THE STATUS OF THE CALIFORNIA LEAST TERN

AT SAN DIEGO UNIFIED PORT DISTRICT PROPERTIES

IN 2014

Prepared under Contract

For

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Photo by Matt Sadowski

By

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SUMMARY

In preparation for the 2014 nesting season at D Street Fill, in late February, U.S. Fish and Wildlife Service staff applied herbicide to invasive plant species; and in mid- to late March, 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 late February through August one to three days per week.

Least terns were first observed at the D Street Fill on 15 April 2014. They were observed each visit after that through 12 August. At least 148 nests were initiated by 125 to 129 estimated pairs between 6 May and 21 July. The maximum number of concurrently active nests was 121 on 23 May, and the maximum number of concurrently active nests and broods was 120 nests with five broods of chicks on 27 May.

At least 224 chicks from 126 nests hatched successfully. It is estimated that between 36 and 42 chicks reached fledgling age and 28 to 36 survived to fledge from the site. The outcome of two nests with two eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. At least three northern harriers were observed consistently within the colony coinciding with depredation of two nests with two eggs. One egg was damaged when the adult was depredated on the nest apparently by a peregrine falcon. Sixteen nests with 23 eggs were abandoned pre-term, one single-egg nest and one two-egg nest were abandoned following prolonged incubation, and five eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully.

Seven fledglings and 59 chicks were found with no obvious cause of death. One additional chick was found dead being scavenged by ants, but whether ants contributed to its mortality could not be determined. The bones and feathers of two large chick/fledglings were found but it could not be determined whether they had been depredated or not. One adult was observed being taken by a red-tailed hawk, another by a peregrine falcon, and piles of feathers of four to seven additional adults suggested predation by peregrines. The depredated bill, forehead, and feathers of an adult were found with tracks of a large owl. Feathers possibly from a second adult suggested predation by either a large owl or peregrine. One chick was observed being taken by a northern harrier and a second was suspected of being taken when a harrier with small unidentified prey was seen from a distance leaving the nesting area. Three chicks were observed being taken by an American kestrel. One fledgling carcass was found with trauma to the head and either a kestrel or peregrine falcon were suspected to be 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 114 to 122 chicks coincided with documented depredation and daily disturbances to the colony by northern harrier, American kestrel, peregrine falcon, and visits by Cooper's hawk, red-tailed hawk, and barn owl. Other potential predator species observed in the area included great blue heron, great egret, black-crowned night-heron, gulls, gull-billed tern, great horned owl, common raven, American crow, European starling, western meadowlark, opossum, rats, California ground squirrel, coyote, feral cat, striped skunk, raccoon, and gopher snake.

There were no western snowy plovers documented at D Street Fill during the peak of nesting season from mid-April to mid-August. No nests were established by snowy plovers this season. Up to 74 plovers were observed foraging on adjacent mudflats during ebbing or low tides prior to nesting season and at least 24 post-season. Band combinations observed indicated plover origins elsewhere in San Diego County and captive-reared individuals from Project Wildlife.

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INTRODUCTION

The California least tern (Sternula antillarum browni) 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 2013 was estimated to be 4353 to 5561 pairs (Frost 2014).

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 2014 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 previously managed by 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 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. Appendix A summarizes annual least tern productivity at D Street Fill. The site was abandoned by nesting terns in 1981 and 1990 (Copper 1981, Obst and Johnston 1992), but the colony re-established with up to 135 nests in1992 (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 then, annual nest numbers have ranged from 100 in 2006 to 148 in 2008, with 144 established in 2013; and annual fledgling production has ranged from nine individuals in 2012 to 32 in 2011 and 2013 (Patton 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013). 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.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Nests	111	101	100	130	148	132	119	116	114	144
Fledglings	4-17	9-17	18-29	25-28	17-24	19-29	15-27	25-32	9	23-32

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 grading 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.

