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

California Least Tern Breeding Survey

2016 Season

by
Nancy Frost

Nongame Wildlife Program, 2017-03

Final Report

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ABSTRACT

Monitoring to document breeding success of California least terns (*Sternula antillarum browni*) continued in 2016, with observers at 42 nesting sites providing data. An estimated 3989-4661 California least tern breeding pairs established 4746 nests and produced 1612-2000 fledglings at 50 documented locations across California. The fledgling to breeding pair ratio was 0.35 to 0.50. Statewide, 7891 eggs were reported, with a Statewide clutch size of 1.37 eggs (St Dev = 0.64) for Type 1 sites where monitors walk within the colony.

Numbers of nesting least terns were not uniformly distributed across all sites. Camp Pendleton, Naval Base Coronado, Batiquitos, Point Mugu, Huntington, and Alameda Point each had over 300 minimum breeding pairs, which represented 72% of the state total, and produced 63% of the state's fledglings. Sites with greater than 35 fledglings each (the five aforementioned sites plus Hayward, LA Harbor, Huntingon, Bolsa Chica, and Oceano Dunes) contributed 88% of the state's fledgling production.

Least tern mortality due to non-predation factors was greater than mortality due to predation in 2016. Of non-predation egg mortality events, the highest cause of failure was attributed to abandonment prior to the expected hatching date and abandonment post-term. The 2016 statewide non-predation chick mortality rate was 29%, higher than that in 2015. The number of fledglings and adults that died in 2016 due to non-predation factors was similar to that in 2015. The predators known to be responsible for the greatest number of depredated least terns in 2016 were peregrine falcons, rats, common ravens, northern harriers, and coyotes. The monitoring effort of 2016 is scheduled to continue in 2017.

[1] Frost, N. 2017. California least tern breeding survey, 2016 season. California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report, 2017-03. Sacramento, CA. 20 pp + Appendices.

INTRODUCTION

Species Taxonomy and Life History

The California least tern (*Sternula antillarum browni*) is a 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). Least terns have been documented to nest on Midway Atoll (1989) and on the island of Hawaii (Szczys et al. 2014). 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 taxonomic change by the AOU (Banks et al. 2006) resurrected the genus *Sternula* for the least tern (formerly *Sterna*) based on the work of Bridge et al. (2005).

California least terns winter along the west coast of Central and South America (Massey 1977). Winter sightings have been reported from western Mexico, Guatemala, Gulf of Panama, Ecuador, Peru, Chile, and Hawaii (Tom Ryan 2014, pers. comm., 17 Jan.). They migrate to the nesting areas by mid- to late- April and are generally present through September (Massey 1974, Cogswell 1977, Patton 2002). California least terns often have two waves of nesting during this time period (Massey and Atwood 1981). Late-season nests may be established by renesters from the first wave or late-arriving first time breeders (Massey and Atwood 1981). The age of first breeding is typically 3 years; however, breeding by 2 year-old California least terns has been documented (Massey and Atwood 1981). California least terns establish nesting colonies on sandy soils with little vegetation along the ocean, lagoons, and bays, where they forage by plunge-diving for small fish (e.g., anchovy, *Engraulis* sp., and silversides, *Antherinopsidae*). Their nests are shallow depressions lined with shells or other debris (Massey 1974, Cogswell 1977). Given that vegetative cover in active least tern colonies is generally less than 20% (Gockfeld 1983, Carreker 1985), removal of non-native vegetation and select native vegetation is recommended to maintain open nesting areas with some dense vegetation that can be used by chicks to hide from predators (Ryan et al. 2010). On average, there are two eggs per nest that are incubated by both parents for approximately three weeks. Upon hatching, the semi-precocial young are tended by both parents, become mobile within three days, and can fly by 28 days (U.S. Fish and Wildlife Service 1985). California least terns are a long-lived species and banded birds have been recovered after 24 years (Brian Foster 2013, pers. comm., 13 July).

Listing Status

The California least tern 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. The Revised California Least Tern Recovery Plan (U.S. Fish and Wildlife Service 1985) identifies the recovery of the species as follows:

> "The annual breeding population in California must increase to at least 1200 pairs distributed in at least 20 secure coastal management areas throughout their 1982 breeding range before delisting can be considered. Each of the 20 secure management areas must have a minimum of 20 breeding pairs with a 5-year mean reproductive rate of at least 1.0 young fledged/per breeding pair. Of these 20 secure management areas San Francisco Bay, Mission Bay and San Diego Bay must have a minimum of 4, 6 and 6 secure

colonies, respectively. If 1,200 breeding pairs in California occur in 15 secure management areas with a 3-year mean reproduction rate of 1.0, the California least tern may be considered for threatened status. When additional information is available on the extent of nesting in Baja California, the Mexican colonies may be considered in the recovery goal for both threatened status and delisting."

However, the U.S. Fish and Wildlife Service has recognized that the Recovery Plan needs to be updated and anticipates doing so in the next few years (Bradd Bridges 2015, pers. comm., 9 Jan.).

Monitoring Efforts

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 to 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 leave the nesting area within approximately three weeks of hatching. Based on that analysis, she recommended that an evening count of fledglings be done every three weeks, starting approximately eight to nine weeks after the first egg is laid, or three weeks after the first fledgling is observed.

Since 1971, the frequency of nest 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 APHIS 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 chicks 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 pairs renesting on a site (Caffrey 1998). These equations have been used since the 1998 nesting season (Keane 2000). For over a decade, monitors have continued to provide comparable California least tern breeding success data, which has been compiled into annual summary reports.

In 2014, the Institute for Ecological Monitoring and Management (IEMM) completed an analysis of the long-term California least tern dataset to: (1) identify population trends and drivers of

those trends; and (2) evaluate current monitoring and management practices. Based on their analyses, they recommended:

- Adopting the new data collection and reporting protocol deployed by CDFW in 2013 (Appendix A);
- Decreasing emphasis on number of eggs per nest;
- Increased emphasis on fledgling monitoring using the improved chick classification method;
- Improved vital rate monitoring through a well-designed and coordinated recapture effort;
- Exploring new methods of colony monitoring like video or pellet and isotope analyses; and
- Rebalancing the effort directed to data collection and analysis to include more frequent comprehensive analyses.

The new data collection and reporting protocols were utilized by monitors during the 2016 breeding season in California.

METHODS

Monitors for each site that had least tern nesting in 2015 or who planned monitoring activities for 2016 were provided the instructions and spreadsheet to report final breeding data used for the annual report (Appendix A). The spreadsheet format was revised in 2013, but the data fields remained similar to those used since the 1998 nesting season in order to continue standardized data collection for the entire state. The revised spreadsheet included more detailed information in the Season Chronology worksheet, which was used to calculate values that previously had to be entered separately in the Monitoring, Pair Estimation, Productivity, and Chronology worksheets. Likewise, the revised Mortality worksheet combined the data fields that had to be entered separately in the previous Mortality, Non-nest Mortality, and Predation worksheets.

Site Information

Site Preparation

Prior to the arrival of California least terns on the nesting grounds, land managers conducted a variety of site preparation activities, which varied by site based on need, staffing, and available funding. 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. Following established conservation and monitoring methods for least terns and other similar species, monitors reported 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 with a yes/no response. However, fence type, vegetation management, and predator management were more variable. In an attempt to standardize and simplify these three 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 (e.g., glyphosate or fusilade use; (4) combination of 1, 2 or 3; (5) vegetation removed by other means (e.g., spraying with salt water, soil solarization); (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.

Predator management was reported as one of three categories: (1) proactive (pre-nesting season) predator removal; (2) reactive predator removal; or (3) none.

Sampling Type

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 nest marking (generally with a tongue depressor or wooden stake), egg marking (numbering the shell), bird banding, and fledgling estimate method. When birds were banded or resighted, band number and color, nest number, date, and bird age and status (i.e., trapped and released, found dead, or other) was requested.

Fledgling estimate method was reported as one of four categories: (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; or (Other) based on alternate method. Nest information including nest number, grid code, and UTM coordinates were requested.

Monitoring Breeding Season Chronology

For each day breeding colonies were monitored, the following was reported: date; number of monitors, hours in the colony or blind, adults, fledges, chicks off nest, and each predator species observed; and status of each nest using the following egg codes (e.g., two eggs in nest was coded 2E, or one egg and one hatch in nest was coded 1E/1H): E (egg); C (chick); DC (dead chick); DH (died hatching); H (hatched and no longer present); PH (probable hatch); A (abandoned pre-term); NV (abandoned post-term/non-viable); P (predated); B (buried by wind); D (damaged); T (human take); F (flooded); U (unknown); and INC (actively-incubated nest, contents unknown).

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 (unless otherwise specified by the site monitor). If there is a time period with an obvious lull in nest initiation, dates of nest initiation dictate the start of the second wave. For Method I, 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)

Pair estimation and total nest calculations included eggs that were laid and likely abandoned shortly thereafter, as the eggs were not observed to be incubated or attended by an adult.

Productivity

Productivity was measured by counting the number of nests, eggs, and eggs hatched, hatching success (ratio of eggs hatched to total eggs), 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.

Statewide mean clutch size was 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). As defined above, at least four specific techniques may be used. Reported fledgling counts are based on the total number of fledglings produced at each site, including those that were later found dead.

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). Therefore, mortality data was reported by date and included numbers of lost nests and individuals of each age class (egg, chick, fledgling, and adult). Causes of mortality were reported using one of the following mortality codes: P (predated); D (damaged); T (human take); F (flooded); B (buried by wind); DS (disease suspected); U (unknown); DH (died hatching); A (abandoned pre-term); or NV (abandoned post-term/non-viable). If the mortality cause was believed to be predation, predator species, type, and evidence were reported. Predator types were characterized as either "possible," "suspected," or "documented." 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. Evidence of predation was reported using one of the following codes: O (observed predation); V (visual of predator on site); S (predator sign); and/or C (least tern carcass).

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 least tern individuals they were documented or suspected to have depredated. 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).

<u>Predator Control</u>

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. Number, sex, age, and disposition of each predator species, date, and control method and effort (e.g., hours on colony, trap hours, or trap nights) were requested. Predator disposition was reported using one of the following codes: H (harass); U (unsuccessful capture attempt); E (escaped); T (transferred); C (captively-held); R (relocated); K (killed); and D (found dead).

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. Vegetation was managed at 84% of sites where it was needed. The majority of nesting sites (73%) were protected by fencing or an adjacent water body. Fences were extremely variable, ranging from wire or twine to a chain link fence completely enclosing the site. While over half of the sites used chick shelters, less than half of the sites used decoys. Site specific and site preparation data are in Appendix B-1.

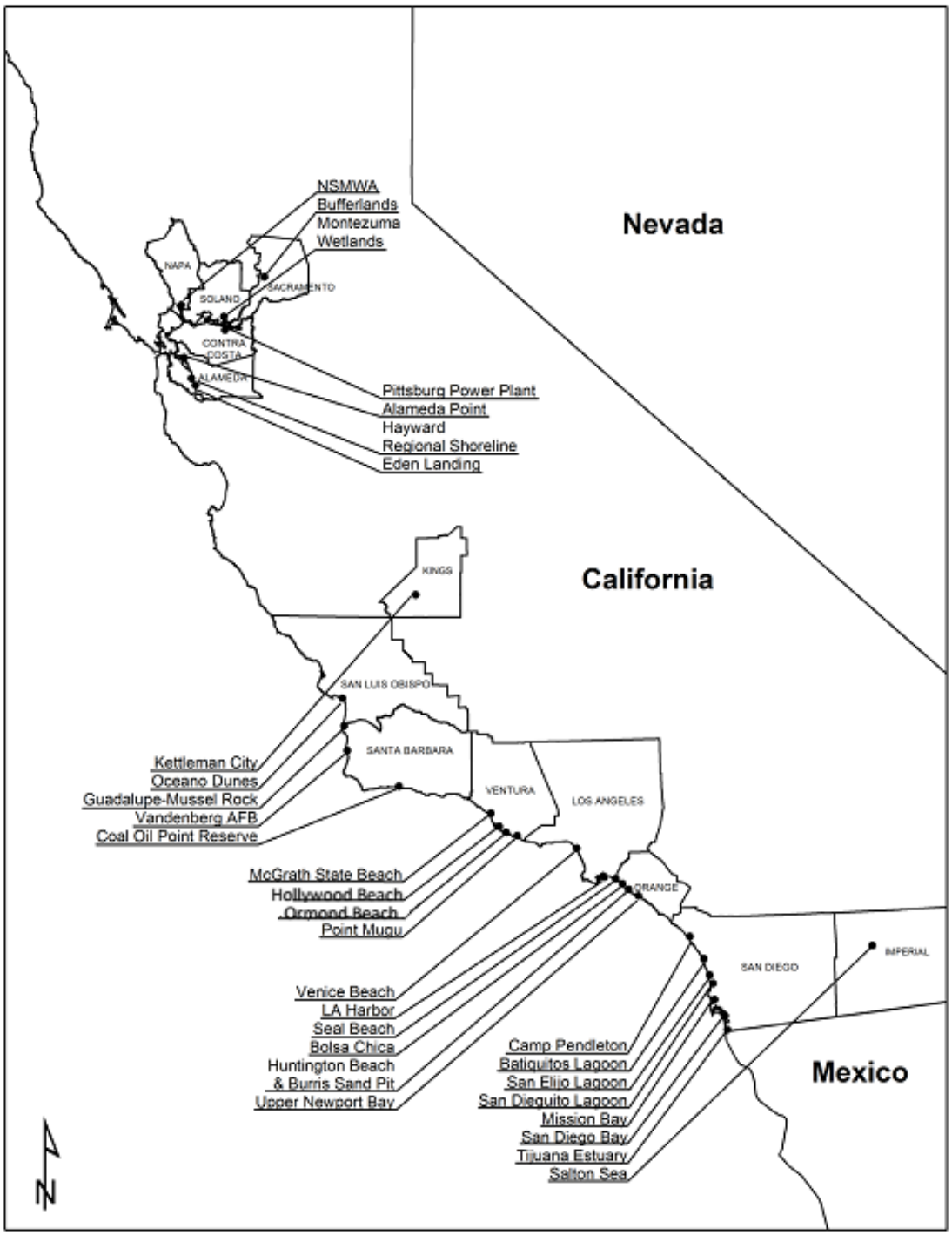

Figure 1. California sites monitored for California least tern nesting in 2016.

Monitoring

The majority of subcolonies monitored in 2016 were Type 1 sites and monitored at least one or two times per week. A grid system to assist in locating nests was used at most sites and nest marking was used at nearly all of the sites. Site-specific monitoring data are in Appendix B-2.

Productivity

The 2016 California least tern nesting season lasted almost five months. Least terns were heard vocalizing at Huntington State Beach on 6 April, one week earlier than the first detection in 2015. The first nest was detected on 25 April at Camp Pendleton (the same date and location as the first nest in 2015), the first chick on 20 May (Hayward), and first fledgling on 7 June (Alameda Point). In 2016, least terns were last observed in California at Tijuana Estuary on 1 September. There was a new nesting location established this year at Anaheim Lake, situated two miles northeast of Burris Basin. Statewide, 7891 eggs were reported, with a Statewide clutch size of 1.37 eggs (St Dev = 0.64; range=1.0-2.06). Four-egg clutches were observed in 2016 at Hayward (n=1) and Huntington (n=1). Site-specific and complete productivity data are located in Appendix B-3 (breeding pair estimation) and B-4 (productivity).

An estimated 3989-4661 California least tern breeding pairs established 4746 nests and produced 1612-2000 fledglings at 50 documented locations, including sub-sites (Table 1, Figure 2, Appendix B-3). The fledgling to breeding pair ratio was 0.35 to 0.50, slightly higher than that in 2015 (0.29 to 0.45 fledglings per pair). For a few sites (Anaheim Lake, North Fiesta Island, Stony Point, Saltworks), the maximum number of concurrently active nests was higher than the minimum number of pairs based on the three pair estimation methods (Appendix B-4). Based on the results of the three pair estimation methods (that have been used consistently over the past 10+ years) and the maximum number of concurrently active nests, the minimum number of pairs for 2016 would be 3997. The 3989 minimum number of breeding pairs in 2016 represented the lowest count since 2002 (Figure 2). However, the minimum fledgling count in 2016 (1612) was higher than that in 2015 (1514; Frost 2016), indicating improved reproductive success in 2016. The majority of breeding pairs nested in San Diego County (2409 pairs, 60%) and the fewest in the central coast area: San Luis Obispo and Santa Barbara counties combined (67 pairs, 2%) (Table 1, Appendix B-3). While 86% of breeding pairs nested in the coastal southern California counties (San Diego, Orange, LA, and Ventura), the San Francisco Bay and central coast areas had the highest minimum fledgling-to-maximum pair ratio. This ratio is the most conservative estimate of fledgling success and ranged from a low of 0.17 in San Diego County to a high of 1.37 in the San Francisco Bay area. The colony with the highest ratio was Bufferlands with 2.0 fledglings per pair (Table 1). The only other colonies statewide that had a ratio greater than one were Hayward (1.80), Alameda Point (1.54), and Oceano Dunes (1.20).

A few sites constituted the majority of breeding activity for the state in 2016, which is a trend consistently observed in the past (Frost 2016). Camp Pendleton, Naval Base Coronado, Batiquitos, Point Mugu, Huntington, and Alameda Point each had over 300 minimum breeding pairs, which represented 72% of the state total, and produced 63% of the state's fledglings (Table 1). Sites with more than 35 fledglings (the five aforementioned sites plus Hayward, LA Harbor, Huntingon, Bolsa Chica, and Oceano Dunes) contributed 88% of the state's fledgling production.

