State of California
THE RESOURCES AGENCY
Department of Fish and Game

CALIFORNIA LEAST TERN
CENSUS AND NESTING SURVEY, 1977[1/]

by

Jonathan L. Atwood, Paul D. Jorgensen
Ronald M. Jurek and Timothy D. Manolis

ABSTRACT

In the fifth consecutive annual breeding population survey of California least terns (Sterna albifrons browni), 775 breeding pairs were located at 29 colony sites. Nesting success was generally good, although at least 9 colonies were abandoned or had poor nesting success because of human disturbance, predation or flooding. Breeding population size was the largest recorded since surveys began; most of the increase is attributable to the unprecedented coverage of colonies in 1977 which resulted in more thorough censuses and the discovery of many sites missed in earlier surveys.

1/ Supported by Endangered Wildlife Program, E-1-1, Nongame Wildlife Investigations, California Department of Fish and Game. Job V - 2.11, Job Final Report (December, 1977).

RECOMMENDATIONS

On the basis of this survey, the Department recommends that:

1. Colony censusing and protection efforts; documentation of nesting, feeding and roosting areas; and population monitoring be conducted in the 1978 breeding season in the same manner as in 1977.

2. Breeding colony protection efforts be expanded or modified for sites experiencing colony disturbance and harassment in 1977.

3. Increased colony reconnaissance efforts be made in northern Santa Barbara County, San Luis Obispo County and south San Francisco Bay.

CALIFORNIA LEAST TERN
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by
Ronald M. Jurek

INTRODUCTION

The diminutive California least tern (Sterna albifrons browni) arrives each spring on the west coast of California and Baja California to establish breeding colonies and to raise young. Arriving from unknown wintering areas, the terns occupy coastal habitats in California from the Mexican border to San Francisco Bay from April through early autumn (Wilbur, 1974).

Early this century the least tern was an abundant breeding bird in California. Subsequent human developments and recreational use of the coast reduced the population to such a low level by the late 1960s that this subspecies was declared "endangered" under state and federal laws. A preliminary inventory of breeding colonies was conducted in California in 1969-70 (Craig, 1971), and more intensive surveys and censuses of the breeding population were conducted annually beginning in 1973 (Bender, 1974a, 1974b; Massey, 1975; Jurek, 1977). Recently, attention has been directed toward inventorying the breeding population in Baja California (Massey, 1977).

The 1977 survey is the fifth consecutive annual survey of the least tern breeding population in California. Annual surveying is an essential action in current efforts to restore the least tern to a nonendangered status.

PURPOSE

The objectives of this survey were to document least tern colony locations and breeding population size in California, to evaluate nesting success and to identify important feeding areas. This survey was part of a larger Department project, the purposes of which, in addition to survey objectives, were to coordinate nest colony protection efforts before and during the 1977 breeding season. As in past years, a banding and marking study was conducted concurrently with the survey to place marked birds into the population, to gather information on local movements of fledglings, and to gather return information on immature and adult birds.

METHODS

Three Department censuser/monitors were assigned separate segments of the least tern breeding range: northern (San Francisco Bay area), central (San Luis Obispo County to Orange County) and southern (San Diego County). Monitors coordinated with resource agency personnel in least tern management and protection efforts by identifying management and protection needs at known colony sites before the arrival of birds; assisting in posting, fencing or enhancing nest sites; notifying appropriate land owners, land users, and local agencies regarding the need to protect colonies; monitoring the arrival, presence and departure of colonies; identifying emergency management and protection needs during the nesting season, and assisting in these

efforts; identifying key feeding areas of colonies; censusing each colony; and preparing and disseminating weekly status reports to resource agencies and cooperators.

RESULTS

Censusers located an estimated 775 nesting pairs of least terns at 29 colony sites in California in 1977 (Table 1). Nesting success of colonies, based on number of fledglings produced, was generally good, although at least 9 colonies were abandoned or had poor nesting success because of human disturbance, animal predation or flooding.

Results of experimental efforts to enhance nesting conditions in selected colonies were encouraging. Clay pipes, clay roofing tiles, and special concrete blocks stratigically placed in nesting areas were used for shade and other protection by chicks at Huntington Beach State Park, where this technique was successful in 1976, and at two new test areas, Alameda Naval Air Station and Venice Beach. In another experiment, one of 40 mounds of sand placed at the Bair Island colony site was used as a nest site by the only pair of terns found in the area.

Routine vegetation clearing operations at Huntington Beach State Park and FAA Island in Mission Bay seemed exceptionally successful, as evidenced by the high density of nesting in these areas this year. A promising technique for mechanically preparing substrates was employed at two other Mission Bay sites.

Many newly recognized nesting areas were documented by censusers this season. Four newly described colony sites (Alameda Naval Air Station, Santa Maria River, Beethoven Street Hill and North Island Naval Air Station) are suspected or are known to have been occupied in previous years. Two other sites (Bolsa Chica and Upper Newport Bay) were newly discovered, but it is not known for certain whether the areas had been used by nesting terns in the past. At two other sites (Naval Training Center and 5th Street Marina in San Diego), recent land use changes had provided new breeding areas for terns deprived of a former, nearby site. One new colony (Venice Beach) is probably the result of abandonment of another nearby colony; however, past, undetected nesting by some pairs at the site is possible.

Colony sites and the use by least terns of each one in 1977 are described in Appendices A, B and C. Included in these accounts are descriptions of tern feeding areas and important roosting areas.

Banding operations resulted in the banding of 297 least tern chicks. Banding results are contained in Department of Fish and Game, Endangered Wildlife Program, Job Final Report, Job V - 2.12, 1976-1977, (in preparation).

DISCUSSION

The known 1977 breeding population is the highest index figure recorded since annual surveys began. This total is 111 pairs greater than that reported in 1976 and 175 pairs greater than the 1975 figure. Although the least tern breeding population in California may have increased to some extent in the

Table 1

California Least Tern Breeding Colonies
And Nesting Data, 1977

County	Site	Estimated No. of Pairs	Notes on Nesting Success[1]
Alameda	Alameda Naval Air Station	45	20 + fledglings
	Oakland Airport	7	Unknown
San Mateo	Bair Island	1	None
Santa Barbara	Santa Maria River	25	Approx. 20 fledglings
Ventura	Santa Clara River[1]	(6)	Approx. 10 fledglings
	Ormond Beach	30	Maximum of 10 fledglings (extensive renesting)
	Mugu Lagoon[1]	(5)	Approx. 5 fledglings
Los Angeles	Venice Beach	35	Possibly 30 + fledglings
	Beethoven Street, Fill	3	None
	Terminal Island	85	Approx. 80 fledglings
	San Gabriel River[2]	(35)	3 fledglings
Orange	Bolsa Chica	7	None
	Huntington Beach State Park	45	Approx. 60 fledglings
	Upper Newport Bay	12	Approx. 15 fledglings
San Diego	Santa Margarita River Mouth	120	Fewer than 30 fledglings (extensive renesting)
	Agua Hedionda Lagoon[3]	(13)	Poor
	Batiguitos Lagoon[3]	(11)	Unknown
	San Elijo Lagoon	4	None
	Los Penasquitos Lagoon	14	At least 8 fledglings (extensive renesting)
	Mission Bay		
	North Fiesta Island	8	At least 3 fledglings (extensive renesting)
	FAA Island	125	At least 80 fledglings
	North San Diego Bay		
	Naval Training Center	35	At least 25 fledglings
	San Diego Airport	25	Fair
	5th Avenue Marina	17	At least 6 fledglings (extensive renesting)
	North Island Naval Air Station[4]	(13)	None
	South San Diego Bay		
	Sweetwater River	40	At least 20 fledglings (extensive renesting)
	Coronado Cays	17	At least 7 fledglings
	Saltworks	69	Poor, at least 8 fledglings
	Tijuana River Mouth	6	Unknown
	Total	775	

See next page for footnotes.

Table 1 (continued)

1/ Santa Clara River and Mugu Lagoon represent renesting efforts by pairs from the Ormond Beach colony. Only the Ormond Beach figure is used in the statewide total.

2/ Following failure of the San Gabriel River colony, renesting of these birds presumably occurred at several nearby locations, especially Terminal Island. The San Gabriel River figure is not included in the statewide total.

3/ These colonies formed late and probably included birds counted at other sites. They will not be included in the total estimate.

4/ This flock disbanded early enough to have joined other nearby colonies and will not be included in the total estimate.

last year or two, most of the reported increase is the result of the unprecedented coverage by censusers in 1977 of known colony sites and previously unsearched areas. Most colonies were censused in 1977 far more regularly and frequently than in the past. Also, more field time was expended this year by censusers in areas of suspected colonies. As a result, many nesting colonies were described or accurately censused for the first time. If it were assumed that the 1976 and 1977 populations were in fact identical, approximately 80 percent of the reported disparity could be explained by the discovery in 1977 of colonies that conceivably were missed or that were only partially censused in the 1976 search. Even for colonies known to have been occupied both years, the more frequent 1977 censuses were more likely to have documented all breeding pairs present; part of the remaining 20 percent disparity could be explained by these more frequent censuses.

The discovery in 1977 of two colony sites known to have been active for many years, and the discovery of at least four others that possibly have been missed in previous censuses, indicate that past annual breeding population estimates in California were too low.

Continuing problems of human disturbance of tern colonies, particularly by off road vehicles (ORV) activity, limited nesting success at many colonies. Sign posting and placement of ribbon or rope boundary markers have been ineffective in controlling ORV drivers. Increasing efforts are needed to prevent such disturbance by erecting substantial fences and by increasing law enforcement activity.

The least tern chick banding program contributed useful information to the survey. Late in the breeding season, sightings of fledglings color banded as chicks were valuable in tracing movements of flocks from colony sites to post-breeding season feeding and roosting areas.

The increased coverage in 1977 of least tern abundance, activity and resource problems at breeding colony sites, the discovery of previously undescribed colonies, and the identification of important roosting areas and feeding areas contribute to the store of knowledge necessary for development of conservation programs that will restore this population to a nonendangered status.

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APPENDIX A

LEAST TERN BREEDING SEASON IN THE SAN FRANCISCO BAY AREA, 1977

by

Timothy D. Manolis

Alameda Naval Air Station (Figure A-1)

This breeding area was first brought to the attention of the Department in 1976, when adults and large young were observed at the airfield late in the season. Nesting was not in progress at that time. Because the suspected nesting site in 1976 appeared hazardously close to runway and taxiway traffic from aircraft and maintenance vehicles, an attempt was made in early spring 1977 to create an alternate colony site on a nearby, safer, ice-plant covered, sandy fill. A large area was cleared of ice-plant by the Navy.

No least terns were found on visits to this cleared site and the supposed 1976 site on May 19 and June 1. Shortly thereafter, the Department was made aware, through airfield personnel, of the presence of a least tern colony in the center of the airfield. This colony was first checked on June 15. It occupied a triangular asphalt apron, covered with a fine coat of gravel and sand and was situated between a runway and two taxiways. On June 15, an estimated 45 pairs were nesting. Most appeared to be on eggs, but some nests had 1-3 chicks, and a few chicks were running around and being fed by adults. During subsequent visits, the nesting cycle appeared to progress smoothly. On July 19, 10-20 large chicks (probably more were present but missed) were observed at the site. Nesting at the site seemed to be quite successful.

Airfield personnel (E. Craw, pers. comm.) have been aware of this colony for about 10 years and report that it has been about the same size throughout its known existence.

Terns observed flying and fishing at Ballena Bay, and in shallow water areas around the air station, undoubtedly were birds from this site. Birds were observed arriving at the site with fish from both north and south of the air station (the air station is bounded by water on the north, west and south).

There is very little vegetation or other shelter at the site, and on a number of visits, chicks were observed wandering around on the runway and taxiways. If this is the same colony site used in 1976, the chicks observed that year at the southeast corner of the airfield had to have crossed a major taxiway at some time in their wanderings. In an attempt to keep chicks from wandering and to provide them with shelter, 15 concrete blocks /U-shaped, 20 cm (8 in.) x 20 cm x 20 cm/ were placed to form shady tunnels near the colony on June 23. Chicks were observed using the blocks for shelter on June 28. Additional blocks should be placed at this site before the 1978 nesting season.

This site, on first inspection, seems hazardous. An airfield accident, or inadvertant vehicle traffic, could do considerable damage to this colony. However, the chance of an airfield accident at the site is probably very small, though unavoidable. Fortunately, air station personnel were cooperative and took precautions to avoid disturbing the site during the nesting season.

for a few eggshell fragments. It is unlikely this nesting was successfully completed between June 30 and July 15. Predation seems the most likely cause of failure.

Bair Island has had an intermittent history of use, and it seems likely to be used again in the future as it remains a suitable site. The use by one pair of a sand pile for nesting indicates the feasibility of these piles being used in the future. Greater scrutiny of this site in the future (i.e., more frequent visits) may reveal the nature of any predation, which has been a problem at this site in the past.

On June 1, a helicopter was observed hovering and practicing landings and take-offs over an area near this site. Such helicopter activity at other least tern sites (e.g., Bair Island and Playa del Rey) has been a problem in the past. The air station should be apprised of the situation so that helicopter activity near the nest site will be controlled during the breeding season.

It seems unlikely that least terns will use the unused area cleared by the Navy in the spring as long as the current nesting site is stable. The cleared area is also vulnerable to predation by feral cats. It would probably be unwise to attempt to deter terns from the nesting site. The colony is not in jeopardy from, nor is it a hazard to normal airfield operations. This site also appears to be free of major predators because of its location in the center of the airfield; this may be an important influence on the size and stability of the colony.

Oakland Airport

This site is sandy bay fill at the north end of the main runway. It was used for nesting by least terns in 1973, 1975 and 1976. In 1977, 8 birds were observed at this site on May 19. Courtship activity and defense of the area by the birds indicated intentions to nest. Three visits to this site in June and July indicated the presence of about 7 pairs, probably nesting. On July 19 a nest with 2 eggs was found. On that date, terns were observed flying into the area with fish, and the intensity of territorial defense at the time strongly suggested the presence of chicks. Chicks and nests are very difficult to find among the rolling, sparcely vegetated sand dunes of this site. On August 3, no least terns were observed. Five single, cold eggs were found scattered in the area of greatest use by terns. The reason for the failure of these eggs to hatch, and their significance, as far as the reproductive success of the colony is concerned, remains unknown.

The site appears to be suitable and stable, however, this colony remains small. It is possible predation is hindering the growth of this colony. Reproduction may be successful only if nests are few and scattered. Gulls are common in this area, and mammalian predators no doubt inhabit nearby vegetated areas. This colony should continue to be monitored in future seasons to determine effects of predation at this site.

Bair Island

This site was used for nesting by least terns in 1971 and every year since 1974. Fourteen pairs nested in 1976. The substrate at Bair Island, a silty loam, was observed to stick to eggs when wetted, and hampered the hatching of some eggs in 1976. In an attempt to remedy this, Department of Fish and Game and San Francisco Bay National Wildlife Refuge personnel deposited 40 piles of sand in mid-April 1977 to provide alternative nesting substrates at this site. Each mound was approximately 1 m (3 ft.) in diameter and 0.3 m (10-12 in.) high. This technique was previously used with some success at Camp Pendleton, San Diego County (Swickard, 1974).

No least terns were observed at Bair Island or its vicinity during visits to the site on May 13 and June 10. On June 30, 1 pair and a clutch of 3 eggs were observed in a scrape atop one of the sand piles (C. Osugi). On a return visit on July 15, no terns were observed. The nest scrape was empty except

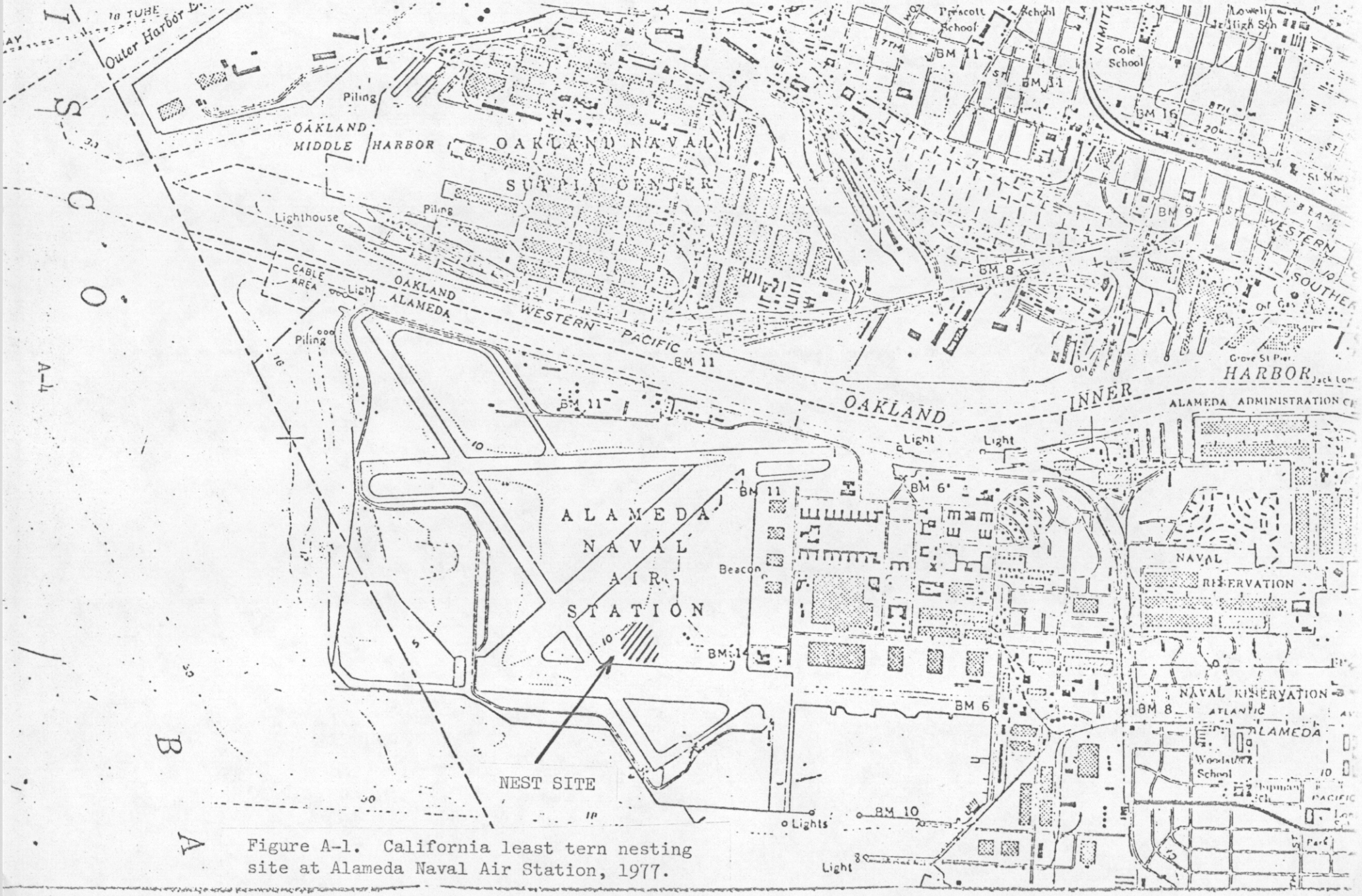

Figure A-1. California least tern nesting site at Alameda Naval Air Station, 1977.

APPENDIX B

LEAST TERN BREEDING SEASON FROM SAN LUIS OBISPO COUNTY TO ORANGE COUNTY, 1977

by

Jonathan L. Atwood

Santa Maria River (Figure B-1)

For several years least tern nesting has been suspected along the coastline of northern Santa Barbara County and/or southern San Luis Obispo County. Approximately 16 km (10 mi.) of somewhat suitable nesting habitat occur between the mouth of the Santa Maria River and the Nipomo Dunes region, making location of the suspected colony difficult.

On June 10, 1977, a moderate sized colony of least terns was discovered nesting approximately 0.6 km (0.4 mi.) south of the Santa Maria River mouth in extreme northern Santa Barbara County. Nests were scattered over an extensive area (approximately 80 ha, or 20 ac.) of relatively flat sand dunes 45-90 m (50-100 yds.) east of the beach's high tide line. Hummocks of stabilized sand, ranging from 0.6 to 1.8 m (2 to 6 ft.) high, are scattered throughout the area; vegetation promoting formation of these hummocks includes Abronia latifolia, Franseria chamissonis, Cakile edentula, and very limited amounts of Mesembryanthenum sp. Ecologically, this is probably one of the most "natural" least tern nesting areas remaining in California. ORV use of the area is considerable, though due to the relatively flat terrain, it is not as intense as in other nearby sand dune areas. Ownership of the area was undetermined.

The nesting site was visited on 6 dates between June 10 and September 12. The size of the area, coupled with limited visibility due to the rolling terrain and sand hummocks, made censusing of the colony very difficult. Estimates of colony size were made from counts of adults mobbing me as I cautiously walked through the area late in the nesting season, when such activity did not jeopardize the colony. Only a small fraction of the nests and chicks which must have been present during the season were actually located.

Data indicate that approximately 25 pairs nested at the Santa Maria River site in 1977. The nesting season was quite prolonged; the first fledgling was seen July 12, and small chicks were still present on August 8. Rather than reflecting a large amount of renesting activity, I feel that this prolonged nesting period more likely was the result of a low degree of colony synchronization relative to the onset of breeding. Hatching and fledging success was good; while some disturbance undoubtedly resulted from ORV activity in the area, the nesting density of the colony was so low that by chance probably only minimal nest desertion or direct mortality occurred. Assuming that fledglings seen at nearby localities were from this colony, I would estimate that approximately 20 fledglings were produced at this site in 1977.

Most of the foraging activity took place in the ocean immediately adjacent to the nesting area, rather than in the channels of the nearby Santa Maria River. It appeared that some increase in use of the river mouth area occurred late in the season when the small fish necessary for feeding chicks were being sought. However, even during August, the bulk of least tern foraging in the area (including both adults and fledglings) apparently took place in the ocean.

Dispersal away from the nesting area occurred fairly rapidly, assuming that least terns seen at Oso Flaco Lake and the Santa Ynez River were from the Santa Maria River (Figure B-2). Although there was no evidence of nesting near either of these two areas in 1977, it remains possible that other small to moderate sized colonies remain undiscovered along this stretch of coastline. On July 12 a pair with 1 fledgling was seen at the mouth of the Santa Ynez River; on July 22 none were at the Santa Ynez River, but 10 (including 4 fledglings) were at Oso Flaco Lake. On August 8, 10 (including 6 fledglings) were present at the Santa Ynez River, and 15 (including at least 6 fledglings) were at Oso Flaco Lake. No least terns were seen in the Dune Lakes area this year after a brief sighting of approximately 30 in mid-May (Churchward).

The absence of suitable resting sites in the Dune Lakes area may account for the failure of least terns to regularly use this location for foraging. The sandspit at White Lake which was used as a post-nesting flocking area in 1975 is now heavily overgrown with willows, and at all of the lakes which I observed there was dense riparian vegetation or tules extended fully to the water's edge. At Oso Flaco Lake, least terns made heavy use of several abandoned duck blind frames located in the center of the lake for resting and for feeding of fledglings. Artificial construction of resting platforms or floats might be a simple, yet profitable, management technique in this region.

In light of several proposed projects which would have major environmental impacts along this stretch of coastline (LNG Terminal in the Pt. Conception area and large scale space programs based at Vandenburg Air Force Base), it is recommended that major efforts be made to better define the status of least terns in northern Santa Barbara County and southern San Luis Obispo County.

Santa Clara River

Nesting at this locality has been previously documented only in 1975, when only one pair was found nesting. This year the area was visited on 10 dates between May 2 and September 13, at intervals ranging from 6 to 22 days. Least terns were not regularly seen until late July; on July 23, 4 nests were located south of the Santa Clara River mouth, and by July 29, 5 were present (including 1 isolated nest located several hundred meters north of the river mouth channel). By August 25, hatching was underway, and an additional clutch was present south of the river mouth. Hatching and fledging success appeared good, and approximately 10 fledglings were produced.

The late date of nesting and relatively low average clutch size (2.1 eggs) indicate that these pairs were probably renesting after an initial nest failure at another locality. Since the Ormond Beach colony was declining in numbers at the same time that least terns began appearing at the Santa Clara River, it is almost certain that the same birds were involved at each location. The two areas are approxmmately 18 km (11 mi.) apart.

The foraging activity of this colony occurred in three main locations: 1) the adjacent river mouth, especially along the shallow edges and channels, 2) the ocean adjacent to the nesting site, and 3) the Ventura Marina.

Ormond Beach

For the third known year since 1974, least terns returned to the nesting area previously used at Ormond Beach. The site was visited on 13 dates between May 2 and August 8 at intervals ranging from 3 to 14 days.

Least terns were present in the area by May 16, and on May 26 small numbers of nests were present. Nesting activity, which occurred over a much longer stretch of beach than has been noted in previous years, seemed to be loss synchronized than at most other colonies. Many of the early nests were located in a small area immediately north of the Southern California Edison Company power plant; later nesting activity, which included the bulk of the colony, took place farther north on the portion of beach used in 1974 and 1976. This area was semi-protected by the use of sand fencing and posting erected on June 14; these measures were largely ineffective in preventing ORV disturbance of the nesting site. By June 24 the colony had increased to its maximum size of approximately 30 pairs; since at least 8 early nests were destroyed by ORV activity, both renesting and initial nesting attempts are thought to have been taking place at this time. The colony showed a gradual decline in numbers throughout the remainder of the season, probably more as a result of continued ORV disturbance than due to dispersal following successful nesting. On July 8 approximately 18 pairs were present, on July 15 this number had dropped to 9 pairs, and by July 29 only 2 pairs remained in the area. At best, the colony had only moderate hatching and fledging success; a maximum of 10 fledglings was produced.