METHODS

Site Preparation

Prior to any site preparation efforts, the site was surveyed for the presence, courting or nesting of western snowy plovers, and for nests of other species. From mid- to late February 2014, staff of the San Diego National Wildlife Refuge Complex applied herbicide in limited areas to reduce invasive plant species, particularly iceplant (Carpobrotus and Mesembryanthemum sp.), tamarisk (Tamarix sp.), and Bermuda grass (Cynodon dactylon). From March 18 to 20, USFWS staff conducted mechanical scraping of the site to reduce vegetation and further enhance it for use by least terns and snowy plovers. New growth of vegetation in some areas was reduced by manual weeding, most notably Baccharis and Astragalus species, and to reduce invasive non-native garland chrysanthemum (Glebioinis coronaria), iceplant, and mustard (Brassica) species. Vegetation around the periphery of the cleared area was pruned back by contract monitors to limit predator perches and cover.

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 the status of the site were repaired. 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 group was arranged to simulate single birds (spaced 1.0 to 2.0 m apart) and the remainder of each group set as pairs of birds (spaced approximately 15.0 cm apart) according to Burger (1988).

Monitoring

The site was monitored one to three times per week by one to four people for one to four hours. Each visit was supervised by at least one senior monitor with extensive experience with nesting least terns, snowy plovers, and their young. Once to twice-weekly monitoring for snowy plovers was conducted at D Street Fill beginning in late February. 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 at each site 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 during hot weather, 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. Due to the continued presence of terns, monitoring continued twice per week to mid-August until the terns departed. Monitoring was discontinued when no least terns had been observed for three consecutive visits. The final monitoring visit for 2014 was on 28 August for 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 and stored on-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. When known, the nest from which the chick originated was noted. 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 possible 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.

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 as an estimate of the number 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 are to be 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, frozen, and delivered per direction from USFWS to San Diego State University for isotope and/or contaminant analysis.

RESULTS AND DISCUSSION

Least terns were observed from 15 April through 12 August 2014 at and adjacent to properties and facilities of the San Diego Unified Port District. At the three Port and San Diego County Regional Airport Authority sites, 335 nests were established from 6 May to 21 July (Appendix C). At least 85 to 109 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 15 April through 12 August. Approximately 125 to 129 pairs established 148 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 take into account the 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 143 breeding pairs this season. However, up to 17 nests and 81 broods were lost prior to 20 June. Timing of these losses and new nest initiations suggests that at least 19 nests could have resulted from renesting by pairs that had lost earlier clutches or broods, leading to a maximum number of 129 breeding pairs. The maximum number of concurrently active nests was 121 on 23 May, but the maximum number of concurrently active nests and broods was 125 on 27 May with 120 nests and five broods.

Figure 3 depicts graphically the chronology of nesting events at the D Street Fill in 2014. The numbers of active nests plotted in Figure 3 were those nests being tended by an adult. The majority of nests (89%) were initiated between 6 and 27 May. Seven more nests were then established from 3 to 7 June. Four nests were established from 19 to 21 June, then two more on 8 July. The remaining two nests were found on 21 July and 15 August, but each had been previously abandoned. The number of active nests plotted in Figure 3 diverged from the number of total nests in early May due to destruction of the egg during predation of the adult at one nest. Divergence increased through late May with abandonment of six nests and predation of another, then through June with hatching of chicks, additional nest abandonments, and predation. Active nest numbers dropped from late May through mid-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 where substrate appeared softer and relatively richer in shell content, and vegetation was sparser. The densest nesting occurred in the southwest portion of this concentration of nests. Other nests were established in areas of less dense vegetation 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).

Eight nests this season were established farther east in the site than most nests of recent 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 channel along the northeast edge of the site with its 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 ten years. From 1997 through 2003, no nests were documented east of grid row 12 (see Figure 2). 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 at least since 1997 this area has been cleared of vegetation, except in 2005 when miscommunication resulted in the eastern portion of the site not being disked. (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 some years it has not been extended beyond row 19). Prior to the 2004 breeding season, a portion of the northeastern fill north of rows 18 through 24 was excavated for saltmarsh and tidal channel restoration. Prior to the 2011 breeding season, a portion of the northwestern fill that had included grid rows 1 through 10, A through E, was excavated for the L-ditch mitigation project. Least terns have been observed foraging in the channels of both these areas and roosting with their fledglings on adjacent shoreline.

