

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

California Least Tern Breeding Survey

2007 Season

**by
Daniel A. Marschalek**

Final Report

To

State of California
Department of Fish and Game
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ABSTRACT

Monitoring to document breeding success of California least terns (*Sternula antillarum browni*) continued in 2007, with observers at 35 nesting sites providing data. An estimated 6744-6989 California least tern breeding pairs established 7667 nests and produced 2293-2639 fledglings at 48 documented locations. The fledgling to breeding pair ratio was 0.33-0.39. Statewide, 12,238 eggs were reported, with a Site Mean clutch size of 1.67 eggs per nest (St Dev = 0.133) and the statewide clutch size of 1.62 eggs (St Dev = 0.493) 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 Baticuitos Lagoon represented 55% of the breeding pairs while Venice Beach, Camp Pendleton, Huntington Beach and Naval Base Coronado produced 52% of the fledglings. Although the state experienced a lower chick mortality rate (9%) for the third consecutive year, four of the largest sites (Alameda Point, Venice Beach, Baticuitos Lagoon and Camp Pendleton) experienced levels of chick mortality greater than the state average. These four sites reported 42% of the total chicks, but 79% of the dead chicks. The main predators of least terns in 2007 were unknown species, black-crowned night-herons (*Nycticorax nycticorax*) and gull-billed terns (*Gelochelidon nilotica*). Coyote (*Canis latrans*) and American crow (*Corvus brachyrhynchos*) predation was lower compared to previous years, but predation due to protected species appears to be increasing. Gulls (*Larus* sp.) and peregrine falcons (*Falco peregrinus*) were reported from the most sites. The monitoring effort of 2007 is scheduled to continue in 2008.

¹ Marschalek, D.A. 2008. California least tern breeding survey, 2007 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Program Report, 2008-01. Sacramento, CA. 24 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) 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). In an attempt to provide a more accurate statewide (rather than site specific) method of estimating the number of breeding pairs, calculations consider the number of renesting pairs a site may produce rather than the number of renesting pairs actually at the site (Caffrey 1998). These equations have been used to some extent since the 1998 nesting season (Keane 2000). 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 2007 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2006 or who planned monitoring activities for 2007 were provided datasheets prior to the arrival of adult terns (Appendix A). These forms were similar to those used since the 1998 nesting season 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), or (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, or (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 or 2007)

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 (Site Mean clutch size). To reduce the influence of sites with only a couple nests of small or large clutch size, 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 (Statewide clutch size). 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.

To quantify the impact of each predator species on the reproductive success and survivorship of least terns, two statistics are provided. The first ranks the species by the number of sub-colonies they were documented as predators. The second quantifies mortality by calculating the proportion of total least tern eggs, chicks, fledglings, and adults depredated by specific predators. The number of eggs, rather than the number of nests, was used in calculations since they more accurately represent individual terns. For the few cases when the number of eggs was not reported, the number of nests was used as a conservative estimate of the number of eggs depredated. 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).

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-eight of 35 sites monitored in 2007 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 2007. An estimated 6744-6989 California least tern breeding pairs established 7667 nests and produced 2293-2639 fledglings at 48 documented locations (Table 2). The fledgling to breeding pair ratio was 0.33 to 0.39 fledglings per pair. Statewide, 12,238 eggs were reported, with a Site Mean clutch size of 1.67 eggs per nest (St Dev = 0.133) and a Statewide clutch size of 1.62 eggs (St Dev = 0.493).

The 2007 California least tern nesting season lasted approximately five months. The first recorded least tern at a nesting site was on 14 April at Bolsa Chica Ecological Reserve and the last observed on 13 September at Camp Pendleton. The first nest was detected on 10 May at Alameda Point, the first chick at NAB Ocean and NI MAT on 4 June, and first fledgling at Santa Clara River on 21 June. Least terns nested at all locations used in 2006 and nested at six locations not used last year (Green Island, Pittsburg Power Plant, Eden Landing, Guadalupe-Mussel Rock, Holiday Beach Salt Panne, and Burris Sand Pit). The five locations used in 2007 and not in 2006 had 25 nests total. For at least a fourth consecutive year, a second nesting wave was not documented at many sites (Marschalek 2005, 2006, 2007). Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

The 6744 recorded minimum breeding pairs in 2007 was 4% lower than the 7006 total in 2006 (Marschalek 2007). This represents the third 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, 2007). Due to concerns regarding late

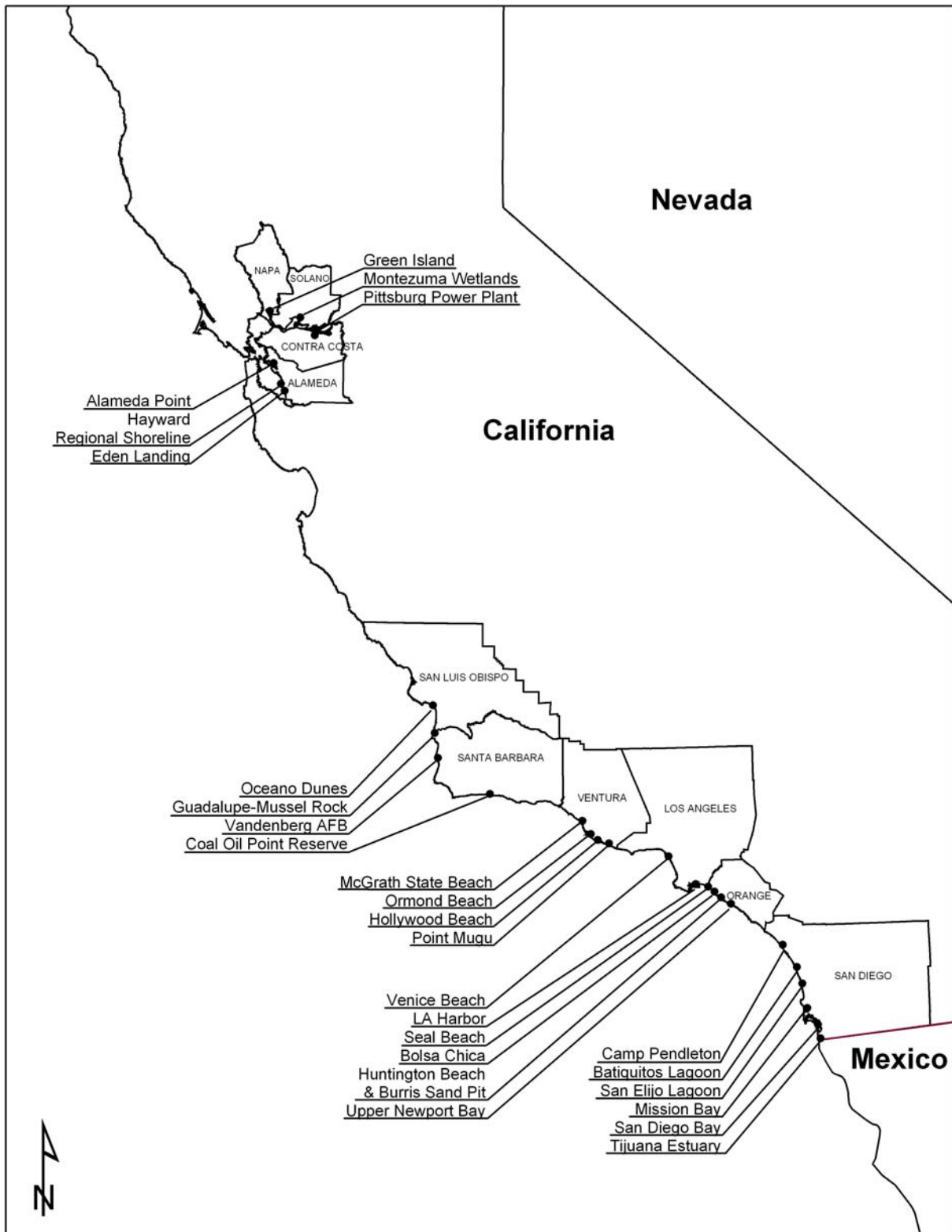


Figure 1. California sites monitored for California least tern nesting in 2007. Some listed areas include multiple sites, sites with nesting at more than one location, or both.

Table 2. California least tern productivity in 2007.

