State of California
The Resources Agency
Department of Fish and Game
Habitat Conservation Planning Branch

California Least Tern Breeding Survey

2005 Season

by
Daniel A. Marschalek

Species Conservation and Recovery Program Report, 2006-01

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 (*Sterna antillarum browni*) continued in 2005, with observers at 28 nesting sites providing data. An estimated 6865-7341 California least tern breeding pairs established 8120 nests and produced 1721-2471 fledglings at 42 documented locations. The fledgling to breeding pair ratio was 0.23-0.36. Statewide, 13,752 eggs were reported, with a site average of 1.74 eggs per nest (St Dev = 0.111) and an average clutch size of 1.67 eggs (St Dev = 0.659) for Type 1 sites. Numbers of nesting least terns were not uniformly distributed across all sites. Camp Pendleton, Los Angeles Harbor, Naval Base Coronado, Batiquitos Lagoon and Pt. Mugu represented 68% of the breeding pairs while Los Angeles Harbor, Camp Pendleton, Bolsa Chica Ecological Reserve, Alameda Point, Naval Base Coronado and Batiquitos Lagoon Ecological Reserve produced 76% of the fledglings. Only two sites, Los Angeles Harbor and Camp Pendleton, produced 44% of the statewide fledgling total. Four large sites (Alameda Point, Los Angeles Harbor, Camp Pendleton and Batiquitos Lagoon) experienced high levels of chick mortality. Starvation is a suggested cause of the 33-49% chick death rate. The main predators of least tern chicks were American kestrels (*Falco sparverius*), American crows (*Corvus brachyrhynchos*) and coyotes (*Canis latrans*), accounting for up to 297, 287 and 170 deaths, respectively. Coyotes were reported from the most sites. The monitoring effort of 2005 is scheduled to continue in 2006.

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[1] Marschalek, D.A. 2006. California least tern breeding survey, 2005 season. California Department of Fish and Game, Habitat Conservation and Planning Branch, Species Conservation and Recovery Program Report, 2006-01. Sacramento, CA. 21 pp. + app.

INTRODUCTION

The California least tern (*Sterna antillarum browni*) is a migratory species, nesting along the west coast of North America, from Baja California, Mexico, north to the San Francisco Bay area (USFWS 1980). 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 2005 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2004 or who planned monitoring activities for 2005 were provided datasheets prior to the arrival of adult terns (Appendix A). These forms were identical to those used in 2004 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

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.

Total Pairs = # nests prior to 15 June + [(# 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.

Total Pairs = total nests - (# unsuccessful nests prior 20 June + # 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.

pairs first wave = # nests prior to 15 June - estimated renesters prior to 15 June

pairs second wave = # nests 15 June or after - estimated renesters 15 June or after

Total Pairs = pairs first wave + 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. 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-two of 28 sites monitored in 2005 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.

Productivity

At least partial data were received and analyzed for all monitored least tern nesting areas in California for 2005. An estimated 6865-7341 California least tern breeding pairs established 8120 nests and produced 1717-2467 fledglings at 42 documented locations (Table 2). The fledgling to breeding pair ratio was 0.23 to 0.36 fledglings per pair. Statewide, 13,752 eggs were

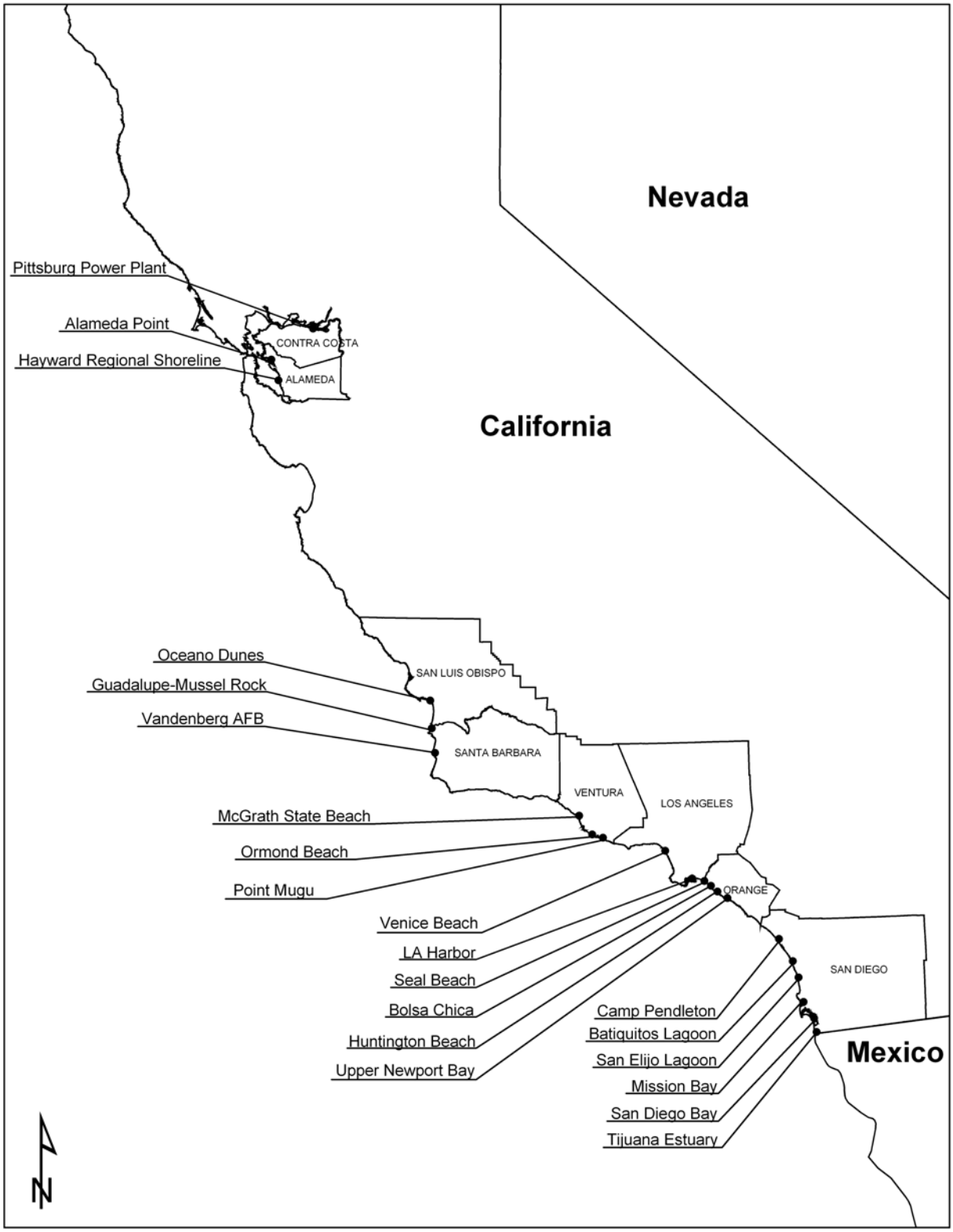

Figure 1. California sites monitored for California least tern nesting in 2005. Some listed areas include multiple sites, sites with nesting at more than one location, or both.

Table 2. California least tern productivity in 2005.

