State of California
Natural Resources Agency
Department of Fish and Game
Wildlife Branch

California Least Tern Breeding Survey

2010 Season

by
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Nongame Wildlife Program, 2011-06

Final Report

To

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

Monitoring to document breeding success of California least terns (*Sternula antillarum browni*) continued in 2010, with observers at 41 nesting sites providing data. An estimated 6437-6699 California least tern breeding pairs established 6968 nests and produced 1971-2245 fledglings at 51 documented locations. The fledgling to breeding pair ratio was 0.29-0.35. Statewide, 12,826 eggs were reported, with a Site Mean clutch size of 1.82 eggs per nest (St Dev = 0.198) and the Statewide clutch size of 1.84 eggs (St Dev = 0.441) for Type 1 sites. Numbers of nesting least terns were not uniformly distributed across all sites. Camp Pendleton, Naval Base Coronado, Pt. Mugu, Batiquitos Lagoon, Bolsa Chica Ecological Reserve and Huntington Beach represented 73% of the breeding pairs while Camp Pendleton, Huntington Beach, Alameda Point, Naval Base Coronado and Batiquitos Lagoon Ecological Reserve produced 68% of the fledglings. The 2010 chick mortality rate of 18% is slightly greater than the last two years. Seal Beach, North Island Maintenance and Training Facility (NIMAT), Camp Pendleton, and Naval Base Coronado represented 73% of the total reported chick deaths, but only 56% of the total chicks. The predators responsible for the greatest number of depredated least terns in 2010 were gull-billed terns (*Gelochelidon nilotica*), common ravens (*Corvus corax*), coyotes (*Canis latrans*) and American crows (*Corvus brachyrhynchos*). Peregrine falcons (*Falco peregrinus*), great blue herons (*Ardea herodias*), common ravens, red-tailed hawks (*Buteo jamaicensis*), American crows, and western gulls (*Larus occidentalis*) were reported from the most sites. The monitoring effort of 2010 is scheduled to continue in 2011.

[1] Marschalek, D.A. 2011. California least tern breeding survey, 2010 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Program Report, 2011-06. Sacramento, CA. 28 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 2010 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2009 or who planned monitoring activities for 2010 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.

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.

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). Only the numbers of terns lost to a suspected or documented predator (possible category excluded) were used in calculating the proportion of least terns lost to predators. Past data shows little difference between only documented predation and combining suspected and documented predation (Marschalek 2008).

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-five of 41 sites monitored in 2010 were Type I sites, the majority monitored at least one or two times per week. A grid system to assist in locating nests was not used at every site but almost every monitor marked nests in some fashion. Site-specific and complete monitoring data are located in Appendix B-2.

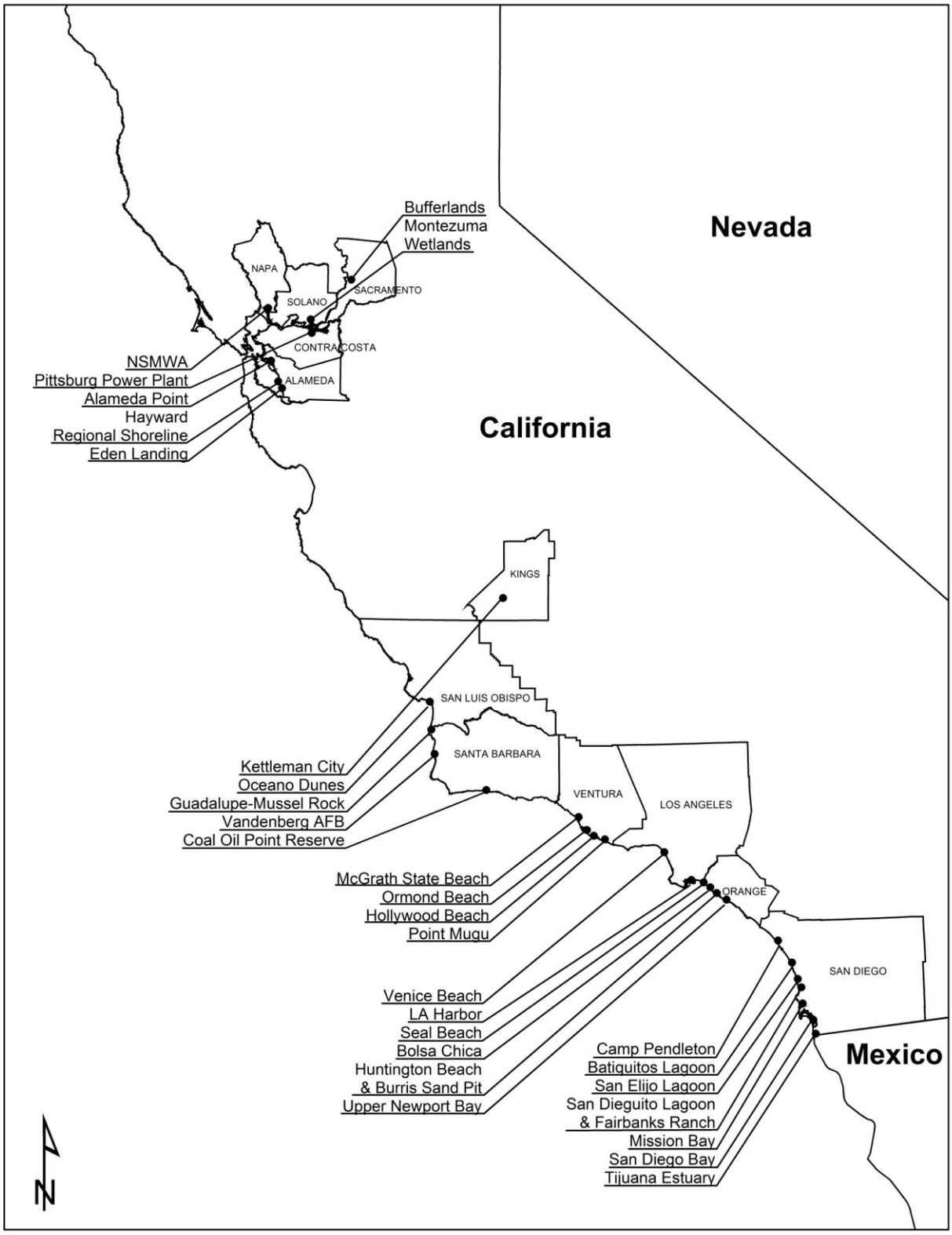

Figure 1. California sites monitored for California least tern nesting in 2010. Some listed areas include multiple sites, sites with nesting at more than one location, or both.

Productivity

At least partial data were received and analyzed for all monitored least tern nesting areas in California for 2010. An estimated 6437-6699 California least tern breeding pairs established 6968 nests and produced 1971-2245 fledglings at 51 documented locations (Table 1 and "Summary by Site" Section). The fledgling to breeding pair ratio was 0.29 to 0.35 fledglings per pair. Statewide, 12,826 eggs were reported, with a Site Mean clutch size of 1.82 eggs per nest (St Dev = 0.198) and a Statewide clutch size of 1.84 eggs (St Dev = 0.441). A correction is required for the 2009 Site Mean clutch size due to initially using sites with more than 50 nests rather than 50 eggs. The correct Site Mean clutch size for 2009 is 1.79 eggs per nest (St Dev = 0.115).

The 2010 California least tern nesting season lasted approximately four and a half months. The first recorded least tern at a nesting site was on 12 April at North Island Maintenance and Training Facility (NIMAT) and the last observed on 1 September at Oceano Dunes. The first nest was detected on 29 April at Camp Pendleton, the first chick at Bolsa Chica Ecological Reserve on 23 May, and first fledgling at Naval Amphibious Base (NAB) Ocean on 7 June. Least terns did not nest at three locations used in 2009 (Napa Sonoma Marsh Wildlife Area (NSMWA)- Huichica Creek Unit, Eden Landing, Fairbanks Ranch), however, they nested at four locations not used last year (Bolsa Chica Ecological Reserve- Nesting Site 3 and North Tern Island, San Diego River Mouth and Stony Point). The three locations used in 2009 and not in 2010 had seven nests total. Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

The 6437 recorded minimum breeding pairs in 2010 was about 10% lower than the 7130 total in 2009 (Marschalek 2010). This represents the lowest count recorded for California since 2004 (Figure 2) (Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood et al. 1977; Jurek 1977; Atwood et al. 1979; Collins 1984, 1986, 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, 2008, 2009, 2010). Due to concerns regarding late 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 about 13% greater than the 2009 count (Marschalek 2010), representing production similar to the average number of fledglings of the last seven years. The higher number of dead fledglings found in 2010 initiated a closer look at reported fledgling counts. This resulted in the discovery that the number of dead fledglings was included in the total fledgling numbers for some sites, while other sites did not include the dead fledglings in the total count. Different reporting of fledglings has likely continued for years but will be clarified for the 2011 statewide report.

The majority of breeding pairs nested in San Diego County (3864 pairs, 60.0%) and the fewest in San Luis Obispo, Santa Barbara, and King Counties (51 pairs, 0.8%) (Table 2). Breeding pairs were not a predictor for fledgling numbers, however. The fledgling-to-pair ratio ranged from a low of 0.177 in Ventura County to a high of 1.216 in San Luis Obispo, Santa Barbara, and King counties. This is the first year since 2006 that San Diego County did not have the lowest fledgling to pair ratio within this regional comparison.

Table 1. California least tern productivity in 2010. Sub-colony data included in the "Summary by Site" section.

2010	Estimated Number of Breeding Pairs		Number of Nests	Estimated Number of Fledglings		Fledgling per Pair Ratio	
Site	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum
Sacramento Area							
Bufferlands	1	1	1	1	1	1.00	1.00
San Francisco Bay Area							
Napa Sonoma Marsh Wildlife Area- Totals	46	47	47	85	85	1.81	1.85
Montezuma Wetlands	23	23+	17+	5	5+	0.22	0.22
Pittsburg Power Plant	0	0	0	0	0	0.00	0.00
Alameda Point	287	302	320	221	221	0.73	0.77
Hayward Regional Shoreline	49	53	53	75	75	1.42	1.53
Eden Landing	0	0	0	0	0	0.00	0.00
Kings County							
Kettleman City Evaporation Ponds	1	1	1	2	2	2.00	2.00
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	17	23	23	29	29	1.26	1.71
Guadalupe-Mussel Rock	1	1	1	2	2	2.00	2.00
Vandenberg AFB	32	33	34	29	29	0.88	0.91
Coal Oil Point Reserve	0	0	0	0	0	0.00	0.00
Ventura County							
Santa Clara River/McGrath State Beach	36	36	36	14	14	0.39	0.39
Ormond Beach	48	48	48	16	16	0.33	0.33
Hollywood Beach	1	1	1	0	0	0.00	0.00
Pt Mugu- Totals	640	642	708	98	98+	0.15	0.15
Los Angeles/Orange Counties							
Venice Beach	148	164	164	0	0	0.00	0.00
LA Harbor	149	195	216	4	4	0.02	0.03
Seal Beach NWR - Anaheim Bay	259	259	265	32	32	0.12	0.12
Bolsa Chica Ecological Reserve- Totals	417	446	446	67	114	0.15	0.27
Huntington State Beach	398	405	433	298	298	0.74	0.75
Burris Sand Pit/Burris Basin	7	7	8	4	4	0.57	0.57
Upper Newport Bay Ecological Reserve	13	13+	13+	8	8	0.62	0.62
San Diego County							
MCB Camp Pendleton- Totals	1691	1691	1722	385	512	0.23	0.30
Batiquitos Lagoon Ecological Reserve- Totals	458	480	480	208	261	0.43	0.57
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0.00	0.00
Fairbanks Ranch	0	0	0	0	0	0.00	0.00
San Dieguito Lagoon Ecological Reserve	0	0	0	0	0	0.00	0.00
Mission Bay							
FAA Island	11	15	17	0	0	0.00	0.00
North Fiesta Island	16	25	25	0	0	0.00	0.00
Mariner's Point	87	99	117	40	50	0.40	0.57
Stony Point	1	1	1	0	0	0.00	0.00
San Diego River Mouth	8	8	9	6	9	0.75	1.13
San Diego Bay							
Lindbergh Field & Former Naval Training Center	100	111	116	29	38	0.26	0.38
NI MAT	82	82	84	25	25	0.30	0.30
Naval Base Coronado- Totals	1071	1075	1115	220	220	0.20	0.21
D Street Fill/Sweetwater Marsh NWR	105	118	119	15	27	0.13	0.26
Chula Vista Wildlife Reserve	19	35	40	2	2	0.06	0.11
South San Diego Bay Unit, SDNWR - Saltworks	41	57	65	5	11	0.09	0.27
Tijuana Estuary NERR	174	202	223	46	53	0.23	0.30
Totals:	**6437**	**6699+**	**6968+**	**1971**	**2245+**	**0.29**	**0.35**

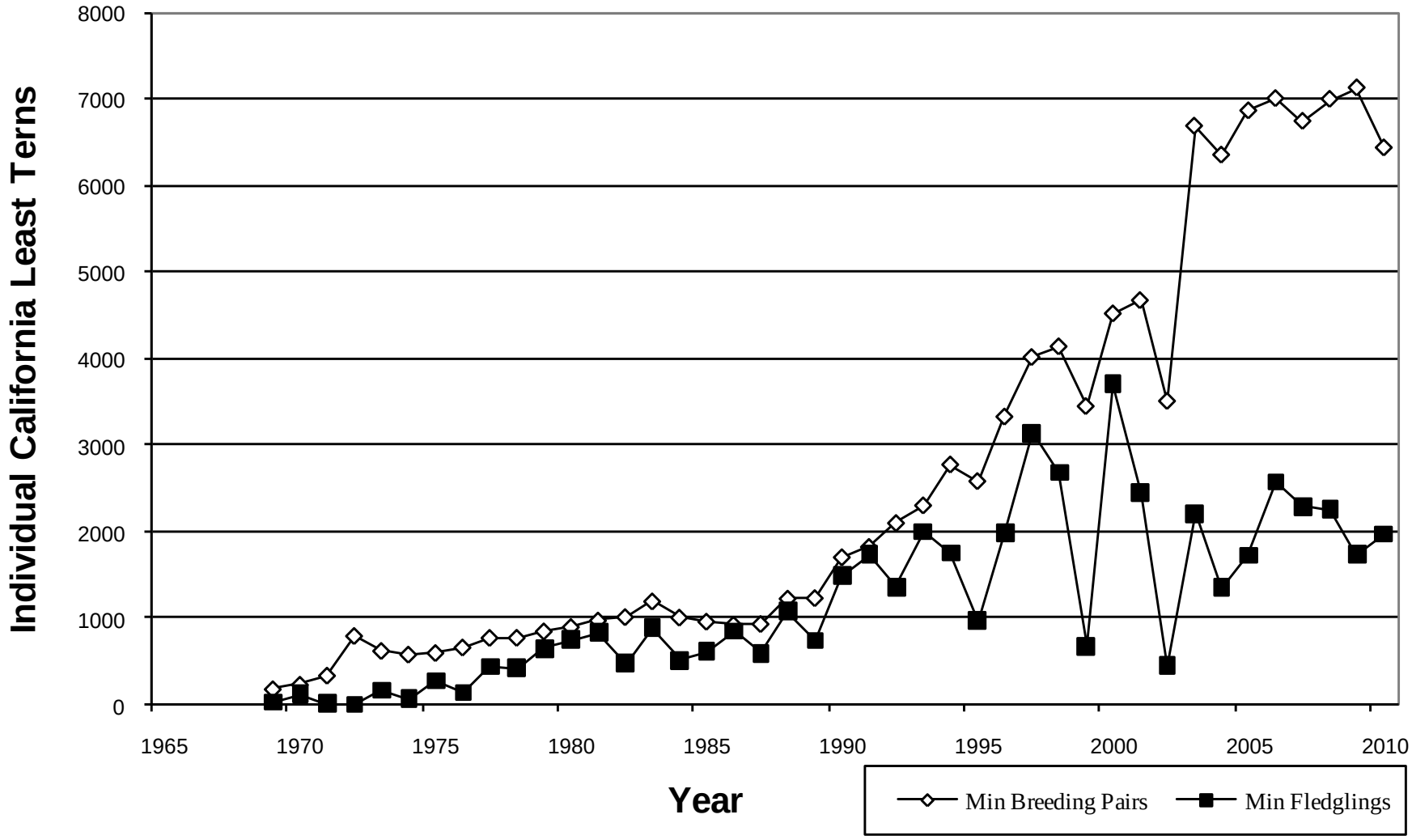

Figure 2. Minimum number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1969-2010. (Data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al*. 1977; Jurek 1977; Atwood *et al*. 1979; Collins 1984, 1986, 1987; Gustafson 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, 2008, 2009, 2010).