2007	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							
Green Island	2	10	2	unknown	unknown	unknown	unknown
Montezuma Wetlands	32	32	32	5	25	0.16	0.78
Pittsburg Power Plant	7	7	7	0	0	0.00	0.00
Alameda Point	355	358	394	148	309	0.41	0.87
Hayward Regional Shoreline	35	35	35	49	49	1.40	1.40
Eden Landing	5	6	6	0	0	0.00	0.00
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	54	54	66	70	70	1.30	1.30
Guadalupe-Mussel Rock	1	1	1	1	1	1.00	1.00
Vandenberg AFB	18	18	18	16	16	0.89	0.89
Coal Oil Point Reserve	4	4	6	0	0	0.00	0.00
Ventura County							
Santa Clara River/McGrath State Beach	56	77	77	76	76	0.99	1.36
Ormond Beach	49	50	52	35	35	0.70	0.71
Hollywood Beach	1	1	1	2	2	2.00	2.00
Pt Mugu- Totals	349	428	431	139	139	0.32	0.40
Ormond Beach East	286	350	351	134	134	0.38	0.47
Holiday Beach	57	63	65	4	4	0.06	0.07
Holiday Beach Salt Panne	4	6	6	0	0	0.00	0.00
Eastern Arm	2	9	9	1	1	0.11	0.50
Los Angeles/Orange Counties							
Venice Beach	449	453	546	414	440	0.91	0.98
LA Harbor	669	669	710	186	186	0.28	0.28
Seal Beach NWR - Anahiem Bay	164	166	166	12	12	0.07	0.07
Bolsa Chica Ecological Reserve	200	200	226	15	15	0.08	0.08
Huntington State Beach	445	445	485	215	215	0.48	0.48
Burriss Sand Pit	8	9	9	7	9	0.78	1.13
Upper Newport Bay Ecological Reserve	37	37	42	12	18	0.32	0.49
San Diego County							
MCB Camp Pendleton- Totals	1422	1422	1530	369	369	0.26	0.26
Red Beach	12	12	14	4	4	0.33	0.33
White Beach	109	109	117	38	38	0.35	0.35
Santa Margarita River - North Beach North	266	266	288	60	60	0.23	0.23
Santa Margarita River - North Beach South	922	922	984	260	260	0.28	0.28
Santa Margarita River - Saltflats	74	74	85	7	7	0.09	0.09
Santa Margarita River - Saltflats Island	39	39	42	0	0	0.00	0.00
Batiquitos Lagoon Ecological Reserve- Totals	575	578	594	146	226	0.25	0.39
W1	37	40	40	15	21	0.38	0.57
W2	371	371	379	116	188	0.31	0.51
E1	163	163	170	15	17	0.09	0.10
E2	0	0	0	0	0	0.00	0.00
E3	4	4	5	0	0	0.00	0.00
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0.00	0.00
Mission Bay							
FAA Island	22	22	28	2	2	0.09	0.09
North Fiesta Island	20	30	39	6	8	0.20	0.40
Mariner's Point	75	75	105	20	30	0.27	0.40
Stony Point	30	40	45	8	10	0.20	0.33
San Diego River Mouth	20	20	30	8	10	0.40	0.50
San Diego Bay							
Lindbergh Field & Former Naval Training Center	120	127	135	34	42	0.27	0.35
USN- Totals	1149	1149	1285	231	232	0.20	0.20
NI MAT	115	115	123	31	32	0.27	0.28
Delta Beach North	207	207	224	50	50	0.24	0.24
Delta Beach South	147	147	156	35	35	0.24	0.24
NAB Ocean	680	680	782	115	115	0.17	0.17
D Street Fill/Sweetwater Marsh NWR	100	115	130	25	28	0.22	0.28
Chula Vista Wildlife Reserve	33	39	46	0	0	0.00	0.00
South San Diego Bay Unit, SDNWR - Saltworks	50	73	97	13	18	0.18	0.36
Tijuana Estuary NERR	188	239	291	29	47	0.12	0.25
Totals:	6744	6989	7667	2293	2639	0.33	0.39

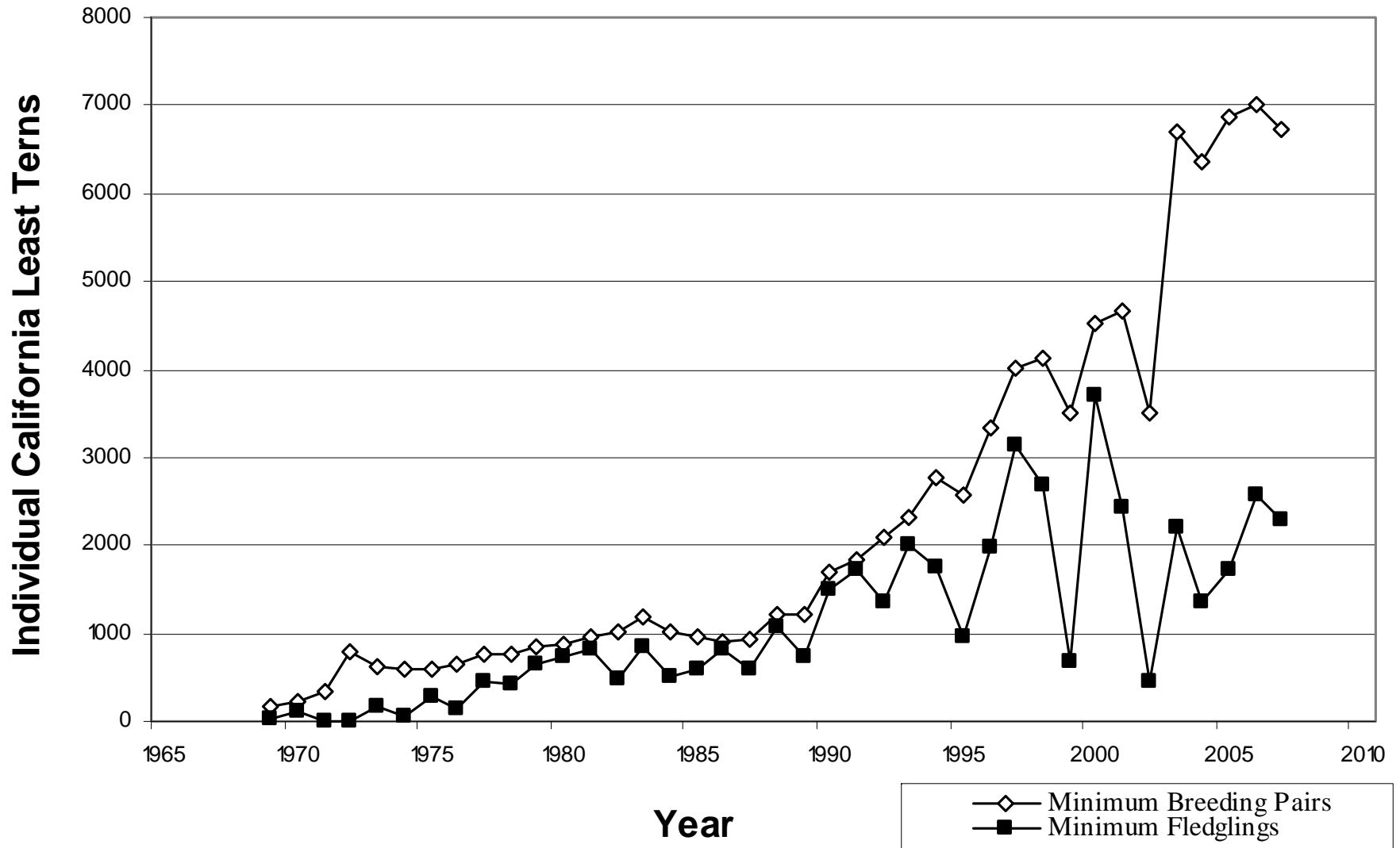


Figure 2. Number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1969-2007. (Data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al.* 1977; Jurek 1977; Atwood *et al.* 1979; Collins 1984, 1986 and 1987; Gustafson 1986; 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, 2007).

nesting, any technique monitors determined to be most representative of the actual number of breeding pairs was used as the estimate. Late nest initiation will often result in an underestimation when calculating the number of breeding pairs using any of the three traditional estimates. For consistency, the traditional estimates are provided in the appendices. Fledgling numbers were 11% lower than 2006 (Marschalek 2007), representing an average number over the last decade and the sixth highest total recorded.

The majority of breeding pairs nested in San Diego County (3804 pairs, 56.4%) and the fewest in San Luis Obispo and Santa Barbara Counties (77 pairs, 1.1%) (Table 3). Breeding pairs were not a predictor for fledgling numbers, however. The fledgling-to-pair ratio ranged from a low of 0.234 in San Diego County to a high of 1.130 in San Luis Obispo and Santa Barbara Counties.

Table 3. Regional productivity comparison, 2007.

Region	Breeding Pairs**	Proportion of Total	Fledglings**	Proportion of Total	Fledgling:Pair*
San Francisco Bay Area	436	0.065	202	0.088	0.469
San Luis Obispo/Santa Barbara Counties	77	0.011	87	0.038	1.130
Ventura County	455	0.067	252	0.110	0.554
Los Angeles/Orange County	1972	0.292	861	0.375	0.437
San Diego County	3804	0.564	891	0.389	0.234
Total	6744	1.000	2293	1.000	0.340

* 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.

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, Naval Base Coronado, LA Harbor, Batiquitos, and Venice Beach had the highest number of breeding pairs, nests, eggs, and chicks in the state in 2007. Rankings were the same in each of these categories with the exception of Naval Base Coronado having the most chicks. The five sites with the most fledglings produced differed due to different survival rates at each site. Hayward (1.40), Oceano Dunes (1.30), and Santa Clara (0.99) are the only three sites that produced more than two fledglings and had a minimum fledgling-to-pair ratio very close to or greater than one.

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 (1422)	Camp Pendleton (1530)	Camp Pendleton (2235)	Naval Base Coronado (1641)	Venice Beach (414)
Naval Base Coronado (1034)	Naval Base Coronado (1162)	Naval Base Coronado (2005)	Camp Pendleton (1600)	Camp Pendleton (369)
LA Harbor (669)	LA Harbor (710)	LA Harbor (1135)	LA Harbor (742)	Huntington Beach (215)
Batiquitos (575)	Batiquitos (594)	Batiquitos (939)	Batiquitos (711)	Naval Base Coronado (200)
Venice Beach (449)	Venice Beach (546)	Venice Beach (775)	Venice Beach (571)	LA Harbor (186)

A few sites constituted the majority of breeding activity for the state in 2007, which is a trend observed in the past (Caffrey 1994, 1995, 1997, 1998; Marschalek 2005, 2006, 2007). Four sites (Camp Pendleton, Naval Base Coronado, Los Angeles Harbor, and Batiquitos Lagoon Ecological Reserve) had over 500 minimum breeding pairs, which represented 55% of the state total, similar to 58% in 2006. 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 four sites with over 200 fledglings each (Venice Beach, Camp Pendleton, Huntington Beach, and Naval Base Coronado) contributed 52% of the state's production.

Mortality and Predation

The 2007 chick mortality rate of 9% represented a decrease for the third consecutive year (Marschalek 2005, 2006, 2007) (Table 5). Despite the lower mortality statewide, the larger nesting colonies continued to experience rates greater than the average. At Alameda Point, Venice Beach, Batiquitos Lagoon Ecological Reserve, and Camp Pendleton 26, 22, 15, and 15% of chicks were found dead, respectively. This represents a decrease in chick mortality rates for these sites compared to 2006 with the exception of Venice Beach, which increased from 1.5% a year ago. These four sites represented 79% of the total reported chick deaths, but only 42% of the total chicks hatched. Least tern mortality due to non-predation factors was greater than mortality due to predation in 2007.