Since the decline of the Ormond Beach colony in late July coincided with the arrival of nesting least terns at Mugu Lagoon and the Santa Clara River mouth, both of these sites presumably served as renesting localities for this colony. This pattern closely resembles that seen in 1975, when late nesting took place at both Mugu Lagoon and the Santa Clara River but was not reported from Ormond Beach. I suspect, however, that early nesting did occur at Ormond Beach in 1975 but was overlooked; if the colony had been located in the area of the Edison power plant, where a portion nested this year, its presence could have easily remained undetected.

The foraging activity of the Ormond Beach colony took place in 3 main areas: 1) Mugu Lagoon, located approximately 5 km (3 mi.) southeast of the nesting area, 2) the ocean immediately adjacent to the nesting site, and 3) the small marsh area and drainage channels immediately adjacent to the nesting area. As at other colonies this year, foraging in the ocean seemed to predominate until relatively late in the season. The use of Mugu Lagoon by Ormond Beach birds came as somewhat of a surprise; during late July adults regularly were seen carrying fish away from this foraging area in the direction of Ormond Beach, flying over the Mugu Lagoon least tern nesting area.

Mugu Lagoon

For the third consecutive year, least terns nested along the northwest stretch of the Pt. Mugu Pacific Missile Range. Previous reports have not underscored the proximity of this area to the Ormond Beach nest site, which is located less than 3 km (2 mi.) northwest of the Mugu Lagoon area along an ecologically continuous stretch of beach. Nesting at Mugu Lagoon has always occurred relatively late in the season (early July 1975 and late June 1976); this fact, together with similar but more complete data from 1977, strongly suggest that least tern nesting in the Mugu Lagoon area represents the renesting efforts of birds from the heavily disturbed Ormond Beach colony.

Least tern nesting at Mugu Lagoon was first noted this year on June 24, when a single nest was found and 2 additional pairs were involved in courtship behavior at the site. By July 18 approximately 9 pairs were in the area, and 4 nests were located; this increase in numbers coincided closely with a decrease in the population at Ormond Beach. On July 28 a fledgling banded at Ormond Beach was observed with its parents at the Mugu Lagoon site -- a further indication of the interchange of birds which occurs between those two slightly separated areas. By August 8 only a single pair with 2 chicks remained at the Mugu Lagoon site. Average clutch size (2.0 eggs) for this colony was rather low. This is consistent with the hypothesis that these nests were replacement clutches of pairs which had deserted the Ormond Beach site. Hatching and fledging success at Mugu Lagoon appeared good, and approximately 5 fledglings were produced.

A surprisingly late observation of 6 least terns (2 adults, 4 immatures) was made at this locality on September 20 (Massey).

Venice Beach (Figure B-3)

For the last 4 years least terns have nested on an alkali flat located at Playa del Rey; of those attempts, 3 have been at least moderately successful. During those years the colony has averaged about 20 pairs.

In 1977, least terns returned to the Playa del Rey site between April 20 and May 6, on which date 14 were observed foraging in the adjacent Ballona Creek channel and several were involved in early courtship behavior at the site. On May 8, however, an unseasonal storm left over 5 cm (2 in.) of rain in the area, flooding nearly the entire nesting site. On May 16 the site still had considerable standing water, and the exposed substrate was far too wet for any nesting activities. No least terns were seen at this locality throughout the remainder of the season.

On May 23 it was discovered that 3 pairs, presumably from the abandoned Playa del Rey nest site, had relocated themselves at Venice Beach, located 1.2 km (3/4 mi.) east of the Playa del Rey site. The 3 nests present were widely scattered over an area of approximately 3 ha (8 ac.); this area was posted and roped off on May 25, and on May 27, 1 m (3 ft.) high metal sand fencing was erected around the site through the assistance of local property owners and the Los Angeles County Department of Beaches. Since loose dogs are a problem along this stretch of beach, it is certain that the use of this sand fencing was instrumental in the success of this colony. The specific location of the nesting enclosure was in the central portion of the beach, immediately north of the Ballona Creek channel. The substrate was loose, light colored beach sand with no vegetation cover present. This stretch of beach is owned by the California Department of Parks and Recreation but is administered by local city and county authorities.

The nest site was visited on 17 dates between May 23 and August 30, at intervals ranging from 1 to 16 days. Data indicate that approximately 35 pairs nested at Venice Beach during 1977. The season was quite prolonged, with nests being present from May 23 to August 1. Hatching and fledging success appeared good; no problems with nest desertion, predation, or unusual chick mortality were noted. As has been previously found at Huntington Beach State Park, chicks at Venice Beach made heavy use of clay roofing tiles which were placed within the nesting area as artificial shelters. Although the intermixing of fledglings during post-breeding dispersal makes definite counts of fledglings produced at

a given colony somewhat tenuous (see discussion of post-breeding dispersal from Terminal Island), most of the 35-40 fledglings present at Venice Beach in early August were probably from this colony. Small numbers of least terns seemed to linger in the area of Venice Beach longer than at other nesting sites; 25 were present on September 6, but only 2 could be found on September 16.

Since 35 pairs are considerably more than the 20 pairs historically present at the Playa del Rey site, there may have been some renesting activity at Venice Beach following initial nesting failures at colonies such as San Gabriel River. An alternative explanation can not be ruled out, however. Although nesting of least terns on Venice Beach has never been previously documented, past observations of adults feeding fledglings at this location suggest that a small number of widely scattered pairs may have attempted to nest in this vicinity in the past. While in my opinion somewhat unlikely, it is conceivable that the increase from 20 to 35 pairs reflects the presence of these previously unnoticed birds.

Foraging activity was noted in the ocean immediately adjacent to the nest site and in the nearby Ballona Creek flood control channel. No preference between these two areas, which are probably nearly identical biologically, was observed.

Beethoven Street Fill (Figure B-3)

Following an observation (Johnson) of defensive least terns at this location along the Ballona Creek channel, a single pair with a clutch of 3 eggs was found on June 2. These eggs had recently hatched on June 10, indicating that nesting at this site had begun around May 20. Only 3 nests were established at the Beethoven Street site in 1977, with a maximum of 2 breeding pairs present at any one time. Chicks successfully hatched in two of the nests but no young fledged; the third nest was abandoned. It is likely that human disturbance was responsible for the nesting failure of this colony.

The nesting area is a small (approximately 0.1 ha, or 0.2 ac.), triangular portion of property owned by the Los Angeles County Flood Control District. It is bounded on two sides by flood control channels (including the Ballona Creek channel) and on the third side by a chain link fence. The potential for controlling human access to the site is good. The substrate is light colored, sandy dredge material with sparse vegetation cover.

This is the first year that nesting has been documented at this site. However, least terns almost certainly nested in this area in 1976 following abandonment of the Playa del Rey site (located 2.4 km, or 1.5 mi., southwest of the Beethoven Street fill); at least 6 pairs were observed at the site during July 1976, but nesting was never confirmed. It is unknown whether this area is used only when the Playa del Rey site is not used for nesting (as in 1976 and 1977), or if a small number of pairs regularly use this location.

Terminal Island

Least terns returned in 1977 to the Reeves Field nesting site, which has been used 4 of the last 5 years. No terns were seen at the nesting area used in 1975; this location remains unsuitable due to heavy vegetation growth and use of the area for storage of petroleum coke by the Los Angeles Harbor Department.

Reeves Field was visited on 26 dates between April 11 and August 16 at intervals ranging from 1 to 14 days. The first least terns were observed on May 6. Nesting was underway by May 18, and continued throughout June and July; the last eggs were noted on July 27. The maximum nest count was 75 present on June 7; at least 95 nests probably were present during the course of the season. This figure likely represents the nesting efforts of approximately 85 pairs. Hatching and fledging success appeared good; no evidence of nest desertion, predation, or unusual chick mortality was noted. Three dead adults found intact on the nesting area (June 23, July 13, August 3) showed no signs of external injuries and are available for chemical analysis. The absence of any marked surge of renesting activity indicates that the initial attempt of most pairs was generally successful. While some of the later nests undoubtedly represent second attempts, I suspect that many of these pairs had moved to the Terminal Island site after earlier failure at the nearby San Gabriel River colony. Data on interchange of pairs between nearby colonies during a given nesting season remain a major gap in our understanding of least terns; the banding program, as currently being pursued, will not provide this information. Due to rapid dispersal from the nesting area, accurate counts of fledglings produced are difficult; I would estimate that approximately 80 young were fledged from the Terminal Island colony in 1977.

The foraging activity of this colony was scattered throughout Los Angeles Harbor, with most occurring in harbors of the U. S. Naval Shipyard located immediately adjacent to the nesting site. However, no significant concentrations of foraging least terns were noted prior to post-breeding dispersal.

As in previous years, Harbor Lake was an important foraging area for this colony during July and August. No least terns were seen at Harbor Lake in June; however, by early July small numbers of adults had begun to make foraging trips to this area from Reeves Field. By July 13 approximately 55 terns were foraging at Harbor Lake; only 10 of these were fledglings. Numerous observations were made of adults carrying fish away from Harbor Lake in the direction of Terminal Island, a direct flight distance of 7.2 km (4.5 mi.). Such interchange between Harbor Lake and Reeves Field diminished as more and more fledglings joined their parents at Harbor Lake, presumably following them there from the nesting site. Least terns apparently do not roost at Harbor Lake during the night, but merely use this area for foraging; this point has been unclear in previous reports. By August 3 approximately 50 least terns, almost half of them fledglings, were at Harbor Lake. This number gradually decreased in late August, and by September 6 none were observed at this locality.

The large sample of chicks which were color marked at Terminal Island provided considerable data on post-breeding dispersal of this colony. The majority of the colony moves to Harbor Lake, at least temporarily, following the fledging of young (up to 15 banded fledglings seen at once). However, at least 3 Terminal Island fledglings were also seen at Bolsa Chica (located 19 km, or 12 mi. southwest of Reeves Field) and Venice Beach (approximately 29 km, or 18 mi. NNW of Reeves Field). The post-breeding dispersal of a colony can hardly be considered a cohesive movement; rather, small numbers of birds appear to move in various directions away from the nesting site. The interchange of fledglings between such distant colonies as Venice Beach and Terminal Island is interesting since it casts some doubt on the accuracy of figures such as "fledglings produced at a given colony." The possible role of a multi-colony roosting flock in promoting such interchange is considered in the discussion of Belmont Shores beach. A single Terminal

Island fledgling also was seen with its parents at the San Gabriel River site; perhaps this pair experienced an early nest failure at San Gabriel River and then renested successfully at Terminal Island.

San Gabriel River

For the seventh consecutive year, least terns returned to the fill area located east of Pacific Coast Highway between the north bank of the San Gabriel River and what is now "The Market Place" shopping center. Commercial development of this area has continued to expand; the northern portion of the nesting area used in 1976 is now an asphalt parking lot. The property owners cooperated fully in providing for ground preparation of the remaining nesting area; grading was completed on April 29 under DFG supervision. The entire nesting area was posted and roped off to discourage human entry; these efforts were, for the most part, successful.

Data were gathered on 38 visits to the nest site between April 9 and August 10. Least terns were first observed on April 23; numbers gradually increased and by May 6 a minimum of 15 pairs was at the site. The courtship and site selection cycle was interrupted, however, on May 8 when an unseasonal storm left 3 cm (1.2 in.) of rain in the Long Beach area, thereby flooding major portions of the nesting area. Included in these was the southern portion of the site which had been the focal point of least tern courtship and site selection activities; following the storm, these activities shifted to the drier northern and eastern portions of the area which had been previously ignored by the birds. By May 18 nesting was well underway, and 30-35 pairs were present on the site; the colony appeared strong with no obvious problems. However, on May 30 only 16 nests were present, and the overall activity of the colony was noticeably reduced. On June 7, 13 nests were present, at least 4 of which had not been seen on May 30; since no chicks could be found, the loss of about 7 nests during this 8 day period is indicated. By June 22 renesting had begun, with 15 nests present; on June 29, 20 nests were located (8 of which were in the previously flooded southern portion of the area), and a four day old chick was seen. The colony appeared to have stabilized and once again seemed strong; however, on July 11 only 5 nests were present and no chicks were seen. Of these 5 nests, only one was finally successful in producing fledglings (seen on August 9). Only 3 young were produced from this colony, which fledged 42 in 1975 and "many more" than 65 in 1976.

Human trespass into the nesting area was minimal until late July, at which point the nesting site was already mostly deserted. Traffic along Pacific Coast Highway caused no apparent disturbance, nor did the fairly limited activity in the adjacent shopping center parking lot. Nesting failure was probably due to predation or some sort of animal associated disturbance. Many cat tracks were found in the area, but rat, (Rattus sp.), dog, and ground squirrel (Otospermophilus beecheyi) tracks were also found making it difficult to conclusively point to a single source of the problem. Little direct evidence of predation was found; occasionally broken egg shells were located, but for the most part eggs and chicks merely disappeared. It is recommended that predator control measures, directed toward feral cats and rats, be initiated annually at this site prior to the arrival of the terns.

Foraging activity mainly occurred throughout the Long Beach Marina directly west of the nesting site, and to a lesser extent in the channel of the San Gabriel River adjacent to the area. Early in the season foraging least terns, presumably from this colony, were regularly seen as far away as the Long

Beach Marine Stadium; however, as nesting progressed, this locality was utilized only occasionally.

Bolsa Chica (Figure B-4)

On June 27 a small colony of least terns was discovered nesting on a large landfill area owned by Signal Landmark Company. A total of 3 nests was present, with an additional 5 pairs involved in courtship behavior at the site. The nesting area was posted and roped off and experienced virtually no human disturbance throughout the remainder of the season. By July 11, however, the nesting activity had greatly declined, with only 1 nest and a total of 5 adults present; no chicks were seen. Many cat and dog tracks were found in the area, presumably representing the source of disturbance for this colony. On July 20 a single nest was present (different from that seen July 11); no other terns were in the immediate vicinity of the nest site. By August 8 the colony had abandoned the area.

The history of least tern nesting activity in this area is not well known. While this is the first time in recent years that nesting has been documented in the Bolsa Chica area, it is possible that small numbers have attempted to nest in the area previously and have merely gone unnoticed. The Bolsa Chica colony more likely represents a renesting attempt by a small portion of the San Gabriel River colony, located 11 km (7 mi.) NW of the Bolsa Chica nest site.

Huntington Beach State Park

Vegetation removal within the fenced least tern sanctuary was completed well in advance of the nesting season, with approximately 20 percent vegetation cover being left on the site. The area was visited on 21 dates between April 21 and August 22 at intervals ranging from 2 to 11 days. Additionally, Russ and Marion Wilson checked the site frequently throughout the nesting season; their data have been incorporated into this report.

Least terns arrived at Huntington Beach this year between May 3 and May 13; numbers rapidly increased and by May 20 approximately 15 pairs were in the area. Since much of the early tern activity occurred in the beach area west of the fenced sanctuary, an additional area (approximately 0.3 ha, or 0.7 ac.) was posted and roped off on May 20 to discourage human disturbance. This posted area was used by the terns throughout the season for courtship, flocking, roosting, feeding of young, and a limited amount of nesting (3 pairs); all investigators familiar with this colony felt that the additional area was beneficial to the terns and should be annually protected during the breeding season. Nesting was underway by May 25, and by June 9, 28 nests or scrapes were present. Nesting continued over an extended period of time; on July 11, 23 nests and at least 15 chicks and 15 fledglings were counted. There was no apparent surge of renesting activity. On July 28, when the colony had noticeably dropped on overall numbers due to post-breeding dispersal, there were 6 nests, 25 chicks, and 40 fledglings present. Nesting was completed in early August, and by August 19 the area was totally vacated.

The protracted nesting season, possibility of renesting attempts, and rapid post-breeding dispersal from the nesting site make analysis of these data difficult. Approximately 50-55 nests are known to have been present; considering the apparently good hatching and fledging success (no evidence of nest

desertion, predation, or unusual chick mortality), this figure probably represents the nesting efforts of at least 45 pairs. Accurately enumerating fledged young was similarly difficult, but I would estimate that approximately 60 were produced.

Most of the observed foraging activity of this colony occurred in close proximity to the nesting site. Early in the season (i.e., prior to the hatching of chicks), most foraging occurred in the ocean; it appeared that a shift to the brackish, relatively shallow channels of the Santa Ana River was made when the smaller fish required for chicks were being sought. More data on the food requirements of least terns are necessary, especially relative to the sizes of fish taken. It is possible that the food utilized by adults may differ sufficiently from that of young chicks as to require, at least at some colonies, parental foraging activity in very different habitats.

Data on the post-breeding movements of terns from this colony are sparse, but it appears that at least the Bolsa Chica area, located 12 km (7.5 mi.) northwest of the Huntington Beach State Park nest site, may be an important post-breeding area. Up to 25 least terns, including at least 14 (and probably more) fledglings were present at this locality between July 28 and late August; at least 3 of the fledglings had been color banded at the Huntington Beach colony. Considering the relatively small color banded sample from this colony (24 chicks), it is likely that many of the unbanded fledglings seen at Bolsa Chica were also from the Huntington Beach State Park colony.

Upper Newport Bay (Figure B-5)

Following a report of least terns in this area (Loughran), a small colony of approximately 10 pairs of least terns was confirmed to be nesting on July 2, when 4 nests were located. One of these contained a very recently hatched chick. This observation, together with that of a fledgling seen July 20, suggests that nesting probably began at this site in early June. Data obtained on 9 visits to the colony between July 2 and August 19 indicate that approximately 12 pairs nested at this location in 1977. Hatching and fledging success appeared good, and approximately 15 fledglings were produced from the colony.

The nesting site is located in the abandoned saltworks at the northern end of DFG's Upper Newport Bay Ecological Reserve. Plans for enhancement of a portion of the saltworks area as a least tern nesting site are currently under consideration.

Although least terns are known to have bred historically in the Newport Bay area, this is the first time in recent years that nesting has been documented. While the origin of these birds is purely speculative, I feel that it is possible that limited nesting has occurred in the saltworks area previously but has gone unnoticed. (For example, the foraging patterns of this colony take the birds away from those areas of the Ecological Reserve most frequented by local birders).

Given the colony's proximity to a sizable, natural saltwater estuary, the foraging behavior of these birds was somewhat surprising. Only limited foraging activity occurred in the bay itself; least terns were only occasionally seen south of the broken main dike prior to post-breeding dispersal from the nesting area. Slightly greater foraging activity was noted immediately adjacent to the nesting site in the shallow channels passing through the

saltworks area. But by far the majority of this colony's foraging was done away from the Ecological Reserve at the following freshwater locations in the Newport/Irvine area: 1) a small, man-made lake located in the middle of the Koll Center office complex, 2) the ponds of the San Joaquin Marsh, administered by U. C. Irvine, and 3) a small pond located at the intersection of MacArthur Boulevard and Jamboree Road (Figure 5). Adult least terns were frequently observed carrying fish from each of these locations in the direction of the Upper Newport Bay nesting site. Fledglings were also seen at each of these locations late in August; it is suspected that these areas, with dense concentrations of mosquito fish (Gambusia affinis), provide prime foraging sites which may be especially important to fledglings learning how to catch fish. For instance, during a 3 minute observation period at the Koll Center Lake, one recently fledged bird was observed to make 3 unsuccessful dives at fish; during the same time period, one of this fledgling's parents was successful on each of 4 dives. The continuance of good food supplies at the Koll Center Lake and the San Joaquin Marsh may be essential to the future existence of an Upper Newport Bay least tern colony.

Belmont Shores Beach Night Roost (Figure B-6)

It was discovered in 1976 that following nesting, large numbers of least terns (maximum count of 171) roosted at night on the Belmont Shores Beach in Long Beach. Banding data on the source of these birds, although difficult to obtain, indicated that much of this flock was from the San Gabriel River colony.

In 1977, it was discovered that not only is this area used for roosting following the nesting season, but also preceding and even during nesting. Small numbers of least terns were first observed along this stretch of beach early on the morning of May 3 (Flanagan). Thereafter, data on the number of roosting terns were obtained on 19 visits to this area between May 5 and August 29 by Dorothy Rypka, Barbara Massey, and me.

Shortly before sunset, least terns began to appear throughout the Long Beach Harbor area, arriving individually, as pairs, and in small groups. These birds engaged in some foraging activity in the harbor areas, gradually coalescing into larger and larger groupings. The area chosen for roosting was remarkably consistent considering that identical beach extends for miles in either direction. After making several low passes over this area, the flock would quickly settle on the sand, perform some preening behavior, and then settle low into the sand for protection from the wind. The entire flock would disperse the following morning prior to sunrise, leaving usually as pairs or small groups; directions of flight under these light conditions were impossible to determine.

The pattern of changing abundance of roosting terns at this site probably reflected migratory movements and stages of the breeding cycle of local colonies:

1) Several local colonies must be represented in this roosting flock. The maximum count of 280 birds, present on May 9, far exceeds the number present at any local colony, or even the combination of the two closest colonies (Terminal Island and San Gabriel River). Northward bound migrants may be represented in this flock at this time.

2) There was a gradual decline in numbers from mid-May through early July. On July 2, only 6 terns were counted. This undoubtedly reflects increasing numbers of birds remaining at local nesting areas as well as the dispersal of birds to more distant, northern colonies. Even during mid-June, however, at the peak of local nesting activity, considerable numbers (approximately 130) continued to roost at this location. Either there is a sizable percentage of the population which nests relatively late in the season (unlikely), or both members of a pair do not always remain together on the nesting grounds at night.

3) A sharp increase in numbers in late July (to a peak of 170) coincided with the arrival of many fledglings, which comprised approximately 25 percent of the flock throughout the remainder of the season. Although color bands could not be seen under the poor light conditions, it is almost certain that the bulk of these fledglings came from the Terminal Island colony.

4) Numbers gradually declined throughout late July and August, probably due to southward migration or widespread dispersal to other post-breeding flocking localities.

Other large night roosts such as this may occur in other portions of the least tern breeding range. Craig (personal communication) counted at least 500 least terns in a night roost at San Diego International Airport on May 21, 1971. Identification and protection of such night roosts throughout the state may prove to be very important in efforts to maintain tern breeding colonies.

Clutch Sizes

Below are listed average clutch sizes of selected least tern breeding colonies in Santa Barbara, Ventura and Los Angeles counties during 1977. Small clutches in the Santa Clara River and Mugu Lagoon colonies probably reflect renesting efforts late in the breeding season following partial colony abandonment at Ormond Beach (Lack 1954, Klomp 1970).

Colony	Colony Size (pairs)	No. Clutches Checked	Date	Aug. Clutch Size
Santa Clara River	6	6	July 23-Aug 25	2.1
Ormond Beach	30	5	June 14	2.4
Mugu Lagoon	5	5	June 24-Aug 8	2.0
Venice Beach	35	6	June 2	2.5
Terminal Island	85	14	May 29	2.6

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Orange County: Kristen Bender, Margaret Carlberg (Sea and Sage Audubon Society), Charles Collins, Ronald Hein, Jack Hiehle (Huntington Beach State Park), Preston Johns, John Lindell, Lois Loughran, Barbara Massey, Michael Mulligan, Dorothy Rypka, Russel and Marion Wilson.

Figure B-1. California least tern nesting site at Santa Maria River, 1977.

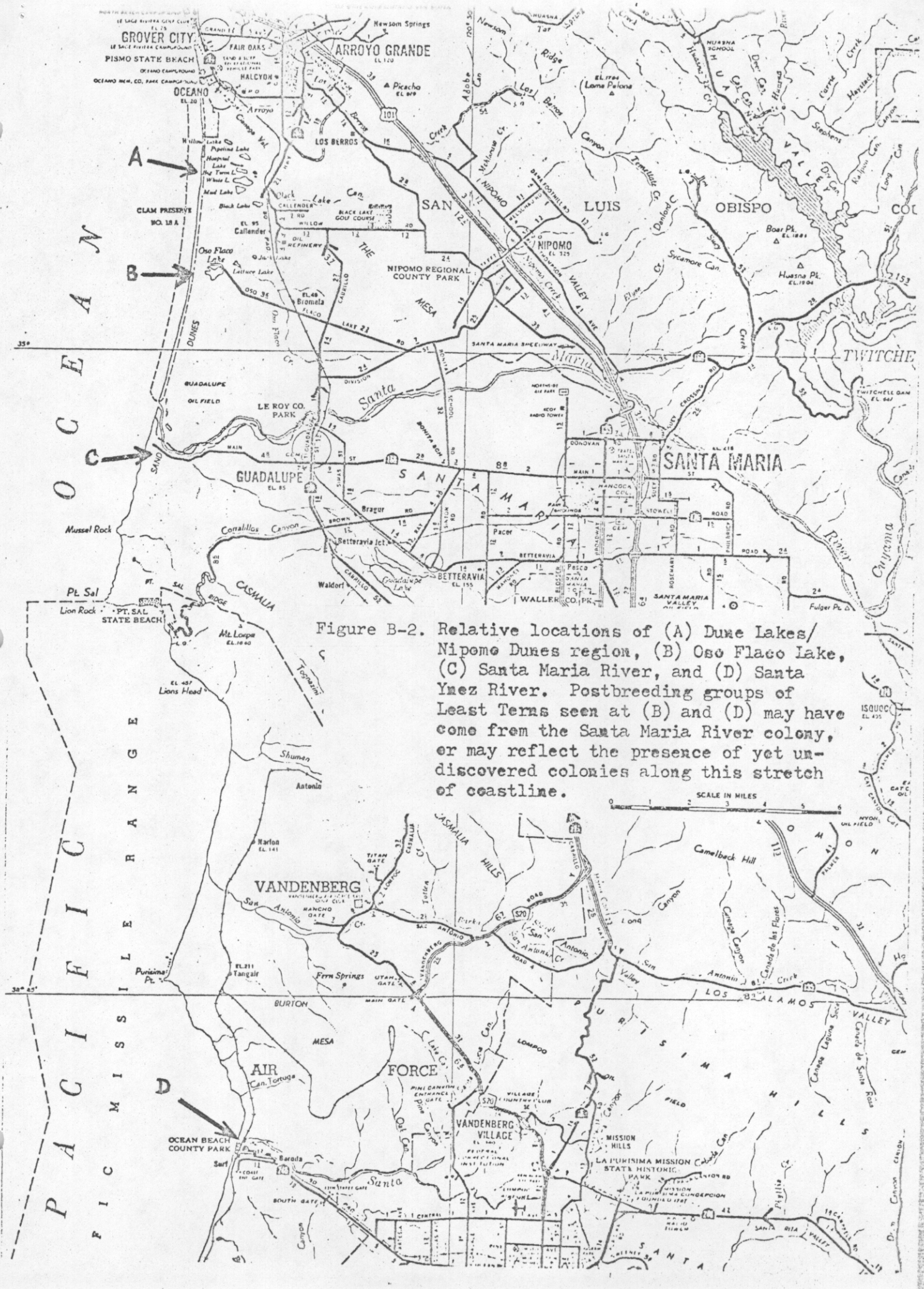

Figure B-2. Relative locations of (A) Dune Lakes/ Nipomo Dunes region, (B) Oso Flaco Lake, (C) Santa Maria River, and (D) Santa Ynez River. Postbreeding groups of Least Terns seen at (B) and (D) may have come from the Santa Maria River colony, or may reflect the presence of yet undiscovered colonies along this stretch of coastline.