Clutch Size

Approximately 125 to 129 estimated pairs of least terns established 148 nests with 260 eggs at the D Street Fill in 2014. The average clutch size was 1.76 eggs per nest with 112 two-egg clutches and 36 single egg clutches (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 86 percent of the eggs at D Street Fill hatched successfully this season, resulting in an average of 1.51 chicks per nest and 1.78 chicks per nest that experienced hatching (Table 1). This was an increase over that of last season and a substantial increase over that of the previous season when nest predation and abandonment severely limited hatching success (Patton 2012, 2013). Nest abandonment was still the primary known limiting factor to hatching success, with 11 percent of nests abandoned pre-term (16 nests). Five additional eggs were abandoned after the other egg in each clutch hatched; and two nests, one single-egg and one two-egg, were abandoned after

prolonged incubation of 41 to 44 days. Although only two nests were documented to have been depredated and another damaged during depredation of the adult at the nest, 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.

Chick Banding

In 2014, 145 chicks from at least 108 nests were banded at D Street Fill. Chicks were banded on the right leg with USFWS metal bands individually numbered 2421-52247 through -52300, and 2421-52801 through -52894.

Fledging Success and Seasonal Production

From 36 to 42 chicks are estimated to have reached fledging age this season but carcasses of eight were recovered, resulting in 28 to 36 young being estimated to have survived to fledge from the colony. Productivity was thus 0.19 to 0.24 fledglings per nest, 0.22 to 0.29 per pair. Although relatively low, this was among the highest number of fledglings produced at this site over the past 10 years and a substantial increase over 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 94 percent of the chicks from 27 May to 17 June. This is in turn reflected in numbers of fledglings three weeks later. The two curves generally track, although daily numbers of observed fledglings are somewhat reduced from earlier corresponding hatching numbers since mortality and predation limited the number of chicks reaching fledging age. However, these losses were spread throughout the season with numbers of each weekly cohort surviving to fledge, as opposed to 2012 when all of the early hatchlings were depredated or died and the resulting fledgling curve skewed to the late season (Patton 2012).

The drop in fledgling numbers on 18 July reflects increasing fledgling mobility and ability to follow adults to foraging areas. Fledgling numbers generally decreased from early July into August

as the young gained flight experience and dispersed from the colony with the adults. Variations in daily observed numbers of fledglings reflect dispersal to foraging and roosting areas, return visits to the colony site, and visits by migrants from other colonies.

Chick recovery for band recapture and growth measurement data at times was complicated by and monitoring protocol adjusted to accommodate 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, as well as 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. At least 59 chicks were found dead of undetermined causes, at least four were depredated, and it was unclear whether three more had been depredated or had been scavenged post mortem. Seven fledglings were found dead of undetermined causes and at least one was depredated.

Mortality

Eleven percent of nests (16 nests) with 23 eggs were abandoned after one to 34 days of incubation (Table 2). Eggs of five two-egg clutches failed to hatch and were abandoned after the other in each clutch hatched, and one single-egg clutch and one two-egg clutch were abandoned after prolonged incubation of 41 and 44 days. Fifty-nine chicks and seven fledglings were found dead of undetermined causes (29 percent of those hatched). Two more were found skeletonized so it was possible that predator-inflicted wounds no longer visible may have caused death. One additional chick was found dead being scavenged by ants, but whether ants contributed to its death could not be determined.

	Hatched	Abandoned Pre-term	Abandoned Post-term (Failed to Hatch)	Uncertain Outcome	Predation	Possible Non-predation Mortality	Non-predation Mortality
Nests	126	16	7	2	3		
Eggs	224	23	8	2	3		
Chicks					4-5	3	59
Fledglings					1		7
Adults					7-11		0

The majority of chick mortality and nest abandonment occurred through June and 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. However, this relatively high number of chick and fledgling deaths also coincided with mortality reported at other colonies (J. Jackson and V. Johnson, pers. comm.). 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.