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	2427	1257	755	112	22
Predation	747	347	578-583	86-87	107-109

Abandonment prior to the expected hatching date was the second highest death rate from non-predation events, leading to the loss of 905-1290 eggs (37-53%). 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.

High levels of chick mortality attributed to food shortages have been observed in past years (Caffrey 1993, Marschalek 2005, 2006, 2007). A few biologists suggested that fish of inappropriate size could be a cause of chick mortality in 2007. Others observed a satisfactory food supply. It is likely the food supply was better in 2007 than previous years due to the lower chick mortality rate.

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. Uncertainty is also reflected in a predation event reported as either suspected or documented in some cases, based on the evidence available and the conservative nature of the biologist. For this reason, the proportion of least terns lost to each predator species includes two different calculations: (1) only documented species, and (2) suspected and documented species.

Thirty-nine species were reported as possible, suspected, or documented predators of least terns (Table 6). The most commonly documented predators were gulls (*Larus* sp.), peregrine falcons (*Falco peregrinus*), common ravens (*Corvus corax*), and American kestrels (*Falco sparverius*). As in past years, most reported 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 (8)	Peregrine falcon (15)	Skunk (6)
Great egret (3)	Barn owl (3)	Gray fox (3)
Black-crowned night heron (4)	Great-horned owl (8)	Red fox (1)
Hérons (1)	Burrowing owl (4)	Coyote (10)
Egrets (1)	Owls (10)	Domestic dog (3)
Gulls (15)	American crow (10)	Bobcat (2)
Caspian tern (2)	Common raven (13)	Domestic cat (6)
Gull-billed tern (11)	Corvids (2)	California ground squirrel (3)
Black skimmer (2)	Loggerhead shrike (3)	Rats (7)
Black-bellied plover (3)	European starling (2)	Rodents (3)
Northern harrier (11)	Western meadowlark (2)	Unknown mammal (5)
White-tailed kite (4)	Unknown avian (11)	Snakes (4)
Cooper's hawk (8)	Long-tailed weasel (1)	Black widow spider (2)
Red-tailed hawk (10)	Rabbit (1)	Ants (8)
Crested caracara (1)	Opossum (7)	Unknown (10)
American kestrel (12)	Raccoon (6)	

Predation led to the loss of about 747 eggs, 578-583 chicks, 86-87 fledglings, and 107-109 adults (Table 5). Monitors reported fewer eggs and nests depredated than in 2006, but a greater number of chicks, fledglings and adults. A total of 1171 least tern individuals (including eggs) were reported with a documented predator species, and 1552 individuals were reported with a documented or suspected predator species.

Unknown predators were responsible for the greatest loss of least terns (258 total individuals, 17%) in 2007 for documented and suspected data (Table 7). Black-crowned night-herons were responsible for the greatest loss among documented predator species (168 total individuals, 14%). Although each category had a different predator species responsible for the most predated least tern individuals, both calculations had common species with similar proportions. Black-crowned night-heron (a single event at Bolsa Chica) and gull-billed tern predation were higher than previous years, while coyotes and American crows were responsible for a lower proportion of predated terns than previous years (Marschalek 2005, 2006, 2007). Nests were excluded from this analysis since the number of eggs better represents the loss of individuals. Abandonment was also excluded from depredation data but can be driven by a predator. 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 (Documented and Suspected Predators)*	Species	Proportion of Least Tern Individuals Depredated (Documented Predators)*
Unknown	0.1663	Black-crowned night-heron	0.1435
Gull-billed tern	0.1305	Unknown	0.1239
Black-crowned night-heron	0.1086	Coyote	0.1205
Coyote	0.0935	Gull-billed tern	0.1136
American kestrel	0.0748	American crow	0.0889
American crow	0.0703	American kestrel	0.0641
Unknown avian species	0.0413	Unknown avian species	0.0530
Peregrine falcon	0.0345	Burrowing owl	0.0350
Burrowing owl	0.0277	Unknown mammal species	0.0333
Owl	0.0255	Owl	0.0316
Unknown mammal species	0.0251	Black skimmer	0.0290

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

It is evident from predation data that specific predator species are difficult to determine. Unknown species, black-crowned night-herons, gull-billed terns, and coyotes comprised about 50% of the predator mortality. Despite not expanding their nesting range, gull-billed tern individuals appear to be extending their foraging area, with observations at almost every least tern nesting site in San Diego County. This may result in increased predation; however, it appears least tern predation due to gull-billed terns is quite variable from year-to-year.

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, but is not meant to be all inclusive. Site-specific reports produced by the site biologist may be referred to if additional details are desired.

San Francisco Bay Area

Green Island

In 2007, a new least tern nesting site was discovered on the Napa River about 0.3 miles NNE of Good Luck Point. As part of monthly bird surveys, 19 least terns were observed on 27 June and 21 on 24 July with nesting activity. Due to the general nature of the surveys, specific breeding data is not available. At least two pairs established nests and each nest produced two chicks each. The outcome of these four chicks is unknown.

Montezuma Wetlands

This was the second year least tern nesting was documented at Montezuma Wetlands, with 32 pairs establishing 32 nests and producing 5-25 fledglings. This nesting site was unintentionally created as part of a tidal wetland restoration project that requires increasing the elevation of certain areas prior to flooding. A pile of sand and shells attracted least terns prior to breaching the levees and flooding the area. Possibilities of creating an alternative nesting site are being discussed so that the restoration project can be completed. Prior to the 2007 nesting season, some vegetation management was conducted and is more is planned prior to the 2008 season.

Pittsburg Power Plant

After least terns not nesting at Pittsburg Power Plant in 2006, seven breeding pairs established seven nests. However, no fledglings were produced due to predation or abandonment. Least terns have historically used 0.7 acres of a 4.0 acre berm with gravel substrate (WRA Environmental Consultants 2007). Site enhancement appears to have deterred Canada goose (*Branta canadensis*) use in 2007.

Alameda Point

At the Alameda Point site, 355-358 breeding pairs established 394 nests and produced 148-309 fledglings with reproductive activities later in the year than in 2006. There were fewer signs of predators than a year ago; however, barn (*Tyto alba*), burrowing (*Athene cunicularia*) and great horned (*Bubo virginianus*) owls, and red-tailed hawks (*Buteo jamaicensis*) were regularly observed in or near the nesting site. Predator sightings at Alameda Point, as well as Hayward Regional Shoreline, increased at the time least tern fledglings became more abundant. A couple of raptors that represented potential predators were trapped and relocated. The three previous years have experienced high chick mortality, but 2007 was much lower (26% compared

to 55% is 2006). A Tern Watch (TW) volunteer monitoring program was developed this year and is planned for 2008.

Hayward Regional Shoreline

Hayward Regional Shoreline experienced the third consecutive year of least tern nesting activity and the second production of fledglings. In 2007, 35 breeding pairs established 35 nests and produced 49 fledglings. In terms of fledgling per breeding pair ratio, this was one of the most successful sites in the state. Predation was minimal due to efforts of Wildlife Services; however, predator sightings at Hayward Regional Shoreline, as well as Alameda Point, increased at the time least tern fledglings became more abundant.

Prior to the 2007 breeding season, 165 tons of sand, salt, and oyster shells were moved onto the island. Starting in the spring of 2005, a solar-recharged sound system was installed specifically for attracting California least terns. This work has included 2,100 volunteers contributing 7,200 hours and more than \$55,000 in grant funds and donations were secured for the Tern Island Project from several sources. More details of the restoration work were recently published (Riensch 2007).

Eden Landing

In 2007, a new California least tern nesting site was discovered at Eden Landing Ecological Reserve. Five or six breeding pairs established six nests and no fledglings. It is believed that all nests of chicks were lost due to predation. The least tern nesting activity was discovered during surveys for western snowy plovers (*Charadrius alexandrinus nivosus*). The site has been monitored for plovers over the last five or six years with occasional least tern foraging observed, but this is the first year least terns have been observed nesting.

San Luis Obispo/Santa Barbara Counties

Oceano Dunes SVRA

The Oceano Dunes State Vehicular Recreational Area (SVRA) site had 54 breeding pairs, 66 nests, and produced 70 fledglings. This represents a near doubling in reproductive success compared to 2006. Least terns were observed roosting during the evening in the historic night roost area of the park, within a large seasonal enclosure.

Guadalupe-Mussel Rock

After not nesting at Guadalupe-Mussel Rock in 2006, one pair of least terns established one nest and produced one fledgling in 2007. This represents the first fledgling produced since 2002.

Vandenberg AFB

At Vandenberg AFB, 18 breeding pairs established 18 nests and produced 16 fledglings. This is the first year since 2003 that more than one fledgling was produced. Nesting activity was delayed at this site in 2007.

Coal Oil Point Reserve

For the third time in four years, least terns nested at Coal Oil Point Reserve. Four breeding pairs established four nests and failed to produce fledglings due to predation by red-tailed hawks and skunks. This site was used by about 25 least terns from other sites prior to migration.

Ventura County

Santa Clara River/McGrath State Beach

The Santa Clara River site had 56-77 breeding pairs establish 77 nests and produce 76 fledglings. Predation due to canids was the main cause of mortality. This site had limited monitoring in 2006 and the only estimate provided was 34 nests, which was not included in the 2006 annual report because of a delay in reporting.

Hollywood Beach

At Hollywood Beach, one breeding pair established one nest and produced two fledglings. This is the first year since 2004, and the third year overall that least tern nesting has been recorded at this site.

Ormond Beach

At Ormond Beach, 49-50 breeding pairs established 52 nests and produced 35 fledglings. The number of pairs and nests are nearly identical to the 2006 counts; however, the number of fledglings was slightly less.