Table 2. Regional productivity comparison, 2010.

Region	Breeding Pairs**	Proportion of Total	Fledglings**	Proportion of Total	Fledgling:Pair*
San Francisco Bay Area (w/Bufferlands)	406	0.063	387	0.196	0.953
San Luis Obispo/Santa Barbara/King Counties	51	0.008	62	0.031	1.216
Ventura County	725	0.113	128	0.065	0.177
Los Angeles/Orange County	1391	0.216	413	0.210	0.297
San Diego County	3864	0.600	981	0.498	0.254
Total	6437	1.000	1971	1.000	0.306

* 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 3). Camp Pendleton, Naval Base Coronado, Pt. Mugu and Batiquitos Lagoon Ecological Reserve had the highest number of breeding pairs, nests, and eggs in the state in 2010. The five sites with the most fledglings produced differed due to different survival rates at each site. Kettleman City Evaporation Ponds (2.00), Guadalupe-Mussel Rock (2.00), Napa Sonoma Marsh Wildlife Area (1.81), Hayward Regional Shoreline (1.42) and Oceano Dunes (1.12) are the only sites that had a minimum fledgling-to-pair ratio greater than one.

Table 3. 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 (1691)	Camp Pendleton (1722)	Camp Pendleton (3348)	Camp Pendleton (2858)	Camp Pendleton (385)
Naval Base Coronado (1071)	Naval Base Coronado (1115)	Naval Base Coronado (2112)	Naval Base Coronado (1829)	Huntington Beach (298)
Pt. Mugu (640)	Pt. Mugu (708)	Pt. Mugu (1165)	Batiquitos (816)	Alameda (221)
Batiquitos (458)	Batiquitos (480)	Batiquitos (922)	Huntington Beach (686)	Naval Base Coronado (220)
Bolsa Chica (417)	Bolsa Chica (446)	Huntington Beach (843)	Pt. Mugu (573)	Batiquitos (208)

A few sites constituted the majority of breeding activity for the state in 2010, which is a trend observed in the past (Caffrey 1994, 1995b, 1997, 1998; Marschalek 2005, 2006, 2007, 2008, 2009, 2010). Six sites (Camp Pendleton, Naval Base Coronado, Pt. Mugu, Batiquitos

Lagoon and Bolsa Chica Ecological Reserves, and Huntington State Beach) had over 300 minimum breeding pairs, which represented 73% 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. No four-egg clutches were observed in 2010. Fledgling numbers were also unevenly distributed as the five sites with over 100 fledglings each (Camp Pendleton, Huntington State Beach, Alameda Point, Naval Base Coronado and Batiquitos Lagoon Ecological Reserve) contributed 68% of the state's production.

Mortality and Predation

The 2010 chick mortality rate of 18% is slightly higher than rates of the last two years (15% in 2009 and 14% in 2008; Marschalek 2009, 2010) (Table 4). Several larger nesting colonies continued to experience rates greater than the average. At Seal Beach, NIMAT, Camp Pendleton, and Naval Base Coronado, 39, 24, 24 and 20% of chicks were found dead, respectively. These four sites represented 73% of the total reported chick deaths, but only 56% of the total chicks hatched in California. Least tern mortality due to non-predation factors was greater than mortality due to predation in 2010.

Table 4. 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	Chicks	Fledglings	Adults	Total
Non-predation	2141	1619	549	24	4333
Predation	1007	340	161	115-129	1623-1637

Abandonment prior to the expected hatching date was the second highest death rate from non-predation events behind chick mortality, leading to the loss of 1048 eggs, which was 49% of the eggs lost due to non-predation mortality. Abandonment post-term or failure to hatch is often difficult to distinguish from pre-term abandonment and contributed a slightly lower rate (22%) to the non-predation mortality. These rates are similar to those of 2009, however, the number of fledglings found dead (549) was much higher than in 2009 (93, Marschalek 2010).

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 both suspected and documented species. Previous calculations show similar trends when using only documented predator species (Marschalek 2008).

Forty-seven species were reported as possible, suspected, or documented predators of least terns (Table 5). The most commonly reported predators were peregrine falcons (*Falco peregrinus*), great blue herons (*Ardea herodias*), common ravens (*Corvus corax*), red-tailed hawks (*Buteo jamaicensis*), American crows (*Corvus brachyrhynchos*), and western gulls (*Larus occidentalis*). In addition to the usual predatory species, a least tern fledgling was observed attempting to eat a least tern chick. As in past years, most reported predators were avian species.

Table 5. 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 (17)	Long-billed curlew (1)	Skunk (10)
Great egret (11)	Rock pigeon (2)	Gray fox (3)
Black-crowned night-heron (10)	Barn owl (5)	Red fox (2)
Ring-billed gull (1)	Great horned owl (7)	Coyote (13)
California gull (9)	Owls (7)	Domestic dog (6)
Western gull (15)	American crow (15)	Canid (1)
Gulls (13)	Common raven (17)	Bobcat (1)
Caspian tern (5)	Corvids (3)	Domestic cat (7)
Gull-billed tern (8)	Loggerhead shrike (2)	California ground squirrel (9)
Least tern (1)	European starling (4)	Pocket gopher (1)
Black skimmer (3)	Western meadowlark (3)	Rats (5)
Northern harrier (14)	Red-winged blackbird (2)	Rodents (6)
White-tailed kite (5)	Great-tailed grackle (2)	Unknown mammal (9)
Cooper's hawk (12)	Unknown avian (13)	Gopher snake (2)
Red-tailed hawk (16)	Long-tailed weasel (1)	Snakes (5)
Swainson's hawk (1)	Black-tailed jackrabbit (3)	Ants (8)
Osprey (4)	Opossum (6)	Black widow spider (1)
American kestrel (13)	River otter (2)	Unknown (12)
Peregrine falcon (24)	Raccoon (9)	

Predation led to the loss of 1007 eggs, 340 chicks, 161 fledglings, and 115-129 adults (Table 4). A total of 1464 least tern individuals (including eggs) were reported with a documented or suspected predator species, meaning about ten percent of depredated least terns were due to unknown species. Of those lost to suspected or documented predator species, gull-billed terns (*Gelochelidon nilotica*, 222 total individuals, 14%), common ravens (203 total individuals, 13%), coyotes (*Canis latrans*, 191 total individuals, 12%) and American crows (170 total individuals, 11%) (Table 6) depredated the most least terns. All other species not listed in Table 6 each represented less than 5% of the depredation. 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 6. Species responsible for greatest proportion of known depredated least tern eggs, chicks, fledglings or adults.

Species	Proportion of Least Tern Individuals Depredated (Documented and Suspected Predators)*
Gull-billed tern	0.1438
Common raven	0.1318
Coyote	0.1240
American crow	0.1104
Avian species	0.0825
Peregrine falcon	0.0782

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

As in past years, most predation was a result of American crows, gull-billed terns, common ravens, and coyotes (Marschalek 2010). The foraging area of gull-billed terns appears to be expanding since 2007 and the predation rate is increasing as well; however the number of least terns suspected or documented to be depredated by gull-billed terns was much lower in 2010 (222) compared to 2009 (813). Predator species varied in importance among each least tern age class. Common ravens, coyotes and American crows had the largest depredation rate of eggs, while gull-billed terns depredated the most chicks, and peregrine falcons and unknown avian species depredated the most fledglings and adults (Table 7). In addition, fledgling and adult predation was almost exclusively restricted to avian predators.

Table 7. The five species responsible for greatest proportion of depredated least tern for each age class. Total least terns of each age class depredated in parentheses.

Eggs		Chicks		Fledglings		Adults	
Predator	**Proportion***	**Predator**	**Proportion***	**Predator**	**Proportion***	**Predator**	**Proportion***
Common raven (203)	0.2154	Gull-billed tern (188.5)	0.5108	Peregrine Falcon (56.5)	0.3779	Unknown avian (23)	0.2911
Coyote (187)	0.1984	American kestrel (49.5)	0.1341	Unknown avian (53)	0.3545	Peregrine falcon (22)	0.2785
American crow (170)	0.1804	Peregrine falcon (41)	0.1111	Red-tailed hawk (17)	0.1137	Great horned owl (19)	0.2405
Ground squirrel (71)	0.0753	Avian species (35)	0.0949	Unknown species (12)	0.0803	Domestic cat (6)	0. 0760
Unknown species (54)	0.0573	Ants (14)	0.0379	Western gull (4)	0.0268	Two different species (3)	0. 0380

*This value represents the proportion of least terns within the particular age class depredated by the particular predator species.

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.

Sacramento Area
Bufferlands

One pair established a nest on a gravel road situated between two treatment ponds associated with the Sacramento Regional Wastewater Treatment Plant for the third consecutive year and second consecutive year successfully producing fledglings.

San Francisco Bay Area
Napa Sonoma Marsh Wildlife Area (*NSMWA*)

This was the fourth year least tern nesting was documented at NSMWA-Green Island Unit (Napa Plant). In 2010, 46-47 pairs established 47 nests and produced 85 fledglings (Table 8). The number of nests is similar to counts in 2009 but the 2010 fledgling counts are the highest reported from this site. This site had the highest fledgling to pair ratio (1.81) of any site with more than one nest.

Table 8. Sub-colony data for NSMWA.

	Breeding Pairs			Fledglings		Fledgling per Pair Ratio	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
Green Island Unit	46	47	47	85	85	1.81	1.85
Huichica Unit	0	0	0	0	0	0.00	0.00

Montezuma Wetlands

At Montezuma Wetlands, at least 23 pairs established at least 17 nests and produced at least 5 fledglings. Monitoring every other week and from an off-site location resulted in difficulties tracking individuals and nests throughout the breeding season.

Pittsburg Power Plant

There was no least tern nesting at Pittsburg Power Plant in 2010. This is the third time in the last four years that least terns did not nest at this site. A pair of Caspian terns (*Sterna caspia*) did nest at this site.

Alameda Point

At the Alameda Point site, 287-302 breeding pairs established 320 nests and produced 221 fledglings. A relatively high number of fledglings were depredated by avian predators in 2010.

Hayward Regional Shoreline

In 2010, 49-53 breeding pairs established 53 nests and produced 75 fledglings. This site had the second highest fledgling to pair ratio (1.42) in the state for sites with more than one nest.

Eden Landing

This was the first year least terns did not nest at Eden Landing after three years of attempted nesting. The area least terns used for nesting in the past was flooded due to restoration efforts. In addition, a high number of California gulls (*Larus californicus*) were present in 2010 that resulted in high depredation of snowy plovers (*Charadrius alexandrinus*).

Kings County

Kettleman City Evaporation Ponds

The Kettleman City Evaporation Ponds had one breeding pair establish one nest and produce two fledglings at the Westlake Farms South Evaporation Basin sub-colony. Least terns have not nested at the Tulare Lake Drainage District (TLDD) Hacienda Evaporation Basin sub-colony since 2004.

San Luis Obispo/Santa Barbara Counties

Oceano Dunes SVRA

The Oceano Dunes State Vehicular Recreational Area (SVRA) site had 25 breeding pairs, 23 nests, and produced 29 fledglings. This site had the third highest fledgling to pair ratio (1.26) in the state for sites with more than one nest.

Guadalupe-Mussel Rock

Guadalupe-Mussel Rock had one pair establish one nest and produce two fledglings in 2010.

Vandenberg Air Force Base (AFB)

At Vandenberg AFB, 32-33 breeding pairs established 34 nests and produced 29 fledglings. This represents the second consecutive year of higher fledgling counts following poor productivity in 2004-2006.

Coal Oil Point Reserve

There were no least tern nesting attempts at Coal Oil Point Reserve in 2010.

Ventura County

Santa Clara River/McGrath State Beach

The Santa Clara River site had 36 breeding pairs establish 36 nests and produce 14 fledglings.

Ormond Beach

At Ormond Beach, 48 breeding pairs established 48 nests and produced 16 fledglings.

Hollywood Beach

At Hollywood Beach, one breeding pair established one nest but failed to produce fledglings. This is the sixth year of least tern nesting at this site.

NAS Point Mugu

Point Mugu had a total of 640-642 breeding pairs, 708 nests, and at least 98 fledglings (Table 9). As in the last four years, Ormond Beach East had the highest number of pairs, nests and fledglings of the sub-colonies. Ground squirrel predation resulted in the loss of 95 eggs.

Table 9. Sub-colony data for Point Mugu.

