrine Falcon was seen 5 times in the area and twice on the island eating a Least Tern chick (or fledgling). No steps were taken against the Peregrine.

Sixteen visits were made by monitors between 6 May and 20 Aug.

HUNTINGTON BEACH STATE PARK (J. Fancher, W.A. Schew)
Breeding pairs: 86.

Nesting began on 5 May and 104 nests were laid throughout the season. There were 58 pairs in the 1st wave; of the 28 nests in the 2nd wave, 19 were considered to be young birds nesting for the first time. About 43 fledglings were produced, a ratio of 0.5/pr. Clutch size was significantly lower than in 1987 (Table 3).

Predation was again serious, with 45 nests lost to red foxes. Two were trapped, but not before major damage was done. For the 3rd year in a row foxes have been responsible for poor fledgling production (0.49 in 1986, 0.16 in 1987).

The colony was monitored on 29 visits between 8 May and 24 Aug.

The fence at HBSP is in poor shape and should be replaced with a cantilevered model (as at Venice) before the 1989 season. A good fence coupled with pre-season fox trapping both locally and regionally up along the Santa Ana River should enhance prospects for Least Tern nesting.

UPPER NEWPORT BAY (W.A. Schew, G. Gerstenberg, M. Bounds)
Breeding pairs: 70-75

Approximately 60 pairs nested in the 1st wave, starting 2 May. Data on the 2nd wave were inconclusive, as the island was monitored from shore and heavy growth of vegetation obscured viewing. The total number of nests was thought to be 105-110. It was also difficult to determine the number of fledglings - a rough estimate of 50-60 was calculated for the season. The fledgling adult ratio was 0.71/pr.

The site was monitored from shore on 36 occasions, and twice by on-site visits.

SANTA MARGARITA RIVER (K. Keane, L. Belluomini, J. Tutton, D. Statlander)
Breeding pairs: 246

Least Terns bred at 3 sites at the mouth of the Santa Margarita River, but did not use Aliso Creek (= White Beach), although the site there was fenced and monitored for predators. Most terns bred at the North Beach site and success was high; the 24 pairs within the electric fence on the saltflat, and 25 pairs on the saltflat island did well also. The total number of nests was 315 (231 at North Beach, 33 at Saltflat, 51 on Saltflat Island) representing 246 pairs (182 at NB, 27 at SF, 35 on SFI). The fledgling total was 365-403, a ratio of 1.48-1.63/pr. This was an exceptionally good season at Camp Pendleton.

North Beach. There were 152 pairs in the 1st wave, and of the 79 nests in the 2nd wave approximately 32 were young terns nesting for the 1st time, the rest were renesting. The total

number of nests was 231. There were 269-296 fledglings from this site, a ratio of 1.46 - 1.6/pr. Predation was at a minimum, thanks to extraordinary efforts by the natural resources office to maintain the electric fence and to trap and remove both mammalian and avian predators from the area.

The site was monitored every other day between 1 May and 1 July, then 3-5 times/week until the end of the season. On alternate days two researchers were in the colony in blinds, so that monitoring was effectively taking place daily. Data were taken in the colony as at Venice.

The electric fence had to be maintained constantly, especially after high tides and windstorms, and the voltage dropped significantly at night. There was, however, no mammalian predation. A windstorm early in the season buried a few nests and caused some early renesting, and several nests were washed out by high tides in late June, but these occurrences caused only minor damage.

Saltflat. Twenty-four pairs nested in the 1st wave; there were 9 nests in the 2nd wave of which 3 were thought to be 1st time nesters. There were 38-42 fledglings, a ratio of 1.4 - 1.6/pr.

Saltflat Island. There were 25 pairs in the 1st wave, 26 in the 2nd, of which 10 were probably breeding for the 1st time. An estimated 58-65 juveniles fledged from the site, a ratio of 1.7 - 1.85/pr.

BUENA VISTA LAGOON

Breeding pairs: 0

BATIKUITOS LAGOON (J. Konecny, L. Patla, M. Bounds, C. Gronholt, E. Copper)

Breeding pairs: 38

Despite problems of several kinds, Batiquitos Lagoon has been one of the most consistently used sites in San Diego County. Predators and fluctuating water levels have been the most serious concerns. This season only two of 6 possible sites were used - the west end and the southeast corner. Predation has usually been the chief problem, and was again in 1988, with dogs the major suspect at the west end and racoons in the SE corner.