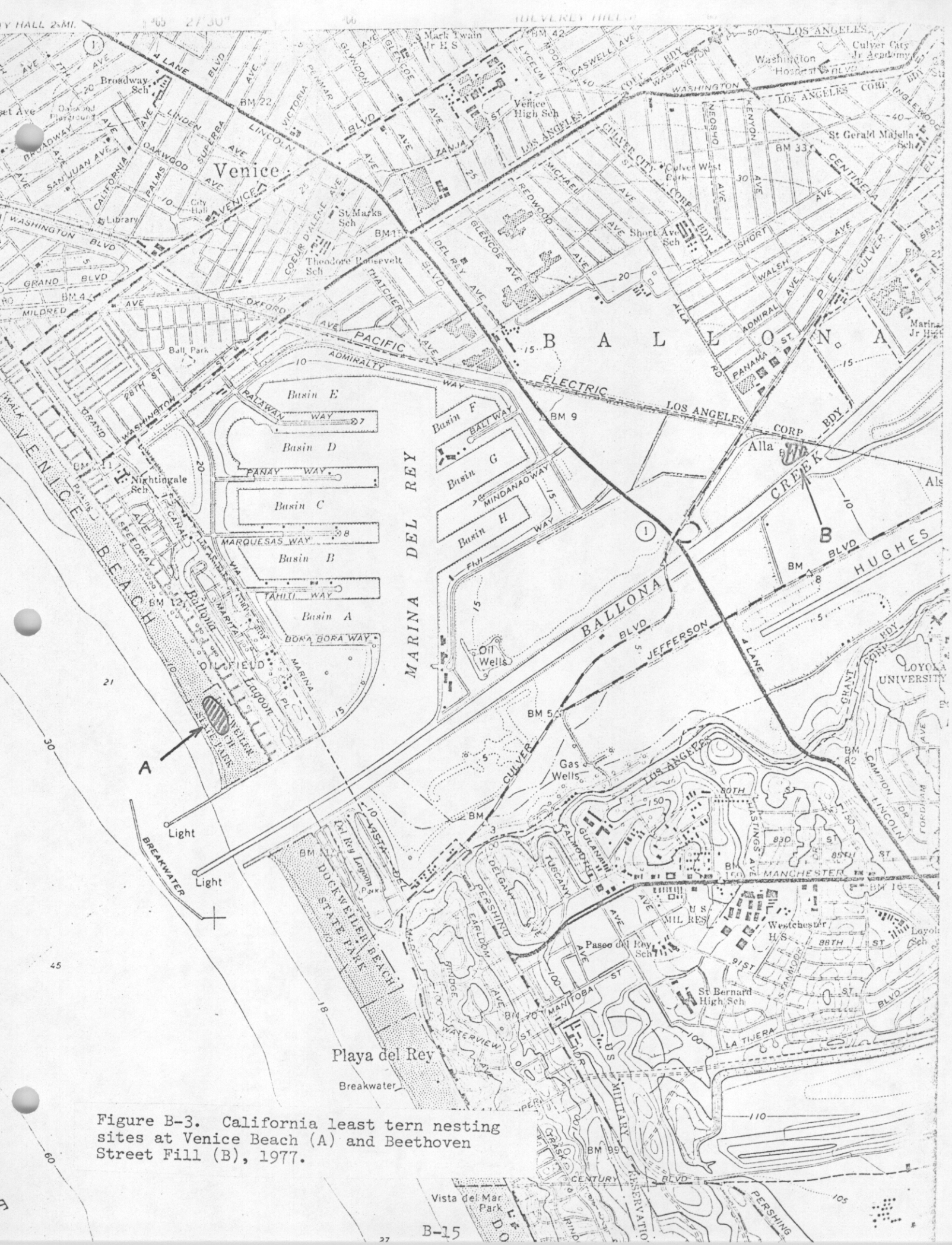

Figure B-3. California least tern nesting sites at Venice Beach (A) and Beethoven Street Fill (B), 1977.

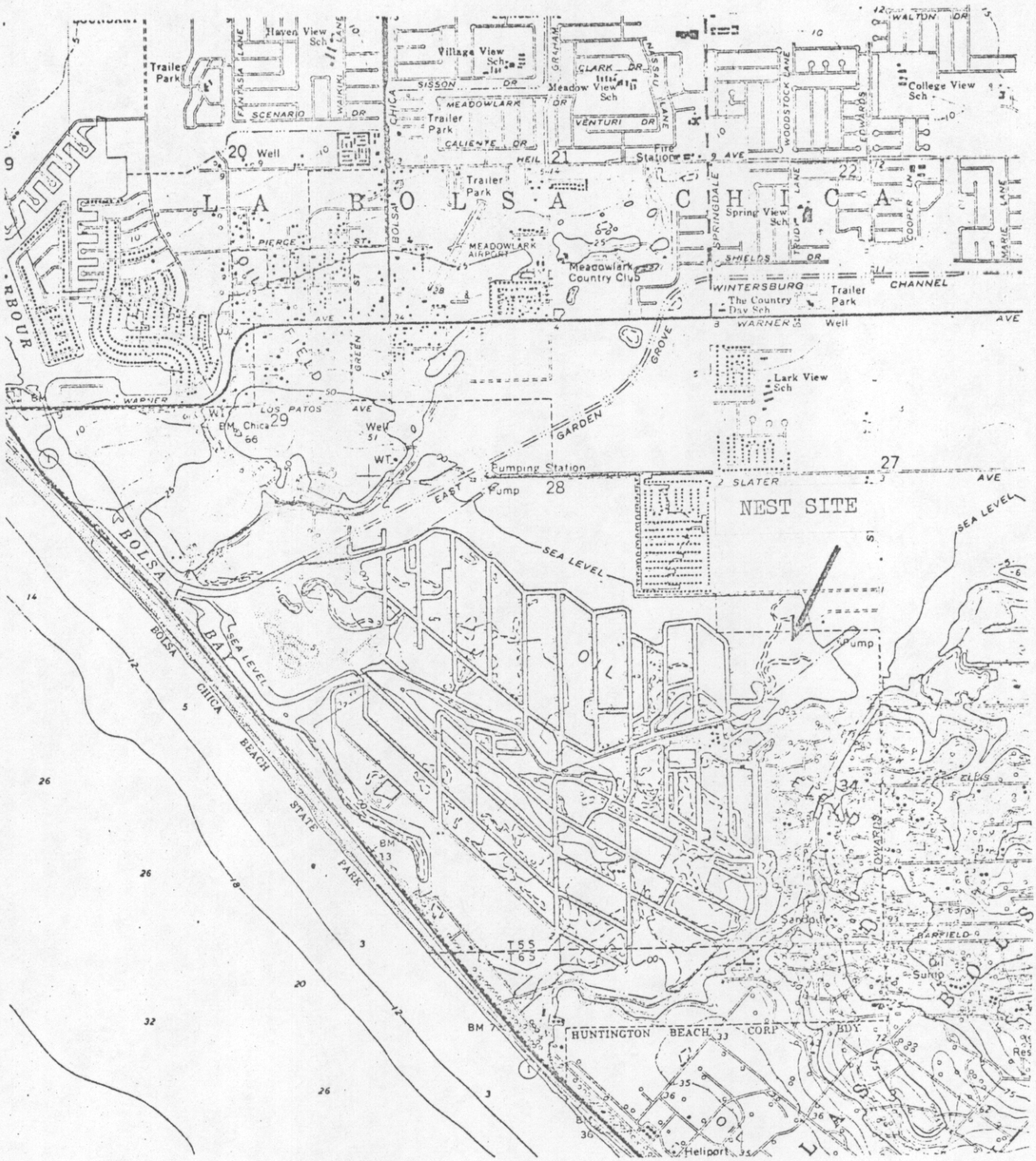

Figure B-4. Location of 1977 Least Tern nesting site at Bolsa Chica

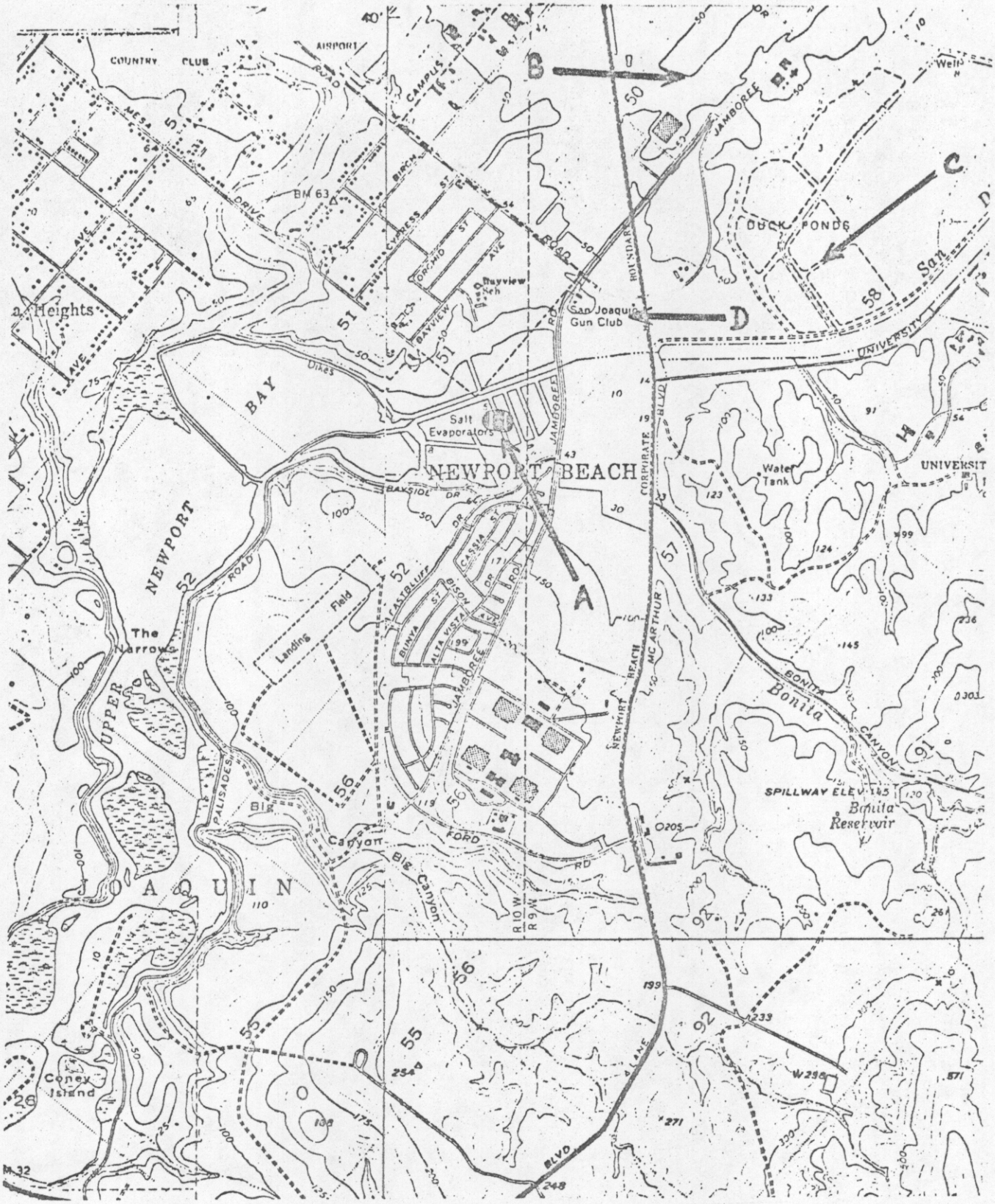

Figure B-5. 1977 least tern nesting sites at Upper Newport Bay (A). Also shown are locations of three primary foraging ponds: (B) Koll Center Lake, (C) San Joaquin Marsh, and (D) pond at intersection of MacArthur Boulevard and Jamboree Road.

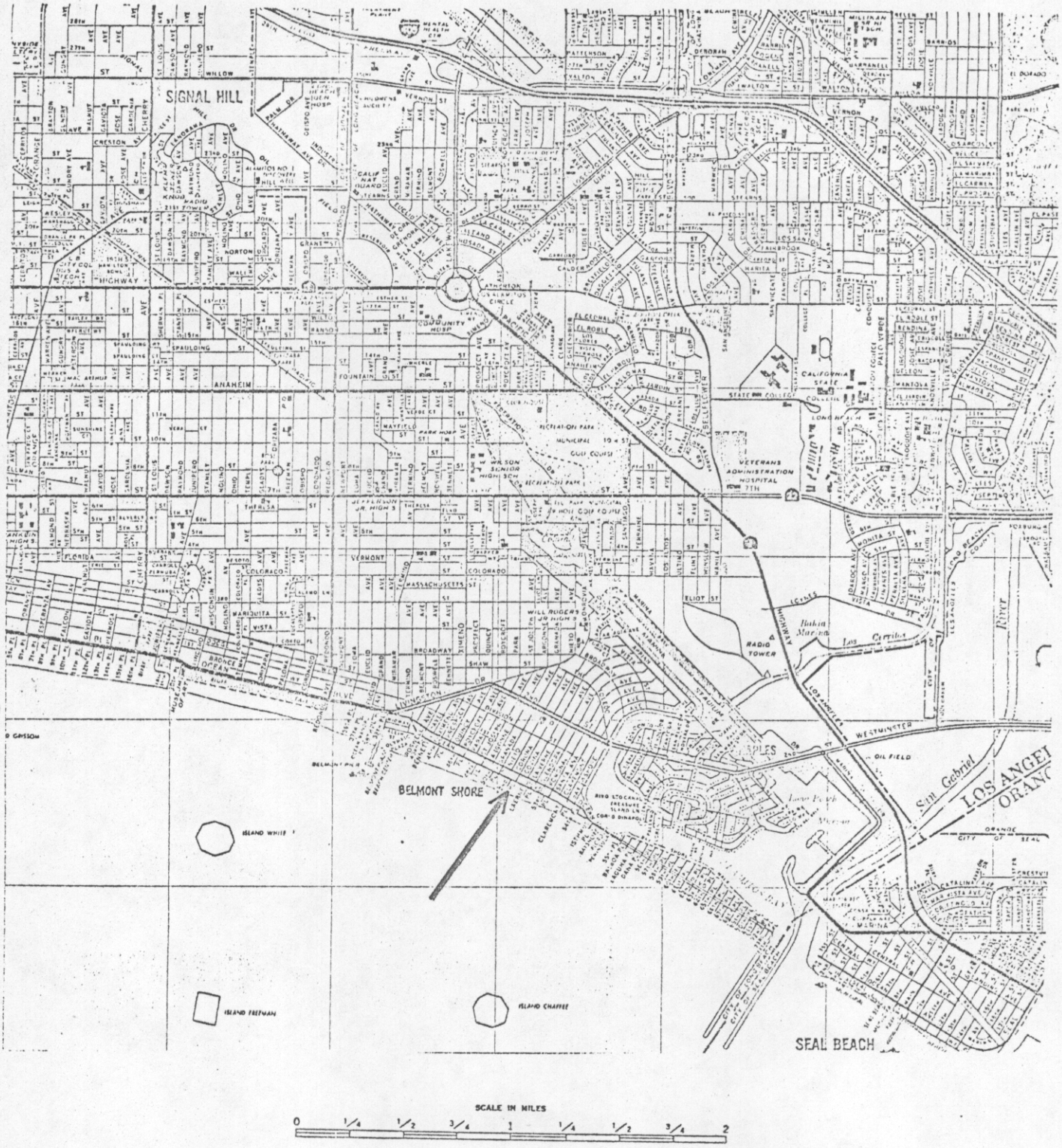

Figure B-6. California least tern roosting site, Belmont Shores Beach, Los Angeles County, 1977.

APPENDIX C

LEAST TERN BREEDING SEASON IN SAN DIEGO COUNTY, 1977

by

Paul D. Jorgensen

An estimated 480 pairs nested at 14 sites along the San Diego County coast, and although the total number of pairs was similar to last year, the nesting distribution was not. The largest and most successful breeding colony was the 125 pairs at the Federal Aviation Administration Island in Mission Bay.

Breeding success in the county was similar to that reported in 1976. Off road vehicle disturbance was the primary cause of harrassment to tern colonies and resulted in reduced nesting success at Sweetwater River, North Fiesta Island and Agua Hedionda Lagoon. Predation was believed to be the main cause of poor nesting success at Camp Pendleton and South San Diego Bay Saltworks and of total failure at North Island. High water levels caused by rain runoff resulted in a reduction of early season nesting habitat at Los Penasquitos, San Elijo and Batiquitos lagoons. The lack of nesting at San Elijo was attributed to this problem.

Large post-breeding flocks of adults and fledglings were present at Tijuana River (80 birds), west San Diego River Floodway (120 birds), San Dieguito Lagoon (140 birds) and Buena Vista Lagoon (58 birds). These areas are important after the nesting season when adults are still feeding the juveniles.

Santa Margarita River

Predation on eggs and chicks throughout the breeding season accounted for a drastic reduction in nesting success compared with previous years (Swickard 1971, Wilbur 1974, Bender 1974, Massey 1975). It is estimated that fewer than 30 young fledged from nesting attempts of approximately 120 pairs in 1977.

Least terns began arriving in mid-April and by May 27 their numbers peaked when 290 adults and 118 nests were counted. Nests were distributed in nearly the same areas as in previous years with roughly 70 to 80 percent of the nests located along the beach. In addition there were about 20 pairs strung out for 0.5 km (0.3 mi.) north along the beach beyond last year's barrier. These were apparently renesting attempts since they appeared one week after major nesting failure in other parts of the colony.

Networks of fresh coyote tracks were found throughout the colony on each weekly visit. Ravens were seen regularly and were responsible for destroying eggs in two nests on May 13. A black-crowned night heron (Nycticorax nycticorax) was seen eating a least tern chick on the edge of the beach colony in June by Marine Corps Sgt. Cross of the base game unit. Numerous ground squirrels, fox tracks and two long-tailed weasels (Mustela frenata) were also seen at the colony.

Marine Corps troops marched into the nesting area on the beach through the well marked protective barrier on two occasions. The impact on nesting terns could not be measured; these trespassings took place after major nest failure had occurred.

Feeding activity was seen frequently in nearby open ocean and the adjacent lagoon, particularly in the northwest ponded area known as "sweetwater." During my visits to the nesting areas, I saw from 5 to 15 individuals feeding in the sweetwater ponds, and while walking the 2.4 km (1.5 mi.) of beach, I usually counted a similar number returning to the colony from the ocean with fish. In the past 5 years, local observer Alice Fries reports that she normally has seen 30 to 60 least terns feeding at Oceanside Harbor each time she has visited. This year, a total of 11 was seen on 3 visits. This dramatic decrease may reflect the poor nesting success at the colony, which is only about 1.6 km (1 mi.) north.

I recommend that the south and east boundaries of the mudflat area be posted and roads blocked at the time the beach barriers are erected in order to curtail foot traffic which persisted in the area in 1977. Cooperation in observing the "off limits" status of the colony area during nesting and general management of the colony could be enhanced by a basewide early notice (March) of the coming nesting season. A similar notice announcing the arrival of the terns and the beginning of nesting should be issued in May. These notices could be issued through or by the base game unit and would provide immeasurable help in directing basewide attention to one of Camp Pendleton's unique inhabitants. No recommendation on predator problems can be made without more information on the exact causes of nesting failure.

Buena Vista Lagoon

No nesting occurred here due to lack of habitat, but least terns used the lagoon for feeding and roosting from the end of May to early August. An old boat house in the large lagoon between Interstate 5 and Highway 101 served as the principal roost platform for 20 to 60 adults. Adults were frequently seen fishing throughout the lagoon. Many individuals, usually 30 or more, were present all summer, suggesting that the lagoon was the main source of their food supply.

I recommend that the boat house not be removed, or if it is removed that an adequate replacement roosting platform be furnished. The open water with a nearly continuous border of heavy reed vegetation throughout the entire lagoon affords no alternative roosting. It is probable that, without a raised platform or broad open flat for the terns to roost, their use of the lagoon would decrease. This lagoon is also a potential breeding area for least terns, but an adequate nesting site is lacking.

Aqua Hedionda Lagoon

Least terns began arriving in late May, and by June 10, 6 pairs were nesting on the salt flat 0.5 km (0.3 mi.) east of the lagoon, next to Park Drive. By June 24, 2 more pairs were nesting on the flat and 5 additional pairs were nesting on the salt flat southeast of the lagoon. In all, 13 pairs nested here. On subsequent visits fresh motorcycle tracks were found at both nesting sites. This off road vehicle activity resulted in the destruction of at least half of the nests.

The large mudflat along the shore at the east end of the lagoon served as a roosting area for between 5 and 15 adults during the nesting season. On July 16, 14 adults and 6 fledglings were seen on the mudflat. The fledglings

could have been from the local colony or from another site. The lack of prior feeding activity associated with the care of young at Agua Hedionda suggests that these young may have come from elsewhere.

Protection of the colony under the present uncontrolled conditions of vehicle use would require an estimated 500 m (1,640 ft.) of fencing and more intensive monitoring by law enforcement personnel.

Batiquitos Lagoon

On June 18, 20 adults and 4 nests were found on the sandy shoreline at the east end of the lagoon. On June 24, 55 adults and 11 nests were present. On July 8, several fledglings were present and the original 11 nests were still being incubated. These young were from earlier, undiscovered nests or from other colonies. Hatching was underway in most nests on July 15. Two weeks later, 46 adults were roosting together but no chicks were found. Close examination had shown earlier that 2 of 11 nests had been abandoned before hatching, but otherwise hatching was successful. The lack of adult feeding and other activities associated with care for the young indicates that the young were moved or that the nesting effort had failed due to chick mortality. Thus, the degree of breeding success of this colony was not determined.

Nearby principle areas of feeding were the shallows at the east end of the lagoon and along the south shoreline. The importance of the lagoon as a food source is not known. Several times while driving on I-5 and Highway 101 at the west end of the lagoon, I saw adult least terns flying over the road toward the ocean. Possibly they were obtaining part of their food from the nearby open ocean.

San Elijo Lagoon

No successful nesting occurred here this year. The sites used in 1976, in the east basin and on the road parallel to the railroad tracks in the west basin, were flooded when least terns began arriving in the third week of April. The sites were not available for nesting until after the lagoon water level was lowered on May 27. So, unfortunately, last year's sites were unavailable when terns were first selecting nesting areas, and once available they were not used.

On 8 visits during May, an average of 10 individuals was seen feeding and roosting near the 1976 nesting areas. The first week of June, 4 pairs nested on a small mounded area north of the east basin mudflat site and only 50 m (164 ft.) from Manchester Avenue. All 4 nests were abandoned before hatching began. The reason for failure is not known.

No nesting occurred in the west basin (west of Highway I-5) but large flocks, including fledglings, used the open mudflats for roosting and the lagoon channels for feeding. The presence of large flocks from June through August is summarized: June 10, 40 adults; June 17, 8 adults; June 26, 46 adults, 9 first year plumaged birds; July 7, 1 adult; July 22, 20 adults and 23 fledglings; July 23, 50 individuals; August 4, 15 adults and 4 fledglings; August 10, 28 adults and 23 fledglings. The main area of use was the mudflats at the south portion of the west basin in line with Rios Avenue. By August 20, the lagoon was again flooded from rains, covering the roosting areas. No terns were seen after the flooding.

At the beginning of the nesting season in April, the heavily vegetated island-dike in the northwest corner of the lagoon was cleared of vegetation in hope of attracting nesting least terns. The site supported 15 to 20 pairs in 1970 (Craig 1971). Although no nesting occurred this year, it is recommended that the site be similarly cleared each year. Being above inundation levels and relatively free of human disturbance, this sandy island is potentially the best site in the west basin.

Current plans by the County of San Diego for altering the east basin should be reviewed to insure that nesting habitat used by the least tern in 1975-76 is protected. The site has been the most productive in San Elijo Lagoon in recent years.

Signs should be posted at the south end of the road paralleling the railroad tracks in the west basin in April to block vehicle traffic. San Diego County Vector Control (Mosquito Abatement) should be notified in April of the coming breeding season to alert them to possible nesting in spray areas.

San Dieguito Lagoon

Once again this lagoon was an important post-breeding feeding area for adults and fledglings. No nesting occurred as proper habitat was lacking.

One pair was seen at the race track infield in May and June, and several individuals were seen feeding in the lagoon. Not until July 22 were more than 5 individuals counted on one day. The population began to increase in late July, peaked in mid-August, and decreased rapidly after rains flooded roosting areas by August 18. A summary of sightings follows: July 22, 11 adults, 13 fledglings; August 1, 64 adults, 70 fledglings; August 4, 67 adults, 35 fledglings; August 8, 61 adults, 70 fledglings; August 14, 80 adults, 60 fledglings; August 22, 89 individuals.