Table 1. California least tern colony productivity in 2016 (pair estimates using Methods I, II, and III

2016 Results	Estimated Number of Breeding Pairs		Number of Nests	Estimated Number of Fledglings		Fledglings per Pair Ratio	
Site	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum
Sacramento Area							
Bufferlands	1	1	1	2	2	2.00	2.00
San Francisco Bay Area							
Napa Sonoma Marsh Wildlife Area - Totals	60	72	79	5	6	0.07	0.10
Montezuma Wetlands - Totals	4	6	6	1	1	0.17	0.25
Pittsburg Power Plant	1	1	1	0	0	0.00	0.00
Alameda Point	358	381	403	586	639	1.54	1.78
Hayward Regional Shoreline	83	87	88	157	157	1.80	1.89
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	46	49	49	59	59	1.20	1.28
Rancho Guadalupe Dunes	0	0	0	0	0	0.00	0.00
Vandenberg AFB	21	25	27	18	18	0.72	0.86
Coal Oil Point Reserve	0	0	0	0	0	0.00	0.00
Ventura County							
Ormond Beach	15	18	18	14	14	0.78	0.93
Hollywood Beach	0	0	0	0	0	0.00	0.00
Santa Clara River/McGrath State Beach	40	57	62	11	11	0.19	0.28
Pt Mugu - Totals	315	361	361	56	86	0.16	0.27
Saticoy United Water Conservation District	0	0	0	0	0	0.00	0.00
Los Angeles/Orange Counties							
Venice Beach	2	2	2	0	0	0.00	0.00
LA Harbor	109	141	141	46	70	0.33	0.64
Seal Beach NWR - Anaheim Bay	73	80	80	25	25	0.31	0.34
Bolsa Chica Ecological Reserve - Totals	124	142	142	43	43	0.30	0.35
Huntington State Beach	304	337	348	100	123	0.30	0.40
Anaheim Lake (new colony in 2016)	2	4	4	0	0	0.00	0.00
Burris Sand Pit/Burris Basin	6	10	10	0	0	0.00	0.00
Upper Newport Bay Ecological Reserve	18	20	20	2	2	0.10	0.11
San Diego County							
MCB Camp Pendleton - Totals	747	897	897	85	207	0.09	0.28
Batiquitos Lagoon Ecological Reserve - Tota	414	451	451	175	200	0.39	0.48
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
Fairbanks Ranch	0	0	0	0	0	0.00	0.00
Mission Bay							
FAA Island	20	43	50	5	5	0.12	0.25
North Fiesta Island	19	22	25	4	4	0.18	0.21
Mariner's Point	60	125	127	15	20	0.12	0.33
Stony Point	10	12	15	7	7	0.58	0.70
San Diego River Mouth	5	5	5	0	0	0.00	0.00
San Diego Bay							
Lindbergh Field/Former Naval Training Cente	31	37	37	10	17	0.27	0.55
NIMAT	24	32	32	5	5	0.16	0.21
NI Alt*	2	2	2	0	0	0.00	0.00
Naval Base Coronado- Totals	748	859	859	106	191	0.12	0.26
D Street Fill/Sweetwater Marsh NWR	106	113	118	21	22	0.19	0.21
Chula Vista Wildlife Reserve	63	73	76	15	18	0.21	0.29
South San Diego Bay Unit, SDNWR-Saltwork	16	25	26	6	7	0.24	0.44
Tijuana Estuary NERR - Totals	144	173	184	33	41	0.19	0.28
Imperial County							
Salton Sea	0	0	0	0	0	0.00	0.00
Totals	3989	4661	4746	1612	2000	0.35	0.50

*Least terns are no longer nesting at NI 18.

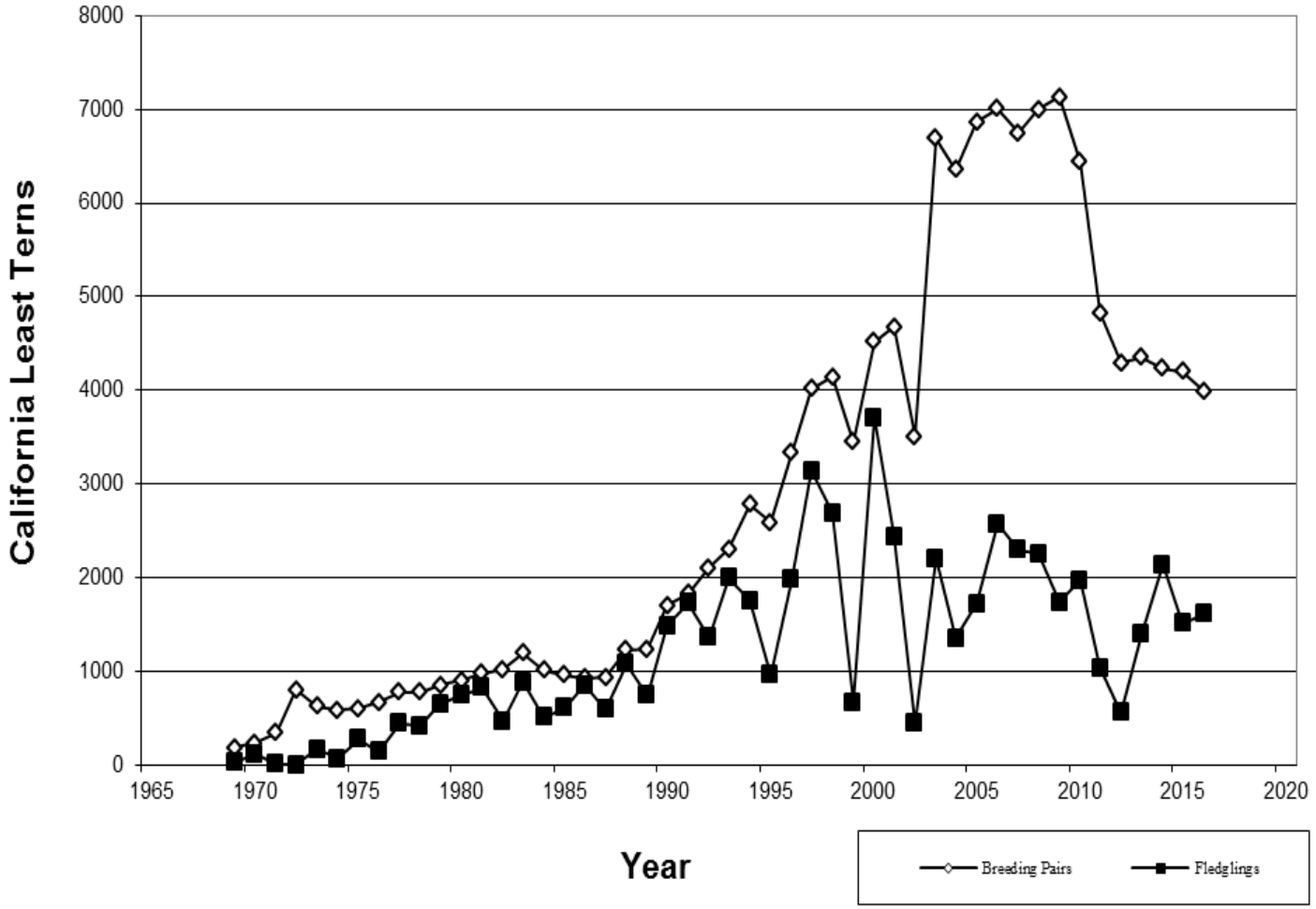

Figure 2. Minimum number of documented California least tern breeding pairs and fledglings in California during annual surveys, 1969-2016 (data from: Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989b; Atwood *et al*. 1977; Jurek 1977; Atwood *et al*. 1979; Collins 1984, 1986, 1987; Gustafson 1986; Johnston and Obst 1992; Obst and Johnston 1992; Caffrey 1993, 1994, 1995b, 1997, 1998; Keane 1998, 2000, 2001; Patton 2002, 2004 unpublished table; Marschalek 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012; Frost 2013, 2014, 2015, 2016).

Mortality and Predation

Least tern mortality due to non-predation factors was greater than mortality due to predation in 2016. Of non-predation egg mortality events, the highest cause of failure (49%) was attributed to abandonment prior to the expected hatching date leading to the loss of 797 eggs (including 3 eggs that were abandoned after being buried due to wind). Abandonment post-term (non-viable) was estimated to constitute 38% of non-predation mortality (616 eggs). The 2016 statewide non-predation chick mortality rate was 29%, higher than that in 2015 (18%; Frost 2016). In 2016, 65 fledglings and 15 adults died due to non-predation factors, similar to that in 2015 (79 fledglings and 21 adults). Predation was reported as the cause of loss of 485 eggs, 63 chicks, 49 fledglings, and 54 adults (Table 4). In 2015, more eggs (894), chicks (115), and fledglings (103), and a similar number of adults (65) were documented as depredated (Frost 2016). Complete and site specific mortality data is located in Appendix B-5 (non-predation) and B-6 (predation).

Table 4. Cause of mortality of least terns with associated counts for each life stage (data taken from Mortality worksheet unless otherwise indicated).

	Eggs*	**Chicks**	**Fledglings**	**Adults**	**Total**
Predation	485**	63	49	54	651
Non-predation	1637	1450	65	15	3167

*An additional 767 eggs were lost to unknown causes.
**Includes data from Chronology worksheet.

In 2016, 71% of sites had predator management. It can be very difficult to accurately determine the predator species involved in tern predation events, which are not typically observed and from which little or no evidence may remain. Level of certainty regarding a predation event may be reflected by reporting it as either suspected or documented, 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.

Forty-seven species as well as 12 other taxa (e.g., corvids, unknown) were reported as possible, suspected, or documented predators of least terns (Appendix B-6). Of the 356 least tern individuals (including eggs) reported as taken by a documented or suspected predator species, 19% were depredated by peregrine falcons, 19% were depredated by rats (all at Mariner's Point), 16% were depredated by common ravens, 8% were depredated by northern harriers, and 5% were depredated by coyotes (the remaining predator species were responsible for fewer than 5% of the depredations; Appendix B-6). 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).

Historically, predation due to gull-billed terns tended to be higher (Marschalek 2010). The foraging area of gull-billed terns has expanded since 2007; however the number of least terns suspected or documented to be depredated by gull-billed terns has decreased over the last several years with 813 individuals depredated in 2009, 222 in 2010, 149 in 2011, 87 in 2012, 2 in 2013 (when the gull-billed tern acanthocephalan die-off may have contributed to reduced depredation), 7 in 2014, 14 in 2015, and 9 in 2016.

Predator species varied in importance among each least tern age class. Rats (31%), common ravens (27%), coyotes (7%), gulls (7%), northern harriers (7%), unknown avian species (6%), and California gulls (5%) had the largest depredation rate of eggs, while northern harriers (20%), ants (19%), gull-billed terns (17%), American kestrels (11%), peregrine falcons (9%), raptor species (6%), and red-tailed hawks (6%) depredated the most chicks. Peregrine falcons (88%), red-tailed hawks (5%), and raptor species (5%) depredated the most fledglings, and peregrine falcons (52%), great horned owls (17%), and raptor species (9%) depredated the most adults (Appendix B-6).

Summary by Site

Management and monitoring of 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. Appendix B-7 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.

Conclusion

California least tern breeding success was monitored in 2016 to track where this endangered species is relative to population recovery. Biologists recorded a minimum of 3989 breeding pairs, the lowest count since 2002; however, the minimum fledgling-to-maximum breeding pair ratio (0.35) was higher than during the previous year (0.29), indicating improved reproductive success in 2016. Since 1977, this ratio has been less than 0.50 for only 17 years (including the last 15 years). Although some of the recovery criteria outlined in the 1985 Recovery Plan have been met (e.g., the minimum breeding pairs), there are concerns regarding the increased level of threats to the species in the last few years (Bradd Bridges 2015, pers. comm., 9 Jan.) and other key metrics, such as the fledgling to pair ratio, which remain variable. While there have been over 1200 minimum breeding pairs every year since 1988, none of these years had a statewide fledgling to pair ratio of at least 1.0 (from 1988-2016, the average minimum fledgling-to-maximum pair ratio was 0.45). In 2016, from a regional perspective, only the San Francisco Bay and central coastal areas met the recovery criteria for the fledgling to pair ratio.

As was the case in 2015, California least tern population growth in 2016 was hindered by relatively low productivity as well as direct limiting factors (651 individuals lost to predation) and indirect limiting factors (3167 individuals lost to non-predation causes including abandonment prior to the expected hatching date and abandonment post-term, which combined contributed to nearly all of the non-predation egg mortality). Non-predation chick mortality in 2016 was higher than that in 2015. In addition to avian predators and coyotes, which were responsible for the highest predation rates over the last several years, rats also contributed to the highest predation rates documented in 2016. A lack of sufficient foraging resources is widely thought to be a significant factor limiting California least tern population growth and warrants additional study. Continued site preparation (including maintenance of fencing and vegetative cover), predator management, and California least tern breeding success monitoring will be key to identifying adaptive management strategies that will contribute to the recovery of this species.

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LITERATURE CITED

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Carreker, R. G. 1985. Habitat suitability index models: least tern. USFWS Biol. Report 82(10.103). 29 pp.

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

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

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

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

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

Frost, N. 2013. California least tern breeding survey, 2012 season. California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report, 2013-01. Sacramento, CA. 19 pp. + app.

Frost, N. 2014. California least tern breeding survey, 2013 season. California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report, 2014-06. Sacramento, CA. 20 pp + Appendices.

Frost, N. 2015. California least tern breeding survey, 2014 season. California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report, 2015-01. Sacramento, CA. 23 pp + Appendices.

Frost, N. 2016. California least tern breeding survey, 2015 season. California Department of Fish and Wildlife, Wildlife Branch, Nongame Wildlife Program Report, 2016-01. Sacramento, CA. 24 pp + Appendices.

Gochfeld, M. 1983. Colony site selection by least terns: physical attributes of sites. Colonial Waterbirds 6:205-213.

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

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

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

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

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

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

Lewison, R.L. and D.H. Deutschman. 2014. Long-term analysis of California least tern data. California Department of Fish and Wildlife, Wildlife Management, Nongame Wildlife Unit Report, 2014-02. Sacramento, CA. 29 pp + app.

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

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

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

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

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

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

Marschalek, D.A. 2011. California least tern breeding survey, 2010 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2011-06. Sacramento, CA. 28 pp. + app.

Marschalek, D.A. 2012. California least tern breeding survey, 2011 season. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Unit Report, 2012-01. Sacramento, CA. 25 pp. + app.

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

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

Massey, B.W. 1977. Occurrence and nesting of the least tern and other endangered species in Baja California, Mexico. West. Birds 8:67-70.

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

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

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

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

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

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

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

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

Ryan, T. P., S. Vigallon, G. Dunno, S. Magier, and A. Delnevo. 2010. Venice Beach Least Tern Colony Habitat Improvement and Restoration Study, 2006-2009. Prepared for the California Department of Fish and Game, Office of Oil Spill Prevention and Response, Sacramento, CA, Ryan Ecological Consulting, Pasadena, CA. 34 pp

Patricia Szczys, Scott Waddington, Timothy Burr, and Patricia Baird. 2014. Least Terns Nesting on the Big Island of Hawaii. Poster presented at the 2014 Waterbird Society Meeting.

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

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

U.S. Fish and Wildlife Service. 1985. Recovery plan for the California least tern, *Sterna antillarum brownii*. U.S. Fish and Wildlife Service, Portland, OR. 112 pp.

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

Appendix A

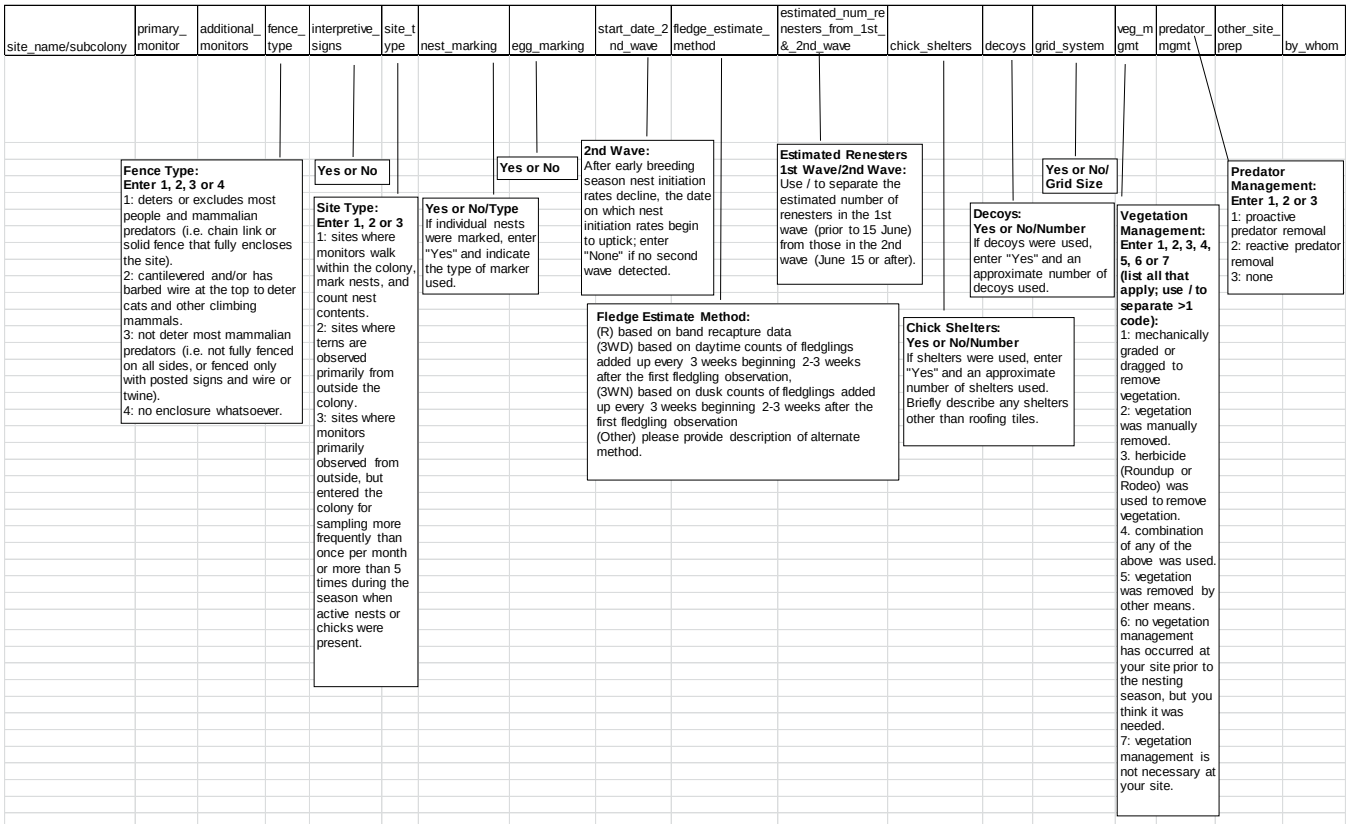
Data Sheets

Data Reporting Spreadsheet

General Instructions

•Start filling in data for your site on the row below the headings.
•If the instructions are in the way, you can move them by clicking on the box border or pointer line. The pointer line does not prevent you from typing in the cells it passes through.
•Use day-month-year format: 17-Apr-16
•If you report a range of values, use the word "to" not a hyphen to avoid Excel mistaking it for a date (1 to 3, NOT 1-3).
•Complete the Site Info, Nest Info, Season Chronology, Mortality, Predator Control, and Banding worksheets for each subcolony.
•The Predator Control worksheet may be provided to the colony's predator control staff for completion, or the site monitor may complete this worksheet using information gleaned from the end-of-season predator control report.
•It is not required to complete the Notes worksheet and Summary Table worksheet.
•Use consistent colony or subcolony names in each worksheet.
•Avoid entering blank spaces before or after codes entered in the spreadsheet.
•Be sure to use 0 (zero), not O (letter) in numbers.

Site Information:



Nest Information: Complete new worksheet for each subcolony. Enter "None" if no grid used or coordinates taken.

site_name/subcolony	nest_num	grid_code	utm_easting	utm_northing	comments
	Nest_01				
	Nest_02				
	Nest_03				
	Nest_04				
	Nest_05				
	Nest_06				
	Nest_07				
	Nest_08				
	Nest_09				
	Nest_10				
	Nest_11				

Comments: If local nest numbers (e.g., NBN-001, NBN-002…) are used, enter them in the comments column.