2005	Estimated Number of Breeding Pairs		Number of Nests	Estimated Number of Fledglings		Fledgling per Pair Ratio	
Site	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum
San Francisco Bay Area							
Pittsburg Power Plant	4	4	4	0	0	0.00	0.00
Alameda Point	424	495	550	140	380	0.28	0.90
Hayward Regional Shoreline	8	8	8	0	0	0.00	0.00
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	47	47	59	18	20	0.38	0.43
Guadalupe-Mussel Rock	4	4	4	0	0	0.00	0.00
Vandenberg AFB	44	44	44	1	1	0.02	0.02
Ventura County							
Santa Clara River/McGrath State Beach	6	6	9	4	4	0.67	0.67
Ormond Beach	27	27	27	0	0	0.00	0.00
Pt Mugu- Totals	516	558.5	608	66	112	0.12	0.22
Holiday Beach	83	98.5	108	18	18	0.18	0.22
Ormond Beach East	415	439	476	46	92	0.10	0.22
Eastern Arm	18	21	24	2	2	0.10	0.11
Los Angeles/Orange Counties							
Venice Beach	90	90	90	0	0	0.00	0.00
Los Angeles Harbor	1254	1254	1332	449	687	0.36	0.55
Seal Beach NWR - Anahiem Bay	131	140	145	87	87	0.62	0.66
Bolsa Chica Ecological Reserve	127	134	135	180	180	1.34	1.42
Huntington State Beach	212	339	339	71	90	0.21	0.42
Upper Newport Bay Ecological Reserve	17	28	28	0	0	0.00	0.00
San Diego County							
MCB Camp Pendleton- Totals	1348	1348	1664	299	384	0.22	0.28
Red Beach	3	3	3	1	1	0.33	0.33
White Beach	98	98	136	3	20	0.03	0.20
Santa Margarita River - North Beach North	297	297	375	39	39	0.13	0.13
Santa Margarita River - North Beach South	847	847	1034	247	350	0.29	0.41
Santa Margarita River - Saltflats	52	52	59	3	7	0.06	0.13
Santa Margarita River - Saltflats Island	51	51	57	6	6	0.12	0.12
Batiquitos Lagoon Ecological Reserve- Totals	571	571	596	109	128	0.19	0.22
W1	45	45	46	15	20	0.33	0.44
W2	352	352	363	76	90	0.22	0.26
E1	148	148	157	15	15	0.10	0.10
E2	0	0	0	0	0	0.00	0.00
E3	26	26	30	3	3	0.12	0.12
San Elijo Lagoon Ecological Reserve	1	1	1	0	0	0.00	0.00
Mission Bay							
FAA Island	5	5	6	0	0	0.00	0.00
North Fiesta Island	0	0	0	0	0	0.00	0.00
Mariner's Point	223	280	281	50	60	0.18	0.27
San Diego River Mouth	80	103	118	6	10	0.06	0.13
San Diego Bay							
Lindbergh Field & Former Naval Training Center	121	150	157	45	85	0.30	0.70
USN- Totals	1135	1135	1269	145	170	0.13	0.15
NI MAT	126	126	134	20	25	0.16	0.20
Delta Beach North	315	315	351	35	40	0.11	0.13
Delta Beach South	192	192	215	20	25	0.10	0.13
NAB Ocean	502	502	569	70	80	0.14	0.16
D Street Fill/Sweetwater Marsh NWR	77	97	101	9	17	0.09	0.22
Chula Vista Wildlife Reserve	44	53	57	2	2	0.04	0.05
South San Diego Bay Unit, SDNWR - Saltworks	23	29	34	2	3	0.07	0.13
Tijuana Estuary NERR	326	391	458	38	51	0.10	0.16
Totals:	**6865**	**7341.5**	**8124**	**1721**	**2471**	**0.23**	**0.36**

reported, with mean clutch size of each site averaging 1.74 eggs per nest (St Dev = 0.111) and a statewide clutch size of 1.67 eggs (St Dev = 0.659).

The 2005 California least tern nesting season lasted approximately five months. The first recorded least tern at a nesting site was on 12 April at Camp Pendleton and the last observed on 13 September at Point Mugu. The first nest was detected on 2 May at NAS North Island, the first chick on 25 May at Camp Pendleton, and the first fledgling on 20 June at Alameda Point. Least terns did not nest at four sites used in 2004 (Coal Oil Point Reserve, Hollywood Beach, Burris Sand Pit and North Fiesta Island), however, they nested at two sites not used last year (Hayward Regional Shoreline and San Elijo Lagoon Ecological Reserve). For at least a second consecutive year, a second nesting wave was not documented at most sites (Marschalek 2005). Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

The 6865 recorded minimum breeding pairs in 2005 was 8% higher than the 6354 total in 2004 (Marschalek 2005). 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). Fledgling numbers increased 28% from 2004 (Marschalek 2005). Although the number of fledglings increased, this represented the fourth lowest total in the last ten years.

The majority of breeding pairs nested in San Diego County (3954 pairs, 57.6%) and the fewest in San Luis Obispo and Santa Barbara Counties (95 pairs, 1.4%) (Table 3). Breeding pairs were not a predictor for fledgling numbers, however. The fledgling-to-pair ratio ranged from a low of 0.128 in Ventura County to a high of 0.430 in Los Angeles and Orange Counties.

Table 3. Regional productivity comparison, 2005.

Region	Breeding Pairs**	Proportion of Total	Fledglings**	Proportion of Total	Fledgling:Pair*
San Francisco Bay Area	436	0.064	140	0.081	0.321
San Luis Obispo/Santa Barbara Counties	95	0.014	19	0.011	0.200
Ventura County	549	0.080	70	0.041	0.128
Los Angeles/Orange County	1831	0.267	787	0.457	0.430
San Diego County	3954	0.576	705	0.410	0.178
Total	6865	1.000	1721	1.000	0.250

* 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.

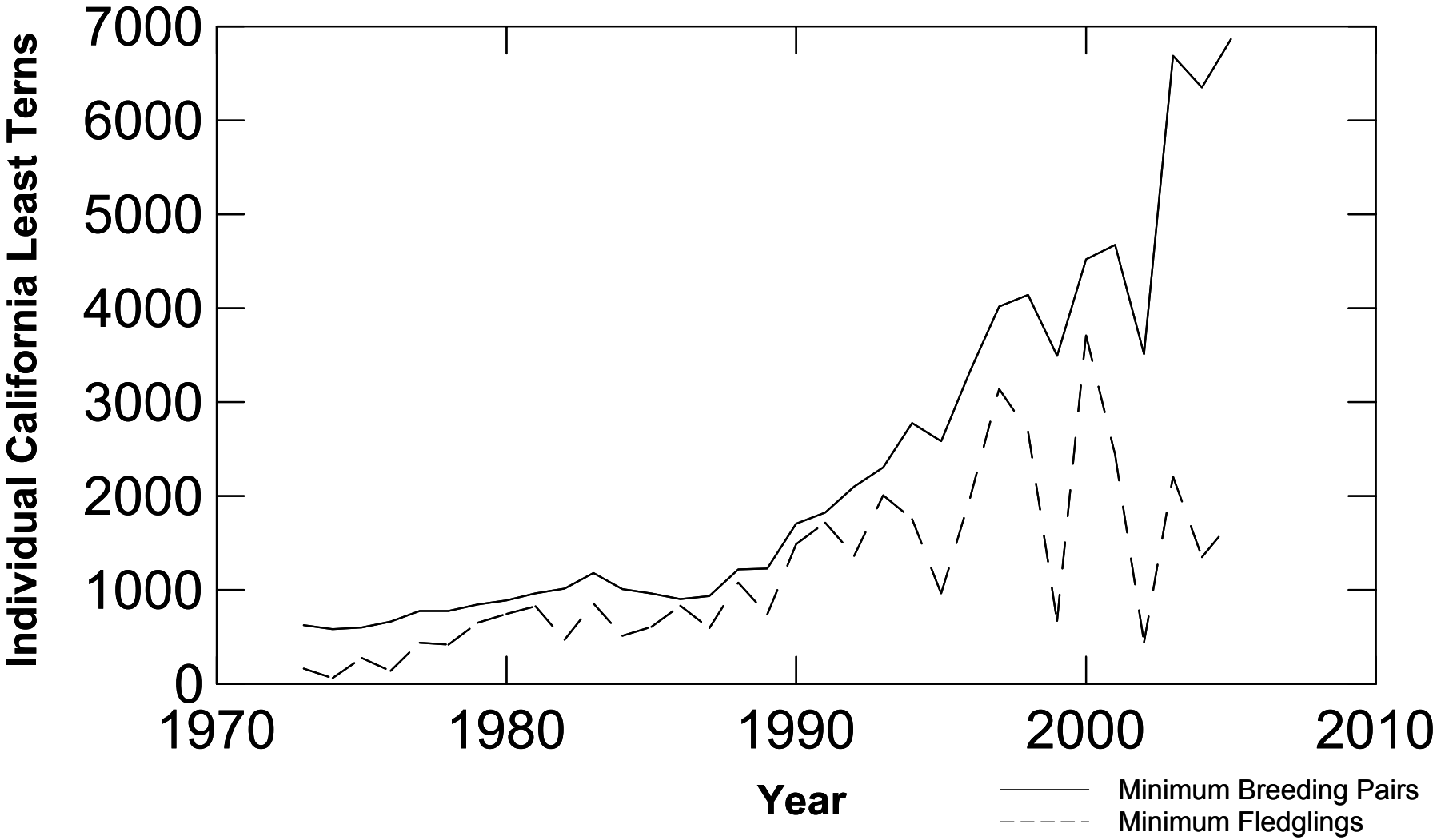

Figure 2. Number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1973-2005. (Data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al*. 1977; Jurek 1977; Atwood *et al*. 1979; Collins 1984, 1986 and 1987; Gustafson 1986; 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).

Camp Pendleton had the highest number of breeding pairs, nests and eggs in the state while Los Angeles Harbor had the highest number of chicks and fledglings (Table 4). Bolsa Chica Ecological Reserve was the only site in 2005 with a minimum fledgling-to-pair ratio greater than one (1.34). The Camp Pendleton site contributed considerably more to the fledgling count in 2005 than 2004, despite the fledgling-to-pair ratio remaining below the state average.