The majority of roosting use was about equally divided between two sandbar sites: one at the confluence of the San Dieguito River Slough and a side slough northeast of San Dieguito Drive, as described by Craig (1971); the other is west of the fairgrounds and just west of the railroad trestle and consists of an approximately 0.2 ha (0.5 ac.) plot at the edge of the ponds between the Atchison, Topeka and Santa Fe Railroad and Highway 101. After mid-August rains covered all of the roosting area near the railroad and most of the one near San Dieguito Drive, a flock of between 10 and 30 individuals began roosting in a Del Mar race track parking lot just north of the San Dieguito Drive site.

Feeding took place in all waters of the lagoon including the area west of Highway 101. Judging by the intensity and success of tern feeding activity, the lagoon was probably the principle food source for the flock.

I recommend that any management plans for the lagoon take into consideration the importance of adequate roosting habitat. Either water level control or construction of suitable roost sites would provide the necessary habitat. Also, some portion of the dry area between San Dieguito Drive and I-5, now used by off road vehicles, should be considered for its potential as a least tern nesting site.

Los Penasquitos Lagoon

About 14 pairs nested here this year. Once the mudflat dried in mid-May, nesting began in the east end of the lagoon, southwest of the junction of Carmel Valley Road and Sorrento Valley Road. A maximum of 10 nests was counted here on May 31. By June 9, 5 nests remained, but 7 punctured eggs indicated that predation had occurred. Soon after, on June 18, 5 new nests appeared just west, along the Gas and Electric Company pole line road. These new nests were soon all abandoned and punctured eggs were found in 2 of 5 nests. In all, 15 nests were found in these 2 sites between May 20 and July 7, but no evidence of successful hatching was found.

An apparent renesting began in the first week of July when 14 pairs nested on a mudflat just east of the railroad tracks and south of the State Park boundary. Least terns were reported to have nested here in 1974 and 1975. Observations of chicks and fledglings at the railroad track site indicated that renesting was successful and at least 8 young survived to flying age. No known problems occurred at this site. In contrast to this year's predation problem at the Carmel Valley Road/Sorrento Valley Road site and success at the site near the railroad tracks, Copper (in Jurek 1977) reported good fledging success at the Sorrento Valley Road/Carmel Valley Road site and no nesting near the railroad. Of the two sites, the one near the railroad is less subject to human disturbance due to a lack of access. Both areas are subject to rain flooding and as Mudie, Browning and Speth (1974) suggested, the site near the railroad appears more likely to be flooded by high tides if tidal flow were restored to the lagoon.

Based on the fairly low frequency of observed feeding in the lagoon, it appears that this colony obtains fish from the adjacent ocean or elsewhere.

I recommend that no posting of the east area be done unless human disturbance is discovered. The signs might attract attention to an otherwise undisturbed site. San Diego County Vector Control (Mosquito Abatement) and San Diego Gas and Electric Company, Rose Canyon Office, should be notified in April regarding potential or known colony sites so that their activities will not jeopardize nesting birds.

Mission Bay

Only two nesting sites were used in Mission Bay this year. One of them, the Federal Aviation Administration Island, proved to be the most productive colony in San Diego County. One hundred and twenty-five pairs nested on the FAA Island with excellent success, while between 4 and 8 pairs nested on the north end of Fiesta Island with fair to poor success.

Least terns began arriving at their nesting grounds in late April. The first eggs discovered were laid on May 2 on the FAA Island. The number of pairs on the island increased until June 1, when 123 incubating birds were counted. Hatching began in the first week of June and continued for 3 weeks. Based on the number of fledglings counted at one time on the island and over nearby waters, it is estimated that no fewer than 80 and possibly as many as 125 young reached flying age. The clearing of vegetation on the island in April by the cooperative FAA personnel is probably partly or wholly responsible for the dramatic increase of nesting pairs over any previous year. No predator or human disturbance problems occurred.

The small colony at the north end of Fiesta Island was continually plagued by illegal off road vehicle activity. Signs announcing the presence of nesting endangered species were promptly removed by vandals. Although nests were repeatedly destroyed by vehicles, as many as 8 pairs persisted in nesting and renesting from early May through July. Somehow, at least 3 young managed to reach flying age. City ordinances prohibit off road vehicle activity on the island, but police and signs have not prevented the heavy use of the area.

Although not used by terns again this year, the fenced sanctuaries at Friars Road and Crown Point were excellently prepared by the City of San Diego in late April. Equipment normally used for removing kelp from the beach proved ideal for tern site preparation. Large skip-loaders fitted on the back with kelp rakes were used to remove vegetation. The debris was removed by dump truck and the site was smoothed by dragging a steel beam behind one of the skip-loaders. Dick Lester of the City coordinated the job.

Other potential sites which were checked during the season but which produced no nesting included: the mudflats east of Sea World; the mudflat south of Sea World, across Sea World Drive; Quivera Basin; the highway cloverleafs between Quivera Basin and Sea World; the sludge ponds on Fiesta Island; and the triangular sandy area north across Fiesta Island Road from the fenced sanctuary. Quivera Basin, the cloverleafs and the sludge ponds were too heavily vegetated for adequate least tern nesting habitat.

Feeding activity appeared to be widely distributed in the bay. During the height of young-rearing, adults arrived at the colonies from all directions. Two areas where feeding adults were seen most regularly were the bay channel east of Fiesta Island and the marsh shoreline just north of the Crown Point Sanctuary.

At the sludge ponds on Fiesta Island, it is recommended that vegetation around and on perimeter dikes be cleared as the city will allow. Operators of the pond facility were very helpful and should be contacted by early April to arrange for clearing. Hereafter, I recommend that a greater area, at least 75 percent, of the Friars Road site be cleared to increase the chances of attracting terns. Both Friars Road and Crown Point may require consecutive years of adequate clearing before terns nest. The importance of these cleared sites will increase as other sites are eliminated by development. I also recommend that the FAA Island be maintained by vegetation clearing just as it was in 1977, when roughly 60 percent of the island was weeded.

North San Diego Bay (Figure C-1)

San Diego Airport. Approximately 25 pairs nested in 3 areas of the airport, with the majority using the ovals (4S, 5S, 1S) between the main runway and the taxiway. The number of adults fluctuated greatly from visit to visit, and censusing was difficult due to air traffic. Least terns began arriving in late April, and on May 2, 30 adults were seen in the oval area. Two weeks later, 25 adults and at least 15 nests were present. By June 15 hatching was underway and 40 adults and 20 chicks, one week of age or less, were seen. In addition, about 6 adults were still incubating eggs.

Between July 4 and 6, most of the birds left the site. Most of the chicks seen two and a half weeks earlier would have been near flight age. On July 6,

only 6 adults, 7 fledglings and 3 chicks were found during a thorough search of the ovals. Five dead 3 week old chicks and 6 dead adults were also found in the ovals and along the runway edges. All the dead appeared to have been killed by planes and not by predators. One week later, 4 adults were all that remained in the colony area.

Six pairs nested east of the airport fire station in the "triangle" area. Incubation of 2 nests began in mid-May and the number increased to 6 nests the following week. Six nests were still being attended on June 15 and 2 remained on July 6, but no chicks were seen in this area. Determining the success at either area was difficult since it was impractical to observe the colonies for more than a few minutes.

The third area, the surcharge, supported 80 pairs last year but will no longer be available due to the construction of the airport's west terminal and its accompanying facilities. Amazingly, one pair nested on a less than 0.05 ha (1/8 ac.) plot, amidst continuous construction activity here and managed to raise 2 fledglings.

The airport manager, Bud McDonald, and his staff were very accomodating in providing access to the nesting grounds and reporting their findings during daily patrols.

Least terns, seen coming to the colony with fish, arrived from the south where they had probably fed along Harbor Drive. They were seen regularly all around Harbor Island, the east shoreline of Point Loma, Shelter Island and southeast of Harbor Island along Harbor Drive up until the abrupt departure of terns from the airport in the first week of July. The lack of feeding activity thereafter indicates that their post-breeding feeding areas did not include North San Diego Bay.

The only recommendation offered here is that in late April the triangle area be cleared of vegetation or otherwise improved for nesting. This possibly would attract nesting pairs away from the ovals where traffic is so heavy. Craig (1971) and Harold McKinnie (pers. comm.) reported nesting in the triangle area and not in the ovals in the early 1970s. Perhaps this tactic would benefit the least tern and the operation of the airport.

U. S. Naval Training Center. Recent grading of a large open area on NTC, just west of the airport surcharge area, attracted 35 to 40 nesting pairs. Least terns began using the site for roosting and courting in the first week of May. On May 16 the colony was well established with 32 adults and 10 nests counted. The highest total was recorded on June 5, when 50 adults and 35 nests were found. Hatching was well underway by June 12, and fledglings were first noted on July 2, when 12 were seen. Thereafter, fledglings were seen grouped together near the center of the colony area. On July 12, at least 25 fledglings were present with many adults feeding the young. Fledglings began to leave the area, and by July 26 only 4 were observed. About 4 pairs nested later than the main group; apparently these birds were renesting after their first attempts failed. From August 8 on, no terns were seen on the site.

The newly graded site was a very sparsely vegetated area of 9 ha (2.5 ac.), which remained undisturbed by humans and predators throughout the season. Navy officials were very cooperative in preventing disturbance to the colony. The site was cleared last year in preparation for the construction of recreation

fields which would cover part of the nesting area. Arrangements are underway in hope of insuring that adequate least tern habitat would be provided. The loss of the surcharge and this site would be a severe setback for the terns in North San Diego Bay. Any decrease in the open, unobstructed area would most likely diminish the attractiveness of the NTC site to the terns, so hopefully, the largest open area possible will be set aside for nesting in the future.

5th Avenue Marina. Seventeen pairs successfully nested on a new sand fill created to form a marina and park. The fill is soon to be developed as part of the City of San Diego's redevelopment plan.

On April 29, 7 least terns were discovered on the northwest fill and on May 10, 12 adults and one nest were present. By June 8, 1 incubating adults were counted. Chicks may have been present earlier but none were seen until June 15, when at least 7 were present. All the young were one week old or less. Approximately 35 adults, 5 fledglings and several late nesting pairs were present throughout July. In August, an increase in fledglings of two and threefold took place, the result of the abrupt appearance of young reared on the site and/or an influx of fledglings from other colonies. The following is a summary of sightings for August: August 1, 35 adults, 15 fledglings and 3 nests; August 6, 20 adults, 20 fledglings and 3 chicks and the remains of 2 apparently preyed upon fledglings; August 15, 23 adults and 12 fledglings; August 18, (after a rainstorm) 7 adults and 6 fledglings; August 29, 1 adult and 1 fledgling.

The site was protected by a vehicle restraint cable and "No Trespassing" signs posted across the entrance of the fill by the San Diego Unified Port District. The Port District's environmental personnel and the Harbor Police cooperated in protecting the area. Unfortunately, the site's proximity to the downtown area resulted in daily use of the site by sightseers, fishermen and occasional vehicles. On June 22, a 2 week old chick was run over by a trespassing motorcyclist.

Adults and fledglings were seen feeding in the bay between the colony and North Island. Terns from this colony probably also fished at nearby Shelter Island, Harbor Island and the east shoreline of Point Loma, where least terns were seen feeding.

North Island Naval Air Station. During a routine search for colonies on May 6, approximately 40 adults were found courting and roosting just north of the intersection of the main runways at NAS. Several scrapes were found but no eggs were present yet. On May 17, 45 adults and one nest with 2 eggs were found. By May 25, 13 birds were incubating eggs and 7 other adults were nearby. The colony area was an asphalt oval between the main runway and a taxiway. Nests were located in cracks, depressions and small drifts of sand. Several nests were even placed on the cement edge of the runway.

On May 30, firemen in the nearby firetower, saw a ground squirrel make repeated visits into the colony area, venturing across approximately 0.4 km (1/4 mi.) of open pavement from Building 793. The squirrel's activity in the colony could not be seen, but after that day the colony immediately decreased to fewer than 5 pairs. On June 8, there were still 8 adults, 3 egg nests and 2 newly hatched chicks. A week later was the last time any birds were seen on the site. Two egg nests were being attended, but no other young or adults were present. It is unlikely that any young fledged. The presence of at

least one grey fox (Urocyon cinereoargenteus), several feral cats, several pairs of burrowing owls (Athene cunicularia), and nearby roosting black-crowned night herons may have contributed to the predator problem.

Least terns with fish came to the colony from the north and northwest, where they were regularly seen fishing along the shore of the island. During periodic surveys along the entire shoreline of the base, feeding activity was restricted to the north and northwest shoreline.

Several longtime employees at the runway firetower said that the terns had been using the area each year for at least 10 years. No one had any specific idea of the number of nesting pairs in previous years except that there were at least as many as this year and that they had once been distributed over a larger area. Before this year, least terns apparently used the cement aircraft parking area, north of the runway firetower, which is no longer available due to the increased helicopter use.

The NAS public works personnel were helpful in providing admittance to the base and in alerting runway maintenance and other people using the nest area to avoid unnecessary use of the site. The runway fire crew was generous in allowing the use of their tower for brief observations and providing access to the colony.

I recommend that an effort be made to set up or enhance additional nesting areas on the base. We have no knowledge of the history of nesting on other areas of the base, but the large, open beach east of Zuniga Point appears to be a potential nesting area. An alternate site somewhere on North Island might attract nesting pairs away from the heavily used runway intersection. There are few adequate nesting habitats remaining in North San Diego Bay. North Island is one of the only areas left which could help to prevent a decrease in nesting terns in the north bay.

South San Diego Bay

Sweetwater River. As many as 40 pairs nested here this year with a high degree of renesting caused by continual off road vehicle activity in the colony. A few least terns began arriving in late April, and by May 23, breeding was well underway with 20 nesting pairs. On June 18, nesting reached a maximum when 40 pairs were found. Hatching in some nests had begun and continued into early August. Although hatching peaked in late June, the presence of nests and hatchlings into August indicates that there were many renesting attempts. Once the chicks began to fly, they were able to escape the onslaught of wheeled traffic. Fledgling success proved to be relatively good, with 20 to 25 flying young present on the site from mid-July until the first week of August. Fledging success probably would have been much better without the ongoing harassment. The last sighting of terns on the site was August 18, when 6 adults and 8 fledgling were present. No evidence of predation at the colony was found during the season. A number of incubating adults and some chicks were found run over by vehicles within the boundaries of the site.

Feeding activity throughout the breeding season was heavy along the bayshore, adjacent to the site and north to 24th Street. The channel leading to the boat ramp north of the colony was also used extensively. Fledglings were frequently seen feeding in groups of 3 or 4 in this channel and roosting either at the west end of the enclosure or on the bay mudflat west of the colony site.

The terns face the immediate problem of raising young on a heavily used area, which is one of the few remaining off road vehicle sites near urban San Diego. It is likely that in the next few years off road vehicle use will increase here, where riders come from 40 km (25 mi.) away or farther. To adequately protect this tern colony, a portable chain link fence should be erected around the nest area from mid-April through August. Rented, temporary fence, erected and removed by the fence company, would be ideal. This would be more effective than the enclosure of posts strung with twine which was erected this year and had to be continually mended. Although off road vehicle activity during nonbreeding months would keep the vegetation cleared to optimum density for nesting, it may prove difficult to convince riders to curtail use during the breeding period. Increased law enforcement efforts are urgently needed at this site.

A much more imposing problem is the impending threat of development. The fill area is a potential site for industrial development. To protect this colony, planning efforts should be directed toward preserving the entire site. If development is unavoidable, a site encompassing as large a portion as possible of the west or bayward end of the fill should be preserved.

This year, in addition to the enclosure and small admonitory signs, a large steel warning sign, 2.1 m by 1.5 m (7 by 5 ft.), was erected by DFG Warden Basom. The sign cautioned that continued use of the area was dependent on the users staying out of the tern nesting area. The large sign proved to be the best way of gaining the cooperation of many of the visitors. I recommend that several of these large semipermanent signs and a more exclusionary fence be erected in future seasons.

Coronado Cays. The number of nesting pairs increased from 6 pairs in 1974, when the site was discovered, to 17 pairs this year. No nesting occurred in 1976, and it is not known if nesting took place in 1975.

The vegetation cover at the site has increased in the past 3 years to the point where there is now an estimated 30 to 40 percent ground cover, including roughly 10 percent cover of bushes a meter (3 ft.) high or more. Still, 17 pairs were found nesting on May 22. Hatching began in the second week of June and continued through July. The first fledglings were seen on July 2, when 35 adults, 4 fledglings and 6 nests were counted. The highest count of fledglings was 7 on July 13. Vegetation obscured the view, preventing complete censusing of adults and chicks. The number of birds decreased rapidly after mid-July, and no terns were seen from August on.

Feeding was observed near the colony in the bay southeast and east and in the channel just west of the colony. Least terns were also seen regularly in the channel west of the Cays administrative offices. Other observers reported seeing small flocks feeding in the ocean along Silver Strand State Beach on several occasions.

I recommend that the site be cleared of most of the vegetation in April. The Port District would have to be contacted for permission. If terns again use the site, the Coronado Cays security police should be notified and signs posted across the entrance to the peninsula.

South San Diego Bay Saltworks. This colony was located on salt pond dikes near the center of the saltworks complex. On the first visit on April 30, 12 adults were found. Rains in early May destroyed initial nesting attempts of several pairs. By May 21, 30 nests were present, and hatching in some earlier nests had begun a week later. The number of nests increased to 69 on June 4, but by the 28th, there were 21 active nests, 10 live chicks and 7 dead chicks, 4 of which showed certain signs of predation. During the season, preyed upon birds totaled 13 young (2 weeks old or older) and 3 adults. Because of the large colony size, this is probably only part of the total that suffered predation. Surveys from mid-July on showed that about 10 pairs were nesting probably as a result of unsuccessful first attempts. These late nesters suffered similar predation problems resulting in poor success. The highest count of fledglings was 8 on July 13. Elizabeth Copper, who banded chicks here last year, found fewer young this year. In summary it appears that poor young survival was due in part to nest abandonment and predation of young and adults.

The predators responsible were not identified. Nearly all of the dead birds appeared to have been struck in the head, with a majority missing the back of the skull. Usually only the head and wing sets were found.

Control of human disturbance was simplified due to the remoteness of the central dikes where nesting occurs. Signs were posted at the ends of all dikes with nests. Dikes are identified by code numbers of ponds adjacent to them. On June 4, dike 5/7 had 15 nests; 5/33, 13 nests; 34/33, 28 nests; and 37/33, 13 nests. Early location of nesting areas is necessary here in order to insure that the saltworks and shrimp gathering operations do not endanger the terns. The management of the Saltworks cooperated in allowing the posting of signs and access to the nesting dikes.

Tijuana River

An estimated 6 pairs nested here this year, and as many as 80 adults and fledglings used the area for post-breeding feeding and roosting.

Least terns began arriving in the third week of April, and from that time until early July, 10 to 20 adults were present. Nesting began in the first or second week of May, and the number of nests present fluctuated between 2 and 6 until the second week of July when nesting activity stopped. Evidence of renesting for the majority of pairs suggests that nest destruction occurred. Although the site is posted and patrolled almost daily by State Park Rangers, it is in the pathway of people and horses walking the beach. The site is also susceptible to flooding when high tides and heavy surf occur together. Young were kept well hidden in dune vegetation until flight age, and by the time they fledged, other fledglings began arriving from other colonies. Therefore, it was difficult to estimate the number of young raised on the site.

Adults and fledglings from other colonies began arriving at the Tijuana River site in mid-July. On July 18, 55 adults and 25 fledglings were counted. The large flock remained in the area, feeding the fledglings and roosting until early August when their numbers dwindled. On August 2, 20 adults and 15 fledglings were seen, and by the 9th, 6 adults and 6 fledglings were counted. A similarly large post-breeding flock occurred last year (P. Pennington, T. Roeder).

Adults bringing fish to the nesting colony were seen arriving from the marsh channels and the ocean. During the summers of 1974, 1975 and this season, I regularly saw small numbers of adults feeding in the channels of Oneonta Slough (the north end of the marsh) and in the large channel that runs east to west from Sunset Avenue. This year I saw the terns feed in the channels just east and in the ocean just west of the nesting site.

The nesting site has been enthusiastically protected by State Park Rangers. It is recommended that in 1978, twine or rope with stringers of colored surveyor's tape be erected to enclose the area where nesting took place this year. With a well marked nest area and the frequent patrolling that the site receives, it should become a more productive site. Before human beach use increased dramatically, the same area supported at least 100 pairs as recently as 1963 (Craig 1971).

OBSERVATIONS AT OTHER AREAS

San Diego River Floodway

The sandbars at the west end of the floodway were used by least terns from April into September. Early in the season in April, a large flock of up to 114 adults roosted and courted on the area during low and medium tides when the sandbars were not flooded. Later, beginning in early July, the site became an important post-breeding location for adults and fledglings. Adults fished extensively along the beach just west and were frequently seen bringing fish back to waiting young. A representative sample follows (low counts often occurred when human and dog use was heavy): April 22, 45 adults; April 27, 114 adults; May 12 and June 5, 0; July 12, 15 adults and 8 fledglings; August 1, 40 adults and 51 fledglings; August 16, 40 adults and 20 fledglings; August 28, 41 adults and 28 fledglings; September 1, 36 adults and 21 fledglings; September 8, 3 adults and 3 fledglings; September 17, 0. Unfortunately, the terns were harrassed and were regularly kept on the move in the area by cars, motorcycles, clam diggers and especially dogs. This site is one of only two local beach areas where dogs are permitted off leash.

The floodway between this roost area and Interstate 5 was used regularly by small numbers of terns for feeding.

Inland

A survey was made of inland water areas for least tern activity. In north San Diego County, Windmill Lake, Whelan Lake, Guajome Lake, Lake Val Sereno, San Dieguito Reservoir and Lake San Marcos were visited 3 times each between July 23 and September 8. These lakes are 6.4 to 10 km (4 to 6.5 mi.) from the coast. Least terns were seen at Val Sereno (1 adult fishing on July 23), Whelan Lake (1 adult, 1 fledgling roosting, July 30), and the Water Pollution Control Facility next to Windmill Lake (1 adult feeding, August 10). Alice Fries visited Guajome Lake 3 times between May 1 and July 19 and Libby Lake on August 14, 1977, and saw no birds. In the 10 years prior to 1975, she had seen least terns regularly at Guajome Lake in June. A sample of her sightings includes: June 28, 1971, 10 adults; June 10, 1968, 22 adults; June 21, 1965, 12 adults. She also saw 15 adults feeding at Lake Val Sereno on September 8, 1972 and reports that there were between 15 and 40 there all

season in 1975. I also checked Lower and Upper Otay Lakes on August 18 and Santee Lakes on August 20, 1977, and found no least terns. Two adults had been observed feeding at Santee Lakes on March 3, 1972 (J. Rieger).

In June of this year small flocks of up to 20 birds regularly were seen feeding and roosting on the kelp in kelp beds offshore from the San Onofre Nuclear Power Plant. On August 12, I saw 5 adults fishing as they were flying north along the coast at the mouth of nearby San Mateo Creek.

ACKNOWLEDGMENTS

Alice Fries gave generously of her time and knowledge and was particularly helpful in keeping track of tern activity in the north county. Larry Ford watched over San Elijo and organized the clearing of the island there. Mike Evans, Jan Larson and John Rieger reported their sightings and I consulted Mike for his opinion on many issues. Leslie Becker helped with field observations, colony protection and typing. Jan Larson at North Island, "Doc" at the sludge ponds, Captain Butler and the personnel at NTC, John Tompkins and Ed Orlicki at the FAA, Rangers Paula Pennington and Terry Roeder at Border Field State Park and Tomas Firle of the Port District went out of their way in their concern for the least tern.

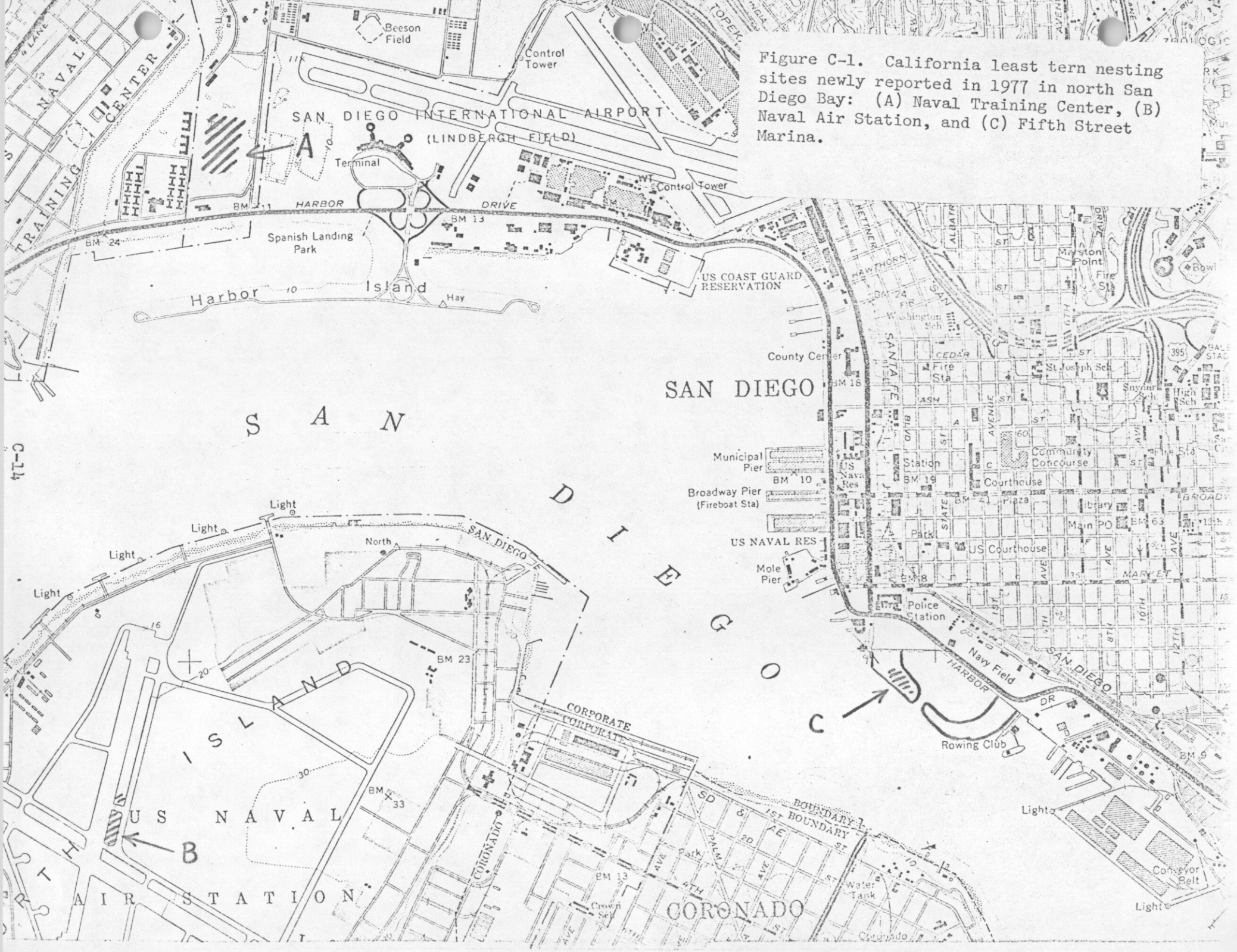

Figure C-1. California least tern nesting sites newly reported in 1977 in north San Diego Bay: (A) Naval Training Center, (B) Naval Air Station, and (C) Fifth Street Marina.