An initial group of 34 pairs nesting at the west end was almost completely wiped out by a dog in mid-June. Renesting was apparently successful and there was no repetition of the predation; 25-30 fledglings were produced.

The 4-8 pairs in the SE corner were not able to hatch a single chick; all nests were predated at the egg stage.

The monitor visited the site 30 times; more visits were made by the DFG seasonal aide.

SAN ELIJO LAGOON (R. Patton, S. Welker, F. Perry, L. Patla,
T. Stewart, J. Konecny)
Breeding pairs: 11

Of 11 nesting pairs only two hatched successfully, and only 3 fledglings resulted. Raccoons were the primary suspect as a predator.

A minimum of 26 visits was made by monitors.

FAA ISLAND (J. Price, L. Patla, E. Copper)
Breeding pairs: 37

This was one of the more successful breeding sites in San Diego County, with 37 pairs (79 nests) raising at least 50 fledglings, a ratio of 1.4/pr. There were 27 pairs nesting in the 1st wave, 52 in the 2nd. However, only 10 of the latter were thought to be young terns nesting for the first time this season.

Egg predation was minimal and if there were predators on chicks, they were not identified. A predator unique to the island is the crab that resides in the rip-rap, against which chicks are protected by chick fencing. Gulls, Meadowlarks and even Rock Doves may be egg predators.

Forty four visits were made to the island. Breeding success at this site has traditionally been either very good or very bad. It has been used for 8 of the past 10 seasons, and when used has usually been occupied by large numbers of terns relative to the small size of the site. The colony did best when FAA personnel were on site to keep off intruders and identify predators. The extra coverage the island got this year by monitors apparently improved the success rate.

NAVAL TRAINING CENTER (G. Johnson, M. Evans-Layng, E. Copper)
Breeding pairs: 1

The site has an abundance of predators. Pre-season 29+ cats were removed, as well as two gray foxes and two feral dogs. Eight Loggerhead Shrikes were relocated. At least two that were taken 63 mi to Temecula returned to the site within two weeks. Massive anti-predator measures are necessary to make this site suitable for successful tern nesting.

The one pair that nested hatched two chicks, one badly deformed with a crossed bill and no right eye. Its healthy sibling survived and fledged.

LINDBERGH FIELD (E. Copper, T. Stewart)
Breeding pairs: 80

The difficulties inherent in monitoring a colony on a busy commercial airport prevented the gathering of good data here. The 1st wave of 70 nests was marked and clutch size recorded, but once hatching began there could be no more walking on the site for fear of dispersing the chicks onto the runways. A 2nd wave of 10 nests was thought to be all new

birds. Predation on chicks began at an undetermined date, but the predators were never identified. By 7 July the site had been abandoned. Approximately 30 juveniles fledged, a ratio of 0.3/pr.

Fourteen visits were made; after 27 May all observations were made from a vehicle.

NORTH ISLAND, NAVAL AIR STATION (R. Patton, E. Copper, M. Evans-Layng, L. Belluomini)
Breeding pairs: 20

Although 27 nests were initiated, 78% were preyed upon. Ten of the 20 nests in the 1st wave suffered predation at the egg stage; the suspected culprits were Rock Doves. Two nests (one with eggs, one with chicks) were destroyed by ants. The last 7 nests were destroyed, probably by ravens. Only 4 fledglings were produced by the colony.

A minimum of 50 visits was made by monitors. The predator problems here are formidable and only by continuous vigilance and prompt response can tern eggs and chicks be saved.

DELTA BEACH (M. Evans-Layng, E. Copper, L. Belluomini, R. Patton)
Breeding pairs: 7

Nesting did not begin here until 5 June, although there were terns around earlier. Thirteen cats, two skunks, one dog and 3 Great Blue Herons were removed from the site early in the season.

Despite the problems posed by a host of predators, 10 fledglings were reared, a ratio of 1.42/pr. American Kestrels, Great Blue Herons, and Ravens were the most probable predators although none were seen actually taking eggs or chicks. Four nests were washed away by high tides.

