

**State of California
The Resources Agency
Department of Fish and Game
Wildlife Branch**

**California Least Tern Breeding Survey
2006 Season**

**by
Daniel A. Marschalek**

Nongame Wildlife Unit, 2007-01

Final Report

To

State of California
Department of Fish and Game
South Coast Region
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ABSTRACT

Monitoring to document breeding success of California least terns (*Sternula antillarum browni*) continued in 2006, with observers at 31 nesting sites providing data. An estimated 7006-7293 California least tern breeding pairs established 8173 nests and produced 2571-3644 fledglings at 45 documented locations. The fledgling to breeding pair ratio was 0.35-0.52. Statewide, 12,698 eggs were reported, with a site average of 1.57 eggs per nest (St Dev = 0.257) and an average clutch size of 1.62 eggs (St Dev = 0.494) for Type 1 sites. Numbers of nesting least terns were not uniformly distributed across all sites. Camp Pendleton, Naval Base Coronado, Los Angeles Harbor and Batiquitos Lagoon represented 58% of the breeding pairs while Camp Pendleton, Los Angeles Harbor, Bolsa Chica Ecological Reserve, Batiquitos Lagoon Ecological Reserve and Venice Beach produced 68% of the fledglings. Only two sites, Camp Pendleton and Los Angeles Harbor, produced 40% of the statewide fledgling total. Four large sites (Alameda Point, Camp Pendleton, Los Angeles Harbor and Batiquitos Lagoon) experienced levels of chick mortality greater than the state average. Weather and food shortage are suggested causes of the 22-55% chick death rate. The main predators of least tern chicks were American crows (*Corvus brachyrhynchos*), coyotes (*Canis latrans*) and gulls (*Larus* sp.) accounting for up to 334, 222 and 157 deaths, respectively. American crows and common ravens were reported from the most sites. The monitoring effort of 2006 is scheduled to continue in 2007.

¹ Marschalek, D.A. 2007. California least tern breeding survey, 2006 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2007-01. Sacramento, CA. 22 pp. + app.

INTRODUCTION

The California least tern (*Sternula antillarum browni*) is the subspecies of least terns nesting along the west coast of North America, from Baja California, Mexico, north to the San Francisco Bay area (USFWS 1980). Two other subspecies, Interior (*S. a. athalassos*) and Eastern (*S. a. antillarum*), are recognized in the United States (American Ornithologists' Union: AOU 1957), however, there is little genetic variation among the subspecies which questions the validity of this division (Whittier et al. 2006). A recent taxonomic change by the AOU (Banks et al. 2006) recently resurrected the genus *Sternula* for the least tern based on the work of Bridge et al. (2005).

California least terns establish nesting colonies on sandy soils with little vegetation along the ocean, lagoons, and bays. Their nests are shallow depressions lined with shells or other debris (Massey 1974, Cogswell 1977). Least terns are generally present at nesting areas between mid-April and late September (Massey 1974, Cogswell 1977, Patton 2002), often with two waves of nesting during this time period (Massey and Atwood 1981). This species was listed as endangered by the U.S. Secretary of the Interior in 1970 (USFWS 1973) and the California Fish and Game Commission in 1971 (CDFG 1976) due to a population decline resulting from loss of habitat (Craig 1971, Cogswell 1977).

The endangered status prompted wildlife agencies to initiate monitoring efforts to estimate the breeding population size of least terns in California. Craig (1971) conducted the initial surveys of breeding colonies in 1969 and 1970, focusing on site characteristics, including historical use and threats to each colony. In 1973, the first annual breeding survey was conducted (Bender 1974a), which changed the focus of the monitoring effort from an earlier descriptive emphasis to quantifying breeding numbers and nesting success for each breeding colony. Factors determining breeding success, such as predation and egg and chick abandonment, were recorded starting in 1975 (Massey 1975). From 1976 to 1978, research and new management techniques were initiated to develop a better understanding of least tern biology and increase breeding success. These techniques included banding to study local movements (Jurek 1977), use of chick shelters (Jurek 1977), identifying key feeding areas (Atwood et al. 1977), and extensive use of decoys (Atwood et al. 1979). The first documented records of fledglings appeared in the 1977 annual survey report (Atwood et al. 1977). Massey (1989a) later conducted an analysis of fledgling survey techniques to determine a method that minimized sampling problems associated with the tendency of young to quickly leave the nesting area.

Since 1971, the frequency of monitoring at breeding colonies increased from one to three visits per year to more than one visit per week. However, wide variation exists among sites and years. The observed statewide population increase of least terns in the 1970s and 1980s has been attributed to increased sampling and associated personnel effort rather than an actual increase in the number of California least terns (Atwood et al. 1977, USFWS 1980 Massey 1988). Additionally, USDA Wildlife Services (formerly Animal Damage Control) commenced predator management activities to benefit least terns in the 1980's. Their involvement resulted from monitors identifying predation of pre-flying young as the main factor of poor breeding success rather than reduced habitat and pair disturbance (Collins 1984). Obst and Johnston (1992) recommended that datasheets and fledgling counts be standardized across the state. This was

accomplished in 1993 when all site monitors were provided with the same datasheets and instructions (Caffrey 1994, 1995a). Over the last decade, monitors continued to provide comparable data of California least tern breeding success and these data were compiled into annual summary reports. These latest monitoring efforts were continued for the 2006 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2005 or who planned monitoring activities for 2006 were provided datasheets prior to the arrival of adult terns (Appendix A). These forms were identical to those used in 2005 to continue standardized data collection for the entire state. Forms and instructions to report final breeding data were provided at the same time so monitors could collect and prepare data requested for the annual report. General updates from each site were compiled about every two weeks throughout the breeding season and distributed to California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service (USFWS) representatives so that any potential problems could be dealt with quickly.

Site Preparation

Information about each nesting site was requested to determine the level of protection provided to the birds. If a site had more than one discrete cluster of nests, the monitor had the option of reporting information for each sub-colony or the site as a whole. Use of shelters to protect chicks from predators and weather, decoys to attract adults, presence of interpretive signs to explain restricted access, and a grid system to assist in locating nests required a yes/no response. However, fence type and vegetation management were more variable. In an attempt to standardize and simplify these two variables, categories were created which were easily reported as a number.

Fence type was reported as one of four categories: (1) the fence deterred or excluded most people and mammalian predators (i.e. chain link or solid fence that fully encloses the site), (2) cantilevered and/or barbed wire at the top deterred cats and other climbing mammals, (3) the fence would not deter most mammalian predators (i.e. not fully fenced on all sides, or fenced only with posted signs and wire or twine), (4) no enclosure.

Vegetation management was reported as one of seven categories: (1) mechanically graded or dragged to remove vegetation, (2) manually removed, (3) herbicide (Roundup or Rodeo) use, (4) combination of 1, 2 or 3, (5) vegetation removed by other means, (6) no vegetation management occurred prior to the nesting season, but was needed in the opinion of the monitor, (7) vegetation management was not necessary.

Monitoring

Sampling Type and Intensity

Each site was categorized as Type 1, 2 or 3 based on the level of sampling intensity employed. At a Type 1 site, monitors entered the colony to mark nests and record the number of

eggs; a Type 2 nesting site was monitored from outside the colony. A Type 3 site was monitored primarily from outside the colony, but sampling within the colony occurred more frequently than once per month or more than 5 times during the season when nests are active or chicks are present. Type 1 sites yield more data, such as clutch size, hatching success, and evidence of predation. This type of monitoring allows more quantitative comparisons to be made among sites and years. Type 2 monitoring, however, minimizes disturbance to the nesting colony, possibly offering better conditions for behavior studies (Keane 1998, 2000, 2001).

Information regarding other monitoring techniques was requested as well. This included whether nests were marked (generally with a tongue depressor or wooden stake), eggs marked (numbering the shell) or birds banded. When color-banding studies were conducted, the band color was requested (Table 1).

Table 1. Color combinations of current and past California least tern banding studies conducted at breeding areas in California.

Site Name	Color Combination	Abbreviation
Oceano Dunes SVRA	Green/Yellow, Yellow/Green	G/Y, Y/G
MCB Camp Pendleton	Mauve (Violet)/Black	M/K
Batiquitos Lagoon Ecological Reserve	Red/White	R/W
Mariner's Point	Blue/Green	B/G
NIMAT	Aqua (light blue)/Orange	A/O
NI 1-1	Black/Aqua (Light Blue)	K/A
Naval Amphibious Base Ocean	Blue/Pink, Red/Blue	B/P, R/B
Delta Beach North	Yellow/Red	Y/R
Delta Beach South	White/Black	W/K
2005 Captive*	Anodized Red	-
2004 Captive*	Anodized Red	-
2003 Captive*	Anodized Green	-
2002 Captive*	Anodized Blue	-

* "captive" refers to rehabilitated birds (Project Wildlife) released to the wild (no releases in 2006)

Sampling intensity was reported as the total number of visits to a site and dates of first and last visits. Optional data included monthly averages of visits per week, number of hours per visit (total, within colony and within colony in blind) and number of monitors per visit.

Pair Estimation

Three different calculations (Methods I, II, III) were used to determine the total number of breeding pairs at any one site. Adjustments to the total number of nests was required to estimate breeding pair totals due to pairs renesting after a failed attempt and young adults nesting later in the year (Massey and Atwood 1981).

Method I assumes the total number of breeding pairs renesting is equal to half of the number of nests in the second wave, with the second wave defined as all nests initiated after 14 June. If there is a time period with an obvious lull in nest initiation, dates of nest initiation dictate the start of the second wave. Total breeding pairs of a site is calculated by adding the number of nests of the first wave (prior to 15 June) to half of the nests in the second wave.

$$\text{Total Pairs} = \# \text{ nests prior to 15 June} + [(\# \text{ nests 15 June or after}) / 2]$$

Method II calculates the total number of breeding pairs by subtracting the total number of nests and broods lost prior to 20 June from the total number of nests. This method assumes that renesting will not occur from a nest or brood lost after 20 June and the number of nests and broods lost before this date are equal to the number of pairs renesting at that same site.

$$\text{Total Pairs} = \text{total nests} - (\# \text{ unsuccessful nests prior 20 June} + \# \text{ broods lost prior 20 June})$$

Method III is much more subjective, relying on the monitor to estimate of the number of renesting pairs in the first and second wave. This calculation subtracts the estimated number of renesting pairs for each wave from the total nests during each wave. The totals for waves one and two are then added to estimate the total number of breeding pairs. Adult banding can reduce the subjectivity of Method III by allowing the monitor to observe renesting pairs.

$$\text{pairs first wave} = \# \text{ nests prior to 15 June} - \text{estimated renesters prior to 15 June}$$

$$\text{pairs second wave} = \# \text{ nests 15 June or after} - \text{estimated renesters 15 June or after}$$

$$\text{Total Pairs} = \text{pairs first wave} + \text{pairs second wave}$$

Productivity

Productivity was measured by counting the number of nests, eggs, eggs hatched, hatching success and total fledglings at each site. Dates of first chick and fledgling were also typically recorded. These data will not be available for Type 2 or 3 sites simply because monitors cannot easily observe eggs and nests from a distance. "Window surveys" of active nests, fledglings, and adults were conducted at two-week intervals throughout the breeding season for statewide comparison.