	Breeding Pairs			**Fledglings**		**Fledgling per Pair Ratio**	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
Ormond Beach E	535	642	592	98	98+	0.18	0.18
Holiday Beach	62	63	70	unknown	unknown	unknown	unknown
Holiday Beach Salt Panne	31	32	34	unknown	unknown	unknown	unknown
Eastern Arm	12	12	12	0	0	0.00	0.00

Los Angeles/Orange Counties

Venice Beach

Venice Beach had 148-164 breeding pairs establish 164 nests, but did not produce any fledglings. Predation due to American crows was extremely high and resulted in 100% failure of nesting attempts for a second consecutive year. It was suspected that low anchovy numbers in the area (reported by local fisherman) resulted in adults spending more time away from the nesting site feeding; therefore, fewer adults were at the colony to defend against the crows.

Los Angeles Harbor

The Los Angeles Harbor site had 149-195 breeding pairs, 216 nests, and four fledglings. Predation due to common ravens (115 eggs) and abandonment (158 eggs) are responsible for the low reproductive success. As with Venice Beach, it was suspected that low food availability resulted in fewer adults being present at the nesting site.

Seal Beach NWR

At Seal Beach NWR, 259 breeding pairs established 265 nests and produced 32 fledglings. The number of pairs and nests are the highest reported from Seal Beach, with previous highs of 219 pairs and 219 nests in 1992. Lower fledgling production resulted from 116 chicks found dead and 65 eggs that were either abandoned post-term or nonviable.

Bolsa Chica Ecological Reserve

At Bolsa Chica Ecological Reserve, 417-446 breeding pairs established 446 nests and produced 67-114 fledglings (Table 10). Coyotes (146 eggs) and common ravens (60 eggs) were responsible for a higher level of predation compared to previous years.

Table 10. Sub-colony data for Bolsa Chica Ecological Reserve.

	Breeding Pairs			Fledglings		Fledgling per Pair Ratio	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
Nest Site 1	295	314	314	25	50	0.08	0.17
Nest Site 2	31	31	31	0	0	0.00	0.00
Nest Site 3	17	19	19	1	4	0.05	0.24
South Tern Island	72	80	80	41	60	0.51	0.83
North Tern Island	2	2	2	0	0	0.00	0.00

Huntington State Beach

At Huntington State Beach, 398-405 breeding pairs established 433 nests and produced 298 fledglings. Nest numbers were similar to 2009 but average clutch size was greater (Table 11).

Table 11. Comparison of clutch sizes for nests at Huntington State Beach in 2009 and 2010.

Year	Nests	1-egg nests	2-egg nests	3-egg nests	Ave. Clutch Size
2009	434	111 (25.6%)	321 (74.0%)	2 (0.5%)	1.75
2010	433	34 (7.9%)	388 (89.6%)	11 (2.5%)	1.95

Burris Sand Pit (*Burris Basin*)

At Burris Sand Pit, seven breeding pairs established eight nests and produced four fledglings. A reconfiguration project began in 2009 that will result in construction of a 2.4-acre, elevated bird nesting site so that the area will not be inundated during water management. During construction, a sand-capped floating island (3500 square feet in size) was provided for nesting and will be present at least until the project is complete, after the 2010 nesting season. Least terns did not nest on floating island, but instead chose two other locations on higher ground.

Upper Newport Bay Ecological Reserve

At Upper Newport Bay Ecological Reserve, at least 13 breeding pairs established at least 13 nests and produced 8 fledglings.

San Diego County

MCB Camp Pendleton

At Camp Pendleton, a total of 1691 breeding pairs established 1722 nests and produced 385-512 fledglings (Table 12), the highest number of breeding pairs of any site within the state for 2010. As in the last five years, the Santa Margarita River North Beach sites (North and South) had the majority of the least tern nesting and production, representing 89% of the nests and 92% of the fledglings at Camp Pendleton. A total of 182 fledglings from this site were found dead.

Table 12. Sub-colony data for Camp Pendleton.

	Breeding Pairs			Fledglings		Fledgling per Pair Ratio	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
Red Beach	0	0	0	0	0	0.00	0.00
White Beach	108	108	113	30	48	0.28	0.44
Delta Beach	6	6	6	0	0	0.00	0.00
Santa Margarita River- N Beach N	417	417	424	100	256	0.24	0.61
Santa Margarita River- N Beach S	1084	1085	1101	253	388	0.23	0.36
Santa Margarita River- Saltflats	54	54	56	2	2	0.04	0.04
Santa Margarita River- Saltflats Island	21	22	22	0	0	0.00	0.00

Batiquitos Lagoon Ecological Reserve

At Batiquitos Lagoon Ecological Reserve, 457-480 breeding pairs established 480 nests and produced 208-261 fledglings (Table 13). A total of 104 fledglings were found dead at this site.

Table 13. Sub-colony data for Batiquitos Lagoon Ecological Reserve.

	Breeding Pairs			Fledglings		Fledgling per Pair Ratio	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
W1	26	27	27	28	29	1.08	1.12
W2	287	301	301	150	192	0.52	0.67
E1	119	124	124	28	37	0.36	0.44
E2	0	0	0	0	0	0.00	0.00
E3	26	28	28	2	3	0.08	0.12

San Elijo Lagoon Ecological Reserve

There was no nesting activity at San Elijo Lagoon Ecological Reserve in 2010.

Fairbanks Ranch

Least tern nesting was not observed at this location in 2010.

Mission Bay
- FAA Island

At FAA Island, 11-15 breeding pairs established 17 nests but no fledglings.

- North Fiesta Island

The North Fiesta Island site had 16-25 breeding pairs establish 25 nests but no fledglings.

- Mariner's Point

At Mariner's Point, 87-99 breeding pairs established 117 nests and produced 40-50 fledglings. This follows two years of very low numbers of breeding pairs, nests and no fledglings but still lower than the counts prior to 2006 when nests consistently totaled over 200. There were 14 dead fledglings found at this site.

- Stony Point

One breeding pair established one nest but failed to produce fledglings at Stony Point in 2010.

- San Diego River Mouth (S)

At the San Diego River Mouth (S) site, eight breeding pairs established nine nests and produced six to nine fledglings.

San Diego Bay
- Lindbergh Field

At Lindbergh Field, 100-111 breeding pairs established 116 nests and produced 29-38 fledglings.

- North Island Maintenance and Training Facility (NIMAT)

At North Island, 82 breeding pairs established 84 nests and produced 25 fledglings.

-Naval Base Coronado

Naval Base Coronado had 1071-1075 breeding pairs, 1115 nests, and 220 fledglings, with most of the production at the Naval Amphibious Base Ocean sub-colony (NAB Ocean, Table 14). The number of breeding pairs decreased 27% from 2009, but the 2010 fledgling count was the highest since 2001. Non-predation mortality was high, including 365 chicks and 168 fledglings found dead. This dead fledgling count is included in the total fledgling count.

Table 14. Sub-colony data for Naval Base Coronado.

Sub-colony	Breeding Pairs		Nests	Fledglings		Fledgling per Pair Ratio	
	minimum	maximum		minimum	maximum	minimum	maximum
Delta Beach N	249	249	257	65	65	0.26	0.26
Delta Beach S	162	163	167	25	25	0.15	0.15
NAB Ocean	660	663	691	130	130	0.20	0.20

- D Street Fill/Sweetwater Marsh NWR

At D Street, 105-118 breeding pairs established 119 nests and produced 15-27 fledglings.

- Chula Vista Wildlife Reserve

Chula Vista NWR had 19-35 breeding pairs establish 40 nests and produce two fledglings.

- South San Diego Bay Unit, San Diego NWR - Saltworks

At Saltworks NWR, 41-57 breeding pairs established 65 nests and produced five to 11 fledglings.

-Tijuana River National Estuary Research Reserve (NERR)

At Tijuana Estuary, 174-202 breeding pairs established 223 nests and produced 46-53 fledglings.

Additional Monitoring Topics

Over the past couple of years, questions have arisen concerning the monitoring protocol outlined in the methods section of this report. Also, other calculations have been proposed at the annual working group meetings for least tern monitoring. Below are some of these:

Population Index: Number of Active Nests

A couple of years ago and again during the 2011 annual meeting, it was proposed that there could be some value in using the number of concurrent active nests as a population size index. An advantage of using nests is that they are easier to count than adult birds that are often flying around the nesting site, as well as leaving the site to forage. To date, it appears the only use of the breeding population size is to look at changes through time and make general comparisons between sites. The Navy sites in San Diego Bay have historically recorded the maximum number of active nests, allowing for a preliminary assessment of this parameter (Table 15)

Table 15. Breeding pair estimates and maximum active nest counts for U.S. Navy sites in San Diego Bay from 1999-2010.

Year:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Max Active Nests:	442	537	663	490	681	754	776	955	923	987	972	961
Estimated Pairs:	640	701	820	605	1119	1041	1135	1356	1149	1481	1586	1153

These data appear to have a linear relationship, supporting the use of linear regression to analyze these two parameters. The estimated number of breeding pairs and the maximum number of active nests are highly correlated ($R^2 = 0.8534$) suggesting either could be used to assess past population trends or to answer similar questions. The correlation is likely due to the number of nests playing a central role in breeding pair estimation. However, the number of maximum active nests could have value in relation to measuring the synchrony of nesting. For the 2011 statewide report, the number and date of maximum active nests will be requested.

Fledgling Estimate

A new fledgling calculation was proposed at the last annual meeting, suggesting that subtracting the number of dead chicks from the number of chicks would provide a more suitable estimate of fledgling numbers. Two reasons provided in support of this change are that past fledgling counts are variable and that past fledgling numbers were too low to explain a breeding population increase. There is no confirmation that fledgling production is a consistent rate, so it cannot be ruled out that past estimates are actually reflecting the natural variability in fledgling production. Because of the large number of chicks with unknown outcomes, subtracting the number of dead chicks from the number of chicks would certainly result in a higher number of fledglings (compared to current estimates) because it assumes all chicks with an unknown outcome are fledglings. Using data included in the annual reports, a preliminary analysis is included below.

Two approaches were taken to compare this new calculation to the originally-reported number of fledglings and breeding pairs. First, calculations of chick numbers included all nesting sites reporting hatched eggs (equals number of chicks) for an individual year but excluded sites reporting unknown number of chicks dead or depredated. This new fledgling estimate is compared with statewide totals originally reporting fledgling numbers and the minimum number of breeding adult least terns (Table 16, Figure 3). The second approach includes numbers from only those sites that reported number of chicks, dead and depredated chicks and fledglings for ***every*** year from 2004-2010 (Table 17). This generally excluded smaller sites, sites that have less regular monitoring, and those sites where least terns started nesting after 2004.

This preliminary assessment of chicks, fledglings and breeding pairs uses only data from 2004-2010 and is mainly descriptive rather than quantitative. Both approaches provided nearly identical trends so a graph of data provided in Table 17 is not shown. During this time period, the number of breeding adults remained relatively steady, the new fledgling estimate shows a general increase over time, and the originally reported fledgling numbers showed a rise and fall in numbers. For purposes of investigating any correlation between these fledgling estimates and

the adult population size, extending the data series may be useful. In addition, site-by-site analyses may also provide a better understanding of fledgling estimates.

Table 16. A comparison of a newly-proposed fledgling estimate (number of dead chicks subtracted from total number of chicks), originally reported fledgling numbers, and the minimum number of breeding adult least terns. The new estimate includes the subset of sites reporting chick numbers, while the original fledgling and adult numbers are statewide totals.

Year	Total chicks minus dead chicks	Original number of reported fledglings*	Minimum number of adults*	Citation
2004	4392	1351-1624	12,708	Marschalek (2005)
2005	6686.5	1721-2471	13,730	Marschalek (2006)
2006	6291	2571-3644	14,012	Marschalek (2007)
2007	6610.5	2293-2639	13,488	Marschalek (2008)
2008	7881.5	2254-2573	13,996	Marschalek (2009)
2009	7444	1734-2132	14,260	Marschalek (2010)
2010	7042	1971-2245	12,874	This report

*Adjustments were made to counts contained in the annual reports due to previously unknown nesting in Kings County. Those data were included in Marschalek (2010).

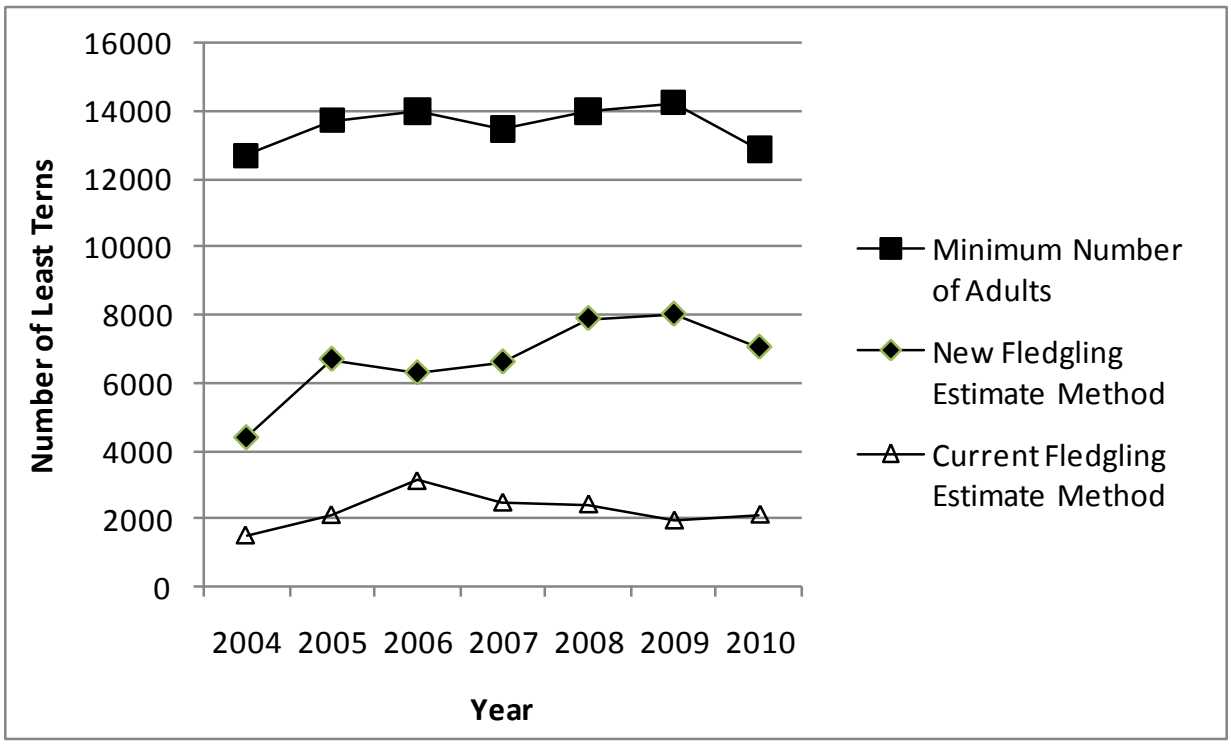

Figure 3. A comparison of a newly proposed fledgling estimate (number of dead chicks subtracted from total number of chicks), originally reported fledgling numbers, and the minimum number of breeding adult least terns. The new estimate includes the subset of sites reporting chick numbers, while the original fledgling and adult numbers are statewide totals.