Over 50 visits were made by monitors.

D STREET FILL (D. Stadtlander, J. Tutton, L. Patla, E. Copper)
Breeding pairs: 19

In a 2 day period between monitor visits in late May, all eggs in the 19 nests of the 1st wave were eaten. The predator was most likely a skunk. The terns deserted the site; there was no evidence of activity for the rest of the season.

Intensive predator management will be necessary if this is to become a viable breeding site again. Pampas grass and tree tobacco should be removed, as they provide nest sites and perches for shrikes. A fence around the area usually selected by the terns for nesting would help protect against human disturbance and mammalian predators.

More than 20 visits were made by monitors.

CHULA VISTA WILDLIFE RESERVE (J. Tutton, D. Stadtlander, L. Patla, E. Copper)
Breeding pairs: 24

Last used in 1984, this site serves as another example of how important it is to maintain abandoned sites. From 38 nests (19 in each nesting wave) 30-40 fledglings were reared, a ratio of 1.25-1.66/pr.

There are no longer Burrowing Owls in the reserve, but Great Horned Owl and fox are both present close by, and are potential threats. Intensive predator management on an annual basis would do much to keep this site viable and productive for terns.

Monitors visited the site 34 times.

SALTWORKS (J. Price, E. Copper)
Breeding pairs: 17

The 35 nests (17 in 1st wave, 18 in 2nd wave) yielded at least 15 fledglings, a ratio of 0.88/pr. Most of the early nests on an isolated levee were predated, probably by Western Gulls which are present in large numbers in the Saltworks.

Access to the levees was restricted by Western Salt Company, which reduced disturbance, but posed some problems for monitors. In all, 36 visits were made.

TIJUANA RIVER ESTUARY, BORDER FIELD STATE PARK (R. Patton, B. Grizzle, D. Patton, L. Patla)
Breeding pairs: 40-47

Least Terns nested in 3 sites: 24-38 pairs at the north end of the barrier beach east of the dunes, 2-7 pairs on the north side of the ocean entrance, and 8-11 pairs on the south side of the ocean entrance. A total of 58-69 nests were initiated, with two nesting waves at each site. But with all this activity the total number of fledglings was only 12-16 (0.3/pr).

The primary cause of nest loss was human disturbance, despite signs and fencing. At least 22 nests with eggs were trampled, and all sites were affected. On the south side of the mouth, traffic of illegal aliens was the primary cause, but on the north side local beach-users and dog-walkers were mostly responsible for losses. Much time was spent by refuge staff and monitors trying to keep people out of the nesting areas.

Because the barrier beach changes every year after winter storms, and the terns keep shifting their nesting sites, a permanent fence is not feasible. Instead, fencing and bi-lingual signs need to be erected each season when the terns have made their site choices.

Sixty visits were made.

BANDING & RESEARCH

Chicks were banded at 10 colonies:

<u>COLONY</u>	<u># CHICKS</u>
Venice	285
Bolsa Chica	117
Huntington Beach	20
Camp Pendleton	438
North Beach -	340
Saltflat -	45
Saltflat I -	53
FAA Island	17
Naval Tr. Center	1
North Island	4
Chula Vista Reserve	24
Delta Beach	9
Saltworks	7
Total	922

Adults were trapped and color banded at 2 colonies:

Venice	40
Camp Pendleton	135
Total	175

Research on banded adults at Venice was continued by Barbara Massey. For the 6th year in a row, an effort was made to identify all banded adults and note age, sex, mate, site of nest in colony, clutch size, hatching success, and renest if it occurred. This was the final year of the study. The data will be analyzed to determine the age profile of the colony, with all of the effects of the 1982-83 El Niño taken into account.

Research on banded adults at Camp Pendleton continued with Patricia Baird, Barbara Massey, Charles Collins and William Schew participating. The objective there is to band every adult possible in order to determine annual survival rate, mate selection and retention, intra-colony movements of pairs, and other parameters.