Predation

Only two eggs were found depredated this season (Tables 1 and 2). Punctures on each side of the shells indicated raptor predation and northern harriers (Circus cyaneus) had been observed within the area of the depredated nests. The outcome of two other nests with two eggs was uncertain, but lack of evidence of hatching or chick presence indicated probable depredation. Up to three northern harriers were observed hunting within the colony at one time during the period of egg and chick loss. The egg at another nest was destroyed when the adult was depredated on the nest; peregrine falcon (Falco peregrinus) was suspected responsible due to the pile of plucked feathers left at the site, observations of predation of another adult and of regular hunting of the area. Feather piles indicated predation of three to six additional adults by peregrine falcon. Tracks of a large owl were found with the bill, forehead, and feathers of a depredated adult least tern, and additional feathers that day suggested the possibility of another adult depredated by either peregrine or owl. Another adult was observed being depredated by a red-tailed hawk (Buteo jamaicensis).

As previously mentioned, the carcass of one chick was found dead being scavenged by ants, but whether ants contributed to its death could not be determined. Likewise, whether predation was involved or not could not be determined in the recovery of bones and feathers of two large chick/fledglings. One chick was observed being taken by a northern harrier, and depredation of a second was suspected when the bird was seen from a distance being mobbed by terns and carrying small unidentified prey from within the nesting area. Three chicks were observed being taken by an American kestrel (Falco sparverius). Additional chicks were suspected of being taken by each of these species. One fledgling was found dead with head trauma suspected inflicted by kestrel or

peregrine.

	Northern Harrier	Red-tailed Hawk	American Kestrel	Peregrine Falcon	Owl sp.	Ant sp.
Nests	2			1		
Eggs	2			1		
Chicks	1-2		3			0-3
Fledglings			0-1	0-1		
Adults		1		5-8	1-2	

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 114 to 122 chicks coincided with documented depredation and daily disturbances to the colony by northern harrier, American kestrel, and peregrine falcon, and visits by Cooper's hawk (Accipiter cooperii), red-tailed hawk, and barn owl (Tyto alba). Other potential predator species observed in the area included gopher snake (Pituophis catenifer), great blue heron (Ardea herodias), great egret (Ardea alba), black-crowned night-heron (Nycticorax nycticorax), western gull (Larus occidentalis), other gull species (Larus spp.), gull-billed tern (Gelochelidon nilotica), great horned owl (Bubo virginianus), common raven (Corvus corax), American crow (Corvus brachyrhynchos), European starling (Sturnus vulgaris), western meadowlark (Sturnella neglecta), opossum (Didelphis virginiana), rats (Rattus spp.), California ground squirrel (Spermophilus beecheyi), coyote (Canis latrans), feral cat (Felis catus), striped skunk (Mephitis mephitis), and raccoon (Procyon lotor).

Snowy Plovers and Other Species

The maximum number of snowy plovers recorded on a single survey this year was 74 which were observed foraging pre-season on mudflats west of the nesting site (Appendix E-1). At least 24 were observed foraging post-season. None were observed during the peak of nesting season from April to August 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 had 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 been filling in along this shoreline as well.

Observations of uniquely banded snowy plovers this season again demonstrated 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). The distance to the flats adjacent to the D Street Fill and Sweetwater Marsh is approximately 1.75 miles from the Orange Beach/north Silver Strand State Beach roost site and 3.25 miles from the Red/Yellow Beach roost site. The numbers of foraging birds observed off D Street Fill represent a majority of those roosting along Silver Strand. Band combinations observed included origins elsewhere in San Diego County (specific sites undetermined) and captive-reared individuals from Project Wildlife (Appendix E-2).