The mean clutch size was calculated by dividing the total number of eggs by the total number of nests for each site, then averaging site values. To reduce the influence of sites with only a couple nests of small or large clutch sized, only the sites totaling more than 50 eggs are included. Sites were treated as independent samples in this calculation. Clutch size was also calculated by using data from sites that reported clutch sizes of every nest detected. In those cases, each nest was treated as an independent sample. Only Type 1 sites were used for clutch size calculations because the data from Type 2 and 3 sites was not reliable.

Accurate fledgling counts are problematic as fledglings quickly move from their nesting areas (Massey 1989a). At least four specific techniques may be used and are reported as an

abbreviation: (R) based on band recapture data, (3WD) based on daytime counts of fledglings added up every 3 weeks beginning 2-3 weeks after the first fledgling observation, (3WN) based on dusk counts of fledglings added up every 3 weeks beginning 2-3 weeks after the first fledgling observation, and (other) description of alternate method.

Mortality and Predation

Identifying causes of mortality was of particular importance since it has been identified as the main cause of low reproductive success for this species (Collins 1984). Numbers of lost nests and individuals of each age class (egg, chick, fledgling and adult) were recorded. Causes of mortality were further separated into either non-predation events or predation. Non-predation causes of death included abandonment, flooding and human damage.

Predators were characterized as either “potential,” “possible,” “suspected” and/or “documented.” *Potential* predators were classified as species known to feed on least terns and observed on or near the site without the loss of terns. If predation of terns occurred and a potential predator was known to be on or near the site through direct observation or other signs (track, scat, etc.), the animal was considered a *possible* predator. A *suspected* predator was reported when loss of least terns directly corresponded to the presence of a predator. These three predator classifications rely on the expertise of the monitors. *Documented* predators required a direct observation of a predator killing a least tern or substantial evidence to indicate responsibility. This evidence could be characteristic feeding patterns or tracks leading to a carcass or shell remains.

Both preventive and reactive predator management techniques were used to reduce the loss of least terns. Select predators were often removed from the site or adjacent areas just prior to the terns arriving in the spring. When predation was documented, the predator was removed using appropriate capture techniques. Sensitive and protected species were either trapped and released at off-site locations or were left on site and monitored.

RESULTS and DISCUSSION

Site Preparation

Managers at most sites (Figure 1) implemented a variety of techniques to control vegetation, generally using mechanical and chemical methods together. Fences to protect nesting sites were extremely variable, ranging from no fence to a chain link fence completely enclosing the site. While the majority of sites used chick shelters, few used decoys. Site specific and complete site preparation data are provided in Appendix B-1.

Monitoring

Twenty-three of 31 sites monitored in 2006 were Type I sites, the majority monitored at least one or two times per week. A grid system to assist in locating nests was not used at every site but almost every monitor marked nests in some fashion. Site-specific and complete monitoring data are located in Appendix B-2.

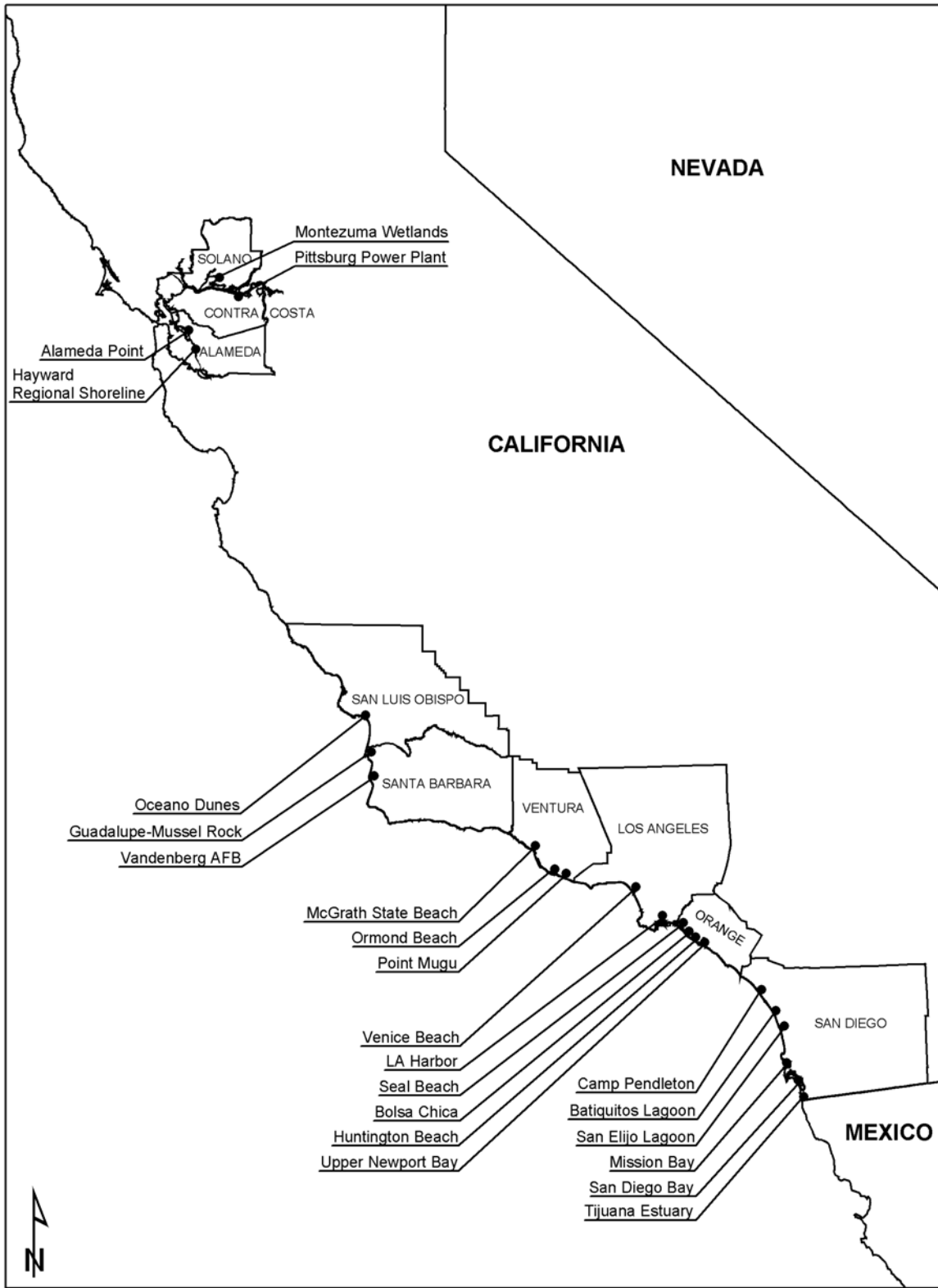


Figure 1. California sites monitored for California least tern nesting in 2006. Some listed areas include multiple sites, sites with nesting at more than one location, or both.

Productivity

At least partial data were received and analyzed for all monitored least tern nesting areas in California for 2006. An estimated 7006-7293 California least tern breeding pairs established 8173 nests and produced 2571-3644 fledglings at 45 documented locations (Table 2). The fledgling to breeding pair ratio was 0.35 to 0.52 fledglings per pair. Statewide, 12,698 eggs were reported, with mean clutch size of each site averaging 1.57 eggs per nest (St Dev = 0.257) and a statewide clutch size of 1.62 eggs (St Dev = 0.494).

The 2006 California least tern nesting season lasted approximately five months. The first recorded least tern at a nesting site was on 6 April at Venice Beach and the last observed on 16 September at Tijuana Estuary NERR. The first nest was detected on 8 May at Alameda Point, and the first chick and fledgling at Seal Beach on 31 May and 21 June, respectively. Least terns did not nest at three sites used in 2005 (Pittsburg Power Plant, Guadalupe-Mussel Rock and San Elijo Lagoon Ecological Reserve), however, they nested at four sites not used last year (Montezuma Wetlands, Coal Oil Point Reserve, North Fiesta Island and Stony Point). The previous three sites that did not experience nesting in 2006 had a total of nine nests in 2005, and the four sites used in 2006 and not in 2005 had 158 nests. For at least a third consecutive year, a second nesting wave was not documented at most sites (Marschalek 2005, 2006). Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

The 2006 recorded minimum breeding pairs in 2006 was 2% higher than the 6865 total in 2005 (Marschalek 2006). This represents the highest count recorded for California (Figure 2) (Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood et al. 1977; Jurek 1977; Atwood et al. 1979; Collins 1984, 1986 and 1987; Gustafson 1986; Johnston and Obst 1992; Obst and Johnston 1992; Caffrey 1993, 1994, 1995b, 1997, 1998; Keane 1998, 2000, 2001; Patton 2002, 2004 unpubl. Table, Marschalek 2005, 2006). Nest initiation for most sites started later than usual, which results in an underestimation when calculating the number of breeding pairs using any of the three traditional estimates. For this reason, any technique monitors determined to be most representative of the actual number of breeding pairs was used as the estimate. Fledgling numbers increased 49% from 2005 (Marschalek 2006), representing the greatest production since 2000 and the third highest total recorded.

The majority of breeding pairs nested in San Diego County (4232 pairs, 60.4%) and the fewest in San Luis Obispo and Santa Barbara Counties (38 pairs, 0.5%) (Table 3). Breeding pairs were not a predictor for fledgling numbers, however. The fledgling-to-pair ratio ranged from a low of 0.260 in San Diego County to a high of 1.132 in San Luis Obispo and Santa Barbara Counties.

As in the past, the number of breeding pairs generally corresponds more closely to the number of nests, eggs and chicks than the number of fledglings (Table 4). Camp Pendleton had the highest number of breeding pairs, nests, eggs, chicks and fledglings in the state in 2006. For a second consecutive year Bolsa Chica Ecological Reserve had a minimum fledgling-to-pair ratio greater than one (1.30). Coal Point Oil Reserve (1.40) and Oceano Dunes SVRA (1.16) also had a ratio greater than one.