Table 17. A comparison of a newly-proposed fledgling estimate (number of dead chicks subtracted from total number of chicks), originally reported fledgling numbers, and the minimum number of breeding adult least terns. All three categories reflect only the subset of sites reporting chick numbers for ***every*** year from 2004-2010, not statewide totals.

Year	Total chicks minus dead chicks	Original number of reported fledglings	Minimum number of adults	Citation
2004	4160.5	1210	11,065	Marschalek (2005)
2005	5853.5	1513	12,260	Marschalek (2006)
2006	5388	2281	12,248	Marschalek (2007)
2007	6102.5	1990	11,540	Marschalek (2008)
2008	6626.5	1568	12,200	Marschalek (2009)
2009	6310	1376	12,298	Marschalek (2010)
2010	6010	1351	11,090	This report

Currently, our ability to effectively and reliably determine fledgling numbers is limited. Certainly this newly-suggested estimate represents a maximum possible fledgling count as it assumes all unknown chicks successfully fledged. The more traditional method of summing periodic counts (Massey 1989a) has been shown to both over- and under-estimate the actual number of fledglings (Bailey and Servello 2008). Further investigation of fledgling counts could provide an understanding of the fledgling to pair ratio required to maintain a stable adult population. These data have been included in the annual reports and will hopefully be explored further.

Breeding Pair Calculations

Many sites have not experienced a distinctive second wave of nesting over the last several years. A second wave has been determined to be important in determining how many pairs are renesting after a failed attempt. This is based on an observation at Seal Beach in 1980 (Massey and Atwood 1981) that half of the pairs comprising the second wave are renesting and the other half are younger adults that start nesting later in the season. June 15 was the date observed as the start of the second wave, however, least tern nesting chronology has varied across years and to a greater degree between sites. June 20 has also been identified as the date after which renesting will not occur if a brood is lost. It has not been identified how these timing shifts will impact breeding pair estimates, but using these strict cutoff dates has presented unrealistic situations, particularly with Pair Estimation Method II. For example, assuming the number of broods lost before June 20 equals the number of pairs renesting, Pt. Mugu Eastern Arm would have zero pairs establishing 12 nests and North Fiesta Island would have one pair establish 25 nests (Appendix B-3). Possible reasons for these results may be that renesting did not occur at these sites or nesting occurred later in the year.

Statewide Chronology

Some biologists have expressed the desire to record and report the statewide chronology of active nest and fledgling numbers. These data may assist in tracking the movement of renesting pairs and fledglings and will be requested for the 2011 annual report.

These topics illustrate the importance of taking a closer look at the historic dataset within these annual reports as well as site-specific reports so that we can implement effective and efficient monitoring and management practices. Monitoring should be conducted in a way so

that the appropriate questions will be answered without unnecessary effort. Management should be directed by this type of monitoring so that the most effective management practices are implemented. The California least tern monitoring program could benefit from identifying or reassessing the questions that monitoring is meant to address.

Conclusion

In 2010, biologists recorded the lowest total of California least tern breeding pairs since 2004. Chick mortality continues to be a factor at specific sites, possibly a result of limited or inappropriate food sources. This may also be the reason for the increased number of fledglings found dead in 2010. Many of the same predator species, such as gull-billed terns, American crows, common ravens, and coyotes, continued to be an issue in 2010. In addition, the minimum fledgling-to-minimum breeding pair ratio (counts shown in Figure 2) continues to be low, at 0.29 in 2010. Since 1977, this ratio has been less than 0.50 in only 11 years which includes the last nine years.

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LITERATURE CITED

American Ornithologists' Union. 1957. Check-list of North American Birds, 5th Ed. American Ornitholoigsts' Union, Ithaca.

Atwood J.L., R.A. Erickson, P.R. Kelly, and P. Unitt. 1979. California least tern census and nesting survey, 1978. California Department of Fish and Game, Nongame Wildl. Investigations, E-W-2, Final Report, Job V-2.13. 6 pp + app.

Atwood, J.L., P.D. Jorgensen, R.M. Jurek, and T.D. Manolis. 1977. California least tern census and nesting survey, 1977. California Department of Fish and Game, Nongame Wildl. Investigations, E-1-1, Final Report, Job V-2.11. 6 pp + app.

Bailey, J.P. and F.A. Servello. 2008. Chick survival, fledgling residency and evaluation of methods for estimating fledgling success in least terns. Waterbirds. 31: 571-579.

Banks, R.C., C. Cicero, J.L. Dunn, A.W. Kratter, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising and D.F. Stotz. 2006. Forty-seventh supplement to the American Ornithologists' Union check-list of North American birds. The Auk. 123(3): 926-936.

Bender, K. 1974a. California least tern census and nesting survey, 1973. California Department of Fish and Game, Spec. Wildl. Investigations, Proj. W-54-R-6, Prog Report, Job II-11. 7 pp + app.

Bender, K. 1974b. California least tern census and nesting survey, 1974. California Department of Fish and Game, Nongame. Wildl. Investigations, Proj. W-54-R-6, Final Report, Job I-1. 4 pp + app.

Bridge, E.S., A.W. Jones and A.J. Baker. A phylogenetic framework for the terns (Sternini) inferred from mtDNA sequences: Implications for taxonomy and plumage evolution. Molecular Phylogenetics and Evolution. 35: 459-469.

Caffrey, C. 1993. California least tern breeding survey, 1992 season. California Department of Fish and Game, Wildlife Management Division, Nongame Bird and Mammal Section Report 93-11, Sacramento, CA. 35 pp.

Caffrey, C. 1994. California least tern breeding survey, 1993 season. California Department of Fish and Game, Wildlife Management Division, Nongame Bird and Mammal Section Report 94-07, Sacramento, CA. 39 pp.

Caffrey, C. 1995a. California Least Tern Monitoring Packet. California Department of Fish and Game, unpublished report under contract FG4121 WM.

Caffrey, C. 1995b. California least tern breeding survey, 1994 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 95-3, Sacramento, CA. 49 pp.

Caffrey, C. 1997. California least tern breeding survey, 1995 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 97-6, Sacramento, CA. 57 pp.

Caffrey, C. 1998. California least tern breeding survey, 1996 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 98-2, Sacramento, CA. 57 pp.

California Department of Fish and Game. 1976. At the crossroads: a report on California's endangered and rare fish and wildlife. State of California, Sacramento. 100 pp.

Cogswell, H. L. 1977. Water Birds of California. University of California Press, Berkeley and Los Angeles, CA. 399 pp.

Collins, C.T. 1984. End of year report California least tern field study, 1984 field season. California Department of Fish and Game. Unpubl. Report. 15 pp.

Collins, C.T. 1986. End of year report California least tern field study, 1986 field season. California Department of Fish and Game. Unpubl. Report. 19 pp.

Collins, C.T. 1987. End of year report California least tern field study, 1987 field season. California Department of Fish and Game. Unpubl. Report. 20 pp.

Craig, A.M. 1971. Survey of California least tern nesting sites. California Department of Fish and Game, Spec. Wildl. Investigations, Proj. W-54-R-4, Job Final Report, II-5.1. 7 pp + app.

Gustafson, J. 1986. Summary of the California least tern seasons for 1979-83 (5 years). California Department of Fish and Game. Unpubl. Report. 7 pp.

Johnston, S.M, and B.S. Obst. 1992. California least tern breeding survey, 1991 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 92-06. 19 pp.

Jurek, R.M. (ed). 1977. California least tern census and nesting survey, 1976. California Least Tern Recovery Team and California Department of Fish and Game, Nongame Wildl. Investigations, E-1-1. 5 pp. + app.

Keane, K. 1998. California least tern breeding survey, 1997 season. California Department of Fish and Game, Wildl. Manage. Div., Bird and Mammal Conservation Program Rep. 98-12, Sacramento, CA. 46 pp.

Keane, K. 2000. California least tern breeding survey, 1998 season. California Department of Fish and Game, Habitat Conservation and Planning Brach Rep., 2000-01, Sacramento, CA. 43 pp.

Keane, K. 2001. California least tern breeding survey, 1999 season. California Department of Fish and Game, Habitat Conservation and Planning Brach, Species Conservation and Recovery Program Rep., 2001-01, Sacramento, CA. 16 pp. + app.

Marschalek, D.A. 2005. California least tern breeding survey, 2004 season. California Department of Fish and Game, Habitat Conservation and Planning Branch, Species Conservation and Recovery Program Report, 2005-01. Sacramento, CA. 24 pp. + app.

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.

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

Marschalek, D.A. 2008. California least tern breeding survey, 2007 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2008-01. Sacramento, CA. 24 pp. + app.

Marschalek, D.A. 2009. California least tern breeding survey, 2008 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2009-02. Sacramento, CA. 23 pp. + app.

Marschalek, D.A. 2010. California least tern breeding survey, 2009 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2010-03. Sacramento, CA. 25 pp. + app.

Massey, B.W. 1974. Breeding biology of the California least tern. Proc. Linnean Soc. New York 72: 1-24.

Massey, B.W. 1975. California least tern census and nesting survey, 1975. California Department of Fish and Game (Nongame Wildl. Investigations) and U.S. Fish and Wildl. Serv. (Kern-Pixley N.W.R- Endangered Species Prog.). 5 pp. + app.

Massey, B.W. 1988. California least tern study, 1988 breeding season. California Department of Fish and Game, EW87 X-1, Contract FG 8553 Final Rep. 20 pp. + app.

Massey, B.W. 1989a. California Least Tern Fledgling Study, Venice CA. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report under contract FG 8553, Sacramento, CA. 8 pp.

Massey, B.W. 1989b. California least tern study, 1989 breeding season. California Department of Fish and Game, EW88 X-1, Contract FG 7660 Final Rep. 22 pp.

Massey, B.W. and J.L. Atwood. 1981. Second-wave nesting of the California least tern: age composition and reproductive success. Auk 98:595-605.

Obst, B.S., and S.M. Johnston. 1992. California least tern breeding survey, 1990 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 92-05. 13 pp.

Patton, R.T. 2002. California least tern breeding survey, 2000 season. California Department of Fish and Game, Species Conservation and Recovery Program Report, 2002-03. 24 pp. + app.

Patton, R.T. 2004. Unpublished table of California least tern productivity data, 2000-2003. California Department of Fish and Game, San Diego, CA.

Riensche, D.L. 2007. California least tern habitat enhancement and nesting in the East Bay Regional Park District, California. Transactions of the Western Section of the Wildlife Society. 43:62-71.

U.S. Fish and Wildlife Service. 1973. Threatened wildlife of the United States. Bureau of Sport Fisheries and Wildlife. Resource Publication 114. U.S. Government Printing Office, Washington, D.C. 289 pp.

U.S. Fish and Wildlife Service. 1980. California least tern recovery plan. U.S. Fish and Wildlife Service, Region 1. Portland, OR. 58 pp.

Whittier, J.B., D.M. Leslie and R.A. Van Den Bussche. 2006. Genetic variation among subspecies of least tern (*Sterna antillarum*): Implications for conservation. Waterbirds. 29(2): 176-184.

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)
		-									
		-									
		-									
		-									
		-									
		-									

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									
2									
3									
4									
5									
6									
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41									

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
1											
2											
3											
4											
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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:
Sacramento Area											
Bufferlands		C Conard		3							
San Francisco Bay Area											
NSMWA-Green Island Unit	South Island, East Island, Main Island and Spit	K Taylor	E Hanahoe	4	No	Yes- 40	Yes- 25	No	7- Total of 3 new man made islands, at an active construction site (former solar salt plant).	Oyster shells placed on (East Island), previous colony (2009) substrate preference (Main Island), base rock mixed with soil (South Island).	CDFG and contractor
NSMWA-Huichica Creek Unit		K Taylor									
Montezuma Wetlands	10NE	A Wallace		4	No	No	No	No	7		
Pittsburg Power Plant	none	D Riggs	J Yakich	1	No	Yes- 20	No	No	4		WRA
Alameda Point		Susan Euing	M Elliott, K Tanner	1	Yes	Yes- 250 wood A frames, 70 tile cylinders, 100 tile half-cylinders, oyster shells	No	Yes	4	Maintain/repair chick fencing, check that gravel around inside perimeter seals any holes at base of fence.	USFWS staff, FAWR and other volunteers.
Hayward Regional Shoreline		D Riensche, S Dulava, E Browhlee	Many	4- Island	Yes	Yes- 10	Yes- 15	Yes	4	335,000 lbs sand, salt, shells on island.	D Riensche and volunteers
Eden Landing		C Strong									
Kings County											
Kettleman City Evaporation Ponds		J Seay		4	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:
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA		J Iwanicha	M Przybylski, A Clark, D Costello, C Lish, J Miller, E Krygsman, D Murray, J Bunkley, P Lancaster, P Myers, R Nuffer, R Slack, D George	1	Yes	Yes- 75 T-shaped (7x19x14in.), 85 L-shaped (6x12x12in.), 75 A-shaped (6x12x11in.) plywood shelters.	No	No	5. Off-highway vehicular recreation use during non-breeding season prevents or removes most vegetation. Some vegetation growth encouraged for chick cover.	Limited amounts of branches, driftwood and woodchips put in exclosure. Seed broadcast or buried and some plants put out to encourage some vegetation for cover. Limited amounts of surf-cast wrack placed on shoreline. Management for both snowy plovers and	California Department of Parks and Recreation (Oceano Dunes State Vehicular Recreation Area)
Guadalupe-Mussel Rock		T Applegate		3	Yes	No	No	No	7	None	
Vandenberg AFB	Purisima Pt	D Robinette	J Howar	2 (electric)	Yes	Yes- 45 wood teepees	No	No	7	No	
Coal Oil Point Reserve											
Ventura County											
Santa Clara River/McGrath State Beach		R Smith	D Glen	3	Yes	No	No	No	7		
Ormond Beach		R Smith		1	Yes	No	No	No	No		
Hollywood Beach		R Smith		3	Yes	No					
Pt Mugu- Totals											
Holiday Beach	Holiday Beach	M Ruane	F Ferrara, R Kelley, S Murphy, J More, K Martinez	4	Yes	Yes- 25	No	No	7		
Holiday Salt Panne	Holiday Salt Panne	M Ruane	F Ferrara, R Kelley, S Murphy, J More, K Martinez	4	Yes	No	No	No	7		
Eastern Arm	Eastern Arm	M Ruane	F Ferrara, R Kelley, S Murphy, J More	4	Yes	No	No	No	7		
Ormond Beach East	Ormond Beach East	M Ruane	F Ferrara, R Kelley, S Murphy, J More, K Martinez, A Cleveland, J Hidalgo, S Alexander	4	Yes	Yes- 50	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		T Ryan	S Vigallon, S Albers	6 ft chain link	Yes- 6 new small signs on fence.	No	Yes- 30	Yes	2	Remove sea rocket & sand from fence, re-set grid, measured vegetation ht, % cover, dune ht & frequency, cleared grids for study.	T Ryan, S Vigallon, LA Audubon Volunteers, Community Volunteers, Dorsey High School Volunteers
LA Harbor		K Keane	M Amalong, L Andersen, S Langdon, N Liberato, O Lopez, S Lopez, N Mudry, W Ross, T Ryan, B Schallmann, M Teutimez	3	No	Yes- approx. 42 over 15 acres.	Yes- approx. 20	Yes	4		LA Harbor Dept.
Seal Beach NWR - Anaheim Bay	NASA Island	C Collins	J Fitch, W Ross, M Taylor	1- electric too	No	Yes- 100	Yes- 15	Yes	3	Grid and shelters prior to season.	NWR personnel
Bolsa Chica Ecological Reserve-Totals											
Nest Site 1 (NS1)		P Knapp	K O'Reilly, G Keller, W Ross, B Peterson, A Gutierrez	4	No	Yes- 15	No	Yes	4		
Nest Site 2 (NS2)		P Knapp	G Keller, B Peterson, A Guiterrez	4	No	No	No	Yes	4		
Nest Site 3 (NS3)		P Knapp	G Keller, B Peterson, A Guiterrez	4	No	Yes- 40	No	Yes	4		
South Tern Island (STI)		P Knapp	G Keller, K O'Reilly	4	No	Yes- 15	No	Yes	4		
North Tern Island (NTI)		P Knapp	G Keller, K O'Reilly	4	No	Yes- 88	Only for other tern species	Yes	4		
Huntington State Beach		C Kam	S Hoffman, J Coumoutso, A Beckman, D McMichael, T Barbee, B Nash, N Housel	1	Yes	Yes- 64	No	Yes	6		CA State Parks
Burris Sand Pit/Burris Basin		R Zembal	T Barbee, B Nash, D McMichael, D Bott, C Olsen	1	No	Yes- 27	No	Yes	1- vegetation partially removed		Orange County water District
Upper Newport Bay Ecological Reserve		C Bean, R Hamilton									