Nest_num: Submit nest numbers in sequential order (e.g., Nest_01, Nest_02…) based on date for each subcolony.

Season Chronology: Enter data for the actual date you conducted the survey (include days when least terns weren't seen). Complete new worksheet for each subcolony.

date	site_name/subcolony	num_monitors	num_hrs_in_colony(C)/blind(B)	num_adults	num_fledges	num_chicks_off_nest	num_observed_predators	nest_01	nest_02	nest_03	nest_04	nest_05	nest_06	nest_07

Number of Adults: Enter counts of adults when seen.

Chick and Fledge Codes
C=chick-downy
CF=chick-feathered
PF=pre-fledge
FY=fledge-young
FO=fledge-old

For "num_chicks_off_nest" only count chicks for which nest affiliation cannot be determined.

For "num_fledges" do not count pulses of fledglings passing through.

Predator Species Codes (use / to separate >1 code & use numbers to indicate how many individuals of each species; click in box & scroll down for more codes)
American crow (AMCR)
American kestrel (AMKE)
Ant
Barn owl (BAOW)
Black skimmer (BLSK)
Black-bellied plover (BBPL)
Black-crowned night-heron (BCNH)
Black-tailed jackrabbit

Egg Codes (use / to separate >1 code & use numbers to indicate how many at nest with that code, i.e., two eggs in nest is coded 2E, or one egg & one hatch in nest is coded 1E/1H; use codes to account for each egg on each visit, unless nest is missed on visit):
E=egg
C=chick-downy
DC=dead chick
DH=died hatching
H=hatched and no longer present
PH=probable hatch
A=abandoned pre-term
NV=abandoned post-term/non-viable
P=predated
B=buried by wind (applies to nests that were active on the visit prior to being found buried)
D=damaged
T=human take
F=flooded
U=unknown
INC=actively-incubated nest, contents unknown

Mortality: Enter each individual predation event (or tally if many in one age class were taken by a single predator species during a single predation event).

site_name/subcolony	date	num_eggs	nest_num	num_chicks	num_fledges	num_adults	mortality_cause	predator_species	predator_type	predation_evidence	comments

Nest Number:
•Be sure all DC=dead chick (including those not associated with a nest) are entered in Mortality so we have complete information on the number of nests and broods that fail.
•For DC found at nest, enter nest number in nest_num column; for DC found on site but not associated with a nest, enter U in nest_num column. This will facilitate counting and cross checking Chronology and Mortality data, which is necessary to ensure accurate results from pair estimation method II.

Mortality Codes:
P=predated
D=damaged
T=human take
F=flooded
B=buried by wind (applies to nests that were active on the visit prior to being found buried)
DS=disease suspected
U=unknown
DH=died hatching
A=abandoned pre-term
NV=abandoned post-term/non-viable

Notes:
•Use code T=human take to distinguish from code D=damaged (non-human take e.g., elegant tern trampling).
•Cross check Mortality data with nest Chronology data to make sure P, DC, D, F, DS, U, and B, as well as A and NV (see below), are recorded the same in both datasets. For instance, if nests are recorded as P in nest Chronology but there is no information in Mortality, we can only record that as an unknown predator.
•If a nest is determined to be inactive (A or NV) and then predated, indicate A or NV in the mortality_cause column. This will allow accurate determination of individual predator species impact.

Predator Species Codes (use if mortality due to predation; click in box & scroll down for more codes):
American crow (AMCR)
American kestrel (AMKE)
Ant
Barn owl (BAOW)
Black skimmer (BLSK)
Black-bellied plover (BBPL)

Predator Type Codes:
PP=possible predator (if predation of terns occurred and a potential predator was known to be on or near the site through direct observation or other signs such as tracks or scat).
SP=suspected predator (when loss of terns directly corresponded to the presence of a predator).
DP=documented predator (direct observation of a predator killing a tern or substantial evidence to indicate responsibility. This evidence could be characteristic feeding patterns or tracks leading to a carcass or shell remains).

Evidence of Predation Codes (use / to separate >1 code):
O=observed predation
V=visual of predator on site
S=predator sign
C=California Least Tern carcass

Predator Control: Enter "None" if no predator control.

species	number	sex	age	date	site_name/subcolony	method	disposition	remarks	notes-hrs_on_colony/trap_hrs/trap_nights

Predator Species Codes (click in box & scroll down for more codes):
American crow (AMCR)
American kestrel (AMKE)
Ant
Barn owl (BAOW)
Black skimmer (BLSK)
Black-bellied plover (BBPL)
Black-crowned night-heron (BCNH)

Disposition codes:
H=harass
U=unsuccessful capture attempt
E=escaped
T=transferred
C=captively-held
R=relocated
K=killed
D=found dead

Banding: Enter "None" if no banding or resightings.

Birds_Banded_This_Year							Resightings_of_Birds_Banded_in_Current_or_Previous_Years						
site_name/subcolony	band_num	color_comb_l-r	nest_num	date	age	died_during_season	band_num	color_comb_l-r	site_name/subcolony	date	age	status	comments

Enter nest number, if banded at nest.

Yes or No

Status Codes:
D=dead
TR=trapped/released
O=other

Summary Table (completion not required)

	Colony Name
Date terns first observed	
Date terns last seen	
Date of first nest	
Date last nest found	
Date last nest established	
Date of first hatch	
Date of last hatch	
Date of first fledgling	
Estimated number of pairs	
Total number of nests	
Total number of eggs	
Clutch size:	
1 egg	
2 egg	
3 egg	
4 egg	
unknown (min. 1 egg)	
Average clutch size	
No. of nests hatching young	
Total number of eggs hatched	
Estimated number of fledglings	
Number of chicks banded	
Number of adults banded	
Uncertain outcome	
Nests	
Eggs	
Documented Mortality	
Preyed upon	
Nests	
Eggs*	
Chicks	
Fledglings	
Adults	
Human disturbance	
Nests	
Eggs	
Chicks	
Fledglings	
Adults	
Other causes	
Nests	
Abandoned (pre-term)	
Failed to hatch (incubated to term)	
Died hatching	
Damaged (eggshell thinning)	
Flooded	
Eggs	
Abandoned (pre-term)	
Failed to hatch (incubated to term)	
Died hatching	
Damaged (eggshell thinning)	
Flooded	
Chicks	
Fledglings	
Adults	

Summary Table: Do not double count nest outcomes. If a nest has at least one hatch and the other egg(s) fails, it would be considered a successful nest and would not be counted as a nest with a failed outcome (i.e., A, FH or NV, DH, D, or F).

* not including previously abandoned eggs that were depredated/scavenged

General Data Sheet

Date:				Site_name/Subcolony:				
Monitors:				start_time:			end_time:	
num_adults:							num_hrs_in_colony_vs_blind: colony(C): /blind(B):	
num_fledges:						For "num_fledges" do not count pulses of fledglings passing through.		
FY (total):	(tally)							
FO (total):	(tally)							
num_chicks_off_nest:						For "num_chicks_off_nest" only count chicks for which nest affiliation cannot be determined.		
C (total):	(tally)							
CF (total):	(tally)							
PF (total):	(tally)							
num_observed_predators:						Use / to separate >1 code & use numbers to indicate how many individuals of each species.		
Notes_comments:								
Chick/Fledge Codes: C=chick-downy, CF=chick-feathered, PF=pre-fledge, FY=fledge-young, FO=fledge-old.								

Date:				Site_name/Subcolony:					
Depredation and Mortalities:									
num_eggs	nest_num	num_chicks	num_fledge	num_adults	mortality___ _cause	predator___ _species	predator___ _type	predation__ _evidence	comments

Evidence of Predation Codes (use / to separate >1 code): O=observed predation, V=visual of predator on site, S=predator sign, C=California least tern carcass

Predator Type Codes: PP=possible predator, SP=suspected predator, DP=documented predator

Mortality codes: P=predated, D=damaged (non-human damage, ie: trampling by ELTE), T=human take, F=flooded, B=buried by wind, DS=disease suspected, U=unknown (can be used for DC found at nest with no obvious signs of trauma), DH=died hatching, A=abandoned pre-term, NV=abandoned post-term/non-viable

Nest Check Sheet

Date (enter date of each survey):										GPS	
Nest	Date Found	Grid	Prior Status*	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	utm_easting	utm_northing
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
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33											
34											
35											
Nest	Date Found	Grid	Prior Status*	Survey 1	Survey 2	Survey 3	Survey 4	Survey 5	Survey 6	utm_easting	utm_northing

Egg/Nest Codes (use / to separate >1 code & use numbers to indicate how many at nest with that code): E=egg, C=chick-downy, DC=dead chick, DH=died hatching, H=hatched and no longer present, PH=probable hatch, A=abandoned pre-term, NV=abandoned post-term/non-viable, P=predated, B=buried by wind, D=damaged, T=human take, F=flooded, U=unknown, INC=actively-incubated nest, contents unknown; *copy nest status entry from last survey and paste into Prior Status column when printing out new sheet to allow for understanding of nest contents while in field.

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

Appendix B

Site Specific Data

Appendix B-1: Site Preparation in 2016.

Legend

Fence Type: 1-Fully enclosed site deterring most predators; 2-Fully enclosed site, 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; 7-None needed. Predator management: 1-Proactive predator removal; 2-Reactive predator removal; or 3-None. *Sites that do egg marking.

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Sacramento Area													
Bufferlands	Chris Conard	Steve Scott	3	No	2	No	No	No	No	7	3	No	None
San Francisco Bay Area													
Napa Sonoma Marsh Wildlife Area/Green Island Unit	Karen Taylor	Poland, Hlusak, Chapman, Seiferheld	4	No	1	Yes/paint pen	Yes/5 Ceramic Roof tiles, 12 drift wood pieces, washed up, 5 other debris pieces	No	No	6	3	No	CDFW
Napa Sonoma Marsh Wildlife Area/Pond 7/7A	Karen Taylor	Poland, Taylor, Taylor	4	No	1	Yes/paint pen	No	No	No	6	3	No	CDFW
Montezuma/Site_1B	Anne Wallace		4	No	2	No	No	No	No	4	3		
Montezuma/Site_3/4C	Anne Wallace		4	No	2	No	Yes/12	Yes/12 (2 quickly lost)	No	4	3	Taped-call playbacks with decoys were used	
Pittsburg Power Plant	Claire Woolf	Jason Yakich	1	No	2	No	Yes/approximately 40 roof tiles	No	No	4	3	No	

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Alameda Point	Susan Euing	Meredith Elliott, Jacquelyn Tom, Alessandra Moyer	1	No	1	Yes/3-inch metal washer placed upright in plaster of paris base, all painted white with nest number applied with black paint marker to washer	Yes/ approx. 250 wooden A-frames, 800 terracotta half-cylinders & scattered oyster shells	No	Yes/9.7 acres comprised of 99 grids (each grid 20m X 20m)	4	1/2	Smooth out and/or add sand as needed; reinstall grid system and chick shelters/ shells; repair/replace sections of chick fence	FWS and Interns
Hayward Regional Shoreline	David Riensche, Mary Riensche, Sarah Riensche, Daniel Riensche, Nathan Riensche, Rebekah Riensche		4	Yes	1	Yes/5cm washers	Yes/26	Yes/24	Yes/10 m grid cells	2/3	1	See Notes	See Notes
Eden Landing	Cheryl Strong												
Kings/San Luis Obispo/ Santa Barbara Counties													
Kettleman City Evaporation Ponds	Jeff Seay												
Oceano Dunes State Vehicular Recreation Area	Doug George, Joanna Iwanicha, Amber Clark, Ryan Slack, Cheryl Lish,	Sarah Stratton, Sarah Robinson, Mattie Bishop, Josh Willems, Alex Velazquez, Anne Bauer, Haven Dlott,	1(49 nest)	Yes	3	Yes/most nests typically marked 30-40 ft. east and west with color-coded bamboo	No; cut branches and driftwood are distributed in nesting area	No	No	5; least tern breeding site open to off-road vehicle use October to February and this prevents or removes most vegetation.	1/2	Habitat enhancement (woodchips for nesting)	

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
	Amber Frazier	Daniel Elting, Karen Hondrick				sticks				Efforts are made to encourage some vegetation for chick cover.			
Rancho Guadalupe Dunes Preserve	Tom Applegate		3	Yes	3	No	No	No	No	6	3	None	
Vandenberg AFB/Purisima Point	Robinette	Hargett, Howar, Miller, Rice	1	Yes	3	Yes/ Tongue Depressor	Yes/43 V-shaped wooden plus 36 teepee snow-fence style	No	No	7	2	Electric Fence Maintenance	ManTech
Coal Oil Point Reserve	Jessica Nielsen	Cris Sandoval, Pat Walker	3	Yes	2	N/A	N/A	21	No	7	1		
Ventura County													
Santa Clara River/ McGrath State Beach	Alexis Frangis	Brooke Sheridan, Chelsea Fletcher	3	Yes	1	Yes/ Natural Driftwood	No	No	No	7	3	None	
Hollywood Beach	Debra Barringer	Danielle Glenn	3	Yes	1	Yes/ tongue depresser	No	No	No	6	3		
Ormond Beach	Cynthia Hartley	Debra Barringer, Danielle Glenn, Dan Robinette	3	Yes	1	Yes/ tongue depresser	No	No	No	7	3		
NBVC Point Mugu/Holiday Beach	Martin Ruane	Josh More, Erica Hadley, Anjanette Butler, Jack Velasquez, Colleen DelVecchio	4	Yes	1	Yes/ tongue depressor	Yes/25 shelters	No	No	7	1/2	No	
NBVC Point Mugu/Holiday Salt Panne	Martin Ruane	Josh More, Erica Hadley, Anjanette Butler, Jack Velasquez, Colleen	4	Yes	1	Yes/ tongue depressor	No	No	No	7	1/2	No	

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
		DelVecchio											
NBVC Point Mugu/Ormond Beach East	Martin Ruane	Josh More, Erica Hadley, Anjanette Butler, Jack Velasquez, Colleen DelVecchio	4	Yes	1	Yes/ tongue depressor	Yes/50 shelters	No	No	7	1/2	No	
NBVC Point Mugu/Eastern Arm	Martin Ruane	Josh More, Erica Hadley, Anjanette Butler, Jack Velasquez, Colleen DelVecchio	4	Yes	1	Yes/ tongue depressor	No	No	No	7	1/2	No	
United Water Conservation District facilities in Saticoy, Ventura County, California	Jennifer Turner, James Rasico, Stephanie McLaughlin Debra Barringer		3/4	No	3	N/A	No	No	No	4/5/6	3		
Los Angeles/ Orange Counties													
Venice Beach	Thomas Ryan	Stacey Vigallon, Carlos Jauregui, Joyce Realegeno	1	Yes	1	No	Yes/8	Yes/15	Yes/ 20x20m	2	1	Dune leveling by the fence	Carlos Jauregui and Joyce Realegeno
Port of Los Angeles Pier 400	Spencer Langdon	Wally Ross, Lorraine Anderse, Nick Liberato, Santiago Lopez, Bob Schallmann, Matt Teutimez, Isaac DeRobles	1	No	1	Yes/ tongue depressor	Yes/40	No	Yes/100 ft	4	2		Quality Sprayers Inc.
Seal Beach National Wildlife Refuge	John Konecny, Kirk Gilligan	Michelle Barton, Bob Schallman, Charles Collins	1	Yes	1	Yes/ wooden tongue depressor	Yes/48	No	Yes/8x12	4	2		Kirk Gilligan/ USFWS

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Bolsa Chica/Nest Site 1	Peter Knapp	Kelly O'Reilly, Charlie Collins	3	Yes	1	Yes/ numbered tongue depressor	Yes/48 roof tiles	Yes/20	Yes/20 m X 20m	2/3	2		CDFW
Bolsa Chica/Nest Site 2	Peter Knapp	Kelly O'Reilly, Gary Keller, Ross Griswold	4	No	1	Yes/ numbered tongue depressor	Yes/12 roof tiles	No	Yes/20 m X 20m	2/3	2		CDFW
Bolsa Chica/Nest Site 3	Peter Knapp	Kelly O'Reilly, Gary Keller, Ross Griswold	2	No	1	Yes/ numbered tongue depressor	Yes/20 roof tiles	No	Yes/20 m X 20m	2/3	2		CDFW
Bolsa Chica/South Tern Island	Peter Knapp	Kelly O'Reilly, Charlie Collins	4	No	1	Yes/ numbered tongue depressor	Yes/20 roof tiles	No	Yes/20 m X 20m	2/3	2		CDFW
Bolsa Chica/Seasonal Ponds Cell 9	Peter Knapp	Ross Griswold	4	No	2	No	No	No	No	7	2		CDFW
Huntington Beach	Nicole Housel	Jill Coumoutso, Lana Ngyuen, Christine Whitcraft, Allyson Beckman, Cynthia Coria, Alec Mang, Nadia Doshi	1	Yes	1	Yes/ tongue depressor	Yes	No	Yes/25 m	1	1		CA State Parks
Anaheim Lake	David McMichael	Bonnie Johnson, ND, AM, CC, CM, Dick Zembal	3	No		No	No	No	No	7	3		
Burris Basin	David McMichael	Bonnie Johnson, ND, AM, CC, CM, Dick Zembal	4	No		No	No	No	No	5	3		
UNBER Tern Island	TJ Graven	Carla Navarro, Kathy Sheridan, Brittany Poloni, Gary Santolo	4	Yes	3	Yes/ tongue depressor	Yes/~50 roofing tiles	No	Yes/40 m	3	3		CDFW

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
San Diego County													
Marine Corps Base Camp Pendleton/RB	Travis Wooten	Rachel Smith, Amie Aguiar, Monica Stupaczuk, Jeanette Boylan, JO, LM, OG, DA, JRG, GI	4	No	1	Yes/white paint stick	No	No	No	7	3		
Marine Corps Base Camp Pendleton/ WBC/S	Travis Wooten	Rachel Smith, Amie Aguiar, Monica Stupaczuk, Jeanette Boylan, JO, LM, OG, DA, JRG, GI	3	Yes	1	Yes/white paint stick	No	No	Yes/ 30X30	1	1/2		
Marine Corps Base Camp Pendleton/ BBN	Travis Wooten	Rachel Smith, Amie Aguiar, Monica Stupaczuk, Jeanette Boylan, JO, LM, OG, DA, JRG, GI	2	Yes	1	Yes/white paint stick	No	No	Yes/ 30X30	1/2	1/2		
Marine Corps Base Camp Pendleton/ BBS	Travis Wooten	Rachel Smith, Amie Aguiar, Monica Stupaczuk, Jeanette Boylan, JO, LM, OG, DA, JRG, GI	2	Yes	1	Yes/white paint stick	No	No	Yes/ 30X30	1/2	1/2		
Marine Corps Base Camp Pendleton/SF	Travis Wooten	Rachel Smith, Amie Aguiar, Monica Stupaczuk, Jeanette Boylan, JO, LM, OG, DA, JRG, GI	3	Yes	1	Yes/white paint stick	No	No	Yes	7	1/2		