State of California
THE RESOURCES AGENCY
Department of Fish and Game

CALIFORNIA LEAST TERN CENSUS AND NESTING SURVEY, 1977[1/]

by

Jonathan L. Atwood, Paul D. Jorgensen
Ronald M. Jurek and Timothy D. Manolis

ABSTRACT

In the fifth consecutive annual breeding population survey of California least terns (Sterna albifrons browni), 775 breeding pairs were located at 29 colony sites. Nesting success was generally good, although at least 9 colonies were abandoned or had poor nesting success because of human disturbance, predation or flooding. Breeding population size was the largest recorded since surveys began; most of the increase is attributable to the unprecedented coverage of colonies in 1977 which resulted in more thorough censuses and the discovery of many sites missed in earlier surveys.

1/ Supported by Endangered Wildlife Program, E-1-1, Nongame Wildlife Investigations, California Department of Fish and Game. Job V - 2.11, Job Final Report (December, 1977).

RECOMMENDATIONS

On the basis of this survey, the Department recommends that:

1. Colony censusing and protection efforts; documentation of nesting, feeding and roosting areas; and population monitoring be conducted in the 1978 breeding season in the same manner as in 1977.

2. Breeding colony protection efforts be expanded or modified for sites experiencing colony disturbance and harassment in 1977.

3. Increased colony reconnaissance efforts be made in northern Santa Barbara County, San Luis Obispo County and south San Francisco Bay.

CALIFORNIA LEAST TERN
CENSUS AND NESTING SURVEY, 1977

by
Ronald M. Jurek

INTRODUCTION

The diminutive California least tern (Sterna albifrons browni) arrives each spring on the west coast of California and Baja California to establish breeding colonies and to raise young. Arriving from unknown wintering areas, the terns occupy coastal habitats in California from the Mexican border to San Francisco Bay from April through early autumn (Wilbur, 1974).

Early this century the least tern was an abundant breeding bird in California. Subsequent human developments and recreational use of the coast reduced the population to such a low level by the late 1960s that this subspecies was declared "endangered" under state and federal laws. A preliminary inventory of breeding colonies was conducted in California in 1969-70 (Craig, 1971), and more intensive surveys and censuses of the breeding population were conducted annually beginning in 1973 (Bender, 1974a, 1974b; Massey, 1975; Jurek, 1977). Recently, attention has been directed toward inventorying the breeding population in Baja California (Massey, 1977).

The 1977 survey is the fifth consecutive annual survey of the least tern breeding population in California. Annual surveying is an essential action in current efforts to restore the least tern to a nonendangered status.

PURPOSE

The objectives of this survey were to document least tern colony locations and breeding population size in California, to evaluate nesting success and to identify important feeding areas. This survey was part of a larger Department project, the purposes of which, in addition to survey objectives, were to coordinate nest colony protection efforts before and during the 1977 breeding season. As in past years, a banding and marking study was conducted concurrently with the survey to place marked birds into the population, to gather information on local movements of fledglings, and to gather return information on immature and adult birds.

METHODS

Three Department censuser/monitors were assigned separate segments of the least tern breeding range: northern (San Francisco Bay area), central (San Luis Obispo County to Orange County) and southern (San Diego County). Monitors coordinated with resource agency personnel in least tern management and protection efforts by identifying management and protection needs at known colony sites before the arrival of birds; assisting in posting, fencing or enhancing nest sites; notifying appropriate land owners, land users, and local agencies regarding the need to protect colonies; monitoring the arrival, presence and departure of colonies; identifying emergency management and protection needs during the nesting season, and assisting in these

efforts; identifying key feeding areas of colonies; censusing each colony; and preparing and disseminating weekly status reports to resource agencies and cooperators.

RESULTS

Censusers located an estimated 775 nesting pairs of least terns at 29 colony sites in California in 1977 (Table 1). Nesting success of colonies, based on number of fledglings produced, was generally good, although at least 9 colonies were abandoned or had poor nesting success because of human disturbance, animal predation or flooding.

Results of experimental efforts to enhance nesting conditions in selected colonies were encouraging. Clay pipes, clay roofing tiles, and special concrete blocks stratigically placed in nesting areas were used for shade and other protection by chicks at Huntington Beach State Park, where this technique was successful in 1976, and at two new test areas, Alameda Naval Air Station and Venice Beach. In another experiment, one of 40 mounds of sand placed at the Bair Island colony site was used as a nest site by the only pair of terns found in the area.

Routine vegetation clearing operations at Huntington Beach State Park and FAA Island in Mission Bay seemed exceptionally successful, as evidenced by the high density of nesting in these areas this year. A promising technique for mechanically preparing substrates was employed at two other Mission Bay sites.

Many newly recognized nesting areas were documented by censusers this season. Four newly described colony sites (Alameda Naval Air Station, Santa Maria River, Beethoven Street Hill and North Island Naval Air Station) are suspected or are known to have been occupied in previous years. Two other sites (Bolsa Chica and Upper Newport Bay) were newly discovered, but it is not known for certain whether the areas had been used by nesting terns in the past. At two other sites (Naval Training Center and 5th Street Marina in San Diego), recent land use changes had provided new breeding areas for terns deprived of a former, nearby site. One new colony (Venice Beach) is probably the result of abandonment of another nearby colony; however, past, undetected nesting by some pairs at the site is possible.

Colony sites and the use by least terns of each one in 1977 are described in Appendices A, B and C. Included in these accounts are descriptions of tern feeding areas and important roosting areas.

Banding operations resulted in the banding of 297 least tern chicks. Banding results are contained in Department of Fish and Game, Endangered Wildlife Program, Job Final Report, Job V - 2.12, 1976-1977, (in preparation).

DISCUSSION

The known 1977 breeding population is the highest index figure recorded since annual surveys began. This total is 111 pairs greater than that reported in 1976 and 175 pairs greater than the 1975 figure. Although the least tern breeding population in California may have increased to some extent in the

Table 1

California Least Tern Breeding Colonies
And Nesting Data, 1977

County	Site	Estimated No. of Pairs	Notes on Nesting Success[1]
Alameda	Alameda Naval Air Station	45	20 + fledglings
	Oakland Airport	7	Unknown
San Mateo	Bair Island	1	None
Santa Barbara	Santa Maria River	25	Approx. 20 fledglings
Ventura	Santa Clara River[1]	(6)	Approx. 10 fledglings
	Ormond Beach	30	Maximum of 10 fledglings (extensive renesting)
	Mugu Lagoon[1]	(5)	Approx. 5 fledglings
Los Angeles	Venice Beach	35	Possibly 30 + fledglings
	Beethoven Street, Fill	3	None
	Terminal Island	85	Approx. 80 fledglings
	San Gabriel River[2]	(35)	3 fledglings
Orange	Bolsa Chica	7	None
	Huntington Beach State Park	45	Approx. 60 fledglings
	Upper Newport Bay	12	Approx. 15 fledglings
San Diego	Santa Margarita River Mouth	120	Fewer than 30 fledglings (extensive renesting)
	Agua Hedionda Lagoon[3]	(13)	Poor
	Batiguitos Lagoon[3]	(11)	Unknown
	San Elijo Lagoon	4	None
	Los Penasquitos Lagoon	14	At least 8 fledglings (extensive renesting)
	Mission Bay		
	North Fiesta Island	8	At least 3 fledglings (extensive renesting)
	FAA Island	125	At least 80 fledglings
	North San Diego Bay		
	Naval Training Center	35	At least 25 fledglings
	San Diego Airport	25	Fair
	5th Avenue Marina	17	At least 6 fledglings (extensive renesting)
	North Island Naval Air Station[4]	(13)	None
	South San Diego Bay		
	Sweetwater River	40	At least 20 fledglings (extensive renesting)
	Coronado Cays	17	At least 7 fledglings
	Saltworks	69	Poor, at least 8 fledglings
	Tijuana River Mouth	6	Unknown
	Total	775	

See next page for footnotes.

Table 1 (continued)

1/ Santa Clara River and Mugu Lagoon represent renesting efforts by pairs from the Ormond Beach colony. Only the Ormond Beach figure is used in the statewide total.

2/ Following failure of the San Gabriel River colony, renesting of these birds presumably occurred at several nearby locations, especially Terminal Island. The San Gabriel River figure is not included in the statewide total.

3/ These colonies formed late and probably included birds counted at other sites. They will not be included in the total estimate.

4/ This flock disbanded early enough to have joined other nearby colonies and will not be included in the total estimate.

last year or two, most of the reported increase is the result of the unprecedented coverage by censusers in 1977 of known colony sites and previously unsearched areas. Most colonies were censused in 1977 far more regularly and frequently than in the past. Also, more field time was expended this year by censusers in areas of suspected colonies. As a result, many nesting colonies were described or accurately censused for the first time. If it were assumed that the 1976 and 1977 populations were in fact identical, approximately 80 percent of the reported disparity could be explained by the discovery in 1977 of colonies that conceivably were missed or that were only partially censused in the 1976 search. Even for colonies known to have been occupied both years, the more frequent 1977 censuses were more likely to have documented all breeding pairs present; part of the remaining 20 percent disparity could be explained by these more frequent censuses.

The discovery in 1977 of two colony sites known to have been active for many years, and the discovery of at least four others that possibly have been missed in previous censuses, indicate that past annual breeding population estimates in California were too low.

Continuing problems of human disturbance of tern colonies, particularly by off road vehicles (ORV) activity, limited nesting success at many colonies. Sign posting and placement of ribbon or rope boundary markers have been ineffective in controlling ORV drivers. Increasing efforts are needed to prevent such disturbance by erecting substantial fences and by increasing law enforcement activity.

The least tern chick banding program contributed useful information to the survey. Late in the breeding season, sightings of fledglings color banded as chicks were valuable in tracing movements of flocks from colony sites to post-breeding season feeding and roosting areas.

The increased coverage in 1977 of least tern abundance, activity and resource problems at breeding colony sites, the discovery of previously undescribed colonies, and the identification of important roosting areas and feeding areas contribute to the store of knowledge necessary for development of conservation programs that will restore this population to a nonendangered status.

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APPENDIX A

LEAST TERN BREEDING SEASON IN THE SAN FRANCISCO BAY AREA, 1977

by

Timothy D. Manolis

Alameda Naval Air Station (Figure A-1)

This breeding area was first brought to the attention of the Department in 1976, when adults and large young were observed at the airfield late in the season. Nesting was not in progress at that time. Because the suspected nesting site in 1976 appeared hazardously close to runway and taxiway traffic from aircraft and maintenance vehicles, an attempt was made in early spring 1977 to create an alternate colony site on a nearby, safer, ice-plant covered, sandy fill. A large area was cleared of ice-plant by the Navy.

No least terns were found on visits to this cleared site and the supposed 1976 site on May 19 and June 1. Shortly thereafter, the Department was made aware, through airfield personnel, of the presence of a least tern colony in the center of the airfield. This colony was first checked on June 15. It occupied a triangular asphalt apron, covered with a fine coat of gravel and sand and was situated between a runway and two taxiways. On June 15, an estimated 45 pairs were nesting. Most appeared to be on eggs, but some nests had 1-3 chicks, and a few chicks were running around and being fed by adults. During subsequent visits, the nesting cycle appeared to progress smoothly. On July 19, 10-20 large chicks (probably more were present but missed) were observed at the site. Nesting at the site seemed to be quite successful.

Airfield personnel (E. Craw, pers. comm.) have been aware of this colony for about 10 years and report that it has been about the same size throughout its known existence.

Terns observed flying and fishing at Ballena Bay, and in shallow water areas around the air station, undoubtedly were birds from this site. Birds were observed arriving at the site with fish from both north and south of the air station (the air station is bounded by water on the north, west and south).

There is very little vegetation or other shelter at the site, and on a number of visits, chicks were observed wandering around on the runway and taxiways. If this is the same colony site used in 1976, the chicks observed that year at the southeast corner of the airfield had to have crossed a major taxiway at some time in their wanderings. In an attempt to keep chicks from wandering and to provide them with shelter, 15 concrete blocks /U-shaped, 20 cm (8 in.) x 20 cm x 20 cm/ were placed to form shady tunnels near the colony on June 23. Chicks were observed using the blocks for shelter on June 28. Additional blocks should be placed at this site before the 1978 nesting season.

This site, on first inspection, seems hazardous. An airfield accident, or inadvertant vehicle traffic, could do considerable damage to this colony. However, the chance of an airfield accident at the site is probably very small, though unavoidable. Fortunately, air station personnel were cooperative and took precautions to avoid disturbing the site during the nesting season.

On June 1, a helicopter was observed hovering and practicing landings and take-offs over an area near this site. Such helicopter activity at other least tern sites (e.g., Bair Island and Playa del Rey) has been a problem in the past. The air station should be apprised of the situation so that helicopter activity near the nest site will be controlled during the breeding season.

It seems unlikely that least terns will use the unused area cleared by the Navy in the spring as long as the current nesting site is stable. The cleared area is also vulnerable to predation by feral cats. It would probably be unwise to attempt to deter terns from the nesting site. The colony is not in jeopardy from, nor is it a hazard to normal airfield operations. This site also appears to be free of major predators because of its location in the center of the airfield; this may be an important influence on the size and stability of the colony.

Oakland Airport

This site is sandy bay fill at the north end of the main runway. It was used for nesting by least terns in 1973, 1975 and 1976. In 1977, 8 birds were observed at this site on May 19. Courtship activity and defense of the area by the birds indicated intentions to nest. Three visits to this site in June and July indicated the presence of about 7 pairs, probably nesting. On July 19 a nest with 2 eggs was found. On that date, terns were observed flying into the area with fish, and the intensity of territorial defense at the time strongly suggested the presence of chicks. Chicks and nests are very difficult to find among the rolling, sparcely vegetated sand dunes of this site. On August 3, no least terns were observed. Five single, cold eggs were found scattered in the area of greatest use by terns. The reason for the failure of these eggs to hatch, and their significance, as far as the reproductive success of the colony is concerned, remains unknown.

The site appears to be suitable and stable, however, this colony remains small. It is possible predation is hindering the growth of this colony. Reproduction may be successful only if nests are few and scattered. Gulls are common in this area, and mammalian predators no doubt inhabit nearby vegetated areas. This colony should continue to be monitored in future seasons to determine effects of predation at this site.

Bair Island

This site was used for nesting by least terns in 1971 and every year since 1974. Fourteen pairs nested in 1976. The substrate at Bair Island, a silty loam, was observed to stick to eggs when wetted, and hampered the hatching of some eggs in 1976. In an attempt to remedy this, Department of Fish and Game and San Francisco Bay National Wildlife Refuge personnel deposited 40 piles of sand in mid-April 1977 to provide alternative nesting substrates at this site. Each mound was approximately 1 m (3 ft.) in diameter and 0.3 m (10-12 in.) high. This technique was previously used with some success at Camp Pendleton, San Diego County (Swickard, 1974).

No least terns were observed at Bair Island or its vicinity during visits to the site on May 13 and June 10. On June 30, 1 pair and a clutch of 3 eggs were observed in a scrape atop one of the sand piles (C. Osugi). On a return visit on July 15, no terns were observed. The nest scrape was empty except

for a few eggshell fragments. It is unlikely this nesting was successfully completed between June 30 and July 15. Predation seems the most likely cause of failure.

Bair Island has had an intermittent history of use, and it seems likely to be used again in the future as it remains a suitable site. The use by one pair of a sand pile for nesting indicates the feasibility of these piles being used in the future. Greater scrutiny of this site in the future (i.e., more frequent visits) may reveal the nature of any predation, which has been a problem at this site in the past.

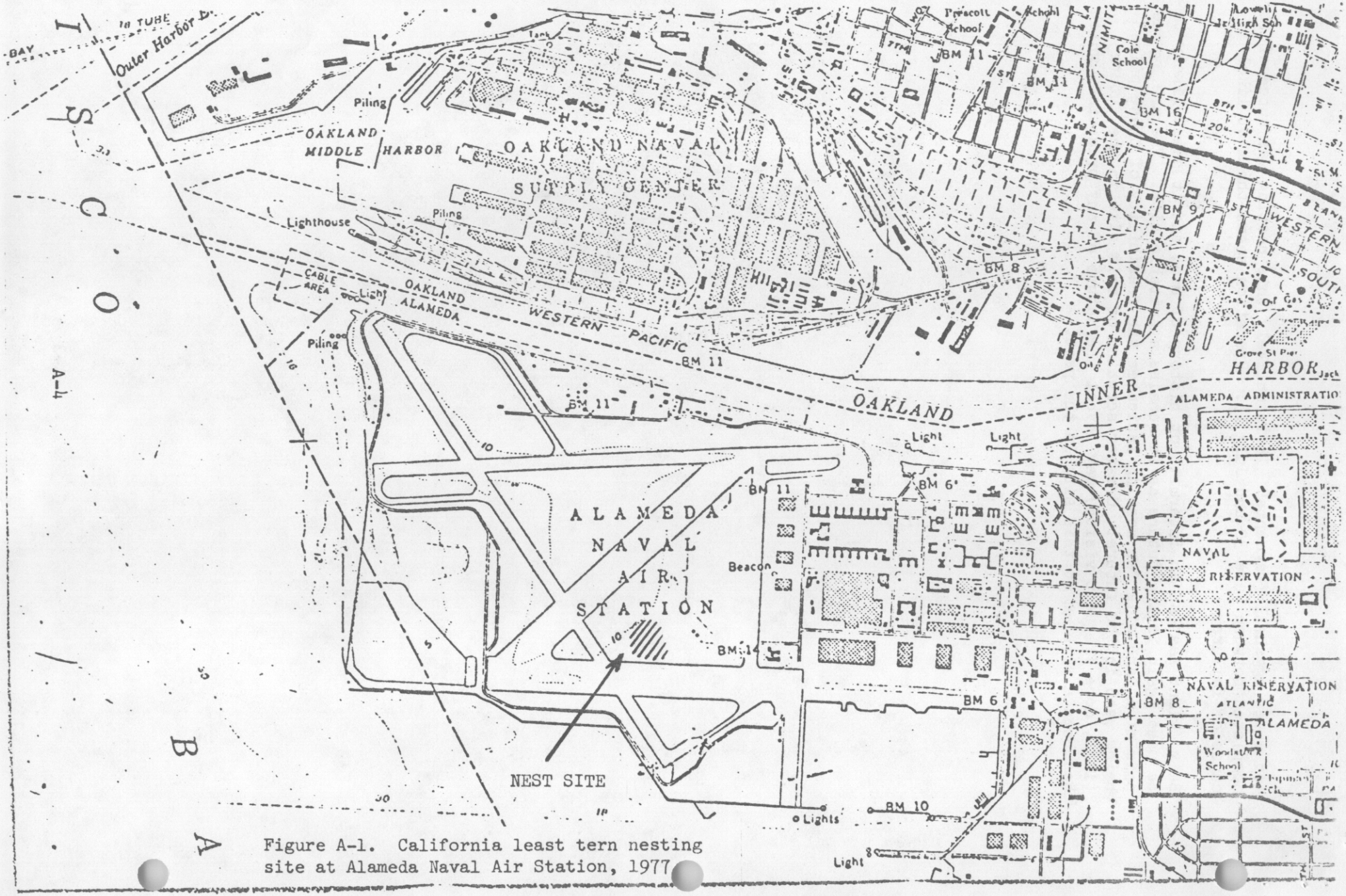

Figure A-1. California least tern nesting site at Alameda Naval Air Station, 1977

APPENDIX B

LEAST TERN BREEDING SEASON FROM SAN LUIS OBISPO COUNTY TO ORANGE COUNTY, 1977

by

Jonathan L. Atwood

Santa Maria River (Figure B-1)

For several years least tern nesting has been suspected along the coastline of northern Santa Barbara County and/or southern San Luis Obispo County. Approximately 16 km (10 mi.) of somewhat suitable nesting habitat occur between the mouth of the Santa Maria River and the Nipomo Dunes region, making location of the suspected colony difficult.

On June 10, 1977, a moderate sized colony of least terns was discovered nesting approximately 0.6 km (0.4 mi.) south of the Santa Maria River mouth in extreme northern Santa Barbara County. Nests were scattered over an extensive area (approximately 80 ha, or 20 ac.) of relatively flat sand dunes 45-90 m (50-100 yds.) east of the beach's high tide line. Hummocks of stabilized sand, ranging from 0.6 to 1.8 m (2 to 6 ft.) high, are scattered throughout the area; vegetation promoting formation of these hummocks includes Abronia latifolia, Franseria chamissonis, Cakile edentula, and very limited amounts of Mesembryanthenum sp. Ecologically, this is probably one of the most "natural" least tern nesting areas remaining in California. ORV use of the area is considerable, though due to the relatively flat terrain, it is not as intense as in other nearby sand dune areas. Ownership of the area was undetermined.

The nesting site was visited on 6 dates between June 10 and September 12. The size of the area, coupled with limited visibility due to the rolling terrain and sand hummocks, made censusing of the colony very difficult. Estimates of colony size were made from counts of adults mobbing me as I cautiously walked through the area late in the nesting season, when such activity did not jeopardize the colony. Only a small fraction of the nests and chicks which must have been present during the season were actually located.

Data indicate that approximately 25 pairs nested at the Santa Maria River site in 1977. The nesting season was quite prolonged; the first fledgling was seen July 12, and small chicks were still present on August 8. Rather than reflecting a large amount of renesting activity, I feel that this prolonged nesting period more likely was the result of a low degree of colony synchronization relative to the onset of breeding. Hatching and fledging success was good; while some disturbance undoubtedly resulted from ORV activity in the area, the nesting density of the colony was so low that by chance probably only minimal nest desertion or direct mortality occurred. Assuming that fledglings seen at nearby localities were from this colony, I would estimate that approximately 20 fledglings were produced at this site in 1977.

Most of the foraging activity took place in the ocean immediately adjacent to the nesting area, rather than in the channels of the nearby Santa Maria River. It appeared that some increase in use of the river mouth area occurred late in the season when the small fish necessary for feeding chicks were being sought. However, even during August, the bulk of least tern foraging in the area (including both adults and fledglings) apparently took place in the ocean.

Dispersal away from the nesting area occurred fairly rapidly, assuming that least terns seen at Oso Flaco Lake and the Santa Ynez River were from the Santa Maria River (Figure B-2). Although there was no evidence of nesting near either of these two areas in 1977, it remains possible that other small to moderate sized colonies remain undiscovered along this stretch of coastline. On July 12 a pair with 1 fledgling was seen at the mouth of the Santa Ynez River; on July 22 none were at the Santa Ynez River, but 10 (including 4 fledglings) were at Oso Flaco Lake. On August 8, 10 (including 6 fledglings) were present at the Santa Ynez River, and 15 (including at least 6 fledglings) were at Oso Flaco Lake. No least terns were seen in the Dune Lakes area this year after a brief sighting of approximately 30 in mid-May (Churchward).

The absence of suitable resting sites in the Dune Lakes area may account for the failure of least terns to regularly use this location for foraging. The sandspit at White Lake which was used as a post-nesting flocking area in 1975 is now heavily overgrown with willows, and at all of the lakes which I observed there was dense riparian vegetation or tules extended fully to the water's edge. At Oso Flaco Lake, least terns made heavy use of several abandoned duck blind frames located in the center of the lake for resting and for feeding of fledglings. Artificial construction of resting platforms or floats might be a simple, yet profitable, management technique in this region.

In light of several proposed projects which would have major environmental impacts along this stretch of coastline (LNG Terminal in the Pt. Conception area and large scale space programs based at Vandenburg Air Force Base), it is recommended that major efforts be made to better define the status of least terns in northern Santa Barbara County and southern San Luis Obispo County.

Santa Clara River

Nesting at this locality has been previously documented only in 1975, when only one pair was found nesting. This year the area was visited on 10 dates between May 2 and September 13, at intervals ranging from 6 to 22 days. Least terns were not regularly seen until late July; on July 23, 4 nests were located south of the Santa Clara River mouth, and by July 29, 5 were present (including 1 isolated nest located several hundred meters north of the river mouth channel). By August 25, hatching was underway, and an additional clutch was present south of the river mouth. Hatching and fledging success appeared good, and approximately 10 fledglings were produced.