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- Totals		J Fournier	C Manning, K Turner								
Red Beach				4	No	No	No	No	None		
Delta Beach				4	No	No	No	No	None		
White Beach				3	Yes	No	No	Yes	None		
Santa Margarita River - North Beach North				3	Yes	No	No	Yes	None		
Santa Margarita River - North Beach South				3	Yes	No	No	Yes	None		
Santa Margarita River - Saltflats				3	No	No	No	Yes	None		
Santa Margarita River - Saltflats Island				3	No	No	No	Yes	None		
Batiquitos Lagoon Ecological Reserve- Totals		S Wolf	D Zaldivar, A Copper								
W1				1	Yes	Yes	No	Yes	4		CDFG & monitors
W2				1	Yes	Yes	No	Yes	4		CDFG & monitors
E1				1	Yes	Yes	No	Yes	4		CDFG & monitors
E2				1	Yes	No	No	Yes	4		CDFG & monitors
E3				Island	Yes	Yes	No	Yes	4		CDFG & monitors
San Elijo Lagoon Ecological Reserve		R Patton	M Bache, S Welker	3	Yes	No	No	N	6	flood control dike gate valve	County of SD Parks Dept
Fairbanks Ranch											
San Dieguito Lagoon Ecological Reserve		B Foster									
Mission Bay											
FAA Island		J Jackson		Island	Yes	Yes	Yes- 60	No	2,3		USFWS
North Fiesta Island		G Johnson		1	Yes	Yes- 60	Yes- 93	Yes	4	Chick fence installed	San Diego City Parks Dept
Mariner's Point		G Johnson		1	Yes	Yes- 40	Yes- 75	Yes	4	Buffer zone between parking lot and site	SD Audubon Soc. (veg. removal) and San Diego City Parks Dept
Stony Point		G Johnson		1	Yes	Yes- 40	Yes- 75	Yes	4	Buffer fence and buffer area where dogs not permitted	San Diego City Parks Dept
San Diego River Mouth		G Johnson		1	Yes	No	No	No	7	Black plastic fencing and chick fence present from early April-early Sept. Sand berms created to protect fence from flooding, preventing dog access.	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		R Patton	E Copper, B Foster, M Sadowski, M Garcia	3	Yes	No	No	Yes	4		
NI MAT		E Copper									
Delta Beach North		E Copper									
Delta Beach South		E Copper									
NAB Ocean		E Copper									
D Street Fill/Sweetwater Marsh NWR		R Patton	B Collins, J Jackson, M Sadowski	3	Yes	Yes- 180	Yes- 100	Yes	4		
Chula Vista Wildlife Reserve		R Patton	J Jackson, M Sadowski	3	Yes	Yes- 40	Yes- 100	Yes	4		
South San Diego Bay Unit, SDNWR - Saltworks		R Patton	B Collins	3	No	Yes- 20	No	No	7		
Tijuana Estuary NERR		R Patton	B Collins, M Sadowski	3	Yes	Yes- 100	No	Yes	7		

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 2009
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:
Sacramento Area								
Bufferlands								
San Francisco Bay Area								
NSMWA-Green Island Unit	1	29-Apr-10	9-Aug-10	24	Yes- marked oyster shells on East Island only.	No	No	
NSMWA-Huichica Creek Unit								
Montezuma Wetlands	3	24-May-10	6-Aug-10	8	No	No	No	No
Pittsburg Power Plant	1	26-Apr-10	9-Jul-10	11	No	No	No	N/A
Alameda Point	3	11-May-10	27-Jul-10	67	Yes- 4 inch metal washer.	No	No	NA
Hayward Regional Shoreline	3	1-Apr-10	13-Aug-10	360	Yes	Yes	No	N/A
Eden Landing								
Kings County								
Kettleman City Evaporation Ponds	2		11-Aug-10		No	No	No	
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	1	1-Mar-10	30-Sep-10	Site received some degree of monitoring on a daily basis.	Yes- naturally occurring materials	No	Yes (chicks only)	White over blue bicolor band on left leg, federal aluminum band placed on right leg and different colored tape on this band to create unique combinations.
Guadalupe-Mussel Rock	3	1-Mar-10	18-Aug-10	63	No	No	No	N/A
Vandenberg AFB	3	15-Apr-10	12-Aug-10	82	Yes- tongue depressor	No	No	
Coal Oil Point 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:
Ventura County								
Santa Clara River/McGrath State Beach	1	13-May-10	19-Aug-10	14	Yes	No	No	
Ormond Beach	1	23-Apr-10	4-Aug-10	14	Yes- tongue depressor	No	No	
Hollywood Beach	1	14-May-10	13-Aug-10	17	Yes	No	No	
Pt Mugu- Totals	1 & 3	27-Apr-10	5-Aug-10		Yes - tongue depressor, arundo stick	No	No	
Holiday Beach	1	27-Apr-10	4-Aug-10		Yes - tongue depressor, arundo stick	No	No	
Holiday Salt Panne	1	27-Apr-10	5-Aug-10		Yes - tongue depressor, arundo stick	No	No	
Eastern Arm	1	27-Apr-10	26-Jul-10		Yes - tongue depressor, arundo stick	No	No	
Ormond Beach East	3	27-Apr-10	3-Aug-10		Yes - tongue depressor, arundo stick	No	No	

Appendix B-2: Monitoring (continued).

Site name:	Site type:	Date of first monitoring visit:	Date of last monitoring visit:	Total number of monitoring visits:	Nest marking:	Egg marking:	Banding:	If color-banding, what color(s) were used:
Los Angeles/Orange Counties								
Venice Beach	1	20-Apr-10	23-Jul-10	20	Yes- tongue depressors	No	No	N/A
LA Harbor	1	1-May-10	28-Jul-10	91	Yes- tongue depressors	No	No	N/A
Seal Beach NWR - Anaheim Bay	1	12-May-10	14-Jul-10	10	Yes	No	Yes- chicks	Single plastic bands yellow/black split bands
Bolsa Chica Ecological Reserve-Totals								
Nest Site 1 (NS1)	1	11-May-10	8-Jul-10	7	Yes- tongue depressor	No	No	
Nest Site 2 (NS2)	1	6-Jun-10	7-Jul-10	3	Yes- tongue depressor	No	No	
Nest Site 3 (NS3)	1	13-May-10	27-Jun-10	15	Yes- tongue depressor	No	No	
South Tern Island (STI)	1	11-May-10	8-Jul-10	7	Yes- tongue depressor	No	No	
North Tern Island (NTI)	1	11-May-10	11-May-10	1	Yes- tongue depressor	No	No	
Huntington State Beach	1	14-May-10	23-Jul-10	17	Yes- tongue depressor	No	No	
Burris Sand Pit/Burris Basin	3	13-May-10	20-Jul-10	19	Yes- tongue depressor	No	No	
Upper Newport Bay 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:
San Diego County								
MCB Camp Pendleton- Totals								
Red Beach	1	31-Mar-10	10-Sep-10	21	N/A	N/A	N/A	N/A
Delta Beach	1	31-Mar-10	10-Sep-10	29	Yes	No	Yes- chicks	None
White Beach	1	31-Mar-10	10-Sep-10	46	Yes	No	Yes- chicks	None
Santa Margarita River - North Beach North	1	31-Mar-10	10-Sep-10	60	Yes	No	Yes- chicks	None
Santa Margarita River - North Beach South	1	31-Mar-10	10-Sep-10	63	Yes	No	Yes- chicks	None
Santa Margarita River - Saltflats	1	10-Apr-10	10-Sep-10	35	Yes	No	Yes- chicks	None
Santa Margarita River - Saltflats Island	1	10-Apr-10	10-Sep-10	35	Yes	No	Yes- chicks	None
Batiquitos Lagoon Ecological Reserve- Totals								
W1	1	16-Feb-10	30-Sep-10	81	Yes-wood shim		Yes- chicks	White over red
W2	1	16-Feb-10	30-Sep-10	89	Yes-wood shim		Yes- chicks	Red over white
E1	1	16-Feb-10	30-Sep-10	92	Yes-wood shim		Yes- chicks	Red over white
E2	1	16-Feb-10	30-Sep-10	71				
E3	1	16-Feb-10	30-Sep-10	44	Yes-wood shim		Yes- chicks	Red over white
San Elijo Lagoon Ecological Reserve	3	12-Apr-10	13-Sep-10	18+	Yes- tongue depressor	No	No	
Fairbanks Ranch								
Mission Bay								
FAA Island	1	28/04/10	24-Jul-10	18	Yes- tongue depressor	Yes	Yes- chicks	
North Fiesta Island	1	24-Apr-10	31-Aug-10	23	Yes- tongue depressor	Yes	Yes- chicks	L/B - S
Mariner's Point	1	20-Apr-10	28-Aug-10	31	Yes- tongue depressor	Yes	Yes- chicks	G/B - S
Stony Point	1	26-Apr-10	26-Aug-10	16	Yes- tongue depressor	Yes	No	
San Diego River Mouth	1	19-Apr-10	25-Aug-10	27	Yes- tongue depressor	Yes	Yes- chicks	G/B - S

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 Bay								
Lindbergh Field & Former Naval Training Center	1	2-Apr-10	17-Aug-10	75	Yes- tongue depressor	N	CH/AD	
NI MAT	1							
Delta Beach North	1							
Delta Beach South	1							
NAB Ocean	1							
D Street Fill/Sweetwater Marsh NWR	1	6-Apr-10	20-Sep-10	61	Yes- tongue depressor	N	CH/AD	
Chula Vista Wildlife Reserve	1	1-Apr-10	25-Aug-10	49	Yes- tongue depressor	N	CH/AD	
South San Diego Bay Unit, SDNWR - Saltworks	1	3-Apr-10	15-Sep-10	56	Yes- tongue depressor	N	CH/AD	
Tijuana Estuary NERR	1	1-Apr-10	16-Sep-10	40	Yes- tongue depressor	N	CH	

Appendix B-2: Monitoring (continued).