NAS Point Mugu

Point Mugu had a total of 349-428 breeding pairs, 431 nests, and 139 fledglings. As in 2006, Ormond Beach East had the highest number of pairs, nests and fledglings of the sub-colonies. For the first time, least terns started nesting at Holiday Beach Salt Panne, an area adjacent to Holiday Beach. For a second straight year, coyote predation had less of an impact compared to 2004 and 2005. It was noted that the terns arrived at the nesting site a little later than usual.

Los Angeles/Orange Counties

Venice Beach

Venice Beach had 449-453 breeding pairs, 546 nests, and 414-440 fledglings, but fledglings were believed to be closer to 440. This represents the most productive year recorded at Venice Beach despite fairly high levels of predation from American kestrels (*Falco sparverius*) and American crows (*Corvus brachyrhynchos*), and 22% chick mortality rate. Nesting activities started later in 2007 than the previous two years.

Los Angeles Harbor

The Los Angeles Harbor site had 669 breeding pairs, 710 nests, and 186 fledglings. The chick mortality rate (47%) was similar to that of 2005 (40%) and more than in 2004 and 2006 (32% and 25%, respectively). As was the case in 2006, abandonment was the leading cause of mortality, with 385 eggs abandoned. Early in the nesting season it was observed that prey was limited based on number and size of courtship fish.

Seal Beach NWR

At Seal Beach NWR, 164-166 breeding pairs established 166 nests and produced 12 fledglings. Mortality due to great blue heron and coyote predation resulted in the low reproductive success. For the last several years, monitors are using 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, 200 breeding pairs established 226 nests and produced 15 fledglings, with Nest Site 1 having more nesting activity than South Tern Island. Nest trampling by black skimmers and black-crowned night-heron predation resulted in the low reproductive success in 2007, following two very productive years at Bolsa Chica.

Huntington State Beach

At Huntington State Beach, 445 breeding pairs established 485 nests and produced 215 fledglings. Mortality and predation were relatively low; however, disturbances due to helicopters were fairly common.

Burris Sand Pit

At Burris Sand Pit, eight or nine breeding pairs established nine nests and produced seven to nine fledglings. This is the first documented nesting at this site since 2004. Predation, dogs, human access, and water levels are reported potential threats to the nesting area.

Upper Newport Bay Ecological Reserve

At Upper Newport Bay Ecological Reserve, 37 breeding pairs established 42 nests and produced 12-18 fledglings. This was a Type 2 site so specific reproductive data are not available.

San Diego County
MCB Camp Pendleton

At Camp Pendleton, a total of 1422 breeding pairs established 1530 nests and produced 243-267 fledglings, the highest number of breeding pairs and nests of any site within the state for 2007. As in the last three years, the Santa Margarita River North Beach sites (North and South) had the majority of the least tern nesting and production, representing 84% of the pairs and 97% of the fledglings at Camp Pendleton. In fact, the North Beach South sub-colony alone had 65% of the breeding pairs and produced 93% of the fledglings of Camp Pendleton. There were 28 eggs that were found damaged, 26 believed to be trampled by black skimmers and two that may have been a result of the adult depredation. All are placed in the predation category. Chick mortality rate (15%) was much lower this year than previous years (43% in 2006, 49% in 2005, and 57% in 2004). Gull-billed terns were possible or suspected predators in past years, but first documented in 2007. Camp Pendleton represents the northernmost site from which gull-billed terns have been documented as least tern predators.

Batiquitos Lagoon Ecological Reserve

At Batiquitos Lagoon Ecological Reserve, 579 breeding pairs established 594 nests and produced 145-204 fledglings. Counts in these three categories are slightly lower than in 2006, but very similar to counts in 2003 and 2005 (Patton 2003; Marschalek 2006, 2007). Chick mortality (15%) decreased for the second consecutive year, resulting in only 109 dead chicks. Documented predation was slightly greater than in 2006, particularly with the chick age class.

San Elijo Lagoon Ecological Reserve

There was no nesting activity at San Elijo Lagoon Ecological Reserve in 2007.

Mission Bay
- FAA Island

At FAA Island, 22 breeding pairs established 28 nests and produced two fledglings. The number of breeding pairs and nests were lower than 2006 but fledgling production was the same. Predation was the cause for low reproductive success, particularly rats and gulls. Human activity on the island was more prevalent than in previous years.

- North Fiesta Island

The North Fiesta Island site had 20-30 breeding pairs establish 39 nests and produce 6-8 fledglings. This is the only site in the state that had a nest with four eggs. Predation post hatching was at a moderate level.

- Mariner's Point

At Mariner's Point, 75 breeding pairs established 105 nests and produced 20-30 fledglings. This follows a year that all nesting attempts failed.

- Stony Point

At Stony Point, 30-40 adults established 45 nests and 8-10 fledglings. Counts of all categories were considerably lower than 2006, which represented the first nesting since 1976.

- San Diego River Mouth (S)

The San Diego River Mouth (S) site had 20 breeding pairs, 30 nests, and 8-10 fledglings. This is the fourth year of documented nesting of least terns at this site, and the third year fledglings were produced.

San Diego Bay

- Lindbergh Field

At Lindbergh Field, 120-127 breeding pairs established 135 nests and produced 34-42 fledglings. Abandonment and predation led to a relatively low hatching rate (66%), particularly for a site with a larger breeding population.

- NAS North Island

At North Island, 115 breeding pairs established 123 nests and produced 31-32 fledglings.

-Naval Base Coronado

Naval Base Coronado had 1034 breeding pairs, 1162 nests, and 200 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 for the second consecutive year.

- D Street Fill/Sweetwater Marsh NWR

At D Street, 100-115 breeding pairs established 130 nests and produced 25-28 fledglings.

- Chula Vista Wildlife Reserve

Chula Vista NWR had 33-39 breeding pairs establish 46 nests but failed to produce fledglings.

- South San Diego Bay Unit, SDNWR - Saltworks

At Saltworks NWR, 50-73 breeding pairs established 97 nests and produced 13-18 fledglings.

Tijuana Estuary NERR

At Tijuana Estuary, 188-239 breeding pairs established 291 nests and produced 29-47 fledglings. The North subsite includes North Site, Southeast Dunes, and North Rivermouth, and the South subsite includes the South Rivermouth, North Trail, and South Trail.

California least terns experienced one of the most successful breeding seasons in 2007, with the third highest number of breeding pairs and sixth highest number of fledgling on record. Chick mortality was low again for a second consecutive year, but predation post-hatch was greater. Many of the same predator species, such as American crows and coyotes, continued to be an issue in 2007. However, it appears that predation by “protected” species or species of special concern is increasing and will be an important topic that will have to be addressed.

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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.

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
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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31											
32											
33											
34											
35											
36											
37											
38											
39											
40											
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.

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		Dana Riggs (WRA Env. Consultants)		1		Yes	No	Yes		4 Sand and gravel were added, gravel loosened.	
Alameda Point		Susan Euing	Devon Yacura, Meredith Elliott	2	Yes	Yes	No	Yes		4 No	USFWS and FAWR for US Navy
Hayward Regional Shoreline	Island #5	David Riensche	Luis Basso, K&G Bloom, Nathan Callison, Maggie Clark, Nancy Teruko Dodd, Peter Dramer, Meredith Elliott, Susan Euing, The Highs, John Mena, Marty Morrow, Brian Pinomaki, The Riensches, M&K Schynert, Petra Shawen, Mark Taylor, Pam Thompson, Pete Thompson, The Wileys.	4- Island	Yes	Yes- 10 roof tiles, 16 wood A-frames	Yes- 26 pairs	Yes		4 330,000 pounds of sand, salt, and oyster shells were moved onto the island.	Dave Riensche and volunteers.

Appendix B-1: Site Preparation (continued).

San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA		Joanna Iwanicha	Margaret Przybylski, Amber Clark, Mark Enos, Clint Scheuerman, Daniel Costello, Krysta Rogers, Kelly Biesen, Sharon Fee, Doug George. Limited time: Rebecca Fay, Cheryl Lish, Carie Wingert	1	Yes	Yes- approx. 40 tee pee shelters, approx. 20 A and T-frames	No	No	5. The nesting site is open to off-highway recreational vehicular use during the non-breeding season and this prevents or removes most vegetation.	Wood chips, branches and driftwood placed in enclosure, surf-cast wrack placed on shoreline. Seed broadcasted to encourage some vegetation for cover.	California Department of Parks and Recreation (Oceano Dunes State Vehicular Recreation Area)
Rancho Guadalupe Dunes Preserve/Park		Tom Applegate	None	Symbolic rope	Yes- seasonal closure signs on fence	None	No	No	None	No	N/A
Vandenberg AFB	Purisima Pt	Dan Robinette	Julie Lanser	2- electric	Yes	Yes- 45	No	No	7	No	
Coal Oil Point Reserve		Cris Sandoval		1- mesh net							
Ventura County											
Santa Clara River/McGrath State Beach		Reed Smith	Danielle Glenn	3 & 4	Yes- WSP signs	No	No	No	No		
Ormond Beach		Reed Smith		3	Yes	No	No	No	No		
Hollywood Beach		Reed Smith		3	Yes	No	No	No	No		
NBVC Pt. Mugu	Ormond East	Martin Ruane	Carly Gocal, Nate Lang, Robbie Sweet, Shelly Vogel	4	No	Yes	No	No	7		
	Holiday Beach			4	No	Yes	No	No	7		
	Holiday Beach Salt Panne			4	No	No	No	No	7		
	Eastern Arm			3	No	No	No	No	7		

