THE STATUS OF THE CALIFORNIA LEAST TERN

AT SAN DIEGO UNIFIED PORT DISTRICT PROPERTIES

IN 2018

Prepared under Contract

For

San Diego Unified Port District

By

Robert T. Patton
Consulting Biologist

Final Report
October 2018 (revised June 2019)

SUMMARY

In preparation for the 2018 nesting season at D Street Fill, San Diego Unified Port District (Port) and U.S. Fish and Wildlife Service (USFWS) staff and contractors applied herbicide to invasive plant species; and in late March, USFWS staff completed mechanical grading 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-March through early August one to three days per week.

Least terns were first observed at the D Street Fill on 17 April 2018. They were observed each visit after that through 23 July. At least 109 nests were initiated by 94 to 100 estimated pairs between 8 May and 3 July. The maximum number of concurrently active nests and broods was 93 nests with one brood of chicks on 29 May. At least nine nests were suspected to have resulted from renesting by pairs that lost earlier clutches.

At least 155 chicks from 85 nests hatched successfully. It is estimated that only 12 to 15 chicks reached fledgling age and survived to fledge from the site. Twelve nests with 14 eggs were abandoned pre-term, and eight eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully. Four eggs from two nests died while hatching. At least 10 nests with 13 eggs were depredated by northern harrier, common raven, coyote, and additional abandoned eggs were scavenged by harriers. The outcome of two nests with four eggs were uncertain, but lack of evidence of hatching or chick presence indicates probable depredation.

Forty-five chicks were found dead with no obvious causes of mortality. The carcass of one additional chick was found being scavenged by ants but it was not possible to determine whether the ants had contributed to cause of death or not. A gull-billed tern was observed carrying prey that was suspected to be a tern chick. The band of one chick was recovered in necropsy of a great blue heron at Naval Amphibious Base Delta Beach North. The remains of one depredated chick suggested a harrier as responsible. One large chick/fledgling and two fledglings were observed being taken by a northern harrier. The remains of one additional depredated fledgling suggested harrier as responsible, and depredated remains of another was suspected to be from either harrier or great blue heron. Feathers of one adult suggested possible raptor predation. 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 86 to 90 chicks coincided with documented depredation and/or daily disturbances to the colony by northern harrier and gull-billed tern, and visits by coyote, red-tailed hawk, peregrine falcon, American kestrel, and American crow. Other potential predator species observed in the area included ant species, great blue heron, Cooper's hawk, gulls, common raven, European starling, western meadowlark, opossum, rats, California ground squirrel, feral cat, and striped skunk.

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The California least tern (*Sternula antillarum browni*)(tern) once nested in large, loose colonies on beaches throughout Southern California. Increasing urbanization and habitat loss have led to the decline of its population and shifted much of the nesting to less traditional colony sites such as landfills and airports (California Least Tern Recovery Team 1977). The subspecies has been listed as endangered since 1972 (California Department of Fish and Game 1972, US Bureau of Sport Fisheries and Wildlife 1973). The population in California in 1973 was thought to be as low as 300 nesting pairs; by 2009, the population had grown to an estimated 7130 nesting pairs (Marschalek 2009). The breeding population in 2016 was estimated to be 3989 to 4661 pairs (Frost 2017), and preliminary estimates of 4095 to 5598 pairs in 2017 were reported (CDFW unpublished data).

This report addresses monitoring and management of the least tern colony site at the "D Street Fill" on the eastern shore of San Diego Bay and south of the mouth of the Sweetwater River under contract with the San Diego Unified Port District (Port) during the 2018 breeding season. San Diego International Airport - Lindbergh Field and the Chula Vista Wildlife Reserve are two other nesting sites located on facilities and properties adjacent to San Diego Bay and within jurisdiction of the Port, but monitoring in recent years has been under separate contract through the San Diego County Regional Airport Authority (Figure 1).

Guidelines were established by the U.S. Fish and Wildlife Service (USFWS) through informal consultation conducted for the maintenance of the D Street Fill within the Sweetwater Marsh National Wildlife Refuge Planning Area. Work was conducted under Federal Fish & Wildlife Endangered & Threatened Species Permit number TE-789255, Federal Bird Marking & Salvage Permit number 20047-H, National Wildlife Refuge Special Use Permit, and State of California Department of Fish & Wildlife (CDFW) Memorandum of Understanding (MOU) regarding California least tern and western snowy plover (*Charadrius nivosus nivosus*).

STUDY AREA

Least terns have nested on the sand-shell substrate of dredge spoil at the "D Street Fill",

south of the mouth of the Sweetwater River, along the eastern shore of San Diego Bay, since 1973 (WESTEC 1981). This site is owned and managed jointly by the Port and the USFWS as part of the Sweetwater Marsh National Wildlife Refuge. Colony size and reproductive success have varied widely from year to year depending on the availability of nesting habitat with low vegetation height and density, availability of prey fish, predation and predator presence, and human disturbance. Annual least tern productivity at D Street Fill is summarized in Appendix A. Notable events in the site's history included it being abandoned by nesting terns in 1981 and 1990 (Copper 1981, Obst and Johnston 1992), and the colony being re-established with up to 135 nests in 1992 (Caffrey 1993). At least 41 nests were established at D Street in 1997, but there were significant losses to predation, and only seven nests were established in 1998 (Patton 1998a & 1998b). Nest numbers increased to 36 in 1999, but remained relatively low through 2002 when 24 nests were initiated (Patton 1999, 2000, 2001, 2002). Numbers then increased with 91 nests in 2003 and 111 in 2004. Since 2005, annual nest numbers have ranged from 100 in 2006 to 148 in 2008 and 2014; and annual fledgling production has ranged from nine individuals in 2012 to 36 in 2014 (Patton 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017). Over the past 10 years, annual numbers of fledglings produced per nest have ranged from 0.08 to 0.29 and numbers of fledglings per pair from 0.10 to 0.33.

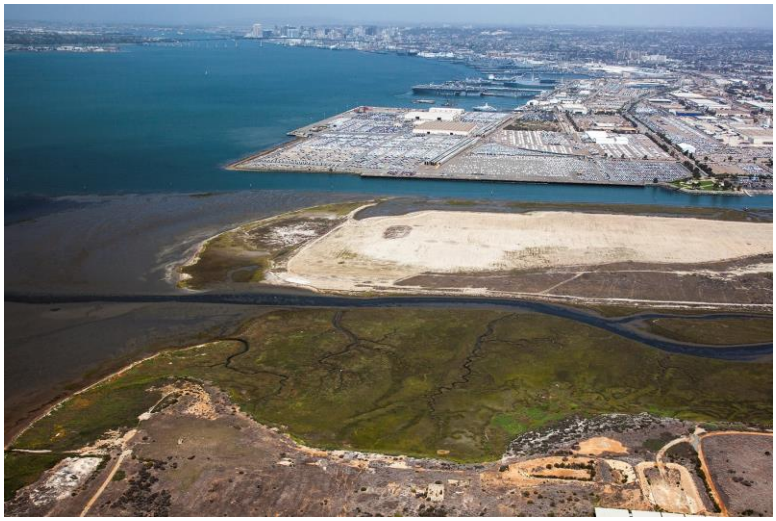
	1980	1981	1982	1983	1984	1988	1989	1990	1991	1992
Nests	12	0	1	1	41	19	2	0	59	135

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Nests	41	7	36	34	32	24	91	111	101	100	130

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Nests	148	132	119	116	114	144	148	123	118	127
Fledglings	17-24	19-29	15-27	25-32	9	23-32	28-36	21-34	21-22	25-27

The site consists of a roughly rectangular peninsula of dredge deposits with relatively even topography, bordered by saltmarsh, mudflats, and San Diego Bay to the west, the historic Sweetwater River channel and saltmarsh to the south, the Sweetwater River flood control channel and saltmarsh to the north, and channels and saltmarsh of Sweetwater and Paradise Marshes to the east. A vehicle bridge and railroad trestle provide access from the north, a second trestle provides access from the south, but chain-link fencing and bollards limit accessibility to the bridges. The area of historic use by terns is further protected by a six-foot-tall chain link fence running north-

south across the eastern end of the site and is closed to unauthorized access. Vegetation is diminished by mechanical scraping, grading, and/or dragging prior to each nesting season and species assemblages altered to resemble coastal strand habitat. Ceramic tiles are laid out at grid intersections of 30 meter squares to assist in nest mapping and provide shade and shelter for chicks.



Aerial view of Sweetwater Marsh, D Street Fill, and Sweetwater River.

METHODS

Site Preparation

The eastern portion of the nesting area (grid rows 18 through 24) was again left heavily furrowed this year. This initially had been intended as erosion control for a component of a wetland mitigation project completed by San Diego Gas and Electric in 2015 to 2016; but then was left in an effort to limit the spread of seeds following discovery of a highly invasive non-native weed, broad-leaved or perennial pepperweed (*Lepidium latifolium*), that had apparently been introduced to the site by equipment involved in the mitigation project. Monitors flagged individuals or patches of *Lepidium*, including within grids 16 and 17 of the prepared nesting area, and contractors, staff of the Port, and staff of the San Diego National Wildlife Refuge Complex applied herbicide. Port and Refuge staff also applied herbicide to invasive non-native iceplant (*Carpobrotus* sp.) scattered around the site, and to recently established stands of Bermuda grass (*Cynodon dactylon*) in the

western portion of the nesting area.

Prior to any site preparation efforts after mid-February, the site was surveyed for the presence, courting or nesting of western snowy plovers, and for nests of other species. In late March, Refuge staff conducted mechanical scraping of the site to reduce vegetation and further enhance it for use by terns and snowy plovers. Additional new growth of vegetation in the nesting area was reduced by manual weeding, most notably mustard (*Brassica*) species. Vegetation around the periphery of the cleared area was pruned back by contract monitors to limit predator perches and cover, most notably *Baccharis* species. Manual weeding also targeted reducing invasive plant species, particularly iceplant, garland chrysanthemum (*Glebionis coronaria*), and Russian thistle (*Salsola* sp.).

Monitors surveyed a 30 m grid system and placed ceramic roofing tiles at each grid intersection to assist in nest mapping and provide shade and shelter for chicks. Existing perimeter signs indicating that the area is an endangered species nesting site were repaired or replaced. Ceramic, plastic, and papier-mache decoys were placed in three groups of 20 each in the central portion of the cleared site and in the western third where the majority of nests have occurred in the past. At least half of each decoy group was arranged to simulate single birds (spaced 1.0 to 2.0 m apart) and the remainder of each decoy group set as pairs of birds (spaced approximately 15.0 cm apart) according to Burger (1988).

Mechanical scraping to reduce vegetation and prepare the site for least tern nesting.

Monitoring

The site was monitored one to three times per week by one to six people for one to four hours. Each visit was supervised by at least one senior monitor with extensive experience in monitoring and managing nesting least terns, snowy plovers, and their young. Weekly monitoring for snowy plovers was conducted at D Street Fill beginning in early March. The site was monitored for terns and plovers for approximately two hours each visit from 15 through 30 April. During the peak season of May through July, monitoring time was increased to four hours per visit to accommodate nest location, marking, and chick banding and recapture. The time of day of the site visits varied, but efforts were made to conduct censuses during the cooler hours of the day (before 1300 or after 1600) to avoid causing heat stress to chicks. Monitoring was rescheduled in cases of precipitation or high winds. Monitoring continued twice per week to early August until the terns departed. Monitoring was discontinued when no least terns had been observed for three consecutive visits. The final monitoring visit for 2018 was on 14 August at D Street Fill.

Monitoring methodology was adapted from that described by Foster, Hyde, and Patton (1982). Monitoring visits typically involved scanning the site from the perimeter with binoculars and/or spotting scope and recording observations in a site log book, on daily site maps, and on daily standardized data forms (Appendix B). Log books, master nest lists, maps, band lists, and specimen/mortality lists were maintained for each site. Log book entries were made for every visit, including the name(s) of the observer(s), the date and the times of the visit, and any significant observations. To minimize disturbance, additional observations were made from within a portable blind used within the colony and along the perimeter. Likewise, observations were made using the vehicle as a blind from along the perimeter road.

Each visit, transects were walked along the grid system to locate and record nests, chicks, or signs of disturbance. Monitors noted presence and location of predators on or in the vicinity of the site. Conditions of nests and decoys were checked, and any abandoned eggs, eggshell fragments, bone, feathers, carcasses, or damaged decoys were collected. If tracks or other signs of predator presence were noted, predator management personnel were notified. Egg abandonment or nonviability was determined by the eggs being present over 40 days or the eggs being cool and unturned with no attending adult observed at or near the nest for at least three consecutive visits.

Nests located at D Street Fill were marked by numbered wooden tongue depressors placed vertically in the sand one to two meters west of each nest. Nest numbers were assigned by order of discovery.

Chick Banding

An attempt was made to band all chicks. Chicks were banded on the right leg with an individually numbered USFWS metal band. Whenever feasible, the chicks were weighed with an Acculab 150 or Ohaus 320 gram electronic scale and a right wing chord measurement taken, both at initial banding and each recapture. One or both of these measurements were at times omitted to save time and reduce disturbance to the colony. The nest number from which the chick originated was noted if known. Band recapture data was used to estimate chick survival and fledging success, and band recovery data was used to quantify mortality and predation. In addition, banding of chicks provides for future recapture and recovery of bands to document longevity, dispersal, and to correlate age and colony of origin with breeding location, effort, success, and other factors.

Banding a least tern chick.

Fledgling Estimation

Estimates of fledgling numbers were derived from a combination of two approaches: the

first being to assume that all chicks recaptured with a wing length of 67 to 84 millimeters (14 to 17 days of age; unpublished data, C. Collins, E. Copper) or greater will fledge; the second, to total the number of fledglings observed every two to three weeks, on the assumption that fledged birds stay approximately two weeks at the colony after fledging (Thompson and Slack 1984, Massey 1989). The resulting range was used to estimate of the number of juvenile terns surviving to fledging age. The number of documented dead or depredated fledglings was then subtracted for the estimate of young surviving to fledge from the site.

