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

California Least Tern Breeding Survey

2011 Season

by
Daniel A. Marschalek

Nongame Wildlife Program, 2012-1

Final Report

To

State of California
Department of Fish and Game
South Coast Region
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Prepared 23 May 2012
Revised 2 August 2012

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ABSTRACT

Monitoring to document breeding success of California least terns (*Sternula antillarum browni*) continued in 2011, with observers at 40 nesting sites providing data. An estimated 4826-6108 California least tern breeding pairs established 6435 nests and produced 1038-1195 fledglings at 49 documented locations. The fledgling to breeding pair ratio was 0.17-0.25. Statewide, 11,140 eggs were reported, with a Site Mean clutch size of 1.76 eggs per nest (St Dev = 0.111) and the Statewide clutch size of 1.75 eggs (St Dev = 0.459) for Type 1 sites. Numbers of nesting least terns were not uniformly distributed across all sites. Camp Pendleton, Naval Base Coronado, Batiquitos Lagoon Ecological Reserve, Huntington Beach, Pt. Mugu and Alameda Point represented 79% of the breeding pairs while Alameda Point, Camp Pendleton, Huntington Beach, Naval Base Coronado and Tijuana River NERR produced 55% of the fledglings. The 2011 chick mortality rate of 20% is slightly greater than the last three years. Alameda Point, Batiquitos Lagoon Ecological Reserve, Camp Pendleton, Huntington State Beach and Naval Base Coronado represented 87% of the total reported chick deaths, but only 70% of the total chicks. The predators responsible for the greatest number of depredated least terns in 2011 were unknown avian species, American crows (*Corvus brachyrhynchos*), gull species (*Laris* sp.), peregrine falcons (*Falco peregrinus*), gull-billed terns (*Gelochelidon nilotica*), and common ravens (*Corvus corax*). Common ravens, peregrine falcons, American crows, American kestrels (*Falco sparverius*), red-tailed hawks (*Buteo jamaicensis*), and coyotes (*Canis latrans*) were reported from the most sites. The monitoring effort of 2011 is scheduled to continue in 2012.

[1] Marschalek, D.A. 2012. California least tern breeding survey, 2011 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Program Report, 2012-1. Sacramento, CA. 25 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 2011 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2010 or who planned monitoring activities for 2011 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. Appendix B includes the full dataset reported by biologists. Blank cells or rows in the appendices indicate that no data were reported. 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.

There is one change to the 2011 fledgling count reporting in an effort for standardization across all nesting sites. Monitors were requested to provide the total number of fledglings produced at their site, including those that were later found dead. In 2010 it became evident that some monitors would generate the fledgling count by subtracting the number of dead fledglings from the maximum count, but others would not (Marschalek 2011).

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.

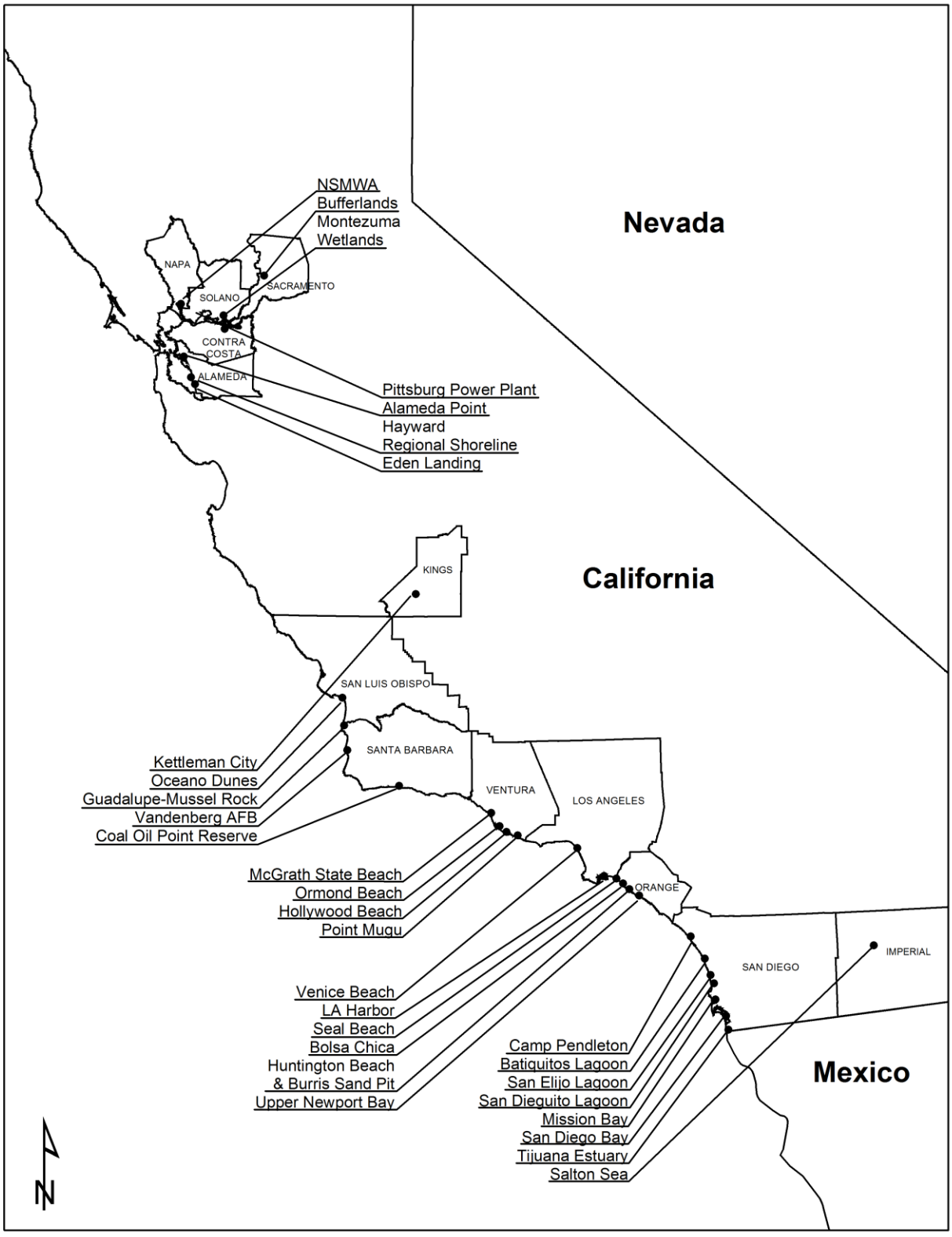

Figure 1. California sites monitored for California least tern nesting in 2011. Some listed areas include multiple sites, sites with nesting at more than one location, or both.

Monitoring

Twenty-five of 40 sites monitored in 2011 were Type I sites, the majority monitored at least one or two times per week. A grid system to assist in locating nests was not used at every site but almost every monitor marked nests in some fashion. Site-specific and complete monitoring data are located in Appendix B-2.

Productivity

At least partial data were received and analyzed for all monitored least tern nesting areas in California for 2011. An estimated 4826-6108 California least tern breeding pairs established 6435 nests and produced 1038-1195 fledglings at 49 documented locations (Table 1 and "Summary by Site" Section). The fledgling to breeding pair ratio was 0.17 to 0.25 fledglings per pair. Statewide, 11,140 eggs were reported, with a Site Mean clutch size of 1.76 eggs per nest (St Dev = 0.111) and a Statewide clutch size of 1.75 eggs (St Dev = 0.459). Two site totals were mistakenly included in the 2010 calculation which should be 1.87 eggs (St Dev = 0.422)

The 2011 California least tern nesting season lasted approximately four and a half months. The first recorded least tern at a nesting site was on 7 April at Seal Beach and the last observed on 25 August at Saltworks, Santa Clara River/McGrath State Beach and Ormond Beach. The first nest was detected on 28 April at Tijuana Estuary, the first chick at Santa Margarita River- North Beach North on 23 May, and first fledgling at Delta Beach North on 12 June. Least terns did not nest at four locations used in 2010 (Kettleman City Evaporation Ponds, Guadalupe-Mussel Rock, Hollywood Beach and Bolsa Chica Ecological Reserve- North Tern Island), however, they nested at two locations not used last year (Coal Oil Point Reserve and Salton Sea). The three locations used in 2010 and not in 2011 had five nests total. Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

The 4826 recorded minimum breeding pairs in 2011 was about 25% lower than the 6437 total in 2009 (Marschalek 2011), following a 10% decline in 2010 compared to 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, 2011). Fledgling numbers were about half of the 2010 count (Marschalek 2011), representing production similar to the lower numbers about a decade ago.

The majority of breeding pairs nested in San Diego County (3002 pairs, 62.2%) and the fewest in San Luis Obispo, Santa Barbara, and King Counties (51 pairs, 1.1%) (Table 2). Breeding pairs were not a predictor for fledgling numbers, however. The fledgling-to-pair ratio ranged from a low of 0.159 in San Diego and Imperial Counties to a high of 1.059 in San Luis Obispo, Santa Barbara, and King Counties.

Table 1. California least tern productivity in 2011. Sub-colony data included in the "Summary by Site" section.

2011	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	3	3	3.00	3.00
San Francisco Bay Area							
Napa Sonoma Marsh Wildlife Area- Totals	19	28	38	unknown	unknown	unknown	unknown
Montezuma Wetlands	15	15	15	unknown	unknown	unknown	unknown
Pittsburg Power Plant	0	1	0	0	0	0.00	0.00
Alameda Point	304	329	355	179	191	0.54	0.63
Hayward Regional Shoreline	64	73	77	24	37	0.33	0.58
Eden Landing	0	0	0	0	0	0.00	0.00
Kings County							
Kettleman City Evaporation Ponds	0	0	0	0	0	0.00	0.00
San Luis Obispo/Santa Barbara Counties							
Oceano Dunes SVRA	30	34	35	50	50	1.47	1.67
Guadalupe-Mussel Rock	0	0	0	0	0	0.00	0.00
Vandenberg AFB	20	32	32	4	4	0.13	0.20
Coal Oil Point Reserve	1	1	1	0	0	0.00	0.00
Ventura County							
Santa Clara River/McGrath State Beach	26	26	26	20	20	0.77	0.77
Ormond Beach	49	51	60	12	12	0.24	0.24
Hollywood Beach	0	0	0	0	0	0.00	0.00
Pt Mugu- Totals	498	703	717	72	72	0.10	0.14
Los Angeles/Orange Counties							
Venice Beach	14	21	28	0	0	0.00	0.00
LA Harbor	7	8	10	0	0	0.00	0.00
Seal Beach NWR - Anaheim Bay	159	177	177	11	11	0.06	0.07
Bolsa Chica Ecological Reserve-Totals	80	80	167	66	95	0.83	1.19
Huntington State Beach	518	707	712	107	107	0.15	0.21
Burris Sand Pit/Buris Basin	13	14	14	12	12	0.86	0.92
Upper Newport Bay Ecological Reserve	6	6	6	0	0	0.00	0.00
San Diego County							
MCB Camp Pendleton- Totals	1014	1510	1526	104	105	0.07	0.10
Batiquitos Lagoon Ecological Reserve- Totals	519	522	532	50	50	0.10	0.10
San Elijo Lagoon Ecological Reserve	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	16	19	21	9	9	0.47	0.56
North Fiesta Island	1	1	1	0	0	0.00	0.00
Mariner's Point	118	143	145	50	60	0.35	0.51
Stony Point	9	11	12	3	3	0.27	0.33
San Diego River Mouth	10	11	13	5	6	0.45	0.60
San Diego Bay							
Lindbergh Field & Former Naval Training Center	42	77	78	11	15	0.14	0.36
NI MAT	66	83	83	12	25	0.14	0.38
Naval Base Coronado- Totals	950	976	1062	96	147	0.10	0.15
D Street Fill/Sweetwater Marsh NWR	41	113	116	34	41	0.30	1.00
Chula Vista Wildlife Reserve	34	47	53	12	19	0.26	0.56
South San Diego Bay Unit, SDNWR - Saltworks	27	45	55	2	3	0.04	0.11
Tijuana Estuary NERR	152	240	264	90	98	0.38	0.64
Imperial County							
Salton Sea	3	3	3	0	0	0.00	0.00
Totals:	**4826**	**6108**	**6435**	**1038**	**1195**	**0.17**	**0.25**