DISCUSSION AND CONCLUSIONS: In 1988 there were 28 active California Least Tern (*Sterna antillarum browni*) breeding sites in the state (Table 1). The number of breeding pairs increased from 944 in 1987 to 1253 in 1988 (Table 1). This was the largest number of pairs since 1983; it was also the largest annual increment during the 15 yr period of monitoring (Fig. 1). The increase was primarily attributable to a large contingent of first-time breeders, both 2 and 3-yr olds, an element of the population that was much reduced

after the El Niño of 1982-83. It has taken the Least Tern 5 years to recover from the devastating effects of that El Niño, and if there is not another such natural catastrophe, we can expect this year's increase to continue.

Fig. 2 is a map of California's breeding colonies showing the 5 clusters into which the colonies group. Table 2 gives a population breakdown by cluster in 1987 and 1988. There was no change in numbers in the northernmost group; the San Luis Obispo County colonies declined; the southern 3 clusters all showed very large increases.

The first egg was found on 27 April at Anaheim Bay; the first fledgling was seen at Venice Beach on 12 June. Table 3 shows clutch size for 15 colonies at which data were collected. Table 4 summarizes the activity period at each colony.

The number of fledglings increased - not only the total number, which would be expected with this year's larger adult population, but the ratio of fledglings/pair at most colonies (Table 1). The total number of fledglings in the state was estimated as 1130; in 1987 it was 633. This year's fledgling/pair ratio was 0.9, in 1987 it was 0.67.

Predation was again the major problem for most colonies. Predators that took the heaviest tolls were red foxes (at Anaheim Bay, Bolsa Chica and Huntington Beach), American Kestrels (at Venice), Northern Harriers (at Oakland Airport), American Crows (at Terminal Island) and skunks (at D Street Fill). In other places predators were not so readily identified, nor were the losses as severe.

Flooding by high tides in late June washed out the bulk of the nests at Point Mugu. The 35 nests that were laid subsequently were all raised about 1 m onto sandbagged tires by a group of agency people and volunteers, to prevent the same catastrophe by the next high tides. The effort was a success.

The two largest colonies - Venice and Santa Margarita River - had excellent seasons, as did the smaller ones at NAS Alameda, FAA Island in Mission Bay and the Chula Vista Reserve. All had a fledgling/pr ratio of >1.0 . The Venice and the Santa Margarita River colonies received the most attention in terms of monitoring and research activities of any in the state, with people present virtually every day May-July. This allowed problems to be identified and dealt with immediately as they arose. This year, predator control at the Santa Margarita sites was intensively pursued before and all through the season, and was extremely effective. The colony fledged 365-409 juveniles and predation was never a real problem.

Much of the success of the season was due to increased monitoring at all colonies, helped by the addition of 3 CDFG seasonal aides. The services of U.S. Department of Agriculture, Animal Damage Control (ADC) in handling predators were of great value at many colonies.

It continues to be very important to manage and protect even the very small colonies, and to preserve sites that have

been temporarily abandoned, usually because of heavy predator pressures. Chula Vista Ecological Reserve was used this year for the first time since 1984 and was very productive and relatively predator free. In Los Angeles County, when a site must be abandoned, as was Terminal Island this year, there is no place for that group of terns to go except an already established (and possibly crowded) colony. The Terminal Island birds relocated at Venice and Anaheim Bay.

RECOMMENDATIONS:

Recommendations for 1989 include the following. A new fence at Huntington Beach to protect the colony against mammalian predators. Continued monitoring at all colonies at least at the level of 1988. Predator control before the season at colonies where there are known problems (e.g. crows at Terminal Island, harriers at Oakland). More monitoring at Ormond Beach, Guadalupe Dunes, Point Mugu and the Vandenberg Air Force Base colonies, sites that have received less attention than the others.

Fledgling counts have never been as accurate as we could wish. A research project is being proposed by Barbara Massey to standardize the methods and develop guidelines for more accurate counts, and will be implemented in 1989.

The red fox, whose expansion and population explosion in the coastal marshes of California continues, threatens both the Least Tern and the Light-footed Clapper Rail, as well as many non-endangered species on which it preys. It is more possible to protect the tern (by fencing) than the rail, but even fencing is not impermeable. The fox problem has been handled by applying stop-gap measures such as trapping and fencing at the most afflicted colonies, but needs to be approached regionally.