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, White/Blue	G/Y, Y/G, W/B
Seal Beach	Yellow/Black	Y/K
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 2006-2010)

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 in first wave:	Total nests in second wave:	Total pairs:
Sacramento Area							
Bufferlands	27-May-10	24-Aug-10	10-Jun-10	10-Jun-10	1	0	1
San Francisco Bay Area							
NSMWA-Green Island Unit	29-Apr-10	9-Aug-10	25-May-10	14-Jul-10	44	3	45.5
NSMWA-Huichica Creek Unit							
Montezuma Wetlands	24-May-10	28-Jul-10	2-Jun-10	unknown	unknown		unknown
Pittsburg Power Plant	N/A	N/A	N/A	N/A	0	0	0
Alameda Point	23-Apr-10	25-Jul-10	7-May-10	13-Jul-10	284	36	302
Hayward Regional Shoreline	26-Apr-10	13-Aug-10	14-May-10	15-Jul-10	45	8	49
Eden Landing							0
Kings County							
Kettleman City Evaporation Ponds	28-May-10	27-Jul-10	2-Jun-10		1		1
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	13-May-10	1-Sep-10	7-Jun-10	28-Jun-10	11	12	17
Guadalupe-Mussel Rock	7-Jun-10	10-Aug-10	16-Jun-10	16-Jun-10	1	0	1
Vandenberg AFB	11-May-10	10-Aug-10	25-May-10	7-Jul-10	29	5	31.5
Coal Oil Point Reserve							0
Ventura County							
Santa Clara River/McGrath State Beach	13-May-10	12-Aug-10	4-Jun-10	22-Jul-10	36	0	36
Ormond Beach	12-May-10	11-Aug-10	26-May-10	7-Jul-10	48	0	48
Hollywood Beach	14-May-10	29-Jun-10	15-Jun-10	15-Jun-10	1		1
Pt Mugu- Totals	27-Apr-10	30-Aug-10	12-May-10	15-Jul-10	575	133	641.5
Holiday Beach	27-Apr-10	4-Aug-10	13-May-10	15-Jul-10	55	15	62.5
Holiday Salt Panne	27-Apr-10	28-Jul-10	20-May-10	29-Jun-10	29	5	31.5
Eastern Arm	27-Apr-10	June 2010	21-May-10	25-May-10	12	0	12
Ormond Beach East	27-Apr-10	4-Aug-10	12-May-10	29-Jun-10	479	113	535.5
Los Angeles/Orange Counties							
Venice Beach	20-Apr-10		23-May-10	23-Jul-10	132	32	148
LA Harbor	11-May-10	27-Jul-10	20-May-10	10-Jul-10	174	42	195
Seal Beach NWR - Anaheim Bay	late April	mid July	12-May-10	7-Jul-10	253	12	259
Bolsa Chica Ecological Reserve-Totals	14-Apr-10	15-Aug-10	5-May-10	1-Jul-10	386	60	416
Nest Site 1 (NS1)					276	38	295
Nest Site 2 (NS2)					31	0	31
Nest Site 3 (NS3)					14	5	16.5
South Tern Island (STI)					63	17	71.5
North Tern Island (NTI)					2	0	2
Huntington State Beach	30-Apr-10	27-Jul-10	14-May-10	2-Jul-10	363	70	398
Burris Sand Pit/Burris Basin	13-May-10	20-Jul-10	3-Jun-10	24-Jun-10	6	2	7
Upper Newport Bay Ecological Reserve							13+

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 in first wave:	Total nests in second wave:	Total pairs:
San Diego County							
MCB Camp Pendleton- Totals	16-Apr-10	3-Aug-10	29-Apr-10	19-Jul-10	1660	62	1691
Red Beach		13-Jul-10	N/A	N/A	0	0	0
Delta Beach	7-May-10	13-Jul-10	7-May-10	25-May-10	6	0	6
White Beach	16-Apr-10	13-Jul-10	7-May-10	30-Jun-10	103	10	108
Santa Margarita River - North Beach North	19-Apr-10	3-Aug-10	29-Apr-10	25-Jun-10	410	14	417
Santa Margarita River - North Beach South	17-Apr-10	30-Jul-10	3-May-10	19-Jul-10	1068	33	1084.5
Santa Margarita River - Saltflats	19-Apr-10	20-Jul-10	7-May-10	6-Jul-10	52	4	54
Santa Margarita River - Saltflats Island	19-Apr-10	20-Jul-10	7-May-10	17-Jun-10	21	1	21.5
Batiquitos Lagoon Ecological Reserve- Totals	17-Apr-10	5-Aug-10	4-May-10	24-Jun-10	434	46	457
W1	17-Apr-10	20-Jul-10	4-May-10	27-May-10	25	2	26
W2	17-Apr-10	3-Aug-10	4-May-10	24-Jun-10	272	29	286.5
E1	17-Apr-10	5-Aug-10	6-May-10	17-Jun-10	113	11	118.5
E2	20-Apr-10	10-Jul-10	N/A	N/A	0	0	0
E3	24-Apr-10	5-Aug-10	15-May-10	10-Jun-10	24	4	26
San Elijo Lagoon Ecological Reserve	2-May-10	10-Aug-10	N/A		0	0	0
Fairbanks Ranch							0
Mission Bay							
FAA Island	5-May-10	19-Jul-10	12-May-10	28-Jun-10	11	6	14
North Fiesta Island	4-May-10	29-Jun-10	12-May-10	12-Jun-10	25	0	25
Mariner's Point	25-Apr-10	16-Aug-10	11-May-10	21-Jul-10	80	37	98.5
Stony Point	13-May-10	15-Jul-10	20-May-10	20-May-10	1	0	1
San Diego River Mouth	12-May-10	19-Aug-10	19-May-10	23-Jun-10	6	3	7.5
San Diego Bay							
Lindbergh Field & Former Naval Training Center	20-Apr-10	10-Aug-10	4-May-10	2-Jul-10	105	11	110.5
NI MAT	12-Apr-10	28-Jul-10	6-May-10	5-Jun-10	80	4	82
Delta Beach North	14-Apr-10	2-Aug-10	3-May-10	25-Jun-10	242	15	249.5
Delta Beach South	14-Apr-10	6-Aug-10	3-May-10	15-Jun-10	159	8	163
NAB Ocean	16-Apr-10	9-Aug-10	3-May-10	25-Jun-10	636	55	663.5
D Street Fill/Sweetwater Marsh NWR	16-Apr-10	30-Jul-10	4-May-10	29-Jun-10	117	2	118
Chula Vista Wildlife Reserve	19-Apr-10	2-Aug-10	11-May-10	29-Jun-10	30	10	35
South San Diego Bay Unit, SDNWR - Saltworks	23-Apr-10	7-Aug-10	11-May-10	7-Jul-10	40	25	52.5
Tijuana Estuary NERR	15-Apr-10	21-Aug-10	3-May-10	15-Jul-10	181	42	202

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:	Estimated renesters first wave:	Total Pairs first wave:	Total nests 2nd wave:	Estimated renesters 2nd wave:	Total Pairs 2nd wave:	Total Pairs:
Sacramento Area												
Bufferlands	1	0	0	1	N/A	1	0	1	0	0	0	1
San Francisco Bay Area												
NSMWA-Green Island Unit	47	0	0	47	12-Jul-10	44		44	3		3	47
NSMWA-Huichica Creek Unit												
Montezuma Wetlands	unknown											
Pittsburg Power Plant	0	0	0	0	N/A	0	0	0	0	0	0	0
Alameda Point	320	18	15	287	15-Jun-10	284	18	266	36	0	36	302
Hayward Regional Shoreline	53	2	0	51	16-Jun-10	45	2	43	8	2	6	49
Eden Landing	0											
Kings County												
Kettleman City Evaporation Ponds	1			1		1		1			0	1
San Luis Obispo/Santa Barbara Counties												
Oceano Dunes SVRA	23	0	0	23				0			0	0
Guadalupe-Mussel Rock	1	0	0	0	N/A	1	0	1	0	0	0	1
Vandenberg AFB	34	2	0	32	7-Jul-10	29	1	28	5	0	5	33
Coal Oil Point Reserve	0											
Ventura County												
Santa Clara River/McGrath State Beach	36			36				0			0	0
Ormond Beach	48	0		48	16-Jun-10	48		48	0		0	48
Hollywood Beach	1			1		1		1			0	1
Pt Mugu- Totals	708	145	0	563								
Holiday Beach	70	52		18								
Holiday Salt Panne	34	29		5								
Eastern Arm	12	12		0								
Ormond Beach East	592	52		540								
Los Angeles/Orange Counties												
Venice Beach	164	132	0	32		132	0	132	32	0	32	164
LA Harbor	216	67	0	149		174	0	174	42	26	16	190
Seal Beach NWR - Anaheim Bay	265	unknown	10	unknown	15-Jun-10	253	unknown	unknown	12	unknown	unknown	unknown
Bolsa Chica Ecological Reserve-Totals	446			446								
Nest Site 1 (NS1)	314			314								
Nest Site 2 (NS2)	31			31								
Nest Site 3 (NS3)	19			19								
South Tern Island (STI)	80			80								
North Tern Island (NTI)	2			2								
Huntington State Beach	433	26	2	405	8-Jun-10	363	14	349	70	20	50	399
Burris Sand Pit/Burris Basin	8	1	0	7	24-Jun-10	6	2	6	2	1	1	7
Upper Newport Bay Ecological Reserve	13+											

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:	Estimated renesters first wave:	Total Pairs first wave:	Total nests 2nd wave:	Estimated renesters 2nd wave:	Total Pairs 2nd wave:	Total Pairs:
San Diego County												
MCB Camp Pendleton- Totals	1722	136	145	1441								
Red Beach	0	0	0	0								
Delta Beach	6	0	0	6								
White Beach	113	15	6.5	91.5								
Santa Margarita River - North Beach North	424	26	36	362								
Santa Margarita River - North Beach South	1101	49	102.5	949.5								
Santa Margarita River - Saltflats	56	29	0	27								
Santa Margarita River - Saltflats Island	22	17	0	5								
Batiquitos Lagoon Ecological Reserve- Totals	480			480								
W1	27			27								
W2	301			301								
E1	124			124								
E2	0			0								
E3	28			28								
San Elijo Lagoon Ecological Reserve	0			0								
Fairbanks Ranch	0											
Mission Bay												
FAA Island	17	2	0	15	28-Jun-10	11	2	9	4	2	2	11
North Fiesta Island	25	21	3	1		25	7	18	0	0	0	18
Mariner's Point	117	23	5	89	15-Jun-10	80	15	65	37	15	22	87
Stony Point	1	1	0	0		1	0	1			0	1
San Diego River Mouth	9	1	0	8	19-Jun-10	6	1	5	3	0	3	8
San Diego Bay												
Lindbergh Field & Former Naval Training Center	116	8	4	104	15-Jun-10	105	6	99	11	10	1	100
NI MAT	84											
Delta Beach North	257											
Delta Beach South	167											
NAB Ocean	691											
D Street Fill/Sweetwater Marsh NWR	119	6	8	105	29-Jun-10	117	6	111	2	2	0	111
Chula Vista Wildlife Reserve	40	3	18	19	15-Jun-10	30	2	28	10	10	0	28
South San Diego Bay Unit, SDNWR - Saltworks	65	4	4	57	16-Jun-10	40	4	36	25	20	5	41
Tijuana Estuary NERR	223	17	32	174	16-Jun-10	181	13	168	42	32	10	178

Appendix B-4: Productivity.

Site name:	Total nests:	Total eggs:	No. of eggs hatched:	Hatching Success:	Date of first chick:	Date of last hatch:	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Sacramento Area									
Bufferlands	1	1	1	1.0000	5-Jul-10	5-Jul-10	25-Jul-10	Direct Observation	1
San Francisco Bay Area									
NSMWA-Green Island Unit	47	101	88	0.8713	14-Jun-10	19-Jul-10	12-Jul-10	Observed short flights	85
NSMWA-Huichica Creek Unit	0								0
Montezuma Wetlands	unknown			unknown	28-Jun-10	unknown	unknown	Maximum count	5
Pittsburg Power Plant	0	0	0						0
Alameda Point	320	619	499	0.8061	28-May-10	20-Jul-10	16-Jun-10	Sum of highest counts of every two week period beginning June 1.	221
Hayward Regional Shoreline	53	100	91	0.9100	30-May-10		20-Jun-10	3WD	75
Eden Landing	0								0
Kings County									
Kettleman City Evaporation Ponds	1	unknown	2	unknown	29-Jun-10		27-Jul-10		2
San Luis Obispo/Santa Barbara Counties									
Oceano Dunes SVRA	23	45	35	0.7778	30-Jun-10	18-Jul-10	21-Jul-10	Identification of individuals by reading color band combinations unique to each individual	29
Guadalupe-Mussel Rock	1	2	2	1.0000	7-Jul-10	same	obs 8/3	Direct Observation	2
Vandenberg AFB	34	65	56	0.8615	15-Jun-10	23-Jul-10	12-Jul-10	Highest number observed during daily roost counts from 12 July - 8 August	29
Coal Oil Point Reserve	0								0
Ventura County									
Santa Clara River/McGrath State Beach	36	59	34	0.5763	15-Jul-10	29-Jul-10	15-Jul-10	Massey	14
Ormond Beach	48	85	60	0.7059	16-Jun-10	7-Jul-10	7-Jul-10	Massey	16
Hollywood Beach	1	2	0	0.0000					0
Pt Mugu- Totals	708	1165	573	0.4918	7-Jun-10	22-Jul-10	28-Jul-10	3WN	98
Holiday Beach	70	107	16	0.1495	29-Jun-10	13-Jul-10	?	3WN	unknown
Holiday Salt Panne	34	54	4	0.0741	1-Jul-10	22-Jul-10	?	3WN	unknown
Eastern Arm	12	21	0	0.0000	N/A	N/A	N/A	3WN	0
Ormond Beach East	592	983	553	0.5626	7-Jun-10	14-Jul-10	28-Jun-10	3WN	98

Appendix B-4: Productivity (continued).