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Batiquitos Lagoon/W1	Joelle Fournier	Nancy Frost	1	Yes	1	Yes	Yes	No	Yes	4	1		
Batiquitos Lagoon/W2	Joelle Fournier	Nancy Frost	1	Yes	1	Yes	Yes	No	Yes	4	1		
Batiquitos Lagoon/E1	Joelle Fournier	Nancy Frost	1	Yes	1	Yes	Yes	No	Yes	4	1		
San Elijo Lagoon	Robert Patton		3	Yes			No	No	No	7	1		
San Dieguito Lagoon	Brian Foster		3	No	1		Yes/ several	Yes/40	Yes/30 m	1/3	1		
Fairbanks Ranch	Brian Foster												
Mission Bay													
FAA Island	Jennifer Jackson		4/Island moat	Yes	1	Yes/ tongue depressor	Yes/40 roof tiles and grid markers	Yes/3 sets of 20 = 60 total	Yes/10 m	2/3	1	Chick fence repair	
North Fiesta Island	Jennifer Jackson		1	No	1	Yes/ tongue depressor	Yes	Yes	Yes	3	1		
Mariners Point*	Ginger Johnson		1	Yes	1	Yes/ tongue depressor	Yes/~50	Yes/ ~50	Yes/ approx. 12800 square meters/ squares 400 square meters	2	1	Grid system, decoys, shelters, vegetation management	San Diego City Parks Dept/ San Diego Audubon Society
Stony Point	Jennifer Jackson		1	Yes	1	Yes/ tongue depressor	Yes	Yes	Yes	2/3/4	1		
San Diego River Mouth	Ginger Johnson	None	1	Yes	1	No	No	No	No	7	3	Installation of temporary chain link fence for duration of tern nesting season, creation of sand berm to	San Diego City Parks Dept

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
												keep high tides from washing out sand under fence	
San Diego Bay													
Lindbergh Field	Robert Patton	Elizabeth Copper, Brian Foster, Mayra Garcia, Matt Sadowski	2	Yes	1	Yes/nest number spray-painted on substrate 1m to S	No	No	Yes/30 m	4	1		Site prep by SDCRAA staff & ZSSD contractors; monitoring by ZSSD contractors; pred control by USDA WS
Naval_Base_Coronado/ NIMAT	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	1	Yes	1	No/gps only	Yes/100 to 200	Yes/50	Yes/ 30mx30 m	1	1/2		
Naval_Base_Coronado/ NIAlt	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	1	No	1	Yes/green tongue depressor	No	Yes/50	No	7	1/2		
Naval_Base_Coronado/ DBN	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	1	Yes	1	Yes/3 inch high PVC ring, painted green/sand colors	Yes/100 to 200	No	Yes/ 30mx30 m	1	1/2		
Naval_Base_Coronado/ DBS	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	1	Yes	1	Yes/3 inch high PVC ring, painted green/sand colors	Yes/100 to 200	Yes/ 200 to 300	Yes/ 30mx30 m	1	1/2		
Naval_Base_Coronado/ NABON	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	4	No	1	Yes/green tongue depressor	No	No	Yes/ 30m x variable	2	1/2		

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Naval_Base_ Coronado/ NABOS	Katrina Murbock	Maggie Post, Julia Hoopes, Christy Stanton, PB, AD, KN, AA	3	Yes	1	Yes/green tongue depressor	No	No	Yes/ 30m x variable	2	1/2		
D Street Fill	Robert Patton	Jennifer Jackson, Brian Foster, Lea Squires, Matt Sadowski, Thomas Myers, Kate Goodenough, Anita Sanchez, Katelyn Gomez	3	Yes	1	Yes/ tongue depressor	Yes/174 roofing tiles	Yes/80	Yes/30 m	4	1		Site prep by USFWS NWR & SD Port staff & contractors; monitoring by Port contractors; pred control by USDA WS
Chula Vista Wildlife Refuge	Robert Patton	Matt Sadowski, Jennifer Jackson, Lea Squires, Brian Foster, Kate Goodenough, Thomas Myers, Anita Sanchez, Katelyn Gomez	3	Yes	1	Yes/ tongue depressor	Yes/44 roofing tiles	Yes/60	Yes/30 m	4	1		Site prep by ZSSD contractors; pred control by USDA WS
Saltworks	Robert Patton	Lea Squires, Matt Sadowski, Kate Goodenough, Brian Collins, Elizabeth Copper	3	No	1	Yes/ tongue depressor	Yes/10 roofing tiles	No	No	6	1		Monitoring by NWR contractors, predator control by USDA WS
Tijuana Estuary NERR, Tijuana North (NTJ)	Robert Patton	Lea Squires, Matt Sadowski, Brian Collins, Anita Sanchez, Katelyn Gomez	3	Yes	1	Yes/ tongue depressor	Yes/76	No	Yes/30 m	6	1		Monitoring by NWR contractors, predator control by USDA WS

Site name	Name of primary monitor	Names of other monitors	Fence type	Interpretive signs at site	Site Type	Nest Marking	Chick shelters	Decoys	Grid system	Vegetation management	Predator management	Other site preparation	By whom
Tijuana Estuary NERR, Tijuana South (STJ)	Robert Patton	Lea Squires, Matt Sadowski, Brian Collins, Anita Sanchez, Katelyn Gomez, Thomas Myers	3	Yes	1	Yes/ tongue depressor	Yes/62	No	Yes/30 m	6	1		Monitoring by NWR contractors, predator control by USDA WS
Imperial County													
Salton Sea	Guy McCaskie												

Appendix B-2: Monitoring in 2016 (continued). Color combinations of current and past California least tern banding studies conducted at breeding areas in California.

Site	Year	Age	Abbreviation	Color*
Oceano Dunes SVRA	2004-2016	Chicks	Y/G, G/Y, W/B, B/W,A/B, B/A, A/Y, B/G, B/O, O/B, B/R, R/W, W/R, R/Y, W/Y	Yellow/Green, Green/Yellow, White/Blue, Blue/White, Aqua/Blue, Blue/Aqua, Aqua/Yellow, Blue/Green, Blue/Orange, Orange/Blue, Blue/Red, Red/White, White/Red, Red/Yellow, White/Yellow (left)
Seal Beach	2015-2016	Adults	Y/K, M/R	Yellow/Black, Mauve/Red
Camp Pendleton	?-2009	Chicks	K/M	Black/Mauve
Batiquitos	198?-2011	Chicks/Adults	R/W	Red/White
San Dieguito	2013	1 Adult	K/F	Black/Fuchsia
North Fiesta Island	2014-2015	Chicks	B/L	Blue/Lime
Mariner's Point	198?-2013, 2015	Chicks	B/G	Blue/Green
Mariner's Point	2014, 2016	Chicks	G/B	Green/Blue
Stony Point	2013-2014	Chicks	B/G	Blue/Green
Lindbergh Field	2008-2011	Adults	G/W	Green/White
Lindbergh Field	2012-2014	Adults	K/F	Black/Fuchsia
North Island MAT	198?-2010	Chicks/Adults	O/A	Orange/Aqua
North Island Runway 11		Chicks	K/A	Black/Aqua
Delta Beach North	198?-2010, 2014	Chicks/Adults	R/Y	Red/Yellow
Delta Beach South	199?-2010, 2014	Chicks/Adults	K/W	Black/White
Naval Amphibious Base Ocean	199?-2010, 2014	Chicks/Adults	P/B	Dark Pink/Blue
D Street	2008, 2012, 2014	Chicks/Adults	M/W	Mauve/White
Chula Vista Wildlife Reserve	2008-2013	Adults	K/Y	Black/Yellow
Chula Vista Wildlife Reserve	2014	Chicks/Adults	A/K	Aqua/Black
Saltworks	2008-2014	Chicks/Adults	M/L	Mauve/Lime
Tijuana Estuary	2008-2014	Chicks/Adults	R/G	Red/Green
Project Wildlife (rehabilitated birds released to the wild)	2002			Anodized Blue
Project Wildlife (rehabilitated birds released to the wild)	2003			Anodized Green
Project Wildlife (rehabilitated birds released to the wild)	2004			Anodized Red
Project Wildlife (rehabilitated birds released to the wild)	2005			Anodized Red
Various	2000	Adults	G	Green
Various	2008	Adults	A	Light Blue
Various	2009	Adults	R	Red
Various	2010	Adults	K	Black
Various	2011	Adults	L	Lime Green
Various	2012	Adults	F	Fuchsia
Various	2013	Adults	W	White
Various	2014	Adults	B	Dark Blue

*With the exception of Oceano Dunes, Seal Beach, and Project Wildlife, all color band information provided by E. Copper (pers. comm. November 4, 2014).

Note: Least terns were banded only with Service bands at the following colonies in 2016: FAA Island, North Fiesta Island, Stony Point, Lindbergh Field, D Street, Chula Vista Wildlife Reserve, Saltworks, and Tijuana Estuary.

Least terns were banded with Service and alphanumeric bands at the following colonies in 2016: Bolsa Chica, Huntington State Beach, Camp Pendleton, Batiquitos Lagoon, Naval Base Coronado, Tijuana Estuary.

Appendix B-3: Pair Estimation in 2016 (Method I).

Site name	Date terns first observed*	Date terns last observed	Date of first nest	Date of last nest initiation	Total number of monitoring visits	Total nests in first wave	Total nests in second wave	Total pairs	Total Nests
Sacramento Area									
Bufferlands	23-May-16	29-Jul-16	23-May-16	na	11	1	0	1	1
San Francisco Bay Area									
Napa Sonoma Marsh Wildlife Area – Totals						40	39	59.5	79
Green Island Unit	12-May-16	22-Aug-16	26-May-16	8-Aug-16	19	3	15	10.5	18
Pond 7/7A	12-Apr-16	2-Aug-16	23-May-16	5-Jul-16	17	37	24	49	61
Montezuma – Totals						4	2	5	6
Site 1						0	0	0	0
Site 3/4	16-May-16	13-Jul-16	20-May-16	1-Jul-16	18	4	2	5	6
Pittsburg Power Plant	16-Jun-16	18-Jul-16	16-Jun-16	na	9	0	1	0.5	1
Alameda Point	10-Apr-16	24-Aug-16	3-May-16	19-Jul-16	106	313	90	358	403
Hayward Regional Shoreline	2-May-16	12-Aug-16	30-Apr-16	4-Jul-16	21	78	10	83	88
San Luis Obispo/Santa Barbara Counties									
Oceano Dunes SVRA	1-May-16	16-Aug-16	17-May-16	9-Jul-16	119	43	6	46	49
Rancho Guadalupe Dunes Preserve	12-May-16	4-Aug-16	na	na	52	0	0	0	0
Vandenberg AFB-Purisima Pt.	2-May-16	4-Aug-16	24-May-16	15-Jul-16	83	15	12	21	27
Coal Oil Point Reserve	10-Jun-16	16-Aug-16	na	na	13		0	0	0
Ventura County									
Ormond Beach	5-May-16	9-Aug-16	26-May-16	26-Jun-16	24	12	6	15	18
Hollywood Beach	1-May-16	31-Jul-16	na	na	36	0	0	0	0
Santa Clara River/McGrath State Beach	5-May-16	31-Aug-16	2-Jun-16	4-Aug-16	26	17	45	39.5	62
Pt Mugu						314	47	337.5	361
Holiday Beach	16-May-16	1-Aug-16	16-May-16	2-Jul-16	68	172	10	177	182
Holiday Salt Panne	16-May-16	16-Jul-16	16-May-16	29-Jun-16	48	18	3	19.5	21
Eastern Arm	17-May-16	21-Jul-16	17-May-16	12-Jul-16	35	21	17	29.5	38
Ormond Beach East	19-May-16	22-Jul-16	19-May-16	27-Jun-16	47	103	17	111.5	120

Site name	Date terns first observed*	Date terns last observed	Date of first nest	Date of last nest initiation	Total number of monitoring visits	Total nests in first wave	Total nests in second wave	Total pairs	Total Nests
Saticoy United Water Conservation District	na	na	na	na	11	0	0	0	0
Los Angeles/Orange Counties									
Venice Beach/Marina del Rey	9-Apr-16	5-Jul-16	23-May-16	na	16	2	0	2	2
LA Harbor	18-Apr-16	16-Aug-16	14-May-16	6-Jul-16	136	112	29	126.5	141
Seal Beach NWR - Anaheim Bay	4-May-16	13-Jul-16	11-May-16	19-Jun-16	20	79	1	79.5	80
Bolsa Chica Ecological Reserve						139	3	140.5	142
Nest Site 1 (NS1)	10-May-16	4-Aug-16	10-May-16	14-Jun-16	26	18	0	18	18
Nest Site 2 (NS2)	12-May-16	28-Jun-16	12-May-16	28-Jun-16	10	86	1	86.5	87
Nest Site 3 (NS3)	12-May-16	23-Jun-16	12-May-16	26-May-16	7	5	0	5	5
South Tern Island (STI)	10-May-16	28-Jun-16	10-May-16	21-Jun-16	34	29	2	30	31
Cell 9	3-Jun-16	30-Jun-16	3-Jun-16	na	29	1	0	1	1
Huntington State Beach	24-Apr-16	28-Jul-16	10-May-16	1-Jul-16	21	326	22	337	348
Anaheim Lake	16-Jun-16	11-Jul-16	16-Jun-16	29-Jun-16	5	0	4	2	4
Burris Sand Pit/Burris Basin	14-Jun-16	12-Jul-16	14-Jun-16	12-Jul-16	14	1	9	5.5	10
Upper Newport Bay Ecological Reserve	29-Apr-16	1-Aug-16	27-May-16	na	35	15	5	17.5	20
San Diego County									
MCB Camp Pendleton						833	64	865	897
Red Beach	14-May-16	30-Jun-16	21-May-16	18-Jun-16	21	3	1	3.5	4
White Beach	12-Apr-16	19-Jul-16	7-May-16	25-Jun-16	45	78	8	82	86
Santa Margarita River – North Beach North	8-Apr-16	22-Aug-16	25-Apr-16	13-Jul-16	see below	see below	see below	see below	nests combined into North Beach South below
Santa Margarita River - North Beach South	8-Apr-16	22-Aug-16	25-Apr-16	13-Jul-16	77	751	53	777.5	804
Santa Margarita River - Saltflats and Island	27-May-16	11-Jul-16	6-Jun-16	22-Jun-16	21	1	2	2	3
Batiquitos Lagoon Ecological Reserve						440	11	445.5	451
E1	19-Apr-16	12-Jul-16	3-May-16	28-Jun-16	33	50	3	51.5	53
W1	19-Apr-16	19-Jul-16	8-May-16	10-Jun-16	30	34	0	34	34

Site name	Date terns first observed*	Date terns last observed	Date of first nest	Date of last nest initiation	Total number of monitoring visits	Total nests in first wave	Total nests in second wave	Total pairs	Total Nests
W2	8-Apr-16	23-Aug-16	3-May-16	1-Jul-16	35	356	8	360	364
San Elijo Lagoon Ecological Reserve	9-May-16	11-Jul-16	na	na		0	0	0	0
Fairbanks Ranch	na					0	0	0	0
San Dieguito Lagoon Ecological Reserve	4-May-16	18-Jul-16	na	na		0	0	0	0
Mission Bay									
FAA Island	28-Apr-16	15-Jul-16	2-May-16	6-Jul-16	32	35	15	42.5	50
North Fiesta Island	28-Apr-16	8-Jul-16	12-May-16	21-Jun-16	26	17	8	21	25
Mariner's Point	30-Apr-16	13-Aug-16	6-May-16	23-Jun-16	36	123	4	125	127
Stony Point	9-May-16	12-Jul-16	9-May-16	8-Jul-16	25	9	6	12	15
San Diego River Mouth	29-May-16	31-May-16	31-May-16	na	16	5	0	5	5
San Diego Bay									
Lindbergh Field & Former Naval Training Center	13-Apr-16	26-Jul-16	4-May-16	20-Jun-16	77	36	1	36.5	37
US Navy - NI MAT	19-Apr-16	25-Jul-16	12-May-16	30-Jun-16	51	29	3	30.5	32
US Navy – NI Alt	24-May-16	26-May-16	24-May-16	24-May-16	43	2	0	2	2
Naval Base Coronado - Totals						736	123	797.5	859
Delta Beach North	14-Apr-16	2-Aug-16	30-Apr-16	14-Jul-16	55	118	32	134	150
Delta Beach South	12-Apr-16	11-Aug-16	2-May-16	6-Jul-16	55	113	12	119	125
NAB Ocean	15-Apr-16	26-Aug-16	27-Apr-16	19-Jul-16	63	505	79	544.5	584
D Street Fill/Sweetwater Marsh NWR	11-Apr-16	26-Jul-16	29-Apr-16	11-Jul-16	52	108	10	113	118
Chula Vista Wildlife Reserve	16-Apr-16	2-Aug-16	9-May-16	12-Jul-16	54	70	6	73	76
South San Diego Bay Unit, SDNWR - Saltworks	16-Apr-16	10-Aug-16	11-May-16	6-Jul-16	35	20	6	23	26
Tijuana Estuary NERR						161	23	172.5	184
Tijuana North	21-Apr-16	1-Sep-16	10-May-16	14-Jul-16	30	57	14	64	71
Tijuana South	21-Apr-16	11-Aug-16	12-May-16	7-Jul-16	29	104	9	108.5	113
Imperial County									
Salton Sea	13-Jul-16	13-Jul-16	na	na		0	0	0	0

Appendix B-3 Legend: *Some dates determined from initiation of first nest.

Appendix B-3: Pair Estimation in 2016 (Method II and III).