If the population is to continue to rise, new sites must be created and current sites expanded to accommodate increasing numbers of breeding pairs. Beach sanctuaries are the optimum sites, as there are usually fewer predators to deal with. Alternate sites are in particularly short supply in Los Angeles and Orange Counties, where the population is increasing most rapidly (both terns and humans).

FIELD WORKERS

This report is based on the original field observations made by a number of field workers funded by this contract (*), by other funding sources, and some not funded at all. The principal workers are listed here; others who have contributed are acknowledged in the colony accounts.

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Klope, Jack Fancher, Esther Burkett, Jane Tutton *, Doreen Stadtlander *, Robert Patton *, Debra Patton *, Jennifer Price *, John Konecny *, Marit Evnas-Layng *, Clark Williams, Ventura Audubon Society *, Karen Pestana *, Marilyn Bounds, Laurie Patla, Mike Silbernagle, Linda Belluomini, and Michael McElligot.

Fig. 1. Number of breeding pairs of Least Terns in California from 1976 - 1988.
(mean of minimum and maximum estimated numbers)

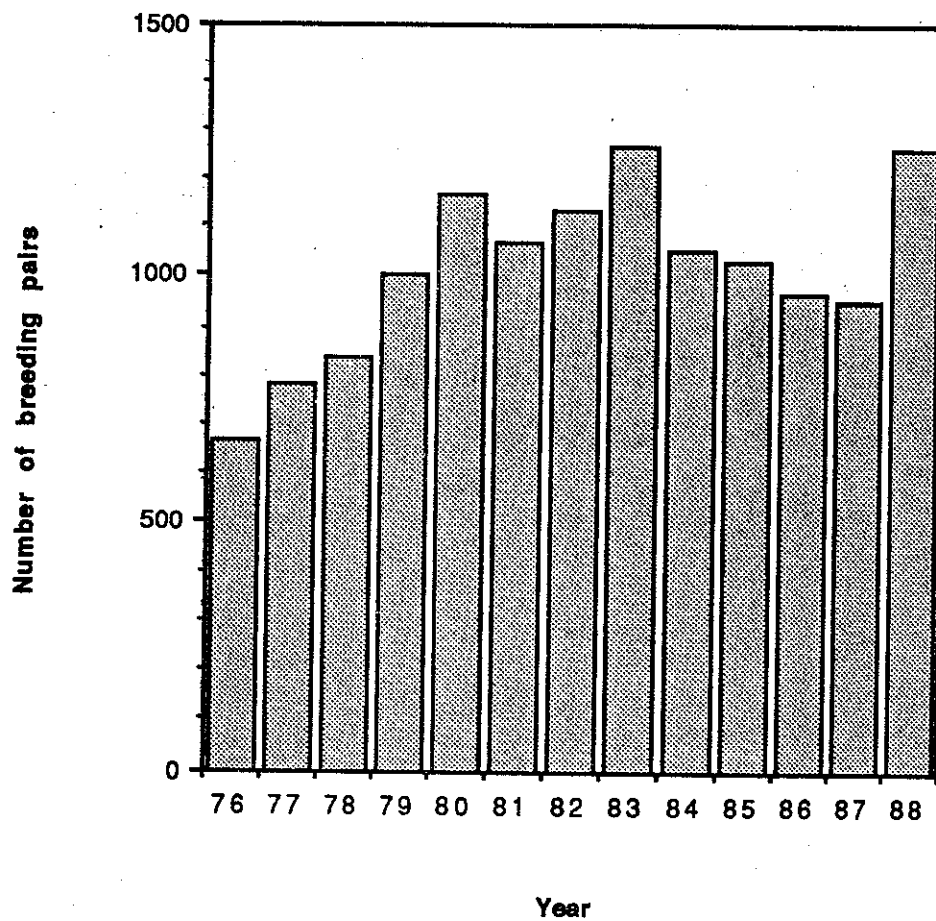


Table 1. California Least Tern breeding colony size and fledging success, 1987 and 1988.