Predator Management

Management of avian and mammalian predators was conducted by personnel of the U.S. Department of Agriculture, Wildlife Services (USDA WS) under a separate contract. Predator management activities were reported separately by that agency. Sick or injured birds were taken to Project Wildlife for veterinary treatment and possible rehabilitation and release. Abandoned egg, chick and adult carcass specimens were collected and frozen, pending direction from USFWS for isotope and/or contaminant analysis.

RESULTS AND DISCUSSION

California least terns were observed from 28 March through 23 July 2018 at and adjacent to properties and facilities of the Port. At the three Port and San Diego County Regional Airport Authority sites, 211 nests were established from 8 May to 3 July (Appendix C). At least 32 to 39 tern young are estimated to have fledged from San Diego International Airport - Lindbergh Field, D Street Fill, and Chula Vista Wildlife Reserve.

Breeding Chronology

California least terns were observed at the D Street Fill nesting site from 17 April through 23 July. Approximately 94 to 100 pairs established 109 nests spread throughout the site but with most in the central western portion of the site (Figure 2). Observations of birds late in the season consisted of foraging along adjacent shoreline and loafing on the adjacent mudflats.

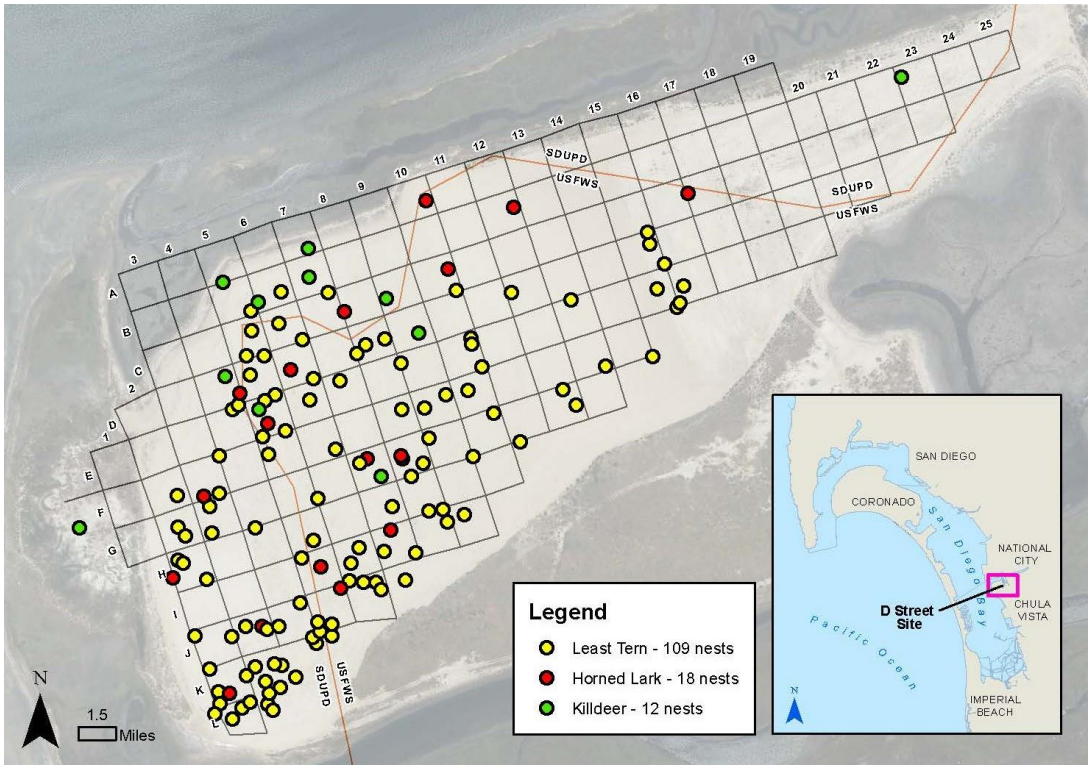
The pair estimation method used for the CDFW breeding pair index for tracking long-term trends is based on the total number of nests established before 15 June plus half the number of nests established 15 June and later. This two-tiered approach is an attempt to standardize pair estimates and by taking into account the possibility of renesting of pairs that had lost earlier clutches as well as young birds breeding for the first time and arriving late from wintering grounds (Massey and Atwood 1981). However, given the lack of productivity in recent seasons, particularly with significant predation around San Diego Bay, the question has been raised as to whether the maximum number of concurrently active nests may be a more accurate measure of the number of breeding pairs. The CDFW method results in a maximum index estimate of 108 breeding pairs this season. However, at least 13 nests were lost prior to 20 June. Timing of these losses and new nest initiations suggests that at least nine nests could have resulted from renesting by pairs that had lost earlier clutches or broods, leading to a maximum number of 100 breeding pairs. The minimum number of breeding pairs was 94, based on the maximum number of concurrently active nests and broods (93 nests and one brood of chicks on 29 May).

Typically, nest initiation occurs in early May (Massey 1974), and this year's first nests were found on 8 May. Figure 3 depicts graphically the chronology of nesting events at the D Street Fill in 2018. The numbers of active nests plotted in Figure 3 were those nests being tended by an adult. The majority of nests (85%) were initiated between 8 and 25 May. Fourteen more nests were then established from 29 May to 12 June, accounting for 98 percent of this season's nests. One more nest was established on 19 June. The remaining nest was found on 10 July but had been previously abandoned and was estimated to have been established by 3 July. The number of active nests plotted in Figure 3 diverged from the number of total nests in mid-May due to the predation of six nests. Divergence between numbers of active and total nests increased in late May through June with hatching of chicks and additional nest abandonments and predation. Breeding activity occurred across a briefer time period than usual this season with active nest numbers dropping rapidly through June to early July with chicks hatching, reduced nest initiation, and losses to nest abandonment and predation.

Nest Distribution

All nesting attempts occurred on the sparsely vegetated, mechanically cleared portion of the

site, with light-colored sand-shell substrate (Figure 2 and Appendix C). Late spring rainfall resulted in significant vegetative cover in portions of the site. The majority of nests were located in the central western half of the site with the densest nesting in the southwest portion of this concentration of nests. Other nests were established radiating from this primary concentration of nests, with a secondary scattering of nests extending to the east. The advantages of group defense and/or adherence and the influence of colony formation/nest-site selection factors on nest distribution patterns within a colony have been previously demonstrated (Coulson 1968, Siegal-Causey and Hunt 1986, Patton and Foster 1984). Gaps in nesting between dense clusters of nests in the western site corresponded with dense cover of invasive Bermuda grass that has increased on the site in recent years.



Least tern nest distribution at D Street Fill in 2018.

This season, 11 nests were established farther east in the site than most nests in past years. Reasons for this expansion in nest distribution are speculative, but likely include vegetation reducing the area available for nesting elsewhere on the site, predator disturbance in the main colony nest cluster, and proximity to the restored tidal channels along the north northeast and east

southeast edges of the site with their increased prey availability. Although most nests each year have been focused in the central western site, terns and plovers regularly nested farther east when the site had significantly more open area and less peripheral vegetation in the 1980s.

Appendix D lists nest numbers and distribution for the site over the past 20 years. Generally each season the site is cleared so that 30 m wide grid rows numbered 1 through 24 are established west to east on the site, although clearing in some years has not extended beyond row 18 (see Figure 2). From 1997 through 2003, no nests were documented east of grid row 12. Three nests were established in rows 13 and 14 in 2004, and one nest was in row 13 in 2005. Since 2006, eight to 20 nests have been established each season in rows 13 through 20. Each year from 1997 through 2015 this area had been cleared of vegetation, except in 2005 when miscommunication resulted in the eastern portion of the site not being cleared. In 2003, a portion of the northeastern fill north of rows 18 through 24 was excavated for saltmarsh and tidal channel restoration. In 2011, prior to the breeding season, a portion of the northwestern fill, grid rows 1 through 10, A through E, was excavated for the L-ditch mitigation project. A portion of the southeastern fill southeast of row 18 was excavated prior to the 2016 season as a component of a San Diego Gas and Electric wetland mitigation project (and the site east of grid row 18 not cleared of vegetation to minimize spreading invasive pepperweed). Terns have been observed foraging in the channels of each of these mitigation areas. No on-ground activity has been observed to date in the southeastern project area, but adults roost with their fledglings on the slope and shoreline of the northwestern project area.

Clutch Size

Ninety-four to 100 estimated pairs of least terns established 109 nests with 198 eggs at the D Street Fill in 2018. The average clutch size was 1.82 eggs per nest with 87 two-egg clutches, 21 single egg clutches, and one three-egg clutch (Table 1). This average clutch size was lower than the 2.15 recorded by Massey in her initial study of least tern breeding biology (1974) but above the 1.63 average recorded at this site over the ten previous years (Appendix C). Reduced average clutch sizes have been noted to indicate locally reduced food availability (Atwood and Kelly 1984).

Hatching Success

Over 78 percent of the eggs at D Street Fill hatched successfully this season, resulting in an

average of 1.42 chicks per nest and 1.82 chicks per nest that experienced hatching (Table 1). This was slightly lower than in 2015 but higher than the last two years and a substantial increase over that of the 2012 season when nest predation and abandonment severely limited hatching success (Patton 2012, 2015, 2016, 2017). Nest abandonment was still the primary known limiting factor to hatching success, with 11 percent of nests abandoned pre-term (12 nests). Eight additional eggs were abandoned after the other egg in each clutch hatched, and four eggs in two nests died while hatching. Ten nests were documented to have been depredated; the outcome of two additional nests was unknown and predation likely, either of eggs or of recently hatched chicks. These undetermined nest outcomes coincided with documented predation of eggs and chicks. Nest abandonments were likely influenced by predator presence and/or possible depredation of one or both adults.

Least tern chick being weighed prior to banding.

Chick Banding

In 2018, 92 chicks from at least 62 nests were banded at D Street Fill. Chicks were banded on the right leg with USFWS metal bands individually numbered 1781-97334 through -97400, 2421-50401 through -50421, and -50424 through -50429.

Fledging Success and Seasonal Production

In 2018, only 12 to 15 chicks are estimated to have reached fledging age and to have survived to fledge from the colony. Productivity was thus 0.11 to 0.13 fledglings per nest, 0.12 to 0.15 per pair. Although low, this was slightly higher than that of 2012 when fledgling success was severely limited by predation and mortality to only nine fledglings (Patton 2012).

Figure 4 depicts daily numbers of hatchings and observed numbers of fledglings. The temporal distribution of hatching reflected the early pulse of nesting and corresponding hatching of 99 percent of the chicks from 29 May to 19 June. This pattern in hatching numbers is in turn reflected in the numbers of fledglings three weeks later. However, the contrast between the two curves is notable, with daily numbers of observed fledglings reduced from earlier hatching numbers due to mortality and predation limiting the number of chicks reaching fledging age. Fledglings generally remain at the colony site for two weeks after first flying, as reflected in the number of observed fledglings peaking later than three weeks after the peak of hatching. Fledgling numbers dropped as the young gained flight experience and dispersed from the colony with the adults. The late season variations in day-to-day observed numbers of fledglings indicated dispersal to foraging and roosting areas and return visits to the colony site. As noted previously, the breeding season was of shorter duration than usual this year.

Chick recovery for band recapture and growth measurement data was complicated at times by vegetative cover conditions, weather fluctuations, and predator presence. Fledgling survival estimates were complicated by fledgling mobility, the inability to collect recapture data to identify individuals, their tendency to shift to roost and forage along the shoreline of the bay, and possibly by the arrival of fledglings from other colonies. However, the consistency of twice-weekly counts of numbers of chicks observed, recaptures, and fledglings, with the corresponding observations of predator presence, depredation, and recovery of carcasses, supports the accuracy of this season's fledgling estimate.

Mortality

Eleven percent of nests (12 nests) with 14 eggs were abandoned after one to 28 days of incubation (Table 2). Eggs of eight additional two-egg clutches failed to hatch and were abandoned after the other in each clutch hatched, and another four eggs in two clutches died hatching. Chick

mortality was higher than usual this season with 46 chicks found dead of undetermined causes (30 percent of those hatched). This included the carcass of one chick found being scavenged by ants but it was not possible to determine whether they had contributed to cause of death or not.

	Hatched	Abandoned Pre-term	Abandoned Post-term (Failed to Hatch)	Died Hatching	Uncertain Outcome	Predation	Non-predation Mortality
Nests	85	12	8	2	2	10	
Eggs	155	14	8	4	4	13	
Chicks						3-5	46
Fledglings						4	0
Adults						0-1	0

The majority of chick mortality and nest abandonment occurred through June and early July when depredation and daily disturbances to the colony by predators were documented. Some nest abandonment and chick mortality were possibly related to depredation of one or both adults. The high number of chick deaths also coincided with high mortality rates reported at other colonies (M. Post, B. Bonesteel, pers. comm.), and with examples of delayed chick growth (R.P., unpubl. data). Such mortality may be related to localized decreases in prey fish availability during this critical period of the season, possibly due to shifting currents or sea surface temperatures. However, without regular sampling of the appropriate size fish, such conclusions as to fluctuations in prey availability are only speculative.

Least tern chick having wing measured for growth data.

Predation

Ten nests with 13 eggs were documented to have been depredated this season (Tables 1 and 2). This included three nests found depredated with coyote tracks (*Canis latrans*), three suspected of having been depredated by common raven (*Corvus corax*), two depredated by northern harrier (*Circus cyaneus*), and two by undetermined predator species. Additional previously abandoned eggs were also scavenged by harriers. The outcomes of two other nests with four eggs were uncertain, but lack of evidence of hatching or chick presence indicated probable depredation. The presence of a well-lined nest scrape without eggs also raised the possibility of eggs having been depredated before monitors had documented the nest.