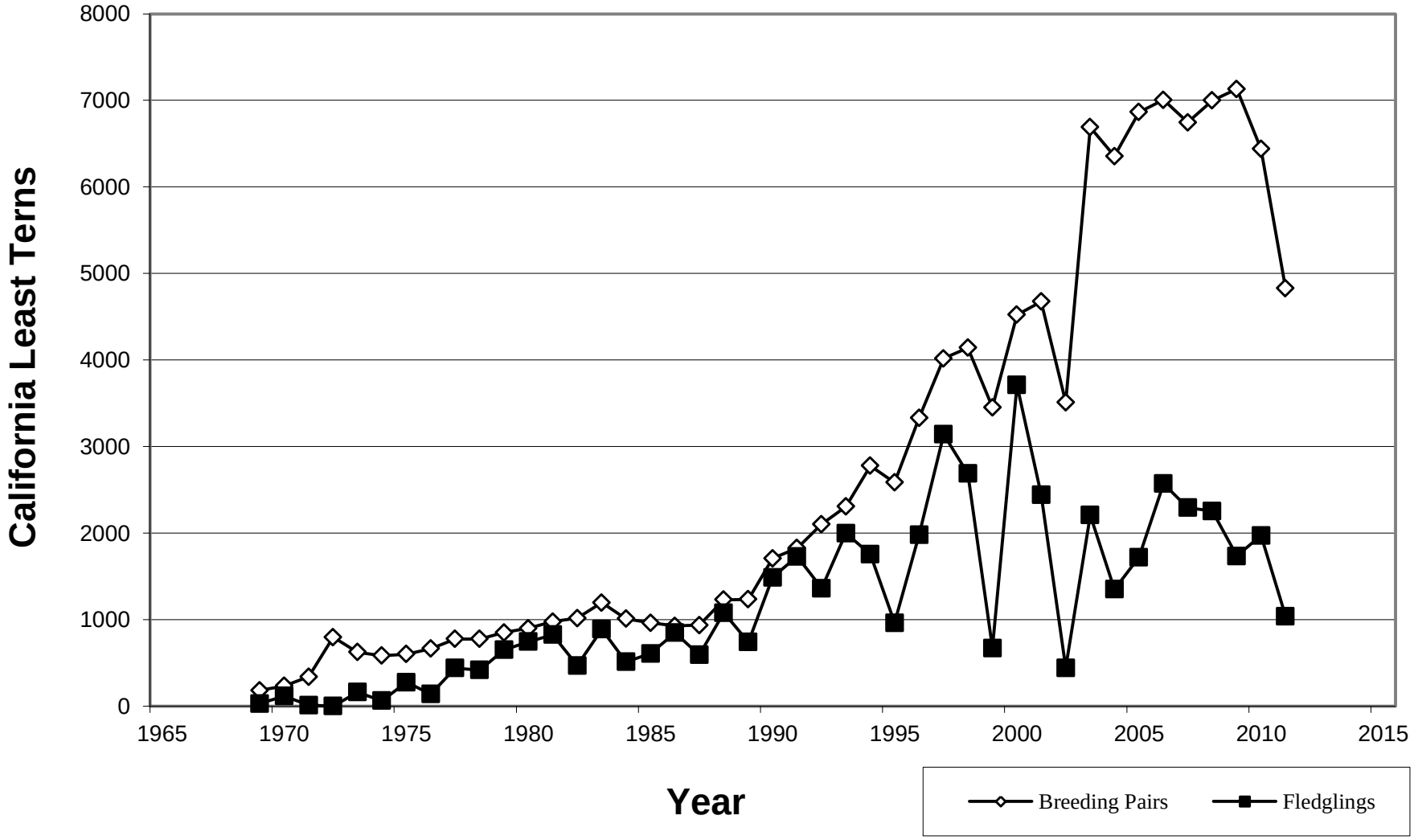

Figure 2. Minimum number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1969-2011. (Data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al*. 1977; Jurek 1977; Atwood *et al*. 1979; Collins 1984, 1986, 1987; Gustafson 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, 2011).

Table 2. Regional productivity comparison, 2011.

Region	Breeding Pairs**	Proportion of Total	Fledglings**	Proportion of Total	Fledgling:Pair*
San Francisco Bay Area (w/Bufferlands)	403	0.084	206	0.198	0.511
San Luis Obispo/Santa Barbara/King Counties	51	0.011	54	0.052	1.059
Ventura County	573	0.119	104	0.100	0.182
Los Angeles/Orange Counties	797	0.165	196	0.189	0.246
San Diego/Imperial Counties	3002	0.622	478	0.461	0.159
Total	4826	1.000	1038	1.000	0.215

* 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, Huntington Beach, Pt. Mugu and Batiquitos Lagoon Ecological Reserve had the highest number of breeding pairs, nests, and eggs in the state in 2011. The five sites with the most fledglings produced differed due to different survival rates at each site. Bufferlands (3.00) and Oceano Dunes (1.47) 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 (1014)	Camp Pendleton (1526)	Camp Pendleton (2662)	Camp Pendleton (1649)	Alameda Point (179)
Naval Base Coronado (950)	Naval Base Coronado (1062)	Naval Base Coronado (1865)	Naval Base Coronado (1562)	Huntington Beach (107)
Batiquitos (519)	Pt. Mugu (717)	Huntington Beach (1208)	Batiquitos (730)	Camp Pendleton (104)
Huntington Beach (518)	Huntington Beach (712)	Pt. Mugu (1163)	Huntington Beach (708)	Naval Base Coronado (96)
Pt. Mugu (498)	Batiquitos (532)	Batiquitos (995)	Pt. Mugu (452)	Tijuana Estuary (90)

A few sites constituted the majority of breeding activity for the state in 2011, which is a trend observed in the past (see references in Marschalek 2011). Six sites (Camp Pendleton, Naval Base Coronado, Batiquitos Lagoon Ecological Reserve, Huntington State Beach, Pt. Mugu, and Alameda Point) had over 300 minimum breeding pairs, which represented 79% 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. Five four-egg clutches were observed in 2011, with three at Camp Pendleton and one each at Huntington State Beach and Seal Beach NWR. Fledgling numbers were also unevenly distributed as the five sites with over 90 fledglings each (Alameda Point, Huntington State Beach, Camp Pendleton, Naval Base Coronado and Tijuana Estuary NERR) contributed 55% of the state's production.

Mortality and Predation

The 2011 chick mortality rate of 20% is slightly higher than rates of the last three years (18% in 2010, 15% in 2009 and 14% in 2008; Marschalek 2009, 2010, 2011) (Table 4). Several larger nesting colonies continued to experience rates greater than the average. At Alameda Point, Batiquitos Lagoon Ecological Reserve, Camp Pendleton, Huntington State Beach and Naval Base Coronado, 50, 34, 33, 16 and 9% of chicks were found dead, respectively. These five sites represented 87% of the total reported chick deaths, but only 70% of the total chicks hatched in California. Least tern mortality due to non-predation factors was greater than mortality due to predation in 2011.

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	2766-2778	1445	82	38	4331-4343
Predation	1144	764-784+	121	69	2098-2118+

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 1196-1202 eggs, which was 43% 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 (30%) to the non-predation mortality.

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-six species were reported as possible, suspected, or documented predators of least terns along with 11 other taxa (Table 5). The most commonly reported predators were common

ravens (*Corvus corax*), peregrine falcons (*Falco peregrinus*), American crows (*Corvus brachyrhynchos*), American kestrels (*Falco sparverius*), red-tailed hawks (*Buteo jamaicensis*), and coyotes (*Canis latrans*). 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 (15)	Black-bellied plover (4)	Striped skunk (5)
Great egret (8)	Long-billed curlew (1)	Gray fox (4)
Black-crowned night-heron (11)	Barn owl (14)	Red fox (1)
Ring-billed gull (10)	Great horned owl (11)	Coyote (19)
California gull (11)	Owls (4)	Domestic dog (5)
Western gull (16)	American crow (24)	Canid (1)
Gulls (11)	Common raven (29)	Bobcat (1)
Caspian tern (2)	Corvids (5)	Domestic cat (8)
Gull-billed tern (8)	Horned lark (2)	California ground squirrel (14)
Least tern (1)	Loggerhead shrike (8)	Mice (6)
Black skimmer (4)	European starling (5)	Rats (8)
Northern harrier (12)	Western meadowlark (2)	Rodents (1)
White-tailed kite (5)	Red-winged blackbird (1)	Unknown mammal (4)
Cooper's hawk (11)	Great-tailed grackle (2)	Snapping turtle (1)
Red-tailed hawk (19)	Unknown avian (18)	Southern Pacific rattlesnake (1)
Osprey (4)	Black-tailed jackrabbit (2)	Gopher snake (3)
Merlin (3)	Opossum (11)	Snakes (3)
American kestrel (21)	River otter (1)	Ants (6)
Peregrine falcon (28)	Raccoon (9)	Unknown (9)

Predation led to the loss of 1144 eggs, 764-784+ chicks, 121 fledglings, and 69 adults (Table 4). A total of 1848 least tern individuals (including eggs) were reported with a documented or suspected predator species, meaning about 12% of depredated least terns were due to unknown species. Of those lost to suspected or documented predator species, unknown avian species (564.5 total individuals, 29%), American crows (218 total individuals, 11%), gull species (*Laris* sp., 199 total individuals, 10%), peregrine falcons (161.5 individuals, 8%), gull-billed terns (*Gelochelidon nilotica*, 148.5 individuals, 8%), and common ravens (148 total individuals, 8%) (Table 6) depredated the most least terns. All other species not listed in Table 6 each represented less than 3.5% 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)*
Avian species	0.2933
American crow	0.1133
Gull species	0.1034
Peregrine falcon	0.0839
Gull-billed tern	0.0772
Common raven	0.0769

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

Historically, predation due to American crows, gull-billed terns, common ravens, and coyotes tended to be higher (Marschalek 2010). The foraging area of gull-billed terns appears to be expanding since 2007; however the number of least terns suspected or documented to be depredated by gull-billed terns has decreased over the last two years with 813 individuals depredated in 2009, 222 in 2010 and 149 in 2011. Predator species varied in importance among each least tern age class. American crows, gull species, and common ravens had the largest depredation rate of eggs, while unknown avian species and gull-billed terns depredated the most chicks, and peregrine falcons, unknown avian species and domestic cats (*Felis catus*) depredated the most fledglings and adults (Table 7).

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***
American crow (216)	0.2340	Unknown avian (474.5)	0.5961	Unknown avian (53)	0.4417	Peregrine falcon (58.5)	0..6842
Gull species (199)	0.2156	Gull-billed tern (100.5)	0.1263	Peregrine falcon (47)	0.3917	Domestic cat (13)	0.1520
Common raven (134)	0.1452	Peregrine falcon (52)	0.0653	Domestic cat (8)	0.0667	Unknown avian (9)	0.1053
Unknown species (75)	0.0813	Red-tailed hawk (43)	0.0540	Western gull (4)	0.0333	Barn owl (2)	0. 0234
Coyote (65)	0.0704	American kestrel (41.5)	0.0521	Two different species (3)	0.0250	Great horned owl (2)	0. 0234

*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 fourth consecutive year and third consecutive year successfully producing fledglings (three in 2011).

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

This was the fifth year least tern nesting was documented at NSMWA-Green Island Unit (Napa Plant). In 2011, 19-28 pairs established 38 nests and produced an unknown number of fledglings (Table 8).

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	19	28	38	unknown	unknown	unknown	unknown
Huichica Unit	0	0	0	0	0	0.00	0.00

Montezuma Wetlands

At Montezuma Wetlands, 15 pairs established 15 nests and produced an unknown number of fledglings.

Pittsburg Power Plant

There was no least tern nesting at Pittsburg Power Plant in 2011. This is the fourth time in the last six years that least terns did not nest at this site.

Alameda Point

At the Alameda Point site, 304-329 breeding pairs established 355 nests and produced 179-191 fledglings.

Hayward Regional Shoreline

In 2011, 64-73 breeding pairs established 77 nests and produced 24-37 fledglings. Predation was primarily due to raccoons (*Procyon lotor*), but red foxes (*Vulpes vulpes*) were likely another main predator species.

Eden Landing

This was the second year least terns did not nest at Eden Landing after three years of attempted nesting.

Kings County
Kettleman City Evaporation Ponds

The Kettleman City Evaporation Ponds did not have least tern nesting for the first time since 2004 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 30-34 breeding pairs, 35 nests, and produced 50 fledglings. This site had the highest fledgling to pair ratio (1.47) in the state for sites with more than one nest.

Guadalupe-Mussel Rock

Guadalupe-Mussel Rock did not have least terns nesting in 2011.

Vandenberg Air Force Base (AFB)

At Vandenberg AFB, 20-32 breeding pairs established 32 nests and produced four fledglings. Fledgling production continues to be variable across years at this site.

Coal Oil Point Reserve

At Coal Oil Point Reserve, one pair abandoned their nest after one week.

Ventura County
Santa Clara River/McGrath State Beach

The Santa Clara River site had 26 breeding pairs establish 26 nests and produce 20 fledglings.

Ormond Beach

At Ormond Beach, 49-51 breeding pairs established 60 nests and produced 12 fledglings.

Hollywood Beach

At Hollywood Beach did not have least tern nesting in 2011. This is the first year without nesting since 2006.