No attempt was made to document all nests or all species nesting at D Street Fill. However, nests encountered during monitoring for least terns and snowy plovers were marked, mapped, and contents recorded (Figure 2). Mallard (Anas platyrhinos) initiated at least one nest along the north perimeter and killdeer (Charadrius vociferus) established at least nine nests within the interior and on the northwest slope. Horned larks (Eremophila alpestris) appeared to nest throughout the site, and at least five nests were found within the tern colony. Belding's savannah sparrows (Passerculus sandwichensis beldingi) established at least one nest in the north shore and the presence and behavior of them, western meadowlarks, and their fledglings indicated additional nesting of both species adjacent to the prepared colony site. Although breeding was not confirmed, a federally endangered light-footed clapper rail (Rallus longirostris levipes) was observed along the northeast shore. 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).

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. Within the limitations of recent budget reductions, 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. The possibility of herbicide application should continue to be considered, particularly in the southwestern site where Bermuda grass and salt grass (Distichlis spicata) regrowth precluded nesting again this season, in the south central site where extensive stands of iceplant prevent nesting, and in the northern site where locoweed and mustard have become a problem. 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 by such projects. 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 may have reduced human intrusion into nesting areas. Many signs have weathered significantly or been removed so that new and additional signs are now needed. 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 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.

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TABLES

Table 1. Least tern nest and egg data, D Street Fill, 2014.

	nests*	eggs
Total	148	260
1 egg clutch	36	36
2 eggs	112	224
Known Hatch		
Total	126*	224
1 egg	22	22
2 eggs	104*	202
Uncertain Outcome		
Total	2	2
1 egg	2	2
2 eggs	0	0
Failed to Hatch		
Total	26*	34
1 egg	12	12
2 eggs	14*	22
Depredated		
Total	3*	3
1 egg	2	2
2 eggs	1*	1
Abandoned (pre-term)		
Total	16	23
1 egg	9	9
2 eggs	7	14
Abandoned post-term/nonviable		
Total	7*	8
1 egg	1	1
2 eggs	6*	7

* inclusion in more than one category: one egg each of five two-egg clutches was abandoned/failed to hatch after the other hatched; one egg of a two-egg clutch hatched after the other had been depredated.

Table 2. Documented causes of least tern mortality, D Street Fill, 2014.

Cause	Least Tern Age Class	Total Losses D Street Fill
Total:		
	egg	34
	chick	64*
	chick/fledgling	2
	fledgling	8
	adult	7-11
Predation*:		
Ant species		
	chick (possibly died previously)	1
Northern Harrier		
	egg	2
	chick	1-2
Red-tailed Hawk		
	adult	1
American Kestrel		
	chick	3
Peregrine Falcon		
	egg (damaged when adult depredated)	1
	adult	5-8
American Kestrel or Peregrine Falcon		
	fledgling	1
Peregrine Falcon or Large Owl		
	adult	0-1
Barn or Great Horned Owl		
	adult	1
Non-predation Mortality:		
Abandonment (pre-term)		
	egg	23
Unknown		
Abandoned post-term/nonviable		
	egg	8
No visible trauma		
	chick	59*
	chick/fledgling	2*
	fledgling	7

*daily-observed chick numbers and recapture data indicate additional losses of up to 114-122 chicks, species suspected as responsible for losses include northern harrier, American kestrel, and peregrine falcon, with possible losses also to ant species, barn or great horned owl, and Cooper's hawk. Northern harrier was observed preying on a chick and being mobbed by terns when carrying a possible chick; two depredated eggs were found with beak punctures on each side and coincided with observations of harrier within the site. Red-tailed hawk was observed preying on an adult. American kestrel was observed preying on three chicks. Peregrine falcon was observed preying on one adult, and suspected responsible for feather piles of four to seven others, including one killed at the nest and the egg damaged. Great horned or barn owl tracks were found with adult bill, forehead, and feather pile; additional feather piles suggested another adult depredated by either owl or peregrine. One fledgling was found with head trauma suspected inflicted by either kestrel or peregrine. One chick was found being scavenged by ants, but it was unclear whether it had been depredated by ants or had died previously and subsequently scavenged. Skeletons and feathers of two large chick/fledglings were found but it could not be determined if they had been depredated or not.