The carcass of one chick was found being scavenged by ants but it was not possible to determine whether they had caused its mortality or not. A gull-billed tern (*Gelochelidon nilotica*) was observed carrying prey that was suspected to be a tern chick. The band of one chick from D Street was recovered in necropsy of a great blue heron (*Ardea herodias*) that had been lethally removed from Naval Base Coronado Delta Beach North after being observed depredating chicks (M. Post, pers. Comm.). One large chick/fledgling and two fledglings were observed being taken by northern harriers. The depredated remains of an additional chick and an additional fledgling suggested harrier as responsible, and depredated remains of another fledgling was suspected to be from either harrier or great blue heron. Feathers of an adult least tern found on site suggested possible raptor predation. Additional chicks were suspected of being taken by each of these species.

	Ants sp.	Coyote	Great Blue Heron	Heron or Harrier	Northern Harrier	Raptor Species	Gull-billed Tern	Common Raven	Uknown Species
Nests		3			2			3	2
Eggs		4			3			3	3
Chicks	0-1		1		2		0-1		
Fledglings				1	3				
Adults						0-1			

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 86 to 90 chicks coincided with documented depredation and/or daily disturbances to the colony by northern harrier and gull-billed tern, and visits by coyote, red-tailed

hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), peregrine falcon (*Falco peregrinus*), and American crow (*Corvus brachyrhynchos*). Other potential predator species observed in the area included ant species, great blue heron, Cooper's hawk (*Accipiter cooperii*), gull species (*Larus* spp.), common raven, European starling (*Sturnus vulgaris*), western meadowlark (*Sturnella neglecta*), opossum (*Didelphis virginiana*), rats (*Rattus* spp.), California ground squirrel (*Spermophilus beecheyi*), feral cat (*Felis catus*), and striped skunk (*Mephitis mephitis*).

Snowy Plovers and Other Species

The number of snowy plovers and frequency of sightings were reduced this year from previous years. Ten were observed pre-season in January and two were observed post-season in July foraging on mudflats west of the nesting site during ebbing to low tide. None were observed during the peak of nesting season from late March through early July, none were observed within potential nesting habitat, and no nests were found. Site suitability for nesting by snowy plovers had decreased due to encroaching saltmarsh vegetation and its increasing density where mudflats used to exist adjacent to the southwest and northwest fill so that plovers and young no longer have access between foraging and nesting habitats. The last documented nesting attempt by snowy plovers at D Street Fill was in 2000. The excavation of the northwest edge of the site to an unvegetated gentler slope adjacent to mudflats in 2011 increased the potential for plover use of the site and for nesting to be re-established. However, saltmarsh vegetation has filled in along this shoreline as well.

Despite this, continued observations of snowy plovers this season reinforce the importance of Sweetwater Marsh bayfront tidal flats to the species. Color-banded plovers observed roosting at high tide along ocean-facing beaches of Naval Amphibious Base Coronado have been observed to spread out along the beach as tide ebbs, then cross the bay to forage as mudflats adjacent to the mouth of the Sweetwater River are exposed during receding low tide (unpubl. data, E. Copper and US Navy).

No attempt was made to document all nests or all species nesting at D Street Fill. However, nests encountered during monitoring for terns and snowy plovers were marked, mapped, and contents recorded (Figure 2). Killdeer (*Charadrius vociferus*) established at least 11 nests within the interior and on the northwest slope of the site. Horned larks (*Eremophila alpestris*) appeared to

nest throughout the site, and at least 17 nests were found within the tern colony. Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) and western meadowlarks were present and singing throughout the season, indicating probable nesting of both species adjacent to the prepared colony site. Other sensitive species observed on-site this season included San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), and two low-growing coastal strand plant species considered endangered by the California Native Plant Society (CNPS): coast wooly-heads (*Nemacaulis denudata*) and Nuttall's lotus (*Lotus nuttallianus = Acmispon prostratus*).

Least tern adult feeding fish to fledgling. Photo by Matt Sadowski.

MANAGEMENT RECOMMENDATIONS

Site preparation, monitoring, and predator management efforts should continue as implemented in 1997 and modified each season since. Marking of permanent grid intersections with rebar or PVC would reduce site preparation time and cost. The use of a portable tower blind may enhance chick counting and recapture efforts. The use of color bands to identify least tern chicks by natal colony would enhance fledgling estimates and provide long-term data and insight on colony dynamics and recruitment.

Mechanical scraping of the site should continue and be planned for mid-February each season to precede potential snowy plover nest-site selection, with additional vegetation control done by early April if no plovers are nesting. If plovers are not present on-site in February, mechanical scraping should be delayed until late March to ensure clearing of seedlings following any late rains. Efforts should be made to secure appropriate staff, equipment, and budget prior to each season to ensure adequate site preparation. This would include experienced operator(s) communicating with monitors, agency, and Wildlife Services personnel, and access to a road grader or a four-wheel-drive tractor with Gannon box or equivalent box scraper. Additional mechanical scraping to reduce vegetation in the off-season has been recommended previously and should continue to be considered as an option.

A focused effort of multiple herbicide treatments in the off-season is needed to reduce the increasing cover of Bermuda grass in the western portion of the site. Continued monitoring and herbicide treatment of perennial pepperweed will be necessary, although the dramatic reduction this season suggests that eradication may be near. Additional herbicide treatment and physical clearing of vegetation in the eastern portion of the site will be needed once pepperweed eradication has been confirmed. The possibility of herbicide application should continue to be considered, particularly in light of the shift in abundance and distribution of mustard throughout the site in recent years. Non-native and peripheral scrub vegetation should continue to be removed to reduce encroachment of these species on the site as well as to reduce potential predator perches. Efforts in recent years have been successful in reducing non-native invasive plant species, including iceplant, mustard, sea-rocket (*Cakile maritima*), cocklebur (*Xanthium spinosum*), pampas grass (*Cortaderia* sp.), garland chrysanthemum, sweet fennel (*Foeniculum vulgare*), Russian thistle (*Salsola tragus*), Brazilian pepper tree (*Schinus terebinthifolius*), tamarisk and *Acacia* sp.. Coordination is needed in removal of any piles of vegetation or soil generated. Previous seasons, piles of manually removed iceplant had been deposited and left within the nesting site, creating small hummocks used by raptors and corvids, and creating the potential for the site-clearing equipment to spread the iceplant into the nesting area.

If snowy plover nesting is to be re-established, the access points between upland nesting habitat and tidal flat foraging habitat would need to be maintained and expanded. Encroachment of vegetation along the fill periphery and increasing density of saltmarsh vegetation between the fill

and western tidal mudflats appears to have formed enough of a barrier to plover chicks that site-selecting adults have abandoned D Street as a nesting site. Non-vegetated pathways at least three to eight meters wide would need to be cleared through the saltmarsh to make the site again suitable for use by snowy plovers. However, current regulatory processes appear to not recognize the importance of non-vegetated tidal mudflat habitat for shorebirds and to prevent maintenance or creation of such pathways without mitigation for saltmarsh.

The signs installed in past seasons and replaced in recent years may have reduced human intrusion into nesting areas. Interpretive/informational signs or kiosks at entrances or adjacent focal points of public activity, recreation, viewing, or access would lessen the need for confrontation or law enforcement, lessen the likelihood of impacts such as colony disturbance, chick and egg losses, and increase public awareness, cooperation, understanding, and support. To limit use by perching raptors, all signs should be topped with anti-perching hardware such as Nixalite.

The level of predation each season, despite the prompt response by USDA WS staff to perceived predation problems or threats, illustrates the difficulty in management of endangered species on the periphery of urbanized areas. The difficulty in dealing with evasive predators justifies continued reliance on the experienced staff of USDA WS for predator management. In light of the continued decline in the local snowy plover population, proactive monitoring of potential predator species should begin at least by 1 March if not 1 February, and precautionary trapping efforts maintained at all sites throughout the season. The administrative difficulties experienced by USDA WS personnel in recent seasons in attempting to obtain permission to live-trap and relocate harriers and peregrines need to be addressed and protocol established before each season. Likewise, the ability to hold trapped raptors until late in the season to limit continued impacts if/when they return following release should be reinstated. The recent requirements to release raptors within 72 hours of trapping has been shown to have limited effectiveness in reducing predation and limited success in improving raptor health or survivability (USDA WS data; B. Shemai USMC data).

The populations of scavengers and potential predators such as corvids and gulls have increased dramatically in Southern California in recent years. An aggressive policy of corvid removal and deterrence to gull nesting should be incorporated at each site. Daily disturbance to gulls loitering at sites may be necessary, and if that is not sufficient, removal of nesting individuals

and their eggs may be warranted. Control of other mammalian and avian predators should continue, and permits, personnel, and equipment secured for at least early March through September.

ACKNOWLEDGEMENTS

In addition to the author, field work was conducted by subcontract biologists Monica Alfaro, Jennifer Jackson, Thomas Myers, Matt Sadowski, and Lea Squires, Janne Torres of Environment for the Americas, and Brian Collins and Edward Owens of the U.S. Fish & Wildlife Service. Shauna Wolf completed computer data entry. Eileen Maher, Timothy Barrett, Brent Eastty, and Joely Habib of the San Diego Unified Port District administered the contract and were responsible for coordination of the project. Timothy Barrett and Tom Ortiz of San Diego Unified Port District completed GIS data entry and produced maps. Staff of the San Diego National Wildlife Refuge Complex completed pre-season mechanical scraping of the site. David Hunt, Mark Stahl, and personnel from U.S. Department of Agriculture Wildlife Services provided predator management and monitoring. Appreciation goes out to the personnel of the San Diego Unified Port District, and U.S. Fish & Wildlife Service San Diego National Wildlife Refuge Complex for access, site preparation and maintenance, and their assistance and cooperation.

LITERATURE CITED

Atwood, J.L., and P.R. Kelly. 1984. Fish dropped on breeding colonies as indicators of least tern food habits. Wilson Bull. 96:34-47.

Burger, J. 1988. Social attraction in nesting least terns: effects of numbers, spacing, and pairbonds. Condor 90:575-582.

Caffrey, C. 1993. California least tern breeding survey, 1992 season. CA Dep. Fish & Game, Wildl. Manag. Div., Nongame Bird & Mammal Section Rep. 93-11, Sacramento, CA. 35 pp.

_____. 1994. California least tern breeding survey, 1993 season. CA Dep. Fish & Game, Wildl. Manag. Div., Nongame Bird & Mammal Section Rep. 94-07, Sacramento, CA. 39 pp.

_____. 1995. California least tern breeding survey, 1994 season. CA Dep. Fish & Game, Wildl. Manag. Div., Bird & Mammal Conservation Program Rep. 94-3, Sacramento, CA. 49 pp.

_____. 1998. California least tern breeding survey, 1996 season. CA Dep. Fish & Game, Wildl. Manag. Div., Bird & Mammal Conservation Program Rep. 98-2, Sacramento, CA. 57 pp.

California Department of Fish and Game. 1972. At the crossroads: a report on California's endangered and rare fish and wildlife. 99 pp.

California Least Tern Recovery Team. 1977. California least tern recovery plan. Unpublished draft.

Copper, E. 1980. Least tern breeding season in San Diego County, 1980. Unpublished report.

_____. 1981. Least tern breeding season in San Diego County, 1981. Unpublished report.

_____. 1987. Final report on least tern nesting in San Diego County, 1987. Unpublished report.

_____. and R. Patton. 1985. California least tern nesting, San Diego County, 1985. Unpublished report.

Coulson, J.C. 1968. Differences in the quality of birds nesting in the centre and on the edges of a colony. Nature 217:478-479.

Foster, B., K.M. Hyde, and R. Patton. 1982. 1982 observation and management of the California Least Tern site, Naval Air Station, North Island, San Diego, CA. Unpublished report.

Frost, N. 2017. California least tern breeding survey, 2016 season. CA Dep. Fish & Wildlife, Wildl. Branch, Nongame Wildl. Program Rep., 2017-03. Sacramento, CA. 20 pp. + app.

Marschalek, D.A. 2009. California least tern breeding survey, 2009 season. CA Dep. Fish & Game, Wildl. Branch, Nongame Wildl. Program Rep., 2009-02. Sacramento, CA. 23 pp. + app.

Massey, B.W. 1974. Breeding biology of the California least tern. Proc. Linnaean Soc. N.Y. 72:1-24.

_____. 1989. California least tern fledgling study, Venice, California, 1989. CA Dep. Fish & Game, Wildl. Manag. Div., Nongame Bird & Mammal Section Rep. (1989), Sacramento, CA. 8 pp.

_____. and J.L. Atwood. 1981. Second-wave nesting of the California least tern: age composition and reproductive success. Auk 98:596-605.

Obst, B.S. and S.M. Johnston. 1992. California least tern breeding survey, 1990 season. CA Dep. Fish & Game, Wildl. Manag. Div., Nongame Bird & Mammal Section Rep. 92-05, Sacramento, CA. 13 pp.

Patton, R. 1998a. The status of the California least tern at San Diego Unified Port District properties in 1997. Unpublished report.

_____. 1998b. The status of the California least tern at San Diego Unified Port District properties in 1998. Unpublished report.

_____. 1999. The status of the California least tern at San Diego Unified Port District properties in 1999. Unpublished report.

_____. 2000. The status of the California least tern at San Diego Unified Port District properties in 2000. Unpublished report.

_____. 2001. The status of the California least tern at San Diego Unified Port District properties in 2001. Unpublished report.

_____. 2002. The status of the California least tern at San Diego Unified Port District properties in 2002. Unpublished report.

_____. 2003. The status of the California least tern at San Diego Unified Port District properties in 2003. Unpublished report.

_____. 2004. The status of the California least tern at properties of the San Diego Unified Port District and San Diego County Regional Airport Authority in 2004. Unpublished report.