Table 2. California least tern productivity in 2006.

2006 Site	Estimated Number of Breeding Pairs		Number of Nests	Estimated Number of Fledglings		Fledgling per Pair Ratio	
	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum
San Francisco Bay Area							
Montezuma Wetlands	17	42	17	28	53	0.67	3.12
Pittsburg Power Plant	0	0	0	0	0	0.00	0.00
Alameda Point	409	409	441	9	130	0.02	0.32
Hayward Regional Shoreline	15	15	15	4	13	0.27	0.87
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	31	31	38	36	36	1.16	1.16
Guadalupe-Mussel Rock	0	0	0	0	0	0.00	0.00
Vandenberg AFB	2	2	2	0	0	0.00	0.00
Coal Oil Point Reserve	5	5	5	7	7	1.40	1.40
Ventura County							
Santa Clara River/McGrath State Beach							
Ormond Beach	52	52	53	44	44	0.85	0.85
Pt Mugu- Totals	352	397	470	106	496	0.27	1.41
Holiday Beach	34	43	45	8	56	0.19	1.65
Ormond Beach East	292	324	389	88	430	0.27	1.47
Eastern Arm	26	30	36	10	10	0.33	0.38
Los Angeles/Orange Counties							
Venice Beach	276	328	384	208	325	0.63	1.18
LA Harbor	835	835	907	511	771	0.61	0.92
Seal Beach NWR - Anaheim Bay	165	176	186	108	108	0.61	0.65
Bolsa Chica Ecological Reserve	175	211	222	275	290	1.30	1.66
Huntington State Beach	420	491	512	131	162	0.27	0.39
Upper Newport Bay Ecological Reserve	20	36	46	2	2	0.06	0.10
San Diego County							
MCB Camp Pendleton- Totals	1423	1423	1540	520	520	0.37	0.37
Red Beach	21	21	27	16	16	0.76	0.76
White Beach	137	137	147	30	30	0.22	0.22
Santa Margarita River - North Beach North	275	275	301	35	35	0.13	0.13
Santa Margarita River - North Beach South	891	891	951	430	430	0.48	0.48
Santa Margarita River - Saltflats	56	56	66	7	7	0.13	0.13
Santa Margarita River - Saltflats Island	43	43	48	2	2	0.05	0.05
Batiquitos Lagoon Ecological Reserve- Totals	601	601	627	223	270	0.37	0.45
W1	35	35	36	25	29	0.71	0.83
W2	399	399	409	158	193	0.40	0.48
E1	145	145	160	38	46	0.26	0.32
E2	0	0	0	0	0	0.00	0.00
E3	22	22	22	2	2	0.09	0.09
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0.00	0.00
Mission Bay							
FAA Island	60	60	104	2	2	0.03	0.03
North Fiesta Island	24	24	30	4	6	0.17	0.25
Mariner's Point	70	70	120	0	0	0.00	0.00
Stony Point	130	130	136	10	20	0.08	0.15
San Diego River Mouth	10	10	14	0	0	0.00	0.00
San Diego Bay							
Lindbergh Field & Former Naval Training Center	114	114	131	54	65	0.47	0.57
USN- Totals	1356	1356	1605	206	206	0.15	0.15
NI MAT	170	170	180	35	35	0.21	0.21
Delta Beach North	201	201	223	42	42	0.21	0.21
Delta Beach South	141	141	155	25	25	0.18	0.18
NAB Ocean	844	844	1047	104	104	0.12	0.12
D Street Fill/Sweetwater Marsh NWR	88	94	100	18	29	0.19	0.33
Chula Vista Wildlife Reserve	12	13	15	2	2	0.15	0.17
South San Diego Bay Unit, SDNWR - Saltworks	41	61	82	6	7	0.10	0.17
Tijuana Estuary NERR	303	307	371	57	80	0.19	0.26
Totals:	7006	7293	8173	2571	3644	0.35	0.52

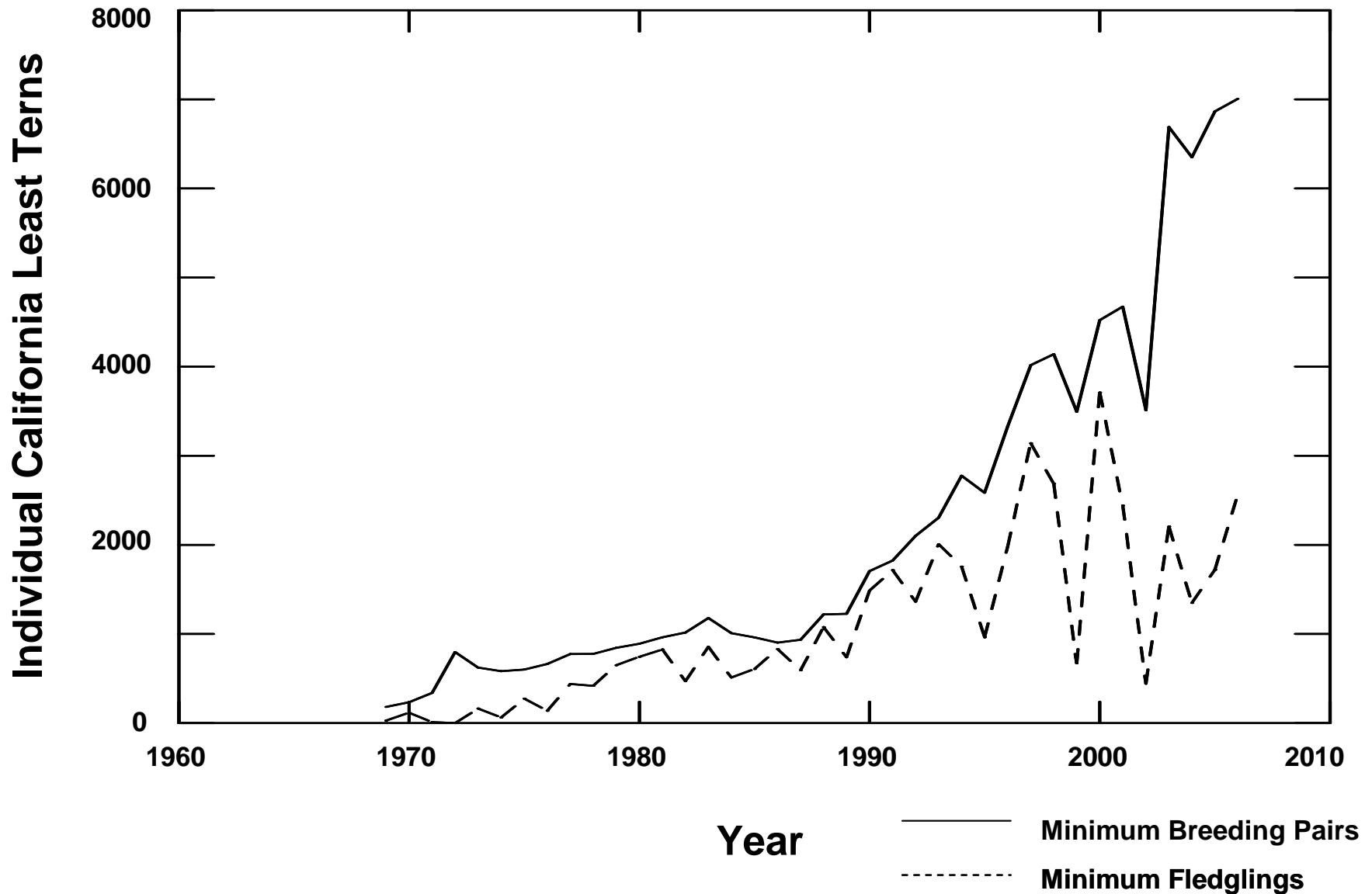


Figure 2. Number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1969-2006. (Data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al.* 1977; Jurek 1977; Atwood *et al.* 1979; Collins 1984, 1986 and 1987; Gustafson 1986; Johnston and Obst 1992; Obst and Johnston 1992; Caffrey 1993, 1994, 1995b, 1997, 1998; Keane 1998, 2000, 2001; Patton 2002, 2004 unpubl. Table; Marschalek 2005, 2006).

Table 3. Regional productivity comparison, 2006.

Region	Breeding Pairs**	Proportion of Total	Fledglings**	Proportion of Total	Fledgling:Pair*
San Francisco Bay Area	441	0.063	41	0.016	0.093
San Luis Obispo/Santa Barbara Counties	38	0.005	43	0.017	1.132
Ventura County	404	0.058	150	0.058	0.371
Los Angeles/Orange County	1891	0.270	1235	0.480	0.653
San Diego County	4232	0.604	1102	0.429	0.260
Total	7006	1.000	2571	1.000	0.367

* This is not the minimum fledgling-to-breeding pair ratio since the maximum number of pairs is not used.

** Breeding pair and fledgling numbers represent the minimum number recorded if a site reported a range of abundance.

Table 4. Top five nesting sites with highest observed number of breeding pairs, nests, eggs, chicks and fledglings (actual number observed in parenthesis).

Breeding Pairs	Nests	Eggs	Chicks	Fledglings
Camp Pendleton (1423)	Camp Pendleton (1540)	Camp Pendleton (2435)	Camp Pendleton (1839)	Camp Pendleton (520)
Naval Base Coronado (1186)	Naval Base Coronado (1425)	Naval Base Coronado (2201)	Naval Base Coronado (1246)	LA Harbor (511)
LA Harbor (835)	LA Harbor (907)	LA Harbor (1494)	LA Harbor (1031)	Bolsa Chica (275)
Batiquitos (601)	Batiquitos (627)	Batiquitos (1027)	Batiquitos (752)	Batiquitos (223)
Huntington Beach (420)	Huntington Beach (512)	Pt Mugu (837)	Huntington Beach (559)	Venice Beach (208)

A few sites constituted the majority of breeding activity for the state in 2006, which is a trend observed in the past (Caffrey 1994, 1995, 1997, 1998; Marschalek 2005, 2006). Four sites (Camp Pendleton, Naval Base Coronado, Los Angeles Harbor, and Batiquitos Lagoon Ecological Reserve) had over 600 minimum breeding pairs, which represented 58% of the state total. Eggs and nests tend to show a linear relationship with number of breeding pairs, resulting in an uneven distribution of eggs and nests as well. Fledgling numbers were also unevenly distributed as the five sites with over 200 fledglings each (Camp Pendleton, Los Angeles Harbor, Bolsa Chica Ecological Reserve, Batiquitos Lagoon Ecological Reserve and Venice Beach) contributed 68% of the state's production. In fact, Camp Pendleton and Los Angeles Harbor contributed almost half (40%) of the fledglings.