Site name:	Total nests:	Total eggs:	No. of eggs hatched:	Hatching Success:	Date of first chick:	Date of last hatch:	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Los Angeles/Orange Counties									
Venice Beach	164	164	0	0.0000	none	none	none	N/A	0
LA Harbor	216	345	49	0.1420	14-Jun-10	6-Jul-10	7-Jul-10	Observations	4
Seal Beach NWR - Anaheim Bay	265	493	298	0.6045	9-Jun-10	16-Jun-10	23-Jun-10	Growth and size at last capture	32
Bolsa Chica Ecological Reserve-Totals	446	829	201	0.2425	23-May-10	6-Jul-10	16-Jun-10	estimate	67 -114
Nest Site 1 (NS1)	314	586	94	0.1604	23-May-10	29-Jun-10		estimate	25 -50
Nest Site 2 (NS2)	31	52	3	0.0577	29-Jun-10	29-Jun-10		estimate	0
Nest Site 3 (NS3)	19	35	11	0.3143	1-Jun-10	27-Jun-10		estimate	1-4
South Tern Island (STI)	80	152	93	0.6118	27-May-10	6-Jul-10		estimate	41-60
North Tern Island (NTI)	2	4	0	0.0000	N/A	N/A	N/A	estimate	0
Huntington State Beach	433	843	686	0.8138	28-May-10	16-Jul-10	18-Jun-10	2 week count	298
Burris Sand Pit/Burris Basin	8	15	8	0.5333	23-Jun-10	29-Jun-10	19-Jul-10	2 week count	4
Upper Newport Bay Ecological Reserve	13+								8
San Diego County									
MCB Camp Pendleton- Totals	1722	3348	2858	0.8536	24-May-10	7-Jul-10	14-Jun-10		385-512
Red Beach	0	0		N/A	N/A	N/A	N/A	N/A	0
Delta Beach	6	13	13	1.0000	1-Jun-10	18-Jun-10	unknown	N/A	0
White Beach	113	226	167	0.7389	25-May-10	26-Jun-10	15-Jun-10	every 2	30-48
Santa Margarita River - North Beach North	424	816	712	0.8725	24-May-10	29-Jun-10	19-Jun-10	Sum highest count every 2 weeks/3WD	100-256
Santa Margarita River - North Beach South	1101	2148	1918	0.8929	24-May-10	7-Jul-10	14-Jun-10	Sum highest count every 2 weeks/3WD	253-388
Santa Margarita River - Saltflats	56	104	41	0.3942	30-May-10	6-Jul-10	2-Jul-10	High count during 2 week period FL observed on site	2
Santa Margarita River - Saltflats Island	22	41	7	0.1707	30-May-10	26-Jun-10	unknown		0
Batiquitos Lagoon Ecological Reserve- Totals	480	922	816	0.8850	25-May-10	15-Jul-10	15-Jun-10		208-261
W1	27	49	45	0.9184	29-May-10	17-Jun-10	17-Jun-10	recap data	28-29
W2	301	573	514	0.8970	25-May-10	15-Jul-10	15-Jun-10	recap data	150-192
E1	124	245	214	0.8735	27-May-10	3-Jul-10	19-Jun-10	daily count	28-37
E2	0	0	0	N/A	N/A	N/A	N/A	N/A	0
E3	28	55	43	0.7818	5-Jun-10	1-Jul-10	22-Jun-10	daily count	2-3
San Elijo Lagoon Ecological Reserve	0	0		N/A	N/A	N/A	N/A	N/A	0
Fairbanks Ranch	0	0		N/A	N/A	N/A	N/A	N/A	0
Mission Bay									
FAA Island	17	31	18	0.5806	28-Jun-10	19-Jul-10	N/A	N/A	0
North Fiesta Island	25	45	7	0.1556	8-Jun-10	16-Jun-10	N/A	N/A	0
Mariner's Point	117	211	143	0.6777	1-Jun-10	16-Jul-10	25-Jun-10	3WD	40-50
Stony Point	1	2	0	0.0000	N/A	N/A	N/A	N/A	0
San Diego River Mouth	9	19	13	0.6842	8-Jun-10	14-Jul-10	28-Jun-10	3WD	6-9
San Diego Bay									
Lindbergh Field & Former Naval Training Center	116	211	161	0.7630	2-Jun-10	15-Jul-10	22-Jun-10	R/2WD	29-38
NI MAT	84	151	112	0.7417	28-May-10	26-Jun-10	18-Jun-10		25
Delta Beach North	257	487	429	0.8809	24-May-10	16-Jul-10	12-Jun-10		65
Delta Beach South	167	319	283	0.8871	24-May-10	7-Jul-10	16-Jun-10		25
NAB Ocean	691	1306	1117	0.8553	24-May-10	19-Jul-10	7-Jun-10		130
D Street Fill/Sweetwater Marsh NWR	119	227	158	0.6960	25-May-10	2-Jul-10	15-Jun-10	R/2WD	15-27
Chula Vista Wildlife Reserve	40	76	41	0.5395	1-Jun-10	2-Jul-10	29-Jun-10	R/2WD	2
South San Diego Bay Unit, SDNWR - Saltworks	65	124	60	0.4839	1-Jun-10	22-Jul-10	23-Jun-10	R/2WD	5-11
Tijuana Estuary NERR	223	414	245	0.5918	25-May-10	15-Jul-10	16-Jun-10	R/2WD	46-53

Appendix B-4: Productivity, clutch sizes 2010.

			Number of nests			
Site name:	Nest total	Egg total	1 egg clutch	2 egg clutch	3 egg clutch	4 egg clutch
Sacramento Area						
Bufferlands	1	1	1	0	0	0
San Francisco Bay Area						
NSMWA-Green Island Unit	47	101	5	30	12	0
NSMWA-Huichica Creek Unit	0	0	0	0	0	0
Montezuma Wetlands	17	0	0	0	0	0
Pittsburg Power Plant	0	0	0	0	0	0
Alameda Point	320	619	40	261	19	0
Hayward Regional Shoreline	53	100	10	39	4	0
Eden Landing	0	0	0	0	0	0
Kings County						
Kettleman City Evaporation Ponds	0	0	0	0	0	0
San Luis Obispo/Santa Barbara Counties						
Oceano Dunes SVRA	0	0	0	0	0	0
Guadalupe-Mussel Rock	1	2	0	1	0	0
Vandenberg AFB	34	65	4	29	1	0
Coal Oil Point Reserve	0	0	0	0	0	0
Ventura County						
Santa Clara River/McGrath State Beach	37	59	15	44	0	0
Ormond Beach	48	85	12	35	1	0
Hollywood Beach	1	2	0	1	0	0
Pt Mugu- Totals	708	1165	264	431	13	0
Holiday Beach	70	107	36	31	3	0
Holiday Salt Panne	34	54	15	18	1	0
Eastern Arm	12	21	3	9	0	0
Ormond Beach East	592	983	210	373	9	0

Appendix B-4: Productivity, clutch sizes 2010 (continued).

			Number of nests			
Site name:	Nest total	Egg total	1 egg clutch	2 egg clutch	3 egg clutch	4 egg clutch
Los Angeles/Orange Counties						
Venice Beach	164	165	163	1	0	0
LA Harbor	216	345	87	129	0	0
Seal Beach NWR - Anaheim Bay	265	493	48	206	11	0
Bolsa Chica Ecological Reserve-Totals	446	829	82	345	19	0
Nest Site 1 (NS1)	314	586	57	242	15	0
Nest Site 2 (NS2)	31	52	12	17	2	0
Nest Site 3 (NS3)	19	35	3	16	0	0
South Tern Island (STI)	80	152	10	68	2	0
North Tern Island (NTI)	2	4	0	2	0	0
Huntington State Beach	433	843	34	388	11	0
Burris Sand Pit/Burris Basin	8	15	1	7	0	0
Upper Newport Bay Ecological Reserve						
San Diego County						
MCB Camp Pendleton- Totals	1722	3350	153	1511	58	0
Red Beach	0	0	0	0	0	0
Delta Beach	6	13	0	5	1	0
White Beach	113	226	12	89	12	0
Santa Margarita River - North Beach North	424	817	42	371	11	0
Santa Margarita River - North Beach South	1101	2149	85	985	31	0
Santa Margarita River - Saltflats	56	104	11	42	3	0
Santa Margarita River - Saltflats Island	22	41	3	19	0	0
Batiquitos Lagoon Ecological Reserve- Totals	0	0	0	0	0	0
W1	25	47	3	22	0	0
W2	272	531	18	249	5	0
E1	113	228	4	103	6	0
E2	0	0	0	0	0	0
E3	24	48	2	20	2	0
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0
Fairbanks Ranch	0	0	0	0	0	0
Mission Bay						
FAA Island	17	31	3	14	0	0
North Fiesta Island	25	45	5	20	0	0
Mariner's Point	117	211	26	88	3	0
Stony Point	1	2	0	1	0	0
San Diego River Mouth	9	19	0	8	1	0
San Diego Bay						
Lindbergh Field & Former Naval Training Center	116	211	23	91	2	0
NI MAT	0	0	0	0	0	0
Delta Beach North	0	0	0	0	0	0
Delta Beach South	0	0	0	0	0	0
NAB Ocean	0	0	0	0	0	0
D Street Fill/Sweetwater Marsh NWR	119	227	11	108	0	0
Chula Vista Wildlife Reserve	40	76	4	36	0	0
South San Diego Bay Unit, SDNWR - Saltworks	65	124	7	57	1	0
Tijuana Estuary NERR	223	414	39	177	7	0

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	
Sacramento Area														
Bufferlands	0	0	0	0	0	0	0	0	0	0	0	0	0	
San Francisco Bay Area														
NSMWA-Green Island Unit	0	0	5	12	1	0	0	3	7	0	3	0	0	Mortality caused by heat, very hot day.
NSMWA-Huichica Creek Unit														
Montezuma Wetlands														
Pittsburg Power Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	
Alameda Point	0	4	48	42	25	0	2	34	35	19	68	5	0	Unknown; 35 = 29 partial FTH nests, 6 fully FTH nests; 19 = 10 partial, 9 fully unknown
Hayward Regional Shoreline				9					4	0	2	2	0	
Eden Landing														
Kings County														
Kettleman City Evaporation Ponds														
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	0	6	1	0	0	0	1		1	1	0	
Guadalupe-Mussel Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	
Vandenberg AFB	0	0	9	0	0	0	0	5	0	0	5	0	0	Unknown
Coal Oil Point Reserve														
Ventura County														
Santa Clara River/McGrath State Beach			3					2						
Ormond Beach	0	0	12					7			2		2	
Hollywood Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pt Mugu- Totals	0	6	216		232	0	3	145		132	91	27	1	
Holiday Beach	0	0	18		13	0	0	16		10		1		
Holiday Salt Panne	0	0	1		0	0	0	1		0				
Eastern Arm	0	2	19		0	0	1	11		0		1		
Ormond Beach East	0	4	178		219	0	2	117		122	91	25	1	
Los Angeles/Orange Counties														
Venice Beach			1					1						
LA Harbor	0	0	158	0	0	0	0	110	0	0	6	0	0	
Seal Beach NWR - Anaheim Bay	4	0	??	65	??	2	0	??	30	??	116	2	2	
Bolsa Chica Ecological Reserve-Totals	1	0				1	0			52				
Nest Site 1 (NS1)	0	0				0	0							
Nest Site 2 (NS2)	0	0				0	0							
Nest Site 3 (NS3)	1	0				1	0							A plover ME was mistakenly placed on LETE egg.
South Tern Island (STI)	0	0				0	0			52				
North Tern Island (NTI)	0	0				0	0							
Huntington State Beach	0	0	76	44	34	0	0	46	5	17	17	3	1	
Burris Sand Pit/Burris Basin	0	0	0	0	0	0	0	1	0	0	0	0	0	
Upper Newport Bay Ecological Reserve														

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

Site name:	No. of eggs					No. of nests					No. of dead			Comments on cause(s) of non-predation mortality:
	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks	fledglings	adults	
San Diego County														
MCB Camp Pendleton- Totals	8	60	119	140	36	4	37	97	114	27	679	182	6	Unkown outcomes include eggs found damaged at nest with no pred or other sign as well as eggs that completely disappeared without hatching or predator sign. Also includes run over, trampling, etc by non-predator species.
Red Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
Delta Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
White Beach	4	10	2	7	2	2	6	2	7	2	12	3	0	One egg (one nest) died while hatching and are listed as non-viable.
Santa Margarita River - North Beach North	0	15	24	48	2	0	10	21	35	2	140	36	1	Three eggs (three nests) died while hatching and are listed as non-viable.
Santa Margarita River - North Beach South	4	35	86	80	31	2	21	68	68	22	524	142	5	
Santa Margarita River - Saltflats	0	0	6	3	1	0	0	5	3	1	3	1	0	
Santa Margarita River - Saltflats Island	0	0	1	2	0	0	0	1	1	0	0	0	0	
Batiquitos Lagoon Ecological Reserve-Totals	0	0	62	36	1	0	0	44	7	0	131	104	1	Eight eggs (four nests) died while hatching and are listed as non-viable.
W1	0	0	3	5	0	0	0	3	2	0	2	6	0	One fledgling found run over in the road. Four eggs (two nests) died while hatching and are listed as non-viable.
W2	0	0	35	18	1	0	0	25	1	0	91	85	0	
E1	0	0	18	12	0	0	0	12	3	0	33	11	1	Three eggs (one nest) died while hatching and are listed as non-viable.
E2														
E3	0	0	6	1	0	0	0	4	1	0	5	2	0	One eggs (one nest) died while hatching and are listed as non-viable.
San Elijo Lagoon Ecological Reserve														
Fairbanks Ranch														

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:
Mission Bay														
FAA Island	0	0	2	1	1	0	0	1	1	1	2	0	0	
North Fiesta Island	0	0	5	0	0	0	0	4	0	0	0	0	0	Abandonment probably occurred because of presence of predators (skunks)
Mariner's Point	0	0	68	0	0	0	0	46	0	0	27	14	1	Dead chicks and fledglings from this site were probably abandoned and died of starvation. 4 dead fledglings found here were banded at other tern sites, Batiquitos Lagoon (2), NAB, and possibly Camp Pendleton. A dead adult found on site was banded as a chick
Stony Point	0	0	0	0	0	0	0	0	0	0	0	0	0	
San Diego River Mouth			6					1			2	6	1	2 dead chicks were from this site; 1 dead fledgling from this site (nest 1), 5 from other sites; 1 dead adult from another site. The dead adult was banded at North Island; 4 dead fledglings were banded at Batiquitos Lagoon, Lindbergh Field, NAB, and D St.
San Diego Bay														
Lindbergh Field & Former Naval Training Center	0	0	23	10	4	0	0	18	9	3	36	5	2	Also 1 egg with eggshell thinning, 1 egg/chick died while hatching
NI MAT	0	0	19	13	0	0	0	14	2	0	27	5	0	1 egg listed as abandoned post-term died hatching
Delta Beach North	0	0	18	26	2	0	0	16	2	1	80	26	0	4 eggs listed as abandoned post-term died hatching
Delta Beach South	0	0	19	10	0	0	0	14	3	0	49	18	0	1 egg listed as abandoned post-term died hatching
NAB Ocean	24	0	93	31	9	14	0	65	2	4	236	124	4	5 eggs listed as abandoned post-term died hatching
D Street Fill/Sweetwater Marsh NWR	0	0	8	5	51	0	0	5	4	27	28	11	0	includes 2 chicks skeletonized & unclear if depredated or not & 2 chicks dead with ants unclear if ants caused death or just scavenged post-mortem
Chula Vista Wildlife Reserve	0	0	2	0	12	0	0	2	0	6	1	1	0	
South San Diego Bay Unit, SDNWR - Saltworks	0	0	13	1	42	0	0	9	1	22	1	1	1	also 1 egg/chick died hatching
Tijuana Estuary NERR	0	10	63	10	63	0	5	47	10	33	9	12	2	

Appendix B-6: Predation.