NAS Point Mugu

Point Mugu had a total of 498-703 breeding pairs, 717 nests, and 72 fledglings (Table 9). As in the last five years, Ormond Beach East had the highest number of pairs, nests and fledglings of the sub-colonies.

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	467	672	683	59	59	0.09	0.13
Holiday Beach	28	28	31	12	12	0.43	0.43
Holiday Beach Salt Panne	2	2	2	1	1	0.50	0.50
Eastern Arm	1	1	1	0	0	0.00	0.00

Los Angeles/Orange Counties

Venice Beach

Venice Beach had 14-21 breeding pairs establish 28 nests, but did not produce any fledglings. This is the third consecutive year that least terns failed to produce fledglings. Predation due to American crows resulted in 100% failure of nesting attempts for a third consecutive year.

Los Angeles Harbor

The Los Angeles Harbor site had seven to eight breeding pairs, 10 nests, and no fledglings. The number of breeding pairs has declined every year since reaching a high of 1254 pairs in 2007. This is the first year since the early 1990s that no fledglings were produced at this site.

Seal Beach NWR

At Seal Beach NWR, 159-177 breeding pairs established 177 nests and produced 11 fledglings.

Bolsa Chica Ecological Reserve

At Bolsa Chica Ecological Reserve, 80 breeding pairs established 167 nests and produced 66-95 fledglings (Table 10). Strictly using the breeding pair calculations resulted in a number of breeding pairs that would require each pair to establish, on average, at least 2 nests. It is possible that the calculations are overestimating the number of renesting pairs and therefore underestimating the actual number of breeding pairs. Least terns did not nest at the North Tern Island sub-colony as they did in 2010 (two nests).

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	4	4	31	1	2	0.25	0.50
Nest Site 2	36	36	49	51	72	1.42	2.00
Nest Site 3	24	24	66	2	3	0.08	0.13
South Tern Island	16	16	21	12	18	0.75	1.13

Huntington State Beach

At Huntington State Beach, 518-707 breeding pairs established 712 nests and produced 107 fledglings. The number of breeding pairs was higher in 2011 compared to previous years but the number of fledglings was lower than the past five years. Increased predation, resulting in the loss of 211 eggs, is a likely reason.

Burris Sand Pit (*Burris Basin*)

At Burris Sand Pit, 13-14 breeding pairs established 14 nests and produced 12 fledglings. This represents the second highest fledgling to pair ratio (0.86) in the state for sites with more than one nest.

Upper Newport Bay Ecological Reserve

At Upper Newport Bay Ecological Reserve, six breeding pairs established six nests but did not produce fledglings.

<u>San Diego County</u>
MCB Camp Pendleton

At Camp Pendleton, a total of 1014-1510 breeding pairs established 1526 nests and produced 104-105 fledglings (Table 11), the highest number of breeding pairs of any site within the state for 2011. As in the last six years, the Santa Margarita River North Beach sites (North and South) had the majority of the least tern nesting and production, representing 88% of the nests and 93% of the fledglings at Camp Pendleton.

Table 11. Sub-colony data for Camp Pendleton.

Sub-colony	Breeding Pairs		Nests	Fledglings		Fledgling per Pair Ratio	
	minimum	maximum		minimum	maximum	minimum	maximum
Red Beach	0	0	0	0	0	0.00	0.00
White Beach	77	130	132	6	6	0.05	0.08
Delta Beach	3	3	4	0	0	0.00	0.00
Santa Margarita River- N Beach N	145	281	283	13	13	0.05	0.09
Santa Margarita River- N Beach S	756	1056	1067	84	85	0.08	0.11
Santa Margarita River- Saltflats	22	29	29	1	1	0.03	0.05
Santa Margarita River- Saltflats Island	11	11	11	0	0	0.00	0.00

Batiquitos Lagoon Ecological Reserve

At Batiquitos Lagoon Ecological Reserve, 519-522 breeding pairs established 532 nests and produced 50 fledglings (Table 12). Predation was higher in 2011 compared to previous years, resulting in the loss of 117 eggs, 420 chicks, and 44 fledglings. In 2011, a state order prohibited new contracts which would have provided monitoring and predator control at Batiquitos Lagoon. This resulted in reduced monitoring effort and no predator management, both of which were utilized in past years and planned for 2012.

Table 12. Sub-colony data for Batiquitos Lagoon Ecological Reserve.

Sub-colony	Breeding Pairs		Nests	Fledglings		Fledgling per Pair Ratio	
	minimum	maximum		minimum	maximum	minimum	maximum
W1	22	22	22	0	0	0.00	0.00
W2	463	466	476	50	50	0.11	0.11
E1	28	28	28	0	0	0.00	0.00
E2	0	0	0	0	0	0.00	0.00
E3	6	6	6	unknown	unknown	unknown	unknown

San Elijo Lagoon Ecological Reserve

There was no nesting activity at San Elijo Lagoon Ecological Reserve in 2011.

San Dieguito Lagoon Ecological Reserve

There was no nesting activity at San Dieguito Lagoon Ecological Reserve in 2011.

Mission Bay
- FAA Island

At FAA Island, 16-19 breeding pairs established 21 nests and produced nine fledglings.

- North Fiesta Island

The North Fiesta Island site had one breeding pair establish one nest but no fledglings.

- Mariner's Point

At Mariner's Point, 118-143 breeding pairs established 145 nests and produced 50-60 fledglings.

- Stony Point

Nine to 10 breeding pairs established 12 nests and produced three fledglings at Stony Point in 2011.

- San Diego River Mouth (S)

At the San Diego River Mouth (S) site, 10-11 breeding pairs established 13 nests and produced five to six fledglings.

San Diego Bay
- Lindbergh Field

At Lindbergh Field, 42-77 breeding pairs established 78 nests and produced 11-15 fledglings.

- NIMAT

At North Island, 66-83 breeding pairs established 83 nests and produced 12-25 fledglings.

-Naval Base Coronado

Naval Base Coronado had 950-976 breeding pairs, 1062 nests, and 96-147 fledglings, with most of the production at the Naval Amphibious Base Ocean sub-colony (NAB Ocean, Table 13).

Table 13. Sub-colony data for Naval Base Coronado.

	Breeding Pairs			Fledglings		Fledgling per Pair Ratio	
Sub-colony	**minimum**	**maximum**	**Nests**	**minimum**	**maximum**	**minimum**	**maximum**
Delta Beach N	205	220	230	40	45	0.18	0.22
Delta Beach S	140	150	158	15	40	0.10	0.29
NAB Ocean	605	606	674	41	62	0.07	0.10

- D Street Fill/Sweetwater Marsh NWR

At D Street, 41-113 breeding pairs established 116 nests and produced 34-41 fledglings.

- Chula Vista Wildlife Reserve

Chula Vista NWR had 34-47 breeding pairs establish 53 nests and produced 12-19 fledglings.

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

At Saltworks NWR, 27-45 breeding pairs established 55 nests and produced two to three fledglings.

-Tijuana River National Estuary Research Reserve (NERR)

At Tijuana Estuary, 152-240 breeding pairs established 264 nests and produced 90-98 fledglings.

Imperial County
Salton Sea

At the Salton Sea, three breeding pairs established three nests but did not produce fledglings. The specific location was in the southwestern portion of the Wister Unit. This is the first documented least tern nesting at the Salton Sea, however nesting has been suspected based on previous adult observations during the breeding season.

Conclusion

In 2011, biologists recorded the lowest total of California least tern breeding pairs (minimum breeding pairs) since 2002. Generally the minimum and maximum number of breeding pairs are within 300 pairs of each other, with a couple exceptions and up to 700 apart in 2008. In 2011, the difference was almost 1300 pairs, indicating increased uncertainty in the actual breeding population. A possible explanation is that the adults were in the area and counted, but did not establish nests.

This is the first time since 1986 that the recorded breeding population declined in two consecutive years. Chick mortality continues to be a factor at specific sites, possibly a result of limited or inappropriate food sources. Lack of food has also been suggested as an explanation for why adults chose not to nest at certain sites in 2011 (e.g. Port of Los Angeles). Avian predators, sometimes an unknown avian species, are responsible for the highest predation rates over the last several years. In addition, the minimum fledgling-to-minimum breeding pair ratio (counts shown in Figure 2) continues to be low, at 0.17 in 2011. Since 1977, this ratio has been less than 0.50 for only 12 years which includes the last 10 years.

ACKNOWLEDGEMENTS

I would like to thank Nancy Frost, Kim McKee and Terri Stewart (CDFG) for providing the opportunity and funding for this position. Field monitors, site managers and others involved in

the 2011 coordinated efforts towards the recovery of the California least tern deserve a great deal of credit for their hard work before, during and after the 2011breeding season. These include, but are not limited to (alphabetically): Joy Albertson, Monica Alfaro, John Anderson, Tom Applegate, Arlene Arnold, Maryanne Bache, Pat Baird, Sandra Baldwin, Chris Barr, Steve Bauman, Connie Bean, Mark Billings, Kristi Birney, Brian Bonesteel, Rachel Bonnefil, John Bradley, Arriana Brand, Don Brubaker, Slader Buck, Tim Burr, Lori Charett Gerbac, Amber Clark, Brian Collins, Charles Collins, Laura Collins, Lyann Comrack, Chris Conard, Elizabeth Copper, Dan Cordova, Mac Crome, Chris Dellith, Tim Dillingham, Shannon Dougherty, Adam Eidson, Susan Euing, Rhys Evans, Rick Farris, Meryl Faulkner, Francesca Ferrara, Ayoola Folarin, Brian Foster, Joelle Fournier, Nancy Frost, Dustin Fuller, Josh Garcia, Doug George, Doug Gibson, Richard Gilb, Kirk Gilligan, Ronnie Glick, Kate Goodenough, Glenn Greenwald, Scott Hampton, Gjon Hazard, Laird Henkel, Steve Henry, Susan Hoffman, Nic Huber, Joanna Iwanicha, Ginger Johnson, Andrea Jones, Cyndie Kam, Susan Kaveggia, Kathy Keane, Rebecca Kelley, Eric Kershner, Steve Kirkland, Peter Knapp, John Krause, Carolyn Lieberman, Stephanie Little, Santiago Lopez, Casey Lott, Eileen Maher, Carol Manning, Paul Martin, Ryan McCreary, Robert McMorran, Mitch Medeiros, Eric Mellink, Melissa Mersy Tu, Jennifer Miller, Karen Miner, Kathy Molina, Chuck Morton, Nathan Mudry, Bonnie Nash, Carla Navarro, Tracie Nelson, Paloma Nieto, Jeff Opdycke, Kelly O'Reilly, Gary Page, Eduardo Palacios, Dennis Parker, Robert Patton, Nicole Peltier, Chris Peregrin, David Pereksta, Bonnie Peterson, Jim Peugh, Jennifer Price Jackson, Kat Prickett, Dave Pryor, Maggie Przybylski, Chris Redfern, Don Reierson, Jacque Rice, Dave Riensche, Dana Riggs, Dan Robinette, Caitlin Robinson, Kurt Roblek, Deborah Rogers, Wally Ross, Martin Ruane, Michael Rust, Tom Ryan, Cristina Sandoval, Bob Schallmann, Justin Schuetz, Jeff Seay, Barak Shemai, Tiffany Shepherd, Joel Shinn, Reed Smith, Jonathan Snyder, Bob Stafford, Mark Stahl, Dale Steele, Terri Stewart, William Stewart, Cheryl Strong, Ronald Swaisgood, Karen Taylor, Matt Teutimez, Vicky Touchstone, John Turman, Rick Vetter, Sandy Vissman, Anne Wallace, Jim Watkins, Anna Weinstein, Sabrina West, Lauren White, Doug Willick, Tyler Willsey, Lauren Wilson, Lisa Wilson, Carie Wingert, Shauna Wolf, Warren Wong, Darryl York, Andy Yuen, Dick Zembal.

Funding for this project was provided by the U. S. Fish and Wildlife Service Grant-in-Aid for threatened and endangered species program (Section 6).