	Pair Estimation II			Pair Estimation III							
Site name	**Total nests**	**Number of unsuccessful nests plus estimated broods lost before 20 June**	***Total pairs not renesting**	**Date of second wave start (if any)**	**Total first wave nests**	**Estimated renesters first wave**	**Total Pairs first wave**	**Total nests 2nd wave**	**Estimated renesters 2nd wave**	**Total Pairs 2nd wave**	**Total Pairs**
Sacramento Area											
Bufferlands	1	0	1		1	0	1	0	0	0	1
San Francisco Bay Area											
Napa Sonoma Marsh Wildlife Area - Totals	79	7	72								72
NSMWA-Green Island Unit	18	0	18		3	0	3	15	2	13	16
NSMWA-Pond 7/7A	61	7	54		37	0	37	24	5	19	56
Montezuma Wetlands - Totals	6	0	6								4
Site 1	0	0	0		0		0	0	0	0	0
Site 3/4	6	0	6		4	1	3	2	1	1	4
Pittsburg Power Plant	1	0	1		0	0	0	1	0	1	1
Alameda Point	403	22	381	4-Jun-16	357	0	357	46	29	17	374
Hayward Regional Shoreline	88	1	87		78	3	75	10	0	10	85
San Luis Obispo/Santa Barbara Counties											
Oceano Dunes SVRA	49	0	49		43	0	43	6	2	4	47
Rancho Guadalupe Dunes Preserve	0	0	0				0			0	0
Vandenberg AFB-Purisima Pt.	27	3	24		15	0	15	12	2	10	25
Coal Oil Point Reserve	0	0	0				0			0	0
Ventura County											
Ormond Beach	18	0	18		12	0	12	6	0	6	18
Hollywood Beach	0	0	0		0		0	0		0	0
Santa Clara River/McGrath State Beach	62	5	57		17	0	17	45	18	27	44
Pt Mugu- Totals	361	46	315								361
Holiday Beach	182	16	166		172	0	172	10	0	10	182

	Pair Estimation II			Pair Estimation III							
Site name	**Total nests**	**Number of unsuccessful nests plus 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**
Holiday Salt Panne	21	1	20		18	0	18	3	0	3	21
Eastern Arm	38	12	26		21	0	21	17	0	17	38
Ormond Beach East	120	17	103		103	0	103	17	0	17	120
Saticoy United Water Conservation District	0	0	0		0		0	0		0	0
Los Angeles/Orange Counties											
Venice Beach/Marina del Rey	2	2	0		2	0	2	0	0	0	2
LA Harbor- Pier 400	141	32	109		112	0	112	29	0	29	141
Seal Beach NWR - Anaheim Bay	80	7	73	18-Jun-16	79	0	79	1	1	0	79
Bolsa Chica Ecological Reserve -Totals	142	18	124								142
Nest Site 1 (NS1)	18	1	17		18	0	18	0	0	0	18
Nest Site 2 (NS2)	87	14	73		86	0	86	1	0	1	87
Nest Site 3 (NS3)	5	1	4		5	0	5	0	0	0	5
South Tern Island (STI)	31	2	29		29	0	29	2	0	2	31
Cell 9	1	0	1		1	0	1	0	0	0	1
Huntington State Beach	348	42	306	21-Jun-16	326	44	282	22	0	22	304
Anaheim Lake	4	0	4		0	0	0	4	0	4	4
Burris Sand Pit/Burris Basin	10	0	10		1	0	1	9	0	9	10
Upper Newport Bay Ecological Reserve	20	0	20		15	2	13	5	0	5	18
San Diego County											
MCB Camp Pendleton - Totals	897	150	747								897
Red Beach	4	0	4		3	0	3	1	0	1	4
White Beach	86	41	45		78	0	78	8	0	8	86

	Pair Estimation II			Pair Estimation III							
Site name	**Total nests**	**Number of unsuccessful nests plus 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**
Santa Margarita River - North Beach North	nests combined into North Beach South below									see below	see below
Santa Margarita River - North Beach South	804	108	696		751	0	751	53	0	53	804
Santa Margarita River - Saltflats and Island	3	1	2		1	0	1	2	0	2	3
Batiquitos Lagoon Ecological Reserve - Totals	451	37	414								451
E1	53	1	52		50		50	3		3	53
W1	34	3	31		34		34	0		0	34
W2	364	33	331		356		356	8		8	364
San Elijo Lagoon Ecological Reserve	0	0	0		0		0	0		0	0
Fairbanks Ranch	0	0	0		0		0	0		0	0
San Dieguito Lagoon Ecological Reserve	0	0	0		0		0	0		0	0
Mission Bay											
FAA Island	50	30	20	1-Jun-16	35	17	18	15	2	13	31
North Fiesta Island	25	6	19	3-Jun-16	17	3	14	8	0	8	22
Mariner's Point	127	66	61	20-Jun-16	123	67	56	4	0	4	60
Stony Point	15	5	10	3-Jun-16	9	1	8	6	2	4	12
San Diego River Mouth	5	5	0		5	0	5	0	0	0	5
San Diego Bay											
Lindbergh Field & Former Naval Training Center	37	5	32		36	6	30	1	0	1	31
US Navy - NI MAT	32	8	24		29		29	3		3	32
US Navy - NIAlt	2	2	0		2		2	0		0	2

	Pair Estimation II			Pair Estimation III							
Site name	**Total nests**	**Number of unsuccessful nests plus 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**
Naval Base Coronado - Totals	859	111	748								859
Delta Beach North	150	12	138		118		118	32		32	150
Delta Beach South	125	10	115		113		113	12		12	125
NAB Ocean	584	89	495		505		505	79		79	584
D Street Fill/Sweetwater Marsh NWR	118	10	108		108	12	96	10	0	10	106
Chula Vista Wildlife Reserve	76	11	65		70	13	57	6	0	6	63
South San Diego Bay Unit, SDNWR - Saltworks	26	1	25		20	5	15	6	5	1	16
Tijuana Estuary NERR - Totals	184	40	144								144
Tijuana North	71	11	60		57	11	46	14	0	14	60
Tijuana South	113	29	84		104	29	75	9	0	9	84
Imperial County											
Salton Sea	0	0	0				0			0	0

Appendix B-3 Legend:
*Total pairs not renesting calculated using nesting chronology and mortality databases.

Appendix B-4: Productivity in 2016.

Site name	Total nests	Total eggs	Average clutch size	No. of eggs hatched	Egg Hatching Rate	Date of first hatch	Date of last hatch	Max # active nests & broods	Date of max active nests	Date of first fledgling	Fledgling estimate method	Total fledglings
Sacramento Area												
Bufferlands	1	2	2.00	2	1.00	15-Jun-16	15-Jun-16	1	23-May-16	30-Jun-16	Other	2
San Francisco Bay Area												
Napa Sonoma Marsh Wildlife Area - Totals	79	158	2.00	77	0.49							5-6
NSMWA-Green Island Unit	18	31	1.72	7	0.23	16-Jun-16	1-Aug-16	11	14-Jul-16	7-Jul-16	3WD	
NSMWA-Pond 7/7A	61	127	2.08	70	0.55	7-Jun-16	5-Jul-16	38	15-Jun-16	5-Jul-16	3WD	
Montezuma Wetlands - Totals*	6	6	1.00	5	0.83							
Site 1	0	0	0.00	0	na	na	na	0		na	na	0
Site 3/4	6	6	1.00	5	0.83	14-Jun-16	26-Jun-16	3	26-May to 6-Jun-16	6-Jul-16	Other	1
Pittsburg Power Plant	1	1	1.00	1	1.00	14-Jul-16	14-Jul-16	1	16&30-Jun-16	na	na	0
Alameda Point	403	820	2.03	710	0.87	24-May-16	2-Aug-16	275	24-May-16	7-Jun-16	3WD	586-639
Hayward Regional Shoreline	88	181	2.06	152	0.84	20-May-16	20-Jul-16	50	22-May-16	13-Jun-16	3WD	157
San Luis Obispo/Santa Barbara Counties												
Oceano Dunes SVRA	49	96	1.96	82	0.85	10-Jun-16	26-Jul-16	42	17&19-Jun-16	4-Jul-16	Other, R	59
Rancho Guadalupe Dunes Preserve	0	0	0.00	0	na	na	na	0		na	na	0
Vandenberg AFB-Purisima Pt.	27	49	1.81	38	0.78	14-Jun-16	19-Jul-16	21	21-Jun-16	5-Jul-16	3WD	18
Coal Oil Point Reserve	0	0	0.00	0	na	na	na	0		na	na	0
Ventura County												
Ormond Beach	18	34	1.89	31		16-Jun-16	14-Jul-16	10	2-Jun-16	7-Jul-16	3WD	14
Hollywood Beach	0	0	0.00	0	na	na	na	0		na	na	0
Santa Clara River/McGrath State Beach	62	105	1.69	50	0.48	13-Jul-16	11-Aug-16	26	13-Jul-16	3-Aug-16	3WD	11
Pt Mugu- Totals	361	640	1.77	373	0.58							56-86
Holiday Beach	182	334	1.84	231	0.69	6-Jun-16	21-Jul-16	148	8-Jun-16	4-Jul-16	Other	
Holiday Salt Panne	21	37	1.76	23	0.62	7-Jun-16	27-Jul-16	14	7-Jun-16	na	Other	
Eastern Arm	38	65	1.71	27	0.42	3-Jun-16	21-Jul-16	15	28-Jun-16	13-Jul-16	Other	

Site name	Total nests	Total eggs	Average clutch size	No. of eggs hatched	Egg Hatching Rate	Date of first hatch	Date of last hatch	Max # active nests & broods	Date of max active nests	Date of first fledgling	Fledgling estimate method	Total fledglings
Ormond Beach East	120	204	1.70	92	0.45	13-Jun-16	7-Jul-16	70	13-Jun-16	8-Jul-16	Other	
Saticoy United Water Conservation District	0	0	0.00	0	na	na	na	0		na	na	0
Los Angeles/Orange Counties												
Venice Beach/Marina del Rey	2	2	1.00	0	0.00	na	na	1	23-May-16	na	na	0
LA Harbor- Pier 400	141	209	1.48	103	0.49	8-Jun-16	16-Jul-16	85	4-Jun-16	25-Jun-16	3WD	46-70
Seal Beach NWR - Anaheim Bay	80	148	1.85	110	0.74	25-May-16	26-Jun-16	73	29-May-16	22-Jun-16	R	25
Bolsa Chica Ecological Reserve -Totals	142	245	1.73	179	0.73						Other	43
Nest Site 1 (NS1)	18	32	1.78	21	0.66	31-May-16	3-Jul-16	15	31-May-16	21-Jun-16	Other	
Nest Site 2 (NS2)	87	153	1.76	115	0.75	26-May-16	28-Jun-16	81	26-May-16	26-Jun-16	Other	
Nest Site 3 (NS3)	5	7	1.40	5	0.71	2-Jun-16	16-Jun-16	4	26-May&2-Jun-16	na	na	
South Tern Island (STI)	31	51	1.65	37	0.73	29-May-16	21-Jun-16	27	31-May-16	26-Jun-16	Other	
Cell 9	1	2	2.00	1	0.50	20-Jun-16	20-Jun-16	1	3-Jun-16	na	na	
Huntington State Beach	348	555	1.59	419	0.75	27-May-16	28-Jun-16	283	31-May-16	21-Jun-16	2WD	100-123
Anaheim Lake	4	6	1.50	2	0.33	11-Jul-16	11-Jul-16	4	29-Jun-16	na	Other	0
Burris Sand Pit/Burris Basin	10	14	1.40	1	0.07	12-Jul-16	12-Jul-16	6	12-Jul-16	na	Other	0
Upper Newport Bay Ecological Reserve	20	32	1.60	10	0.31	10-Jun-16	8-Jul-16	13	15-Jun-16	6-Jul-16	Other	2
San Diego County												
MCB Camp Pendleton - Totals	897	1375	1.53	622	0.45							85-207
Red Beach	4	6	1.50	0	0.00	na	na	3	18&20-Jun-16	na	3WD	
White Beach	86	143	1.66	47	0.33	31-May-16	30-Jun-16	47	28&30-May-16	18-Jun-16	3WD	
Santa Margarita River - North Beach North	nests combined into North Beach South below					Data combined with North Beach South below		5	9&13-Jun-16		3WD	

Site name	Total nests	Total eggs	Average clutch size	No. of eggs hatched	Egg Hatching Rate	Date of first hatch	Date of last hatch	Max # active nests & broods	Date of max active nests	Date of first fledgling	Fledgling estimate method	Total fledglings
Santa Margarita River - North Beach South	804	1222	1.52	575	0.47	23-May-16	18-Jul-16	377**	27-May-16	17-Jun-16	3WD, R	
Santa Margarita River - Saltflats and Island	3	4	1.33	0	0.00	na	na	1	6 to 22-Jun-16	na	3WD	see NBS
Batiquitos Lagoon Ecological Reserve - Totals	451	790	1.75	679	0.86							175-200
E1	53	95	1.79	83	0.87	27-May-16	28-Jun-16	46	27-May-16	21-Jun-16	Other	
W1	34	62	1.82	53	0.85	31-May-16	28-Jun-16	27	31-May-16	24-Jun-16	Other	
W2	364	633	1.74	543	0.86	27-May-16	1-Jul-16	310	24&27-May-16	21-Jun-16	3WD, other	
San Elijo Lagoon Ecological Reserve	0	0	0.00	0	na	na	na	0		na	na	0
Fairbanks Ranch	0	0	0.00	0	na	na	na	0		na	na	0
San Dieguito Lagoon Ecological Reserve	0	0	0.00	0	na	na	na	0		na	na	0
Mission Bay												
FAA Island	50	75	1.50	24	0.32	6-Jun-16	1-Jul-16	20	5-May-16	27-Jun-16	3WD	5
North Fiesta Island	25	45	1.80	21	0.47	6-Jun-16	21-Jun-16	20	6-Jun-16	1-Jul-16	3WD	4
Mariner's Point	127	191	1.50	69	0.36	6-Jun-16	14-Jul-16	53	13-Jun-16	1-Jul-16	3WD	15-20
Stony Point	15	27	1.80	9	0.33	6-Jun-16	22-Jun-16	12	3-Jun-16	1-Jul-16	3WD	7
San Diego River Mouth	5	5	1.00	0	0.00	na	na	5	31-May-16	na	na	0
San Diego Bay												
Lindbergh Field & Former Naval Training Center	37	61	1.65	38	0.62	26-May-16	25-Jun-16	31	1-Jun-16	17-Jun-16	R	10-17
US Navy - NI MAT	32	50	1.56	33	0.66	4-Jun-16	28-Jun-16	27	2,3&6-June-16	30-Jun-16	3WD	5
US Navy - NIAlt	2	2	1.00	0	0.00	na	na	2	24&25-May-16	na	na	0
Naval Base Coronado - Totals	859	1307	1.52	706	0.54							106-191
Delta Beach North	150	227	1.51	123	0.54	24-May-16	16-Jul-16	52	27-29-June-16	25-Jun-16	3WD	
Delta Beach South	125	187	1.50	81	0.43	25-May-16	29-Jun-16	59	30-May-16	15-Jun-16	3WD	
NAB Ocean	584	893	1.53	502	0.56	24-May-16	25-Jul-16	289	26-May-16	21-Jun-16	3WD	
D Street Fill/Sweetwater Marsh NWR	118	196	1.66	149	0.76	27-May-16	28-Jun-16	91	27-May-16	17-Jun-16	2WD, R	21-22

Site name	Total nests	Total eggs	Average clutch size	No. of eggs hatched	Egg Hatching Rate	Date of first hatch	Date of last hatch	Max # active nests & broods	Date of max active nests	Date of first fledgling	Fledgling estimate method	Total fledglings
Chula Vista Wildlife Reserve	76	122	1.61	103	0.84	31-May-16	16-Jul-16	56	31-May-16	21-Jun-16	2WD, R	15-18
South San Diego Bay Unit, SDNWR - Saltworks	26	41	1.58	32	0.78	6-Jun-16	6-Jul-16	19	6&15-Jun-16	27-Jun-16	2WD, R	6-7
Tijuana Estuary NERR - Totals	184	301	1.64	158	0.52			104	2-Jun-16			33-41
Tijuana North	71	110	1.55	68	0.62	2-Jun-16	14-Jul-16			30-Jun-16	2WD, R	
Tijuana South	113	191	1.69	90	0.47	2-Jun-16	7-Jul-16			30-Jun-16	2WD, R	
Imperial County												
Salton Sea	0	0	0.00	0	na	na	na	0		na	na	0-1

*Max active counts may be slightly low due to monitoring occurring mainly outside of colony.
**Not all nests were monitored; estimate is based only on the surveyed nests.

Appendix B-4: Productivity: clutch sizes in 2016.

			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	2	0	1	0	0
San Francisco Bay Area						
Napa Sonoma Marsh Wildlife Area - Totals	79	158	20	39	20	0
NSMWA-Green Island Unit	18	31	7	9	2	0
NSMWA-Pond 7/7A	61	127	13	30	18	0
Montezuma Wetlands - Totals	6	6	1	1	1	0
Site 1	0	0	0	0	0	0
Site 3/4	6	6	1	1	1	0
Pittsburg Power Plant	1	1	1	0	0	0
Alameda Point	403	820	43	303	57	0
Hayward Regional Shoreline	88	181	9	66	12	1
San Luis Obispo/Santa Barbara Counties						
Oceano Dunes SVRA	49	96	4	43	2	0
Rancho Guadalupe Dunes Preserve	0	0	0	0	0	0
Vandenberg AFB-Purisima Pt.	27	49	5	22	0	0
Coal Oil Point Reserve	0	0	0	0	0	0
Ventura County						
Ormond Beach	18	34	2	16	0	0
Hollywood Beach	0	0	0	0	0	0
Santa Clara River/McGrath State Beach	62	105	19	43	0	0
Pt Mugu- Totals	361	640	78	278	2	0
Holiday Beach	182	334	30	149	2	0
Holiday Salt Panne	21	37	5	16	0	0
Eastern Arm	38	65	11	27	0	0
Ormond Beach East	120	204	32	86	0	0
Saticoy United Water Conservation District	0	0	0	0	0	0
Los Angeles/Orange Counties						
Venice Beach/Marina del Rey	2	2	2	0	0	0
LA Harbor- Pier 400	141	209	73	68	0	0
Seal Beach NWR - Anaheim Bay	80	148	14	64	2	0
Bolsa Chica Ecological Reserve -Totals	142	245	42	97	3	0
Nest Site 1 (NS1)	18	32	4	14	0	0
Nest Site 2 (NS2)	87	153	24	60	3	0
Nest Site 3 (NS3)	5	7	3	2	0	0
South Tern Island (STI)	31	51	11	20	0	0
Cell 9	1	2	0	1	0	0
Huntington State Beach	348	555	141	205	0	1
Anaheim Lake	4	6	2	2	0	0
Burris Sand Pit/Burris Basin	10	14	6	4	0	0
Upper Newport Bay Ecological Reserve	20	32	8	12	0	0

			Number of nests			
Site name	**Nest total**	**Egg total**	**1 egg clutch**	**2 egg clutch**	**3 egg clutch**	**4 egg clutch**
San Diego County						
MCB Camp Pendleton - Totals	897	1375	419	478	0	0
Red Beach	4	6	2	2	0	0
White Beach	86	143	29	57	0	0
Santa Margarita River - North Beach North	nests combined into North Beach South below					
Santa Margarita River - North Beach South	804	1222	386	418	0	0
Santa Margarita River - Saltflats and Island	3	4	2	1	0	0
Batiquitos Lagoon Ecological Reserve - Totals	451	790	113	337	1	0
E1	53	95	11	42	0	0
W1	34	62	6	28	0	0
W2	364	633	96	267	1	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	50	75	25	25	0	0
North Fiesta Island	25	45	5	20	0	0
Mariner's Point	127	191	63	64	0	0
Stony Point	15	27	3	12	0	0
San Diego River Mouth	5	5	5	0	0	0
San Diego Bay						
Lindbergh Field & Former Naval Training Center	37	61	13	24	0	0
US Navy - NI MAT	32	50	14	18	0	0
US Navy - NIAlt	2	2	2	0	0	0
Naval Base Coronado - Totals	859	1307	412	446	1	0
Delta Beach North	150	227	74	75	1	0
Delta Beach South	125	187	63	62	0	0
NAB Ocean	584	893	275	309	0	0
D Street Fill/Sweetwater Marsh NWR	118	196	40	78	0	0
Chula Vista Wildlife Reserve	76	122	30	46	0	0
South San Diego Bay Unit, SDNWR - Saltworks	26	41	11	15	0	0
Tijuana Estuary NERR - Totals	184	301	67	117	0	0
Tijuana North	71	110	32	39	0	0
Tijuana South	113	191	35	78	0	0
Imperial County						
Salton Sea	0	0	0	0	0	0

Appendix B-5: Non-Predation Mortality in 2016.