The late date of nesting and relatively low average clutch size (2.1 eggs) indicate that these pairs were probably renesting after an initial nest failure at another locality. Since the Ormond Beach colony was declining in numbers at the same time that least terns began appearing at the Santa Clara River, it is almost certain that the same birds were involved at each location. The two areas are approxmmately 18 km (11 mi.) apart.

The foraging activity of this colony occurred in three main locations: 1) the adjacent river mouth, especially along the shallow edges and channels, 2) the ocean adjacent to the nesting site, and 3) the Ventura Marina.

Ormond Beach

For the third known year since 1974, least terns returned to the nesting area previously used at Ormond Beach. The site was visited on 13 dates between May 2 and August 8 at intervals ranging from 3 to 14 days.

Least terns were present in the area by May 16, and on May 26 small numbers of nests were present. Nesting activity, which occurred over a much longer stretch of beach than has been noted in previous years, seemed to be loss synchronized than at most other colonies. Many of the early nests were located in a small area immediately north of the Southern California Edison Company power plant; later nesting activity, which included the bulk of the colony, took place farther north on the portion of beach used in 1974 and 1976. This area was semi-protected by the use of sand fencing and posting erected on June 14; these measures were largely ineffective in preventing ORV disturbance of the nesting site. By June 24 the colony had increased to its maximum size of approximately 30 pairs; since at least 8 early nests were destroyed by ORV activity, both renesting and initial nesting attempts are thought to have been taking place at this time. The colony showed a gradual decline in numbers throughout the remainder of the season, probably more as a result of continued ORV disturbance than due to dispersal following successful nesting. On July 8 approximately 18 pairs were present, on July 15 this number had dropped to 9 pairs, and by July 29 only 2 pairs remained in the area. At best, the colony had only moderate hatching and fledging success; a maximum of 10 fledglings was produced.

Since the decline of the Ormond Beach colony in late July coincided with the arrival of nesting least terns at Mugu Lagoon and the Santa Clara River mouth, both of these sites presumably served as renesting localities for this colony. This pattern closely resembles that seen in 1975, when late nesting took place at both Mugu Lagoon and the Santa Clara River but was not reported from Ormond Beach. I suspect, however, that early nesting did occur at Ormond Beach in 1975 but was overlooked; if the colony had been located in the area of the Edison power plant, where a portion nested this year, its presence could have easily remained undetected.

The foraging activity of the Ormond Beach colony took place in 3 main areas: 1) Mugu Lagoon, located approximately 5 km (3 mi.) southeast of the nesting area, 2) the ocean immediately adjacent to the nesting site, and 3) the small marsh area and drainage channels immediately adjacent to the nesting area. As at other colonies this year, foraging in the ocean seemed to predominate until relatively late in the season. The use of Mugu Lagoon by Ormond Beach birds came as somewhat of a surprise; during late July adults regularly were seen carrying fish away from this foraging area in the direction of Ormond Beach, flying over the Mugu Lagoon least tern nesting area.

Mugu Lagoon

For the third consecutive year, least terns nested along the northwest stretch of the Pt. Mugu Pacific Missile Range. Previous reports have not underscored the proximity of this area to the Ormond Beach nest site, which is located less than 3 km (2 mi.) northwest of the Mugu Lagoon area along an ecologically continuous stretch of beach. Nesting at Mugu Lagoon has always occurred relatively late in the season (early July 1975 and late June 1976); this fact, together with similar but more complete data from 1977, strongly suggest that least tern nesting in the Mugu Lagoon area represents the renesting efforts of birds from the heavily disturbed Ormond Beach colony.

Least tern nesting at Mugu Lagoon was first noted this year on June 24, when a single nest was found and 2 additional pairs were involved in courtship behavior at the site. By July 18 approximately 9 pairs were in the area, and 4 nests were located; this increase in numbers coincided closely with a decrease in the population at Ormond Beach. On July 28 a fledgling banded at Ormond Beach was observed with its parents at the Mugu Lagoon site -- a further indication of the interchange of birds which occurs between those two slightly separated areas. By August 8 only a single pair with 2 chicks remained at the Mugu Lagoon site. Average clutch size (2.0 eggs) for this colony was rather low. This is consistent with the hypothesis that these nests were replacement clutches of pairs which had deserted the Ormond Beach site. Hatching and fledging success at Mugu Lagoon appeared good, and approximately 5 fledglings were produced.

A surprisingly late observation of 6 least terns (2 adults, 4 immatures) was made at this locality on September 20 (Massey).

Venice Beach (Figure B-3)

For the last 4 years least terns have nested on an alkali flat located at Playa del Rey; of those attempts, 3 have been at least moderately successful. During those years the colony has averaged about 20 pairs.

In 1977, least terns returned to the Playa del Rey site between April 20 and May 6, on which date 14 were observed foraging in the adjacent Ballona Creek channel and several were involved in early courtship behavior at the site. On May 8, however, an unseasonal storm left over 5 cm (2 in.) of rain in the area, flooding nearly the entire nesting site. On May 16 the site still had considerable standing water, and the exposed substrate was far too wet for any nesting activities. No least terns were seen at this locality throughout the remainder of the season.

On May 23 it was discovered that 3 pairs, presumably from the abandoned Playa del Rey nest site, had relocated themselves at Venice Beach, located 1.2 km (3/4 mi.) east of the Playa del Rey site. The 3 nests present were widely scattered over an area of approximately 3 ha (8 ac.); this area was posted and roped off on May 25, and on May 27, 1 m (3 ft.) high metal sand fencing was erected around the site through the assistance of local property owners and the Los Angeles County Department of Beaches. Since loose dogs are a problem along this stretch of beach, it is certain that the use of this sand fencing was instrumental in the success of this colony. The specific location of the nesting enclosure was in the central portion of the beach, immediately north of the Ballona Creek channel. The substrate was loose, light colored beach sand with no vegetation cover present. This stretch of beach is owned by the California Department of Parks and Recreation but is administered by local city and county authorities.

The nest site was visited on 17 dates between May 23 and August 30, at intervals ranging from 1 to 16 days. Data indicate that approximately 35 pairs nested at Venice Beach during 1977. The season was quite prolonged, with nests being present from May 23 to August 1. Hatching and fledging success appeared good; no problems with nest desertion, predation, or unusual chick mortality were noted. As has been previously found at Huntington Beach State Park, chicks at Venice Beach made heavy use of clay roofing tiles which were placed within the nesting area as artificial shelters. Although the intermixing of fledglings during post-breeding dispersal makes definite counts of fledglings produced at

a given colony somewhat tenuous (see discussion of post-breeding dispersal from Terminal Island), most of the 35-40 fledglings present at Venice Beach in early August were probably from this colony. Small numbers of least terns seemed to linger in the area of Venice Beach longer than at other nesting sites; 25 were present on September 6, but only 2 could be found on September 16.

Since 35 pairs are considerably more than the 20 pairs historically present at the Playa del Rey site, there may have been some renesting activity at Venice Beach following initial nesting failures at colonies such as San Gabriel River. An alternative explanation can not be ruled out, however. Although nesting of least terns on Venice Beach has never been previously documented, past observations of adults feeding fledglings at this location suggest that a small number of widely scattered pairs may have attempted to nest in this vicinity in the past. While in my opinion somewhat unlikely, it is conceivable that the increase from 20 to 35 pairs reflects the presence of these previously unnoticed birds.

Foraging activity was noted in the ocean immediately adjacent to the nest site and in the nearby Ballona Creek flood control channel. No preference between these two areas, which are probably nearly identical biologically, was observed.

Beethoven Street Fill (Figure B-3)

Following an observation (Johnson) of defensive least terns at this location along the Ballona Creek channel, a single pair with a clutch of 3 eggs was found on June 2. These eggs had recently hatched on June 10, indicating that nesting at this site had begun around May 20. Only 3 nests were established at the Beethoven Street site in 1977, with a maximum of 2 breeding pairs present at any one time. Chicks successfully hatched in two of the nests but no young fledged; the third nest was abandoned. It is likely that human disturbance was responsible for the nesting failure of this colony.

The nesting area is a small (approximately 0.1 ha, or 0.2 ac.), triangular portion of property owned by the Los Angeles County Flood Control District. It is bounded on two sides by flood control channels (including the Ballona Creek channel) and on the third side by a chain link fence. The potential for controlling human access to the site is good. The substrate is light colored, sandy dredge material with sparse vegetation cover.

This is the first year that nesting has been documented at this site. However, least terns almost certainly nested in this area in 1976 following abandonment of the Playa del Rey site (located 2.4 km, or 1.5 mi., southwest of the Beethoven Street fill); at least 6 pairs were observed at the site during July 1976, but nesting was never confirmed. It is unknown whether this area is used only when the Playa del Rey site is not used for nesting (as in 1976 and 1977), or if a small number of pairs regularly use this location.

Terminal Island

Least terns returned in 1977 to the Reeves Field nesting site, which has been used 4 of the last 5 years. No terns were seen at the nesting area used in 1975; this location remains unsuitable due to heavy vegetation growth and use of the area for storage of petroleum coke by the Los Angeles Harbor Department.

Reeves Field was visited on 26 dates between April 11 and August 16 at intervals ranging from 1 to 14 days. The first least terns were observed on May 6. Nesting was underway by May 18, and continued throughout June and July; the last eggs were noted on July 27. The maximum nest count was 75 present on June 7; at least 95 nests probably were present during the course of the season. This figure likely represents the nesting efforts of approximately 85 pairs. Hatching and fledging success appeared good; no evidence of nest desertion, predation, or unusual chick mortality was noted. Three dead adults found intact on the nesting area (June 23, July 13, August 3) showed no signs of external injuries and are available for chemical analysis. The absence of any marked surge of renesting activity indicates that the initial attempt of most pairs was generally successful. While some of the later nests undoubtedly represent second attempts, I suspect that many of these pairs had moved to the Terminal Island site after earlier failure at the nearby San Gabriel River colony. Data on interchange of pairs between nearby colonies during a given nesting season remain a major gap in our understanding of least terns; the banding program, as currently being pursued, will not provide this information. Due to rapid dispersal from the nesting area, accurate counts of fledglings produced are difficult; I would estimate that approximately 80 young were fledged from the Terminal Island colony in 1977.

The foraging activity of this colony was scattered throughout Los Angeles Harbor, with most occurring in harbors of the U. S. Naval Shipyard located immediately adjacent to the nesting site. However, no significant concentrations of foraging least terns were noted prior to post-breeding dispersal.

As in previous years, Harbor Lake was an important foraging area for this colony during July and August. No least terns were seen at Harbor Lake in June; however, by early July small numbers of adults had begun to make foraging trips to this area from Reeves Field. By July 13 approximately 55 terns were foraging at Harbor Lake; only 10 of these were fledglings. Numerous observations were made of adults carrying fish away from Harbor Lake in the direction of Terminal Island, a direct flight distance of 7.2 km (4.5 mi.). Such interchange between Harbor Lake and Reeves Field diminished as more and more fledglings joined their parents at Harbor Lake, presumably following them there from the nesting site. Least terns apparently do not roost at Harbor Lake during the night, but merely use this area for foraging; this point has been unclear in previous reports. By August 3 approximately 50 least terns, almost half of them fledglings, were at Harbor Lake. This number gradually decreased in late August, and by September 6 none were observed at this locality.

The large sample of chicks which were color marked at Terminal Island provided considerable data on post-breeding dispersal of this colony. The majority of the colony moves to Harbor Lake, at least temporarily, following the fledging of young (up to 15 banded fledglings seen at once). However, at least 3 Terminal Island fledglings were also seen at Bolsa Chica (located 19 km, or 12 mi. southwest of Reeves Field) and Venice Beach (approximately 29 km, or 18 mi. NNW of Reeves Field). The post-breeding dispersal of a colony can hardly be considered a cohesive movement; rather, small numbers of birds appear to move in various directions away from the nesting site. The interchange of fledglings between such distant colonies as Venice Beach and Terminal Island is interesting since it casts some doubt on the accuracy of figures such as "fledglings produced at a given colony." The possible role of a multi-colony roosting flock in promoting such interchange is considered in the discussion of Belmont Shores beach. A single Terminal

Island fledgling also was seen with its parents at the San Gabriel River site; perhaps this pair experienced an early nest failure at San Gabriel River and then renested successfully at Terminal Island.

San Gabriel River

For the seventh consecutive year, least terns returned to the fill area located east of Pacific Coast Highway between the north bank of the San Gabriel River and what is now "The Market Place" shopping center. Commercial development of this area has continued to expand; the northern portion of the nesting area used in 1976 is now an asphalt parking lot. The property owners cooperated fully in providing for ground preparation of the remaining nesting area; grading was completed on April 29 under DFG supervision. The entire nesting area was posted and roped off to discourage human entry; these efforts were, for the most part, successful.

Data were gathered on 38 visits to the nest site between April 9 and August 10. Least terns were first observed on April 23; numbers gradually increased and by May 6 a minimum of 15 pairs was at the site. The courtship and site selection cycle was interrupted, however, on May 8 when an unseasonal storm left 3 cm (1.2 in.) of rain in the Long Beach area, thereby flooding major portions of the nesting area. Included in these was the southern portion of the site which had been the focal point of least tern courtship and site selection activities; following the storm, these activities shifted to the drier northern and eastern portions of the area which had been previously ignored by the birds. By May 18 nesting was well underway, and 30-35 pairs were present on the site; the colony appeared strong with no obvious problems. However, on May 30 only 16 nests were present, and the overall activity of the colony was noticeably reduced. On June 7, 13 nests were present, at least 4 of which had not been seen on May 30; since no chicks could be found, the loss of about 7 nests during this 8 day period is indicated. By June 22 renesting had begun, with 15 nests present; on June 29, 20 nests were located (8 of which were in the previously flooded southern portion of the area), and a four day old chick was seen. The colony appeared to have stabilized and once again seemed strong; however, on July 11 only 5 nests were present and no chicks were seen. Of these 5 nests, only one was finally successful in producing fledglings (seen on August 9). Only 3 young were produced from this colony, which fledged 42 in 1975 and "many more" than 65 in 1976.

Human trespass into the nesting area was minimal until late July, at which point the nesting site was already mostly deserted. Traffic along Pacific Coast Highway caused no apparent disturbance, nor did the fairly limited activity in the adjacent shopping center parking lot. Nesting failure was probably due to predation or some sort of animal associated disturbance. Many cat tracks were found in the area, but rat, (Rattus sp.), dog, and ground squirrel (Otospermophilus beecheyi) tracks were also found making it difficult to conclusively point to a single source of the problem. Little direct evidence of predation was found; occasionally broken egg shells were located, but for the most part eggs and chicks merely disappeared. It is recommended that predator control measures, directed toward feral cats and rats, be initiated annually at this site prior to the arrival of the terns.

Foraging activity mainly occurred throughout the Long Beach Marina directly west of the nesting site, and to a lesser extent in the channel of the San Gabriel River adjacent to the area. Early in the season foraging least terns, presumably from this colony, were regularly seen as far away as the Long

Beach Marine Stadium; however, as nesting progressed, this locality was utilized only occasionally.

Bolsa Chica (Figure B-4)

On June 27 a small colony of least terns was discovered nesting on a large landfill area owned by Signal Landmark Company. A total of 3 nests was present, with an additional 5 pairs involved in courtship behavior at the site. The nesting area was posted and roped off and experienced virtually no human disturbance throughout the remainder of the season. By July 11, however, the nesting activity had greatly declined, with only 1 nest and a total of 5 adults present; no chicks were seen. Many cat and dog tracks were found in the area, presumably representing the source of disturbance for this colony. On July 20 a single nest was present (different from that seen July 11); no other terns were in the immediate vicinity of the nest site. By August 8 the colony had abandoned the area.

The history of least tern nesting activity in this area is not well known. While this is the first time in recent years that nesting has been documented in the Bolsa Chica area, it is possible that small numbers have attempted to nest in the area previously and have merely gone unnoticed. The Bolsa Chica colony more likely represents a renesting attempt by a small portion of the San Gabriel River colony, located 11 km (7 mi.) NW of the Bolsa Chica nest site.

Huntington Beach State Park

Vegetation removal within the fenced least tern sanctuary was completed well in advance of the nesting season, with approximately 20 percent vegetation cover being left on the site. The area was visited on 21 dates between April 21 and August 22 at intervals ranging from 2 to 11 days. Additionally, Russ and Marion Wilson checked the site frequently throughout the nesting season; their data have been incorporated into this report.

Least terns arrived at Huntington Beach this year between May 3 and May 13; numbers rapidly increased and by May 20 approximately 15 pairs were in the area. Since much of the early tern activity occurred in the beach area west of the fenced sanctuary, an additional area (approximately 0.3 ha, or 0.7 ac.) was posted and roped off on May 20 to discourage human disturbance. This posted area was used by the terns throughout the season for courtship, flocking, roosting, feeding of young, and a limited amount of nesting (3 pairs); all investigators familiar with this colony felt that the additional area was beneficial to the terns and should be annually protected during the breeding season. Nesting was underway by May 25, and by June 9, 28 nests or scrapes were present. Nesting continued over an extended period of time; on July 11, 23 nests and at least 15 chicks and 15 fledglings were counted. There was no apparent surge of renesting activity. On July 28, when the colony had noticeably dropped on overall numbers due to post-breeding dispersal, there were 6 nests, 25 chicks, and 40 fledglings present. Nesting was completed in early August, and by August 19 the area was totally vacated.

The protracted nesting season, possibility of renesting attempts, and rapid post-breeding dispersal from the nesting site make analysis of these data difficult. Approximately 50-55 nests are known to have been present; considering the apparently good hatching and fledging success (no evidence of nest

desertion, predation, or unusual chick mortality), this figure probably represents the nesting efforts of at least 45 pairs. Accurately enumerating fledged young was similarly difficult, but I would estimate that approximately 60 were produced.

Most of the observed foraging activity of this colony occurred in close proximity to the nesting site. Early in the season (i.e., prior to the hatching of chicks), most foraging occurred in the ocean; it appeared that a shift to the brackish, relatively shallow channels of the Santa Ana River was made when the smaller fish required for chicks were being sought. More data on the food requirements of least terns are necessary, especially relative to the sizes of fish taken. It is possible that the food utilized by adults may differ sufficiently from that of young chicks as to require, at least at some colonies, parental foraging activity in very different habitats.

Data on the post-breeding movements of terns from this colony are sparse, but it appears that at least the Bolsa Chica area, located 12 km (7.5 mi.) northwest of the Huntington Beach State Park nest site, may be an important post-breeding area. Up to 25 least terns, including at least 14 (and probably more) fledglings were present at this locality between July 28 and late August; at least 3 of the fledglings had been color banded at the Huntington Beach colony. Considering the relatively small color banded sample from this colony (24 chicks), it is likely that many of the unbanded fledglings seen at Bolsa Chica were also from the Huntington Beach State Park colony.

Upper Newport Bay (Figure B-5)

Following a report of least terns in this area (Loughran), a small colony of approximately 10 pairs of least terns was confirmed to be nesting on July 2, when 4 nests were located. One of these contained a very recently hatched chick. This observation, together with that of a fledgling seen July 20, suggests that nesting probably began at this site in early June. Data obtained on 9 visits to the colony between July 2 and August 19 indicate that approximately 12 pairs nested at this location in 1977. Hatching and fledging success appeared good, and approximately 15 fledglings were produced from the colony.

The nesting site is located in the abandoned saltworks at the northern end of DFG's Upper Newport Bay Ecological Reserve. Plans for enhancement of a portion of the saltworks area as a least tern nesting site are currently under consideration.

Although least terns are known to have bred historically in the Newport Bay area, this is the first time in recent years that nesting has been documented. While the origin of these birds is purely speculative, I feel that it is possible that limited nesting has occurred in the saltworks area previously but has gone unnoticed. (For example, the foraging patterns of this colony take the birds away from those areas of the Ecological Reserve most frequented by local birders).

Given the colony's proximity to a sizable, natural saltwater estuary, the foraging behavior of these birds was somewhat surprising. Only limited foraging activity occurred in the bay itself; least terns were only occasionally seen south of the broken main dike prior to post-breeding dispersal from the nesting area. Slightly greater foraging activity was noted immediately adjacent to the nesting site in the shallow channels passing through the

saltworks area. But by far the majority of this colony's foraging was done away from the Ecological Reserve at the following freshwater locations in the Newport/Irvine area: 1) a small, man-made lake located in the middle of the Koll Center office complex, 2) the ponds of the San Joaquin Marsh, administered by U. C. Irvine, and 3) a small pond located at the intersection of MacArthur Boulevard and Jamboree Road (Figure 5). Adult least terns were frequently observed carrying fish from each of these locations in the direction of the Upper Newport Bay nesting site. Fledglings were also seen at each of these locations late in August; it is suspected that these areas, with dense concentrations of mosquito fish (Gambusia affinis), provide prime foraging sites which may be especially important to fledglings learning how to catch fish. For instance, during a 3 minute observation period at the Koll Center Lake, one recently fledged bird was observed to make 3 unsuccessful dives at fish; during the same time period, one of this fledgling's parents was successful on each of 4 dives. The continuance of good food supplies at the Koll Center Lake and the San Joaquin Marsh may be essential to the future existence of an Upper Newport Bay least tern colony.

Belmont Shores Beach Night Roost (Figure B-6)

It was discovered in 1976 that following nesting, large numbers of least terns (maximum count of 171) roosted at night on the Belmont Shores Beach in Long Beach. Banding data on the source of these birds, although difficult to obtain, indicated that much of this flock was from the San Gabriel River colony.

In 1977, it was discovered that not only is this area used for roosting following the nesting season, but also preceding and even during nesting. Small numbers of least terns were first observed along this stretch of beach early on the morning of May 3 (Flanagan). Thereafter, data on the number of roosting terns were obtained on 19 visits to this area between May 5 and August 29 by Dorothy Rypka, Barbara Massey, and me.

Shortly before sunset, least terns began to appear throughout the Long Beach Harbor area, arriving individually, as pairs, and in small groups. These birds engaged in some foraging activity in the harbor areas, gradually coalescing into larger and larger groupings. The area chosen for roosting was remarkably consistent considering that identical beach extends for miles in either direction. After making several low passes over this area, the flock would quickly settle on the sand, perform some preening behavior, and then settle low into the sand for protection from the wind. The entire flock would disperse the following morning prior to sunrise, leaving usually as pairs or small groups; directions of flight under these light conditions were impossible to determine.

The pattern of changing abundance of roosting terns at this site probably reflected migratory movements and stages of the breeding cycle of local colonies:

1) Several local colonies must be represented in this roosting flock. The maximum count of 280 birds, present on May 9, far exceeds the number present at any local colony, or even the combination of the two closest colonies (Terminal Island and San Gabriel River). Northward bound migrants may be represented in this flock at this time.

2) There was a gradual decline in numbers from mid-May through early July. On July 2, only 6 terns were counted. This undoubtedly reflects increasing numbers of birds remaining at local nesting areas as well as the dispersal of birds to more distant, northern colonies. Even during mid-June, however, at the peak of local nesting activity, considerable numbers (approximately 130) continued to roost at this location. Either there is a sizable percentage of the population which nests relatively late in the season (unlikely), or both members of a pair do not always remain together on the nesting grounds at night.

3) A sharp increase in numbers in late July (to a peak of 170) coincided with the arrival of many fledglings, which comprised approximately 25 percent of the flock throughout the remainder of the season. Although color bands could not be seen under the poor light conditions, it is almost certain that the bulk of these fledglings came from the Terminal Island colony.

4) Numbers gradually declined throughout late July and August, probably due to southward migration or widespread dispersal to other post-breeding flocking localities.

Other large night roosts such as this may occur in other portions of the least tern breeding range. Craig (personal communication) counted at least 500 least terns in a night roost at San Diego International Airport on May 21, 1971. Identification and protection of such night roosts throughout the state may prove to be very important in efforts to maintain tern breeding colonies.

Clutch Sizes

Below are listed average clutch sizes of selected least tern breeding colonies in Santa Barbara, Ventura and Los Angeles counties during 1977. Small clutches in the Santa Clara River and Mugu Lagoon colonies probably reflect renesting efforts late in the breeding season following partial colony abandonment at Ormond Beach (Lack 1954, Klomp 1970).

Colony	Colony Size (pairs)	No. Clutches Checked	Date	Aug. Clutch Size
Santa Clara River	6	6	July 23-Aug 25	2.1
Ormond Beach	30	5	June 14	2.4
Mugu Lagoon	5	5	June 24-Aug 8	2.0
Venice Beach	35	6	June 2	2.5
Terminal Island	85	14	May 29	2.6

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Orange County: Kristen Bender, Margaret Carlberg (Sea and Sage Audubon Society), Charles Collins, Ronald Hein, Jack Hiehle (Huntington Beach State Park), Preston Johns, John Lindell, Lois Loughran, Barbara Massey, Michael Mulligan, Dorothy Rypka, Russel and Marion Wilson.

Figure B-1. California least tern nesting site at Santa Maria River, 1977.