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Appendix A

Data Sheets

General Data Sheet

Page 1

Location:		Date:	Job:	Observer(s):		
Time start:		Time stop:		On site:		
Est/Measured	Time:	Temp:	Wind Spd/Dir:	Cloud cvr (%):	Precip. (Y/N):	Tide: H L In Out
ADULTS	Total:	NESTS	Total:	New:		
CHICKS	Observed:	Est max:	New Chicks:	Fledglings Obs:	Est max:	
Mortality (Y/N):	Adult:	Fledgling:	Chick:	Egg:	Nest:	
Predation (Y/N):	Adult:	Fledgling:	Chick:	Egg:	Nest:	
Take (Y/N):	Adult:	Fledgling:	Chick:	Egg:	Nest:	
Col Live (Y/N):	Adult:	Fledgling:	Chick:	Egg:	Other:	
Col Dead (Y/N):	Adult:	Fledgling:	Chick:	Egg:	Fish:	Other:

Nest No.	Grid No.	New/ Incub.	Status	Nest No.	Grid No.	New/ Incub.	Status	Nest No.	Grid No.	New/ Incub.	Status
1				31				61			
2				32				62			
3				33				63			
4				34				64			
5				35				65			
6				36				66			
7				37				67			
8				38				68			
9				39				69			
10				40				70			
11				41				71			
12				42				72			
13				43				73			
14				44				74			
15				45				75			
16				46				76			
17				47				77			
18				48				78			
19				49				79			
20				50				80			
21				51				81			
22				52				82			
23				53				83			
24				54				84			
25				55				85			
26				56				86			
27				57				87			
28				58				88			
29				59				89			
30				60				90			

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

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

Ants Y / N   Grid Location(s):

Documented Predation/Mortality:

Human Disturbance/Take:

Comment:

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

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

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

Documented Predation/Mortality:

Human Disturbance/Take:

Comment:

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

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									
7									
8									
9									
10									
11									
12									
13									
14									
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34									
35									
36									
37									
38									
39									
40									
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											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
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30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											
41											
Nest	Found	Grid	Prior	Date 1	Date 2	Date 3	Date 4	Date 5	Date 6	Date 7	Band Number

Appendix B

Site Specific Data

Appendix B-1: Site Preparation.

Site name:	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Predator management:	Other site preparation:	By whom:
Sacramento Area											
Bufferlands											
San Francisco Bay Area											
Napa Sonoma Marsh Wildlife Area- Totals											
NSMWA-Green Island Unit	K Taylor	E Hanahoe, F Bradley	4	No	Yes- 45 to 50	Yes- 25	No	7-three islands constructed 1 year prior.	Oyster shells placed on all 3 islands prior to nesting.	CDFG and Ducks Unlimited	
NSMWA-Huichica Creek Unit											
Montezuma Wetlands	A Wallace		4	No	No	No	No	7	No		
Pittsburg Power Plant	D Riggs	J Yakich	1	Yes	Yes- 50	No	Yes	4	Yes	Clear out spider webs from shelters.	WRA
Alameda Point	S Euing	M Elliot, J Byron de Yampert	1	Yes	Yes- 250 wood A-frames, 70 tile cylinders, 100 tile half-cylinders, oyster shells	No	Yes	4	Yes	Maintain/repair chick fencing, check that gravel around inside perimeter seals any holes at base of fence.	USFWS staff, FAWR and other vols.
Hayward Regional Shoreline	D Riensche, T Groff	Many (33 individuals)	4- island	Yes	Yes- 10 roofing tile shelters, 16 small wooden A-frame.	Yes- 12 pairs	Yes	4 (2 and 3)		335,000 lbs sand, salt, shells on island.	D Riensche and volunteers.
Eden Landing	C Strong										
Kings County											
Kettleman City Evaporation Ponds	J Seay										

Appendix B-1: Site Preparation (continued).

Site name:	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Predator management:	Other site preparation:	By whom:
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA	D George, A Clark, M Pryzbylski, D Costello, E Krygsman, C Lish, J Iwanicha	R Slack, P Lancaster, K Surgalski, K Clearwater, S Flores, M Graeser, J Trunzo, T Pell, D Murray	1	Yes	Yes- 240 wood A-frames, L-shape shelters, or T-shape shelters.	No	No	5- Off-road vehicle use Oct-Feb prevents or removes vegetation. Efforts are made to encourage some vegetation for chick cover.	Yes	Limited amounts of driftwood, woodchips, seed, and plants were put out for nest and chick cover.	California Department of Parks and Recreation (Oceano Dunes State Vehicular Recreation Area)
Guadalupe-Mussel Rock											
Vandenberg AFB	D Robinette	L Hargett	2 (electric)	Yes	Yes- wood teepee shelters	No	No	7	Yes	Electric fence maintenance.	Existing wood teepee shelters left in place. Broken shelters replaced with wooden shelters.
Coal Oil Point Reserve											
Ventura County											
Santa Clara River/McGrath State Beach	R Smith	D Glenn	3	Yes	No	No	No	No	No		
Ormond Beach	C Wingert	N Fox-Fernandez, J Turner, S Hongola, C Sulzman, C Kahler, L Cook, F Griego	1	Yes	No	No	No	7	No	No	
Hollywood Beach											
Pt Mugu- Totals											
Holiday Beach	M Ruane	F Ferrara, R Kelley, S Murphy, J More, A Convery	4	Yes	Yes- 25 shelters	No	No	7	Yes		
Holiday Beach Salt Panne	M Ruane	F Ferrara, R Kelley, S Murphy, J More, A Convery	4	Yes	No	No	No	7	Yes		
Eastern Arm	M Ruane	F Ferrara, R Kelley, S Murphy, J More, A Convery	4	Yes	No	No	No	7	Yes		
Ormond Beach East	M Ruane	F Ferrara, R Kelley, S Murphy, J More, A Convery, A Cleveland, F Rivas, R Dolinar, S Buckner, J Buckner, L Chang, C Mehlberg, D Metcalf	4	Yes	Yes- 50 shelters	No	No	7	Yes		

Appendix B-1: Site Preparation (continued).

Site name:	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Predator management:	Other site preparation:	By whom:
Los Angeles/Orange Counties											
Venice Beach	T Ryan	S Vigallon	6 ft chain link	6 small signs on fence	No	Yes- 30	Yes	2		Sand clearing from fence, sea rocket removal, 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- Pier 400	N Mudry	S Langdon	3	Yes	Yes	Yes- 15	Yes	4	Yes		Port of Los Angeles
Seal Beach NWR - Anaheim Bay	M Teutimez, S Lopez	K Gilligan, B Schallmann, J Fitch	1	Yes	Yes- roofing tiles	Yes- 17	Yes	3	Yes	Sand relocation at site, electric fence maintenance.	USFWS
Bolsa Chica Ecological Reserve-Totals											
Nest Site 1 (NS1)	P Knapp	K O'Reilly, G Keller, W Ross	2	Yes	Yes-, 36 roofing tiles	No	Yes	4	Yes		
Nest Site 2 (NS2)	P Knapp	K O'Reilly, G Keller, W Ross	4	No	No	No	No	4	Yes		
Nest Site 3 (NS3)	P Knapp	K O'Reilly, G Keller, W Ross	4	No	Yes- 10 roofing tiles	No	Yes	4	Yes	Beach sand and shell added to site.	Contractor
South Tern Island (STI)	P Knapp	K O'Reilly, G Keller, W Ross	4	No	Yes- 50 roofing tiles	No	Yes	4	Yes		
Huntington State Beach	C Kam	N Housel, S Hoffman, A Beckman, J Coumousto, B Nash, T Barbee, D McMichael	1	Yes	Yes- 64	No	Yes	1	Yes		CA State Parks, SAWA
Burris Sand Pit/Buris Basin	R Zembal	B Johnson, D McMichael, T Barbee, E Peralta, S Hoffman, D Willick	4, water	Yes	Yes- 10	No	Yes	4	No	Planted native coastal strand species.	OCWD
Upper Newport Bay Ecological Reserve											

Appendix B-1: Site Preparation (continued).

Site name:	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Predator management:	Other site preparation:	By whom:
San Diego County											
MCB Camp Pendleton- Totals	J Fournier	C Manning, K Turner, E Rice									
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	B Foster										
W1			1	Yes	Yes	No	Yes	4	No		D Zaldivar
W2			1	Yes	Yes	No	Yes	4	No		D Zaldivar
E1			4	Yes	Yes	No	Yes	4	No		D Zaldivar
E2			4	No	No	No	Yes	4	No		D Zaldivar
E3			4	No	No	No	Yes	4	No		D Zaldivar
San Elijo Lagoon Ecological Reserve	R Patton	M Bache, S Wolf	3	Yes	No	No	No	7	No		
Fairbanks Ranch											
San Dieguito Lagoon Ecological Reserve											
Mission Bay											
FAA Island	J Jackson		4	Yes	No	No	No	6	No		
North Fiesta Island	G Johnson		1	Yes	Yes- 60	Yes- 93	Yes	4	Yes	Chick fence installed in some areas.	San Diego City Parks Dept and volunteers
Mariner's Point	G Johnson		1	Yes	Yes- 40	Yes- 75	Yes	4	Yes	Buffer zone maintained between public parking lot and tern site.	San Diego Audubon Society volunteers, San Diego City Parks Dept
Stony Point	G Johnson		1	Yes	Yes- 40	Yes- 79	Yes	4	Yes	Grid system improved; fence into water lengthened for dogs.	San Diego City Parks Dept
San Diego River Mouth	G Johnson		1	Yes	No	No	No	No	No	Fencing with chick fence at base installed early Apr and removed mid-Sept.	San Diego City Parks Dept.

Appendix B-1: Site Preparation (continued).

Site name:	Name of primary monitor:	Names of other monitors:	Fence type:	Interpretive signs at site:	Chick shelters:	Decoys:	Grid system:	Vegetation management:	Predator management:	Other site preparation:	By whom:
San Diego Bay											
Lindbergh Field & Former Naval Training Center	R Patton	E Copper, B Foster, M Garcia, M Sadowski, L Squires	3	Yes	No	No	Yes	4	Yes		
US Navy											
NI MAT	J Fournier	D Parker, C Beck	2	Yes	Yes	No	Yes	4	Yes		
Naval Base Coronado- Totals											
Delta Beach North	J Fournier	M Sadowski, R Mendez, P Del Pizzo, C Beck, D Zaldivar, E Rice	3	Yes	Yes	Yes- 54	Yes	4	Yes		
Delta Beach South	J Fournier	M Sadowski, R Mendez, P Del Pizzo, C Beck, D Zaldivar, E Rice	3	Yes	Yes	Yes- 54	Yes	4	Yes		
NAB Ocean	J Fournier	M Sadowski, R Mendez, D Zaldivar, E Rice	4	Yes	No	Yes- 54	Yes	7	Yes		
D Street Fill/Sweetwater Marsh NWR	R Patton	B Collins, B Foster, J Jackson, M Sadowski, L Squires	3	Yes	Yes	Yes	Yes	4	Yes		
Chula Vista Wildlife Reserve	R Patton	B Foster, J Jackson, M Sadowski, L Squires	3	Yes	Yes	Yes	Yes	4	Yes		
South San Diego Bay Unit, SDNWR - Saltworks	R Patton	B Collins, B Foster, K Goodenough, M Sadowski, L Squires	3	Yes	Yes	No	Yes	6	Yes		
Tijuana Estuary NERR	R Patton	B Collins, M Sadowski, L Squires	3	Yes	Yes	No	Yes	7	Yes		
Imperial County											
Salton Sea	G McCaskie										