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	Stacey Vigallon & Lauren Seckel	1- 6 foot high chain link	Yes- few	Yes	Yes	Yes	Yes	Sand clearing from fence, sea rocket removal, re-set grid.	Thomas Ryan, Stacey Vigallon & Lauren Seckel, LA Audubon Volunteers, Community Volunteers
LA HARBOR Pier 400		Kathy Keane									
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- clay roof tiles, approx. 180	Yes- approx. 10	Yes		Electric fence maintenance	USFWS/NWR and NWS Seal Beach
Bolsa Chica Ecological Reserve	South Tern Island	P. Knapp	B. Peterson, L. Hays, K. O'Reilly	3	Yes	Yes	No	Yes	2	No	P. Knapp, L. Hayes
	Nest Site 1	P. Knapp	B. Peterson, L. Hays, K. O'Reilly	3	Yes- WSP signs	No	Yes		7		P. Knapp, L. Hayes
Huntington State Beach	none	Jim Kelly	Randy Nagel, Cyndie Kam	2	Yes	Yes	No	Yes		1- It appeared that corridors had been dragged	
Upper Newport Bay ER		Kathy Keane		None	None	Yes	No	Yes			

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											
Camp Pendleton	Red Beach	Brian Foster		None	No	No	No	No	No		
	White Beach	Brian Foster		Temp/Permanent	Yes	No	No	Yes	Yes		Base Contract
	Santa Margarita Riv-N Beach N	Brian Foster		Temp/Permanent	Yes	No	No	Yes	Yes		Base Contract
	Santa Margarita Riv-N Beach S	Brian Foster		Temp/Permanent	Yes	No	No	Yes	Yes		Base Contract
	Santa Margarita Riv-Saltflats	Brian Foster		None	No	No	No	Yes	No		
	Santa Margarita Riv-Saltflats Island	Brian Foster		None	No	No	No	Yes	No		
Batiquitos Lagoon Ecological Reserve	W1	Shauna Wolf	Lea Squires, Alexandra Copper, Brian Gibson	3	Yes	Yes	No	Yes	Yes		CDFG
	W2			3	Yes	Yes	No	Yes	Yes		CDFG
	E1			3	Yes	Yes	No	Yes	Yes		CDFG
	E2			3	Yes	Yes	No	Yes	Yes		CDFG
	E3			4	Yes	Yes	No	Yes	Yes		CDFG
San Elijo Lagoon Ecological Reserve		Robert Patton	Susan Welker, Maryanne Bache	3	Yes	No	No	No		7	

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:
Mission Bay											
FAA		Jennifer Jackson	Nancy Frost	3-Island	Yes	Yes	Yes	No		chick fence repair	J.Jackson
North Fiesta Island		Ginger Johnson	Jennifer Jackson	1	Yes	Yes-about 50	Yes 99	Yes		Plastic tarp for weed control	San Diego City Parks Dept
Mariner's Point		Ginger Johnson	Mark Billings	1	Yes	Yes-about 30	No	Yes		Fence & chick fence repair	San Diego City Parks Dept, SD Audubon Soc. volunteers
Stony Point		Ginger Johnson	Jennifer Jackson	1	Yes	No	No	Yes		New grid & chick fence added	San Diego City Parks Dept
San Diego River Mouth		Ginger Johnson	Mark Billings	1	Yes	No	No	No		Temp. plastic mesh fence & chick fence	San Diego City Parks Dept
San Diego Bay											
Lindbergh Field & Former Naval Training Center		Robert Patton	Elizabeth Copper, Brian Foster, Joe Barth	3	Yes	No	No	Yes			
NI MAT		Elizabeth Copper		1	No	Yes	Yes	Yes	Yes	Addition of sand	Navy Contractor
Delta Beach North		Elizabeth Copper		1	No	Yes	Yes	Yes	Yes	Addition of sand	Navy Contractor
Delta Beach South		Elizabeth Copper		1	to be installed in Spring 08	Yes	Yes	Yes	Yes	Addition of sand	Navy Contractor
NAB Ocean		Elizabeth Copper		3	No	No	No	Yes	intermittent		
D Street Fill/Sweetwater Marsh NWR		Robert Patton	Brian Collins, Jennifer Jackson, Joe Barth	3	Yes	Yes	Yes	Yes			
Chula Vista Wildlife Reserve		Robert Patton	Jennifer Jackson, Joe Barth	3	Yes	Yes	Yes	Yes			
South San Diego Bay Unit, SDNWR - Saltworks		Robert Patton	Brian Collins	3	No	Yes	No	No			
Tijuana Estuary NERR	North and South	Robert Patton	Brian Collins, Richard Burg, Joe Barth	3	Yes	Yes	No	Yes			

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	2	4-May-07	17-Jul-07	8	No	No	No	N/A
Alameda Point	1	24-Apr-07	21-Aug-07	91; 24 Type 1, 67 Type 2	Yes	No	No	N/A
Hayward Regional Shoreline	3	30-Apr-07	31-Aug-07	176	Yes	No	No	N/A
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	1	1-Mar-07	28-Sep-07	Some degree of monitoring on a daily basis.	Yes	No	Yes (chicks only)	Green over yellow on right leg, USFWS band on left leg and tape in 1 to 2 colors.
Rancho Guadalupe Dunes Preserve	1	5-Mar-07	12-Sep-07	64	No	No	No	N/A
Vandenberg AFB- Purisima Pt	3	15-Apr-07	7-Sep-07	105	Yes	No	No	N/A
Coal Oil Point Reserve	1						No	N/A
Ventura County								
Santa Clara River/McGrath State Beach	1	1-Jun-07	9-Aug-07	12	Yes	No	No	N/A
Ormond Beach	1	26-Apr-07	15-Aug-07	17	Yes	No	No	N/A
Hollywood Beach	1	31-May-07	13-Aug-07	11	Yes	No	No	N/A
NBVC Pt. Mugu (Total)	1	1-May-07	20-Aug-07	22	Yes	No	No	N/A
Ormond East	1	1-May-07	20-Aug-07	22	Yes	No	No	N/A
Holiday Beach	1	1-May-07	20-Aug-07	17	Yes	No	No	N/A
Holiday Beach Salt Panne	1	1-May-07	20-Aug-07	11	Yes	No	No	N/A
Eastern Arm	1	1-May-07	20-Aug-07	7	Yes	No	No	N/A
Los Angeles/Orange Counties								
Venice Beach, Marina del Rey, California	1	16-Apr-07	23-Aug-07	20	Yes	No	Yes	None
LA HARBOR Pier 400	1							
Seal Beach NWR/Anaheim Bay	1	16-May-07	11-Jul-07	9	Yes	No	Yes (chicks only)	None
Bolsa Chica Ecological Reserve	1	30-May-07	11-Jul-07	19	Yes	No	No	N/A
Huntington State Beach	1	16-May-07	8-Aug-07	13	Yes	No	No	N/A
Upper Newport Bay ER	2							

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	1				Yes	No	Yes	black/mauve
Red Beach	1				Yes	No	Yes	black/mauve
White Beach	1				Yes	No	Yes	black/mauve
Santa Margarita River - North Beach North	1				Yes	No	Yes	black/mauve
Santa Margarita River - North Beach South	1				Yes	No	Yes	black/mauve
Santa Margarita River - Saltflats	1				Yes	No	Yes	black/mauve
Santa Margarita River - Saltflats Island	1				Yes	No	Yes	black/mauve
Batiquitos Lagoon Ecological Reserve	1				Yes		Yes	W/R and R/W
W1	1				Yes		Yes	W/R
W2	1				Yes		Yes	R/W
E1	1				Yes		Yes	R/W
E2	1				N/A	N/A	N/A	N/A
E3	1				Yes		Yes	R/W
San Elijo Lagoon Ecological Reserve	1	9-Apr-07	1-Sep-07	15	N/A	N/A	N/A	N/A
Mission Bay								
FAA	2	16-Apr-07	17-Aug-07	22	Yes	Yes	No	N/A
North Fiesta Island	1	24-Apr-07	17-Aug-07	19	Yes	Yes	Yes- chicks	G/B left, USFWS band right.
Mariner's Point	1	23-Apr-07	16-Aug-07	19	Yes	Yes	Yes- chicks	G/B left, USFWS band right.
Stony Point	1	24-Apr-07	26-Jul-07	16	Yes	Yes	Yes- chicks	G/B left, USFWS band right.
San Diego River Mouth	1	22-Apr-07	18-Aug-07	20	Yes	Yes	Yes- chicks	G/B left, USFWS band right.
San Diego Bay								
Center	1	12-Apr-07	31-Aug-07	64	Yes	No	Yes	
USN Totals	1				Yes	Yes	Yes	
NI MAT	1				Yes	Yes	Yes	O/A
Delta Beach North	1				Yes	Yes	Yes	R/Y
Delta Beach South	1				Yes	Yes	Yes	W/K
NAB Ocean	1				Yes	Yes	Yes	B/F
D Street Fill/Sweetwater Marsh NWR	1	10-Apr-07	31-Aug-07	57	Yes	No	Yes	
Chula Vista Wildlife Reserve	1	10-Apr-07	31-Aug-07	48	Yes	No	Yes	
South San Diego Bay Unit, SDNWR -	1	12-Apr-07	5-Sep-07	40	Yes	No	Yes	
Tijuana Estuary NERR	1	12-Apr-07	20-Sep-07	39	Yes	No	Yes	