	No. of eggs					No. of nests					No. of dead			
Site name	damaged (includes human caused)	lost to flooding	abandoned pre-term (includes buried)	abandoned post-term/nonviable	outcome unknown	damaged (includes human caused)	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	0	0	0	0	0	0	0	0	0	0	0	0	0	
San Francisco Bay Area														
Napa Sonoma Marsh Wildlife Area - Totals	7	0	5	23	4	7	0	19	2	2	0	0	0	
Green Island Unit	3	0	0	20	0	3	0	14	0	0	0	0	0	
Pond 7/7A	4	0	5	3	4	4	0	5	2	2	0	0	0	
Montezuma - Totals	0	0	1	0	0	0	0	1	0	0	0	0	0	
Site 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Site 3/4	0	0	1	0	0	0	0	1	0	0	0	0	0	
Pittsburg Power Plant	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Alameda Point	0	0	21	62	21	0	0	20	50	4	40	0	0	includes 3 DH
Hayward Regional Shoreline	0	0	14	0	0	0	0	12	12	0	0	0	0	
San Luis Obispo/Santa Barbara Counties														
Oceano Dunes SVRA	0	0	0	8	6	0	0	0	7	1	1	1	0	
Rancho Guadalupe Dunes Preserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Vandenberg AFB-Purisima Pt.	0	0	0	3	0	0	0	0	3	0	0	0	0	
Coal Oil Point Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Ventura County														
Ormond Beach	0	0	0	3	0	0	0	0	2	0		1	1	

	No. of eggs					No. of nests					No. of dead			
Site name	damaged (includes human caused)	lost to flooding	abandoned pre-term (includes buried)	abandoned post-term/nonviable	outcome unknown	damaged (includes human caused)	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks	fledglings	adults	Comments on cause(s) of non-predation mortality
Hollywood Beach	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Santa Clara River/McGrath State Beach	0	0	5	1	3	0	0	4	1	1	0	0	0	
Pt Mugu - Totals	0	102	44	51	44	0	56	29	38	29	14	0	0	
Holiday Beach	0	27	16	35	18	0	14	10	25	11	7	0	0	
Holiday Salt Panne	0	2	4	4	0	0	1	3	3	0	2	0	0	
Eastern Arm	0	22	0	6	1	0	12	0	5	0	2	0	0	
Ormond Beach East	0	51	24	6	25	0	29	16	5	18	3	0	0	includes 1 DH
Saticoy united Water Conservation District	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Los Angeles/Orange Counties														
Venice Beach/Marina del Rey	0	0	1	0	0	0	0	1	0	0	0	0	0	
LA Harbor- Pier 400	1	0	86	0	0	1	0	66	0	0	10	0	0	
Seal Beach NWR - Anaheim Bay	0	0	1	29	1	0	0	1	22	0	17	1	2	
Bolsa Chica Ecological Reserve -Totals	1	0	13	41	6	0	0	9	34	4	16	0	0	
Nest Site 1 (NS1)	1	0	4	2	4	0	0	2	2	2	2	0	0	
Nest Site 2 (NS2)	0	0	3	31	1	0	0	2	25	1	8	0	0	includes 3 DH
Nest Site 3 (NS3)	0	0	0	1	0	0	0	0	1	0	1	0	0	
South Tern Island (STI)	0	0	6	7	1	0	0	5	6	1	5	0	0	
Cell 9	0	0	0	0	0	0	0	0	0	0	0	0	0	
Huntington State Beach	0	0	93	40	3	0	0	62	35	2	89	0	1	
Anaheim Lake	0	0	1	0	3	0	0	1	0	1	0	0	0	
Burris Sand Pit/Burris Basin	0	0	2	0	5	0	0	2	0	3	0	0	0	

	No. of eggs					No. of nests					No. of dead			
Site name	damaged (includes human caused)	lost to flooding	abandoned pre-term (includes buried)	abandoned post-term/nonviable	outcome unknown	damaged (includes human caused)	lost to flooding	abandoned pre-term	abandoned post-term/nonviable	outcome unknown	chicks	fledglings	adults	Comments on cause(s) of non-predation mortality
Upper Newport Bay Ecological Reserve	0	0	3	8	11	0	0	2	6	6	0	0	0	
San Diego County														
MCB Camp Pendleton - Totals	6	62	103	171	310	5	42	79	137	206	423	16	2	
Red Beach	0	0	0	0	2	0	0	0	0	1	0	0	0	
White Beach	1	41	2	5	6	1	26	2	4	3	8	0	0	
Blue Beach - North & South Beach combined	5	21	101	166	302	4	16	77	133	202	415	16	2	includes 4 DH
Santa Margarita River - Saltflats and Island	0	0	0	0	0	0	0	0	0	0	0	0	0	
Batiquitos Lagoon Ecological Reserve - Totals	1	0	68	38	1	2	0	55	34	1	310	25	3	
E1	0	0	7	5	0	0	0	5	4	0	16	1	0	
W1	0	0	6	2	0	0	0	4	2	0	26	1	0	includes 1 DH
W2	1	0	55	31	1	2	0	46	28	1	268	23	3	includes 3 DH
San Elijo Lagoon Ecological Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Fairbanks Ranch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
San Dieguito Lagoon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Mission Bay														
FAA Island	0	0	10	0	3	0	0	7	0	2	0	0	0	
North Fiesta Island	0	0	21	2	1	0	0	13	2	1	0	0	0	
Mariner's Point	0	0	42	0	0	0	0	0	29		13	1	0	
Stony Point	0	0	10	1	2	0	0	6	1	1	1	0	0	

	No. of eggs					No. of nests					No. of dead			
Site name	damaged (includes human caused)	lost to flooding	abandoned pre-term (includes buried)	abandoned post-term/nonviable	outcome unknown	damaged (includes human caused)	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 River Mouth	0	0	0	0	0	0	0	0	0		0	0	0	
San Diego Bay														
Lindbergh Field & Former Naval Training Center	0	0	6	6	2	0	0	4	6	1	5	1	0	
US Navy - NI MAT	0	0	13	3	1	0	0	9	2	1	5	1	0	
US Navy - NIAlt	0	0	2	0	0	0	0	2	0		0	0	0	
Naval Base Coronado - Totals	39	0	152	111	284	37	0	130	91	191	402	10	2	
Delta Beach North	3	0	29	14	56	3	0	25	12	40	60	0	1	includes 1 DH
Delta Beach South	5	0	33	9	58	4	0	24	8	41	64	1	0	includes 1 DH
NAB Ocean	31	0	90	88	170	30	0	81	71	110	278	9	1	includes 5 DH
D Street Fill/Sweetwater Marsh NWR	0	0	27	6	7	0	0	21	6	4	58	1	1	
Chula Vista Wildlife Reserve	0	0	14	2	1	0	0	11	2	1	27	1	0	
South San Diego Bay Unit, SDNWR - Saltworks	0	0	3	0	5	0	0	2	0	5	9	1	0	
Tijuana Estuary NERR – Totals	2	2	37	7	43	1	2	30	7	25	10	5	3	
Tijuana North	0	1	13	4	14	0	1	12	4	8	6	4	2	
Tijuana South	2	1	24	3	29	1	1	18	3	17	4	1	1	
Imperial County														
Salton Sea	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Appendix B-6: Predation in 2016.

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Sacramento Area													
Bufferlands	0	0	0	0	0	0	0	0	0	0	0	0	0
San Francisco Bay Area													
Napa Sonoma Marsh Wildlife Area													
Green Island Unit	Unknown , CATE*, Gulls*, GREG*, CORA*, OSPR*, unidentified raptor*, Corvid*, LOCA*	0	0	Unknown 1P	Unknown 1P	0	0	0	1	1	0	0	0
Pond 7/7A	LOCA, Unknown, GREG*, CORA*, Gulls*, BAEA*, OSPR*, SNEG*, NOHA*, unidentified raptor*, CATE*, GHOW*, PRLO*	0	0	LOCA 4P, Unknown 37P	LOCA 3P, Unknown 19P	0	0	0	41	22	0	0	0
Montezuma													
Site 3/4	NOHA*, GBHE*, SNEG*, Gull*, CATE*, WTKI*	0	0	0	0	0	0	0	0	0	0	0	0
Site 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pittsburg Power Plant	WEME*, NOHA*, CORA*, GREG*, GBHE*, OSPR*, LOSH*, CORA*, LOCA*, PEFA*, RWBL*	0	0	0	0	0	0	0	0	0	0	0	0
Alameda Point	Unknown Avian, PEFA, CORA*, AMKE*, VUVU*, GULLS*, BUOW*, WEGU*, FECA*, GHOW*, CAGU*	PEFA	PEFA	Unknown Avian 3P	Unknown Avian 3P	PEFA 1D, PEFA 1P	PEFA 13D, PEFA 9S, PEFA 3P, unidentified raptor 2P	PEFA 5D	3	3	2	27	5

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Hayward Regional Shoreline	Unknown, CORA*, AMKE*, PEFA*, RTHA*, NOHA*, TUVU*	0	CAGU	CAGU 11D, Unknown 4P	CAGU 6D, Unknown 4P	0	0	0	15	10	0	0	0
Eden Landing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Luis Obispo/ Santa Barbara Counties													
Oceano Dunes SVRA	MERL*, DIVI*, NOHA*, MEME*, CALA*, Owl*, CORA*, GBHE*, RTHA*, AMKE*	0	PEFA	0	PEFA 1D	0	PEFA 1D	0	0	1	0	1	0
Rancho Guadalupe Dunes Preserve	0	0	0	0	0	0	0	0	0	0	0	0	0
Vandenberg AFB-Purisima Pt.	Unknown, GHOW, AMKE*, GULL*, LBCU*, OWL*, WEGU*, CAGU*, LYRU*, NOHA*, RTHA*, LOSH*	0	BAOW, CALA, PEFA	CALA 4D, GHOW 3P, Unknown 1P	CALA 2D, GHOW 2P, Unknown 1P	0	PEFA 1D	BAOW 1D, CALA 1D	8	5	0	1	2
Coal Oil Point Reserve	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventura County													
Santa Clara River/McGrath State Beach	CORA, GULL, Unknown, AMCR*, PEFA	0	CORA, GULL, Unknown avian	CORA 11P, CORA 7D, GULL 3D, Unknown avian 1D, Unknown 24P	CORA 6P, CORA 4D, GULL 2D, Unknown avian 1D, Unknown 14P	0	0	0	46	27	0	0	0
Hollywood Beach	AMCR*, CAFA*, WEGU*, PEFA*, CAFA*	0	Unknown	0	0	0	0	Unknown 1D	0	0	0	0	1
Ormond Beach	AMCR*, GBHE*, CORA*, WEGU*, PRLO*, CAFA*, PEFA*, WEGU *	0	0	0	0	0	0	0	0	0	0	0	0
Pt Mugu													

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Holiday Beach	OTBE*, NOHA*, WEGU*, GREG*, LBCU*, GBHE*, TUVU*, FOTE*, AMKE*, BRPE*, PEFA*	GHOW	GHOW	GHOW 7D	GHOW 4D	0	0	GHOW 7D, GHOW 1S	7	4	0	0	8
Holiday Salt Panne	Unknown	0	0	Unknown 4P	Unknown 2P	0	0	Unknown avian 1P	4	2	0	0	1
Eastern Arm	CORA	0	CORA	CORA 5P, CORA 4D	CORA 3P, CORA 2D	0	0	0	9	5	0	0	0
Ormond Beach East	Unknown avian, Unknown, FOTE*, WEGU*, AMKE*, TUVU*, PEFA*	0	0	Unknown 6P	Unknown 3P	0	0	Unknown avian 1P, Unknown 1P	6	0	0	0	2
Saticoy United Water Conservation District	GBHE*, GREG*, BCNH*, RTHA*, COHA*, WEGU*, AMKE*, GHOW*, AMCR*, CAGU*, LOSH*, PEFA*, CORA*, RWBL*, EUST*, CATE*, HOLA*, Ant*, CAFA*, OTBE*, CALA*	0	0	0	0	0	0	0	0	0	0	0	0
Los Angeles/ Orange Counties													
Venice Beach/Marina del Rey	GBHE*	AMCR	0	AMCR 1S	AMCR 1S	0	0	0	1	0	0	0	0
LA Harbor- Pier 400	CORA, FECA*, RTHA*, AMKE*, AMCR*	0	CORA, WEGU, BUOW, PEFA	CORA 1P, CORA 3D, WEGU 1D, Unknown 17P	CORA 1D, WEGU 1D, Unknown 15P	BUOW 2D, PEFA 1D, Unknown 1P	PEFA 1D	PEFA 1D, Unknown 1P	22	26	4	1	1
Seal Beach NWR - Anaheim Bay	Unknown, CALA*, WEGU*, CORA*, GBHE*, heron sp.*, OWL*	Corvid, ants, Unknown	0	Corvid 1S, Unknown 6P	Corvid 1S, ants 4S, Unknown 3P	ants 5S	0	Unknown 1S	7	8	5	0	1
Bolsa Chica Ecological Reserve													
Nest Site 1 (NS1)	ants*, Gull*	0	0	0	0	0	0	0	0	0	0	0	0

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Nest Site 2 (NS2)	ants , Unknown, PRLO*, GBHE*	0	0	0	ants 1P, Unknown 1P	ants 2P, Unknown 2P	0	0	0	2	4	0	0
Nest Site 3 (NS3)	Corvid, AMKE*, ants*	0	0	Corvid 1P	Corvid 1P	0	0	0	1	1	0	0	0
South Tern Island (STI)	Unidentified raptor*, Gull*, GBHE*	0	0	0	0	0	0	0	0	0	0	0	0
Cell 9	0	0	AMKE	0	AMKE 1D	AMKE 1D	0	0	0	1	1	0	0
Anaheim Lake	0	0	0	0	0	0	0	0	0	0	0	0	0
Burris Sand Pit/Burris Basin	Unknown	0	0	Unknown 6P	Unknown 4P	0	0	0	6	4	0	0	0
Huntington State Beach	CORA*, AMCR*	PEFA	AMKE, PEFA	0	0	AMKE 2D	0	PEFA 1S, PEFA 1D	0	0	2	0	2
Upper Newport Bay Ecological Reserve	BLSK*, AMCR*, GREG*, WEGU*	0	0	0	0	0	0	0	0	0	0	0	0
San Diego County													
MCB Camp Pendleton													
Santa Margarita River - BBN/BBS (combined)	AMCR, CORVID, Gull, Rodent, Unknown, Unknown Avian, GBHE*, CORA *, WEGU *, RATTLESNAKE*, WEGU*, NOHA *	CALA, CORA, HOLA, PEFA, Raptor, Rodent, Unknown Avian	CORA, NOHA, PEFA, Raptor	AMCR 1P, CALA 4S, CORA 1D, CORA 6S, CORVID 1P, Gull 2P, HOLA 1S, Rodent 1P, Rodent 3S, Unknown Avian 5P, Unknown Avian 5S, Unknown 18P	AMCR 1P, CALA 3S, CORA 1D, CORA 4S, CORVID 1P, Gull 1P, HOLA 1S, Rodent 1P, Rodent 2S, Unknown Avian 4P, Unknown Avian 4S, Unknown 13P	Raptor 1S	PEFA 1S, PEFA 3D	Raptor 1S, Raptor 1D, PEFA 4S, PEFA 2D, NOHA 1D	48	37	1	4	9
Santa Margarita River - Saltflats and Island	Unknown, CALA*, CORA*, NOHA* PEFA*	0	0	Unknown 4P	Unknown 3P	0	0	0	4	3	0	0	0

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
White Beach	CALA, Unknown Avian, Unknown, Rattlesnake*, AMKE*, GBHE*, SNEG*, PEFA, RTHA*, PRLO*	CALA, PEFA, Unknown Avian	CORA, PEFA, RODENT	CALA 13P, CALA 7S, CORA 1D, RODENT 1D, Unknown Avian 2P, Unknown Avian 3S, Unknown 14P	CALA 8P, CALA 5S, CORA 1D, RODENT 1D, Unknown Avian 1P, Unknown Avian 2S, Unknown 8P	0	0	PEFA 2S, PEFA 1D	41	26	0	0	3
Red Beach	0	0	CORA	CORA 4D	CORA 3D	0	0	0	4	3	0	0	0
Batiquitos Lagoon Ecological Reserve -													
E1	GREG*, AMCR*, GBHE*, BCNH*	0	RTHA	0	0	RTHA 3D	RTHA 2D	RTHA 2D	0	0	3	2	2
W1	AMCR*, GBHE*, CORA*, GREG*, OTBE*	0	CALA	0	0	CALA 2D	FECA 1D	CALA 1D	0	0	2	1	1
W2	AMCR*, PRLO*, GBHE*, PEFA*, WEGU*, COHA*, OWL*, GREG*, CAFA*, SNEG*, Unidentified raptor*	GULL	Unidentified raptor	GULL 2S	GULL 1S	0	0	Unidentified raptor 1D	2	1	0	0	1
San Elijo Lagoon Ecological Reserve	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fairbanks Ranch	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Dieguito Lagoon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mission Bay													
FAA Island	AMCR, PEFA, GBHE*, WEGU*	CORA	PEFA	AMCR 7P, CORA 31S	AMCR 7P, CORA 20S		PEFA 1D	PEFA 3D, PEFA 1P	38	27	0	1	4
North Fiesta Island	CORA*, AMKE*, Snake*, WEGU*, GHBE*								0	0	0	0	0
Mariner's Point	Corvid, BLSK*	PEFA, Rat		Corvid 14P, Rat 66S	Corvid 11P, Rat 45S			PEFA 1S	80	56	0	0	1

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Stony Point	AMCR, Ant, Pica spp*, PEFA*, AMKE*, WEGU*, CORA*	GBHE		AMCR 3P, GBHE 2S	AMCR 2P, GBHE 1S	Ant 1P			5	3	1	0	0
San Diego River Mouth		AMCR		AMCR 5S	AMCR 5S				5	5	0	0	0
San Diego Bay													
Lindbergh Field & Former Naval Training Center	CORA, AMCR, Ant*, WEGU*, Unknown avian*, Rat*, Gull*, AMKE*, RTHA*, LOSH*, GBHE*, Mouse*, Corvid*, BCNH*	0	ants, PEFA	AMCR 2P, CORA 6P, ants 1D	AMCR 2P, CORA 4P, ants 2D	ants 1D, PEFA 3D	PEFA 1D	0	9	8	4	1	0
US Navy - NI MAT	AMCR*, CORA*, WEGU*, RTHA*	0	0	0	0	0	0	0	0	0	0	0	0
US Navy - NIAlt	CORA*, RTHA*, AMCR*, PEFA*, OTBE*, Unknown mammal*	0	0	0	0	0	0	0	0	0	0	0	0
Naval Base Coronado													
Delta Beach North	COHA*, AMCR*, BCNH*, GREG*	Unknown Avian, Unknown Raptor	GBHE, Unknown Raptor	Unknown Avian 1S	Unknown Avian 1S, Unknown Raptor 1S	GBHE 2D, Unknown Raptor 1S, Unknown Raptor 1D	0	Unknown Avian 1S, Unknown Raptor 1S	1	2	4	0	2
Delta Beach South	AMCR*, COHA*, CORA*, RTHA*, MERL*, Unidentified raptor*, GREG*, PEFA*	GHOW, Unknown Raptor	AMKE, NOHA	0	0	AMKE 1D, GHOW 1S, NOHA 2D	Unknown Raptor 1S	0	0	0	4	1	0
NABON	Unknown, AMCR*, COHA*, Corvid*, CORA*, DIVI*, BCNH*, WEGU*, MERL*, Gull*	Unknown Avian, Unknown Shorebird, Unknown Raptor	GBTE	Unknown 4P, Unknown Avian 1S, Unknown Shorebird 1S	Unknown 2P, Unknown Avian 1S, Unknown Shorebird 1S	GBTE 1D	Unknown Raptor 1S	0	6	4	1	1	0