_____. 2005. The status of the California least tern at San Diego Unified Port District properties in 2005. Unpublished report.

_____. 2006. The status of the California least tern at San Diego Unified Port District properties in

2006. Unpublished report.

_____. 2007. The status of the California least tern at San Diego Unified Port District properties in 2007. Unpublished report.

_____. 2008. The status of the California least tern at San Diego Unified Port District properties in 2008. Unpublished report.

_____. 2009. The status of the California least tern at San Diego Unified Port District properties in 2009. Unpublished report.

_____. 2010. The status of the California least tern at San Diego Unified Port District properties in 2010. Unpublished report.

_____. 2011. The status of the California least tern at San Diego Unified Port District properties in 2011. Unpublished report.

_____. 2012. The status of the California least tern at San Diego Unified Port District properties in 2012. Unpublished report.

_____. 2013. The status of the California least tern at San Diego Unified Port District properties in 2013. Unpublished report.

_____. 2014. The status of the California least tern at San Diego Unified Port District properties in 2014. Unpublished report.

_____. 2014. The status of the California least tern at San Diego Unified Port District properties in 2014. Unpublished report.

_____. 2015. The status of the California least tern at San Diego Unified Port District properties in 2015. Unpublished report.

_____. 2016. The status of the California least tern at San Diego Unified Port District properties in 2016. Unpublished report.

_____. 2017. The status of the California least tern at San Diego Unified Port District properties in 2017. Unpublished report.

_____. and B. Foster. 1984. 1984 observation and management of the California least tern site, Naval Air Station, North Island, San Diego, Ca. Unpublished report.

Siegel-Causey, D. and G.L. Hunt, Jr. 1986. Breeding site selection and colony formation in double-crested and pelagic cormorants. Auk 103:230-234.

Thompson, B.C., and R.D. Slack. 1984. Post-fledging departure from colonies by juvenile least

terns in Texas: implications for estimating production. Wilson Bull. 96:309-313.

U.S. Bureau of Sport Fisheries and Wildlife. 1973. Threatened wildlife of the United States. Resource Publ. 114. 289 pp.

WESTEC Services, Inc. 1981. Biological report on the California least tern (*Sterna albifrons brownii*) at Naval Air Station, North Island. Unpublished report.

TABLES

Table 1. Least tern nest and egg data, D Street Fill, 2018.

	nests*	eggs
Total	109	198
1 egg clutch	21	21
2 eggs	87	174
3 eggs	1	3
Known Hatch		
Total	85*	155
1 egg	6	6
2 eggs	78*	146
3 eggs	1	3
Uncertain Outcome		
Total	2	4
2 eggs	2	4
Failed to Hatch		
Total	33*	39
1 egg	15	15
2 eggs	18*	24
Depredated		
Total	11*	13
1 egg	5	5
2 eggs	6	8
Abandoned (pre-term)		
Total	12	14
1 egg	10	10
2 eggs	2	4
Abandoned post-term/nonviable		
Total	8*	8
2 eggs	8*	8
Died hatching		
Total	2	4
2 eggs	2	4

* inclusion in more than one category: one egg each of eight two-egg clutches was abandoned/failed to hatch after the other hatched; one egg each of two two-egg clutches hatched after predation of the other egg.

Table 2. Documented causes of least tern mortality, D Street Fill, 2018.

Cause	Least Tern Age Class	Total Losses D Street Fill
Total:		
	egg	39
	chick	49-50*
	fledgling	4
	adult	0-1*
Predation*:		
Ant species		
	possible chick	0-1
Coyote		
	egg	4
Great Blue Heron		
	chick	1
Great Blue Heron or Northern Harrier		
	fledgling	1
Northern Harrier		
	egg	3
	chick	2
	fledgling	3
Raptor species		
	suspected adult	0-1
Gull-billed Tern		
	chick	0-1
Common Raven		
	egg	3
Unknown species		
	egg	3
Non-predation Mortality:		
Abandonment (pre-term)		
	egg	14
Unknown		
Abandoned post-term/nonviable		
	egg	8
Died hatching		
	egg	4
No visible trauma		
	chick	46

*daily-observed chick numbers and recapture data indicate additional losses of up to 86-90 chicks, species suspected as responsible for losses include northern harrier and gull-billed tern, with possible losses also to coyote, red-tailed hawk, peregrine falcon, American kestrel, and American crow. 45 chicks were found with no obvious causes of death. The carcass of one additional chick was found being scavenged by ants but it was not possible to determine whether they had contributed to cause of death or not. A gull-billed tern was observed carrying prey that was suspected to be a tern chick. The band of one chick was recovered in necropsy of a great blue heron at Naval Amphibious Base Delta Beach North. The remains of one depredated chick suggested harrier as responsible. One large chick/fledgling and two fledglings were observed being taken by a northern harrier. The remains of one additional depredated fledgling suggested harrier as responsible, and depredated remains of another was suspected to be from either harrier or great blue heron. Feathers of one adult suggested possible predation by a raptor.

FIGURES

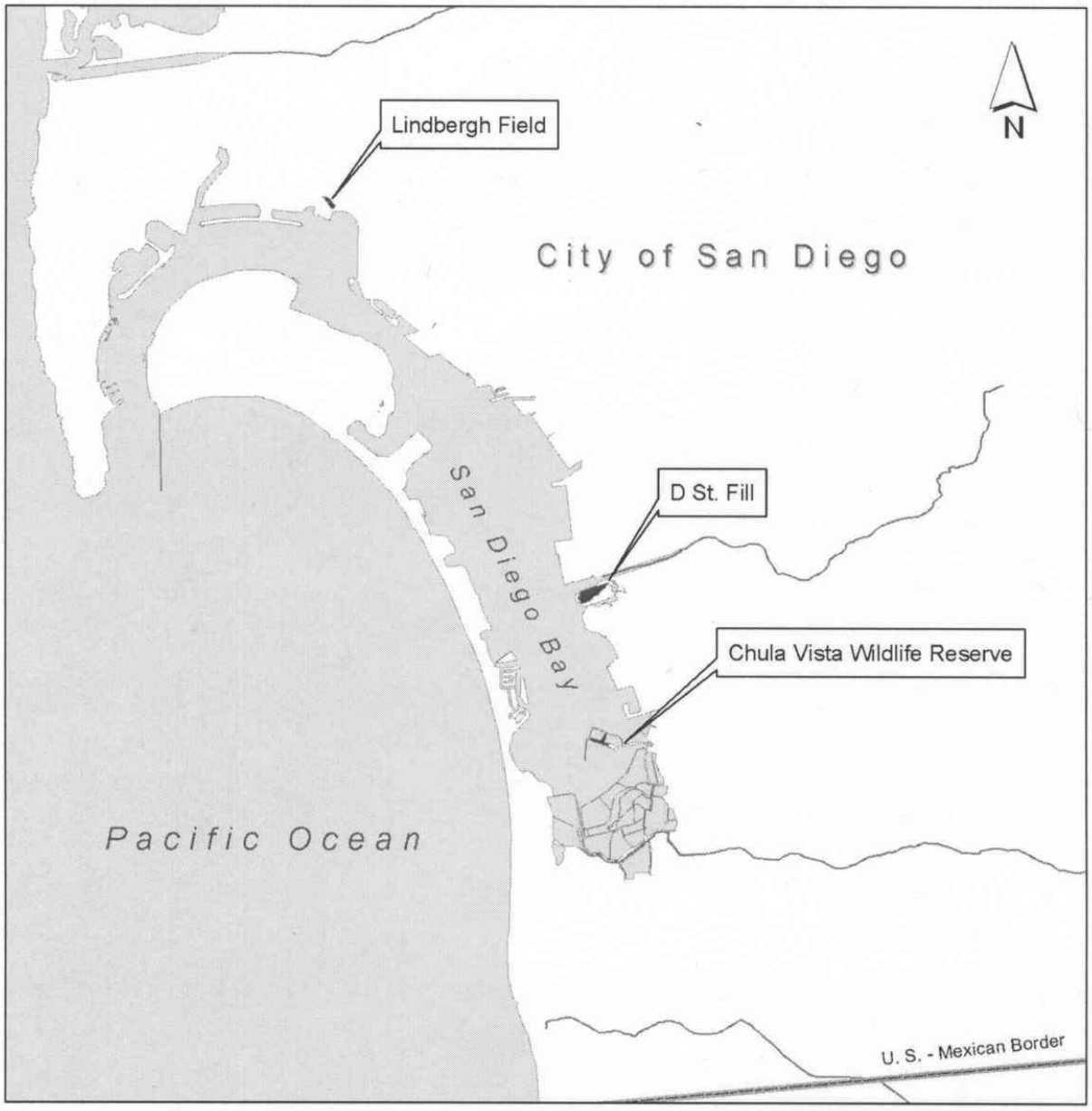


Figure 1. San Diego Unified Port District and San Diego County Regional Airport Authority least tern nesting sites, 2018.

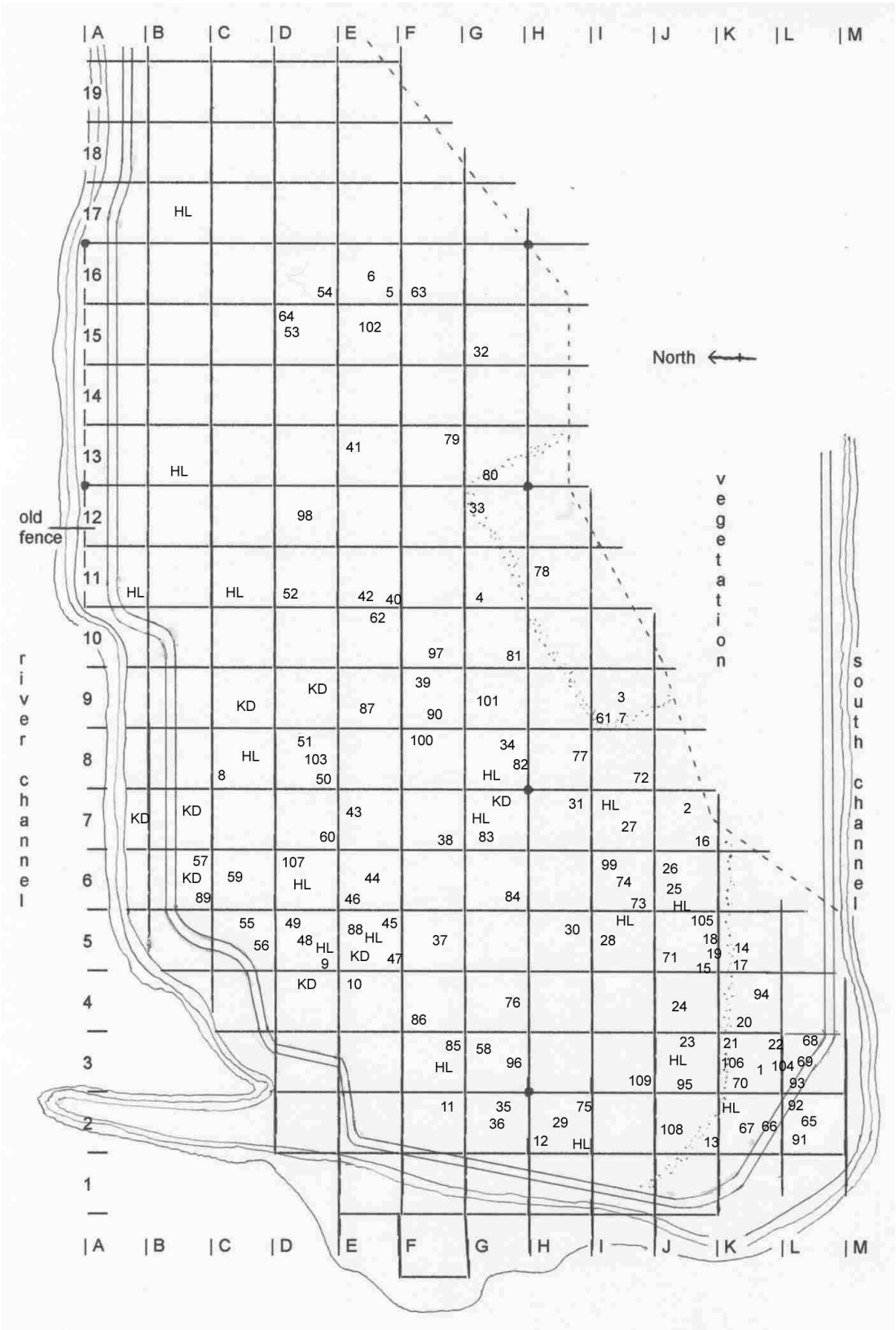


Figure 2. Least tern nest distribution, D Street Fill, 2018.

Figure 3. Least tern breeding chronology, D Street Fill, 2018.