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 2011
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								
Napa Sonoma Marsh Wildlife Area- Totals								
NSMWA-Green Island Unit	1	19-Apr-11	30-Aug-11	32	Yes	No	No	N/A
NSMWA-Huichica Creek Unit								
Montezuma Wetlands	2	26-May-11	9-Aug-11	8	No	No	No	
Pittsburg Power Plant	2		1-Aug-11		No	No	No	N/A
Alameda Point	3	15-May-11	9-Aug-11	86	Yes	No	No	N/A
Hayward Regional Shoreline	3	10-Mar-11	24-Jul-11	307	Yes	Yes	No	N/A
Eden Landing								
Kings County								
Kettleman City Evaporation Ponds								
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	1	1-Mar-11	30-Sep-11	Site received some degree of monitoring on a daily basis.	Yes	No	Yes- chicks	Blue over white tape (bicolored band) on left leg for chicks. USFWS band on right leg and tape in 1 to 2 colors on this band for unique combinations.
Guadalupe-Mussel Rock								
Vandenberg AFB	3	15-Apr-11	21-Jul-11	73	Yes	No	No	N/A
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	9-Jun-11	31-Aug-11	13	Yes	No	No	N/A
Ormond Beach	1	8-Apr-11	15-Sep-11	24	Yes	No	No	N/A
Hollywood Beach								
Pt Mugu- Totals	1 & 3	18-Apr-11	29-Jul-11	33	Yes	No	No	N/A
Holiday Beach	1	18-Apr-11	28-Jul-11	33	Yes	No	No	N/A
Holiday Beach Salt Panne	1	18-Apr-11	25-Jul-11	25	Yes	No	No	N/A
Eastern Arm	1	18-Apr-11	25-Jul-11	14	Yes	No	No	N/A
Ormond Beach East	3	18-Apr-11	29-Jul-11	32	Yes	No	No	N/A
Los Angeles/Orange Counties								
Venice Beach	1	4-Apr-11	28-Jul-11	20	Yes	No	No	N/A
LA Harbor	1	12-Feb-11	31-Jul-11	236	Yes	No	No	N/A
Seal Beach NWR - Anaheim Bay	1	20-Apr-11	27-Jul-11	15	Yes	No	Yes- chicks	yellow & black
Bolsa Chica Ecological Reserve-Totals								
Nest Site 1 (NS1)	1	7-May-11	19-Aug-11	10	Yes	No	No	N/A
Nest Site 2 (NS2)	1	9-May-11	19-Aug-11	8	Yes	No	No	N/A
Nest Site 3 (NS3)	1	19-May-11	13-Jul-11	9	Yes	No	No	N/A
South Tern Island (STI)	1	27-May-11	21-Jul-11	6	Yes	No	No	N/A
Huntington State Beach	1	10-May-11	29-Jul-11	18	Yes	No	No	N/A
Burris Sand Pit/Buris Basin	3	2-May-11	11-Aug-11	24	Yes	No	No	N/A
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		15-Mar-11	12-Sep-11					
Red Beach	1	15-Mar-11	10-Sep-11	30	N/A	N/A	N/A	N/A
Delta Beach	1	15-Mar-11	10-Sep-11	45	Yes	No	Yes- chicks	N/A
White Beach	1	15-Mar-11	10-Sep-11	50	Yes	No	Yes- chicks	N/A
Santa Margarita River - North Beach North	1	15-Mar-11	12-Sep-11	63	Yes	No	Yes- chicks	N/A
Santa Margarita River - North Beach South	1	6-Mar-11	12-Sep-11	85	Yes	No	Yes- chicks	N/A
Santa Margarita River - Saltflats	1	17-Mar-11	12-Sep-11	51	Yes	No	Yes- chicks	N/A
Santa Margarita River - Saltflats Island	1	17-Mar-11	12-Sep-11	51	Yes	No	Yes- chicks	N/A
Batiquitos Lagoon Ecological Reserve- Totals	1	10-Apr-11	5-Aug-11	14	Yes	No	Yes- chicks	N/A
W1								
W2								
E1								
E2								
E3								
San Elijo Lagoon Ecological Reserve	1	7-Apr-11	12-Sep-11	23	No	No	No	N/A
Fairbanks Ranch								
San Dieguito Lagoon Ecological Reserve								
Mission Bay								
FAA Island	1	5-May-11	19-Aug-11	16	Yes	Yes	Yes- chicks	N/A
North Fiesta Island	1	5-May-11	29-Jul-11	14	Yes	Yes	No	N/A
Mariner's Point	1	3-May-11	26-Aug-11	25	Yes	Yes	Yes- chicks	S-B/G
Stony Point	1	6-May-11	9-Aug-11	20	Yes	Yes	Yes- chicks	S-L/B
San Diego River Mouth	1	4-May-11	12-Aug-11	21	Yes	Yes	Yes- chicks	

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	6-Apr-11	18-Aug-11	63	Yes	No	Yes	Chicks X-S; Adult W/G over S, L opposite S to indicate 2011 trapping.
US Navy								
NI MAT	1	11-Mar-11	10-Aug-11	45	Yes	No	Yes- chicks	N/A
Naval Base Coronado- Totals								
Delta Beach North	1	10-Mar-11	1-Sep-11	70	Yes	No	Yes- chicks	N/A
Delta Beach South	1	10-Mar-11	1-Sep-11	70	Yes	No	Yes- chicks	N/A
NAB Ocean	1	10-Mar-11	1-Sep-11	140	Yes	No	Yes- chicks	N/A
D Street Fill/Sweetwater Marsh NWR	1	1-Apr-11	9-Sep-11	70	Yes	No	Yes	Chicks X-S; Adult W/M over S, L opposite S to indicate 2011 trapping.
Chula Vista Wildlife Reserve	1	1-Apr-11	1-Sep-11	64	Yes	No	Yes	Chicks X-S; Adult Y/K over S, L opposite S to indicate 2011 trapping.
South San Diego Bay Unit, SDNWR - Saltworks	1	2-Apr-11	15-Sep-11	79	Yes	No	Yes	Chicks X-S; Adult L/M over S, L opposite S to indicate 2011 trapping.
Tijuana Estuary NERR	1	7-Apr-11	15-Sep-11	44	Yes	No	Yes	Chicks X-S; Adult G/R over S, L opposite S to indicate 2011 trapping.
Imperial County								
Salton Sea								

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 2006-2011)

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:	Total nests:
Sacramento Area								
Bufferlands							1	1
San Francisco Bay Area								
Napa Sonoma Marsh Wildlife Area- Totals	10-May-11	2-Aug-11	31-May-11	14-Jul-11	6	32	19	38
NSMWA-Green Island Unit	10-May-11	2-Aug-11	31-May-11	14-Jul-11	6	32	19	38
NSMWA-Huichica Creek Unit							0	0
Montezuma Wetlands	26-May-11	27-Jul-11	26-May-11	unknown	15		15	15
Pittsburg Power Plant	23-Jun-11	23-Jun-11					0	0
Alameda Point	22-Apr-11	9-Aug-11	15-May-11	26-Jul-11	302	53	328.5	355
Hayward Regional Shoreline	27-Apr-11	24-Jul-11	16-May-11	13-Jul-11	50	27	63.5	77
Eden Landing					0	0	0	0
Kings County								
Kettleman City Evaporation Ponds					0	0	0	0
San Luis Obispo/Santa Barbara Counties								
Oceano Dunes SVRA	12-May-11	20-Aug-11	5-Jun-11	26-Jul-11	25	10	30	35
Guadalupe-Mussel Rock								0
Vandenberg AFB	9-May-11	17-Jul-11	27-May-11	21-Jun-11	32	0	32	32
Coal Oil Point Reserve							1	1
Ventura County								
Santa Clara River/McGrath State Beach	9-Jun-11	25-Aug-11	9-Jun-11	28-Jul-11	26		26	26
Ormond Beach	29-Apr-11	25-Aug-11	27-May-11	23-Jun-11				60
Pt Mugu- Totals	26-Apr-11	16-Aug-11	12-May-11	5-Jul-11	662	24	674	686
Holiday Beach	26-Apr-11	16-Aug-11	16-May-11	29-Jun-11	25	6	28	31
Holiday Beach Salt Panne	26-Apr-11	16-Aug-11	3-Jun-11	10-Jun-11	2	0	2	2
Eastern Arm	26-Apr-11	16-Aug-11	5-Jul-11	5-Jul-11	0	1	0.5	1
Ormond Beach East	26-Apr-11	16-Aug-11	12-May-11	1-Jul-11	660	23	671.5	683
Los Angeles/Orange Counties								
Venice Beach	20-Apr-11	19-Jul-11	18-May-11	1-Jun-11	14	14	21	28
LA Harbor	25-Apr-11	31-Jul-11	6-Jun-11	1-Jul-11	3	7	6.5	10
Seal Beach NWR - Anahiem Bay	7-Apr-11	4-Aug-11	4-May-11	13-Jul-11	140	37	158.5	177
Bolsa Chica Ecological Reserve-Totals								167
Nest Site 1 (NS1)			7-May-11	14-Jun-11			0	31
Nest Site 2 (NS2)		21-Aug-11	9-May-11	27-Jun-11			0	49
Nest Site 3 (NS3)			19-May-11	6-Jul-11			0	66
South Tern Island (STI)	18-Apr-11		21-May-11	13-Jul-11			0	21
Huntington State Beach	19-Apr-11	1-Aug-11	10-May-11	5-Jul-11	701	11	706.5	712
Burris Sand Pit/Buris Basin	2-May-11	11-Aug-11	19-May-11	29-Jun-11	12	2	13	14
Upper Newport Bay Ecological Reserve								6

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	13-Apr-11	22-Aug-11	30-Apr-11	1-Jul-11	1492	34	1509
Red Beach	20-May-11	20-Jun-11	N/A	N/A	0		0
Delta Beach	28-Apr-11	8-Jul-11	12-May-11	21-Jun-11	2	2	3
White Beach	19-Apr-11	8-Jul-11	3-May-11	23-Jun-11	128	4	130
Santa Margarita River - North Beach North	17-Apr-11	22-Aug-11	2-May-11	28-Jun-11	278	5	280.5
Santa Margarita River - North Beach South	13-Apr-11	8-Aug-11	30-Apr-11	1-Jul-11	1045	22	1056
Santa Margarita River - Saltflats	18-Apr-11	11-Jul-11	4-May-11	24-Jun-11	28	1	28.5
Santa Margarita River - Saltflats Island	18-Apr-11	11-Jul-11	7-May-11	13-Jun-11	11	0	11
Batiquitos Lagoon Ecological Reserve- Totals	3-May-11	29-Jul-11	13-May-11	25-Jun-11	505	27	518.5
W1					22		22
W2					449	27	462.5
E1					28		28
E2							0
E3					6		6
San Elijo Lagoon Ecological Reserve	12-Jun-11	8-Aug-11			0	0	0
Fairbanks Ranch							
San Dieguito Lagoon Ecological Reserve							0
Mission Bay							
FAA Island	12-May-11	27-Jul-11	12-May-11	6-Jul-11	17	4	19
North Fiesta Island	5-May-11	4-Jul-11	27-May-11	27-May-11	1	0	1
Mariner's Point	3-May-11	27-Jul-11	7-May-11	27-Jun-11	141	4	143
Stony Point	6-May-11	30-Jul-11	26-May-11	8-Jul-11	5	7	8.5
San Diego River Mouth	12-May-11	4-Aug-11	16-May-11	17-Jul-11	6	7	9.5
San Diego Bay							
Lindbergh Field & Former Naval Training Center	19-Apr-11	3-Aug-11	10-May-11	24-Jun-11	75	3	76.5
US Navy							
NI MAT	20-Apr-11	25-Jul-11	4-May-11	17-Jun-11	82	1	82.5
Naval Base Coronado- Totals							
Delta Beach North	16-Apr-11	18-Jul-11	2-May-11	8-Jul-11	209	21	219.5
Delta Beach South	16-Apr-11	18-Jul-11	6-May-11	4-Jul-11	141	17	149.5
NAB Ocean	18-Apr-11	13-Aug-11	2-May-11	21-Jul-11	537	137	605.5
D Street Fill/Sweetwater Marsh NWR	19-Apr-11	15-Aug-11	6-May-11	2-Jul-11	110	6	113
Chula Vista Wildlife Reserve	19-Apr-11	24-Aug-11	13-May-11	19-Jul-11	41	12	47
South San Diego Bay Unit, SDNWR - Saltworks	23-Apr-11	25-Aug-11	13-May-11	28-Jul-11	35	20	45
Tijuana Estuary NERR	19-Apr-11	18-Aug-11	28-Apr-11	21-Jul-11	216	48	240
Imperial County							
Salton Sea							3

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			1				0			0	0
San Francisco Bay Area												
Napa Sonoma Marsh Wildlife Area- Totals	38	5	5	28	28-Jun-11	6	5	1	32	5	27	28
NSMWA-Green Island Unit	38	5	5	28	28-Jun-11	6	5	1	32	5	27	28
NSMWA-Huichica Creek Unit	0			0				0			0	0
Montezuma Wetlands	15			15				0			0	0
Pittsburg Power Plant	0			0	23-Jun-11	0		0			0	0
Alameda Point	355	47	4	304	15-Jun-11	302	51	251	53	0	53	304
Hayward Regional Shoreline	77	4	0	73	16-Jun-11	50	4	46	27	4	23	69
Eden Landing	0			0								0
Kings County												
Kettleman City Evaporation Ponds	0			0								0
San Luis Obispo/Santa Barbara Counties												
Oceano Dunes SVRA	35	1	0	34		35	2	33			0	33
Guadalupe-Mussel Rock	0											0
Vandenberg AFB	32	12	0	20	None	32	0	32	0	0	0	32
Coal Oil Point Reserve	1			1								1
Ventura County												
Santa Clara River/McGrath State Beach	26			26		26		26			0	26
Ormond Beach	60	8-10	1	49-51								
Pt Mugu- Totals	686	216	0	470								
Holiday Beach	31	3	0	28								
Holiday Beach Salt Panne	2	0	0	2								
Eastern Arm	1	0	0	1								
Ormond Beach East	683	216	0	467								
Los Angeles/Orange Counties												
Venice Beach	28	14	0	14	29-Jun-11	14	0	14	14	14	0	14
LA Harbor	10	1	1	8								
Seal Beach NWR - Anaheim Bay	177	8		169	15-Jun-11	153		153	24		24	177
Bolsa Chica Ecological Reserve-Totals	167	55	32	80								
Nest Site 1 (NS1)	31	9	18	4								
Nest Site 2 (NS2)	49	7	6	36								
Nest Site 3 (NS3)	66	35	7	24								
South Tern Island (STI)	21	4	1	16								
Huntington State Beach	712	189	5	518	15-Jun-11	701	149	552	11	0	11	563
Burris Sand Pit/Buris Basin	14	0	0	14	29-Jun-11	12	0	12	2	0	2	14
Upper Newport Bay Ecological Reserve	6											6