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
NABOS	Unknown, CORA*, AMCR*, RTHA*, COHA*, PEFA*, Corvid*, WEGU*, Unidentified raptor*	0	AMKE, GBTE,NOHA	Unknown 1P	Unknown 1P	AMKE 2D, GBTE 2D, NOHA 4D	0	NOHA 1D	1	1	8	0	1
D Street Fill/Sweetwater Marsh NWR	PEFA, Unknown avian, AMCR*, CORA*, Canid*, CALA*, Gull*, WEGU*, Rat*, AMKE*, Corvid*, MEME*, GBHE*, RTHA*, MERL*, CAGU*, Owl*, COHA*, GREG*, Unknown mammal*, Ant*, WTKI*	PEFA	PEFA, NOHA	Unknown avian 2P, Unknown 7P	Unknown avian 1P, Unknown 4P, PEFA 1P	PEFA 1P, NOHA 2D, Unknown avian 1P	PEFA 1P	PEFA 3P, PEFA 1S, PEFA 1D	9	6	4	1	5
Chula Vista Wildlife Reserve	GBTE, PEFA, CORA*, AMCR*, COHA*, RTHA*, GBHE*, Unknown avian*, FECA*, Owl*, BAOW*, GREG*, AMKE*, Unknown*, WEGU*, Canid*, Gull*, MERL*, OSPR*, DIVI*	0	ants, GBTE, NOHA	GBTE 1P, Unknown mammal 1P	GBTE 1P, ants 2D, Unknown mammal 1P	ants 4D, GBTE 1D, NOHA 1D	0	PEFA 1P	2	4	6	0	1
South San Diego Bay Unit, SDNWR - Saltworks	GULL*, GBTE*, SEOW*, RTHA*, CALA*, AMCR*, WEGU*, CORA*, NOHA*, AMKE*, OTBE*, PRLO*, PICA*	PEFA	0	PEFA 1S	PEFA 1S	0	0	0	1	1	0	0	0
Tijuana Estuary NERR													
Tijuana North	FECA*, CORA*, DIVI*, CAFA*, AMKE*, OTBE*, WEGU*, Corvid*, GBHE*, RTHA*	NOHA	GBTE, gull, NOHA, PEFA	gull 10D	gull 7D	GBTE 3D, NOHA 1D, NOHA 1S	PEFA 4D	PEFA 1D	10	7	5	4	1

	Predators			Number of Depredations					Total Number Documented				
Site name	**Possible***	**Suspected**	**Documented**	**Eggs****	**Nests**	**Chicks**	**Fledglings**	**Adults**	**Eggs****	**Nests*****	**Chicks**	**Fledglings**	**Adults**
Tijuana South	DIVI, NOHA, PEFA, CORA*, Snake*, RTHA*, CALA*, OTBE*, AMKE*, CAFA*, Raptor*, CORA*, Unknown avian*, Owl*, CORVID*, BCNH*, Heron*, COHA*, Canid*, WEGU*, King Snake*, GWGU*, NOMO*	0	GBTE, DIVI, NOHA, PEFA	NOHA 25P, NOHA 14D, DIVI 2P, DIVI 1D	NOHA 14P, NOHA 7D, DIVI 1P, DIVI 1D, PEFA 1P	GBTE 2D	PEFA 2P, PEFA 1D	0	42	24	2	3	0
Imperial County													
Salton Sea	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix B-6 Legend: P: Possible; S: Suspected; D: Documented

* Observations of predators on site recorded in nesting chronology data.

** Number of eggs determined from both nesting chronology data as well as mortality tab.

*** Only complete nests lost to depredation counted in summary.

Predator Species Codes:

American crow (AMCR), American kestrel (AMKE), Ant, Barn owl (BAOW), Black skimmer (BLSK), Black-bellied plover (BBPL), Black-crowned night-heron (BCNH), Black-tailed jackrabbit (LECA), Bobcat (LYRU), Brown pelican (BRPE), California ground squirrel (OTBE), California gull (CAGU), Canid, Caspian tern (CATE), Common raven (CORA), Cooper's hawk (COHA), Corvid, Coyote (CALA), Domestic cat (FECA), Domestic dog (CAFA), European starling (EUST), Glaucous-winged gull (GWGU), Gopher snake (PICA), Gray fox (URCI), Great blue heron (GBHE), Great egret (GREG), Great horned owl (GHOW), Great-tailed grackle (GTGR), Gull-billed tern (GBTE), Gull, Horned lark (HOLA), Least tern (LETE), Loggerhead shrike (LOSH), Long-billed curlew (LBCU), Merlin (MERL), Mice, Northern harrier (NOHA), Northern mockingbird (NOMO), Opossum (DIVI), Osprey (OSPR), Owl, Peregrine falcon (PEFA), Raccoon (PRLO), Rat, Red fox (VUVU), Red-tailed hawk (RTHA), Red-winged blackbird (RWBL), Ring-billed gull (RBGU), River otter (LOCA), Rodent, Short-eared owl (SEOW), Snake, Snapping turtle (CHSE), Southern Pacific rattlesnake (CROR), Striped skunk (MEME), Unknown, Unknown avian, Unknown mammal, Western gull (WEGU), Western meadowlark (WEME), White-tailed kite (WTKI)

Appendix B-7: Site-specific Summaries and Notes (excerpts taken from 2016 California least tern data reporting spreadsheets unless indicated otherwise).

Site name:	**Summary of breeding season at site:**
Sacramento Area	
Bufferlands	This was the 7th year since 2008 we've had nesting here. There's only been one nest each year on a gravel road between wastewater treatment ponds. This was the earliest nest establishment (23 May 16) and the first detection this year was of two adults and a nest with eggs.
San Francisco Bay Area	
Napa Sonoma Marsh	None
Montezuma	None
Pittsburg Power Plant	In 2016, the Pittsburg Power Plant had 1 LETE nest at the site. The first LETE observed for the season were observed on 16-Jun-16. Based on nesting chronology, the one nest for the season was likely incubating during the surveys on 16-Jun-16 and 30-Jun-16. One chick that was beginning to grow feathers was observed on 14-Jul-16. This chick was not observed during the following survey on 18-Jul-16, nor were any chicks observed for the rest of the season. No cause of mortality was identified, and no carcass was observed during the final season walkthrough that occurred on 10-Aug-16. Our survey methods do not include nest checks, so we do not have any egg data or chick data beyond what we can see using binoculars. The last LETE observed for the season was observed on 18-Jul-16.
Alameda Point	None
Hayward Regional Shoreline	1: Annually (before and after terns arrive) maintain the site by mechanically removing vegetation and adding additional substrate (sand/oyster shell) to the site. Additional 100 meters of straw waddles were placed to help slow the wave erosion along the western side of the island. Starting in 2001, we moved 335,000 pounds of materials onto the island. People of all ages spread out 190 tons of sand, salt, and oyster shells to encourage California least terns to nest on the island. Youths participating in service learning opportunities painted and installed decoys to attract terns to the island. Starting in the spring of 2005, a solar-recharged sound system was installed specifically for attracting California least terns. 2: David Riensche - East Bay Regional Park District Wildlife Biologist, and 4,507 volunteers who have contributed nearly 21,000 hours in support of this stewardship effort (cumulative numbers). A very important component of this stewardship project involves the financial support from the community. More than $100,000 in grant funds and donations were secured for the Tern Island Project from the Regional Parks Foundation, U.S. Fish & Wildlife Service Coastal Program, Fremont Bank Foundation, Alameda Countywide Clean Water Community Stewardship Program, New United Motor anufacturing, Orchard Supply Hardware and Johnston’s & Drake's Bay Oyster Farms.
Eden Landing	Per Cheryl Strong 9-6-16 email: No CLTE nesting on the Refuge nor at Eden Landing this year. Eden Landing has been a site in the past.

Kings County	
Kettleman City Evaporation Ponds	Per Jeff Seay 12-20-16 email: No least terns were seen this year. They have repaired the canal that they used to forage in, and it has water in it sometimes, so I am hoping they come back. Not so far though.
San Luis Obispo/Santa Barbara Counties	
Oceano Dunes SVRA	At Oceano Dunes State Vehicular Recreation Area (ODSVRA) the least tern colony and night roost is located among a larger breeding population of western snowy plovers and the park manages predators for both species. All 49 least tern nests were inside a large seasonally fenced exclosure of type 1 fencing (deters or excludes most people and coyotes) in the southern portion of the vehicle riding area. There were an estimated 47-48 breeding pairs, similar to the 44-49 breeding pairs in 2015, and slightly above the average of 41-44 pairs (range=23-60) from 2005-15. There were 49 known nesting attempts and 46 of 47 nests with known fate hatched, for a hatching rate of 98%. The one nest known to fail, was abandoned (unknown if pre- or post-term). Seventy-eight chicks hatched and 69 were color-banded to individual. Fifty-nine of the 78 chicks (including 3 unbanded chicks) are known to have fledged (seen when 21 days old or older) for a fledging rate of 76% and 1.23-1.26 juveniles fledged per pair. This compares to an average fledging rate of 78% (range=66-91%) and an average 1.21-1.28 juveniles fledged per pair (range=0.95-1.57) during the previous ten years when most chicks were banded to individual. In 2015, 11% (6/56) of color-banded juveniles were documented remaining at ODSVRA for 21 days or longer post-fledging. Over the 10-year period 2007-16, 479 color-banded fledglings were tracked at ODSVRA with 30% remaining 21 days or longer.
Rancho Guadalupe Dunes Preserve	Monitoring days and hours in this report were conducted for snowy plovers. If least terns nest at the site they are monitored concurrently with plovers. Terns did not nest on the site in 2016 and were only seen and or heard traversing the site except for one occasion when 2 terns were on the ground briefly.
Vandenberg AFB-Purisima Pt.	None
Coal Oil Point Reserve	Per Jessica Nielsen 9-2-16 email: We did not have any nesting Least Terns this year, but Least Terns were seen frequently at our site between June 10th and August 16th. There was a pair displaying courtship behavior and making scrapes on June 16 and 17, but they did not end up making a nest.
Ventura County	
Ormond Beach	None
Hollywood Beach	Very few LETE were observed flying over colony area. Some carried fish but no landing or courting behavior observed on this beach. Flyover LETEs probably traveling from foraging areas to other colonies. This beach was very busy with people and dogs most days. One fledgling from another colony was observed passing through on July 31.
Santa Clara River/McGrath State Beach	None

NBVC Point Mugu	While fewer California least tern nests were established at NBVC Point Mugu in 2016 (n = 361) compared to 2015 (n=473), approximately the same number of nests hatched. Between 56-86 fledglings were estimated for 2016, while that number was 116-150 in 2015. However, there was not a high rate of chick mortality observed and, anecdotally, prey availability seemed adequate, therefore the fledgling estimate may be conservative. Several severe high tide and flooding events occurred at NBVC Point Mugu during the 2015-2016 winter. This recontoured sections of the beach and made them more prone to flooding. During the 2016 nesting season, the most damaging high tides occurred just before egg-laying and just after most of the nests hatched. A total of 45 nests were lost to flooding, but had the tides been timed differently, even more damage could have been done. While ravens continue to be an ongoing problem, this year great-horned owls depredated a minimum of eight adult tern in the course of a week in early June. Once the problem owls were removed, predation on adult terns ceased immediately. The Ormond East Beach colony, which has been the largest on the installation in the past, has experienced heavy predation pressure in the past few years and continues to decrease size and productivity, meanwhile the Holiday Beach colony has begun to grow and become more active. California least terns established 38 nests the Eastern Arm colony in 2016. This marks the first time they returned to this beach since a complete nesting failure in 2014 when coyotes consumed 24 of 25 nests. As with the other beaches at NBVC Point Mugu, nests were lost to flooding, but 13 of the 38 ultimately hatched. This beach is very exposed with harsh conditions, so this is considered a reasonably good outcome. The Holiday Beach Salt Panne colony was viewable from a Holiday Beach colony monitoring blind. Fledgling counts recorded for Holiday Beach also include any fledglings observed in the Holiday Beach Salt Panne. Number of monitors/hours spent in the blind were not recorded separately for the Holiday Salt Panne.
Saticoy United Water Conservation District	No LETE were observed during the 2016 surveys.
Los Angeles/Orange Counties	
Venice Beach	None
LA Harbor	None
Seal Beach	None
Bolsa Chica (Overall)	The first sighting of California least tern (CLTE) at Bolsa Chica occurred on 8 April and the last sighting (1 fledgling) occurred on 4 August. The first nest was recorded on 10 May and the last nest was found on 28 June. CLTE nested at five locations on the reserve: Nest Sites 1-3, South Tern Island and Cell 9 which is adjacent to Nest Site 3 (NS3). A total of 142 nests were recorded. The estimated number of breeding pairs was 284. Of the total 142 nests, 106 (43.8%) produced at least one chick. A total of 36 nests failed completely: 18 non-viable; 11 abandoned pre-term; 3 depredated; 2 nests with an unknown fate; 1 failed to hatch and, 1 died hatching. Eggs totaled 245. There were 42 1-egg clutches (29.6%); 97 2-egg clutches (68.3%); and, three 3-egg clutches (2.1%). The total of confirmed hatched eggs was 102 and 81 eggs were presumed to have hatched; thus, a total of 183 (74.7%) eggs hatched. The sum of all dead chicks and pre-fledglings found was 28, leaving 155 as the maximum possible number of surviving chicks. Because fledgling counts were not made consistently at all sub-colonies or reserve-wide, we cannot estimate the number of fledglings at Bolsa Chica for the 2016 season. However, it appeared that two of the five colony sites were largely successful: Nest Site 1 (NS1) and Nest Site 2 (NS2). At each of these two sites, we consistently observed numerous fledglings being provisioned and depredation appeared to be low (details

	below). Although coyote typically target CLTE eggs, this did not occur during 2016. The local coyote population was impacted by the taking of 9 coyote by the City of Huntington Beach. Coincidentally, coyote and signs of coyote were infrequently observed during the breeding season and observations of raccoons and raccoon tracks were more numerous than ever before noted.
Bolsa Chica South Tern Island (STI)	STI is one of two tern nesting islands created in 1977 within Inner Bolsa Bay. CLTE do not nest on North Tern Island (NTI) due to the presence of large terns (Caspian, royal, and elegant) and black skimmers during the summer. CDFW staff and volunteers monitored CLTE nests on STI weekly from 10 May to 21 June. Between 11 May and 6 June, Peter Knapp monitored active nests on STI daily from a vehicle on the levee using a spotting scope and recorded observations related to hatching and adult behavior. Some of these observations were troubling. For example, an adult CLTE pulled a chick out of nest #4 and then attempted to mate with it. Also, two chicks that hatched in nest #5 moved to nearby nest #6 which also had two chicks. Subsequently, we found one dead chick in nest #6. The two chicks that hatched in nest #8 were not attended by the adult. The adult CLTE in nest #9 brooded 4 chicks until the chicks moved out of the scrape. An adult was observed chasing and pecking one of the chicks that had been brooded in/near nest #9. A Total of 31 nests were initiated on STI; 51 eggs were laid and 37 chicks hatched. A total of 9 dead chicks were found on the island, leaving 28 potential survivors. One fledgling was observed on 26 June; this is the only record of a fledgling on the island. This site is vulnerable to depredation by a variety of predators; most commonly red-tailed hawks, owls and Corvids. This season, we found numerous great-blue heron and gull tracks and one raptor feather.
Bolsa Chica Nest Site 1 (NS1)	Each end of NS1 is protected by 6ft high chain-link fencing topped with 2ft of barbed wire. The long sides of this mostly rectangular site are bordered by Inner Bolsa Bay along the west side and by the Bolsa Basin along the east side. Mammals can access the site by wading around the ends of the fence during low tide. CLTE nested on opposite ends of this 4-hectare site. Thus, there was a north NS1 sub-colony and a south NS1 sub-colony. Based on numerous observations of feathered chicks and fledglings, each of these sub-colonies appeared to be largely successful and only one nest was suspected to have been depredated; possibly by a Corvid, though no tracks were found. CDFW staff and volunteers monitored CLTE nests on NS1 weekly from 10 May to 28 June, when all nesting activity had concluded. Subsequently, additional observations of the site were made concurrent with western snowy plover monitoring which was conducted from a vehicle using a spotting scope. A total of 18 nests were initiated on NS1; 22 chicks hatched and an unknown number of chicks survived to fledge. CLTE fledglings were observed on NS1 from 21 June to 4 August. The highest count of fledglings occurred on 31 July when 11 fledglings and 12 adults were counted on the north end. The second highest fledgling count on NS1 occurred on 26 June: 3 fledglings on the north end and 4 fledglings on the south end. Toward the end of the CLTE breeding season, CLTE adults and fledglings roosted on the northernmost section of the road that runs the length of NS1. Daily counts of CLTE on this road were made during late afternoon until 5 August, when no CLTE were present at Bolsa Chica. The CLTE on NS1 likely benefited from the presence of a very large elegant tern colony on the center of the site. Raptors such as peregrine falcon preyed on elegant tern daily and apparently ignored the CLTE. In addition, coyote tracks were not observed on NS1 until the end of the breeding season. Monitoring observations suggested that sand verbena growing on the northern end of NS1 may have benefited CLTE by providing additional chick refuge from predators.
Bolsa Chica Nest Site 2 (NS2)	NS2 is a human-made island located within Cell 42 of the East Muted Tidal Basin. The surface of this nesting site is slightly more than 1 hectare. NS2 is vulnerable to numerous avian predators and coyote and raccoon occasionally swim to it. This season, raccoon tracks were found on and near NS2. CDFW staff and volunteers monitored CLTE nests on NS2 weekly from