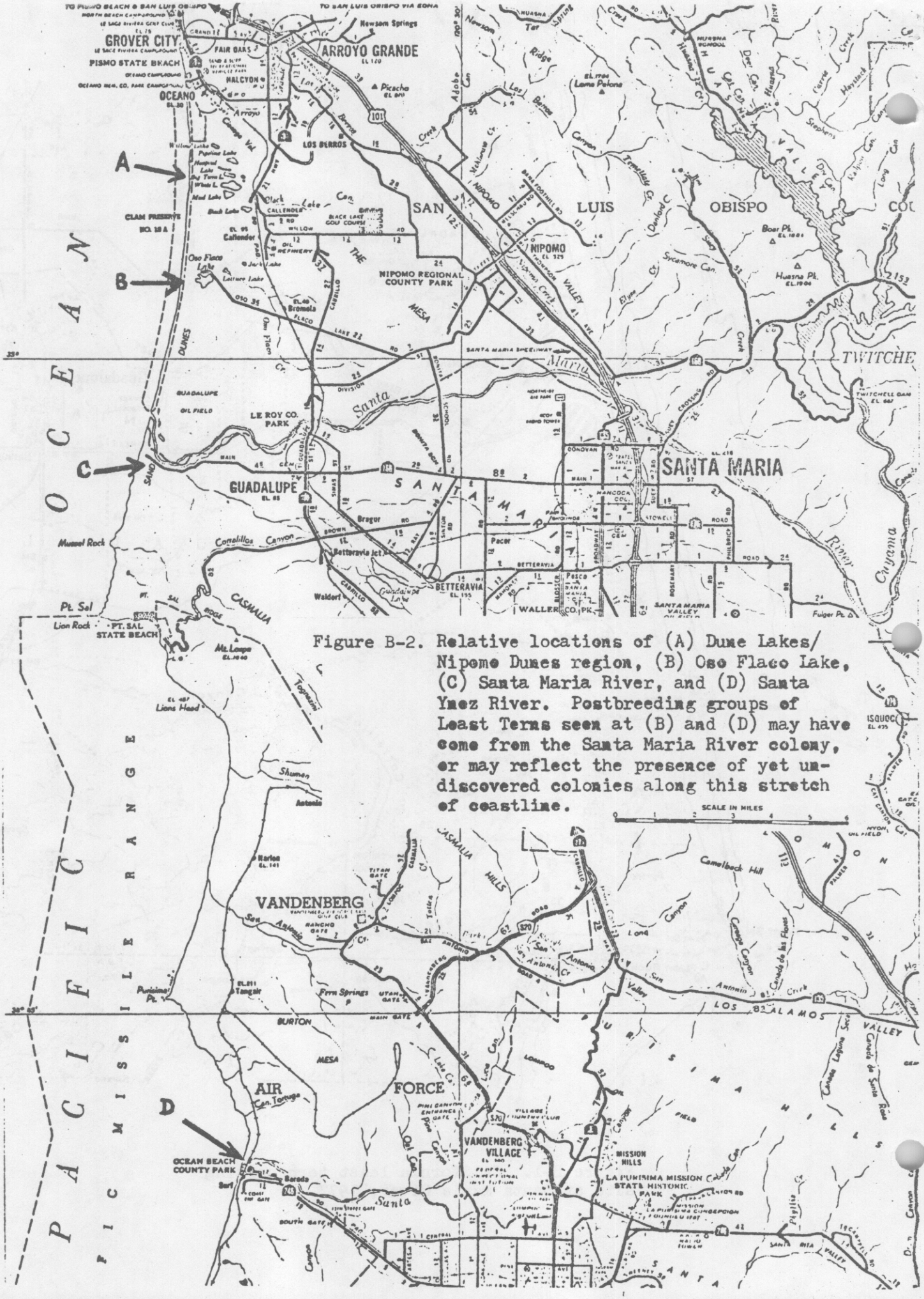

Figure B-2. Relative locations of (A) Dune Lakes/ Nipomo Dunes region, (B) Oso Flaco Lake, (C) Santa Maria River, and (D) Santa Ynez River. Postbreeding groups of Least Terns seen at (B) and (D) may have come from the Santa Maria River colony, or may reflect the presence of yet undiscovered colonies along this stretch of coastline.

Figure B-3. California least tern nesting sites at Venice Beach (A) and Beethoven Street Fill (B), 1977.

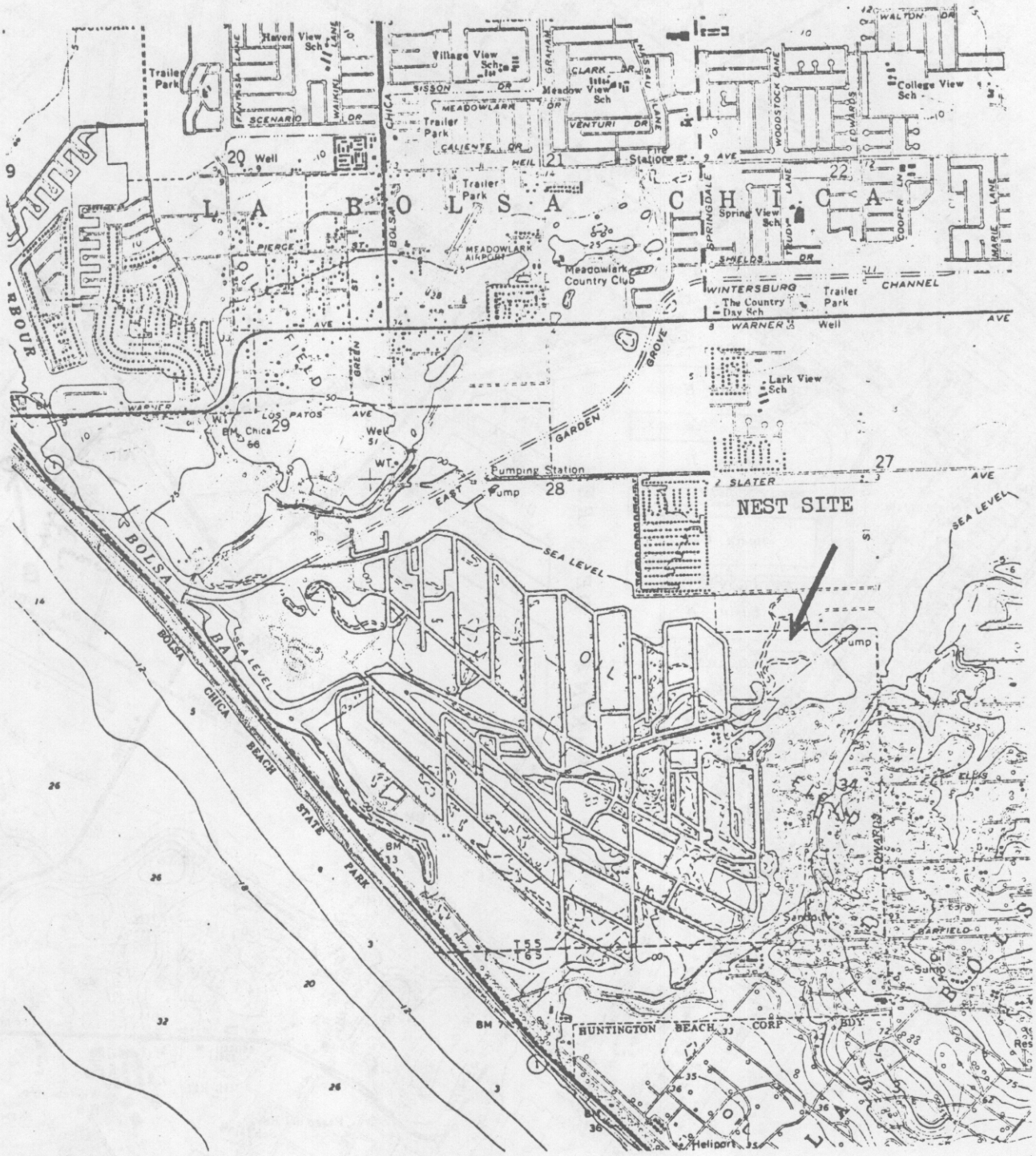

Figure B-4. Location of 1977 Least Tern nesting site at Bolsa Chica

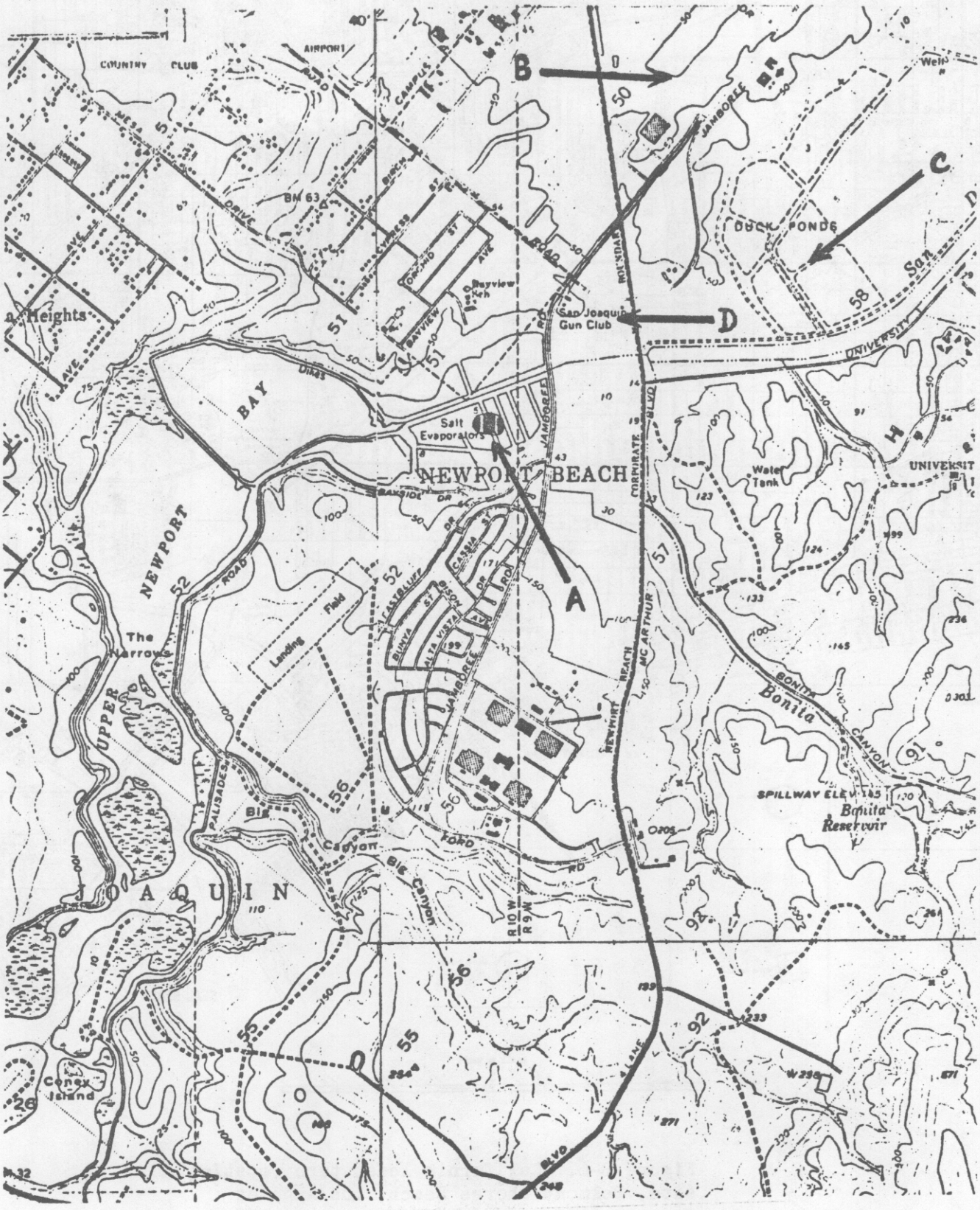

Figure B-5. 1977 least tern nesting sites at Upper Newport Bay (A). Also shown are locations of three primary foraging ponds: (B) Koll Center Lake, (C) San Joaquin Marsh, and (D) pond at intersection of MacArthur Boulevard and Jamboree Road.

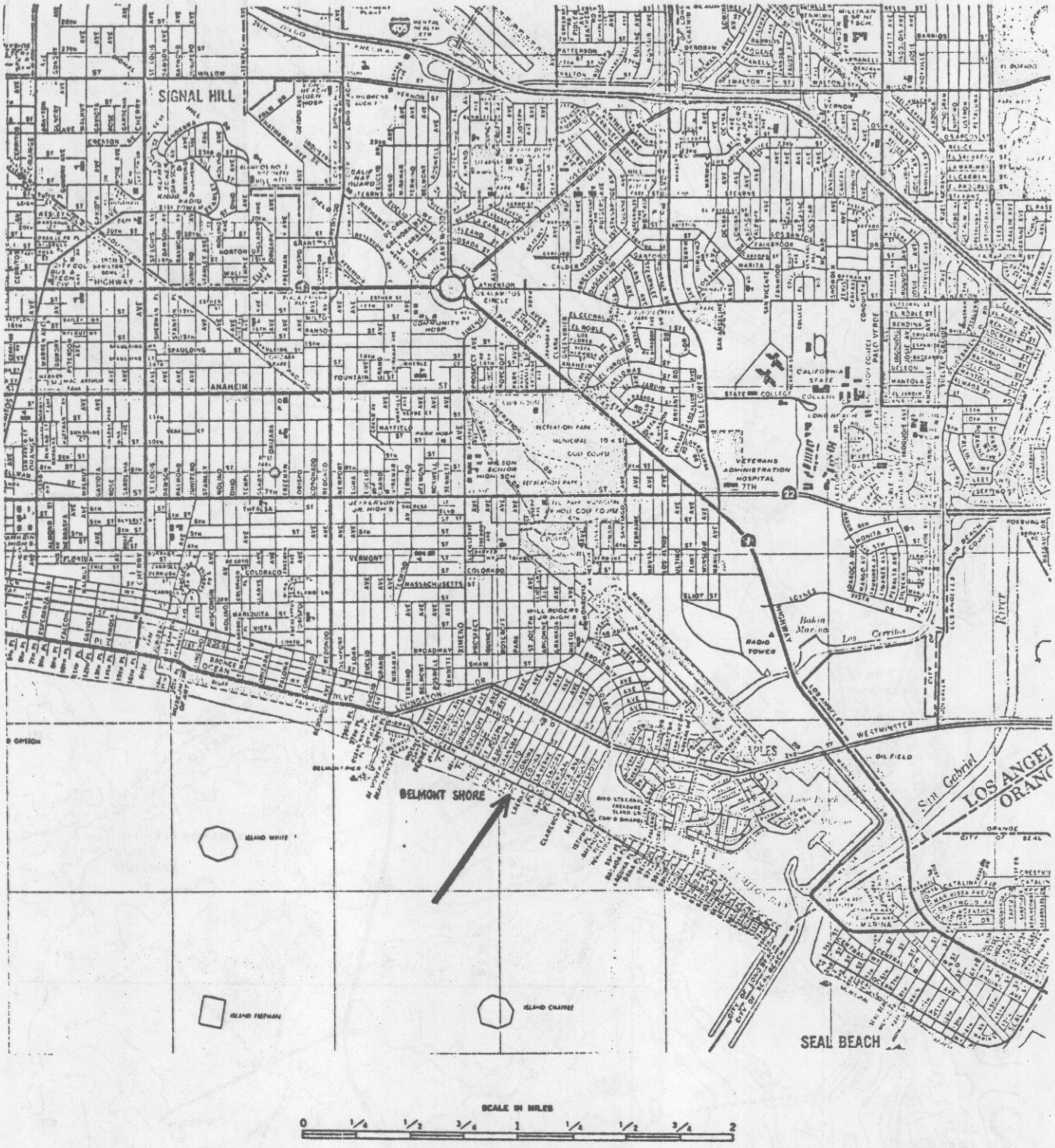

Figure B-6. California least tern roosting site, Belmont Shores Beach, Los Angeles County, 1977.

APPENDIX C

LEAST TERN BREEDING SEASON IN SAN DIEGO COUNTY, 1977

by

Paul D. Jorgensen

An estimated 480 pairs nested at 14 sites along the San Diego County coast, and although the total number of pairs was similar to last year, the nesting distribution was not. The largest and most successful breeding colony was the 125 pairs at the Federal Aviation Administration Island in Mission Bay.

Breeding success in the county was similar to that reported in 1976. Off road vehicle disturbance was the primary cause of harrassment to tern colonies and resulted in reduced nesting success at Sweetwater River, North Fiesta Island and Agua Hedionda Lagoon. Predation was believed to be the main cause of poor nesting success at Camp Pendleton and South San Diego Bay Saltworks and of total failure at North Island. High water levels caused by rain runoff resulted in a reduction of early season nesting habitat at Los Penasquitos, San Elijo and Batiquitos lagoons. The lack of nesting at San Elijo was attributed to this problem.

Large post-breeding flocks of adults and fledglings were present at Tijuana River (80 birds), west San Diego River Floodway (120 birds), San Dieguito Lagoon (140 birds) and Buena Vista Lagoon (58 birds). These areas are important after the nesting season when adults are still feeding the juveniles.

Santa Margarita River

Predation on eggs and chicks throughout the breeding season accounted for a drastic reduction in nesting success compared with previous years (Swickard 1971, Wilbur 1974, Bender 1974, Massey 1975). It is estimated that fewer than 30 young fledged from nesting attempts of approximately 120 pairs in 1977.

Least terns began arriving in mid-April and by May 27 their numbers peaked when 290 adults and 118 nests were counted. Nests were distributed in nearly the same areas as in previous years with roughly 70 to 80 percent of the nests located along the beach. In addition there were about 20 pairs strung out for 0.5 km (0.3 mi.) north along the beach beyond last year's barrier. These were apparently renesting attempts since they appeared one week after major nesting failure in other parts of the colony.

Networks of fresh coyote tracks were found throughout the colony on each weekly visit. Ravens were seen regularly and were responsible for destroying eggs in two nests on May 13. A black-crowned night heron (Nycticorax nycticorax) was seen eating a least tern chick on the edge of the beach colony in June by Marine Corps Sgt. Cross of the base game unit. Numerous ground squirrels, fox tracks and two long-tailed weasels (Mustela frenata) were also seen at the colony.

Marine Corps troops marched into the nesting area on the beach through the well marked protective barrier on two occasions. The impact on nesting terns could not be measured; these trespassings took place after major nest failure had occurred.

Feeding activity was seen frequently in nearby open ocean and the adjacent lagoon, particularly in the northwest ponded area known as "sweetwater." During my visits to the nesting areas, I saw from 5 to 15 individuals feeding in the sweetwater ponds, and while walking the 2.4 km (1.5 mi.) of beach, I usually counted a similar number returning to the colony from the ocean with fish. In the past 5 years, local observer Alice Fries reports that she normally has seen 30 to 60 least terns feeding at Oceanside Harbor each time she has visited. This year, a total of 11 was seen on 3 visits. This dramatic decrease may reflect the poor nesting success at the colony, which is only about 1.6 km (1 mi.) north.

I recommend that the south and east boundaries of the mudflat area be posted and roads blocked at the time the beach barriers are erected in order to curtail foot traffic which persisted in the area in 1977. Cooperation in observing the "off limits" status of the colony area during nesting and general management of the colony could be enhanced by a basewide early notice (March) of the coming nesting season. A similar notice announcing the arrival of the terns and the beginning of nesting should be issued in May. These notices could be issued through or by the base game unit and would provide immeasurable help in directing basewide attention to one of Camp Pendleton's unique inhabitants. No recommendation on predator problems can be made without more information on the exact causes of nesting failure.

Buena Vista Lagoon

No nesting occurred here due to lack of habitat, but least terns used the lagoon for feeding and roosting from the end of May to early August. An old boat house in the large lagoon between Interstate 5 and Highway 101 served as the principal roost platform for 20 to 60 adults. Adults were frequently seen fishing throughout the lagoon. Many individuals, usually 30 or more, were present all summer, suggesting that the lagoon was the main source of their food supply.

I recommend that the boat house not be removed, or if it is removed that an adequate replacement roosting platform be furnished. The open water with a nearly continuous border of heavy reed vegetation throughout the entire lagoon affords no alternative roosting. It is probable that, without a raised platform or broad open flat for the terns to roost, their use of the lagoon would decrease. This lagoon is also a potential breeding area for least terns, but an adequate nesting site is lacking.

Aqua Hedionda Lagoon

Least terns began arriving in late May, and by June 10, 6 pairs were nesting on the salt flat 0.5 km (0.3 mi.) east of the lagoon, next to Park Drive. By June 24, 2 more pairs were nesting on the flat and 5 additional pairs were nesting on the salt flat southeast of the lagoon. In all, 13 pairs nested here. On subsequent visits fresh motorcycle tracks were found at both nesting sites. This off road vehicle activity resulted in the destruction of at least half of the nests.

The large mudflat along the shore at the east end of the lagoon served as a roosting area for between 5 and 15 adults during the nesting season. On July 16, 14 adults and 6 fledglings were seen on the mudflat. The fledglings

could have been from the local colony or from another site. The lack of prior feeding activity associated with the care of young at Agua Hedionda suggests that these young may have come from elsewhere.

Protection of the colony under the present uncontrolled conditions of vehicle use would require an estimated 500 m (1,640 ft.) of fencing and more intensive monitoring by law enforcement personnel.

Batiquitos Lagoon

On June 18, 20 adults and 4 nests were found on the sandy shoreline at the east end of the lagoon. On June 24, 55 adults and 11 nests were present. On July 8, several fledglings were present and the original 11 nests were still being incubated. These young were from earlier, undiscovered nests or from other colonies. Hatching was underway in most nests on July 15. Two weeks later, 46 adults were roosting together but no chicks were found. Close examination had shown earlier that 2 of 11 nests had been abandoned before hatching, but otherwise hatching was successful. The lack of adult feeding and other activities associated with care for the young indicates that the young were moved or that the nesting effort had failed due to chick mortality. Thus, the degree of breeding success of this colony was not determined.

Nearby principle areas of feeding were the shallows at the east end of the lagoon and along the south shoreline. The importance of the lagoon as a food source is not known. Several times while driving on I-5 and Highway 101 at the west end of the lagoon, I saw adult least terns flying over the road toward the ocean. Possibly they were obtaining part of their food from the nearby open ocean.

San Elijo Lagoon

No successful nesting occurred here this year. The sites used in 1976, in the east basin and on the road parallel to the railroad tracks in the west basin, were flooded when least terns began arriving in the third week of April. The sites were not available for nesting until after the lagoon water level was lowered on May 27. So, unfortunately, last year's sites were unavailable when terns were first selecting nesting areas, and once available they were not used.

On 8 visits during May, an average of 10 individuals was seen feeding and roosting near the 1976 nesting areas. The first week of June, 4 pairs nested on a small mounded area north of the east basin mudflat site and only 50 m (164 ft.) from Manchester Avenue. All 4 nests were abandoned before hatching began. The reason for failure is not known.

No nesting occurred in the west basin (west of Highway I-5) but large flocks, including fledglings, used the open mudflats for roosting and the lagoon channels for feeding. The presence of large flocks from June through August is summarized: June 10, 40 adults; June 17, 8 adults; June 26, 46 adults, 9 first year plumaged birds; July 7, 1 adult; July 22, 20 adults and 23 fledglings; July 23, 50 individuals; August 4, 15 adults and 4 fledglings; August 10, 28 adults and 23 fledglings. The main area of use was the mudflats at the south portion of the west basin in line with Rios Avenue. By August 20, the lagoon was again flooded from rains, covering the roosting areas. No terns were seen after the flooding.

At the beginning of the nesting season in April, the heavily vegetated island-dike in the northwest corner of the lagoon was cleared of vegetation in hope of attracting nesting least terns. The site supported 15 to 20 pairs in 1970 (Craig 1971). Although no nesting occurred this year, it is recommended that the site be similarly cleared each year. Being above inundation levels and relatively free of human disturbance, this sandy island is potentially the best site in the west basin.

Current plans by the County of San Diego for altering the east basin should be reviewed to insure that nesting habitat used by the least tern in 1975-76 is protected. The site has been the most productive in San Elijo Lagoon in recent years.

Signs should be posted at the south end of the road paralleling the railroad tracks in the west basin in April to block vehicle traffic. San Diego County Vector Control (Mosquito Abatement) should be notified in April of the coming breeding season to alert them to possible nesting in spray areas.

San Dieguito Lagoon

Once again this lagoon was an important post-breeding feeding area for adults and fledglings. No nesting occurred as proper habitat was lacking.

One pair was seen at the race track infield in May and June, and several individuals were seen feeding in the lagoon. Not until July 22 were more than 5 individuals counted on one day. The population began to increase in late July, peaked in mid-August, and decreased rapidly after rains flooded roosting areas by August 18. A summary of sightings follows: July 22, 11 adults, 13 fledglings; August 1, 64 adults, 70 fledglings; August 4, 67 adults, 35 fledglings; August 8, 61 adults, 70 fledglings; August 14, 80 adults, 60 fledglings; August 22, 89 individuals.

The majority of roosting use was about equally divided between two sandbar sites: one at the confluence of the San Dieguito River Slough and a side slough northeast of San Dieguito Drive, as described by Craig (1971); the other is west of the fairgrounds and just west of the railroad trestle and consists of an approximately 0.2 ha (0.5 ac.) plot at the edge of the ponds between the Atchison, Topeka and Santa Fe Railroad and Highway 101. After mid-August rains covered all of the roosting area near the railroad and most of the one near San Dieguito Drive, a flock of between 10 and 30 individuals began roosting in a Del Mar race track parking lot just north of the San Dieguito Drive site.

Feeding took place in all waters of the lagoon including the area west of Highway 101. Judging by the intensity and success of tern feeding activity, the lagoon was probably the principle food source for the flock.

I recommend that any management plans for the lagoon take into consideration the importance of adequate roosting habitat. Either water level control or construction of suitable roost sites would provide the necessary habitat. Also, some portion of the dry area between San Dieguito Drive and I-5, now used by off road vehicles, should be considered for its potential as a least tern nesting site.

Los Penasquitos Lagoon

About 14 pairs nested here this year. Once the mudflat dried in mid-May, nesting began in the east end of the lagoon, southwest of the junction of Carmel Valley Road and Sorrento Valley Road. A maximum of 10 nests was counted here on May 31. By June 9, 5 nests remained, but 7 punctured eggs indicated that predation had occurred. Soon after, on June 18, 5 new nests appeared just west, along the Gas and Electric Company pole line road. These new nests were soon all abandoned and punctured eggs were found in 2 of 5 nests. In all, 15 nests were found in these 2 sites between May 20 and July 7, but no evidence of successful hatching was found.