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	4-Jun-07	22-Jun-07	15-Jun-07	unknown			7
Alameda Point	24-Apr-07	18-Aug-07	10-May-07	23-Jul-07	316	78	355
Hayward Regional Shoreline	30-Apr-07	31-Aug-07	2-Jun-07	31-Jul-07	18	17	26.5
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	11-May-07	10-Sep-07	4-Jun-07	19-Jul-07	4	62	35
Rancho Guadalupe Dunes Preserve	22-May-07	17-Aug-07	25-Jun-07	25-Jun-07	0	1	0.5
Vandenberg AFB- Purisima Pt	11-May-07	4-Sep-07	19-Jun-07	24-Jul-07	0	18	9
Coal Oil Point Reserve							4
Ventura County							
Santa Clara River/McGrath State Beach	31-May-07	9-Aug-07	31-May-07	19-Jul-07	36	41	56.5
Ormond Beach	9-May-07	22-Aug-07	6-Jun-07	18-Jul-07	28	24	50
Hollywood Beach	6-Jun-07	30-Jul-07	6-Jun-07	6-Jun-07	1	0	1
NBVC Pt. Mugu (Total)	1-May-07	13-Aug-07	29-May-07	30-Jul-07	309	122	370
Ormond East			29-May-07	unknown	250	101	300.5
Holiday Beach			29-May-07	21-Jun-07	55	10	60
Holiday Beach Salt Panne			4-Jun-07	30-Jul-07	3	3	4.5
Eastern Arm			12-Jun-07	9-Jul-07	1	8	5
Los Angeles/Orange Counties							
Venice Beach	23-Apr-07	23-Aug-07	14-May-07	24-Jul-07	353	193	449.5
LA HARBOR Pier 400							669
Seal Beach NWR/Anaheim Bay	16-Apr-07	late July 07	pre 16 May 07	20-Jun-07	162	4	164
Bolsa Chica Ecological Reserve	14-Apr-07	23-Aug-07	15-May-07	10-Jul-07	188	38	207
Huntington State Beach	16-May-07	8-Aug-07	24-May-07	18-Jul-07	403	82	444
Burris Sand Pit							8-9
Upper Newport Bay ER							37

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)	21-Apr-07	13-Sep-07	17-May-07	20-Aug-07			1422
Red Beach	28-Apr-07	4-Aug-07	19-May-07	17-Jul-07			12
White Beach	26-Apr-07	16-Aug-07	19-May-07	9-Jul-07			109
Santa Margarita River - North Beach North	21-Apr-07	8-Sep-07	19-May-07	9-Aug-07			266
Santa Margarita River - North Beach South	26-Apr-07	13-Sep-07	17-May-07	20-Aug-07			922
Santa Margarita River - Saltflats	1-May-07	4-Aug-07	17-May-07	12-Jul-07			74
Santa Margarita River - Saltflats Island	1-May-07	4-Aug-07	22 May 07	23-Jun-07			39
Batiquitos Lagoon Ecological Reserve (Total)	26-Apr-07	18-Aug-07	12-May-07	3-Jul-07	561	33	577.5
W1	1-May-07	14-Aug-07	17-May-07	12-Jun-07	40	0	40
W2	26-Apr-07	18-Aug-07	12-May-07	3-Jul-07	362	17	370.5
E1	1-May-07	11-Aug-07	17-May-07	24-Jun-07	155	15	162.5
E2	10-May-07	21-Jul-07	N/A	N/A	0	0	0
E3	28-Apr-07	24-Jul-07	26-May-07	3-Jun-07	4	1	4.5
San Elijo Lagoon Ecological Reserve	29-Apr-07	13-Aug-07	N/A	N/A	0	0	0
Mission Bay							
FAA	30-Apr-07	17-Aug-07	21-May-07	20-Jul-07	19	9	23.5
North Fiesta Island	30-Apr-07	17-Aug-07	23-May-07	26-Jul-07	22	17	30.5
Mariner's Point	29-Apr-07	4-Aug-07	20-May-07	9-Jul-07	60	45	82.5
Stony Point	12-May-07	16-Jul-07	24-May-07	16-Jul-07	26	19	35.5
San Diego River Mouth	29-Apr-07	18-Aug-07	3-Jun-07	23-Jul-07	15	15	22.5
San Diego Bay							
Lindbergh Field & Former Naval Training	23-Apr-07	22-Aug-07	15-May-07	11-Jul-07	122	13	128.5
USN (Total)	20-Apr-07	15-Aug-07	14-May-07	30-Jul-07	1015	270	1149
NI MAT	24-Apr-07	6-Aug-07	14-May-07	17-Jul-07	107	16	115
Delta Beach North	25-Apr-07	13-Aug-07	14-May-07	23-Jul-07	191	33	207
Delta Beach South	20-Apr-07	15-Aug-07	14-May-07	25-Jul-07	138	18	147
NAB Ocean	30-Apr-07	7-Sep-07	14-May-07	30-Jul-07	579	203	680
D Street Fill/Sweetwater Marsh NWR	22-Apr-07	20-Aug-07	15-May-07	17-Jul-07	103	27	116.5
Chula Vista Wildlife Reserve	23-Apr-07	15-Aug-07	15-May-07	3-Jul-07	33	13	39.5
South San Diego Bay Unit, SDNWR -	22-Apr-07	23-Aug-07	16-May-07	18-Jul-07	50	47	73.5
Tijuana Estuary NERR	23-Apr-07	6-Sep-07	17-May-07	19-Jul-07	189	102	240
North of River	23-Apr-07	6-Sep-07	24-May-07	5-Jul-07	12	10	17
South of River	23-Apr-07	6-Sep-07	17-May-07	19-Jul-07	177	92	223

Appendix B-4: Productivity.

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	7	unknown	unknown	N/A	N/A		N/A	0
Alameda Point	394	678	490	0.7227	5-Jun-07	25-Jun-07	MIN. # = High daytime count every two weeks; MAX # = from total # of chicks hatched-all dead chicks and fledglings	Min: 148 Max: 309 Avg: 229
Hayward Regional Shoreline	35	67	55	0.8209	25-Jun-07	11-Jul-07	3WD	49
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	66	120	90	0.7500	30-Jun-07	21-Jul-07	Color band sightings (Note: using the 3WD method provided a count of 38)	70
Rancho Guadalupe Dunes Preserve	1	2	1	0.5000	17-Jul-07	6-Aug-07	Visual	1
Vandenberg AFB- Purisima Pt	18	29	20	0.6897	13-Jul-07	6-Aug-07	Highest number observed during daily roost counts from 6 Aug - 5 Sept	16
Coal Oil Point	6							0
Ventura County								
Santa Clara River/McGrath State Beach	77	128	100	0.7813	21-Jun-07	21-Jun-07	3WD	76
Ormond Beach	52	92	75	0.8152	27-Jun-07	11-Jul-07	3WD	35
Hollywood Beach	1	2	2	1.0000	26-Jun-07	16-Jul-07	3WD	2
NBVC Pt. Mugu (Total)	431	743	515	0.6931	18-Jun-07	10-Jul-07	3WN	139
Ormond East	351	596	479	0.8037	18-Jun-07	10-Jul-07	3WN	134
Holiday Beach	65	124	28	0.2258	18-Jun-07	18-Jul-07	3WN	4
Holiday Beach Salt Panne	6	9	6	0.6667	25-Jun-07	16-Jul-07	3WN	0
Eastern Arm	9	14	2	0.1429	25-Jul-07	6-Aug-07	None	1
Los Angeles/Orange Counties								
Venice Beach	546	775	571	0.7368	18-Jun-07	9-Jul-07		414-440
LA HARBOR Pier 400	710	1135	742	0.6537				186
Seal Beach NWR/Anaheim Bay	166	291	85	0.2921	13-Jun-07	4-Jul-07	Weight and wing length growth rate	12
Bolsa Chica Ecological Reserve	226	392	230	0.5867	12-Jun-07	2-Jul-07	Actual count	15
Huntington State Beach	485	772		0.8640	13-Jun-07	27-Jun-07	Count inside and outside colony	215
Burris Sand Pit	9	unknown	unknown	N/A	N/A		Actual count	7-9
Upper Newport Bay ER	42	unknown	unknown	N/A	N/A	N/A	N/A	12-18

Appendix B-4: Productivity (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:
San Diego County								
Camp Pendleton (Total)	1530	2235	1600	0.7159	7-Jun-07	30-Jun-07	Wing length + count estimates	369
Red Beach	14	24	8	0.3333	16-Jun-07	30-Jun-07	Wing length + count estimates	4
White Beach	117	194	151	0.7784	7-Jun-07	1-Jul-07	Wing length + count estimates	38
Santa Margarita River - North Beach North	288	420	294	0.7000	9-Jun-07	30-Jun-07	Wing length + count estimates	60
Santa Margarita River - North Beach South	984	1416	1113	0.7860	9-Jun-07	1-Jul-07	Wing length + count estimates	260
Santa Margarita River - Saltflats	85	125	29	0.2320	27-Jun-07	15-Jul-07	Wing length + count estimates	7
Santa Margarita River - Saltflats Island	42	56	5	0.0893	10-Jun-07	15-Jul-07	Wing length + count estimates	0
Batiquitos Lagoon Ecological Reserve (Total)	594	939	711	0.7572	5-Jun-07	24-Jun-07	R, 2W	145-204
W1	40	62	30	0.483871	12-Jun-07	3-Jul-07	R	15-21
W2	379	600	460	0.766667	5-Jun-07	24-Jun-07	R	116-168
E1	170	269	220	0.817844	5-Jun-07	3-Jul-07	2W	14-15
E2	0	0	N/A	N/A	N/A	N/A	N/A	0
E3	5	8	1	0.125	24-Jun-07	N/A	N/A	0
San Elijo Lagoon Ecological Reserve	0	0	N/A	N/A	N/A	N/A	N/A	0
Mission Bay								
FAA	28	47	15	0.3191	18-Jun-07	9-Jul-07	3WD	2
North Fiesta Island	39	64	47	0.7344	11-Jun-07	16-Jul-07	3WD	6-8
Mariner's Point	105	180	142	0.7889	10-Jun-07	3-Jul-07	3WD	20-30
Stony Point	45	78	63	0.8077	12-Jun-07	10-Jul-07	3WD	8-10
San Diego River Mouth	30	54	36	0.6600	13-Jun-07	8-Jul-07	3WD	8-10
San Diego Bay								
Lindbergh Field & Former Naval Training Center	135	238	156	0.6555	10-Jun-07	2-Jul-07	R & 3WD	34-42
USN (Total)	1285	2205	1785	0.8095	4-Jun-07	26-Jun-07		231-232
NI MAT	123	200	144	0.7200	4-Jun-07	26-Jun-07	combination of fledge counts and R	31-32
Delta Beach North	224	393	329	0.8372	5-Jun-07	28-Jun-07	combination of fledge counts and R	50
Delta Beach South	156	264	229	0.8674	6-Jun-07	30-Jun-07	combination of fledge counts and R	35
NAB Ocean	782	1348	1083	0.8034	4-Jun-07	26-Jun-07	combination of fledge counts and R	115
D Street Fill/Sweetwater Marsh NWR	130	214	160	0.7477	8-Jun-07	30-Jun-07	R & 3WD	25-28
Chula Vista Wildlife Reserve	46	81	42	0.5185	8-Jun-07	17-Jul-07	R & 3WD	0
South San Diego Bay Unit, SDNWR - Saltworks	97	166	91	0.5482	9-Jun-07	2-Jul-07	R & 3WD	13-18
Tijuana Estuary NERR	291	511	237	0.4638	8-Jun-07	28-Jun-07	R & 3WD	29-47
North of River	22	42	24	0.5714	14-Jun-07	12-Jul-07	R & 3WD	
South of River	269	469	213	0.4542	8-Jun-07	28-Jun-07	R & 3WD	