	12 May to 28 June, when all nesting activity had concluded. At this site, feathered chicks and pre-fledglings moved to the slopes and lower shoreline to be provisioned by adult CLTE. Thus, once all the nests had hatched, provisioning could be observed from each of two roads that border the wet cell. Between 12 May and 28 June, a total of 87 nests were initiated on NS2. Of the 153 eggs laid, 117 hatched. During monitoring, a total of 16 dead chicks and one dead pre-fledgling were found on the site; leaving 100 potential survivors. The highest fledgling count on NS2 was made on 28 June (n=26).
Bolsa Chica Nest Site 3 (NS3)	NS3 is located inside Cell 14 of the Seasonal Ponds area of the Bolsa Chica Lowlands. This site is completely surrounded by a 6 ft high chain-link fence topped with 2ft of barbed wire and is therefore completely protected from mammalian predators. Avian predators, especially ravens and American kestrels, routinely hunt on NS3. Year after year, this site is so plagued by predators that it rarely produces surviving CLTE and 2016 was no exception. CDFW staff and volunteers monitored CLTE nests on NS3 weekly from 12 May to 23 June, when all nesting activity had concluded. A total of five nests were initiated with 7 eggs and 5 chicks. Nest #1 was depredated (Corvid suspected) and nest #5 had a non-viable egg. One dead chick was found in nest #2. Due to the small colony size and constant threat of predators, we don't think any of the 4 remaining chicks survived.
Bolsa Chica Cell 9	One CLTE pair nested within Cell 9 which is located south of NS3 on the other side of a road that separates Cell 9 and Cell 14 within the Seasonal Ponds area of the Bolsa Chica Lowlands. On 3 June, while monitoring western snowy plover nests in the vicinity, Peter Knapp observed a CLTE incubating a nest. Using a spotting scope from a vehicle, Peter continued to see the nest being incubated daily. On the morning of 20 June, he observed two chicks in the scrape. Within an hour of discovering these hatchlings, he saw an American kestrel fly in and take one of them. Over the following 10 days, the surviving chick was seen being cared for by adult CLTE. This chick was last seen on 30 June.
Huntington State Beach	Biologist car broken into on June 20, data stolen. Individual nest data for Huntington Beach colony was stolen for dates June 1 to June 20. Summary sheets with predator observations, total nests, and total chick counts were kept backed up for these dates. Some individual nest data has been recovered through separate notes and photographs.
Anaheim Lake	None
Burris Basin	None
Upper Newport Bay Ecological Reserve	Nest 8 and Nest 14 may be the same clutch of eggs. The two eggs originally seen in Nest 8 may have been moved/destroyed, as Nest 14 was very close by, did not have a well-defined scrape, and appeared during the same week that the eggs in Nest 8 disappeared. A row of tall vegetation made remote observation of LETE on nests difficult to impossible. Data on pre-term/ full-term abandonment are not available.
San Diego County	
Camp Pendleton	None
Batiquitos Lagoon	None
San Elijo Lagoon	Potential foraging, roosting, and nesting sites of the endangered California least tern and threatened western snowy plover at San Elijo Lagoon Ecological Reserve and Cardiff State Beach were checked up to weekly through 2016, with Lea Squires and Matt Sadowski conducting surveys along the beach under contract with California Department of Parks and Recreation through Avian Research Associates, Robert Patton and Maryanne Bache monitoring potential nesting areas within the lagoon, and coordinating with Jayne Lesley, Steve Brad, and other volunteers along public access trails and beach to conduct monthly bird counts. Least terns were observed in limited numbers again this year. One was observed foraging in the central basin and two in the east basin

	on 9 May, two in the central basin and one in the east basin on 13 June, and five were along the beach and offshore on 11 July. No tern nests were documented this season and no on-ground activity observed on saltpanne east of the east basin dike or in other potential nesting areas. Human footprints, dog tracks, coyote and raccoon tracks were observed in the area, as were raptors and corvids.
San Dieguito Lagoon and Fairbanks Ranch	Per Brian Foster 12-21-16 email: No nesting was detected at either place [San Dieguito and Fairbanks Ranch]. Terns did visit San Dieguito multiple times.
Mission Bay	
FAA Island	Colony failure due to repeated disturbance by PEFA including depredation of adults and fledglings. Egg depredation by corvids followed abandonment of the site in the first wave of nesting. PEFA continued visiting the site throughout the season and was observed on the site feeding on non-tern prey. However, CLT adult a fledgling remains found indicate PEFA depredation of CLTs. The site was abandoned early before other Mission Bay sites (MPT. NFI, SPT).
North Fiesta Island	Observed chicks based on observations of adults due to height of vegetation.
Mariner's Point	Heavy predation by rats at the beginning of nesting was finally controlled, and the season was fairly successful.
Stony Point	Chicks were hard to observe so chick numbers are estimates based on adult feedings.
San Diego River Mouth	8 to 10 least terns attempted to nest [they were flying then landing in the same 5 spots] but were discouraged by presence of AMCRs [walking through the site] and [the terns] left the site.
San Diego Bay	
Lindbergh Field	Prior to the terns' arrival, San Diego County Regional Airport Authority personnel applied herbicide, manually removed vegetation, and contractor Ocean Blue repaired plastic mesh chick barriers and covers over stormdrains. Zoological Society of San Diego subcontract personnel established a 30 m grid system in the primary nesting oval (03-S) and assisted in repairs to chick barriers. Monitoring was conducted April through early August one to three days per week. Predator management was conducted by personnel from USDA Wildlife Services. Least terns were first observed foraging over the bay on 13 April and in flight over the southeast end of Lindbergh Field on 21 April 2016. They were observed each visit after that through 26 July. Breeding pair and nest numbers more than doubled from 2015 to 2016, although they remained significantly lower than those of 2014 and earlier. At least 37 nests were initiated by 31 estimated pairs between 4 May and 20 June. The maximum number of concurrently active nests was 29 on 1 June plus two broods of chicks. Five to six nests appeared to be renesting of pairs that had lost their initial clutches. All nests were established in the main nesting oval 03-S. At least 38 chicks from 25 nests hatched successfully. It is estimated that 15 to 19 chicks reached fledgling age and 10 to 17 young survived to fledge from the site. Five nests with seven eggs were abandoned pre-term, four eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully, and one single egg clutch failed to hatch and was abandoned after prolonged incubation of 41 to 44 days. Nine eggs from seven nests were depredated, one by ants, four suspected by common ravens, and two suspected by American crows or possibly western gulls. The outcomes of two nests were uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. Five chicks and one fledgling were found dead with no apparent cause of death. One chick was depredated by ants and one was found dead being scavenged by ants, but whether they contributed to cause of death was uncertain. Three chicks and one fledgling were observed being depredated by peregrine falcons. Up to 13 to 16 additional chicks

	are suspected to have been depredated, with most suspected to have been taken by peregrine falcon; but American kestrel, crow, gulls, and rats also being observed in the area during the period of losses. Other potential predators observed in the area included great blue heron, black-crowned night-heron, red-tailed hawk, loggerhead shrike, and European starling.
Naval Base Coronado	None
D Street Fill/Sweetwater Marsh NWR	In preparation for the 2016 nesting season at D Street Fill, U.S. Fish and Wildlife Service staff and contractors applied herbicide to invasive plant species; and due to late rains and resulting seedling growth, in late March and again in late April completed mechanical scraping of the site to reduce vegetation and enhance it for use by least terns and snowy plovers. Biological monitors under contract with the Port manually removed non-native invasive plants from the site, pruned back vegetation to reduce cover and potential raptor perches, surveyed the grid system, and placed decoys and ceramic tiles for chick shelters. Predator management was conducted by personnel of US Department of Agriculture, Wildlife Services, and is to be reported separately. Monitoring was conducted from mid-February through early August one to three days per week. Least terns were first observed at the D Street Fill on 11 April 2016. They were observed each visit after that through 26 July. At least 118 nests were initiated by 91 to 106 estimated pairs between 29 April and 11 July. The maximum number of concurrently active nests was 90 on 24 May, and the maximum number of concurrently active nests and broods was 87 nests with four broods of chicks on 27 May. At least 12 nests were suspected to have resulted from renesting by pairs that lost earlier clutches. At least 149 chicks from 89 nests hatched successfully. It is estimated that 21 to 22 chicks reached fledgling age and survived to fledge from the site. Twenty-one nests with 27 eggs were abandoned pre-term, and six eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully. At least five nests with seven eggs were depredated, most suspected to have been taken by northern harrier but one possibly by common raven. The outcome of five nests with seven eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. One adult, one fledgling, and 58 chicks were found with no obvious causes of death. Remains of one adult were found below a perched peregrine falcon, and piles of feathers or parts of an additional five adults, one fledgling, and one chick suggested predation by peregrine. Two chicks were observed being taken by a northern harrier. The carcass of one partially hatched chick was found away from the nest and suspected of having been dropped by a harrier or gull-billed tern. No other definitive evidence of chick depredation was found, but lack of observations, recaptures, fledglings, and attentive adults indicates that others were likely preyed on. The disappearance of up to 63 to 65 chicks coincided with documented depredation and/or daily disturbances to the colony by northern harrier, American kestrel, and peregrine falcon, and visits by common raven. Other potential predator species observed in the area included ant species, great blue heron, great egret, Cooper's hawk, red-tailed hawk, gulls, American crow, European starling, western meadowlark, opossum, rats, California ground squirrel, coyote, feral cat, and striped skunk.
Chula Vista Wildlife Reserve	Prior to early April 2016 and the terns' arrival, Zoological Society of San Diego subcontract personnel coordinated herbicide application, mechanical scraping and dragging of the site, and weeded invasive non-native vegetation, surveyed the grid system, and placed ceramic tiles for chick shelters, decoys, and new signs. Monitoring was conducted from mid-March through mid-August one to three days per week. Predator management was conducted by USDA Wildlife Services staff. Least terns were first observed adjacent to Chula Vista Wildlife Reserve on 16 April and at the Reserve on 21 April 2016. They were seen on each visit through 27 July, and one to two were observed on 2 August. At least 76 nests were initiated by 56 to 63 estimated pairs between 9 May and 12 July with distribution throughout but concentrated in two clusters in the southwestern portion of the site and in the north-central site. The maximum number of concurrently active nests and broods was 54 nests and two broods of chicks on 31 May. At least 13 nests were suspected to have resulted from renesting by pairs that lost earlier clutches. At least 103 chicks from

	63 nests hatched successfully. It is estimated that 16 to 19 chicks reached fledgling age and 15 to 18 young survived to fledge from the site this season. Eleven nests with 14 eggs were abandoned pre-term, and two other eggs were abandoned after the other egg in each clutch hatched successfully. One single-egg nest was depredated with northern harrier suspected responsible, and another was depredated with gull-billed tern suspected responsible. Harriers were also responsible for depredation of previously abandoned eggs. The outcome of one nest was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. One fledgling and 26 chicks were found dead of undetermined causes. Four chicks were apparently depredated by ants; and one was found dead being scavenged by ants, but whether they contributed to cause of death was uncertain. One chick was observed being depredated by a northern harrier. A pellet suspected of being regurgitated by a peregrine falcon was found containing adult least tern feathers and bones; and one adult with wing injuries was suspected of being hit by a peregrine. The band of one depredated chick was recovered in a regurgitated pellet within the South San Diego Bay gull-billed tern colony. No other definitive evidence of chick depredation was found, but lack of observations, recaptures, fledglings, and attentive adults indicates that others were likely preyed on. The disappearance of up to 50 to 53 chicks coincided with repeated hunting of the site by peregrine falcons, and visits by northern harrier, American kestrel, great blue heron, and possibly barn owl. Other potential predator species observed in the area included great egret, osprey, red-tailed hawk, Cooper's hawk, gulls, gull-billed tern, common raven, American crow, opossum, coyote, gray fox, and rats.
South San Diego Bay NWR – Saltworks	Potential nesting sites of the endangered California least tern and western snowy plover were monitored one to three days per week late February through September by Robert Patton, Lea Squires, Matt Sadowski, Kate Goodenough, and Brian Collins. Predator management was conducted by USDA Wildlife Services staff. Least terns were first observed at the saltworks on 16 April 2016. They were observed each visit after that through 1 August, and then a migrant adult and fledgling were seen on 10 August. At least 26 nests were initiated by 19 to 22 pairs between 11 May and 6 July in four concentrations or subcolonies. The maximum number of concurrently active nests was 18 on 3 June, with 19 maximum nests and broods on 6 and 15 June. Four nests appeared to be renesting by pairs that had lost earlier clutches. Eighteen nests were established near the wooden bridge/sluice on the southeast edge of pond 25, east edges of pond 27, west edge of pond 30, and northwest edges of pond 44; three nests were established on dike VII; three nests on mid-dike IV; and two nests were established on the fill in southeast pond 11. At least 32 chicks from 18 nests hatched successfully. Two nests with three eggs were abandoned. One egg was found damaged or depredated, and it was suspected that the adult had been depredated on the nest. The fates of five eggs from five nests were uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. The majority of chicks were not seen beyond the first three days following hatching with predation the most likely limiting factor. Eight are estimated to have reached fledging age and six to seven are estimated to have fledged from the site. Six chicks and one fledglings were found dead with no visible trauma. An additional chick was found dead but the area was covered with both skimmer and coyote tracks. No other definitive evidence of chick depredation was found, but lack of observations, recaptures, fledglings, and attentive adults indicates that the other 16 to 18 chicks were likely preyed on. Their disappearance coincided with regular sightings of peregrine falcons, gull-billed terns, northern harriers, as well as kestrels, gulls, corvids, and coyote tracks. Other predator species observed in the area included red-tailed hawk, Cooper's hawk, gulls, barn owl, common raven, American crow, dog, cat, raccoon, striped skunk, California ground squirrel, and small rodents. Nesting by most tern species in South San Diego Bay was delayed this year and numbers remained lower than usual, likely related both to predator disturbance and to possibly decreased prey fish availability resulting from warmer than usual winter/spring sea surface temps. Elegant terns were an exception in that their numbers increased significantly after initial delays in nesting, but the increase appeared due to the warm-water-related collapse of fisheries in the Gulf of California and relocation of birds from the Mexican colonies to Southern California.

Tijuana Estuary	Potential nesting sites of the endangered California least tern and western snowy plover were monitored one to three days per week from mid-March to late October by Robert Patton, Lea Squires, and Matt Sadowski. Brian Collins of Tijuana Slough NWR and Environment for the Americas interns Katelyn Gomez and Anita Sanchez also monitored. Predator management was conducted by USDA Wildlife Services staff. California least terns were first observed at Tijuana Estuary on 21 April 2016. They were observed each visit after that through 11 August, and then three migrants were seen on 1 September. At least 184 nests were initiated by 104 to 144 pairs between 10 May and 14 July. The maximum number of concurrently active nests and broods was 104 on 2 June. At least 40 nests were likely renests from clutches lost earlier. Nests were distributed in two concentrations or subcolonies. The rivermouth shifted significantly to the south again this season, opening up potential nesting habitat north of the rivermouth but eliminating what had been the largest potential nesting area and historic least tern colony site south of the rivermouth. At least 71 nests were established on upper beach immediately north of the rivermouth but south of the barrier dune. Between the beach parking lot and equestrian access trail at Border Field State Park, 113 nests were established. At least 158 chicks hatched from 93 nests, although evidence of hatching for many simply consisted of eggshell and/or tracks and feces. Most chicks were not seen beyond the first week following hatching with predation the primary limiting factor. This season at Tijuana Estuary, 33 to 41 young were estimated to have fledged from the site.
Tijuana Estuary North	At least 44 to 60 pairs established 71 nests with 110 eggs on the beach north of the Tijuana River this season, most being located just north of the rivermouth and south of the barrier dune. The maximum number of concurrently active nests was 42 plus one brood on 2 June, but the maximum number of concurrently active nests and broods was 44 on 9 June. Eleven to 13 nests appeared to result from renesting. Sixty-eight chicks hatched from 40 nests. Twenty-three chicks reached fledging age and 19 to 23 survived to fledge from the site. Twelve nests with 13 eggs were abandoned pre-term, and three single-egg nests failed to hatch and were abandoned after prolonged incubation. One egg failed to hatch and was abandoned after the other egg in the clutch hatched successfully. The outcomes of nine nests with 14 eggs were undetermined but predation was suspected. At least seven nests with 10 eggs were depredated as gull flocks shifted to roost in the nesting area. Raven tracks and depredation of plover nests and regular hunting by northern harriers suggested that they may be responsible for missing tern nests as well. One adult was found with no visible cause of death, and one freshly hatched chick was found dead in the nest following flooding by high tide overwash. The remains of one adult and four fledglings were found depredated with peregrine falcon tracks. One large chick was observed being depredated by a northern harrier, and mobbing of a harrier and its behavior as it left the nesting area suggested that at least one more was taken. The bands of three chicks were recovered in regurgitated pellets in the gull-billed tern colony in South San Diego Bay. Additional predation of up to 35 to 40 chicks was suspected by each of the above-mentioned species. Loss of other chicks to predation was suspected due to cessation of chick sightings coinciding with continuing observations of regular hunting of the area by northern harriers and gull-billed terns, and by peregrine falcon and American kestrel. Other potential predator species observed in the area were opossum, dog, small rodents, California ground squirrel, great blue heron, black-crowned night-heron, red-tailed hawk, American crow, and western meadowlark.
Tijuana Estuary South	At least 66 to 84 pairs established 113 nests with 191 eggs on the beach south of the Tijuana River this season, north of the beach parking lot near the international border but south of the horse trail. The maximum number of concurrently active nests was 66 on 19 May. Twenty-nine to 39 nests appeared to result from renesting. Fifty-three nests had 90 chicks hatch. Eighteen chicks reached fledging age and 14 to 18 survived to fledge from the site. Eighteen nests with 24 eggs were abandoned pre-term, including one abandoned following ATV activity around it. One two-egg nest was destroyed by Border Patrol ATV activity entering the nesting area. Three eggs failed to hatch and were abandoned after the other egg in each clutch

	hatched successfully, and one nest was abandoned when flooded by high tide. The outcomes of 17 nests with 29 eggs were undetermined but predation was suspected. At least 23 nests with 42 eggs were depredated, including two nests by opossum, seven by northern harrier, and fourteen where harrier was suspected to be responsible. One adult, one fledgling, and three chicks were found dead with no visible trauma. One large chick was found crushed in an equestrian track outside of the nesting area. Monitors had previously noted that harrier and peregrine activity in the dunes and nesting area appeared to be causing adults and broods to shift to the wrackline and unfenced beach. The remains of three fledglings were found depredated and peregrine falcon suspected. The bands of two chicks were recovered in regurgitated pellets in the gull-billed tern colony in South San Diego Bay. Additional predation of up to 62 to 66 chicks was suspected by each of the above-mentioned species due to cessation of chick sightings coinciding with regular hunting of the area by northern harriers and gull-billed terns, American kestrels and by peregrine falcon. Other potential predator species observed in the area were ants, snakes, opossum, dog, small rodents, California ground squirrel, great blue heron, black-crowned night-heron, red-tailed hawk, Cooper's hawk, gulls, American crow, and western meadowlark.
Imperial County	
Salton Sea	Per Guy McCaskie 12-21-16 email: A hatch-year bird near the intersection of Davis and Pound Roads on 13 July 2016 was the only Least Tern seen around the south end of the Salton Sea this year.