Colony	Estimated # of pairs (fledglings)			
	1987		1988	
P.G.E., Pittsburgh	3-4	(5)	3	(1)
Port Chicago	2-3	(1-2)	1	(0)
NAS Alameda	57-59	(77-97)	58-67	(80-87)
Oakland Airport	8-9	(2-5)	6-7	(0)
Baumberg Saltponds	0	(0)	0	(0)
Bair Island	0	(0)	0	(0)
Guadalupe Dunes	20-25	(34-37)	10-12	?
San Antonio Creek	2	(0)	7	(3)
Purisma Point	14	(0)	3	(1)
Santa Inez River	4	(6)	0	(0)
Santa Clara River	0-15	(10)	2-3	(4)
Ormond Beach	0	(0)	2-4	?
Point Mugu	20	(3)	100	(25)
Venice Beach	109	(82)	165	(192)
Terminal Island	40	(5)	4-6	(0)
Costa del Sol	0	0	0	(0)
Anaheim Bay	69	(97-109)	75-90	(60-71)
Huntington Beach St Pk	58	(9)	86	(43)
Bolsa Chica				
TOTAL	78-82	(60-65)	89-94	(62-67)
North I.	[48-50	(10-15)	9	(7)]
South I.	[30-32	(50)	80-85	(55-60)]
Upper Newport Bay	40-45	(30-35)	70-75	(50-60)
Santa Margarita River				
TOTAL	192	(60)	246	(365-409)
North Beach	[150	(50)	184	(269-296)]
Saltflats	[42	(10)	27	(38-40)]
Saltmarsh I.	[0	(0)	35	(58-65)]
Buena Vista Lagoon	0	(0)	0	(0)
Batiquitos Lagoon	6-10	(18)	48	(25-30)
Agua Hedionda	0	(0)	0	(0)
San Elijo Lagoon	13	(1-3)	11	(3)
FAA Island	25	(3)	37	(50)
North Fiesta Island	0	(0)	0	(0)
Naval Training Center	11	(0)	1	(1)
Lindbergh Field	50	(50-70)	80	(30)
Chula Vista Wildlife Res	0	(0)	24	(30-40)
D Street fill	28	(10)	19	(0)
North Island NAS	6	(3-5)	20	(4)
Saltworks	21	(4)	17	(15)
Delta Beach	28	(10)	7	(10)
Tijuana River Mouth	21	(13-19)	40-47	(24-36)
TOTALS	935-963	(593-672)	1228-1278	(1078-1182)
POPULATION ESTIMATES	944	(633)	1253	(1130)

Fig. 2. Map of the California coastline showing the locations of the 5 clusters of breeding colonies of Least Terns active in the 1980's.