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 (1348)	Camp Pendleton (1664)	Camp Pendleton (2683)	LA Harbor (2182)	LA Harbor (449)
LA Harbor (1254)	LA Harbor (1332)	LA Harbor (2411)	Camp Pendleton (1909)	Camp Pendleton (299)
Naval Base Coronado (1009)	Naval Base Coronado (1135)	Naval Base Coronado (1884)	Naval Base Coronado (1363)	Bolsa Chica (180)
Batiquitos (571)	Pt Mugu (608)	Pt Mugu (1105)	Batiquitos (739)	Alameda Pt (140)
Pt Mugu (516)	Batiquitos (595)	Batiquitos (944)	Alameda Pt (665)	Naval Base Coronado (125)

A few sites constituted the majority of breeding activity for the state in 2005, which is a trend observed in the past (Caffrey 1994, 1995, 1997, 1998; Marschalek 2005). Five sites (Camp Pendleton, Los Angeles Harbor, Naval Base Coronado, Batiquitos Lagoon Ecological Reserve and Pt. Mugu) had over 500 minimum breeding pairs, which represented 68% 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 six sites with over 100 fledglings each (Los Angeles Harbor, Camp Pendleton, Bolsa Chica Ecological Reserve, Alameda Point, Naval Base Coronado and Batiquitos Lagoon Ecological Reserve) contributed 76% of the state's production. In fact, Los Angeles Harbor and Camp Pendleton contributed almost half (43%) of the fledglings.

Mortality and Predation

Chick mortality (Table 5) contributed to low reproductive success at a few sites, including Camp Pendleton, Alameda Point, Los Angeles Harbor and Batiquitos Lagoon Ecological Reserve, where 49, 43, 40 and 33% of chicks were found dead, respectively. These chick mortality rates were higher than in 2004 for the Alameda Point and Los Angeles Harbor sites. Despite the high mortality at Camp Pendleton and Batiquitos Lagoon in 2005, rates were lower than in 2004. These four sites represented 89% of the total reported chick deaths. Food shortages were suggested as a possible cause of chick mortality at these sites, although monitors observed adults returning to nests with fish at adequate rates. Cool weather and late rains may have contributed to the death rates observed at Alameda Point. Least tern mortality due to non-predation factors was greater than mortality due to predation in 2005.

Abandonment prior to the expected hatching date was the second highest death rate from non-predation events. This preterm abandonment lead to the loss of 1529-1677 eggs (50-55%). Again, only food shortages were suggested as possible causes.

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	3034	1715	2681[1]	78[1+2]	46[1+2]
Predation	833	405[1-4]	104 – 107[1]	36[1]	35[1]

[1] Tijuana Estuary NERR not submitted.
[2] Saltworks not submitted.
[3] D St. not submitted.
[4] Chula Vista not submitted.

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-five species were reported as possible, suspected or documented predators of least terns, including deer mouse (*Peromyscus* sp.) depredation at Camp Pendleton (Table 6). The most commonly documented predators were American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), peregrine falcons (*Falco peregrinus*) and coyotes (*Canis latrans*). As in 2004, most recorded predators were avian species.

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)	Peregrine falcon (10)	Striped skunk (1)
Great egret (3)	Great-horned owl (2)	Coyote (10)
Black-crowned night heron (1)	Burrowing owl (1)	Domestic dog (1)
Gulls (6)	Owls (4)	Canids (1)
Gull-billed tern (1)	American crow (11)	Domestic cat (1)
Black skimmer (1)	Common raven (10)	California ground squirrel (2)
Osprey (1)	Loggerhead shrike (6)	Deer mouse (1)
Northern harrier (3)	Western meadowlark (1)	Rats (1)
White-tailed kite (5)	Unknown avian (4)	Unknown mammal (3)
Cooper's hawk (2)	Opossum (4)	Snakes (3)
Red-tailed hawk (6)	Raccoon (4)	Ants (4)
American kestrel (9)	Long-tailed weasel (1)	

Predation led to the loss of about 833 eggs, 104-107 chicks, 36 fledglings and 35 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 few depredation events due to specific predator species compared to 2004. American crows were responsible for the greatest loss of least terns (184-287 total individuals, 30%) in 2005, with American kestrel (*Falco sparverius*) (6-297, 19%) and coyote (135-170, 19%) about 20%. 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 7. Species responsible for greatest proportion of depredated least tern eggs, chicks, fledglings or adults.

Species	**Proportion of Least Tern Individuals Depredated***
American crow	0.3002
Coyote	0.1944
American kestrel	0.1931
Owl	0.0325
Peregrine falcon	0.0312
Gull	0.0300
Ant	0.0268
Loggerhead shrike	0.0249
Northern harrier	0.0249
Opossum	0.0249
Common raven	0.0242

*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). These two species continued to be a problem in 2005. American kestrels also depredated a large number of least terns, mainly of chicks and fledglings. Predation from these three species comprised 69% of the documented predator mortality. Abandonment is not included in depredation data but can be driven by a predator, as suspected at FAA and North Fiesta Island in Mission Bay. At these two locations, peregrine falcons were believed to have been responsible for adults with active nests abandoning the area.

High levels of chick mortality attributed to food shortages have also been observed in past years (Caffrey 1993, Marschalek 2005). A few monitors suggested that food shortages were the cause of chick mortality in 2005. However, starvation with these small animals was difficult to confirm. Appropriate sized fish appeared to be available early in the year; however, some sites reported adults providing unsuitable fish for chicks in June.

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

Pittsburg Power Plant

At the Pittsburg Power Plant site, up to four breeding pairs established four possible nests and produced no fledglings. Possible predation by American crow, raccoon (*Procyon lotor*) or canid (*Canid* sp.) resulted in the loss of all four nests. These nests were not confirmed due to suspected predation immediately after nest initiation. The breeding season of 2005 represents the first year since 1983, the year least terns started nesting at this site, that nesting could not be positively confirmed due to the uncertainty of these nests.

Canada geese (*Branta canadensis*) have been a concern at the Pittsburg Power Plant site for the last couple years due to the possibility of trampling least tern nests. Efforts to deter geese from nesting continued including removing the first goose nest initiated in the traditional tern nesting area. However, the geese may have negatively impacted tern nesting in 2005 by competing for nesting areas.

Alameda Point

At the Alameda Point site, 424-495 breeding pairs established 550 nests and produced 140-380 fledglings. For the third consecutive year, chick mortality was high. The cause of the high mortality rate (43%) is likely weather or unsuitable fish size. Documented predation included 20 eggs, six chicks, five fledglings and eight adults lost from northern harrier (*Circus cyaneus*), peregrine falcon, unidentified owl species, common raven and unknown avian species.

Hayward Regional Shoreline

Hayward Regional Shoreline experienced the documented first least tern nesting activity. In 2005, six to 14 breeding pairs established 8 nests but produced no fledglings. Predation by a flock of 100-150 gulls (*Larus* sp.) resulted in the loss of all eight nests in a single predation event. Two adult terns were seen feeding two recently fledged young on the island; however, it is likely that these new birds came from the Alameda Point site. Monitors conducted observations from the perimeter.

More than 1600 people contributed 6000 hours of volunteer service to create this new tern island at Hayward Regional Shoreline, which included $48,500 in grant funds, 165 tons of materials (sand, oyster shells), and removing 80 cubic yards of non-native vegetation.

San Luis Obispo/Santa Barbara Counties

Oceano Dunes SVRA

The Oceano Dunes State Vehicular Recreational Area (SVRA) site had 47 breeding pairs, 59 nests and produced 18-20 fledglings. Predation was minimal, resulting in the loss of two eggs and an adult from an unknown owl species, and one chick from a loggerhead shrike (*Lanius excubitor*). Adults abandoned an additional 25 eggs.

Guadalupe-Mussel Rock

Four breeding pairs established one confirmed nest and produced no fledglings at Guadalupe-Mussel Rock. Monitors at this site were surveying for snowy plovers (*Charadrius alexandrinus*) and did not enter the area of least tern activity to avoid disturbing the pairs. It was believed that the three tern pairs without documented nests were sitting on scrapes or nests. The nest with two eggs was depredated by a coyote. Any least tern monitoring was incidental to the primary plover monitoring at this site.

Vandenberg AFB

Forty-four breeding pairs established 44 nests and produced one fledgling. No nesting was recorded at the Beach 2 sub-colony for the fifth year of the last six. The only documented least tern predation was an adult by an unknown owl species.

Coal Oil Point Reserve

No nesting occurred at Coal Oil Point Reserve in 2005. Monitors observed one courting pair.

Ventura County

Santa Clara River/McGrath State Beach

At the Santa Clara River site, six breeding pairs established nine nests and produced four fledglings.

Ormond Beach

At Ormond Beach, 27 breeding pairs established 27 nests and produced no fledglings. Only three of 46 eggs hatched, as 24 eggs were abandoned, 11 had unknown outcomes, and 9 were predated. One pair established a nest outside of the designated least tern nesting area. This is the second consecutive year of low nest success after over 90% nest success in 2001 and 2002 (Smith 2005). Paraglider and ultralight aircraft disturbed the birds and may have been a factor in the abandonment of the colony. Efforts to limit this aircraft disturbance continue.