Mortality and Predation

The 2006 chick mortality rate of 16% was lower than previous years when 28% of all chicks died in 2005 and 32% in 2004, (Marschalek 2005, 2006) (Table 5). The 2006 rate is closer to rates observed in 1998 and 1999 levels (Keane 2000, 2001). Despite the lower mortality statewide, several of the larger nesting colonies continued to experienced rates greater than the average. At Alameda Point, Camp Pendleton, Los Angeles Harbor and Batiquitos Lagoon Ecological Reserve, 55, 43, 25 and 22% of chicks were found dead, respectively. This represents the second consecutive year chick mortality rates increased for Alameda Point while rates at the other three sites were lower than in 2005. These four sites represented 87% of the total reported chick deaths, but only 39% of the total chicks hatched. Least tern mortality due to non-predation factors was greater than mortality due to predation in 2006.

Abandonment prior to the expected hatching date was the second highest death rate from non-predation events, leading to the loss of 675-1149 eggs (24-63%). Abandonment post-term or failure to hatch is often difficult to distinguish from pre-term abandonment and contributed only slightly lower rate to the non-predation mortality.

Table 5. Cause of mortality of least terns with associated counts for each life stage. Complete and site specific mortality data is located in Appendix B-5 (non-predation) and B-6 (predation).

	Eggs	Nests	Chicks	Fledglings	Adults
Non-predation*	1814-2762	1196-1246	1215+	97	33
Predation	974-975	637	261	22	62

* Santa Clara River, Lindbergh, D Street and Chula Vista not reported

It was very difficult to accurately determine the predator species involved in a tern predation event. These events were not typically observed and often little or no evidence remained at the site. The uncertainty of the exact predator species responsible for a depredation event often resulted in reporting a range of least terns lost to a particular species rather than an exact number.

Thirty-six species were reported as possible, suspected or documented predators of least terns (Table 6). The most commonly documented predators were American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), American kestrels (*Falco sparverius*) and coyotes (*Canis latrans*). As in past years, most recorded predators were avian species.

Predation led to the loss of about 974-975 eggs, 261 chicks, 22 fledglings and 62 adults (Table 5). To quantify mortality resulting from specific predators, the proportion of total least tern eggs, chicks, fledglings and adults depredated by a known predators was calculated (Table 7). When a range of individuals depredated by a species was reported, the average was used. Past analysis with minimum, average or maximum values resulted in only slight differences (Marschalek 2005). Monitors reported a greater number of least terns depredation than in 2005.

American crows were responsible for the greatest loss of least terns (148-334 total individuals, 20%) in 2006, with coyotes (212-222, 17%), gulls (*Larus* sp.) (147-157, 12%) and unknown avian species (137, 11%) also responsible for more than 10% of the total. Nests were excluded from this analysis since the number of eggs better represents the loss of individuals. Site-specific and complete mortality data are located in Appendix B-5 (non-predation) and B-6 (predation).

Table 6. Reported species documented or thought to have depredated least terns. Number of sub-colonies each species was reported from in parenthesis.

Species	Species	Species
Great blue heron (4-9)	Great-horned owl (5-7)	Gray fox (1-6)
Great egret (2)	Burrowing owl (3-8)	Coyote (10-12)
Black-crowned night heron (2-7)	Owls (3)	Domestic dog (2-7)
Gulls (6-8)	American crow (8-13)	Mountain lion (1-6)
Gull-billed tern (1-4)	Common raven (7-12)	Domestic cat (2-7)
Black skimmer (1)	Corvids (3)	California ground squirrel (2-7)
Northern harrier (3)	Loggerhead shrike (3)	Deer mouse (3)
White-tailed kite (1-6)	European starling (1-6)	Rats (3-8)
Cooper's hawk (1-6)	Western meadowlark (1-6)	Unknown mammal (1-3)
Red-tailed hawk (3-8)	Unknown avian (4-6)	Snakes (2-10)
American kestrel (9-11)	Opossum (3-8)	Ants (4)
Peregrine falcon (4-6)	Raccoon (5-10)	Unknown (4)
Barn owl (3)	Striped skunk (1)	

Table 7. Species responsible for greatest proportion of depredated least tern eggs, chicks, fledglings or adults.

Species	Proportion of Least Tern Individuals Depredated*
American Crow	0.1965
Coyote	0.1682
Gull	0.1178
Unknown avian species	0.1062
American kestrel	0.0872
Common raven	0.0872
Rat	0.0671
Burrowing owl	0.0345
Unknown	0.0287
Great horned owl	0.0140

*Based on average of the range reported for least terns depredated by each species.

Predation by coyotes and American crows in past years was a major problem (Keane 2001, Patton 2002, Marschalek 2005, 2006) and continued to be a problem in 2006. Gulls also depredated a large number of least terns, mainly eggs. Predation from these three species comprised 48% of the documented predator mortality. Abandonment is not included in depredation data but can be driven by a predator.

High levels of chick mortality attributed to food shortages have also been observed in past years (Caffrey 1993, Marschalek 2005, 2006). A few monitors suggested that fish of inappropriate size could be the cause of chick mortality in 2006. Others observed a satisfactory food supply. It is likely the food supply was better in 2006 than previous years due to the lower chick mortality rate.

Summary by Site

Management and monitoring of California least terns requires a site-by-site perspective. This can be dictated by the biology or geography of the area or the specific nesting area, or by human related issues. This section includes detailed site-specific information that is of particular importance for management.

San Francisco Bay Area

Montezuma Wetlands

A nesting site was discovered on 11 July adjacent to Montezuma Slough. On this date, a maximum of 110 least terns, including over 20 juveniles of various sizes, were observed. Least tern nesting in this area had not been documented in recent years and it has been suggested that these birds may represent the nesting population which previously used Pittsburg Power Plant.

Pittsburg Power Plant

Least terns did not nest at the Pittsburg Power Plant site for the second consecutive year, following 21 consecutive years of nesting.

Alameda Point

At the Alameda Point site, 409 breeding pairs established 441 nests and produced 9-130 fledglings. For the third consecutive year, chick mortality was high. The cause of the high mortality rate (55%) is likely unusually hot weather or unsuitable fish size. There was also increased avian predator pressure from barn (*Tyto alba*), burrowing (*Athene cunicularia*) and great horned (*Bubo virginianus*) owls, red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*) and common ravens.

Hayward Regional Shoreline

Hayward Regional Shoreline experienced the second consecutive year of least tern nesting activity and the first production of fledglings. In 2006, 15 breeding pairs established 15 nests and produced four fledglings. It appears most terns deserted the island after gulls visited the site. It is possible that least terns from the Alameda Point site are using this site as well.

San Luis Obispo/Santa Barbara Counties
Oceano Dunes SVRA

The Oceano Dunes State Vehicular Recreational Area (SVRA) site had 31 breeding pairs, 38 nests and produced 36 fledglings. Least terns were observed roosting during the evening in the historic night roost area of the park, within a large seasonal enclosure, as well as near the Arroyo Grande Creek mouth area.

Guadalupe-Mussel Rock

No nests were established at Guadalupe-Mussel Rock in 2006. Only one pair was observed courting and creating scrapes. Decoys or fencing may be used in the future to attract least terns.

Vandenberg AFB

Two breeding pairs established two nests and did not produce fledglings. An unknown owl species (Strigidae, Tytonidae) was documented killing three adults.

Coal Oil Point Reserve

For the second time in three years, least terns nested at Coal Oil Point Reserve. Five breeding pairs established five nests and produced seven fledglings.

Ventura County

Santa Clara River/McGrath State Beach

About 64 adult least terns were observed at the Santa Clara River site, but number of breeding pairs, nests and fledglings were not reported. Up to five pairs, including one copulating pair, were observed upriver near Saticoy. Nesting was never confirmed at this location.

Ormond Beach

At Ormond Beach, 52 breeding pairs established 53 nests and produced 44 fledglings. Paraglider and ultralight aircraft, which was a possible reason for nest abandonment in the past, were restricted from this area in 2006.

NAS Point Mugu

Point Mugu had a total of 352-397 breeding pairs, 470 nests and 106-496 fledglings. This represents the greatest number of fledglings recorded at Point Mugu. Ormond Beach East had the highest number of pairs, nests and fledglings of the three sub-colonies. Coyote predation had less of an impact compared to 2004 and 2005.

Los Angeles/Orange Counties
Venice Beach

The fenced nesting area at Venice Beach was expanded from 4.4 to 7.7 acres prior to the 2006 breeding season. Venice Beach had 276-328 breeding pairs, 384 nests and 208-325 fledglings. This represents the first time in three years that all eggs were not depredated. The increased number of adults in 2006, expansion of the enclosure and predator control contributed to better protection of the site from predators such as American crows (Foothill Associates 2006). In fact, nests closer to the center of the enclosure had a lower rate of depredation.

Los Angeles Harbor

The Los Angeles Harbor site had 835 breeding pairs, 907 nests and 511-771 fledglings. The high chick mortality rate (25%) was still above the statewide average, but much lower compared to 40% of chicks dying in 2005. Abandonment was the leading cause of mortality, with 434 eggs abandoned.

Seal Beach NWR

At Seal Beach NWR, 165-176 breeding pairs established 186 nests and produced 108 fledglings. Mortality due to predation or other factors appeared to be minimal, but 78 eggs had unknown outcomes. Monitors used a method based on the growth rate of least terns to calculate fledgling numbers. Chicks that reached fledgling size or would have prior to the next visit, and most likely left the site, were counted. Fledglings are individuals with a weight of over 30 grams and wing exceeding 80 millimeters.

Bolsa Chica Ecological Reserve

At Bolsa Chica Ecological Reserve, 175-211 breeding pairs established 222 nests and produced 275-290 fledglings. Predation and other mortality factors were relatively minor, with California ground squirrels (*Citellus beecheyi*) as the only documented predator. Bolsa Chica had the highest per capita production in the state for a second consecutive year, ranging from 1.30 to 1.66 fledglings per pair.

A major restoration project at Bolsa Chica Ecological Reserve was completed by restoring tidal flow on 24 August. Three potential nesting sites were created prior to the 2006 nesting season and one was used for nesting by least terns this year. The reintroduction of tidal flow is likely to provide food in close proximity to the other two nesting sites in 2007, possibly encouraging nesting at these locations.

Huntington State Beach

At Huntington State Beach, 420-491 breeding pairs established 512 nests and produced 131-162 fledglings. On 26 July at Kraemer Basin, in Anaheim, 38 least terns (approximately 24 adults and 14 juveniles, all able to fly), were observed but not believed to have nested at the location.