Predator Species	Predator Category		
	Possible	Suspected	Documented
black widow spider	X		
ants (spp.)	X	X	X
gopher snake	X		X
snakes (spp.)	X		X
great blue heron	X	X	
great egret	X		
black-crowned night-heron	X		X
ring-billed gull	X		
California gull	X		X
western gull	X	X	X
gulls (spp.)	X	X	X
Caspian tern	X		
gull-billed tern	X	X	X
least tern			X
black skimmer	X	X	X
northern harrier	X	X	X
white-tailed kite	X		
Cooper's hawk	X	X	X
red-tailed hawk	X	X	X
Swainson's hawk	X		
osprey	X		
American kestrel	X	X	X
peregrine falcon	X	X	X
long-billed curlew		X	
rock pigeon	X		
barn owl	X	X	X
great horned owl	X	X	X
owls (spp.)	X	X	X
American crow	X	X	X
common raven	X	X	X
corvids	X	X	X
loggerhead shrike	X		
European starling	X		
western meadowlark	X		
red-winged blackbird	X		
great-tailed grackle	X		
unknown avian spp.	X	X	X
unknown mammal spp.	X	X	X
opossum	X		
river otter	X		
long-tailed weasel	X		
black-tailed jackrabbit	X		X
California ground squirrel	X	X	X
pocket gopher	X	X	
rats (spp.)	X		
rodents	X		
canid (spp.)	X		
domestic dog	X		
coyote	X	X	X
gray fox	X		X
red fox	X	X	
raccoon	X	X	
striped skunk	X	X	X
bobcat	X		
domestic cat	X	X	X
unknown	X	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
Sacramento Area													
Bufferlands									0	0	0	0	0
San Francisco Bay Area													
NSMWA-Green Island Unit	gull, CATE, PEFA, dog, rodent	unknown		unknown 1S					1	0	0	0	0
NSMWA-Huichica Creek Unit													
Montezuma Wetlands	GBHE, GREG, BCNH, CAGU, gulls, CATE, WTKI, NOHA, RTHA, SWHA, CORA, WEME, RWBL, otter, rac, rfox, coyote, cat								0	0	0	0	0
Pittsburg Power Plant	GBHE, GREG, CAGU, gull, CATE, WTKI, NOHA, AMKE, PEFA, BNOW, AMCR, CORA, LSHR, EUST, RWBL, otter								0	0	0	0	0
Alameda Point		RTHA, PEFA	ants, RTHA, PEFA, avian	avian 6D		ants 2D, RTHA 1D, avian 1D	RTHA 10D 6S, avian 19D 10S	PEFA 9D	6	0	4	45	9
Hayward Regional Shoreline	NOHA, RTHA, AMCR, CORA	rfox, rac	CAGU, PEFA			CAGU 2D	PEFA 2D		0	0	2	2	unknown
Eden Landing													
Kings County													
Kettleman City Evaporation Ponds													

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 Luis Obispo/Santa Barbara Counties													
Oceano Dunes SVRA	BCNH, CAGU, WEGU, gull, OSPR, NOHA, COHA, RTHA, AMKE, PEFA, GHOW, owl, AMCR, CORA, corvid, LSHR, btj rabbit, op, rac, st skunk, coyote, dog, canid, bobcat, rodent		op	op 2D	op 1D	BCNH 0-6P, CAGU 0-6P, WEGU 0-6P, gull 0-6P, OSPR 0-6P, NOHA 0-6P, COHA 0-6P, RTHA 0-6P, AMKE 0-6P, PEFA 0-6P, GHOW 0-6P, owl 0-6P, AMCR 0-6P, CORA 0-6P, corvid 0-6P, LSHR 0-6P, btj rabbit 0-6P, op 0-6P, rac 0-6P, st skunk 0-6P, coyote 0-6P, dog 0-6P, cani			2	1	0	0	0
Guadalupe-Mussel Rock													
Vandenberg AFB		owl	coyote					owl 1S, coyote 3D	0	0	0	0	4
Coal Oil Point Reserve													

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
Ventura County													
Santa Clara River/McGrath State Beach		gs	CORA	CORA 8D, gs 9S	CORA 6D, gs 9S				17	11	0	0	0
Ormond Beach			PEFA, gs	gs 13D	gs 6D			PEFA 1D	13	6	0	0	1
Hollywood Beach			AMCR	AMCR 2D	AMCR 1D				2	1	0	0	0
Pt Mugu- Totals	RTHA, PEFA	LBCU	WEGU, RTHA, PEFA, CORA, op, coyote, gs, mammal, unknown	CORA 1D, op 4D, coyote 20D, gs 95D, mammal 1D, unknown 12D, LBCU 5S	CORA 1D, op 2D, coyote 12D, gs 60D, mammal 1D, unknown 9D, LBCU 3S	WEGU 4D, PEFA 2D, unknown 2D	WEGU 3D, RTHA 1D, PEFA 4D, unknown 10D	PEFA 3D	138	88	8	18	3
Holiday Beach		LBCU	op, gs, unknown	gs 49D	gs 30D				58	37	0	1	0
Holiday Salt Panne	rodent, mammal, snake		gs						49	30	0	0	0
Eastern Arm									0	0	0	0	0
Ormond Beach East		GHOW, op	WEGU, RTHA, PEFA, CORA, coyote, mammal, unknown	CORA 1D, coyote 20D, mammal 1D, unknown 9D	CORA 1D, coyote 12D, mammal 1D, unknown 7D	WEGU 4D, PEFA 2D, unknown 2D	WEGU 3D, RTHA 1D, PEFA 4D, unknown 10D	PEFA 3D	31	21	8	18	3

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	GBHE, GREG, BCNH, WEGU, AMKE, PEFA, CORA, rac, st skunk, cat, rat		AMCR	AMCR 164D					164				
LA Harbor	unknown		CORA, corvid	CORA 115D, corvid 6D, unknown 17P					138	0	0	0	0
Seal Beach NWR - Anaheim Bay	GBHE, GBTE	GHOW	PEFA					PEFA 1D	0	0	0	0	1
Bolsa Chica Ecological Reserve-Totals	GBHE, GREG, BCNH, CAGU, WEGU, gull, BLSK, WTKI, NOHA, COHA, RTHA, AMKE, PEFA, AMCR, CORA, covid, coyote, ants, pgopher	gull, BLSK, CORA, corvid, coyote, ants, pgopher	gull, BLSK, CORA, coyote, ants	gull 31D, BLSK 4D, CORA 60D, coyote 146D	gull 13D, BLSK 2D, CORA 31D, coyote 72D	ants 2D			241	118	2	0	0
Nest Site 1 (NS1)													
Nest Site 2 (NS2)													
Nest Site 3 (NS3)													
South Tern Island (STI)													
North Tern Island (NTI)													
Huntington State Beach	GBHE, COHA, PEFA, EUST, dog, gs, rodent	AMKE	WEGU, AMKE, AMCR, ant	AMCR 3D	AMCR 1D, ant 2D	AMKE 35D, ant 2D	WEGU 1D		3	2	37	1	0
Burris Sand Pit/Burris Basin		avian, mammal		avian 3S	avian 2S	mammal 4S			3	2	4	0	0
Upper Newport Bay Ecological Reserve													

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- Totals									147	88	79	73	23
Red Beach									0	0	0	0	0
Delta Beach			owl					owl 1D	0	0	0	0	1
White Beach			BCNH, GHOW, owl, CORA, avian, coyote, mammal, unknown	BCNH 2D, CORA 19D, avian 5D, coyote 8D, mammal 1D	BCNH 1D, CORA 12D, avian 3D, coyote 5D, mammal 1D	GHOW 1D, avian 7D, unknown 2D	owl 1D	avian 2D	35	22	10	1	2
Santa Margarita River - North Beach North		PEFA	BCNH, PEFA, owls, avian, snakes	BCNH 2D, snakes 15D	BCNH 1D, snakes 8D	PEFA 4D 24S, owls 1D, avian 14D	PEFA 6D 17S, avian 6D	PEFA 1D 1S, avian 5D	17	9	43	29	7
Santa Margarita River - North Beach South		GBHE, PEFA	PEFA, avian, st skunk, mammal, unknown	avian 1D, st skunk 2D, mammal 1D, unknown 3D	avian 1D, st skunk 2D, mammal 1D, unknown 3D	GBHE 1S, PEFA 1D 6S, avian 10D, unknown 2D	PEFA 2D 24S, avian 12D	PEFA 5S, avian 5D	7	7	20	38	10
Santa Margarita River - Saltflats		NOHA, PEFA	RTHA, owl, avian, st skunk, mammal, unknown	NOHA 10S, st skunk 7D, mammal 30D, unknown 11D	NOHA 5S, st skunkn 3D, mammal 16D, unknown 9D	RTHA 1D, PEFA 2S, avian 2D	owl 1D, avian 4D	avian 2D	58	33	5	5	2
Santa Margarita River - Saltflats Island		NOHA	avian, mammal, unknown	NOHA 2S, mammal 2D, unknown 26D	NOHA 2S, mammal 1D, unknown 14D	avian 1D		avian 1D	30	17	1	0	1

Appendix B-6: Predation (continued).

	Predation			Number of					Total number documented				
Site name	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Batiquitos Lagoon Ecological Reserve-Totals									2	2	7	9	25-29
W1	GBHE, GREG, owl, lt weasel, op, rac, gfox, coyote	COHA	COHA, avian, unknown				COHA 1D, uknown 2D	avian 1D	0	0	0	3	1
W2	GBHE, GREG, CAGU, WEGU, COHA, RTHA, PEFA, AMCR, rac, mammal, GTGR, RBGU	gull	GHOW, avian, unknown, LETE	gull 1S	gull 1S	LETE 1D		GHOW 8D, avian 2D, unknown 2D	1	1	1	0	12
E1	GBHE, GREG, WEGU, NOHA, COHA, RTHA, AMKE, PEFA, AMCR, CORA, op, rac, st skunk, coyote, rat, mammal, bw spider	GHOW	GHOW, avian, unknown, gsnake			unknown 1D, ants 4D, gsnake 1D		GHOW 7D 4+S, avian 5D	0	0	6	6	12-16
E2									0	0	0	0	0
E3	GBHE, GREG, BLSK, COHA, RTHA, PEFA, avian, snake, GTGR		unknown	unknown 1D	unknown 1D				1	1	0	0	0
San Elijo Lagoon Ecological Reserve	GBHE, GREG, BCNH, CAGU, WEGU, WTKI, NOHA, COHA, RTHA, AMKE, PEFA, BNOW, AMCR, CORA, rac, coyote, dog												
Fairbanks Ranch													

Appendix B-6: Predation (continued).

	Predation			Number of					Total number documented				
Site name	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Mission Bay													
FAA Island	GBHE, CORA	WEGU, gull, AMKE, AMCR	AMKE	gull 19S	gull 11S, AMKE 6S	AMKE 11S			19	17	11		
North Fiesta Island	avian, snake	AMKE, st skunk		avian 0-3P, st skunk 30-33S, snake 5P	st skunk 22S	AMKE 1S, avian 0-6P, st skunk 0-6S							
Mariner's Point	PEFA	cat				PEFA?	PEFA?	cat 6S	3	3	unknown	unknown	6
Stony Point	WEGU, AMCR	GBHE, avian		GBHE 0-2S, WEGU 0-2P, AMCR 0-2P, avian 0-2S	GBHE 0-1S, WEGU 0-1P, AMCR 0-1P, avian 0-1S								
San Diego River Mouth													

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	GBHE, BCNH, WEGU, OSPR, COHA, RTHA, AMKE, PEFA, ROPI, AMCR, CORA, EUST, gfox, cat, rats, ants	COHA, AMKE, PEFA, CORA	COHA, PEFA, AMCR, CORA, ants, cat, gfox	PEFA 1S, AMCR 1D, CORA 2D 1S, ants 2D, cat 0-5D, gfox 0-5D	PEFA 1S, AMCR 1D, CORA 1D 1S, ants 2D, cat 0-3D, gfox 0-3D	COHA 0-1D, AMKE 1S, PEFA 0-1D, ants 1D 1S, cat 0-1D, gfox 0-1D	COHA 1-3D, PEFA 0-2D	PEFA 1S	11	8	5	3	3
NI MAT									8		1	2	1
Delta Beach North			GBTE	GBTE 4D		GBTE 40D 2S			10		43	2	17-19
Delta Beach South			GBTE	GBTE 3D		GBTE 29D 2S			4		30	0	7
NAB Ocean			GBTE	GBTE 13D		GBTE 91D 1S			37		96	1	12
D Street Fill/Sweetwater Marsh NWR	NOHA, RTHA, AMCR, CORA	GBTE, NOHA, COHA, RTHA, AMKE, PEFA, BNOW, cat	GBTE, NOHA, RTHA, BNOW, PEFA, COHA, AMKE	NOHA 5D	NOHA 3D	GBTE 5-8D 1S, RTHA 4D, PEFA 0-1D 1S, BNOW 0-1D, COHA 0-1D, AMKE 0-3D, NOHA 0-3D	PEFA 0-1D, COHA 0-1D, NOHA 0-1D	BNOW 1D	5	3	14	1	1
Chula Vista Wildlife Reserve	WEGU, CATE, GBTE, OSPR, NOHA, COHA, RTHA, AMKE, PEFA, BNOW, CORA, st skunk, gfox, coyote, cat, gs, rat, ants	GBTE, NOHA, AMKE, PEFA, BNOW	GBTE, NOHA, ants	GBTE 2D 2S, NOHA 16D 1S	GBTE 1D 1S, NOHA 9D 1S	GBTE 5-7D, ants 2D			12	21	7-9	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
South San Diego Bay Unit, SDNWR - Saltworks	CAGU, WEGU, CATE, GBTE, BLSK, NOHA, COHA, RTHA, AMKE, PEFA, CORA, rac, st skunk, coyote, dog, cat, gs, rodent, ants	gull, GBTE, NOHA, AMKE, PEFA, coyote	GBTE, BLSK, coyote, ants	GBTE 1S, BLSK 3D, coyote 1D 12S, ants 2D	GBTE 1S, BLSK 2D, coyote 1D 6S, ants 1D	GBTE 3D 1S, coyote 1S			7	5	5	0	0
Tijuana Estuary NERR	GBHE, BCNH, CAGU, WEGU, GBTE, WTKI, NOHA, RTHA, PEFA, BNOW, GHOW, AMCR, CORA, WEME, btj rabbit, op, st skunk, coyote, dog, cat, gs, rodent, snake, ant	GBTE, NOHA, PEFA	GBTE, NOHA, btj rabbit, unknown	GBTE 8S, btj 1D, unknown 3D, cat 0-2D, dog 0-2D	GBTE 6S, btj 1D, unknown 2D, cat 0-1D, dog 0-1D	GBTE 4D 2S, NOHA 5D	NOHA 1D, avian 2D	unknown 1D	14	10	11	3	1

Legend: P: Possible S: Suspected D: Documented S/D: Suspected or Documented

GBHE: Great blue heron
GREG: Great egret
BCNH: Black-crowned night-heron
RBGU: Ring-billed gull
CAGU: California gull
WEGU: Western gull
CATE: Caspian tern
GBTE: Gull-billed tern
LETE: Least tern
BLSK: Black skimmer

NOHA: Northern harrier
WTKI: White-tailed kite
COHA: Cooper's hawk
RTHA: Red-tailed hawk
SWHA: Swainson's hawk
OSPR: Osprey
AMKE: American kestrel
PEFA: Peregrine falcon
LBCU: Long-billed Curlew
ROPI: Rock pigeon

BNOW: Barn owl
GHOW: Great-horned owl
AMCR: American crow
CORA: Common raven
LSHR: Loggerhead shrike
EUST: European starling
WEME: Western meadowlark
RWBL: Red-winged blackbird
GTGR: Great-tailed grackle
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
gsnake: Gopher snake