NAS Point Mugu

Point Mugu had a total of 516-558 breeding pairs, 608 nests and 66 fledglings. Ormond Beach East had the highest number of pairs, nests and fledglings of the three sub-colonies. The Holiday Beach sub-colony continued to see an increase in utilization since its construction in 2003, with 12 nests in 2004 and 108 in 2005. This increase in number may be due to terns selecting nest locations at Holiday Beach rather than the Eastern Arm sub-colony. Mortality rate was highest at the egg age class, due to abandonment (148 eggs), unknown outcomes (401 eggs) or predation (175 eggs). Coyote predation resulted in the loss of 119 eggs, 11% of the total eggs. This is the second year that coyotes have been problematic at Point Mugu.

Los Angeles/Orange Counties

Venice Beach

Venice Beach had 90 breeding pairs, 90 nests and no fledglings. All nests were depredated by American crows, which included 177 eggs. Twenty-three of the 90 nests were initiated outside of the fenced colony between June 2 and 7. A temporary fence enclosure was placed around the new nesting area on June 3rd.

Los Angeles Harbor

The Los Angeles Harbor (Terminal Island) site had 1254 breeding pairs, 1332 nests and 449-687 fledglings. As in 2004, this site experienced a high chick mortality rate, with 40% of chicks dying in 2005. Despite 868 chicks, 13 fledglings and 3 adults found dead, this site produced the most fledglings of any site in the state. Fledglings could be as high as 1284 when subtracting the number of dead chicks and fledglings from the number of eggs hatched. Extremely low predation rates at this site were a result of intense predator management and monitor presence. Predator managers removed nine American crows, five common ravens, two gulls and two feral cats (*Felis* sp.) from the least tern nesting site.

Seal Beach NWR

At Seal Beach NWR, 131-140 breeding pairs established 145 nests and produced 87 fledglings. Mortality due to predation or other factors appeared to be minimal. 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, 131-134 breeding pairs established 135 nests and produced 180 fledglings. Predation and other mortality factors were relatively minor, with the coyote as the only documented predator. Black skimmers (*Rynchops niger*) arriving late in the season may have caused the least terns to leave the area. Bolsa Chica had the highest per capita production in the state, ranging from 1.34 to 1.42 fledglings per pair.

Huntington State Beach

At Huntington State Beach, 212-339 breeding pairs established 339 nests and produced 71-90 fledglings. Starvation may have been the cause of death for 80 chicks found dead, as fish too large for chicks to handle were frequently observed. Twenty-six of these dead chicks were determined close to fledging. Egg abandonment was the leading cause of mortality at Huntington Beach. The only documented predation involved a peregrine falcon predating one adult tern and an unknown owl species depredating two adults.

Upper Newport Bay Ecological Reserve

At Upper Newport Bay Ecological Reserve, 17-28 breeding pairs established 28 nests. Fledgling numbers were unknown, but most likely zero due to suspected predation by coyotes. It appears that one event caused the complete abandonment of the site.

San Diego County
MCB Camp Pendleton

At Camp Pendleton, a total of 1348 breeding pairs established 1664 nests and produced 299-423 fledglings, the highest number of breeding pairs and nests of any site within the state for 2005. As in 2004, the Santa Margarita River North Beach sites (North and South) had the majority of the least tern nesting and production, representing 63% of the pairs and 83% of the fledglings at Camp Pendleton. High chick mortality resulted in the death of 928 chicks (49%) in 2005, down from 57% in 2004.

Batiquitos Lagoon Ecological Reserve

At Batiquitos Lagoon Ecological Reserve, 571 breeding pairs established 596 nests and produced 109-128 fledglings. This site had a 78% hatching rate; however, mortality of 331 chicks (45%) led to a relatively low fledging rate. As in 2004, chick mortality rate was higher at the western sub-colonies (38% at W1 and 54% at W2) than the eastern sub-colonies (E1 was highest at 31%). Predation appeared to be relatively low, with documented predation of nine eggs, 12 to 14 chicks, one fledgling and one adult.

San Elijo Lagoon Ecological Reserve

San Elijo Lagoon Ecological Reserve had one breeding pair establish a nest of two eggs. This nesting attempt was unsuccessful due to predation.

Mission Bay
- FAA Island

At FAA Island, five breeding pairs established six nests, all predated by gulls. The number of breeding pairs and nests were 3% and 2% of the 2004 totals, respectively. Least terns arrived to the site later than usual, with numbers remaining low throughout the year. A peregrine falcon

observed in the area was cited as the cause for tern avoidance of FAA Island and nearby North Fiesta Island. Vegetation management was extremely effective, despite the high precipitation.

- North Fiesta Island

No nesting occurred at the North Fiesta Island in 2005. A peregrine falcon frequently visited the site early in the breeding season. In an attempt to better manage this site in the future, the managed area will be decreased.

- Mariner's Point

At Mariner's Point, 223 breeding pairs established 281 nests and produced 50-60 fledglings. Abandonment was the leading cause of mortality, accounting for 186 eggs. Forty-three chicks were also found dead. Documented predation was minimal; however, American kestrels may have killed up to 50 fledglings (only four confirmed). It is believed that least terns moved between Mariner's Point and the San Diego River Mouth (S) site.

- San Diego River Mouth (S)

The San Diego River Mouth (S) site had 86-103 breeding pairs, 118 nests, and 6-10 fledglings. This is the second year of documented nesting of least terns on the south shore of the San Diego River near the Pacific Ocean. Flooding led to the loss of 17 eggs and the abandonment of 20 additional eggs. American kestrels or American crows were responsible for depredating up to 100 chicks. City of San Diego staff installed a temporary plastic fence upon the arrival of terns to prevent dog and human access to the nesting area.

San Diego Bay
- Lindbergh Field

At Lindbergh Field, 121-150 breeding pairs established 157 nests and produced 45-85 fledglings.

- NAS North Island

At North Island, 126 breeding pairs established 134 nests and produced 20-25 fledglings.

-Naval Base Coronado

Naval Base Coronado had 1009 breeding pairs, 1135 nests and 125-145 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, 77-97 breeding pairs established 101 nests and produced 9-17 fledglings.

- Chula Vista Wildlife Reserve

Chula Vista NWR had 44-53 breeding pairs, 57 nests and two fledglings.

- South San Diego Bay Unit, SDNWR - Saltworks

At Saltworks NWR, 23-29 breeding pairs established 34 nests and produced 2-3 fledglings.

Tijuana Estuary NERR

At Tijuana Estuary, 326-391 breeding pairs established 458 nests and produced 38-51 fledglings.

The 2005 California least tern breeding season resulted in the most breeding pairs on record; however, fledgling counts remained low. The main reason for the lower fledgling counts was the high chick mortality rates at several sites. Predation from American crows and coyotes continued to be an issue in 2005. Developing a better understanding of these mortality factors is important for the management of the increasing least tern population.

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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			
9				39				69			
10				40				70			
11				41				71			
12				42				72			
13				43				73			
14				44				74			
15				45				75			
16				46				76			
17				47				77			
18				48				78			
19				49				79			
20				50				80			
21				51				81			
22				52				82			
23				53				83			
24				54				84			
25				55				85			
26				56				86			
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.

Predators Observed (Time, Species, Location, Activity):

Ants Y / N Grid Location(s):

Documented Predation/Mortality:

Human Disturbance/Take:

Comment:

Band Prefix	Band Number	Comb. L - R	Age	Wing	Weight	Cond.	Nest No.	Egg #	Grid	Comment	Recap. (Y/N)
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		-									
Band Prefix	Band Number	Comb. L - R	Age	Wing	Weight	Cond.	Nest No.	Egg #	Grid	Comment	Recap. (Y/N)

Predators Observed (Time, Species, Location, Activity):

Ants Y / N **Grid Location(s):**

Documented Predation/Mortality:

Human Disturbance/Take:

Comment:

Band Prefix	Band Number	Comb. L - R	Age	Wing	Weight	Cond.	Nest No.	Egg #	Grid	Comment	Recap. (Y/N)
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		-									
		-									
		-									
		-									
		-									

Master Nest List Form

Least Tern Master Nest List				Location:					
Date of 1st Nest:				1st Chick:			1st Fledge:		
Nest No.	Grid No.	Egg No.	Date Found	Hatch Date	Other Outcome	Date	Band Number	Move Y/N	Comments
1									
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Master Band List

Version #1

Species **Year** **Observer(s)**

Band Prefix	Band No.	Date	Band Comb.	Wing	Weight	Cond.	Nest No.	Egg No.	Loc.	Grid	Age	NOTES
Band Prefix	Band No.	Date	Band Comb.	Wing	Weight	Cond.	Nest No.	Egg No.	Loc.	Grid	Age	NOTES

Version #2

Species Year Observer(s)

Band Prefix	Band No.	Date	Band Comb.	Wing	Weight	Cond.	Nest No.	Egg No.	Loc.	Age
Band Prefix	Band No.	Date	Band Comb.	Wing	Weight	Cond.	Nest No.	Egg No.	Loc.	Age