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	1526	323	189	1014								
Red Beach	0	0	0	0								
Delta Beach	4	1	0	3								
White Beach	132	48	7	77								
Santa Margarita River - North Beach North	283	118	20	145								
Santa Margarita River - North Beach South	1067	150	161	756								
Santa Margarita River - Saltflats	29	6	1	22								
Santa Margarita River - Saltflats Island	11	0	0	11								
Batiquitos Lagoon Ecological Reserve- Totals	532	54	6	472		505	48	457	27	27	0	457
W1	22	22		0								
W2	476	4	6	466								
E1	28	28		0								
E2	0			0								
E3	6			6								
San Elijo Lagoon Ecological Reserve												
Fairbanks Ranch												
San Dieguito Lagoon Ecological Reserve												
Mission Bay												
FAA Island	21	4		17		17	4	13	4	1	3	16
North Fiesta Island	1	1	0	0		1	0	1	0	0	0	1
Mariner's Point	145	17	10	118	17-Jun-11	141	17	124	4	0	4	128
Stony Point	12	1	0	11	14-Jun-11	5	1	4	7	0	7	11
San Diego River Mouth	13	2	0	11	29-Jun-11	6	2	4	7	0	7	11
San Diego Bay												
Lindbergh Field & Former Naval Training Center	78	4	32	42	15-Jun-11	75	4	71	3	3	0	71
US Navy												
NI MAT	83	14	3	66				0			0	0
Naval Base Coronado- Totals												
Delta Beach North	230	6	19	205				0			0	0
Delta Beach South	158	3	15	140				0			0	0
NAB Ocean	674	36	33	605				0			0	0
D Street Fill/Sweetwater Marsh NWR	116	7	68	41	15-Jun-11	110	4	106	6	6	0	106
Chula Vista Wildlife Reserve	53	7	12	34	15-Jun-11	41	4	37	12	12	0	37
South San Diego Bay Unit, SDNWR - Saltworks	55	8	10	37	15-Jun-11	35	8	27	20	20	0	27
Tijuana Estuary NERR	264	64	20	180	15-Jun-11	216	64	152	48	48	0	152
Imperial County												
Salton Sea	0											3

Appendix B-4: Productivity.

Site name:	Total nests:	Total eggs:	No. of eggs hatched:	Hatching Success:	Date of first chick:	Date of last hatch:	Max # active nests	Date of max active nests	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Sacramento Area											
Bufferlands	1										3
San Francisco Bay Area											
Napa Sonoma Marsh Wildlife Area- Totals	38	59	17	0.2881	11-Jul-11	26-Jul-11			N/A	Observed short flights	unknown
NSMWA-Green Island Unit	38	59	17	0.2881	11-Jul-11	26-Jul-11			N/A	Observed short flights	unknown
NSMWA-Huichica Creek Unit	0	0									
Montezuma Wetlands	15	unknown	unknown	unknown	19-Jul-11	unknown	15	16-Jun-11	unknown	N/A	unknown
Pittsburg Power Plant	0	0									
Alameda Point	355	601	410	0.68219634	7-Jun-11	22-Jul-11	206	6/8 and 6/9	29-Jun-11	counts of every	179-191
Hayward Regional Shoreline	77	130	85	0.6538	4-Jun-11					3WD	24-37
Eden Landing	0	0									0
Kings County											
Kettleman City Evaporation Ponds	0	0									0
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA	35	65	55	0.8462	28-Jun-11	21-Jul-11	32	June-11	19-Jul-11	color band	50
Guadalupe-Mussel Rock	0										
Vandenberg AFB	32	53	36	0.6792	14-Jun-11	8-Jul-11	20	21-Jun-11	4-Jul-11	3WD	4
Coal Oil Point Reserve	1										
Ventura County											
Santa Clara River/McGrath State Beach	26	43	25	0.58139535	14-Jul-11	28-Jul-11	11	30-Jun-11	14-Jul-11	3WD	20
Ormond Beach	60	104	54	0.5192	15-Jun-11	13-Jul-11	43	9-Jun-11	7-Jul-11	3WD	12
Hollywood Beach	0	0									
Pt Mugu- Totals	717	1163	452	0.3887	10-Jun-11	13-Jul-11	544	10-Jun-11	1-Jul-11	Other	72
Holiday Beach	31	53	38	0.7170	14-Jun-11	5-Jul-11	23	10-Jun-11	15-Jul-11	Other	12
Holiday Beach Salt Panne	2	4	4	1.0000	22-Jun-11	5-Jul-11	2	10-Jun-11	N/A	N/A	1
Eastern Arm	1	2	0	0.0000	N/A	N/A	1	5-Jun-11	N/A	N/A	0
Ormond Beach East	683	1157	448	0.3872	10-Jun-11	13-Jul-11	519	10-Jun-11	1-Jul-11	Other	59

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:	Max # active nests	Date of max active nests	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Los Angeles/Orange Counties											
Venice Beach	28	28	0	0.0000	N/A	N/A			N/A	N/A	0
LA Harbor	10	16	5	0.3125	8-Jul-11	19-Jul-11	5	27-Jun-11	N/A	N/A	0
Seal Beach NWR - Anaheim Bay	177	305	186	0.6098	9-Jun-11	16-Jun-11	132	1-Jun-11	23-Jun-11	3WD	11
Bolsa Chica Ecological Reserve-Totals	167	268	160	0.5970	31-May-11	1-Aug-11			20-Jun-11		66-95
Nest Site 1 (NS1)	31	52	29	0.5577	31-May-11	21-Jun-11	17	31-May-11	20-Jun-11	other	1 - 2
Nest Site 2 (NS2)	49	86	79	0.9186	2-Jun-11	27-Jun-11	41	9-Jun-11	22-Jun-11	other	51 - 72
Nest Site 3 (NS3)	66	95	31	0.3263	14-Jun-11	6-Jul-11	31	7-Jun-11	1-Jul-11	other	2 - 3
South Tern Island (STI)	21	35	21	0.6000	13-Jun-11	1-Aug-11	11	30-Jun-11	6-Jul-11	other	12 - 18
Huntington State Beach	712	1208	708	0.5861	24-May-11	5-Jul-11	444	24-May-11	21-Jun-11	2 week count	107
Burris Sand Pit/Buris Basin	14	25	19	0.7600	16-Jun-11	20-Jul-11	12	16-Jun-11	20-Jul-11	3WD	12
Upper Newport Bay Ecological Reserve	6										0
San Diego County											
MCB Camp Pendleton- Totals	1526	2662	1649	0.6195	23-May-11	8-Jul-11	1067	29-May-11	17-Jun-11	Sum highest coun	104-105
Red Beach	0	0	0	0.0000							0
Delta Beach	4	6	4	0.6667	28-May-11	29-Jun-11	2	16-May-11	na		0
White Beach	132	235	112	0.4766	28-May-11	23-Jun-11	82	1-Jun-11	29-Jun-11	Sum highest coun	6
Santa Margarita River - North Beach North	283	471	203	0.4310	23-May-11	24-Jun-11	171	21-May-11	17-Jun-11	Sum highest coun	13
Santa Margarita River - North Beach South	1067	1882	1290	0.6854	25-May-11	7-Jul-11	826	25-May-11	17-Jun-11	Sum highest coun	84-85
Santa Margarita River - Saltflats	29	47	23	0.4894	6-Jun-11	24-Jun-11	16	4-Jun-11	11-Jul-11	Fledge seen only	1
Santa Margarita River - Saltflats Island	11	21	17	0.8095	1-Jun-11	8-Jul-11	9	21-May-11	na		0
Batiquitos Lagoon Ecological Reserve- Totals	532	995	730	0.7337	6-Jun-11	25-Jun-11	338	27-May-11	25-Jun-11	R: 3WD	50
W1	22	44	0	0.0000	N/A		20	27-May-11			0
W2	476	885	730	0.8249	6-Jun-11	25-Jun-11	310	27-May-11	25-Jun-11	R: 3WD	50
E1	28	54	0	0.0000	N/A		24	20-May-11			0
E2	0	0									
E3	6	12	unknown	unknown	N/A		6	27-May-11			
San Elijo Lagoon Ecological Reserve	0	0									0
Fairbanks Ranch											
San Dieguito Lagoon Ecological Reserve	0	0									0

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:	Max # active nests	Date of max active nests	Date of first fledgling:	Fledgling estimate method:	Total fledglings:
Mission Bay											
FAA Island	21	36	19	0.5278	8-Jun-11	27-Jul-11	8	1-Jun-11	29-Jun-11	count	9
North Fiesta Island	1	1	0	0.0000			1	31-May-11			0
Mariner's Point	145	283	240	0.8481	1-Jun-11	23-Jun-11	123	1-Jun-11	26-Jun-11	3WD	50-60
Stony Point	12	22	14	0.6364	12-Jun-11	21-Jul-11	7	19-Jun-11	9-Jul-11	3WD	3
San Diego River Mouth	13	22	14	0.6364	29-Jun-11	28-Jul-11	6	1-Jul-11	22-Jul-11	3WD	5-6
San Diego Bay											
Lindbergh Field & Former Naval Training Center	78	141	118	0.8369	31-May-11	5-Jul-11	66	31-May-11	21-Jun-11	other	11-15
NI MAT	83	152	121	0.7961	29-May-11	20-Jun-11	69	31-May-11	15-Jun-11	Other/3WD	12-25
Naval Base Coronado- Totals	1063	1865	1562	0.8375	25-May-11	16-Jul-11			12-Jun-11		96-147
Delta Beach North	230	406	366	0.9015	25-May-11	15-Jul-11	166	28-May-11	12-Jun-11	Other/3WD	40-45
Delta Beach South	159	280	238	0.8500	27-May-11	29-Jun-11	117	28-May-11	13-Jun-11	3WD/Other	15-40
NAB Ocean	674	1179	958	0.8126	25-May-11	16-Jul-11	399	28-May-11	16-Jun-11	Other/3WD	41-62
D Street Fill/Sweetwater Marsh NWR	116	217	174	0.8018	27-May-11	8-Jul-11	100	31-May-11	21-Jun-11	other	34-41
Chula Vista Wildlife Reserve	53	100	75	0.7500	3-Jun-11	18-Jul-11	34	31-May-11	21-Jun-11	other	12-19
South San Diego Bay Unit, SDNWR - Saltworks	55	104	34	0.3269	6-Jun-11	13-Jul-11	31	26-May-11	29-Jun-11	other	2-3
Tijuana Estuary NERR	264	472	260	0.5508	2-Jun-11	28-Jul-11	159	26-May-11	23-Jun-11	other	90-98
Imperial County											
Salton Sea	3										0

Appendix B-4: Productivity, clutch sizes 2011.

			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					
San Francisco Bay Area						
Napa Sonoma Marsh Wildlife Area- Totals						
NSMWA-Green Island Unit	38	59	19	21	0	0
NSMWA-Huichica Creek Unit	0	0	0	0	0	0
Montezuma Wetlands	15					
Pittsburg Power Plant	0	0	0	0	0	0
Alameda Point	355	601	112	240	3	0
Hayward Regional Shoreline	77	130	25	51	1	0
Eden Landing	0					
Kings County						
Kettleman City Evaporation Ponds	0	0	0	0	0	0
San Luis Obispo/Santa Barbara Counties						
Oceano Dunes SVRA	35	65	6	28	1	0
Guadalupe-Mussel Rock	0	0	0	0	0	0
Vandenberg AFB	32	53	3	20	1	0
Coal Oil Point Reserve	1					
Ventura County						
Santa Clara River/McGrath State Beach	26	43	9	17	0	0
Ormond Beach	60	104	16	44	0	0
Hollywood Beach	0	0	0	0	0	0
Pt Mugu- Totals	686	1163	216	463	7	0
Holiday Beach	31	53	9	22	0	0
Holiday Beach Salt Panne	2	4	0	2	0	0
Eastern Arm	1	2	0	1	0	0
Ormond Beach East	683	1157	216	460	7	0

Appendix B-4: Productivity, clutch sizes 2011 (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	28	28	28	0	0	0
LA Harbor	10	19	1	9	0	0
Seal Beach NWR - Anaheim Bay	177	305	53	124	0	1
Bolsa Chica Ecological Reserve-Totals	167	268	68	97	2	0
Nest Site 1 (NS1)	31	52	10	21	0	0
Nest Site 2 (NS2)	49	86	14	33	2	0
Nest Site 3 (NS3)	66	95	37	29	0	0
South Tern Island (STI)	21	35	7	14	0	0
Huntington State Beach	712	1208	220	489	2	1
Burris Sand Pit/Buris Basin	14	25	4	9	1	0
Upper Newport Bay Ecological Reserve	6					
San Diego County						
MCB Camp Pendleton- Totals	1524	2662	400	1113	8	3
Red Beach	0	0	0	0	0	0
Delta Beach	4	6	2	2	0	0
White Beach	132	235	34	95	1	2
Santa Margarita River - North Beach North	283	471	98	182	3	0
Santa Margarita River - North Beach South	1065	1882	254	806	4	1
Santa Margarita River - Saltflats	29	47	11	18	0	0
Santa Margarita River - Saltflats Island	11	21	1	10	0	0
Batiquitos Lagoon Ecological Reserve- Totals	532	995	76	449	7	0
W1	22	44	0	22	0	0
W2	476	885	73	397	6	0
E1	28	54	3	24	1	0
E2	6	12	0	6	0	0
E3	0	0	0	0	0	0
San Elijo Lagoon Ecological Reserve	0	0	0	0	0	0
Fairbanks Ranch	0	0	0	0	0	0
San Dieguito Lagoon Ecological Reserve	0	0	0	0	0	0
Mission Bay						
FAA Island	21	38	6	5	0	0
North Fiesta Island	1	1	1	0	0	0
Mariner's Point	145	283	16	120	9	0
Stony Point	12	22	2	10	0	0
San Diego River Mouth	13	22	4	9	0	0
San Diego Bay						
Lindbergh Field & Former Naval Training Center	78	141	15	63	0	0
NI MAT	83	152	14	69	0	0
Naval Base Coronado- Totals	1062	1864	265	792	5	0
Delta Beach North	230	406	55	174	1	0
Delta Beach South	158	280	36	122	0	0
NAB Ocean	674	1178	174	496	4	0
D Street Fill/Sweetwater Marsh NWR	116	217	15	101	0	0
Chula Vista Wildlife Reserve	53	100	6	47	0	0
South San Diego Bay Unit, SDNWR - Saltworks	55	104	8	45	2	0
Tijuana Estuary NERR	264	472	57	206	1	0
Imperial County						
Salton Sea	3					

Appendix B-5: Non Predation Mortality.