Upper Newport Bay Ecological Reserve

At Upper Newport Bay Ecological Reserve, 20-36 breeding pairs established 46 nests and two fledglings. Predation by coyotes or corvids (*Corvus* sp.) appears to be the cause of poor fledgling production.

San Diego County *MCB Camp Pendleton*

At Camp Pendleton, a total of 1423 breeding pairs established 1540 nests and produced 520 fledglings, the highest number of breeding pairs, nests and fledglings of any site within the state for 2006. As in 2004 and 2005, the Santa Margarita River North Beach sites (North and South) had the majority of the least tern nesting and production, representing 82% of the pairs and 92% of the fledglings at Camp Pendleton. High chick mortality resulted in the death of 420 chicks (43%) in 2006, down from 49% in 2005 and 57% in 2004.

Batiquitos Lagoon Ecological Reserve

At Batiquitos Lagoon Ecological Reserve, 601 breeding pairs established 627 nests and produced 223-270 fledglings. Chick mortality included 189 chicks (22%) and was lower than 2005 (45%), resulting in an increase of fledging production. Predation appeared to be relatively low but higher in 2006, with documented predation of 45 eggs, one chick, two fledglings and one adult.

San Elijo Lagoon Ecological Reserve

There was no nesting activity at San Elijo Lagoon Ecological Reserve in 2006.

Mission Bay - FAA Island

At FAA Island, 60 breeding pairs established 104 nests and produce two fledglings. The number of breeding pairs and nests represented a large increase from 2005 but still about a third of the totals from 2004. For a second year, predation by gulls resulted in low fledgling production. Corvids and rats (*Neotoma* sp., *Rattus* sp.) were also suspected predators.

- North Fiesta Island

The North Fiesta Island site had 24 breeding pairs establish 30 nests and produce 4-6 fledglings. This follows no nesting in 2005. American kestrels and common ravens are documented predators that were problematic once chicks appeared.

- Mariner's Point

At Mariner's Point, 70 breeding pairs established 120 nests and produced no fledglings. All nests were depredated by American crows, common ravens and rats.

- Stony Point

A new nesting colony of over 100 adults was discovered on 22 June, with 85 nests and 9 chicks already present. At Stony Point, a total of 130 breeding pairs established 136 nests and produced 10-20 fledglings. It is unclear why so few fledglings were produced. Chicks were difficult to detect due to the amount of vegetation and there were no signs of predation, but common ravens were observed in the area.

Least tern nesting at this southwestern section of Fiesta Island was first mentioned in the annual reports in 1971 (Craig 1971). The most recent recorded nesting occurred in 1976, when the habitat was sludge beds (Jurek 1977; map in Bender 1974b). Since this time, the habitat has been converted to sand and the area was fenced by 1985 (Copper and Patton 1985). Several names have been given to this specific location in the past including Stoney Point (Obst and Johnston 1992), South Fiesta Island (Bender 1974a and 1974b) and Mission Bay Site #2 (Craig 1971).

- San Diego River Mouth (S)

The San Diego River Mouth (S) site had 10 breeding pairs, 14 nests, and no fledglings. This is the third year of documented nesting of least terns on the south shore of the San Diego River near the Pacific Ocean, and the first of the three years that fledglings were not produced. All nests were depredated by American crows and common ravens.

San Diego Bay

- Lindbergh Field

At Lindbergh Field, 114 breeding pairs established 131 nests and produced 54-65 fledglings.

- NAS North Island

At North Island, 170 breeding pairs established 180 nests and produced 35 fledglings.

-Naval Base Coronado

Naval Base Coronado had 1186 breeding pairs, 1425 nests and 171 fledglings with most of the production at the Naval Amphibious Base Ocean sub-colony. South Delta Beach had the fewest numbers of the three sub-colonies.

- D Street Fill/Sweetwater Marsh NWR

At D Street, 88-94 breeding pairs established 100 nests and produced 18-29 fledglings.

- Chula Vista Wildlife Reserve

Chula Vista NWR had 12-13 breeding pairs, 15 nests and two fledglings.

- South San Diego Bay Unit, SDNWR - Saltworks

At Saltworks NWR, 41-61 breeding pairs established 82 nests and produced 6-7 fledglings.

Tijuana Estuary NERR

At Tijuana Estuary, 303-307 breeding pairs established 371 nests and produced 57-80 fledglings.

California least terns experienced one of the most successful breeding seasons recorded in 2006. Monitors reported the greatest number of breeding pairs for the second consecutive year and fledgling counts represented the third highest on record. The reduction in chick mortality from 2005 appears to be the main factor in the increased fledgling production. Predation from American crows and coyotes continued to be an issue in 2006.

The U.S. Fish and Wildlife Service recently completed a five-year review of the California least tern, recommending the status of the subspecies be downlisted to threatened (USFWS 2006). The current recovery plan (USFWS 1980) was determined to be outdated since it does not include recent research concerning the biology or ecology of the subspecies. For this reason, updating the previous downlisting or delisting criteria was recommended. The recent reassessment also determined the subspecies has a low potential for recovery as there is little opportunity for expansion of nesting colonies. For this reason, management and monitoring at current nesting sites is important. Ultimately, restoration of habitats and natural processes will be required for delisting of the California least tern.

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Appendix A

Data Sheets

General Data Sheet

Page 1

Location:				Date:		Job:		Observer(s):			
Time start:				Time stop:				On site:			
Est/Measured	Time:		Temp:	Wind Spd/Dir:		Cloud cvr (%):		Precip. (Y/N):		Tide: H L In Out	
ADULTS	Total:			NESTS	Total:			New:			
CHICKS	Observed:			Est max:		New Chicks:		Fledglings Obs:		Est max:	
Mortality (Y/N):	Adult:		Fledgling:		Chick:		Egg:		Nest:		
Predation (Y/N):	Adult:		Fledgling:		Chick:		Egg:		Nest:		
Take (Y/N):	Adult:		Fledgling:		Chick:		Egg:		Nest:		
Col Live (Y/N):	Adult:		Fledgling:		Chick:		Egg:		Other:		
Col Dead (Y/N):	Adult:		Fledgling:		Chick:		Egg:		Fish:		Other:
Nest No.	Grid No.	New/ Incub.	Status	Nest No.	Grid No.	New/ Incub.	Status	Nest No.	Grid No.	New/ Incub.	Status
1				31				61			
2				32				62			
3				33				63			
4				34				64			
5				35				65			
6				36				66			
7				37				67			
8				38				68			
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27				57				87			
28				58				88			
29				59				89			
30				60				90			

Egg/Nest Codes: E=egg, CH=chick, NC=New Chick, H=hatched and no longer present, PH=probable hatch, FH=failed to hatch, A=abandoned
 P=Preyed on, DAM=damaged, F=flooded, B=buried, Col=collected, M=moved, Unk=unkown. Circle Nest Number if new or if status has changed.

Multi-visit Form

Species:				LOCATION							
Date 1		Date 2		Date 3			Date 4				
Observers:		Observers:		Observers:			Observers:				
Date 5		Date 6		Date 7			Date 8				
Observers:		Observers:		Observers:			Observers:				
Date 9		Date 10		Date 11							
Observers:		Observers:		Observers:							
Nest	Found	Grid	Prior	Date 1	Date 2	Date 3	Date 4	Date 5	Date 6	Date 7	Band Number
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41											
Nest	Found	Grid	Prior	Date 1	Date 2	Date 3	Date 4	Date 5	Date 6	Date 7	Band Number

Appendix B
Site Specific Data

Appendix B-1: Site Preparation (continued).

Site name:	Sub-colony names (if any):	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Other site preparation:	By whom:
Ventura County											
Santa Clara River/McGrath State Beach			Don Davis								
Ormond Beach		Reed Smith	Carly Gocal, Cynthia Hartley	Plastic 2X4" Mesh	Yes	No	No	No			Fence by The Nature Conservancy
NAWS PT Mugu	Eastern Arm	Martin Ruane	Carly Gocal, Nate Lang, Michele Kuter, Amanda Wilhelm, Emilie Lang		3 Yes	No	No	No		4	Contracted Biologists
	Holiday Beach	Martin Ruane	Carly Gocal, Nate Lang, Michele Kuter, Amanda Wilhelm, Emilie Lang		4 Yes	No	No	No		4	Contracted Biologists
	Ormond East	Martin Ruane	Carly Gocal, Nate Lang, Michele Kuter, Amanda Wilhelm, Emilie Lang		4 Yes	Yes- 26	No	1/6 of colony gridded		4	Contracted Biologists

Appendix B-1: Site Preparation (continued).

Site name:	Sub-colony names (if any):	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Other site preparation:	By whom:
Los Angeles/Orange Counties											
Venice Beach, Marina del Rey, California		Thomas Ryan	Traci Caddy, Richard Montijo, Wally Ross, Lyann Comrack	6 ft chain link	Minimal on fence	Yes- tiles	Yes	Yes	yes, 20 x 40 m area cleared prior to nesting	New expanded fence installed in March 2006, expanding the site to 7.7 acres.	CDFG, volunteer monitors, biologist
LA HARBOR Pier 400		K Keane	W Ross, S Langdon, M Teutimez, M Amalong, B Schallmann, N Liberato, S Lopez, L Hays	chain link and chick	No	Yes	Yes	Yes	Yes		Los Angeles Harbor Department
Seal Beach NWR/Anaheim Bay		Charles T. Collins, Kirk Gilligan	J Fitch, M Taylor, P Collins, W Ross, R Schallmann	1- chain link	Yes	Yes- ~180 clay roof tiles	Yes- ~10	Yes		4 electric fence maintenance	USFWS/NWR and NWS Seal Beach
Bolsa Chica Ecological Reserve	South Tern Island, Nest Site 1, Tull Tidal	Peter Knapp	W Ross, J Fancher		2 Yes	Yes- 60 on S. Tern Island	No	Yes		2 None	Peter Knapp
Huntington State Beach		Randy Nagel	Cyndie Kam		2 Yes	Yes- 25	No	Yes		1 trash removal	David Pryor
Upper Newport Bay ER		Kathy Keane	Connie Bean	None	None	Yes	No	yes	Yes		CDFG

Appendix B-1: Site Preparation (continued).

Fence Type:

- 1- Fully enclosed site deterring most predators.
- 2- Fully enclosed site and cantilevered to deter climbing predators.
- 3- Incomplete, deterring few predators.
- 4- No fence/exclosure.