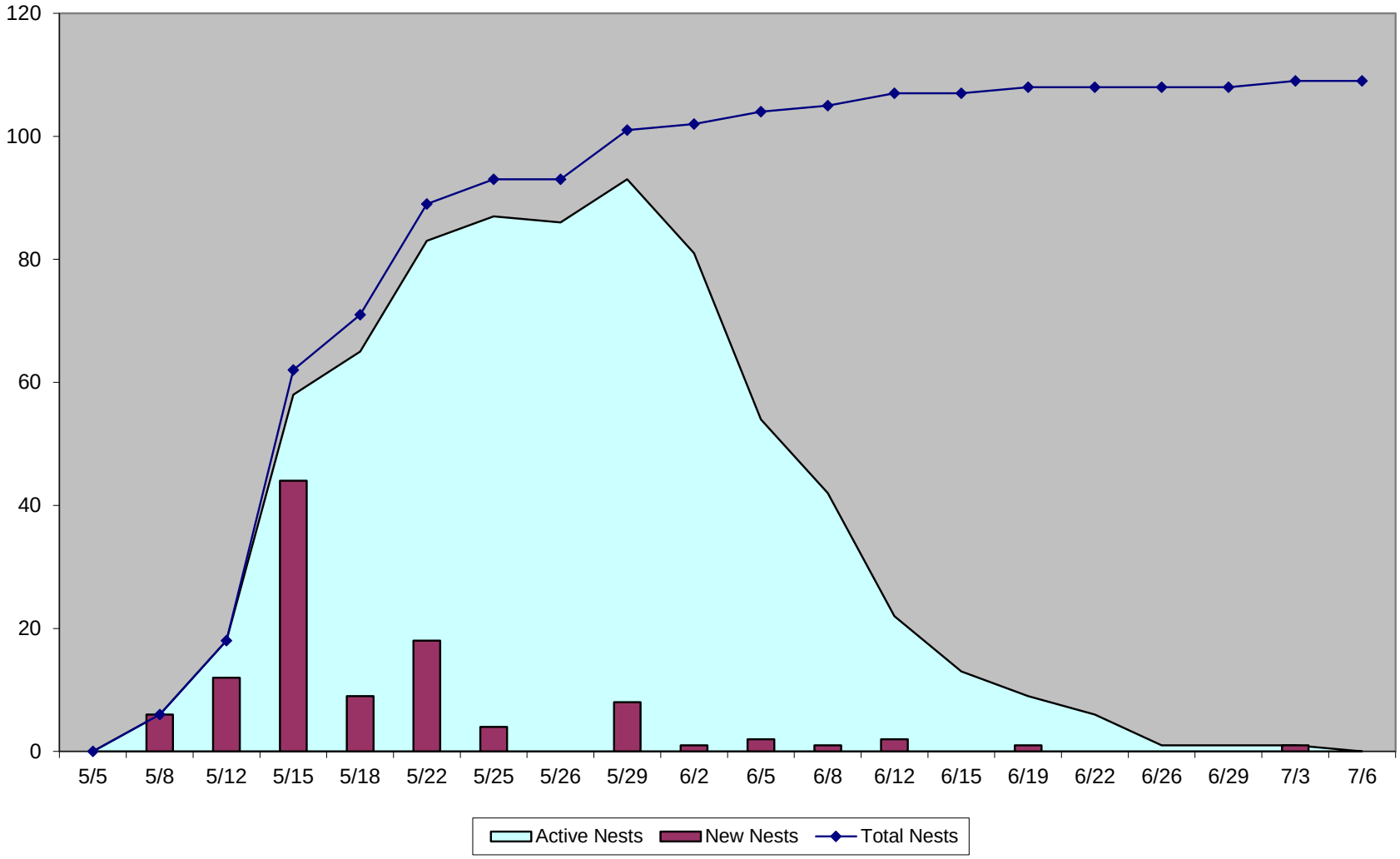
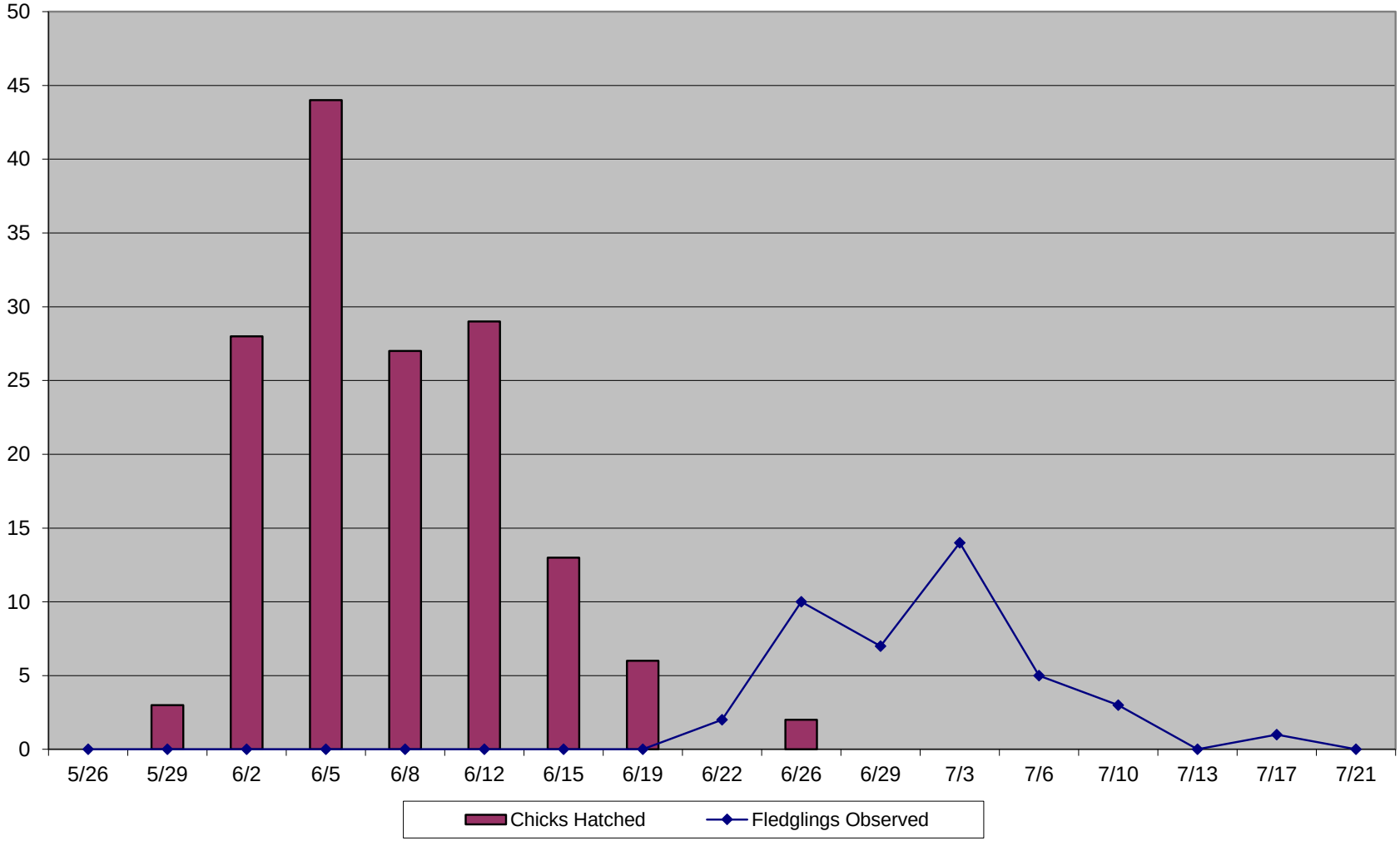


Figure 4. Least tern productivity chronology, D Street Fill, 2018.



APPENDICES

Appendix A. Summary of documented California least tern breeding, D Street Fill and Sweetwater Marsh.

	Estimated Number of Breeding Pairs		Number of	Estimated Number of Fledglings	
Year	Minimum	Maximum	Nests	Minimum	Maximum
1973	4	20	4+	11	11
1974	36	36	36	0	0
1975	10	10	10	0	0
1976	24	24	33	0	0
1977	40	40	40	20	25
1978	47	47	47	15	15
1979	24	28	28	15	20
1980	12	15	15	0	0
1981	0	0	0	0	0
1982	1	1	1	2	2
1983	1	1	1	0	0
1984	16	29	41	15	15
1985	41	47	47	0	0
1986	5	6	10	7	7
1987	28	28	28	10	10
1988	19	19	19	0	0
1989	2	2	2	0	0
1990	0	0	0	0	0
1991	45	47	59	38	42
1992	135	135	135	14	24
1993	23	23	32	1	1
1994	8	8	9	3	3
1995	26	26	27	22	28
1996	25	25	28	15	35
1997	38	38	41	0	0
1998	5	7	7	8	10
1999	30	30	36	2	2
2000	28	31	34	27	30
2001	30	31	32	12	17
2002	23	23	24	8	8
2003	62	85	91	12	19
2004	77	94	111	4	11
2005	77	97	101	9	17
2006	88	94	100	18	29
2007	100	115	130	25	28
2008	133	135	148	17	24
2009	129	129	132	19	29
2010	117	117	119	15	27
2011	100	113	116	25	32
2012	78	93	114	9	9
2013	96	113	144	23	32
2014	125	129	148	28	36
2015	108	111	123	21	34
2016	91	106	118	21	22
2017	93	112	127	25	27
2018	94	100	109	12	15

Appendix B. Sample datasheet.

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

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

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

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

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

Documented Predation/Mortality:

Human Disturbance/Take:

Comment:

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

Appendix C. Summary of the status of the California least tern and western snowy plover at properties of the San Diego Unified Port District and San Diego County Regional Airport Authority in 2018.

Potential nesting sites of the endangered California least tern and western snowy plover were prepared prior to mid-April at Lindbergh Field - San Diego International Airport, D Street Fill, and Chula Vista Wildlife Reserve; and monitored from mid-March through August 2018, by Robert Patton, Elizabeth Copper, Jennifer Jackson, Lea Squires, Thomas Myers, Matt Sadowski, and Monica Alfaro. Janne Torres of Environment for the Americas assisted in monitoring, Mayra Garcia and staff of SDIA Environmental Affairs assisted at Lindbergh Field, and Brian Collins and Edward Owens of Sweetwater Marsh NWR assisted at D Street Fill.

Least terns were observed from 28 March through 23 July 2018 at and adjacent to properties and facilities of the San Diego Unified Port District. At the three Port District and San Diego County Regional Airport Authority sites, 211 nests were established from 8 May to 3 July. At least 32 to 39 young are estimated to have fledged from the sites, with productivity limited primarily by predation but also by unexplained mortality suspected to be related to locally reduced prey availability. Other limiting factors included nest abandonment, most likely related to disturbances from predators.

San Diego International Airport – Lindbergh Field & Former Naval Training Center

Prior to the terns' arrival, San Diego County Regional Airport Authority personnel applied herbicide, manually removed vegetation, and contractor Ocean Blue replaced 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 and manual removal of vegetation. Monitoring was conducted April to 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 and in flight over the southeast end of Lindbergh Field on 19 April 2018. They were observed each visit after that through 19 July, then one again over the bay on 2 August. Breeding pair and nest numbers decreased from those of 2016 and 2017 and remained significantly lower than those of 2014 and earlier, although they were higher than those of 2015. At least 19 nests were initiated by 16 estimated pairs between 8 May and 5 June. The maximum number of concurrently active nests was 16 on 22 May. At least three nests appeared to be renesting of pairs that had lost their initial clutches. All nests were established in the main nesting oval 03-S except for two in oval 04-S.

At least 22 chicks from 13 nests hatched successfully. It is estimated that 13 to 14 chicks reached fledgling age and survived to fledge from the site. Four nests with seven eggs were abandoned pre-term, and one egg failed to hatch and was abandoned after the other egg in the clutch hatched successfully. Two eggs from one nest were depredated, with common ravens or American crows suspected, although western gulls could have possibly been responsible. The outcome of one nest with two eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation either shortly before or shortly after hatching.

Feathers of one depredated adult were found and peregrine falcon or Cooper's hawk were suspected to be responsible. One chick was observed being taken by a Cooper's hawk. A western gull was observed taking what was possibly a chick from the site, and an American kestrel was observed unsuccessfully diving at a large chick. Five chicks were found dead with no visible

external trauma. Additional chicks are suspected to have been depredated, with Cooper's hawk or peregrine falcon suspected as responsible; but American kestrel, crows, gulls, and ants were also observed in the area during the period of losses. Other potential predators observed in the area included rats, great blue heron, raven, European starling, and western meadowlark.

D Street Fill & Sweetwater Marsh NWR

In preparation for the 2018 nesting season at D Street Fill, San Diego Unified Port District and U.S. Fish and Wildlife Service staff and contractors applied herbicide to invasive plant species; and in late March, USFWS staff completed mechanical grading 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 was reported separately. Monitoring was conducted from mid-March through early August one to three days per week.

Least terns were first observed at the D Street Fill on 17 April 2018. They were observed each visit after that through 23 July. At least 109 nests were initiated by 94 to 100 estimated pairs between 8 May and 3 July. The maximum number of concurrently active nests and broods was 93 nests with one brood of chicks on 29 May. At least nine nests were suspected to have resulted from renesting by pairs that lost earlier clutches.

At least 155 chicks from 85 nests hatched successfully. It is estimated that only 12 to 15 chicks reached fledgling age and survived to fledge from the site. Twelve nests with 14 eggs were abandoned pre-term, and eight eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully. Four eggs from two nests died while hatching. At least 10 nests with 13 eggs were depredated by northern harrier, common raven, coyote, and additional abandoned eggs were scavenged by harrier. The outcome of two nests with four eggs were uncertain, but lack of evidence of hatching or chick presence indicates probable depredation.

Forty-five chicks were found dead with no obvious causes of mortality. The carcass of one additional chick was found being scavenged by ants but it was not possible to determine whether they had contributed to cause of death or not. A gull-billed tern was observed carrying prey that was suspected to be a tern chick. The band of one chick was recovered in necropsy of a great blue heron at Naval Amphibious Base Delta Beach North. The remains of one depredated chick suggested harrier as responsible. One large chick/fledgling and two fledglings were observed being taken by a northern harrier. The remains of one additional depredated fledgling suggested harrier as responsible, and depredated remains of another was suspected to be from either harrier or great blue heron. Feathers of one adult suggested possible raptor predation. 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 86 to 90 chicks coincided with documented depredation and/or daily disturbances to the colony by northern harrier and gull-billed tern, and visits by coyote, red-tailed hawk, peregrine falcon, American kestrel, and American crow. Other potential predator species observed in the area included ant species, great blue heron, Cooper's hawk, gulls, common raven, European starling, western meadowlark, opossum, rats, California ground squirrel, feral cat, and striped skunk.