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:
San Francisco Bay Area											
Pittsburg Power Plant		Laura Collins		2	Yes	Yes- 70	No	No	4	The monitor cleared shelters of spiders and their webs, and attempted to deter Canada geese from competing for the tern nesting grounds, aided by a Federal Depredation Permit, and Scientific Collection Permit (State), allowing the destruction of goose eggs.	Mirant funded the management measures and applied the herbicide. The monitor accomplished some manual weeding.
Alameda Point		Rachel Hurt	Chris Bandy	2	Yes	Yes- 120 ceramic tiles, 90 wooden A-frames	No	Yes	4	added more new sand and more oyster shells	USFWS for US Navy
Hayward Regional Shoreline	Island #5	David Riensche	Peter Dramer, Mark Taylor	4	Yes	Yes- 10	Yes- 22 pairs	No	4	Over 330,000 lbs of sand, salt and oyster shells moved onto island	Dave Riensche (East Bay Regional Park), 1600 volunteers for more than 6000 hours

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:
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA		Doug George	Joanna Iwanicha, Stephanie Little, Kelly Sleeth, Julie Stout, Margaret Przybylski, Sharon Fee, Rebecca Fay, Nina Richerts, Grant Rettig, Jim Walth	1	Yes	No	No	No	5- The least tern breeding site is open to off-highway recreational vehicle use during the non-breeding season, which removes most vegetation that may have developed during this period.	A limited amount of driftwood distributed to provide some cover. A limited amount of wrack was placed on the shoreline.	California Dept. of Parks and Recreation (Oceano Dunes SVRA)
Guadalupe-Mussel Rock		Cristina Sandoval									
Vandenberg AFB											
Purisima Pt		Dan Robinette	Elizabeth Rogan	2 (electric)	Yes	Yes- 45	No	No	7	No	
Beach 2		Dan Robinette	Elizabeth Rogan	4	Yes	No	No	No	7	No	

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	McGrath Campground South, McGrath Lake	Don Davis		Santa Clara River N: 4; McGrath Lake: 1	No	No	No	No	7	No	
Ormond Beach		Reed Smith	Carly Gocal	3	Yes	No	No	No	7		
Pt Mugu- Totals											
Eastern Arm	Eastern Arm Beach	Martin Ruane	Nathan Lang, Emilie Craig, Nancy Fernandez, Amanda Wilhelm	4	Yes	No	No	No	6-need to remove arundo		NBVC Point Mugu & TTEMI
Holiday Beach	Holiday Beach	Martin Ruane	Nathan Lang, Emilie Craig, Nancy Fernandez, Amanda Wilhelm	4	Yes	No	No	No	6-need to remove arundo		NBVC Point Mugu & TTEMI
Ormond Beach East	Ormond East Beach	Martin Ruane	Nathan Lang, Emilie Craig, Nancy Fernandez, Amanda Wilhelm	4	Yes	No	No	No	6-need to remove arundo	Small areas of beach grass were removed	NBVC Point Mugu & TTEMI

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		Thomas Ryan	Wally Ross, Lyann Comrack	2	Yes	Yes	No	Yes			USFWS, CDFG
LA Harbor - Pier 400		Kathy Keane	Matt Amalong, Wally Ross, Nick Liberato, Santiago Lopez, Spencer Langdon, Orlando Lopez, Matt Teutimez	1	Yes	Yes- 50	Yes	Yes	1	repaired holes in fencing, predator observations, CATE/ELTE hazing	veg - POLA; other - monitors
Seal Beach NWR - Anahiem Bay		Charles Collins	J. Fitch, W. Ross, R. Schallmann, P. Collins, K. Gilligan, M. Taylor	1	Yes	Yes- 180	Yes- 10	Yes	4	electric fence maintenance	USFWS, R. Schallmann (SBNWS), other contractor
Bolsa Chica Ecological Reserve	South Tern Island	Peter Knapp	Wally Ross, Jack Fancher	3	No	Yes- 55	No	Yes	2	N/A	N/A
Huntington State Beach		Joel Pagel	Cyndie Kam, Kevin Clark, Jonathon Snyder	2	Yes	Yes	No	Yes	6		
Upper Newport Bay Ecological Reserve	Tern Island	Brian Shelton	Constance Bean, Travis Oberg	4	No	Yes- 23	No	Yes	2		DFG & volunteers, Coastal Commission

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:
San Diego County											
MCB Camp Pendleton		Brian Foster									
Red Beach		Brian Foster									
White Beach		Brian Foster									
Santa Margarita River - North Beach North		Brian Foster									
Santa Margarita River - North Beach South		Brian Foster									
Santa Margarita River - Saltflats		Brian Foster									
Santa Margarita River - Saltflats Island		Brian Foster									
Batiquitos Lagoon Ecological Reserve		Shauna Wolf	Lea Norton, Donna Mattson	1	Yes	Yes	No	Yes	4		
San Elijo Lagoon Ecological Reserve		Robert Patton									
Mission Bay											
FAA Island		Jennifer Jackson		4		Yes		Yes	4		CDFG, USFWS
North Fiesta Island		Ginger Johnson		1	Yes	Yes- 40	Yes- 45	Yes	4		San Diego City Parks Dept, San Diego Audubon Society
Mariner's Point		Ginger Johnson		1	Yes	Yes- 30	No	Yes	2		San Diego City Parks Dept, San Diego Audubon Society
San Diego River Mouth		Ginger Johnson		1	Yes	No	No	No	7	Black plastic mesh fence installed for nesting season only; chick fence added later at base.	San Diego City Parks Dept.

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:
San Diego Bay											
Lindbergh Field & Former Naval Training Center		Robert Patton									
USN Totals		Elizabeth Copper									
NI MAT		Elizabeth Copper									
DBN		Elizabeth Copper									
DBS		Elizabeth Copper									
NABO		Elizabeth Copper									
D Street Fill/Sweetwater Marsh NWR		Robert Patton									
Chula Vista Wildlife Reserve		Robert Patton									
South San Diego Bay Unit, SDNWR - Saltworks		Robert Patton									
Tijuana Estuary NERR		Robert Patton									

Legend

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.

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	2	19-Apr-05	29-Apr-05	29	No	No	No	N/A
Alameda Point	1	25-Apr-05	26-Aug-05	85	Yes	No	No	N/A
Hayward Regional Shoreline	2	4-May-05	22-Aug-05	34	No	No	No	N/A
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	1	1-Mar-05	30-Sep-05	Daily	Yes	No	Yes	Yellow over Green
Guadalupe-Mussel Rock	2				No	No	No	N/A
Vandenberg AFB								
Purisima Pt	3	15-Apr	26-Aug	113	Yes	No	No	N/A
Beach 2	3	17-May	27-Jun	6	Yes	No	No	N/A
Ventura County								
Santa Clara River/McGrath State Beach	1	12-May-05	12-Aug-05	18	No	No	No	N/A
Ormond Beach	1	29-Apr-05	26-Jun-05	37	Yes	No	No	N/A
Pt Mugu- Totals								
Eastern Arm	1	15-May-05	5-Aug-05	14	Yes	No	No	N/A
Holiday Beach	1	15-May-05	10-Aug-05	17	Yes	No	No	N/A
Ormond Beach East	1	15-May-05	31-Aug-05	20	Yes	No	No	N/A
Los Angeles/Orange Counties								
Venice Beach	1	9-Apr-05	5-Jul-05	18	Yes	No	No	N/A
LA Harbor - Pier 400	1	8-Apr-05	3-Sep	~60	Yes	No	Yes	
Seal Beach NWR - Anahiem Bay	1	12-May-05	20-Jul-05	11	Yes	No	Yes	N/A
Bolsa Chica Ecological Reserve	1	15-May-05	11-Jul-05	9	Yes	No	No	N/A
Huntington State Beach	1	11-May-05	4-Aug-05	12	Yes	No	No	N/A
Upper Newport Bay Ecological Reserve	3	23-May-05	8-Jun-05	8	Yes	No	No	N/A
San Diego County								
MCB Camp Pendleton	1							
Red Beach	1							
White Beach	1							
Santa Margarita River - North Beach N	1							
Santa Margarita River - North Beach S	1							
Santa Margarita River - Saltflats	1							
Santa Margarita River - Saltflats Island	1							
Batiquitos Lagoon Ecological Reserve	1				Yes			
San Elijo Lagoon Ecological Reserve								