Legend

Vegetation Management

- 1- Mechanical Removal
- 2- Manual Removal
- 3- Herbicide
- 4- Combination of 1, 2 or 3
- 5- Other Means
- 6- Needed, but not conducted in 2004
- 7- None Needed

Appendix B-2: Monitoring.

Site name:	Site type:	Date of first monitoring visit:	Date of last monitoring visit:	Total number of monitoring visits:	Nest marking:	Egg marking:	Banding:	If color-banding, what color(s) were used:
San Francisco Bay Area								
Pittsburg Power Plant								
Alameda Point	1	13-Apr-06	15-Aug-06	83; 25 Type 1, 58 Type 2	Yes	No	No	N/A
Hayward Regional Shoreline	2	7-Jul-06	5-Aug-06	24	No	No	No	N/A
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	1	1-Mar-06	20-Sep-06	daily	Yes	No	Yes-chicks	Yellow over green on left leg, USFWS band on right leg with 1/2 colors for unique combos
Guadalupe-Mussel Rock								
Vandenberg AFB								
Purisima Point	3	15-Apr-01	17-Jul-06	113	Yes	No	No	
Beach 2	3	23-May-06	29-Jun-06	8	Yes	No	No	
Ventura County								
Santa Clara River/McGrath State Beach								
Ormond Beach	1	9-Apr-06	13-Sep-06	47	Yes	No	No	
NAWS Pt Mugu (Total)	1	23-May-06	22-Aug-06	56	Yes	No	No	
Ormond East	1	23-May-06	22-Aug-06	16	Yes	No	No	
Holiday Beach	1	23-May-06	22-Aug-06	21	Yes	No	No	
Eastern Arm	1	23-May-06	22-Aug-06	19	Yes	No	No	
Los Angeles/Orange Counties								
Venice Beach, Marina del Rey, California	1	6-Apr-06	6-Sep-06	20	Yes	No	No	N/A
LA HARBOR Pier 400	1		1-May-06	unknown	Yes	No	Yes	None
Seal Beach NWR/Anaheim Bay	1	10-May-06	26-Jul-06	13	Yes	No	Yes-chicks	None
Bolsa Chica Ecological Reserve	1	15-May-06	16-Aug-06	42+	Yes	No	No	N/A
Huntington State Beach	1	18-May-06	27-Jul-06	11	Yes	No	No	
Upper Newport Bay ER	1	12-May-06	17-Aug-06	35	Yes	No	No	

Appendix B-2: Monitoring (continued).

Site name:	Site type:	Date of first monitoring visit:	Date of last monitoring visit:	Total number of monitoring visits:	Nest marking:	Egg marking:	Banding:	If color-banding, what color(s) were used:
San Diego County								
Camp Pendleton								
Red Beach	1							
White Beach	1							
Santa Margarita River - North Beach North	1							
Santa Margarita River - North Beach South	1							
Santa Margarita River - Saltflats	1							
Santa Margarita River - Saltflats Island	1							
Batiquitos Lagoon Ecological Reserve								
W1	1	13-Apr-06	26-Aug-06	47	Yes	No	Yes	RW
W2	1	13-Apr-06	7-Sep-06	64	Yes	No	Yes	RW
E1	1	8-Apr-06	19-Aug-06	60	Yes	No	Yes	RW
E2	1	13-Apr-06	31-Aug-06	47	N/A	N/A	N/A	na
E3	1	13-Apr-06	31-Aug-06	23	Yes	No	Yes	RW
San Elijo Lagoon Ecological Reserve								
Mission Bay								
FAA	1	12-Apr-06	31-Jul-06	30	Yes	Yes	No	N/A
North Fiesta Island	1	19-Apr-06	7-Aug-06	24	Yes	Yes	Yes-chicks	
Mariner's Point	1	21-Apr-06	3-Aug-06	19	Yes	Yes	No	
Stony Point	1	23-Jun-06	24-Aug-06	15	Yes	Yes	Yes-chicks	Blue/green stripe
San Diego River Mouth	1	18-Apr-06	23-Jul-06	18	Yes	Yes	No	
San Diego Bay								
Lindbergh Field & Former Naval Training Center	1							
USN Totals	1							
NI MAT	1							
Delta Beach North	1							
Delta Beach South	1							
NAB Ocean	1							
D Street Fill/Sweetwater Marsh NWR	1							
Chula Vista Wildlife Reserve	1							
South San Diego Bay Unit, SDNWR -	1							
Tijuana Estuary NERR	1							

Appendix B-3: Pair Estimation (Method I).

Site name:	Date terns first observed:	Date terns last observed:	Date of first nest:	Date of last nest initiation:	Total nests prior to 15 June:	Total nests 15 June & later:	Total pairs:
San Francisco Bay Area							
Pittsburg Power Plant							0
Alameda Point	13-Apr-06	14-Aug-06	8-May-06	28-Jul-06	377	64	409
Hayward Regional Shoreline	21-Jun-06	5-Aug-06	21-May-06	21-Jul-06	0	15	7.5
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	8-Apr-06	9-Sep-06	8-Jun-06	18-Jul-06	4	34	21
Guadalupe-Mussel Rock							0
Vandenberg AFB (Total)	12-May-06*	11-Jul-06	19-Jun-06	20-Jun-06	0	2	1
Purisima Point	12-May-06*	11-Jul-06	19-Jun-06	20-Jun-06	0	2	1
Beach 2	No Terns	No Terns	No Nests	No Nests	0	0	0
Ventura County							
Santa Clara River/McGrath State Beach							
Ormond Beach	6-May-06	3-Sep-06	7-Jun-06	15-Jul-06	19	34	36
NAWS Pt Mugu (Total)	25-Apr-06	14-Aug-06	23-May-06	25-Jul-06	238	231	353.5
Ormond East			23-May-06	13-Jul-06*	195	194	292
Holiday Beach			23-May-06	25-Jul-06	24	21	34.5
Eastern Arm			2-Jun-06	11-Jul-06	19	16	27
Los Angeles/Orange Counties							
Venice Beach, Marina del Rey, California	6-Apr-06	16-Aug-06	10-May-06	31-Jul-06	272	112	328
LA HARBOR Pier 400	20-Apr-06	15-Aug-06	12-May-06	17-Jul-06	808	99	857.5
Seal Beach NWR/Anaheim Bay	11-Apr-06	late July	10-May-06	12-Jul-06	143	43.00	164.5
Bolsa Chica Ecological Reserve	14-Apr-06	11-Sep-06	15-May-06	9-Jul-06	128	94	175
Huntington State Beach	18-May-06	27-Jul-06	25-May-06	13-Jul-06	319	202	420
Upper Newport Bay ER	12-May-06	9-Aug-06	18-May-06	2-Jul-06	26	20	36

Appendix B-3: Pair Estimation (Method I) (continued).

Site name:	Date terns first observed:	Date terns last observed:	Date of first nest:	Date of last nest initiation:	Total nests prior to 15 June:	Total nests 15 June & later:	Total pairs:
San Diego County							
Camp Pendleton (Total)	20-Apr-06	31-Aug-06	20-May-06	27-Jul-06			1423
Red Beach	30-Apr-06	24-Aug-06	28-May-06	27-Jun-06			21
White Beach	25-Apr-06	10-Aug-06	23-May-06	27-Jun-06			137
Santa Margarita River - North Beach North	23-Apr-06	29-Aug-06	23-May-06	27-Jul-06			275
Santa Margarita River - North Beach South	20-Apr-06	31-Aug-06	20-May-06	16-Jul-06			891
Santa Margarita River - Saltflats	4-May-06	6-Aug-06	25-May-06	6-Jul-06			56
Santa Margarita River - Saltflats Island	4-May-06	6-Aug-06	23-May-06	6-Jul-06			43
Batiquitos Lagoon Ecological Reserve (Total)	20-Apr-06	29-Aug-06	20-May-06	4-Jul-06	533	88	577
W1	27-Apr-06	19-Aug-06	25-May-06	15-Jun-06	35	1	35.5
W2	20-Apr-06	29-Aug-06	20-May-06	4-Jul-06	353	56	381
E1	27-Apr-06	12-Aug-06	20-May-06	1-Jul-06	123	31	138.5
E2	27-Apr-06	30-Jul-06	N/A	N/A	0	0	0
E3	27-Apr-06	19-Aug-06	25-May-06	8-Jun-06	22	0	22
San Elijo Lagoon Ecological Reserve							
Mission Bay							
FAA	1-May-06	21-Jul-06	18-May-06	21-Jul-06	72	32	51
North Fiesta Island	13-May-06	3-Aug-06	30-May-06	10-Jul-06	15	15	22.5
Mariner's Point	29-Apr-06	25-Jun-06	16-May-06	22-Jun-06	102	18	111
Stony Point	22-Jun-06	5-Aug-06	25-May-06	8-Jul-06	56	80	96
San Diego River Mouth	8-May-06	16-Jun-06	13-May-06	8-Jun-06	14	0	14
San Diego Bay							
Lindbergh Field & Former Naval Training							114
USN (Total)	6-Apr-06	15-Sep-06	10-May-06	22-Jul-06	1106		1356
NI MAT	1-May-06	7-Aug-06	15-May-06	30-Jun-06	161		170
Delta Beach North	6-Apr-06	1-Sep-06	12-May-06	7-Jul-06	179		201
Delta Beach South	20-Apr-06	1-Sep-06	19-May-06	11-Jul-06	126		141
NAB Ocean	21-Apr-06	15-Sep-06	10-May-06	22-Jul-06	640		844
D Street Fill/Sweetwater Marsh NWR							88-94
Chula Vista Wildlife Reserve							12-13
South San Diego Bay Unit, SDNWR -	26-Apr-06	8-Sep-06	20-May-06	26-Jul-06			41-61
Tijuana Estuary NERR	18-Apr-06	16-Sep-06	18-May-06	27-Jul-06			303-307

Appendix B-3: Pair Estimation (Method II and III).