Snowy plovers were recorded only twice at D Street Fill this year with ten foraging on the mudflats west of the site during ebbing tides in January and two in July.

Chula Vista Wildlife Reserve

Prior to early April 2018 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, placed decoys, and repaired or replaced 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.

One least tern was first observed at the Chula Vista Wildlife Reserve on 28 March. They were next seen on 18 April, 24 April, and then on each visit through 17 July, and then one observed on 23 July. At least 83 nests were initiated by 77 to 81 estimated pairs between 12 May and 19 June 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 75 nests and two broods of chicks on 2 June. At least two nests were suspected to have resulted from renesting by pairs that lost earlier clutches.

At least 101 chicks from 59 nests hatched successfully. It is estimated that seven to 10 chicks reached fledgling age and survived to fledge from the site this season. Two eggs from two nests died while hatching. Five eggs were abandoned after the other egg in each clutch hatched successfully. Twenty nests with 28 eggs were abandoned pre-term, including one that was abandoned after the other egg in the nest was depredated and one each from two nests where one was abandoned after unknown outcome of the other egg in the clutch. Two eggs from two nests were depredated by ants and four eggs from four nests were depredated by unknown species. The outcomes of two nests with two eggs were uncertain, but lack of evidence of hatching or chick presence indicates probable depredation.

The carcasses of two chicks were found being scavenged by ants and it is possible that ants had contributed to their deaths. An additional 26 chicks were found dead of undetermined causes and delayed growth was noted in some chicks. Feathers and body parts of one to two depredated adults were found with a barn owl feather nearby. The feather pile of another adult suggested predation by peregrine falcon. Parts of a depredated large chick or fledgling were found with either an owl or peregrine suspected of being responsible. 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 62 to 66 chicks coincided with repeated hunting of the site by peregrine falcons, gull-billed terns, and visits by great blue heron, northern harrier, red-tailed hawk, and barn owl. Other potential predator species observed in the area included great egret, osprey, Cooper’s hawk, American kestrel, gulls, common raven, American crow, opossum, feral cat, striped skunk, and rats.

One to two dispersing snowy plovers were noted roosting at CVWR on each of four dates in July and August this season.

Appendix C. Summary of California least tern breeding at San Diego Unified Port District and San Diego County Regional Airport Authority sites, 2018.

	SDIA-LF	D St Fill	CVWR
Date terns first observed	4/19	4/17	3/28
Date terns last seen	7/19	7/23	7/23
Date of first nest	5/8	5/8	5/12
Date last nest found	6/5	7/10	6/19
Date last nest established	6/5	7/3	6/19
Date of first hatch	5/29	5/29	6/2
Date of last hatch	6/12	6/26	6/22
Date of first fledgling	6/22	6/22	6/26
Estimated number of pairs	16	94-100	77-81
Total number of nests	19	109	83
Total number of eggs	34	198	144
Clutch size:			
1 egg	4	21	23
2 egg	15	87	59
3 egg	0	1	1
4 egg	0	0	0
unknown (min. 1 egg)	0	0	0
Average clutch size	1.79	1.82	1.73
No. of nests hatching young*	13	85	59
Total number of eggs hatched	22	155	101
Estimated number of fledglings	13-14	12-15	7-10
Number of chicks banded	22	92	61
Number of adults banded	0	0	0
Uncertain outcome			
Nests*	1	2	2
Eggs	2	4	2
Documented Mortality			
Preyed upon			
Nests*	1	10	6
Eggs**	2	13	6
Chicks	1	3-5	1-3
Fledglings	0	4	0
Adults	1	0-1	2-3
Human disturbance			
Nests*	0	0	0
Eggs	0	0	0
Chicks	0	0	0
Fledglings	0	0	0
Adults	0	0	0
Other causes			
Nests*			
Abandoned (pre-term)	4	12	20
Failed to hatch (incubated to term)	1	8	5
Died hatching	0	2	2
Damaged (eggshell thinning)	0	0	0
Flooded	0	0	0
Eggs			
Abandoned (pre-term)	7	14	28
Failed to hatch (incubated to term)	1	8	5
Died hatching	0	4	2
Damaged (eggshell thinning)	0	0	0
Flooded	0	0	0
Chicks	5	46	26-28
Fledglings	0	0	0
Adults	0	0	0

* may be included in more than one category

** not including previously abandoned eggs that were depredated/scavenged

Appendix C-1. Summary of California least tern breeding at San Diego International Airport - Lindbergh Field, 2004-2018.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Date terns first observed	4/20	4/21	4/19	4/23	4/22	4/21	4/20	4/19	4/16	4/22	4/15	4/15	4/13	4/16	4/19
Date terns last seen	8/18	8/3 (9/2 bay)	8/30	8/22	8/15	8/11	8/10	8/3	8/7	8/19	7/23	7/14	7/26	7/31 (8/19 bay)	7/19
Date of first nest	5/11	5/4	5/15	5/15	5/16	5/10	5/4	5/10	5/8	5/13	5/6	5/9	5/4	5/5	5/8
Date last nest found	7/6	7/5	8/1	7/11	7/18	8/11	7/20	7/19	7/3	8/6	6/17	6/6	6/20	6/8	6/5
Date last nest established	7/6	7/5	7/18	7/11	7/18	7/2	7/2	6/24	7/3	7/16?	6/17	6/3	6/20	6/8	6/5
Date of first hatch	6/1	5/31	6/13	6/10	6/6	6/2	6/2	5/31	5/31	6/7	5/29	6/2	5/26	5/30	5/29
Date of last hatch	7/1	7/19	8/1	7/18	7/21	7/7	7/15	7/5	7/6	7/16	6/24	6/26	6/25	6/18	6/12
Date of first fledgling	6/28	6/20	7/8	7/2	6/30	6/22	6/22	6/21	6/21	7/2	6/17	6/23	6/14	6/18	6/22
Estimated number of breeding pairs	65-70	121-150	114	120-127	122-124	136	110	66-76	96-124	90-95	90-99	9-10	31	20-21	16
Total number of nests	76	157	131	135	139	145	116	78	130	114	100	18	37	24	19
Total number of eggs	126	278	207	238	238	268	211	141	197	159-166	180	27	61	45	34
Clutch Size															
1 egg	27	39	55	33	43	26	23	15	63	64-71	20	9	13	3	4
2 egg	48	115	76	101	94	116	91	126	67	42-49	80	9	24	21	15
3 egg	1	3	0	1	1	2	2	0	0	0	0	0	0	0	0
4 egg	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0
Average clutch size	1.66	1.77	1.53	1.76	1.71	1.85	1.82	1.81	1.54	1.42-1.46	1.80	1.50	1.65	1.88	1.79
No. of nests hatching young*	42	128	81	93	112	103	88	66	84	80	65	8	25	18	13
Total number of eggs hatched	78	222	124	156	193	183	161	118	136	109	113	15	38	27	22
Estimated number of fledglings	10-17	45-85	54-65	34-42	115-128	36-38	29-38	11-15	36	34	34-46	8-9	10-17	13-17	13-14
Number of chicks banded	62	183	120	116	167	138	144	93	110	85	99	15	32	26	22
Number of adults banded	0	0	0	0	12	3	12	7	0	1	2	0	0	0	0
Uncertain outcome															
Nests*	14	2	4	3	3	9	3	1	9	3	10	0	2	1	1
Eggs	19	4	7	5	3	16	4	2	9	3-7	14	0	2	1	2
Documented Mortality															
Preyed upon:															
Eggs**	5	3	56	23	13	11	11	0	6	5	8	5	9	8	2
Chicks	8	15	8	15	2	0	5	23	3	8	9-10	1-4	4-5	0	1
Fledglings	0	11	13-14	3-4	1	3	3	7	0	1	3-4	0	1	0	0
Adults	0	1	4-8	1-2	2	2	3	1	1	6	2	1	0	1-2	1
Other than preyed upon:															
Eggs															
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	1	15	8	13	19	12	10	9	2	4	18	2	5	7	1
Died hatching	0	0	0	1	0	0	1	0	1	0	3	0	0	0	0
Abandoned (pre-term)	23	34	12	40	9	46	23	12	42	38	24	3	7	2	7
Flooded	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chicks	15	21	1	12	19	46	36	10	47	13	18	0	5-6	1	5
Fledglings	0	10	1	3	5	2	6	0	3	4	1	1	1	0	0
Adults	0	1	0	1	0	0	2	1	1	0	0	0	0	0	0
Nests															
Human damaged*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preyed upon*	5	2	37	17	11	7	8	0	5	5	7	4	7	5	1
Failed to hatch*	1	15	8	13	16	11	9	8	2	4	15	1	5	7	1
Abandoned (pre-term)*	16	25	10	26	8	31	18	9	35	27	17	3	5	1	4
Flooded	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

* included in more than one category

** not including previously abandoned eggs that were depredated/scavenged

Appendix C-2. Summary of California least tern breeding at D Street Fill, 2004-2018.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Date terns first observed	4/19	4/19	4/18	4/22	4/22	4/21	4/16	4/19	4/12	4/16	4/15	4/17	4/11	4/11	4/17
Date terns last seen	8/26	8/1	8/14	8/20	8/13	7/28	7/30	8/15	8/6	8/13	8/12	7/25	7/26	7/29	7/23
Date of first nest	5/18	5/10	5/16	5/15	5/10	5/8	5/4	5/6	5/5	5/7	5/6	5/5	4/29	4/28	5/8
Date last nest found	7/20	7/8	7/11	8/20	7/18	8/11	6/29	7/2	7/10	7/23	8/15	7/7	7/12	7/8	7/10
Date last nest established	7/20	7/8	7/11	7/17	7/16	6/27	6/29	7/2	7/10	7/22	7/8	7/3	7/11	7/3	7/3
Date of first hatch	6/8	6/4	6/9	6/8	6/3	5/29	5/25	5/27	5/26	6/1	5/27	6/2	5/27	5/19	5/29
Date of last hatch	7/13	6/28	7/25	7/24	7/22	7/14	7/2	7/8	7/3	7/19	7/12	7/9	7/5	7/1	6/26
Date of first fledgling	7/6	6/28	7/4	6/30	6/24	6/19	6/15	6/21	6/22	6/25	6/17	6/23	6/17	6/9	6/22
Estimated number of breeding pairs	77-94	77-97	88-94	100-115	133-135	129	117	100-113	78-93	96-113	125-129	108-111	91-106	93-112	94-100
Total number of nests	111	101	100	130	148	132	119	116	114	144	148	123	118	127	109
Total number of eggs	163	161	140	214	262	229	227	217	162	215	260	224	196	210	198
Clutch Size															
1 egg	59	42	60	47	34	35	11	15	66	73	36	22	40	44	21
2 egg	52	58	40	82	114	97	108	101	48	71	112	101	78	83	87
3 egg	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1
Average clutch size	1.47	1.59	1.40	1.65	1.77	1.73	1.91	1.87	1.42	1.49	1.76	1.82	1.66	1.65	1.82
No. of nests hatching young*	71	79	74	91	124	110	83	97	47	114	126	99	89	96	85
Total number of eggs hatched	105	122	98	160	223	189	158	174	65	174	224	184	149	162	155
Estimated number of fledglings	4-17	9-17	18-29	25-28	17-24	19-29	15-27	25-32	9	23-32	28-36	21-34	21-22	25-27	12-15
Number of chicks banded	52	79	52	83	129	122	86	112	41	108	145	128	80	103	92
Number of adults banded	0	0	0	0	5	0	4	2	7	1	3	0	0	0	0
Uncertain outcome															
Nests*	19	3	5	5	6	11	27	2	16	5	2	4	5	2	2
Eggs	23	5	7	9	8	16	51	4	20	7	2	7	7	2	4
Documented Mortality															
Preyed upon:															
Eggs**	5	11	14	14	2	0	5	14	21	1	3	4	7	6	13
Chicks	7	8	2	9-12	11	8-11	14	4-7	6	4-8	4-7	7	4	4-5	3-5
Fledglings	0	1	1	4	0	1	1	1	0	3	1	2	1	6	4
Adults	0	1	1	2	0	5	1	3-4	0	0	7-11	4	5	0	0-1
Other than preyed upon:															
Eggs															
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	4	7	6	3	9	8	5	6	4	3	8	5	6	10	8
Died hatching	0	0	0	0	0	2	0	3	0	3	0	0	0	7	4
Abandoned (pre-term)	26	16	16	28	20	14	8	16	52	27	23	24	27	23	14
Flooded	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chicks	10	17	8	7	12	12	28	40	16	54-58	59-62	31	58	33	46
Fledglings	0	1	0	5	0	0	11	9	0	11	7	11	1	3	0
Adults	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0
Nests															
Human damaged*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preyed upon*	5	7	10	11	2	0	3	9	14	1	3	2	5	6	10
Failed to hatch*	4	7	6	3	6	8	4	6	4	3	7	5	6	10	8
Abandoned (pre-term)*	22	12	13	24	16	11	5	11	40	22	16	19	21	18	12
Flooded	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* included in more than one category