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:
Mission Bay								
FAA Island	1							
North Fiesta Island	1	11-Apr	29-Jul	19	No	No	No	
Mariner's Point	1	22-Apr-05	13-Aug-05	38	Yes	Yes	Yes	Green/Blue
San Diego River Mouth	1	20-Apr	8-Aug	39	Yes	Yes	Yes	none used
San Diego Bay								
Lindbergh Field & Former Naval Training Center	1							
USN Totals	1							
NI MAT	1							
DBN	1							
DBS	1							
NABO	1							
D Street Fill/Sweetwater Marsh NWR	1							
Chula Vista Wildlife Reserve	1							
South San Diego Bay Unit, SDNWR - Saltworks	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	29-Apr-05	27-Jun-05	6-18 May-05	end of June	unknown	about 4	about 4
Alameda Point	18-Apr-05	27-Aug-05	9-May-05	1-Aug-05	440	110	495
Hayward Regional Shoreline	11-May-05	22-Aug-05	12-May-05	26-Jun-05	6	8	8
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	6-May-05	6-Sep-05	8-Jun-05	13-Jul-05	11	48	35
Guadalupe-Mussel Rock							4
Vandenberg AFB	8-May-05	25-Aug-05	14-Jun-05	21-Jul-05	1	43	22.5
Purisima Pt	8-May-05	25-Aug-05	14-Jun-05	21-Jul-05	1	43	22.5
Beach 2	N/A	N/A	N/A	N/A	0	0	0
Ventura County							
Santa Clara River/McGrath State Beach	5-May-05	13-Aug-05	4-May-05	9-Jul-05	3	6	6
Ormond Beach	25-May-05	22-Jun-05	1-Jun-05	15-Jun-05	24	3	25.5
Pt Mugu- Totals	3-May-05	13-Sep-05	24-May-05	25-Jul-05	508	100	558
Eastern Arm	14-May-05	16-Aug-05	28-May-05	25-Jul-05	18	6	21
Holiday Beach	9-May-05	13-Sep-05	26-May-05	19-Jul-05	89	19	98.5
Ormond Beach East	3-May-05	29-Jul-05	24-May-05	12-Jul-05	401	75	438.5
Los Angeles/Orange Counties							
Venice Beach	17-Apr-05	5-Jul-05	24-May-05	7-Jun-05	90	0	90
LA Harbor - Pier 400							1254
Seal Beach NWR - Anahiem Bay	early April	late July	12-May-05	23-Jun-05	131	14	138
Bolsa Chica Ecological Reserve	16-Apr-05	15-Aug-05	10-May-05	30-Jun-05	121	14	128
Huntington State Beach	19-Apr-05	21-Jul-05	11-May-05	7-Jul-05	287	52	313
Upper Newport Bay Ecological Reserve	26-May-05	8-Jun-05	26-May-05	unknown	28	0	28
San Diego County							
MCB Camp Pendleton	12-Apr-05	6-Sep-05	4-May-05	9-Aug-05			1348
Red Beach	26-Apr-05	28-Aug-05	18-Jun-05	26-Jun-05			3
White Beach	26-Apr-05	28-Aug-05	7-May-05	9-Aug-05			98
Santa Margarita River - North Beach N	12-Apr-05	6-Sep-05	5-May-05	13-Jul-05			297
Santa Margarita River - North Beach S	17-Apr-05	27-Aug-05	4-May-05	30-Jul-05			847
Santa Margarita River - Saltflats	23-Apr-05	13-Aug-05	11-May-05	3-Aug-05			52
Santa Margarita River - Saltflats Island	23-Apr-05	13-Aug-05	12-May-05	1-Jul-05			51
Batiquitos Lagoon Ecological Reserve	13-Apr-05	16-Aug-05	10-May-05	22-Jun-05			571
W1	16-Apr-05	19-Jul-05	14-May-05	9-Jun-05			45
W2	13-Apr-05	16-Aug-05	10-May-05	18-Jun-05			352
E1	19-Apr-05	6-Aug-05	10-May-05	18-Jun-05			148
E2	7-May-05	7-Jul-05	NA	NA			0
E3	21-Apr-05	21-Jul-05	17-May-05	22-Jun-05			26
San Elijo Lagoon Ecological Reserve	26-Apr-05	24-Jul-05	13-Jun-05	13-Jun-05			1

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:
Mission Bay							
FAA Island							5
North Fiesta Island	20-Apr-05	15-Jun-05	NA	NA	0	0	0
Mariner's Point	22-Apr-05	26-Jul-05	15-May-05	19-Jul-05	166	115	223.5
San Diego River Mouth	28-Apr-05	27-Jul-05	16-May-05	13-Jul-05	88	30	103
San Diego Bay							
Lindbergh Field & Former Naval Training Center	21-Apr-05	3-Aug-05	4-May-05	5-Jul-05			121
USN Totals	16-Apr-05	24-Aug-05	2-May-05	2-Jul-05			1135
NI MAT	18-Apr-05	11-Aug-05	2-May-05	25-Jun-05			126
DBN	25-Apr-05	12-Aug-05	5-May-05	24-Jun-05			315
DBS	16-Apr-05	17-Aug-05	9-May-05	1-Jul-05			192
NABO	18-Apr-05	24-Aug-05	9-May-05	2-Jul-05			502
D Street Fill/Sweetwater Marsh NWR	19-Apr-05	1-Aug-05	10-May-05	8-Jul-05			77
Chula Vista Wildlife Reserve	26-Apr-05	29-Jul-05	17-May-05	1-Jul-05			44
South San Diego Bay Unit, SDNWR - Saltworks	21-Apr-05	10-Sep-05	18-May-05	6-Jul-05			23
Tijuana Estuary NERR	27-Apr-05	24-Aug-05	19-May-05	14-Jul-05			326

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

Site name:	Total nests:	Number of unsuccessful nests before 20 June:	Estimated broods lost before 20 June:	Total pairs not renesting:	Date of second wave start (if any):	Total first wave nests (or prior to 15 June):	Estimated renesters first wave:	Total Pairs first wave:	Total nests 2nd wave (or 15 June & later):	Estimated renesters 2nd wave:	Total Pairs 2nd wave:	Total Pairs:
San Francisco Bay Area												
Pittsburg Power Plant	about 4	unknown	0	about 4	24/27 June	about 4	0	about 4	unknow	unknown	unknown	about 4
Alameda Point	550	73	53	424								
Hayward Regional Shoreline	8	0	0	8	N/A	7	1	6	2	2	0	6
San Luis Obispo/Santa Barbara Counties												
Oceano Dunes SVRA	59			59								
Guadalupe-Mussel Rock	1											
Vandenberg AFB	44	0	0	44	N/A	44	0	44	0	0	0	44
Purisima Pt	44	0	0	44	N/A	44	0	44	0	0	0	44
Beach 2	0	0	0	0	N/A	0	0	0	0	0	0	0
Ventura County												
Santa Clara River/McGrath State Beach	9											
Ormond Beach	27	8	8	11								
Pt Mugu- Totals	608	68	0	540	N/A	508	50	458	100	41	59	517
Eastern Arm	24	6	0	18	N/A	18	1	17	6	4	2	19
Holiday Beach	108	18	0	90	N/A	89	15	74	19	10	9	83
Ormond Beach East	476	44	0	432	N/A	401	34	367	75	27	48	415
Los Angeles/Orange Counties												
Venice Beach	90			90	N/A	90	0	90	0	0	0	90
LA Harbor - Pier 400	1332											
Seal Beach NWR - Anahiem Bay	145	11	3	131	unknown	131	0	131	14	4.5	9.5	140.5
Bolsa Chica Ecological Reserve	135	4	4	127	N/A	124	4	120	14	0	14	134
Huntington State Beach	339	112	15	212	N/A	287	0	287	52	0	52	339
Upper Newport Bay Ecological Reserve	28	6	5	17	N/A	28	0	28	0	unknown	0	28
San Diego County												
MCB Camp Pendleton	1664											
Red Beach	3											
White Beach	136											
Santa Margarita River - North Beach N	375											
Santa Margarita River - North Beach S	1034											
Santa Margarita River - Saltflats	59											
Santa Margarita River - Saltflats Island	57											
Batiquitos Lagoon Ecological Reserve	595				N/A							
W1	46				N/A							
W2	362				N/A							
E1	157				N/A							
E2	0				N/A							
E3	30				N/A							
San Elijo Lagoon Ecological Reserve	1											

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

Site name:	Total nests:	Number of unsuccessful nests before 20 June:	Estimated broods lost before 20 June:	Total pairs not renesting:	Date of second wave start (if any):	Total first wave nests (or prior to 15 June):	Estimated renesters first wave:	Total Pairs first wave:	Total nests 2nd wave (or 15 June & later):	Estimated renesters 2nd wave:	Total Pairs 2nd wave:	Total Pairs:
Mission Bay												
FAA Island	6											
North Fiesta Island	0	0	0	0	0	0	0	0	0	0	0	0
Mariner's Point	281	2	0	279	16-Jun-05	166	2	164	115	0	115	279
San Diego River Mouth	118	22	10	86	15-Jun	88	32	56	30	0	30	86
San Diego Bay												
Lindbergh Field & Former Naval Training Center	157											
USN Totals	1269											
NI MAT	134											
DBN	351											
DBS	215											
NABO	569											
D Street Fill/Sweetwater Marsh NWR	101											
Chula Vista Wildlife Reserve	57											
South San Diego Bay Unit, SDNWR - Saltworks	34											
Tijuana Estuary NERR	458											