Site name:	F + G = Total nests:	Number of unsuccessful nests before 20 June:	Estimated broods lost before 20 June:	I - (J+K)= Total pairs not renesting:	Date of second wave start (if any):	Total first wave nests (or prior to 15 June):	Estimated renesters first wave:	N - O = Total Pairs first wave:	Total nests 2nd wave (or 15 June & later):	Estimated renesters 2nd wave:	Q - R = Total Pairs 2nd wave:
San Francisco Bay Area											
Pittsburg Power Plant	0										
Alameda Point	441	170	27	244	23-Jun-06	391	163	228	50	38	12
Hayward Regional Shoreline	15	0	15	0	N/A	15	0	15	0	0	0
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA	38	late start to season, a minimum of 31 pairs are present									
Guadalupe-Mussel Rock	0			0							
Vandenberg AFB (Total)	2	0	0	2	N/A	0	0	0	2	0	2
Purissima Point	2	0	0	2	N/A	0	0	0	2	0	2
Beach 2	0	0	0	0	N/A	0	0	0	0	0	0
Ventura County											
Santa Clara River/McGrath State Beach											
Ormond Beach	53	1		52							
NAWS Pt Mugu (Total)	469	48	28	393	N/A	238	46	192	231	38	193
Ormond East	389	42	26	321		195	35	160	194	30	164
Holiday Beach	45	3	0	42		24	0	24	21	2	19
Eastern Arm	35	3	2	30		19	3	16	16	6	10
Los Angeles/Orange Counties											
Venice Beach, Marina del Rey, California	384	108	0	276	N/A	308	0	308	76	0	76
LA HARBOR Pier 400	907	43	unknown	unknown				0			0
Seal Beach NWR/Anaheim Bay	186	18	unknown	168	14 to 21-Jun-06	143	0	143	43	10	33
Bolsa Chica Ecological Reserve	222	8	3	211	N/A	128	15	113	94	0	94
Huntington State Beach	521	30	5	486							
Upper Newport Bay ER	46	14	0	32	15-Jun-06	26	8	18	10	8	2

Appendix B-4: Productivity, 2005.

Site name:	Total nests:	Total eggs:	No. of eggs hatched:	Hatching Success:	Date of first chick:	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
San Francisco Bay Area								
Pittsburg Power Plant	0	0	0	0	none	none	N/A	0
Alameda Point	441	754	352	0.4668	1-Jun-06	23-Jun-06	Daily count (daytime) (= min #), (max count = total # of chicks hatched - dead chicks and fledglings - predated chicks and fledglings)	Min=9, Max=130, Avg=69.5
Hayward Regional Shoreline	15	13+	13+	unknown	12-Jul-06	31-Jul-06	daytime observations	4-13
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	38	59	45	0.7627	1-Jul-06	22-Jul-06	color band combos, 3WD	bands: 36 3WD: 17
Guadalupe-Mussel Rock	0	0	0	0	none	none	N/A	0
Vandenberg AFB (Total)	2	4	0	0	none	none	none	0
Purisima Point	2	4	0	0	none	none	none	0
Beach 2	0	0	0	0	none	none	none	0
Ventura County								
Santa Clara River/McGrath State Beach								
Ormond Beach	53	100	68	0.6800	28-Jun-06	26-Jul-06	3WD	44
NAWS Pt Mugu (Total)	469	837	559	0.6679	15-Jun-06		Various Methods	106 - 495.41
Ormond East	389	686	459	0.6691	19-Jun-06	15-Jul-06		88 - 429.81
Holiday Beach	45	87	64	0.7356	15-Jun-06	26-Jul-06		8 - 55.6
Eastern Arm	36	65	37	0.5692	27-Jun-06	31-Jul-06		10
Los Angeles/Orange Counties								
Venice Beach, Marina del Rey, California	384	597	382	0.6399	12-Jun-06	5-Jul-06	2 wk counts of feathered chicks/observed fledglings/hatched-mortality	208/228/325
LA HARBOR Pier 400	907	1494	1031	0.6901	9-Jun-06	2-Jul-06	recapture	641
Seal Beach NWR/Anaheim Bay	186	298	177	0.5940	31-May-06	21-Jun-06	Weight and wing length growth rate estimation	108
Bolsa Chica Ecological Reserve	222	363	309	0.8512	5-Jun-06	27-Jun-06	periodic counts	275-290
Huntington State Beach	521	820	750	0.9146	15-Jun-06	29-Jun-06	3WD	222
Upper Newport Bay ER	36	61	18	0.2951	12-Jun-06	9-Aug-06	3WN	2
San Diego County								
Camp Pendleton (Total)	1540	2435	966	0.396715				520
Red Beach	27	43	16	0.372093	20-Jun-06			16
White Beach	147	246	62	0.252033	17-Jun-06			30
Santa Margarita River - North Beach North	301	455	35	0.076923	13-Jun-06			35
Santa Margarita River - North Beach South	951	1499	796	0.531021	11-Jun-06			430
Santa Margarita River - Saltflats	66	113	35	0.309735	17-Jun-06			7
Santa Margarita River - Saltflats Island	48	79	22	0.278481	17-Jun-06			2
Batiquitos Lagoon Ecological Reserve (Total)	627	1027	848	0.825706	8-Jun-06	2-Jul-06		
W1	36	59	57	0.97	17-Jun-06	8-Jul-06	R	25-29
W2	409	671	560	0.83	8-Jun-06	2-Jul-06	R	158-193
E1	160	262	227	0.87	15-Jun-06	6-Jul-06	2WD	38-46
E2	0	0	0	0.00	N/A	N/A	N/A	0
E3	22	35	4	0.11	22-Jun-06	27-Jul-06	2WD	2
San Elijo Lagoon Ecological Reserve	0	0	0	0	none	none	N/A	0

Appendix B-4: Productivity, 2005 (continued).

Site name:	Total nests:	Total eggs:	No. of eggs hatched:	Hatching Success:	Date of first chick:	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Mission Bay								
FAA	104	145	15	0.1034	22-Jun-06	13-Jul-06	3WD	2
North Fiesta Island	30	52	49 (25PH)	0.9400	18-Jun-06	10-Jul-06	3WD	4 to 6
Mariner's Point	120	169	0	0.0000				0
Stony Point	136	236	225 (202PH)	0.9500	14-Jun-06	11-Jul-06	3WD	10 to 20
San Diego River Mouth	14	17	0	0.0000				0
San Diego Bay								
Lindbergh Field & Former Naval Training Center								
USN (Total)	1605	2473	1912	0.77315	3-Jun-06	28-Jun-06		206
NI MAT	180	272	196	0.720588	7-Jun-06	5-Jul-06		35
Delta Beach North	223	327	257	0.785933	5-Jun-06	28-Jun-06		42
Delta Beach South	155	242	213	0.880165	12-Jun-06	5-Jul-06		25
NAB Ocean	1047	1632	1246	0.76348	3-Jun-06	28-Jun-06		104
D Street Fill/Sweetwater Marsh NWR								
Chula Vista Wildlife Reserve								
South San Diego Bay Unit, SDNWR - Saltworks	82	138	83	0.601449	14-Jun-06	5-Jul-06		6-7
Tijuana Estuary NERR	371	606	385	0.635314	22-Jun-06	13-Jul-06		57-80

Appendix B-5: Non Predation Mortality.

Site name:	No. of eggs					No. of nests					No. of dead			Comments on cause(s) of non-predation mortality:
	human damaged:	lost to flooding:	abandoned pre-term	abandoned post-term/nonviable	outcome unknown:	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks:	fledglings:	adults:	
San Francisco Bay Area														
Pittsburg Power Plant														
Alameda Point	0	0	94	154	115	0	0	67	112	90	193 +; 9 died while hatching	1	1	Unknown: chick loss/abandonment may have been due to unusual hot spell and heavy predator pressure in mid June. Also possible problems with fish supply (low quantities/too large for chicks)
Hayward Regional Shoreline	0	0	0	0	0	0	0	0	0	8	0	0	0	
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	5	7	0	0	0	3	6	0	1	2	2	One freshly dead unbanded chick (approx. 1 day old) found 40 feet from nest, cause of mortality unknown. Necropsy results for two dead juveniles attributed the death in one juvenile to impaction of the crop with dense fibrous material; salmonellosis was determined to be the cause of death in the second juvenile (see attached necropsy reports).
Guadalupe-Mussel Rock														
Vandenberg AFB (Total)	0	0	4	0	0	0	0	2	0	0	0	0	0	
Purisima Point	0	0	4	0	0	0	0	2	0	0	0	0	0	none
Beach 2	0	0	0	0	0	0	0	0	0	0	0	0	0	none
Ventura County														
Santa Clara River/McGrath State Beach														
Ormond Beach	1		4		10						2			
NAWS Pt Mugu (Total)	0	10	7	68	67	0	5	5	39	31	19	0	0	
Ormond East	0	4	7	42	61	0	2	5	25	29	12	0	0	
Holiday Beach	0	0	0	15	4	0	0	0	8	1	6	0	0	
Eastern Arm	0	6	0	11	2	0	3	0	6	1	1	0	0	

Appendix B-5: Non Predation Mortality (continued).

Site name:	No. of eggs					No. of nests					No. of dead			Comments on cause(s) of non-predation mortality:
	human damaged:	lost to flooding:	abandoned pre-term	abandoned post-term/nonviable	outcome unknown:	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks:	fledglings:	adults:	
Los Angeles/Orange Counties														
Venice Beach, Marina del Rey, California	0	0	60	0	30	0	0	51	0	21	57	0	1	One chick found with large fish lodged in its bill. One chick predated and eaten, all others appeared intact, likely victims of starvation or exposure.
LA HARBOR Pier 400	0	0	434	0	0	0	0	not calculated	0	0	253	7	7	Suitable prey unavailable
Seal Beach NWR/Anaheim Bay	0	0	unknown	27	78	0	0	unknown	unknown	77	15	0	0	Unknown outcome high but many nests and eggs must have hatched to account for the number of chicks found and banded. Predators in colony were minimal but Great Blue Heron tracks in the colony late in the season may have represented a non-observed predator or late eggs or chicks.
Bolsa Chica Ecological Reserve	0	0	40	0	0	0	0	20-25	0	0	14	0	1	
Huntington State Beach														
Upper Newport Bay ER	0	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego County														
Camp Pendleton (Totals)		17	212	78			12	171			420	63	7	
Red Beach		0	8	1			0	5			1	1	0	
White Beach		3	49	8			2	34			23	0	0	
Santa Margarita River - North Beach North		8	30	12			6	26			57	13	0	
Santa Margarita River - North Beach South		6	122	54			4	100			334	49	7	
Santa Margarita River - Saltflats		0	2	3			0	5			4	0	0	
Santa Margarita River - Saltflats Island		0	1	0			0	1			1	0	0	
Batiquitos Lagoon Ecological	1	1	42	37	2	1	1	31	30	2	189	21	5	
W1	0	0	0	2	0	0	0	0	2	0	4	1	0	One nest (#18) was a dropped egg with no scrape. On the 14th day the egg was moved by a CLT into its nest (#19). Nest 19 originally had two eggs. Only one egg hatched.
W2	0	1	28	27	?	0	1	23	25	?	156	12	2	
E1	1	0	12	8	2	1	0	7	3	2	29	8	3	
E2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	
E3	0	0	2	0	0	0	0	1	0	0	0	0	0	
San Elijo Lagoon Ecological Reserve														

Appendix B-5: Non Predation Mortality (continued).