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														Type 2 site.
Alameda Point	0	0	73	49	57	0	0	54	40	49	127 (6 died hatching)	28	0	Possible domoic acid poisoning of the dead fledglings but could neither be confirmed or ruled out with necropsies.
Hayward Regional Shoreline	unknown	unknown	unknown	12	unknown	unknown	unknown	unknown	3	0	unknown	0	0	
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	7	13	10	0	0	6	4	5	4	4	0	Two juveniles and four chicks died of unknown cause. Necropsy of one juvenile was inconclusive and other juvenile and three chicks were found too desiccated to send away for necropsy.
Rancho Guadalupe Dunes Preserve	0	0	0	0	0	0	0	0	0	0	0	0	0	
Vandenberg AFB- Purisima Pt	0	0	5	3	0	0	0	3	2	0	2	0	0	
Coal Oil Point Reserve	0	0	0	0	2	0	0	0	0	1	0	0	0	
Ventura County														
Santa Clara River/McGrath State Beach	4	1	0	8	3	2	1	0	5	2	0	0	0	
Ormond Beach	1	0	3	5	3	1	0	4	2	2	4	0	0	Parent abandon after hatching.
Hollywood Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
NBVC Pt. Mugu (Total)	0	5	29	43	34	0	3	14	21	18	22	2	3	
Ormond East	0	0	27	36	31	0	0	13	18	16	22	2	3	
Holiday Beach	0	0	1	7	0	0	0	1	3	0	unknown	unknown	unknown	
Holiday Beach Salt Panne	0	2	0	0	0	0	1	0	0	0	unknown	unknown	unknown	
Eastern Arm	0	3	1	0	3	0	2	0	0	2	unknown	unknown	unknown	

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	0	1	11	0	0	0	1	5	2	0	0	site.
North Fiesta Island	0	0	15	0	0	0	0	12	0	0	3	5	0	
Mariner's Point	0	0	24	0	0	0	0	15	0	0	8	1	0	
Stony Point	0?	0	4	0	0	0?	0	4	0	0	3	0	0	Humans and dogs on site (tracks found) may have caused abandonment and/or loss of eggs
San Diego River Mouth	0	2	13	1	2	0	1	9	1	1	0	5	0	One nest never relocated after first discovery-probably flooded.
San Diego Bay														
Lindbergh Field & Former Naval Training Center	0	0	40	13	5	0	0	26	13	3	12	3	1	
USN (Total)	31	2	177	84	71	18	2	105	21	24	63	13	0	
NI MAT	0	0	44	12	1	0	0	1	5	1	11	3	0	1 chick died hatching included as pre-term abandonment in egg mortality.
Delta Beach North	0	1	24	23	5	0	1	20	6	2	39	5	0	6 chicks died hatching included as pre-term abandonment in egg mortality.
Delta Beach South	0	1	14	10	1	0	1	9	3	0	12	4	0	3 chicks died hatching included as pre-term abandonment in egg mortality.
NAB Ocean	31	0	95	39	64	18	0	75	7	21	1	1	0	7 chicks died hatching included as pre-term abandonment in egg mortality, one chick and one fledgling death attributed to human causes
D Street Fill/Sweetwater Marsh NWR	0	0	28	3	9	0	0	24	3	5	7	5	0	
Chula Vista Wildlife Reserve	0	0	2	1	0	0	0	2	1	0	0	0	0	
South San Diego Bay Unit, SDNWR - Saltworks	0	0	25	3	30	0	0	19	3	17	4	0	0	
Tijuana Estuary NERR	2	57	70	10	106	1	33	53	10	62	8	2	0	
North of River	0	0	10	0	8	0	0	6	0	4	0	0	0	
South of River	2	57	60	10	98	1	33	47	10	58	8	2	0	

Appendix B-6: Predation.

	Predation		
	Possible	Suspected	Documented
black widow spider	X		
ants (spp.)		X	X
snakes (spp.)	X	X	X
great blue heron	X	X	X
great egret	X		
black-crowned night heron	X	X	X
egrets (spp.)	X		
herons (spp.)	X		
gulls (spp.)	X	X	X
caspian tern	X		
gull-billed tern		X	X
black skimmer	X	X	X
white-tailed (black-shouldered) kite	X		
northern harrier	X	X	X
Cooper's hawk	X	X	X
red-tailed hawk	X		X
crested caracara	X		
American kestrel	X	X	X
peregrine falcon	X	X	X
black-bellied plover		X	X
barn owl	X	X	X
great-horned owl	X	X	X
burrowing owl		X	X
owls (spp.)	X		X
American crow	X	X	X
common raven	X	X	X
corvids			X
loggerhead shrike	X	X	X
European starling		X	X
western meadowlark	X		
unknown avian spp.	X	X	X
unknown mammal spp.			X
opossum	X	X	X
long-tailed weasel		X	
rabbit			X
California ground squirrel	X		
rats (spp.)	X	X	
rodents	X		X
domestic dog	X	X	
coyote	X	X	X
gray fox	X		X
red fox	X		
raccoon	X	X	X
skunk	X		X
bobcat			X
domestic cat	X	X	X
unknown		X	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	herons, egrets, WTKI, NOHA, CORA	rac			rac 8S				0	0	0	0	0
Alameda Point	gull, CORA EUST	ants, AMKE, BAOW, GHOW, BUOW, LOSH	NOHA, RTHA, PEFA, avian	avian 3D		NOHA 1D, PEFA 1D, avian 1D	RTHA 2D, LOSH 1S, avian 19D		3	2.5	3	22	0
Hayward Regional Shoreline	NOHA, RTHA, CORA, rfox, rac, cat		gull, PEFA			gull 1D		PEFA 1D	0	0	1	0	1
San Luis Obispo/Santa Barbara Counties													
Oceano Dunes SVRA	gull, NOHA, RTHA, AMKE, PEFA, GHOW, owl, LOSH, avian, op, coyote		avian	gull 0-9P, NOHA 0-9P, RTHA 0-9P, avian 0-9P, op 0-9P, coyote 0-9P	gull 0-5P, NOHA 0-5P, RTHA 0-5P, avian 0-5P, op 0-5P, coyote 0-5P	gull 0-16P, NOHA 0-16P, RTHA 0-16P, AMKE 0-16P, PEFA 0-16P, GHOW 0-16P, owl sp. 0-16P, LOSH 0-16P, avian 0-2D 0-16P, op 0-16P, coyote 0-16P			0	0	0	2	0
Guadalupe-Mussel Rock									0	0	0	0	0
Vandenberg AFB- Purisima Pt			owl					owl 2D	0	0	0	0	2
Coal Oil Point Reserve	GHOW		RTHA, skunk		Skunk 4D	RTHA 2D			unknown	4	2	0	0
Ventura County													
Santa Clara River/McGrath State Beach		coyote	coyote	coyote 10D	coyote 7D				13	9	0	0	0
Ormond Beach			rodents	rodents 2D	rodents 1D				2	4	0	0	0
Hollywood Beach									0	0	0	0	0
Pt Mugu (Total)			GHOW, avian, mammal, coyote	GHOW 3D, avian 4D, mammal 2D	GHOW 1D, avian 2D, mammal 1D, coyote 50D	coyote 2D		GHOW 1D	104	55	2	0	1

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			ant, gull, GBTE, BLSK, NOHA, RTHA, BAOW, GHOW, owl, CORA, corvid, avian, coyote, skunk, bobcat, mammal, unknown	ant 2D, gull 4D, GBTE 2D, BLSK 31D, NOHA 2D, CORA 7D, corvid 3D, avian 4D, coyote 22D, skunk 4D, bobcat 10D, mammal 35D, unknown 85D	ant 2D, gull 3D, GBTE 2D, BLSK 4D, NOHA 2D, CORA 5D, corvid 3D, avian 4D, coyote 16D, skunk 2D, bobcat 6D, mammal 26D, unknown 62D	ant 1D, gull 1D, GBTE 24D, NOHA 1D, RTHA 1D, GHOW 5D, owl 18D, avian 13D, unknown 94D	GHOW 2D, owl 6D, avian 2D, unknown 20D	BAOW 2D, GHOW 6D, owl 10D, avian 4D, unknown 24D	215	139	156	30	48
Red Beach			CORA, owl	CORA 7D	CORA 5D	owl 1D			7	5	1	0	0
White Beach			ant, BAOW, owl, mammal, unknown	ant 1D, mammal 1D, unknown 2D	ant 1D, mammal 1D, unknown 1D	ant 1D, owl 3D, unknown 9D	unknown 1D	BAOW 1D	4	3	13	1	1
Santa Margarita River - North Beach North			gull, NOHA, BAOW, GHOW, owl, corvid, avian, unknown	gull 1D, NOHA 1D, corvid 1D, unknown 5D	gull 1D, NOHA 1D, corvid 1D, unknown 4D	GHOW 1D, owl 2D, avian 10D, unknown 23D	owl 3D, avian 1D, unknown 1D	BAOW 1D, GHOW 2D, owl 3D, avian 3D, unknown 12D	9	8	39	6	21
Santa Margarita River - North Beach South			ant, gull, GBTE, BLSK, NOHA, RTHA, GHOW, owl, corvid, avian, unknown	ant 1D, gull 3D, GBTE 2D, BLSK 31D, NOHA 1D, corvid 2D, avian 2D, unknown 8D	ant 1D, gull 2D, GBTE 2D, BLSK 4D, NOHA 1D, corvid 2D, avian 2D, unknown 7D	gull 1D, GBTE 7D, NOHA 1D, RTHA 1D, GHOW 4D, owl 13D, avian 3D, unknown 60D	GHOW 2D, owl 3D, avian 1D, unknown 16D	GHOW 4D, owl 7D, avian 1D, unknown 12D	51	22	101	23	24