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	about 4	N/A	N/A	N/A	N/A	N/A	N/A	0
Alameda Point	550	913	665	0.7284	30-May-05	20-Jun-05	3WD: 140; (max count is total number chicks hatched-dead chicks and fledglings-predated chicks and fledglings)	140-380
Hayward Regional Shoreline	8	N/A	N/A	N/A	N/A	N/A	N/A	0
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	59	103	66	0.6408	29-Jun-05	20-Jul-05	R	18-20
Guadalupe-Mussel Rock	4	0	0	N/A	N/A	N/A	N/A	0
Vandenberg AFB	44	74	32	0.4324	19-Jul-05	25-Aug-05		1
Purisima Pt	44	74	32	0.4324	19-Jul-05	25-Aug-05	Followed only large chick on colony until its first flight.	1
Beach 2	0	0	0	N/A	none	none	none	0
Ventura County								
Santa Clara River/McGrath State Beach	9	17	8	0.4706	24-Jun-05	16-Jul-05	Max Evening Count	4
Ormond Beach	27	46	3	0.0652	24-Jun-05	N/A	N/A	0
Pt Mugu- Totals	608	1105	373	0.3376	13-Jun-05	18-Jul-05		66
Eastern Arm	24	45	14	0.3111	23-Jun-05	18-Jul-05	WD	2
Holiday Beach	108	202	82	0.4059	17-Jun-05	19-Jul-05	3WN	18
Ormond Beach East	476	858	277	0.3228	13-Jun-05	7-Jul-05	3WN	46
Los Angeles/Orange Counties								
Venice Beach	90	177	0	0.0000	N/A	N/A	N/A	0
LA Harbor - Pier 400	1332	2411	2182	0.9050	30-May-05	22-Jun-05	3WD	449-687
Seal Beach NWR - Anahiem Bay	145	259	225	0.8687	8-Jun-05	22-Jun-05	Weight and wing length growth rate estimation	87
Bolsa Chica Ecological Reserve	135	243	193	0.7942	1-Jun-05	23-Jun-05	Window Counts	180
Huntington State Beach	339	554	304	0.5487	8-Jun-05	30-Jun-05	3WD	71-90
Upper Newport Bay Ecological Reserve	28	57	15	0.2632	31-May-05	unknown	none	unknown
San Diego County								
MCB Camp Pendleton	1664	2683	1909	0.7115	25-May-05			299-384
Red Beach	3	4	2	0.5000	9-Jul-05			1
White Beach	136	226	159	0.7035	29-May-05			3-20
Santa Margarita River - North Beach N	375	610	465	0.7623	28-May-05			39
Santa Margarita River - North Beach S	1034	1658	1209	0.7292	25-May-05			247-350
Santa Margarita River - Saltflats	59	95	52	0.5474	1-Jun-05			3-7
Santa Margarita River - Saltflats Island	57	90	22	0.2444	1-Jun-05			6
Batiquitos Lagoon Ecological Reserve	596	944	739	0.7828	31-May-05	23-Jun-05		105-124
W1	46	71	58	0.8169	2-Jun-05	25-Jun-05	R	15-20
W2	363	578	448	0.7751	31-May-05	23-Jun-05	R	76-90
E1	157	249	201	0.8072	2-Jun-05	25-Jun-05	R; 3WD	11
E2	0	0	0	N/A	N/A	N/A	N/A	0
E3	30	47	32	0.6809	16-Jun-05	30-Jun-05	R; 3WD	3
San Elijo Lagoon Ecological Reserve	1	2	0	0.0000	N/A	N/A	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 Island	6	7	0	0.0000	N/A	N/A	N/A	0
North Fiesta Island	0	0	0	N/A	N/A	N/A	N/A	0
Mariner's Point	281	483	297	0.6149	7-Jun-05	6-Jul-05	3WD, R	50-60
San Diego River Mouth	118	198	158	0.7980	8-Jun-05	11-Jul-05	3WD	6-10
San Diego Bay								
Lindbergh Field & Former Naval Training Center	157	278	221	0.7950	31-May-05	20-Jun-05		45-85
USN Totals	1269	2073	1505	0.7260	26-May-05	21-Jun-05		145-170
NI MAT	134	229	142	0.6201	3-Jun-05	21-Jun-05		20-25
DBN	351	578	428	0.7405	26-May-05	24-Jun-05		35-40
DBS	215	338	202	0.5976	30-May-05	24-Jun-05		20-25
NABO	569	928	733	0.7899	31-May-05	23-Jun-05		70-80
D Street Fill/Sweetwater Marsh NWR	101	161	122	0.7578	4-Jun-05	28-Jun-05		9-17
Chula Vista Wildlife Reserve	57	101	74	0.7327	10-Jun-05	5-Jul-05		2
South San Diego Bay Unit, SDNWR - Saltworks	34	60	18	0.3000	8-Jun-05	29-Jun-05		2-3
Tijuana Estuary NERR	458	803	366	0.4558	9-Jun-05	20-Jun-05		38-51

Appendix B-5: Non Predation Mortality.

	No. of eggs					No. of nests					No. of dead			
Site name:	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:	Comments on cause(s) of non-predation mortality:
San Francisco Bay Area														
Pittsburg Power Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	
Alameda Point	0	0	130	56	30	0	0	107	51	22	286	0	0	unknown- possibly weather and some parents leaving chicks and/or bringing no fish or wrong size fish. 12 of the 286 dead chicks died while hatching
Hayward Regional Shoreline	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	All nest predated by gulls
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	11	14	0	0	0	7	7	0	9	0	0	Chicks found dead and often in a state of decomposition. One more freshly dead chick necropsied (results inconclusive).
Guadalupe-Mussel Rock														
Vandenberg AFB	0	0	41	1	0	0	0	25	1	0	29	0	0	
Purisima Pt	0	0	41	1	0	0	0	25	1	0	29	1*	0	*One fledgling was found dead on the colony, but was not originally from Purisima Point. The bird was starting to molt into its winter plumage and was likely an older fledgling. We feel that this fledgling likely originated from the Alameda Bay or Oceano colony.
Beach 2	0	0	0	0	0	0	0	0	0	0	0	0	0	No nests
Ventura County														
Santa Clara River/McGrath State Beach	0	0	0	1	8	0	0	0	1	4	0	0	0	
Ormond Beach	0	0	24	0	11	0	0	13	0	6	1	0	0	
Pt Mugu- Totals	0	8	148		401	0	5	83		225	22	2	9	
Eastern Arm	0	4	8		0	0	3	4		0	0	0	0	
Holiday Beach	0	0	36		21	0	0	21		11	2	0	0	
Ormond Beach East	0	4	104		380	0	2	58		214	20	2	9	

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

	No. of eggs					No. of nests					No. of dead			
Site name:	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:	Comments on cause(s) of non-predation mortality:
Los Angeles/Orange Counties														
Venice Beach	0	0	0	0	0	0	0	0	0	0	0	0	1	
LA Harbor - Pier 400	0	0	191	26	9	0	0	167	20	6	868	13	3	
Seal Beach NWR -Anahiem Bay	0	0	unk		unk	0	0		3	unk	4	2	2	
Bolsa Chica Ecological Reserve	0	4	9		25	0	2	3		19	13	1	1	For chicks that hatched, food appeared visually to be sufficient. Weights not taken. Last LETE nest coinsided with arrival of BLSK to South Tern Island from North Tern Island. BLSK moved to STI based upon ELTE #s. BLSK started to nest in area of late LETE nests. Outcome of these nests assumed to ve abandonment/destruction by BLSK activity.
Huntington State Beach	0	0	98+	unk		0	0	unk	unk	0	80	0	7	26 of 80 chicks close to fledging and probably could have flown short distances. Starvation probable with adults and young; prey size of fish was often much larger than what the chicks could accommodate.
Upper Newport Bay Ecological Reserve	0	0	unk	unk	3	0	0	unk	unk	12	1	0	0	
San Diego County														
MCB Camp Pendleton		76	405	75			56	288			928	16	11	14 nests moved; 20 additional eggs damaged
Red Beach		0	1	1			0	1			0	0	0	
White Beach		2	50	8			1	31			37	3	4	1 nest moved; 3 additional damaged eggs
Santa Margarita River - North Beach North		25	79	14			21	59			254	0	2	1 nest moved; 2 additional damaged eggs
Santa Margarita River - North Beach South		40	261	49			28	187			613	13	5	10 nests moved; 14 additional damaged eggs
Santa Margarita River - Saltflats		8	8	3			5	5			13	0	0	2 nests moved
Santa Margarita River - Saltflats Island		1	6	0			1	5			11	0	0	1 additonal damaged egg