Site name:	No. of eggs					No. of nests					No. of dead			Comments on cause(s) of non-predation mortality:
	human damaged:	lost to flooding:	abandoned pre-term	abandoned post-term/nonviable	outcome unknown:	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks:	fledglings:	adults:	
Mission Bay														
FAA	0	0	4	0	0	0	0	3	0	0	0	0	2	
North Fiesta Island	0	0	3	0	0	0	0	3	0	0	2	0	0	2 dead chicks -unknown cause, 3 eggs - abandonment for unknown reasons
Mariner's Point			1					1						The one abandoned egg was later lost to predation
Stony Point			11					8			1			Many chicks were not seen after hatching and may have fallen into the rocks surrounding the site. There is no chick fence.
San Diego River Mouth														No non-predation mortality
San Diego Bay														
Lindbergh Field & Former Naval Training Center														
USN (Total)	25	1	151	118	153	19	1	123	64	68	38	1	7	
NI MAT	0	0	45	20	4	0	0	33	14	1	15	0	0	2 chicks died hatching
Delta Beach North	0	0	25	18	14	0	0	21	8	5	7	0	0	
Delta Beach South	0	0	9	5	3	0	0	8	3	1	1	0	0	
NAB Ocean	25	1	72	75	132	19	1	61	39	61	15	1	7	
D Street Fill/Sweetwater Marsh NWR														
Chula Vista Wildlife Reserve														
South San Diego Bay Unit, SDNWR - Saltworks	0	0	21	3	14		0	15	3	10	2	0	0	
Tijuana Estuary NERR	1	9	56	32	80		6	27	31	49	9	2	0	

Appendix B-6: Predation.

	Predation		
	Possible	Suspected	Documented
crabs (spp.)	X		
ants (spp.)			X
snakes (spp.)	X		X
great blue heron	X	X	
great egret	X		
black-crowned night heron	X	X	
gulls (spp.)	X	X	X
gull-billed tern	X	X	
black skimmer			X
white-tailed (black-shouldered) kite	X		
northern harrier	X		X
Cooper's hawk			X
red-tailed hawk	X		
American kestrel	X	X	X
peregrine falcon	X	X	X
greater roadrunner	X		
barn owl	X		X
great-horned owl	X	X	X
burrowing owl	X	X	X
owls (spp.)	X	X	X
American crow	X	X	X
common raven	X	X	X
corvids			X
loggerhead shrike	X		
European starling	X		X
western meadowlark	X		
unknown avian spp.	X	X	X
unknown mammal spp.	X		
opossum	X		X
California ground squirrel	X	X	
mouse			X
rats (spp.)	X	X	X
domestic dog	X		
coyote	X	X	X
gray fox	X		
raccoon	X		X
striped skunk	X		
mountain lion	X		
domestic cat	X	X	
unknown			X

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Francisco Bay Area													
Pittsburg Power Plant													
Alameda Point	gull, NOHA, RTHA, AMKE, BAOW, GHOW, LOSH	gull, BUOW, CORA, avian	ant, BUOW	gull 3S, CORA 2S, LOSH 1P, avian 10S	CORA 1S, avian 5S	ant 2D, BAOW 1-5P, GHOW 1-5P, BUOW 3D 12S, avian 121P	avian 3S	BUOW 18D 8S	16	6	143	3	26
Hayward Regional Shoreline													
San Luis Obispo/Santa Barbara Counties													
Oceano Dunes SVRA	gull, NOHA, RTHA, AMKE, GHOW, owl, LOSH, op, coyote, rac, skunk	GHOW, owl		gull 0-2P, GHOW 0-2P, owl 0-2P, op 0-2P, coyote 0-2P, rac 0-2, skunk 0-2P	gull 1P, GHOW 1P, owl 1P, op 1P, coyote 1P, rac 1P, skunk 1P	gull 0-8P, NOHA 0-8P, RTHA 0-8P, AMKE 0-8P, PEFA 0-8P, GHOW 0-8P, owl 0-8P, LOSH 0-8P, op 0-8, coyote 0-8, rac 0-8, skunk 0-8		GHOW 1S, owl 1S	2	1	0	0	2
Guadalupe-Mussel Rock													
Vandenberg AFB (Total)			owl					owl 3D	0	0	0	0	3
Purisima Pt Beach 2													
Ventura County													
Santa Clara River/McGrath State Beach													
Ormond Beach			AMCR	AMCR 3D	AMCR 2D								
Pt Mugu (Total)		GHOW	gull, PEFA, AMKE, GHOW, avian, coyote, mammal		avian 2D, mammal 24D, coyote 25D	gull 1D, AMKE 1D, PEFA 1D, coyote 6D	PEFA 2D	PEFA 1D, GHOW 1S	112	69	9	2	2
Eastern Arm									9	6	0	0	0
Holiday Beach									4	2	6	0	0
Ormond Beach East									99	61	3	2	2

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Los Angeles/Orange Counties													
Venice Beach	dog, rac	rat, cat	AMCR, avian	AMCR 123D	AMCR 87D	avian 1D		avian 1D	123	87	1	0	1
LA Harbor - Pier 400	AMKE, PEFA	PEFA, BUOW	EUST, corvids	corvids 25D, EUST 2D				PEFA 0-7S, BUOW 0-7S	27	0	0	0	7
Seal Beach NWR - Anahiem Bay	GTBH, AMCR, CORA, LOSH								5 to 6	0	unknown	0	0
Bolsa Chica Ecological Reserve	AMKE, PEFA, BAOW, coyote	gs		gs 14S	gs 8S				14	8	0	0	0
Huntington State Beach													
Upper Newport Bay Ecological Reserve		AMCR, coyote		AMCR 18S, coyote 25S	AMCR 9S, coyote 17S	AMCR 4S, coyote 12S			43	26	16	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented					
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults	
San Diego County														
*MCB Camp Pendleton	crab, snakes, GTBH, BCNH, GBTE, WTKI, COHA, RTHA, GRRO, BUOW, AMCR, CORA, EUST, WEME, op, gs, rats, dog, gfox, rac, cat, mt lion									170	124	26	9	0
*Red Beach			gull, corvids, coyote	gull 1D	gull 1D		coyote 1D			4	3	0	1	0
*White Beach			AMKE, corvids, coyote, unknown	corvids 5D, coyote 8D, unknown 1D	corvids 3D, coyote 4D, unknown 1D	AMKE 1D, unknown 1D	AMKE 1D, unknown 1D			14	8	2	2	0
*Santa Margarita River - North Beach North			ant, gull, BLSK, NOHA, PEFA, BAOW, GHOW, owl, AMKE, rat, mouse, coyote, unknown	gull 4D, BLSK 1D, mouse 1D, coyote 70D, unknown 8D	gull 4D, BLSK 1D, mouse 1D, coyote 51D, unknown 8D	ant 7D; NOHA 1D; BAOW, GHOW or owl 1D; AMKE 1D; rat 2D; mouse 5D; unknown 14D	NOHA 2D; BAOW, GHOW or owl 1D; AMKE 1D; coyote 1D, unknown 6D	PEFA 1D; BAOW, GHOW or owl 2D, unknown 3D		12	9	2	3	0
*Santa Margarita River - North Beach South										70	56	22	3	0
*Santa Margarita River - Saltflats			ant, mouse, coyote, unknown	coyote 38D, unknown 1D	coyote 25D, unknown 1D	ant 1D				39	26	0	0	0
*Santa Margarita River - Saltflats Island			mouse, coyote, unknown	mouse 1D, coyote 28D, unknown 2D	mouse 1D, coyote 19D, unknown 2D					31	22	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Diego County													
Batiquitos Lagoon Ecological Reserve (Total)									45	28	1	2	1
W1	GREG		ant			ant 1D			0	0	1	0	0
W2	snakes, GTBH, GREG		ant, gull, rac	gull 1D		ant 1D, rac 6D			6	5	10	0	0
E1	snakes, GTBH, GREG		snakes, GHOW, CORA, op, rac	snakes 3D, op 2D, rac 1D		GHOW 2D, CORA 3D			13	7	0	2	1
E2									0	0	0	0	0
E3			avian, coyote, rac	avian 1S, coyote 10S 13D, rac 2D	avian 1S, coyote 8S 8D, rac 1D				26	16	0	0	0
San Elijo Lagoon Ecological Reserve													
Mission Bay													
FAA		gull, AMCR, CORA	GHOW	gull 124S, CORA 2S	gull 90S, CORA 1S	gull 13S		GHOW 2D	126	91	13	0	2
North Fiesta Island		AMKE				AMKE 0-40S	AMKE 3D, 0-10S		0	0	0	3	0
Mariner's Point		AMCR, CORA, rat		AMCR 0-169S, CORA 0-169S, rat 0-169S	AMCR 0-120S, CORA 0-120S, rat 0-120S				169	120	0	0	0
Stony Point		AMCR, CORA		AMCR 0-17S, CORA 0-17S	AMCR 0-14S, CORA 0-14S				0	0	0	0	0
San Diego River Mouth		GTBH, AMKE		GTBH 1S		AMKE 0-100S	AMKE 1-10S		0	0	0	1	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Diego Bay													
Lindbergh Field & Former Naval Training Center													
USN (Total)									76	43	41	0	9
NI MAT									1	2	5	0	3
Delta Beach North									7	4	3	0	2
Delta Beach South									8	4	3	0	0
NAB Ocean									60	33	30	0	4
D Street Fill/Sweetwater Marsh NWR													
Chula Vista Wildlife Reserve													
South San Diego Bay Unit, SDNWR - Saltworks									17	11	3	1	4
Tijuana Estuary NERR									43	31	8	1	5

Legend:

P: Possible

S: Suspected

D: Documented

GTBH: Great blue heron

BCNH: Black-crowned night heron

BBPL: Black-bellied plover

GBTE: Gull-billed tern

NOHA: Northern harrier

RTHA: Red-tailed hawk

AMKE: American kestrel

PEFA: Peregrine falcon

BAOW: Barn owl

GHOW: Great-horned owl

BUOW: Burrowing owl

AMCR: American crow

CORA: Common raven

LOSH: Loggerhead shrike

EUST: European starling

WEME: Western meadowlark

avian: Unknown avian species

op: Opossum

btj rabbit: Black-tailed jackrabbit

gs: California ground squirrel

lt weasel: long-tailed weasel

gfox: Gray fox

rac: Raccoon

mammal: Unknown mammal species