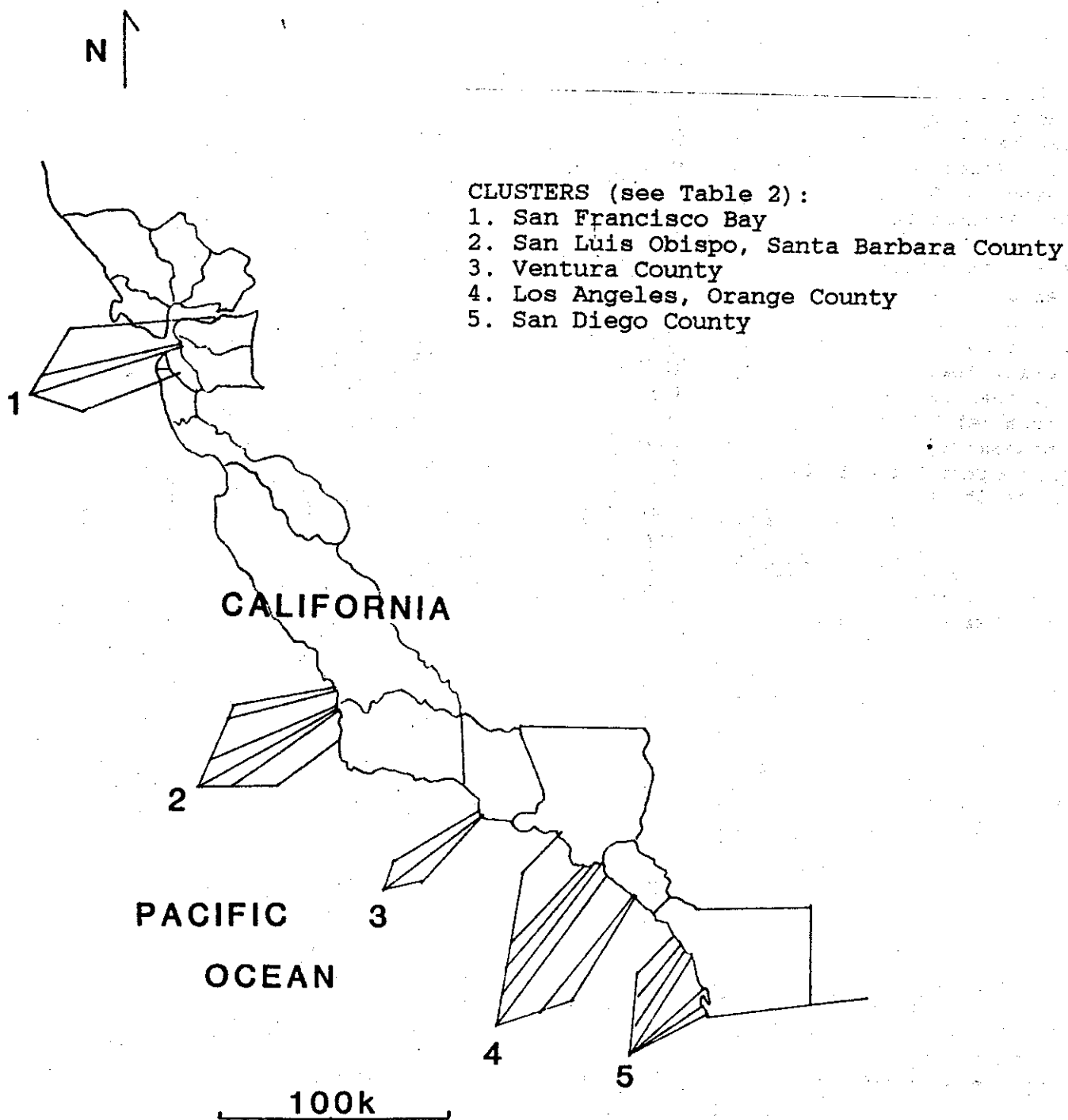


Table 2. California Least Tern breeding colony size and fledging success by cluster, 1987 and 1988.

Colony	Estimated # of pairs (fledglings)			
	1987		1988	
SAN FRANCISCO, ALAMEDA				
P.G.E., Pittsburgh	3-4	(5)	3	(1)
Port Chicago	2-3	(1-2)	1	(0)
NAS Alameda	57-59	(77-97)	58-67	(80-87)
Oakland Airport	8-9	(2-5)	6-7	(0)
Baumberg Saltponds	0	(0)	0	(0)
Bair Island	0	(0)	0	(0)
Totals	70-75	(85-109)	68-78	(81-88)
SAN LUIS OBISPO, SANTA BARBARA				
Guadalupe Dunes	20-25	(34-37)	10-12	?
San Antonio Creek	2	(0)	7	(3)
Purisma Point	14	(0)	3	(1)
Santa Ynez River	4	(6)	0	(0)
Totals	40-45	(40-43)	20-22	(4)
VENTURA				
Santa Clara River	0-15	(10)	2-3	(4)
Ormond Beach	0	(0)	2-4	?
Point Mugu	20	(3)	100	(25)
Totals	30-35	(40)	104-107	(29)
LOS ANGELES, ORANGE				
Venice Beach	109	(82)	165	(192)
Terminal Island	40	(5)	4-6	(0)
Costa del Sol	0	(0)	0	(0)
Anaheim Bay	69	(97-109)	75-90	(60-71)
Huntington Beach St Pk	58	(9)	86	(43)
Bolsa Chica	78-82	(60-65)	89-94	(62-67)
Upper Newport Bay	40-45	(30-35)	70-75	(50-60)
Totals	394-403	(283-305)	489-516	(407-433)
SAN DIEGO				
Santa Margarita River	192	(60)	246	(365-409)
Buena Vista Lagoon	0	(0)	0	(0)
Batiquitos Lagoon	6-10	(18)	48	(25-30)
San Elijo Lagoon	13	(1-3)	11	(3)
FAA Island	25	(3)	37	(50)
North Fiesta Island	0	(0)	0	(0)
Naval Training Center	11	(0)	1	(1)
Lindbergh Field	50	(50-70)	80	(30)
Chula Vista Wildlife Res	0	(0)	24	(30-40)
D Street fill	28	(10)	19	(0)
North Island NAS	6	(3-5)	20	(4)
Saltworks	21	(4)	17	(15)
Delta Beach	28	(10)	7	(10)
Tijuana River Mouth	21	(13-19)	40-47	(24-36)
Totals	401-405	(172-202)	550-557	(557-588)