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

	No. of eggs					No. of nests					No. of dead			
Site name:	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:	Comments on cause(s) of non-predation mortality:
San Diego County														
Batiquitos Lagoon Ecological Reserve	0	0	70	42	73	0	0	56	38	54	307	15	6	
W1	0	0	4	7	1	0	0	4	7	1	20	1	0	
W2	0	0	36	24	63	0	0	29	20	45	227	11	3	Dead fledglings - includes three fledglings found dead at San Elijo Lagoon and 1 found dead at NIMAT
E1	0	0	25	10	3	0	0	18	10	3	56	3	3	
E2	0	0	0	0	0	0	0	0	0	0	0	0	0	
E3	0	0	5	1	6	0	0	5	1	5	4	0	0	
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0	0	0	0	0	0	4	3	dead fledglings from elsewhere, 3 banded as chicks from Batiquitos Lagoon Ecological Reserve
Mission Bay														
FAA Island	0	0	0	0	0	0	0	0	0	0	0	0	0	
North Fiesta Island	0	0	0	0	0	0	0	0	0	0	0	0	0	No nests
Mariner's Point	0	0	186	0	0	0	0	111	0	0	43	4	0	starvation, abandonment
San Diego River Mouth	0	17	20	0	0	0	12	15	0	0	2	1 not from this site	1 not from this site	flooding of nests from high tides caused abandonment, other abandonment for unknown reasons
San Diego Bay														
Lindbergh Field & Former Naval Training Center	0	0	16	15	4	0	0	16	15	2	21	10	1	1 chick died from aircraft strike
USN Totals		14	205	82	89						45	8	3	15 died hatching; 14 additional eggs damaged
NI MAT		0	45	31	1						18	2	2	1 died hatching
DBN		14	61	21	20									10 died hatching; 2 additional eggs damaged
DBS		0	40	7	20						3	1	0	2 died hatching; 2 additional eggs damaged
NABO		0	59	23	48						24	5	1	10 died hatching; 12 additional eggs damaged
D Street Fill/Sweetwater Marsh NWR	0	0	16	7	5	0	0	12	7	3	17	1	1	
Chula Vista Wildlife Reserve	0	0	8	5	5	0	0	7	5	3	5	0	0	
South San Diego Bay Unit, SDNWR - Saltworks	0	0	10	0	27	0	0	6	0	15	0			
Tijuana Estuary NERR	6	0	89	10	208	4	0	70	10	124				

Appendix B-6: Predation.

	Predation		
Species	**Possible**	**Suspected**	**Documented**
Ants	X		X
Snakes	X		
Great blue heron	X		
Great Egret	X		
Black-crowned night heron	X	X	
Gulls	X	X	X
Gull-billed tern		X	
Black Skimmer			X
Osprey	X		
Northern harrier	X		X
White-tailed Kite	X		
Cooper's Hawk	X		X
Red-tailed hawk	X		
American kestrel	X	X	X
Peregrine falcon	X	X	X
Great-horned owl	X	X	X
Burrowing owl		X	
Owls	X	X	X
American crow	X		X
Common raven	X	X	X
Loggerhead shrike	X	X	X
Western Meadowlark	X		
Unknown avian spp.		X	X
Unknown mammal spp.		X	X
Opossum	X	X	X
California ground squirrel		X	X
Deer mouse			X
Rats	X		
long-tailed weasel	X		
Canids	X		
Domestic dog		X	
Coyote	X	X	X
Raccoon	X		
Striped skunk	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	AMCR, rac, canid								0	0	0	0	0
Alameda Point		CORA	NOHA, PEFA, owl, CORA, avain, unknown	CORA 17S 2D; unknown 1		owls 2D, unknown 4	NOHA 2D; PEFA 3D	PEFA 2D, avain 1; unknown 5	20	18	6	5	8
Hayward Regional Shoreline			gull		gull 8				0	8	0	0	0
San Luis Obispo/Santa Barbara Counties													
Oceano Dunes SVRA	gull, NOHA, RTHA, AMKE, PEFA, owl, LOSH, op, coyote, rac, skunk	owl, LOSH	LOSH	owl 2S	owl 1S	gull NOHA RTHA AMKE PEFA owl LOSH op coyote rac skunk 0-35P; LOSH 1D 1S		owl 1S	2	1	1	0	1
Guadalupe-Mussel Rock			coyote	coyote 2D	coyote 1D				2	1	0	0	0
Vandenberg AFB									0	0	0	0	1
Purisima Pt			owl					owl 1D	0	0	0	0	1
Beach 2									0	0	0	0	0
Ventura County													
Santa Clara River/McGrath State Beach													
Ormond Beach		CORA	coyote	CORA 1S, coyote 5D	CORA 1S, coyote 5D				9	6	0	0	0
Pt Mugu- Totals									175	95	2	0	0
Eastern Arm		avian, mammal, coyote	avian, mammal, coyote	avian 4D; mammal 6D; coyote 9D	avian 2D; mammal 3D; coyote 4D				19	9	0	0	0
Holiday Beach	CORA	LOSH, avian, mammal, gs, coyote	avian, mammal, gs, coyote	avian 9D; mammal 5D; gs 2D; coyote 47D	avian 5D; mammal 3D; gs 1D; coyote 25D				63	34	0	0	0
Ormond Beach East	GHOW	AMKE, GHOW, CORA, LOSH, avian, mammal, op, gs, coyote	AMKE, CORA, LOSH, avian, mammal, op, gs, coyote, unknown	avian 4D; mammal 4D; coyote 63D; unknown 22D	avian 2D; mammal 2D; coyote 35D; unknown 13D	op 2D			93	52	2	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
Los Angeles/Orange Counties													
Venice Beach		cat	AMCR	AMCR 177D	AMCR 90D			cat 1S	177	90	0	0	1
LA Harbor - Pier 400		BUOW	AMCR	AMCR 6D					6				
Seal Beach NWR - Anahiem Bay	AMCR, CORA, LOSH								0	0	0	0	0
Bolsa Chica Ecological Reserve	RTHA, AMKE, PEFA, AMCR, LOSH	AMKE	coyote	coyote 7	coyote 5	coyote 2			7	5	2	0	0
Huntington State Beach		PEFA, owl						PEFA 1S, owl 2S	0	0	0	0	3
Upper Newport Bay Ecological Reserve		coyote	coyote										
San Diego County													
MCB Camp Pendleton	GBTE		deer mouse	141	86	19	7	9	141	86	19	7	9
Red Beach				0	0	0	0	0	0	0	0	0	0
White Beach				4	3	0	0	0	4	3	0	0	0
Santa Margarita River - North Beach North				23	20	0	0	2	23	20	0	0	2
Santa Margarita River - North Beach South				76	41	19	7	7	76	41	19	7	7
Santa Margarita River - Saltflats				26	16	0	0	0	26	16	0	0	0
Santa Margarita River - Saltflats Island				12	6	0	0	0	12	6	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									25	11	13-16	1	1
W1	snakes, GTBH, GREG, WTKI, RTHA, AMKE, PEFA, lt weasel		ants			ants 3D			0	0	3	0	0
W2	GTBH, GREG, WTKI, RTHA, PEFA		ants, AMKE, PEFA	ants 1D		ants 6D, AMKE 1D	PEFA 1D	AMKE 1S	3	3	9-11	1	0
E1	ants, snakes, GTBH, GREG, WTKI, RTHA, PEFA, CORA, op, coyote, rac		ants, AMCR	AMCR 1D	AMCR 2D	ants 3D			6	5	3	0	0
E2	WTKI, NOHA, AMKE, PEFA, AMCR, CORA, coyote, rac	GHOW						GHOW 1S	0	0	0	0	1
E3	ant, WTKI, RTHA, AMKE, PEFA, AMCR, CORA, WEME		BLSK	BLSK 1D					16	3	0-1	0	0
San Elijo Lagoon Ecological Reserve									2	1	0	0	1
Mission Bay													
FAA Island		gull		gull 6S; unknown 1	gul 5S; unknown 1				7	6	0	0	0
North Fiesta Island	snakes, gull, COHA, AMKE, PEFA, AMCR, CORA, LOSH, op								0	0	0	0	0
Mariner's Point	GTBH, gull, AMCR, CORA, rat	AMKE	ant	ant 2	ant 8-10	ant 2-10, AMKE 0-100	AMKE 4-50		2	2	2	4	0
San Diego River Mouth	gull, OSPR	AMKE, AMCR, dog	COHA	AMCR 0-3S	AMCR 0-2S	COHA 1D; AMKE 0-100S; AMCR 0-100S; dog 0-10?S	AMKE 0-10		0	0	1	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 Bay													
Lindbergh Field & Former Naval Training Center									3		15	11	1
USN Totals				109	75	33	6	4	109	75	33	6	4
NI MAT		BCNH or GBTE		5	3	5	0	2	5	3	5	0	2
DBN		BCNH or GBTE		21	14				21	14			
DBS		BCNH or GBTE		67	48	11	3	2	67	48	11	3	2
NABO		BCNH or GBTE		16	10	17	3	0	16	10	17	3	0
D Street Fill/Sweetwater Marsh NWR									11		8	1	1
Chula Vista Wildlife Reserve									9		1	0	0
South San Diego Bay Unit, SDNWR - Saltworks									5		1	1	4
Tijuana Estuary NERR									121				

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
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