	No. of eggs					No. of nests					No. of dead			
Site name:	human damaged:	lost to flooding:	abandoned pre-term	abandoned post-term/nonviable	outcome unknown:	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks	fledglings	adults	Comments on cause(s) of non-predation mortality:
Sacramento Area														
Bufferlands														
San Francisco Bay Area														
Napa Sonoma Marsh Wildlife Area- Totals														
NSMWA-Green Island Unit	0	0	2	8	6	0	0	1	4	6	0	0	1	Presumed perigrine falcon.
NSMWA-Huichica Creek Unit														
Montezuma Wetlands														
Pittsburg Power Plant														
Alameda Point	0	12	113	46	25	0	9	86	39	11	207	1	5	Abnormal weather patterns and poor foraging opportunities, as well as possible contaminant issues that are currently under investigation by FWS, USGS & CDFG.
Hayward Regional Shoreline	0	0	0	3	0	0	0	0	4	0	15	3	0	
Eden Landing														
Kings County														
Kettleman City Evaporation Ponds														
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	2	3	0	0	0	2	2	0	0	0	0	
Guadalupe-Mussel Rock														
Vandenberg AFB	0	0	10	0	0	0	0	5	0	0	3	1	0	We assume the chick and fledgling mortality was due to prey availability. Diet was highly variable throughout the season and we observed the lowest foraging rates adjacent to the colony in our 5-year foraging time series. Addtitionally, eight of the ten
Coal Oil Point Reserve						0	0	1	0	0				Adults incubated for only a week.

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:
Ventura County														
Santa Clara River/McGrath State Beach											1			
Ormond Beach	2	0	4 to 10	1 to 7	7	1	0	3 to 6	1 to 4	5	2	0	0	One nest outside of fence enclosure was trampled by humans near hatch date. One nest hatched but abandonded young were found near nest (no sign of injury, dew on feathers)
Hollywood Beach														
Pt Mugu- Totals	0	19	198	99	269	0	10	130	49	152	41	4	0	
Holiday Beach	0	0	5	9	1	0	0	4	6	0	0	0	0	
Holiday Beach Salt Panne	0	0	0	0	0	0	0	0	0	0	0	1	0	
Eastern Arm	0	0	0	0	0	0	0	0	0	0	0	0	0	
Ormond Beach East	0	19	193	90	268	0	10	126	43	152	41	3	0	A severe wind event over 28-30 May 2011 recorded wind speeds up to 33 mph and gusts up to 45 mph. At least 113 nests were abandoned or not seen again after the wind event.
Los Angeles/Orange Counties														
Venice Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
LA Harbor	0	0	11	0		0	0	7	0		5	0	0	
Seal Beach NWR - Anaheim Bay	0	0	91			0	0	71			9		1	
Bolsa Chica Ecological Reserve-Totals	0	0	17	3	16	0	0	10	0	12	2	0	0	
Nest Site 1 (NS1)	0	0	0	0	0	0	0	0	0	0	1	0	0	
Nest Site 2 (NS2)	0	0	5	0	2	0	0	4	0	1	0	0	0	
Nest Site 3 (NS3)	0	0	6	0	14	0	0	6	0	9	0	0	0	
South Tern Island (STI)	0	0	6	3	0	0	0	0	0	2	1	0	0	
Huntington State Beach	0	0	196	35	43	0	0	128	29	20	112	16	5	
Burris Sand Pit/Buris Basin					14					10				
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	0	114	191	443	30	0	81	135	238	18	547	3	6	
Red Beach	0	0	0	0	0	0	0	0	0	0	0	0	0	
Delta Beach	0	2	0	0	0	0	1	0	0	0	0	0	0	
White Beach	0	36	41	34	9	0	23	25	11	5	22	0	2	
Santa Margarita River - North Beach North	0	36	51	72	10	0	30	37	40	6	72	1	0	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 damage/trampling, etc caused by non-predator species.
Santa Margarita River - North Beach South	0	34	95	330	11	0	22	70	184	7	451	2	4	
Santa Margarita River - Saltflats	0	6	2	3	0	0	5	2	2	0	1	0	0	
Santa Margarita River - Saltflats Island	0	0	2	4	0	0	0	1	1	0	1	0	0	
Batiquitos Lagoon Ecological Reserve- Totals	0	0				0	0							
W1	0	0	4			0	0	2				0	10*	*All depredated.
W2	0	0	115	18		0	0	74	22		248**	1; 12*	3*	*All depredated.**8 depredated
E1	0	0	1			0	0	1				0	0	
E2	0	0				0	0					0	0	
E3	0	0				0	0							
San Elijo Lagoon Ecological Reserve														
Fairbanks Ranch														
San Dieguito Lagoon Ecological Reserve														
Mission Bay														
FAA Island	0	0	8	0	2	0	0	5	0	1	4	2	0	Emaciated.
North Fiesta Island														
Mariner's Point			40					27			36	1	1	Unknown.
Stony Point			7					4				1		Dead fledgling found was believed to be from another colony (FAA?).
San Diego River Mouth			5					3			3			Probable abandonment of chicks by adults and resulting starvation.

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

	No. of eggs					No. of nests					No. of dead			
Site name:	human damaged:	lost to flooding:	abandoned pre-term	abandoned post-term/nonviable	outcome unknown:	human damaged	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks	fledglings	adults	Comments on cause(s) of non-predation mortality:
San Diego Bay														
Lindbergh Field & Former Naval Training Center	0	0	12	9	2	0	0	9	8	1	9	0	1	Abandonment & mortality possibly related to predator disturbance.
NI MAT	0	0	13	14	4	0	0	8	5	2	12	0	0	
Naval Base Coronado- Totals	29	2	87	131	28	19	1	73	49	18	143	24	4	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 damage/trampling, etc caused by non-predator species.
Delta Beach North	0	0	8	24	6	0	0	8	10	3	54	5	1	
Delta Beach South	0	0	10	21	7	0	0	9	6	5	26	3	0	
NAB Ocean	29	2	69	86	15	19	1	56	33	10	63	16	3	
D Street Fill/Sweetwater Marsh NWR	0	0	16	6	4	0	0	11	6	2	40	9	0	Also had 3 eggs/chicks died hatching; abandonment & mortality possibly related to predator disturbance, possibly fish prey issue.
Chula Vista Wildlife Reserve	0	0	5	1	15	0	0	4	1	10	2	0	0	
South San Diego Bay Unit, SDNWR - Saltworks	0	0	7	3	33	0	0	4	3	18	3	0	0	
Tijuana Estuary NERR	1	40	41	4	23	1	26	33	4	13	1	4	1	One egg found apparently picked up by trespasser, carried out of nesting area, & dropped; also had 1 egg found damaged but cause unknown; also had 2 eggs/chicks died hatching; abandonment & mortality possibly related to predator disturbance.
Imperial County														
Salton Sea														

Appendix B-6: Predation.

Predator Species	Predator Category		
	Possible	Suspected	Documented
great blue heron	X	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
osprey	X		
merlin	X		
American kestrel	X	X	X
peregrine falcon	X	X	X
black-bellied plover	X		X
long-billed curlew			X
barn owl	X	X	X
great horned owl	X	X	X
owls (spp.)	X		
American crow	X	X	X
common raven	X	X	X
corvids	X	X	X
horned lark	X		
loggerhead shrike	X	X	
European starling	X		X
western meadowlark	X		
red-winged blackbird	X		
great-tailed grackle	X	X	
unknown avian spp.	X	X	X
unknown mammal spp.			X
opossum	X		X
river otter	X		
black-tailed jackrabbit	X		
California ground squirrel	X	X	X
mouse (spp.)	X	X	X
rats (spp.)	X	X	
rodents	X		
canid (spp.)	X		
domestic dog	X	X	X
coyote	X	X	X
gray fox	X		
red fox			X
raccoon	X		X
striped skunk	X		X
bobcat			X
domestic cat	X	X	X
gopher snake	X		
southern Pacific rattlesnake	X	X	
snakes (spp.)	X		X
snapping turtle			X
ants (spp.)	X	X	
unknown		X	X

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Sacramento Area													
Bufferlands									0	0	0	0	0
San Francisco Bay Area													
NSMWA-Green Island Unit	GBHE, GREG, BCNH, BBPL, CAGU, WEGU, gull, CATE, OSPR, NOHA, RTHA, AMKE, PEFA, BNOW, GHOW, owl, AMCR, CORA, btj rabbit, otter, rac, st skunk, gfox, coyote, dog, gs, rat, rodent	unknown		rac 1P, unknown 1S				PEFA 1P	4	3	0	0	1
Montezuma Wetlands													
Pittsburg Power Plant													
Alameda Point		RTHA, PEFA, BNOW, CORA, avian	RTHA, PEFA	CORA 2S, avian 4S		RTHA 2S 1D, BNOW 2S, avian 1S	RTHA 2S, PEFA 1S, avian 1S	PEFA 2D	6		6	4	2
Hayward Regional Shoreline	NOHA, RTHA, PEFA, AMCR, CORA		CAGU, rfox, rac	rfox ?D, rac 27D	rfox ?D, rac 18D	CAGU 2D, rfox ?D, rac 24D	rfox ?D, rac 3D		27	18	26	3	unknown
Eden Landing													
Kings County													
Kettleman City Evaporation Ponds									0	0	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Luis Obispo/Santa Barbara Counties													
Oceano Dunes SVRA	NOHA, COHA, RTHA, AMKE, GHOW, owl, avian	PEFA					NOHA 1P, COHA 1P, RTHA 1P, AMKE 1P, PEFA 1P, GHOW 1P, owl 1P, avian 1P		0	0	0	1	0
Guadalupe-Mussel Rock									0	0	0	0	0
Vandenberg AFB	avian, coyote		PEFA	avian 1D, coyote 9D	avian 1D, coyote 7D		PEFA 1D	PEFA 2D	10	8	0	1	2
Coal Oil Point Reserve									0	0	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Ventura County													
Santa Clara River/McGrath State Beach			AMCR, coyote	AMCR 6D, coyotes 4D	AMCR 4D, coyotes 2D				10	6	0	0	0
Ormond Beach	GREG, BCNH, WEGU, CATE, NOHA, WTKI, RTHA, OSPR, AMKE, BNOW, HOLA, LOSH, RWBL, op, dog, coyote, gfox, rac, gsnake	GBHE, PEFA, CORA, gs, mouse, ant, unknown		GBHE 2S, CORA 15S, gs 8S, mouse 2S, unknown 11S	GBHE 1S, CORA 8S, gs 4S, mouse 2S, ant 1S, unknown 8S	ant 1S, unknown 2S			30	19	3	0	0
Hollywood Beach									0	0	0	0	0
Pt Mugu- Totals	RBGU, CAGU, RTHA, BNOW, GHOW, AMCR, LOSH, avian, op, gs, coyote	avian, gs	WEGU, LETE, AMKE, PEFA, CORA	CORA 2D 36S, gs 36S	CORA 1D 22S, gs 22S	AMKE 1D, BNOW 1S, avian 1S	WEGU 4D, avian 1S	PEFA 1D 2-3S	74	45	6	5	1
Holiday Beach	RBGU, CAGU, WEGU, RTHA, BNOW, GHOW, AMCR, CORA, LOSH, op, gs, coyote								0	0	0	0	0
Holiday Salt Panne	RBGU, CAGU, WEGU, RTHA, BNOW, GHOW, AMCR, CORA, LOSH, op, gs, coyote								0	0	0	0	0
Eastern Arm	RBGU, CAGU, WEGU, RTHA, BNOW, GHOW, AMCR, CORA, LOSH, op, gs, coyote		CORA	CORA 2D	CORA 1D				2	1	0	0	0
Ormond Beach East	RBGU, CAGU, RTHA, BNOW, GHOW, AMCR, CORA, LOSH, op, gs, coyote	GHOW, CORA, gs	WEGU, LETE, AMKE, PEFA, avian	CORA 36S, gs 36S	CORA 22S, gs 22S	WEGU 2D, LETE 1D, AMKE 1D, GHOW 1S, avian 1S	WEGU 4D, avian 1S	PEFA 1D 2-3S	72	44	6	5	1