Table 3. Clutch size of California Least Terns in 1988 ¹.

Colony	# nests	# of 1,2,3 egg nests			x ± SD
NAS Alameda	79	6	59	14	2.10 ± 0.50
Point Mugu ²	35	16	19	0	1.54 ± 0.51
Venice Beach	338	37	267	34	1.99 ± 0.46
Anaheim Bay ³	101	19	78	4	1.85 ± 0.46
Bolsa Chica	159	32	114	13	1.88 ± 0.52
Huntington Beach SP	104	29	70	5	1.77 ± 0.53
Sta Margarita River	315	41	242	32	1.97 ± 0.48
FAA Island	79	9	62	8	1.99 ± 0.47
Lindbergh Field ³	60	8	42	10	2.03 ± 0.55
D Street fill	19	5	13	1	1.79 ± 0.54
Chula Vista Reserve	37	10	25	2	1.78 ± 0.53
North Island NAS	27	4	21	2	1.93 ± 0.47
Delta Beach	14	2	12	0	1.86 ± 0.36
Saltworks	19	4	15	0	1.79 ± 0.42
Tijuana River Mouth	51	9	42	2	1.87 ± 0.44
Total Mean	1.93	± 0.49			

¹ Not available from every colony. Data used only when colony contained 10 or more nests.

² Data from 2nd wave of nesting only.

³ Data from 1st wave of nesting only.

Table 4. Period of colony activity, date of first egg and first fledgling.

Colony	Activity Period	Date of 1st	
		Egg	Fledgling
P.G.E., Pittsburgh	5/5 - 7/7	5/19	7/7
Port Chicago	7/14 - 7/21	7/14	none
NAS Alameda	4/26 - 8/31	5/10	6/20
Oakland Airport	4/27 - 7/12	5/20	none
Baumberg Saltponds	7/13 - 9/14	NA ¹	NA
Guadalupe Dunes	?	?	?
San Antonio Creek	5/13 - 7/11	?	?
Purisma Point	4/25 - 8/26	?	?
Santa Clara River	5/21 - 8/9	5/28	7/15
Ormond Beach	?	?	?
Point Mugu	?	5/27	?
Venice Beach	4/24 - 8/8	5/1	6/12
Terminal Island	5/1 - ?	5/10	none
Anaheim Bay	4/20 - 5/26	4/27	6/15
Huntington Beach SP	5/8 - 8/28	5/8	6/28
Bolsa Chica	5/6 - ?	5/6	6/20
Upper Newport Bay	5/13 - 8/7	5/2	6/13
Santa Margarita River	4/27 - 8/26	5/8	6/22
Batiquitos Lagoon	5/15 - 8/28	5/21	7/1
San Elijo Lagoon	4/26 - 8/21	5/16	7/10
FAA Island	4/19 - 9/2	5/17	7/1
Naval Training Center	4/23 - 8/2	5/18	7/1
Lindbergh Field	4/19 - 8/26	5/7	6/22
Chula Vista Wildlife Res	4/27 - 9/1	6/1	7/13
D Street fill	4/27 - 8/9	5/12	none
North Island NAS	4/26 - 8/2	5/17	7/5
Saltworks	4/21 - 8/5	5/9	7/8
Delta Beach	4/24 - 9/1	6/5	7/13
Tijuana River Mouth	4/14 - 9/1	5/21	6/29

¹ NA = not applicable