** not including previously abandoned eggs that were depredated/scavenged

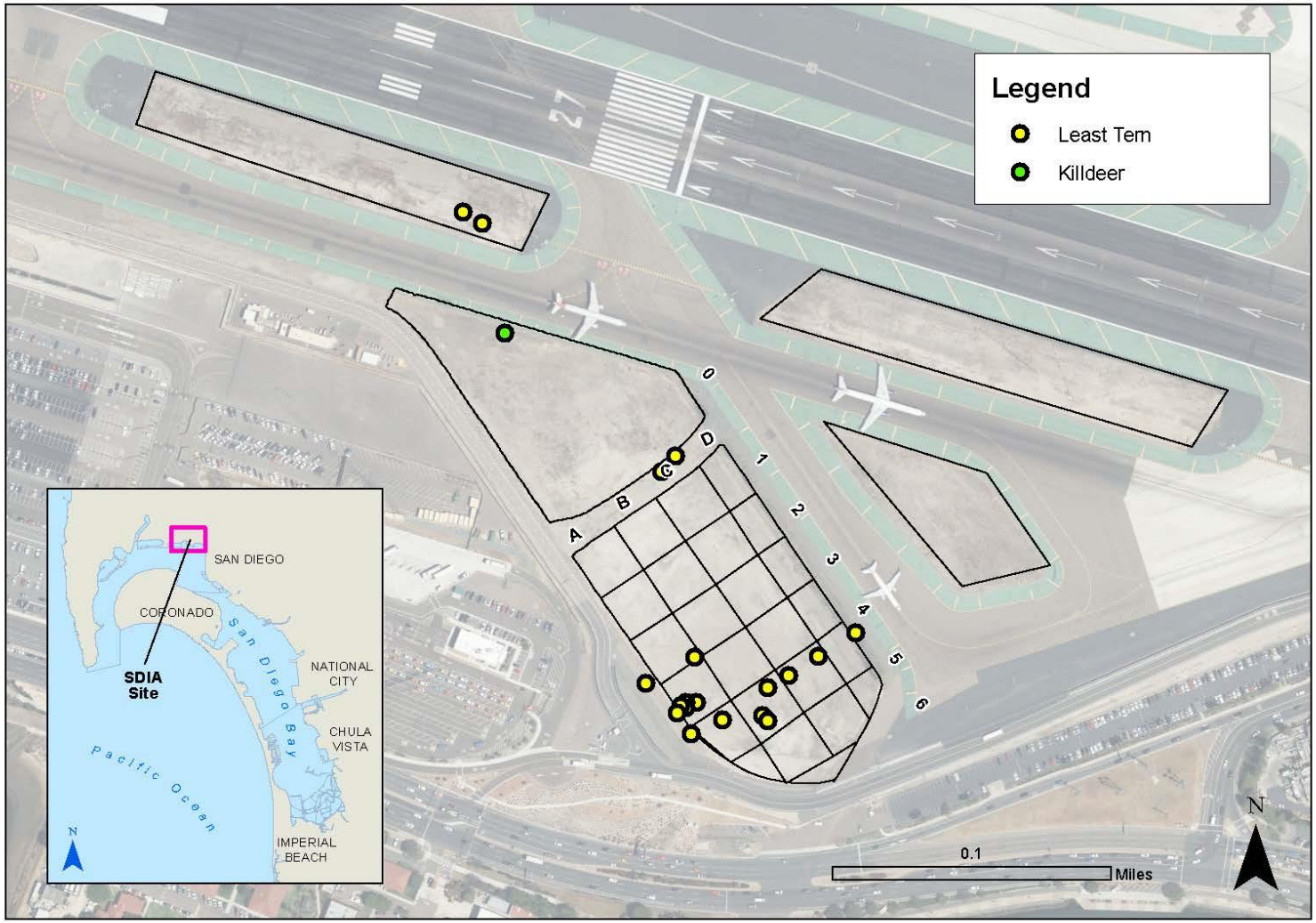
Appendix C-3. Summary of California least tern breeding at Chula Vista Wildlife Reserve, 2004-2018.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Date terns first observed	4/20	4/26	4/21	4/23	4/9	4/24	4/22	4/19	4/12	4/13	4/15	4/20	4/16	4/15	3/28
Date terns last seen	9/5	7/29	8/14	8/15	8/29	8/4	8/2	8/24	9/13	8/19	8/12	8/18	8/2	8/11	7/23
Date of first nest	5/15	5/17	5/30	5/15	5/16	5/12	5/11	5/13	5/12	5/13	5/10	5/10	5/9	5/9	5/12
Date last nest found	7/13	7/1	7/4	7/10	7/8	7/10	6/29	7/19	7/10	7/2	6/20	6/30	7/26	6/20	6/19
Date last nest established	7/13	7/1	7/4	7/3	7/8	7/10	6/29	7/16	7/10	7/2	6/20	6/30	7/12	6/20	6/19
Date of first hatch	6/5	6/10	6/20	6/8	6/6	6/2	6/1	6/3	6/2	6/4	5/31	5/31	5/31	5/30	6/2
Date of last hatch	7/24	7/1	7/22	7/20	7/26	7/24	7/2	7/18	7/31	7/16	6/28	7/6	7/16	7/4	6/22
Date of first fledgling	7/13	7/5	8/4	7/17	8/15	6/23	6/29	6/21	6/29	6/25	6/20	6/20	6/21	6/20	6/26
Estimated number of breeding pairs	30-48	44-53	12-13	33-39	28	37	32	34-47	29-37	58-66	80-86	65-71	56-63	78-86	77-81
Total number of nests	66	57	15	46	33	48	40	53	64	79	87	79	76	96	83
Total number of eggs	103	101	25	81	60	86	76	100	98	129	166	146	122	161	144
Clutch Size															
1 egg	30	13	5	11	7	11	4	6	30	29	8	13	30	31	23
2 egg	35	44	10	35	25	36	36	47	34	50	79	65	46	65	59
3 egg	1	0	0	0	1	1	0	0	0	0	0	1	0	0	1
Average clutch size	1.56	1.77	1.66	1.76	1.82	1.79	1.9	1.89	1.53	1.63	1.91	1.85	1.60	1.68	1.73
No. of nests hatching young*	47	40	9	24	18	22	21	39	36	66	75	70	63	72	59
Total number of eggs hatched	73	74	17	42	32	40	41	75	55	106	142	127	103	120	101
Estimated number of fledglings	11-18	2	2	0	2	4-5	2	12-19	18-20	32-39	23-27	33-37	15-18	17-23	7-10
Number of chicks banded	44	46	10	23	16	18	16	40	43	94	107	99	78	105	61
Number of adults banded	0	0	0	0	7	5	7	1	2	4	1	0	0	1	0
Uncertain outcome															
Nests*	11	3	2	0	11	16	5	10	9	0	1	0	1	8	2
Eggs	13	5	3	0	17	28	10	15	11	0	2	0	1	13	2
Documented Mortality															
Preyed upon:															
Eggs**	0	9	3	36	6	8	21	4	9	2	6	6	2	5	6
Chicks	2	1	0	2	2	2	8-9	5-7	5	1-2	2	15	5-6	7	1-3
Fledglings	0	0	0	0	1	0	0	1	2	2	9	3	0	5-6	0
Adults	1-2	0	1	0	0	0	0	3	2-3	3	6	8-13	2	1-2	2-3
Other than preyed upon:															
Eggs															
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	3	5	0	1	4	3	0	1	1	9	3	3	2	4	5
Died hatching	1	0	0	0	1	2	0	0	0	0	0	0	0	0	2
Abandoned (pre-term)	13	8	2	2	0	5	2	5	22	12	13	10	14	19	28
Flooded	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chicks	1	5	0	0	0	2	1	2	3	28-29	35	16	26-27	25	26-28
Fledglings	0	0	0	0	0	0	1	0	0	3	2	4	1	2	0
Adults	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nests															
Human damaged*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Preyed upon*	0	6	3	21	4	7	11	2	6	1	4	4	2	3	6
Failed to hatch*	2	5	0	1	4	5	0	1	1	8	3	3	2	4	5
Abandoned (pre-term)*	9	7	2	2	0	4	2	4	17	10	9	7	11	14	20
Flooded	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

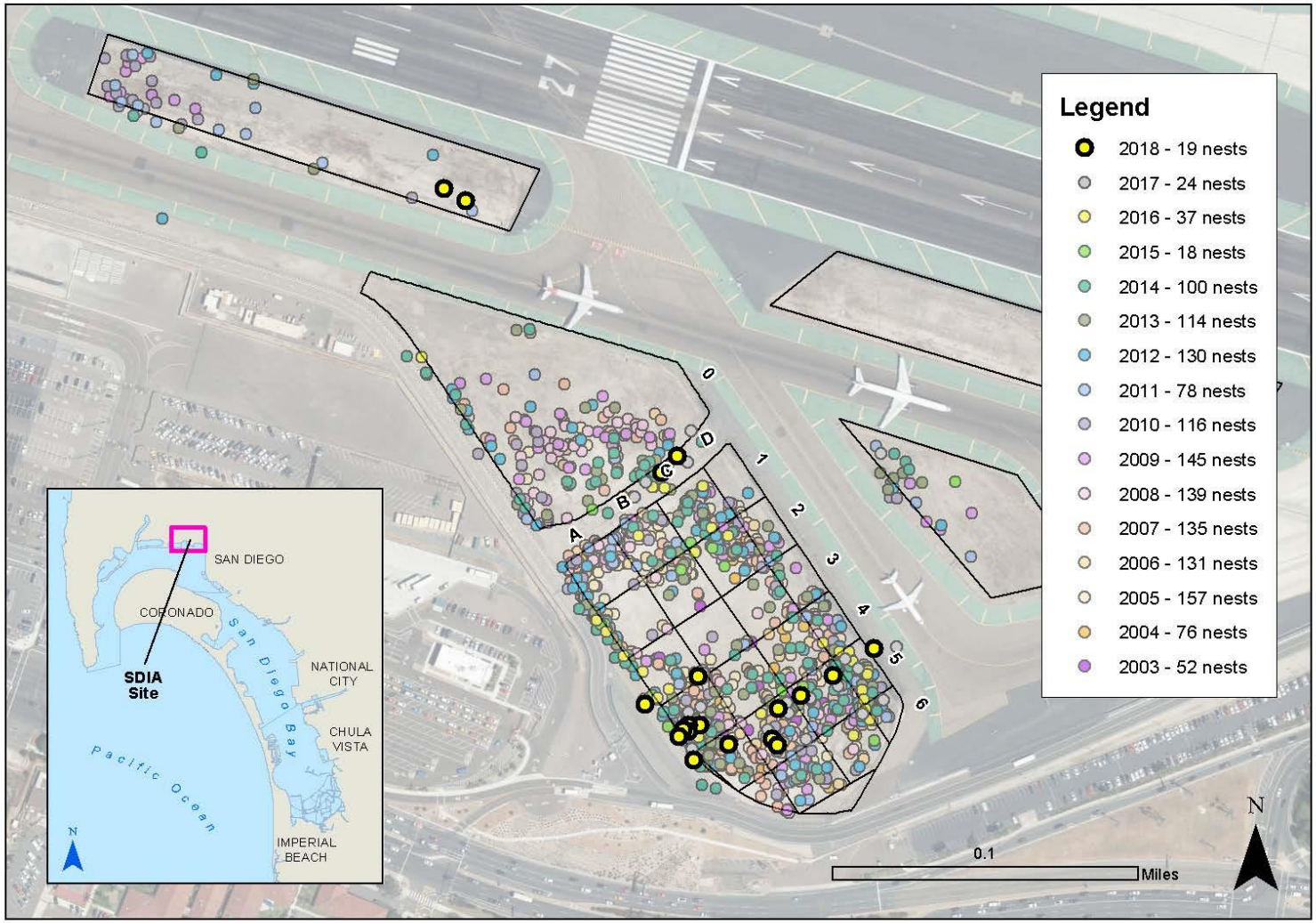
* included in more than one category

** not including previously abandoned eggs that were depredated/scavenged

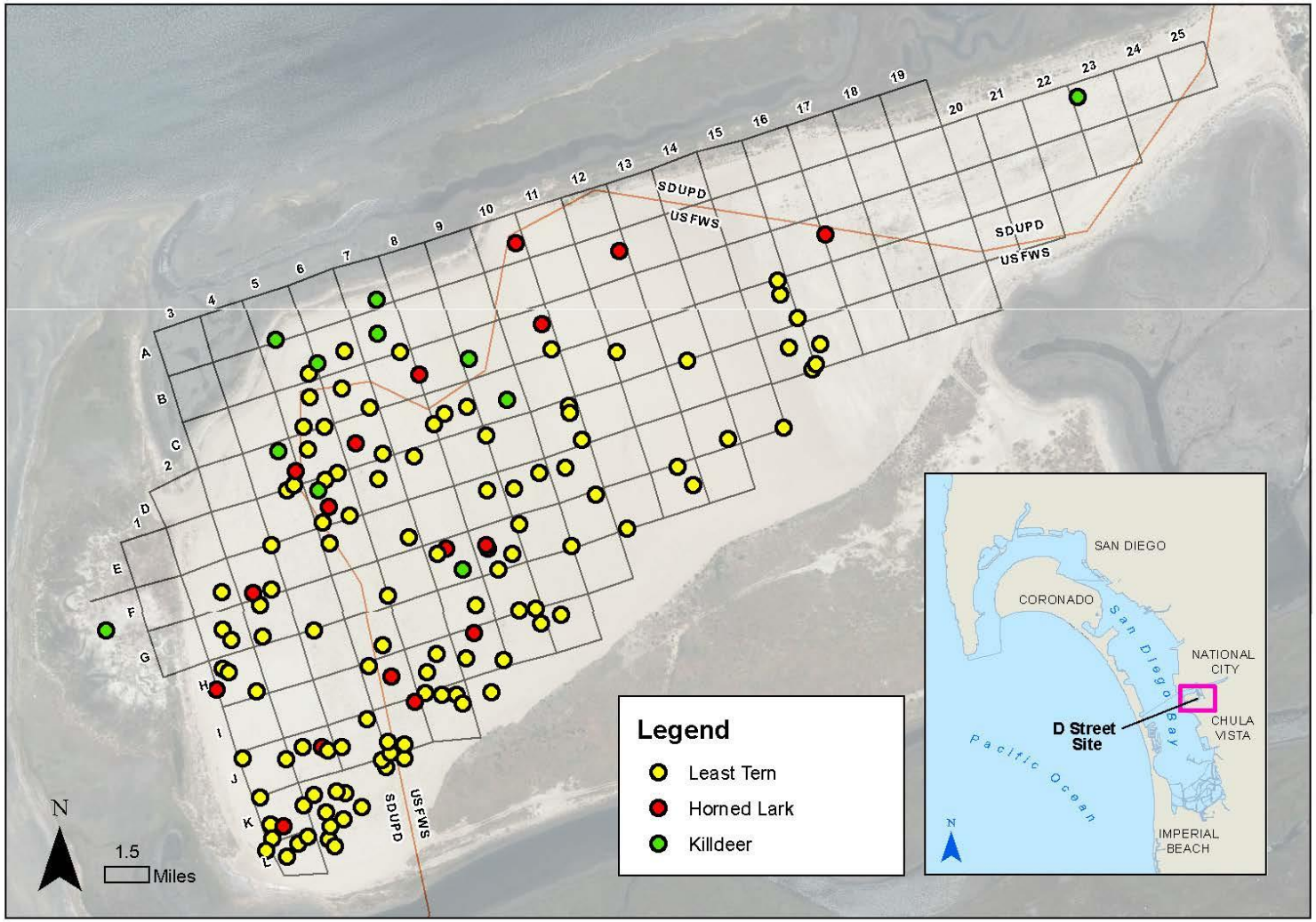
Nesting Sites: San Diego International Airport 2018