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													
Santa Margarita River - Saltflats			avian, coyote, skunk, bobcat, mammal, unknown	avian 1D, coyote 12D, skunk 4D, bobcat 7D, mammal 23D, unknown 48D	avian 1D, coyote 9D, skunk 2D, bobcat 4D, mammal 17D, unknown 31D	unknown 2D	unknown 2D		95	64	2	0	2
Santa Margarita River - Saltflats Island			avian, coyote, bobcat, mammal, unknown	avian 1D, coyote 10D, bobcat 3D, mammal 11D, unknown 24D	avian 1D, coyote 7D, bobcat 2D, mammal 8D, unknown 19D				49	37	0	0	0
Batiquitos Lagoon Ecological Reserve	BW spider	ant, snake, GBTE, COHA, avian, op, unknown	ant, snake, COHA, GHOW, avian, op, unknown	snake 1D, COHA 1S, avian 2S 2D, op 1P 1D, rac 5D, unknown 2S 5D	COHA 1S, avian 2S 2D, op 1P 1D, rac 3D, unknown 2S 3D	BW spider 1P, ant 1S 6D, snake 6S, GBTE 3-4S, op 1S 4D, unknown 2D	COHA 1D, unknown 1S	COHA 1S, GHOW 2D, unknown 3-4S	18	14	23-25	2	6-7
W1		COHA, unknown		COHA 1S	COHA 1S		unknown 1S	COHA 1S	1	1	0	1	1
W2		ant, GBTE, avian, op, unknown	ant, COHA, GHOW, avian, op, unknown	avian 2S 2D, op 1P 1D, unknown 2S 4D	avian 2S 2D, op 1P 1D, unknown 2S 2D	ant 1S 6D, GBTE 3-4S, op 1S 4D, unknown 2D	COHA 1D	GHOW 2D, unknown 3-4S	10	8	17-18	1	5-6
E1	BW spider	snake	snake, unknown	snake 1D, unknown 1D	unknown 1D	BW spider 1P, snake 6S			2	2	6-7	0	0
E2									0	0	0	0	0
E3			rac	rac 5D	rac 3D				5	3	0	0	0
San Elijo Lagoon Ecological Reserve	RTHA, AMKE, AMCR, CORA, dog, coyote, rac								0	0	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
Mission Bay													
FAA	WEME	GTBH, gull, rat	AMCR	gull 2S, AMCR 1D, rat 18S	gull 2S, AMCR 1D, rat 12S	GTBH 4S			21	15	4	0	0
North Fiesta Island	snake, CORA, op, skunk	gull, GBTE, AMKE	gull, GBTE, AMKE	snake 1P, gull 6S, CORA 1P, op 1P, skunk 1P	snake 1P, gull 6S, CORA 1P, op 1P, skunk 1P	gull 1D 0- 10S, GBTE 1D 0-20S, AMKE 6D 0- 20S	GBTE 0-15S, AMKE 0-15S		1	1	8	0	0
Mariner's Point	AMCR, rat	gull, AMKE, PEFA		gull 0-6S, AMCR 0-6P, rat 0-6P	gull 0-5S, AMCR 0-5P, rat 0-5P	AMKE 0-5S, PEFA 0-5S	AMKE 0-30S, PEFA 0-30S		6	5	0	0	0
Stony Point		gull, GBTE	GBTE	gull 4S	gull 4S	GBTE 3D, 0- 50S	GBTE 0-20S		10	7	3	0	0
San Diego River Mouth		COHA, AMKE, AMCR, CORA		AMKE 0-10S, AMCR 0- 10S, CORA 0 10S, COHA 0 10S	AMKE 5-10S, AMCR 5- 10S, CORA 5 10S, COHA 5 10S				0	0	0	5	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	GTBH, BCNH, gull, AMCR, op, rat, rac, skunk, cat	COHA AMKE, PEFA, CORA, LOSH, gfox	ant, AMKE, PEFA, CORA, LOSH, gfox	ant 3D, CORA 3S, gfox 9D 9S	ant 3D, CORA 2S, gfox 6D 7S	ant 8D, AMKE 3D 1S, PEFA 1D, LOSH 2D	COHA 1S, PEFA 3S	PEFA 2S	23	17	15	3-4	1-2
USN (Total)			GBTE, NOHA, COHA, PEFA, BBPL, BAOW, BUOW, owl, CORA, avian, op, rat, rabbit, human	GBTE 33D 1-5S, BBPL 4D, CORA 1D, rat 1D 0-3S, rabbit 1D		GBTE 63D, PEFA 1D 0-1S, BAOW 2D, BUOW 13D, owl 0-1S	COHA 1D, PEFA 7D, BUOW 6D, CORA 2D, op 1D	NOHA 1D, PEFA 5D 0-5S, BUOW 20D 1S, owl 1D 0-4S, avian 1D	45		79	17	34
NI MAT			COHA, PEFA, BUOW, CORA, avian	CORA 1D		BUOW 13D	COHA 1D, PEFA 3D, BUOW 6D, CORA 2D	PEFA 2D, BUOW 3D, avian 1D	1		13	12	6
Delta Beach North			GBTE, NOHA, PEFA, BBPL, BAOW, owl, rat	GBTE 4D 1-5S, BBPL 2D, rat 1D 0-3S		GBTE 17D, BAOW 1D	PEFA 3D	NOHA 1D, PEFA 0-1S, owl 0-1S	11		18	3	2
Delta Beach South			GBTE, PEFA, BAOW, owl, rabbit	GBTE 1D, rabbit 1D		PEFA 1D 0-1S, BAOW 1D, owl 0-1S		PEFA 1D 0-2S, owl 0-1S	3		2	0	3
NAB Ocean			GBTE, PEFA, BBPL, BUOW, owl, op, human	GBTE 29D, BBPL 2D		GBTE 46D	PEFA 1D, op 1D	PEFA 2D 0-2S, BUOW 17D 1S, owl 1D 0-2S	30		46	2	23

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													
D Street Fill/Sweetwater Marsh NWR	BW spider, snake, GTBH, GREG, gull, COHA, RTHA, BAOW, AMCR, CORA, WEME, rat, dog, coyote, skunk	GBTE, NOHA, AMKE, PEFA, cat, unknown	ant, GBTE, NOHA, AMKE	ant 2D, GBTE 6S, NOHA 2S, cat 1S, unknown 3S	ant 2D, GBTE 5S, NOHA 2S, cat 1S, unknown 3S	ant 6D, GBTE 1D 3S, NOHA 1D, AMKE 1D	AMKE 2D 2S	NOHA 1D, PEFA 1S	14	11	9-12	4	2
Chula Vista Wildlife Reserve	ant, GTBH, GREG, BCNH, gull, CATE, WTKI, COHA, RTHA, AMKE, BAOW, AMCR, gs, rat, gfox, skunk, cat	GBTE, NOHA, PEFA, CORA, unknown	mammal	NOHA 11S, CORA 5S, mammal 2D, unknown 18S	NOHA 7S, CORA 3S, mammal 1D, unknown 10S	GBTE 2S			36	21	2	0	0
South San Diego Bay Unit, SDNWR - Saltworks	GREG, CATE, WTKI, NOHA, COHA, RTHA, AMKE, AMCR, op, gs, rodent, rac	gull, GBTE, BLSK, PEFA, BAOW, CORA, EUST, coyote	gull, GBTE, BLSK, EUST, avian, coyote	gull 2D 1S, BLSK 3D, EUST 1D 2S, coyote 2D 4S	gull 2D 1S, BLKS 3D, EUST 1D 1S, coyote 2D 3S	GBTE 2D, avian 1D		PEFA 2S	17	13	3	0	2
Tijuana Estuary NERR	snake, GTBH, BCNH, gull, WTKI, RTHA, CRCA, owl, AMCR, CORA, op, rodent, gfox	GBTE, NOHA, AMKE, PEFA, BBPL, GHOW, BUOW, It weasel, gs, dog, coyote, cat	GBTE, PEFA, BBPL, GHOW, BUOW, avian, gs, cat	BBPL 4D, NOHA 3S, avian 7D, gs 5D, cat 9D	BBPL 3D, NOHA 2S, avian 5D, gs 4D, cat 5D	GBTE 4D, avian 1D	PEFA 1S	PEFA 1D 2S, GHOW 1D, BUOW 2D 1S	28	19	5	1	7
Totals:									672-673	347	557-562	86-87	107-109

Legend: P: Possible S: Suspected D: Documented

BW spider: Black widow spider
 GTBH: Great blue heron
 GREG: Great Egret
 BCNH: Black-crowned night-heron
 CATE: Caspian tern
 BBPL: Black-bellied plover
 GBTE: Gull-billed tern
 BLSK: Black Skimmer

WTKI: White-tailed Kite
 NOHA: Northern harrier
 COHA: Cooper's Hawk
 RTHA: Red-tailed hawk
 CRCA: Created caracara
 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
 It weasel: long-tailed weasel
 gfox: Gray fox
 rac: Raccoon
 mammal: Unknown mammal species