An apparent renesting began in the first week of July when 14 pairs nested on a mudflat just east of the railroad tracks and south of the State Park boundary. Least terns were reported to have nested here in 1974 and 1975. Observations of chicks and fledglings at the railroad track site indicated that renesting was successful and at least 8 young survived to flying age. No known problems occurred at this site. In contrast to this year's predation problem at the Carmel Valley Road/Sorrento Valley Road site and success at the site near the railroad tracks, Copper (in Jurek 1977) reported good fledging success at the Sorrento Valley Road/Carmel Valley Road site and no nesting near the railroad. Of the two sites, the one near the railroad is less subject to human disturbance due to a lack of access. Both areas are subject to rain flooding and as Mudie, Browning and Speth (1974) suggested, the site near the railroad appears more likely to be flooded by high tides if tidal flow were restored to the lagoon.

Based on the fairly low frequency of observed feeding in the lagoon, it appears that this colony obtains fish from the adjacent ocean or elsewhere.

I recommend that no posting of the east area be done unless human disturbance is discovered. The signs might attract attention to an otherwise undisturbed site. San Diego County Vector Control (Mosquito Abatement) and San Diego Gas and Electric Company, Rose Canyon Office, should be notified in April regarding potential or known colony sites so that their activities will not jeopardize nesting birds.

Mission Bay

Only two nesting sites were used in Mission Bay this year. One of them, the Federal Aviation Administration Island, proved to be the most productive colony in San Diego County. One hundred and twenty-five pairs nested on the FAA Island with excellent success, while between 4 and 8 pairs nested on the north end of Fiesta Island with fair to poor success.

Least terns began arriving at their nesting grounds in late April. The first eggs discovered were laid on May 2 on the FAA Island. The number of pairs on the island increased until June 1, when 123 incubating birds were counted. Hatching began in the first week of June and continued for 3 weeks. Based on the number of fledglings counted at one time on the island and over nearby waters, it is estimated that no fewer than 80 and possibly as many as 125 young reached flying age. The clearing of vegetation on the island in April by the cooperative FAA personnel is probably partly or wholly responsible for the dramatic increase of nesting pairs over any previous year. No predator or human disturbance problems occurred.

The small colony at the north end of Fiesta Island was continually plagued by illegal off road vehicle activity. Signs announcing the presence of nesting endangered species were promptly removed by vandals. Although nests were repeatedly destroyed by vehicles, as many as 8 pairs persisted in nesting and renesting from early May through July. Somehow, at least 3 young managed to reach flying age. City ordinances prohibit off road vehicle activity on the island, but police and signs have not prevented the heavy use of the area.

Although not used by terns again this year, the fenced sanctuaries at Friars Road and Crown Point were excellently prepared by the City of San Diego in late April. Equipment normally used for removing kelp from the beach proved ideal for tern site preparation. Large skip-loaders fitted on the back with kelp rakes were used to remove vegetation. The debris was removed by dump truck and the site was smoothed by dragging a steel beam behind one of the skip-loaders. Dick Lester of the City coordinated the job.

Other potential sites which were checked during the season but which produced no nesting included: the mudflats east of Sea World; the mudflat south of Sea World, across Sea World Drive; Quivera Basin; the highway cloverleafs between Quivera Basin and Sea World; the sludge ponds on Fiesta Island; and the triangular sandy area north across Fiesta Island Road from the fenced sanctuary. Quivera Basin, the cloverleafs and the sludge ponds were too heavily vegetated for adequate least tern nesting habitat.

Feeding activity appeared to be widely distributed in the bay. During the height of young-rearing, adults arrived at the colonies from all directions. Two areas where feeding adults were seen most regularly were the bay channel east of Fiesta Island and the marsh shoreline just north of the Crown Point Sanctuary.

At the sludge ponds on Fiesta Island, it is recommended that vegetation around and on perimeter dikes be cleared as the city will allow. Operators of the pond facility were very helpful and should be contacted by early April to arrange for clearing. Hereafter, I recommend that a greater area, at least 75 percent, of the Friars Road site be cleared to increase the chances of attracting terns. Both Friars Road and Crown Point may require consecutive years of adequate clearing before terns nest. The importance of these cleared sites will increase as other sites are eliminated by development. I also recommend that the FAA Island be maintained by vegetation clearing just as it was in 1977, when roughly 60 percent of the island was weeded.

North San Diego Bay (Figure C-1)

San Diego Airport. Approximately 25 pairs nested in 3 areas of the airport, with the majority using the ovals (4S, 5S, 1S) between the main runway and the taxiway. The number of adults fluctuated greatly from visit to visit, and censusing was difficult due to air traffic. Least terns began arriving in late April, and on May 2, 30 adults were seen in the oval area. Two weeks later, 25 adults and at least 15 nests were present. By June 15 hatching was underway and 40 adults and 20 chicks, one week of age or less, were seen. In addition, about 6 adults were still incubating eggs.

Between July 4 and 6, most of the birds left the site. Most of the chicks seen two and a half weeks earlier would have been near flight age. On July 6,

only 6 adults, 7 fledglings and 3 chicks were found during a thorough search of the ovals. Five dead 3 week old chicks and 6 dead adults were also found in the ovals and along the runway edges. All the dead appeared to have been killed by planes and not by predators. One week later, 4 adults were all that remained in the colony area.

Six pairs nested east of the airport fire station in the "triangle" area. Incubation of 2 nests began in mid-May and the number increased to 6 nests the following week. Six nests were still being attended on June 15 and 2 remained on July 6, but no chicks were seen in this area. Determining the success at either area was difficult since it was impractical to observe the colonies for more than a few minutes.

The third area, the surcharge, supported 80 pairs last year but will no longer be available due to the construction of the airport's west terminal and its accompanying facilities. Amazingly, one pair nested on a less than 0.05 ha (1/8 ac.) plot, amidst continuous construction activity here and managed to raise 2 fledglings.

The airport manager, Bud McDonald, and his staff were very accomodating in providing access to the nesting grounds and reporting their findings during daily patrols.

Least terns, seen coming to the colony with fish, arrived from the south where they had probably fed along Harbor Drive. They were seen regularly all around Harbor Island, the east shoreline of Point Loma, Shelter Island and southeast of Harbor Island along Harbor Drive up until the abrupt departure of terns from the airport in the first week of July. The lack of feeding activity thereafter indicates that their post-breeding feeding areas did not include North San Diego Bay.

The only recommendation offered here is that in late April the triangle area be cleared of vegetation or otherwise improved for nesting. This possibly would attract nesting pairs away from the ovals where traffic is so heavy. Craig (1971) and Harold McKinnie (pers. comm.) reported nesting in the triangle area and not in the ovals in the early 1970s. Perhaps this tactic would benefit the least tern and the operation of the airport.

U. S. Naval Training Center. Recent grading of a large open area on NTC, just west of the airport surcharge area, attracted 35 to 40 nesting pairs. Least terns began using the site for roosting and courting in the first week of May. On May 16 the colony was well established with 32 adults and 10 nests counted. The highest total was recorded on June 5, when 50 adults and 35 nests were found. Hatching was well underway by June 12, and fledglings were first noted on July 2, when 12 were seen. Thereafter, fledglings were seen grouped together near the center of the colony area. On July 12, at least 25 fledglings were present with many adults feeding the young. Fledglings began to leave the area, and by July 26 only 4 were observed. About 4 pairs nested later than the main group; apparently these birds were renesting after their first attempts failed. From August 8 on, no terns were seen on the site.

The newly graded site was a very sparsely vegetated area of 9 ha (2.5 ac.), which remained undisturbed by humans and predators throughout the season. Navy officials were very cooperative in preventing disturbance to the colony. The site was cleared last year in preparation for the construction of recreation

fields which would cover part of the nesting area. Arrangements are underway in hope of insuring that adequate least tern habitat would be provided. The loss of the surcharge and this site would be a severe setback for the terns in North San Diego Bay. Any decrease in the open, unobstructed area would most likely diminish the attractiveness of the NTC site to the terns, so hopefully, the largest open area possible will be set aside for nesting in the future.

5th Avenue Marina. Seventeen pairs successfully nested on a new sand fill created to form a marina and park. The fill is soon to be developed as part of the City of San Diego's redevelopment plan.

On April 29, 7 least terns were discovered on the northwest fill and on May 10, 12 adults and one nest were present. By June 8, 1 incubating adults were counted. Chicks may have been present earlier but none were seen until June 15, when at least 7 were present. All the young were one week old or less. Approximately 35 adults, 5 fledglings and several late nesting pairs were present throughout July. In August, an increase in fledglings of two and threefold took place, the result of the abrupt appearance of young reared on the site and/or an influx of fledglings from other colonies. The following is a summary of sightings for August: August 1, 35 adults, 15 fledglings and 3 nests; August 6, 20 adults, 20 fledglings and 3 chicks and the remains of 2 apparently preyed upon fledglings; August 15, 23 adults and 12 fledglings; August 18, (after a rainstorm) 7 adults and 6 fledglings; August 29, 1 adult and 1 fledgling.

The site was protected by a vehicle restraint cable and "No Trespassing" signs posted across the entrance of the fill by the San Diego Unified Port District. The Port District's environmental personnel and the Harbor Police cooperated in protecting the area. Unfortunately, the site's proximity to the downtown area resulted in daily use of the site by sightseers, fishermen and occasional vehicles. On June 22, a 2 week old chick was run over by a trespassing motorcyclist.

Adults and fledglings were seen feeding in the bay between the colony and North Island. Terns from this colony probably also fished at nearby Shelter Island, Harbor Island and the east shoreline of Point Loma, where least terns were seen feeding.

North Island Naval Air Station. During a routine search for colonies on May 6, approximately 40 adults were found courting and roosting just north of the intersection of the main runways at NAS. Several scrapes were found but no eggs were present yet. On May 17, 45 adults and one nest with 2 eggs were found. By May 25, 13 birds were incubating eggs and 7 other adults were nearby. The colony area was an asphalt oval between the main runway and a taxiway. Nests were located in cracks, depressions and small drifts of sand. Several nests were even placed on the cement edge of the runway.

On May 30, firemen in the nearby firetower, saw a ground squirrel make repeated visits into the colony area, venturing across approximately 0.4 km (1/4 mi.) of open pavement from Building 793. The squirrel's activity in the colony could not be seen, but after that day the colony immediately decreased to fewer than 5 pairs. On June 8, there were still 8 adults, 3 egg nests and 2 newly hatched chicks. A week later was the last time any birds were seen on the site. Two egg nests were being attended, but no other young or adults were present. It is unlikely that any young fledged. The presence of at

least one grey fox (Urocyon cinereoargenteus), several feral cats, several pairs of burrowing owls (Athene cunicularia), and nearby roosting black-crowned night herons may have contributed to the predator problem.

Least terns with fish came to the colony from the north and northwest, where they were regularly seen fishing along the shore of the island. During periodic surveys along the entire shoreline of the base, feeding activity was restricted to the north and northwest shoreline.

Several longtime employees at the runway firetower said that the terns had been using the area each year for at least 10 years. No one had any specific idea of the number of nesting pairs in previous years except that there were at least as many as this year and that they had once been distributed over a larger area. Before this year, least terns apparently used the cement aircraft parking area, north of the runway firetower, which is no longer available due to the increased helicopter use.

The NAS public works personnel were helpful in providing admittance to the base and in alerting runway maintenance and other people using the nest area to avoid unnecessary use of the site. The runway fire crew was generous in allowing the use of their tower for brief observations and providing access to the colony.

I recommend that an effort be made to set up or enhance additional nesting areas on the base. We have no knowledge of the history of nesting on other areas of the base, but the large, open beach east of Zuniga Point appears to be a potential nesting area. An alternate site somewhere on North Island might attract nesting pairs away from the heavily used runway intersection. There are few adequate nesting habitats remaining in North San Diego Bay. North Island is one of the only areas left which could help to prevent a decrease in nesting terns in the north bay.

South San Diego Bay

Sweetwater River. As many as 40 pairs nested here this year with a high degree of renesting caused by continual off road vehicle activity in the colony. A few least terns began arriving in late April, and by May 23, breeding was well underway with 20 nesting pairs. On June 18, nesting reached a maximum when 40 pairs were found. Hatching in some nests had begun and continued into early August. Although hatching peaked in late June, the presence of nests and hatchlings into August indicates that there were many renesting attempts. Once the chicks began to fly, they were able to escape the onslaught of wheeled traffic. Fledgling success proved to be relatively good, with 20 to 25 flying young present on the site from mid-July until the first week of August. Fledging success probably would have been much better without the ongoing harassment. The last sighting of terns on the site was August 18, when 6 adults and 8 fledgling were present. No evidence of predation at the colony was found during the season. A number of incubating adults and some chicks were found run over by vehicles within the boundaries of the site.

Feeding activity throughout the breeding season was heavy along the bayshore, adjacent to the site and north to 24th Street. The channel leading to the boat ramp north of the colony was also used extensively. Fledglings were frequently seen feeding in groups of 3 or 4 in this channel and roosting either at the west end of the enclosure or on the bay mudflat west of the colony site.

The terns face the immediate problem of raising young on a heavily used area, which is one of the few remaining off road vehicle sites near urban San Diego. It is likely that in the next few years off road vehicle use will increase here, where riders come from 40 km (25 mi.) away or farther. To adequately protect this tern colony, a portable chain link fence should be erected around the nest area from mid-April through August. Rented, temporary fence, erected and removed by the fence company, would be ideal. This would be more effective than the enclosure of posts strung with twine which was erected this year and had to be continually mended. Although off road vehicle activity during nonbreeding months would keep the vegetation cleared to optimum density for nesting, it may prove difficult to convince riders to curtail use during the breeding period. Increased law enforcement efforts are urgently needed at this site.

A much more imposing problem is the impending threat of development. The fill area is a potential site for industrial development. To protect this colony, planning efforts should be directed toward preserving the entire site. If development is unavoidable, a site encompassing as large a portion as possible of the west or bayward end of the fill should be preserved.

This year, in addition to the enclosure and small admonitory signs, a large steel warning sign, 2.1 m by 1.5 m (7 by 5 ft.), was erected by DFG Warden Basom. The sign cautioned that continued use of the area was dependent on the users staying out of the tern nesting area. The large sign proved to be the best way of gaining the cooperation of many of the visitors. I recommend that several of these large semipermanent signs and a more exclusionary fence be erected in future seasons.

Coronado Cays. The number of nesting pairs increased from 6 pairs in 1974, when the site was discovered, to 17 pairs this year. No nesting occurred in 1976, and it is not known if nesting took place in 1975.

The vegetation cover at the site has increased in the past 3 years to the point where there is now an estimated 30 to 40 percent ground cover, including roughly 10 percent cover of bushes a meter (3 ft.) high or more. Still, 17 pairs were found nesting on May 22. Hatching began in the second week of June and continued through July. The first fledglings were seen on July 2, when 35 adults, 4 fledglings and 6 nests were counted. The highest count of fledglings was 7 on July 13. Vegetation obscured the view, preventing complete censusing of adults and chicks. The number of birds decreased rapidly after mid-July, and no terns were seen from August on.

Feeding was observed near the colony in the bay southeast and east and in the channel just west of the colony. Least terns were also seen regularly in the channel west of the Cays administrative offices. Other observers reported seeing small flocks feeding in the ocean along Silver Strand State Beach on several occasions.

I recommend that the site be cleared of most of the vegetation in April. The Port District would have to be contacted for permission. If terns again use the site, the Coronado Cays security police should be notified and signs posted across the entrance to the peninsula.

South San Diego Bay Saltworks. This colony was located on salt pond dikes near the center of the saltworks complex. On the first visit on April 30, 12 adults were found. Rains in early May destroyed initial nesting attempts of several pairs. By May 21, 30 nests were present, and hatching in some earlier nests had begun a week later. The number of nests increased to 69 on June 4, but by the 28th, there were 21 active nests, 10 live chicks and 7 dead chicks, 4 of which showed certain signs of predation. During the season, preyed upon birds totaled 13 young (2 weeks old or older) and 3 adults. Because of the large colony size, this is probably only part of the total that suffered predation. Surveys from mid-July on showed that about 10 pairs were nesting probably as a result of unsuccessful first attempts. These late nesters suffered similar predation problems resulting in poor success. The highest count of fledglings was 8 on July 13. Elizabeth Copper, who banded chicks here last year, found fewer young this year. In summary it appears that poor young survival was due in part to nest abandonment and predation of young and adults.

The predators responsible were not identified. Nearly all of the dead birds appeared to have been struck in the head, with a majority missing the back of the skull. Usually only the head and wing sets were found.

Control of human disturbance was simplified due to the remoteness of the central dikes where nesting occurs. Signs were posted at the ends of all dikes with nests. Dikes are identified by code numbers of ponds adjacent to them. On June 4, dike 5/7 had 15 nests; 5/33, 13 nests; 34/33, 28 nests; and 37/33, 13 nests. Early location of nesting areas is necessary here in order to insure that the saltworks and shrimp gathering operations do not endanger the terns. The management of the Saltworks cooperated in allowing the posting of signs and access to the nesting dikes.

Tijuana River

An estimated 6 pairs nested here this year, and as many as 80 adults and fledglings used the area for post-breeding feeding and roosting.

Least terns began arriving in the third week of April, and from that time until early July, 10 to 20 adults were present. Nesting began in the first or second week of May, and the number of nests present fluctuated between 2 and 6 until the second week of July when nesting activity stopped. Evidence of renesting for the majority of pairs suggests that nest destruction occurred. Although the site is posted and patrolled almost daily by State Park Rangers, it is in the pathway of people and horses walking the beach. The site is also susceptible to flooding when high tides and heavy surf occur together. Young were kept well hidden in dune vegetation until flight age, and by the time they fledged, other fledglings began arriving from other colonies. Therefore, it was difficult to estimate the number of young raised on the site.

Adults and fledglings from other colonies began arriving at the Tijuana River site in mid-July. On July 18, 55 adults and 25 fledglings were counted. The large flock remained in the area, feeding the fledglings and roosting until early August when their numbers dwindled. On August 2, 20 adults and 15 fledglings were seen, and by the 9th, 6 adults and 6 fledglings were counted. A similarly large post-breeding flock occurred last year (P. Pennington, T. Roeder).

Adults bringing fish to the nesting colony were seen arriving from the marsh channels and the ocean. During the summers of 1974, 1975 and this season, I regularly saw small numbers of adults feeding in the channels of Oneonta Slough (the north end of the marsh) and in the large channel that runs east to west from Sunset Avenue. This year I saw the terns feed in the channels just east and in the ocean just west of the nesting site.

The nesting site has been enthusiastically protected by State Park Rangers. It is recommended that in 1978, twine or rope with stringers of colored surveyor's tape be erected to enclose the area where nesting took place this year. With a well marked nest area and the frequent patrolling that the site receives, it should become a more productive site. Before human beach use increased dramatically, the same area supported at least 100 pairs as recently as 1963 (Craig 1971).

OBSERVATIONS AT OTHER AREAS

San Diego River Floodway

The sandbars at the west end of the floodway were used by least terns from April into September. Early in the season in April, a large flock of up to 114 adults roosted and courted on the area during low and medium tides when the sandbars were not flooded. Later, beginning in early July, the site became an important post-breeding location for adults and fledglings. Adults fished extensively along the beach just west and were frequently seen bringing fish back to waiting young. A representative sample follows (low counts often occurred when human and dog use was heavy): April 22, 45 adults; April 27, 114 adults; May 12 and June 5, 0; July 12, 15 adults and 8 fledglings; August 1, 40 adults and 51 fledglings; August 16, 40 adults and 20 fledglings; August 28, 41 adults and 28 fledglings; September 1, 36 adults and 21 fledglings; September 8, 3 adults and 3 fledglings; September 17, 0. Unfortunately, the terns were harrassed and were regularly kept on the move in the area by cars, motorcycles, clam diggers and especially dogs. This site is one of only two local beach areas where dogs are permitted off leash.

The floodway between this roost area and Interstate 5 was used regularly by small numbers of terns for feeding.

Inland

A survey was made of inland water areas for least tern activity. In north San Diego County, Windmill Lake, Whelan Lake, Guajome Lake, Lake Val Sereno, San Dieguito Reservoir and Lake San Marcos were visited 3 times each between July 23 and September 8. These lakes are 6.4 to 10 km (4 to 6.5 mi.) from the coast. Least terns were seen at Val Sereno (1 adult fishing on July 23), Whelan Lake (1 adult, 1 fledgling roosting, July 30), and the Water Pollution Control Facility next to Windmill Lake (1 adult feeding, August 10). Alice Fries visited Guajome Lake 3 times between May 1 and July 19 and Libby Lake on August 14, 1977, and saw no birds. In the 10 years prior to 1975, she had seen least terns regularly at Guajome Lake in June. A sample of her sightings includes: June 28, 1971, 10 adults; June 10, 1968, 22 adults; June 21, 1965, 12 adults. She also saw 15 adults feeding at Lake Val Sereno on September 8, 1972 and reports that there were between 15 and 40 there all

season in 1975. I also checked Lower and Upper Otay Lakes on August 18 and Santee Lakes on August 20, 1977, and found no least terns. Two adults had been observed feeding at Santee Lakes on March 3, 1972 (J. Rieger).

In June of this year small flocks of up to 20 birds regularly were seen feeding and roosting on the kelp in kelp beds offshore from the San Onofre Nuclear Power Plant. On August 12, I saw 5 adults fishing as they were flying north along the coast at the mouth of nearby San Mateo Creek.

ACKNOWLEDGMENTS

Alice Fries gave generously of her time and knowledge and was particularly helpful in keeping track of tern activity in the north county. Larry Ford watched over San Elijo and organized the clearing of the island there. Mike Evans, Jan Larson and John Rieger reported their sightings and I consulted Mike for his opinion on many issues. Leslie Becker helped with field observations, colony protection and typing. Jan Larson at North Island, "Doc" at the sludge ponds, Captain Butler and the personnel at NTC, John Tompkins and Ed Orlicki at the FAA, Rangers Paula Pennington and Terry Roeder at Border Field State Park and Tomas Firle of the Port District went out of their way in their concern for the least tern.

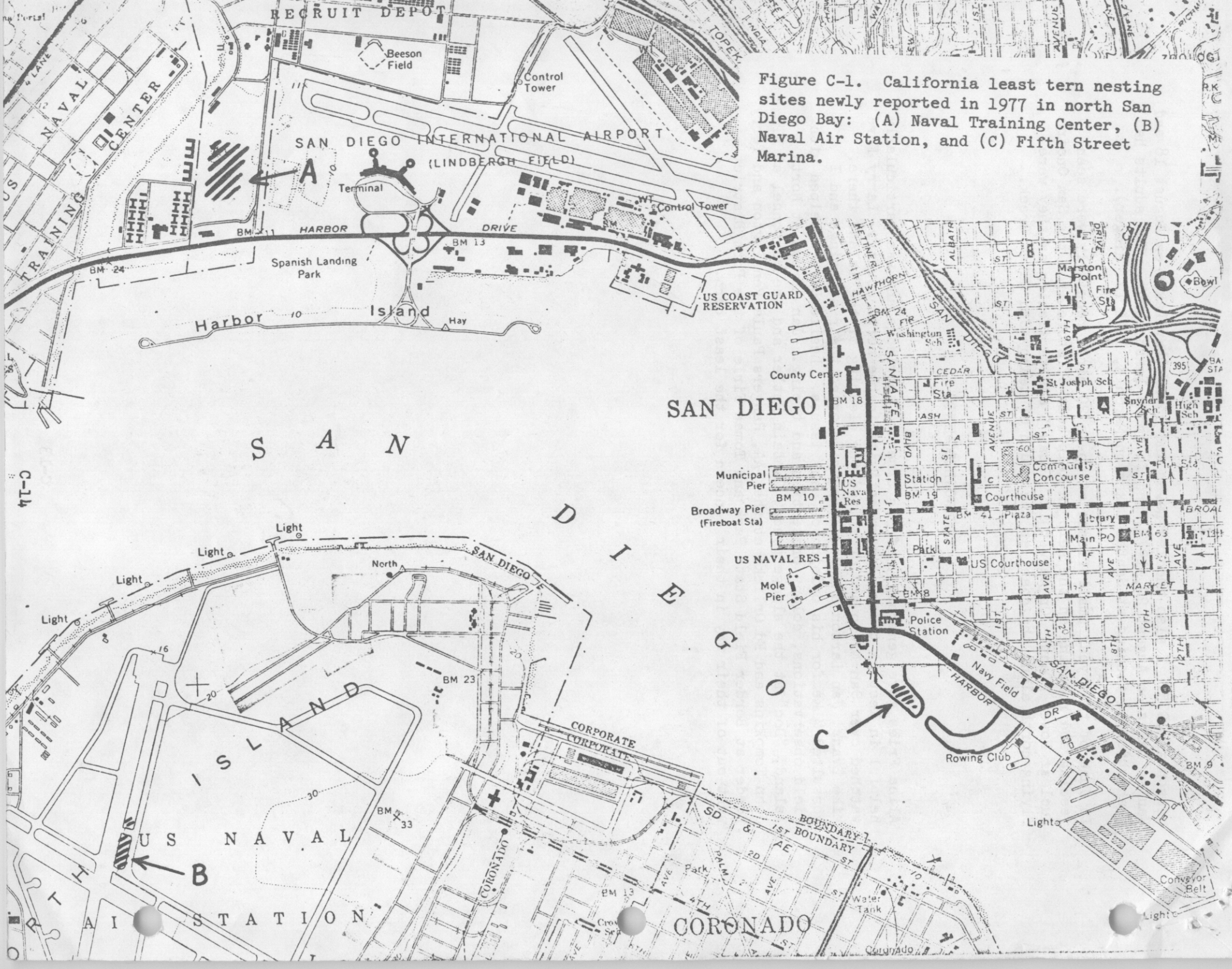

Figure C-1. California least tern nesting sites newly reported in 1977 in north San Diego Bay: (A) Naval Training Center, (B) Naval Air Station, and (C) Fifth Street Marina.