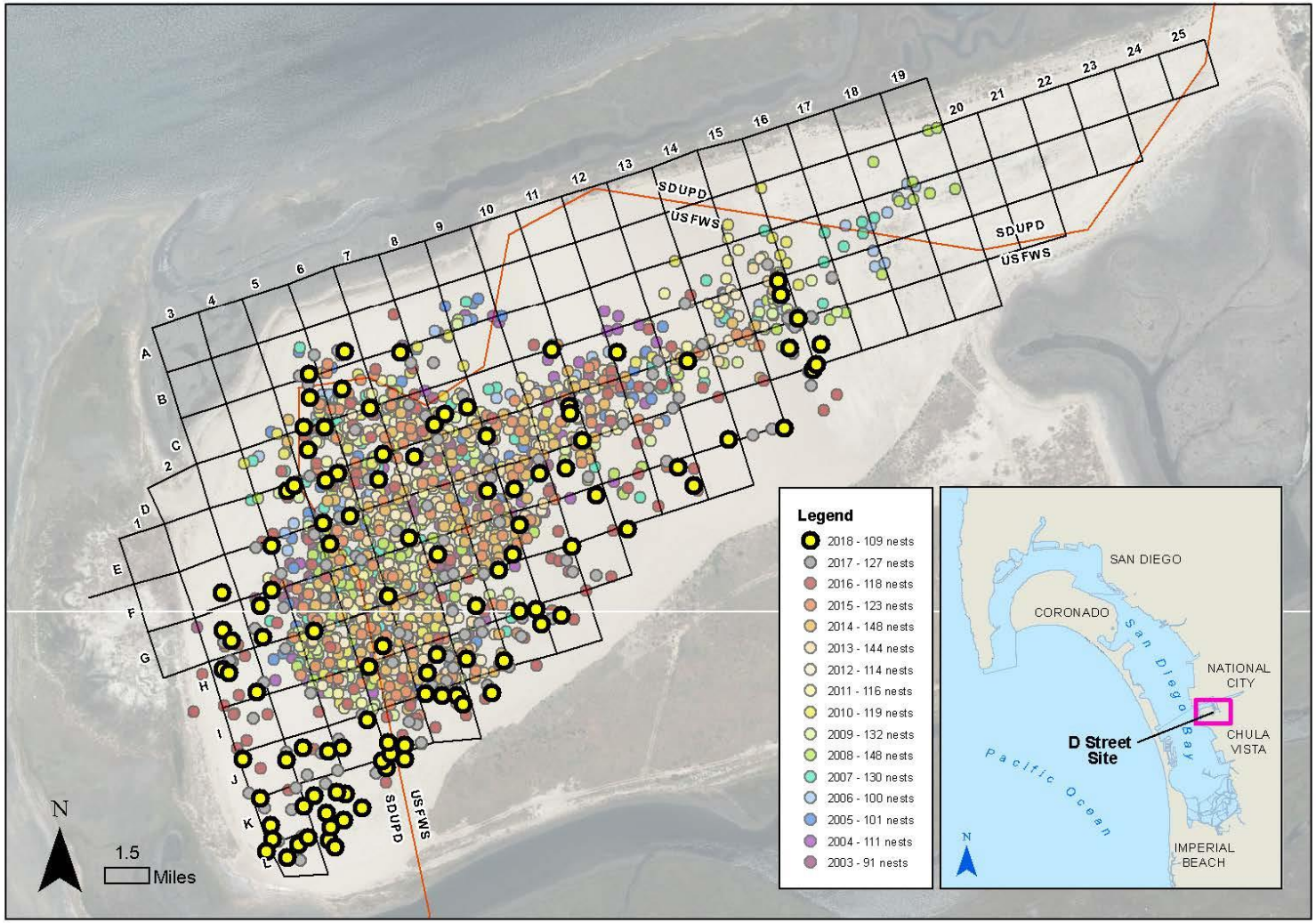
Least Tern Nests: San Diego International Airport Chronological



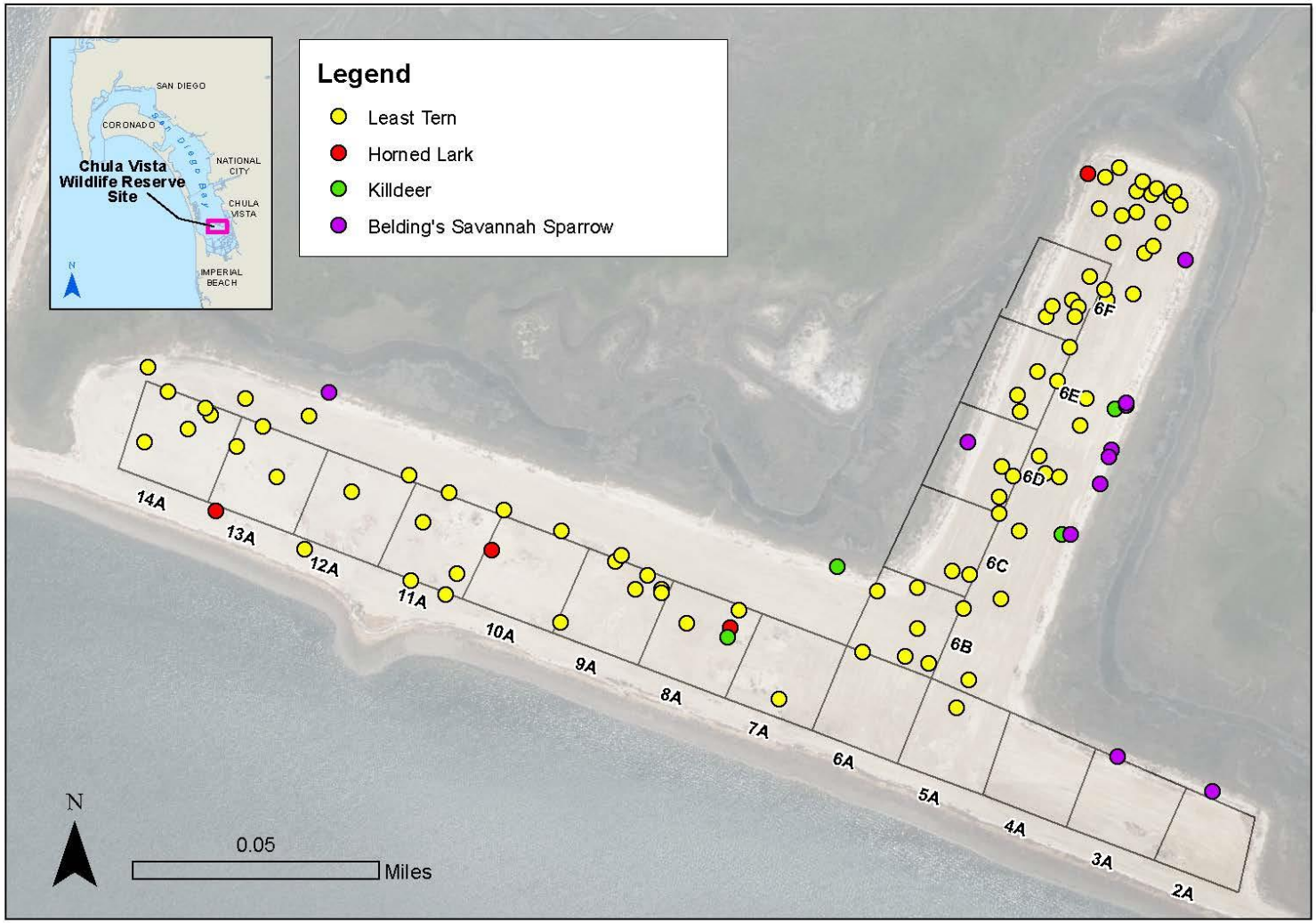
Nesting Sites: D Street 2018



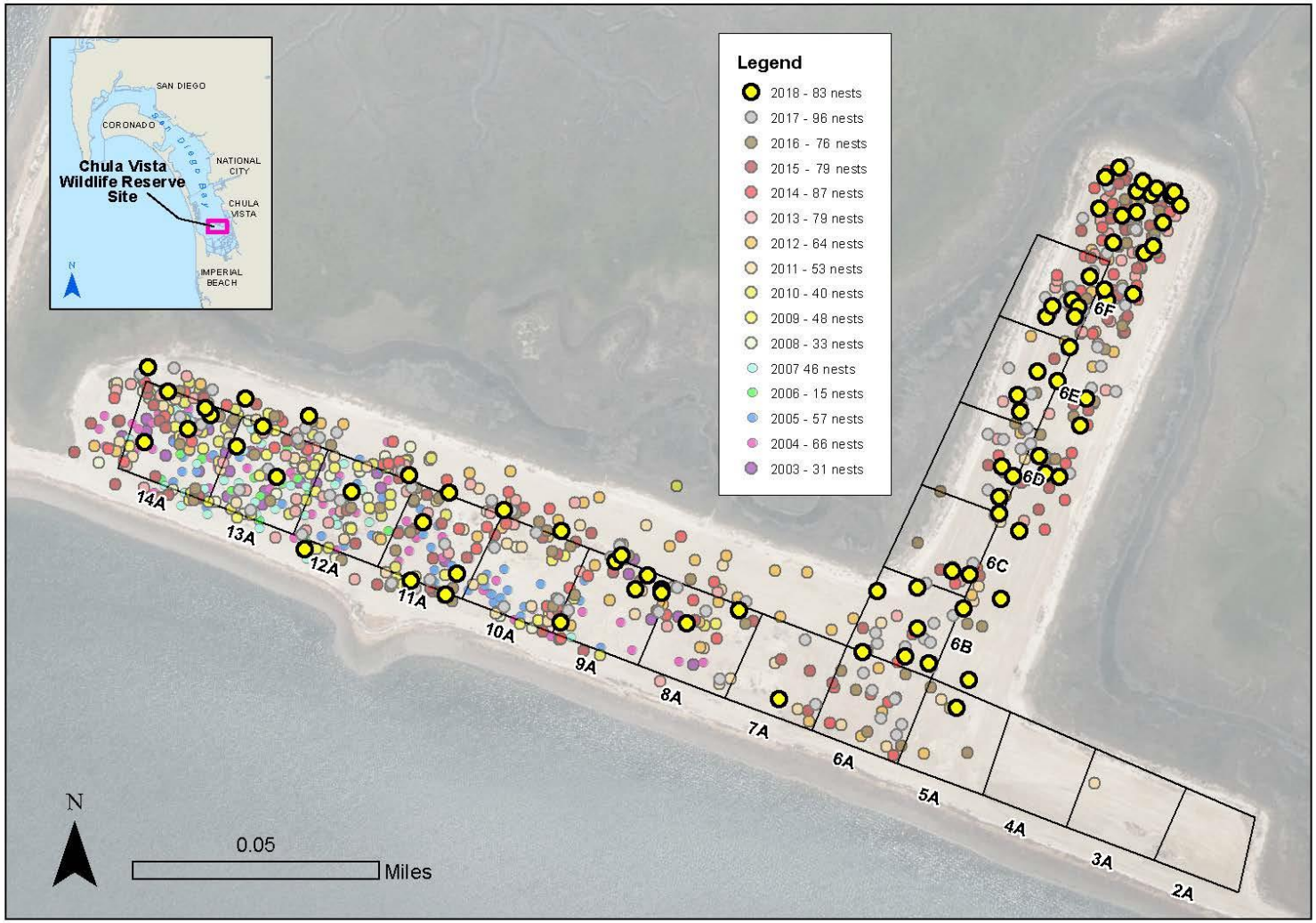
Least Tern Nests: D Street Chronological



Nesting Sites: Chula Vista Wildlife Reserve 2018



Least Tern Nests: Chula Vista Wildlife Reserve Chronological



Appendix D. Distribution of nests of California least tern and western snowy plover at D Street Fill, 1997-2018.

	Number of Nests			
Year	CLT	WSP	W-E Row	N-S Column
1997	41	10-12	3-12	C-I
1998	7	2	4-11	D-F
1999	36	2	4-11	D-H
2000	34	1	4-10	D-H
2001	32	0	4-12	D-H
2002	24	0	4-11	E-H
2003	91	0	2-12	C-I
2004	111	0	3-14	B-I
2005	101	0	3-13	B-I
2006	100	0	3-19	B-I
2007	130	0	3-18	B-I
2008	148	0	3-20	B-I
2009	132	0	4-16	B-J
2010	119	0	4-16	B-J
2011	116	0	3-15	B-J
2012	114	0	4-15	C-I
2013	144	0	4-15	C-J
2014	148	0	4-15	C-J
2015	123	0	3-15	C-J
2016	118	0	2-17	B-K
2017	127	0	2-17	B-L
2018	109	0	2-16	B-L