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Los Angeles/Orange Counties													
Venice Beach	GBHE, GREG, BCNH, WEGU, AMKE, PEFA, CORA, rac, st skunk, cat, rat		AMCR	AMCR 163D					163		0	0	0
LA Harbor		AMCR, CORA, LOSH				AMCR 2S, CORA 2S, LOSH 1S			0	0	5	0	0
Seal Beach NWR - Anaheim Bay		CORA, unknown	AMKE, BNOW	CORA 9S, unknown ?D	CORA 5S	AMKE 26D ?S		BNOW 1D	9	5	26	0	1
Bolsa Chica Ecological Reserve-Totals									78	54	unknown	0	0
Nest Site 1 (NS1)	BCNH, gull, GBTE, BLSK, NOHA, COHA, RTHA, AMKE, PEFA, AMCR, CORA, corvid, HOLA, LOSH, EUST, op, gs, rat, coyote, ant	BLSK, CORA, corvid, coyote	CORA, coyote	CORA 2D, coyote 7D	CORA 1D, coyote 5D	coyote ?D			25	15	unknown	0	0
Nest Site 2 (NS2)	GBHE, GREG, BCNH, gull, NOHA, WTKI, COHA, RTHA, MERL, AMKE, PEFA, owl, AMCR, CORA, corvid, coyote								0	0	0	0	0
Nest Site 3 (NS3)	NOHA, WTKI, COHA, RTHA, MERL, AMKE, PEFA, AMCR, CORA, corvid, LOSH, coyote, rac	CORA, corvid, coyote	corvid, coyote	corvid 3D, coyote 8D	corvid 2D, coyote 5D	corvid ?D, coyote ?D			42	32	unknown	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Los Angeles/Orange Counties													
South Tern Island (STI)	GBHE, GREG, BCNH, gull, BLSK, NOHA, COHA, RTHA, MERL, AMKE, PEFA, AMCR, CORA, corvid, avian, gs, rat, coyote, rac	BLSK, avian, coyote	BLSK, avian	BLSK 6D, avian 2D	BLSK 3D, avian 1D				11	7	0	0	0
Huntington State Beach	AMKE	WEGU, rat, coyote	PEFA	WEGU 2P, coyote 209P	coyote 134P	PEFA 19D, coyote ?D	PEFA ?D	PEFA 1D 2-3S	211	134	19	0	1
Burris Sand Pit/Buris Basin	GBHE, BCNH, COHA, RTHA, PEFA, AMCR, coyote, rac								0	0	0	0	0
Upper Newport Bay Ecological Reserve	AMCR	coyote							6	6	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Diego County													
MCB Camp Pendleton- Totals									240	145	122	48	46
Red Beach									0	0	0	0	0
Delta Beach									0	0	0	0	0
White Beach			PEFA, CORA, avian, mammal, unknown	mammal 1D, unknown 3D	mammal 1D, unknown 2D	PEFA 1S, avian 2D	PEFA 3S, avian 1D	PEFA 2S	4	3	3	4	2
Santa Margarita River - North Beach North			gull, PEFA, avian, mouse, snake	gull 95D, avian 5D	gull 55D, avian 4D	PEFA 1D, avian 4D	PEFA 2D 3S, avian 4D	PEFA 2D 4S, avian 1D	100	59	5	9	7
Santa Margarita River - North Beach South		RTHA, AMKE	BCNH, gull, RTHA, PEFA, LBCU, BNOW, CORA, avian, mammal, op, gs, mouse, st skunk, cat, unknown, sn turtle	BCNH 2D, gull 95D, PEFA 4D, LBCU 2D, CORA 2D, avian 10D, mammal 7D	BCNH 1D, gull 55D, PEFA 3D, LBCU 1D, CORA 1D, avian 8D, mammal 5D	RTHA 38D 1S, AMKE 2S, PEFA 8D 11S, BNOW 2D, avian 47D, mammal 1D, op 1D	PEFA 16D 12 S, avian 6D	PEFA 19D 13S, avian 4D	122	74	111	34	36
Santa Margarita River - Saltflats			CORA, avian, mammal, coyote, bobcat, unknown	CORA 4D, mammal 2D, coyote 2D, bobcat 2S, unknown 4D	CORA 2D, mammal 2D, coyote 1D, bobcat 1S, unknown 3D	avian 3D	avian 1D	avian 1D	14	9	3	1	1
Santa Margarita River - Saltflats Island									0	0	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Batiquitos Lagoon Ecological Reserve-Totals	GREG, gull, rac, st skunk	GBHE, COHA, RTHA, PEFA, BNOW, GHOW, GTGR, avian, cat	COHA, RTHA, PEFA, BNOW, GHOW, AMCR, CORA, avian, coyote, cat, snake, unknown	GBHE 1S, BNOW 2D, GHOW 2D, AMCR 44D, CORA 60D, GTGR 1D, avian 2D, snake 2D, unknown 2D	GBHE 1S, BNOW 1D, GHOW 1D, AMCR 22D, CORA 31D, GTGR 1D, avian 1D, snake 1D, unknown 1D	COHA 7D, RTHA 1D, PEFA 6D, avian 402S 1D, cat 3D	COHA 3D, PEFA 2D, avian 30S 1D, cat 8D	BNOW 1D, GHOW 1D, avian 1D, cat 13D	117	61	420	44	16
W1			AMCR, cat	AMCR 44D	AMCR 22D			cat 12D	44	22	0	0	12
W2	GREG, rac	GBHE, gull, COHA, RTHA, PEFA, CORA, GTGR, avian	gull, COHA, RTHA, PEFA, BNOW, GHOW, CORA, avian, cat, snake, unknown	GBHE 1S, BNOW 2D, GHOW 2D, CORA 7D, GTGR 1D, avian 2D, snake 2D, unknown 2D	GBHE 1S, BNOW 1D, GHOW 1D, CORA 4D, GTGR 1D, avian 1D, snake 1D, unknown 1D	COHA 7D, RTHA 1D, PEFA 6D, avian 402S 1D, cat 3D	COHA 3D, PEFA 2D, avian 30S 1D, cat 8D	BNOW 1D, GHOW 1D, avian 1D, cat 1D	19	11	420	44	4
E1			CORA, coyote	CORA 53D, coyote 1D	CORA 27D, coyote 1D				54	28	0	0	0
E2									0	0	0	0	0
E3									0	0	0	0	0
San Elijo Lagoon Ecological Reserve	GBHE, GREG, BCNH, RBGU, CAGU, WEGU, NOHA, WTKI, COHA, RTHA, AMKE, PEFA, BNOW, GHOW, AMCR, CORA, op, dog								0	0	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
Mission Bay													
FAA Island	RBGU, gull	GBHE, WEGU, CORA		RBGU 2P, WEGU 2S					4		0	0	0
North Fiesta Island		avian		avian 1S					1		0	0	0
Mariner's Point	avian	AMKE, PEFA, owl, ant				AMKE 5+S, PEFA 5+S, owl 1+S, ant 1-10S			0	0	12-21+	0	0
Stony Point	GBHE, WEGU, avian	AMKE, AMCR		GBHE 1P, WEGU 1P, AMCR 1S		AMKE 0-11S, avian 0-11S			3		0-11	0	0
San Diego River Mouth		AMCR, CORA, avian		AMCR 2S, CORA 2S, avian 1S	AMCR 2S, CORA 2S				5	4	0	0	0

Appendix B-6: Predation (continued).

Site name	Predation			Number of					Total number documented				
	Possible	Suspected	Documented	Eggs	Nests	Chicks	Fledglings	Adults	Eggs	Nests	Chicks	Fledglings	Adults
San Diego Bay													
Lindbergh Field & Former Naval Training Center	GBHE, BCNH, WEGU, COHA, AMKE, PEFA, AMCR, CORA, EUST, GTGR, gs, rat, ant	COHA, AMKE, PEFA, AMCR, CORA, ant	COHA, PEFA, CORA, avian			COHA 1D, PEFA 1D, CORA 3D 8S, avian 7D, ant 3D	avain 7D	PEFA 1S	0	0	23	7	1
NI MAT			PEFA				PEFA 1D		0	0	0	1	0
Delta Beach North		GBTE	GBHE, GBTE, PEFA, BBPL, EUST	GBTE 3D 3S		GBHE 2D, GBTE 8D 1S	PEFA 1D		6		11	1	0
Delta Beach South		GBTE	GBTE	GBTE 2D 3S		GBTE 18D 4S			5		22	0	0
NAB Ocean		GBTE	gull, GBTE, AMKE, PEFA, BBPL, CORA, EUST, mammal	GBTE 20D 12S, BBPL 1D, EUST 1D, mammal 1D	EUST 1D, mammal 1D	GBTE 32D 22S, AMKE 1D, CORA 1D	PEFA 2D		35	2	56	2	0
D Street Fill/Sweetwater Marsh NWR	GBHE, RBGU, CAGU, WEGU, GBTE, NOHA, COHA, RTHA, OSPR, AMKE, PEFA, BNOW, AMCR, CORA, WEME, op, btj rabbit, gs, mouse, rat, canid, gfox, rac, st skunk, cat, gsnake, ant	GBTE, NOHA, COHA, AMKE, PEFA, BNOW, cat	GBTE, COHA, PEFA, avian	GBTE 1S, cat 13S	GBTE 1S, cat 8S	GBTE 1D 1-3S, COHA 1D, AMKE 1S, avian 1D	PEFA 1S	PEFA 1D 2-3S	14	9	4	1	3
Chula Vista Wildlife Reserve	GBHE, RBGU, CAGU, WEGU, GBTE, RTHA, OSPR, AMKE, PEFA, BNOW, GHOW, AMCR, CORA, op, gs, rat, gfox, st skunk, cat	GBTE, PEFA, BNOW, GHOW, rat	GBTE, avian	rat 2D, avian 2D	rat 1D, avian 1D	GBTE 5D 1-2S	PEFA 1S	PEFA 2S, avian 1D	4	2	5	1	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
South San Diego Bay Unit, SDNWR - Saltworks	RBGU, CAGU, WEGU, GBTE, BLSK, NOHA, COHA, AMKE, PEFA, GHOW, AMCR, CORA, gs, mouse, dog, coyote, cat, gsnake	gull, GBTE, BLSK, NOHA, PEFA, GHOW, coyote	gull, GBTE, BLSK, GHOW, coyote, unknown	gull 2D, GBTE 2S, BLSK 2D, GHOW 2D, coyote 12D, unknown 7D	gull 1D, GBTE 1S, BLSK 1D, GHOW 1D, coyote 7D, unknown 3D	GBTE 1D 1-2S		PEFA 1S, GHOW 1D	27	14	2	0	2
Tijuana Estuary NERR	GBHE, GREG, BCNH, RBGU, CAGU, WEGU, GBTE, NOHA, WTKI, AMKE, PEFA, BBPL, BNOW, GHOW, AMCR, CORA, EUST, WEME, op, gs, mouse, dog, coyote, cat, snake, ant, sp rattlesnake	gull, GBTE, NOHA, PEFA, BNOW, gs, dog, coyote, cat, sp rattlesnake	gull, GBTE, NOHA, avian, gs, dog, coyote, cat, unknown	gull 7D, GBTE 2S, NOHA 8D, gs 1D, dog 3D, coyote 22D, cat 10D, unknown 47D	gull 5D, GBTE 1S, NOHA 5D, gs 1D, dog 2D, coyote 11D, cat 5D, unknown 25D	GBTE 2D 1-2S, NOHA 4D 1S	PEFA 1S, avian 1D	avian 1D, sp rattlesnake 1S	55	100	7	2	2

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
MERL: Merlin
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
LOSH: 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
sp rattlesnake: Southern Pacific rattlesnake
sn turtle: Snapping turtle