FIGURES

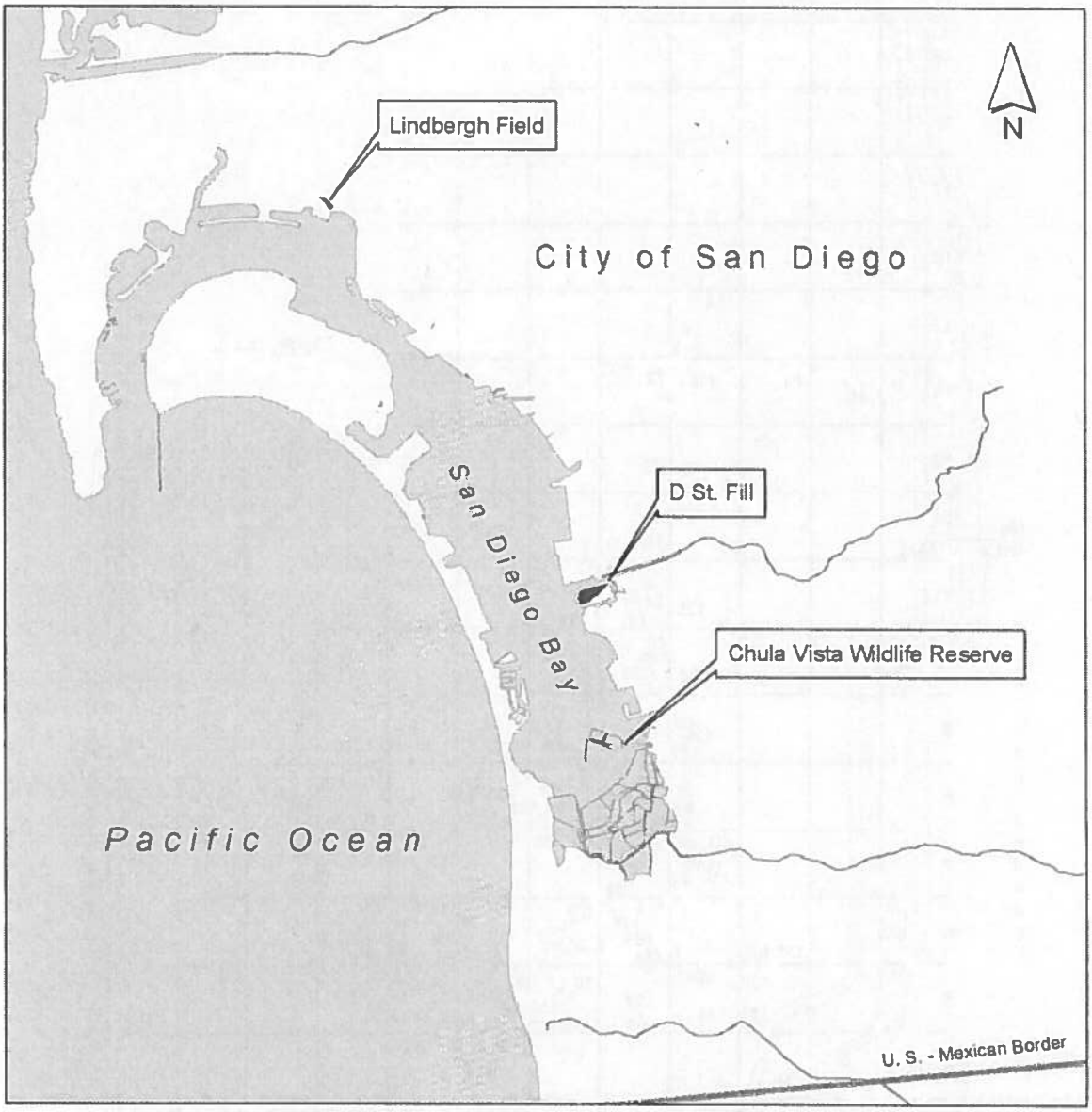


Figure 1. San Diego Unified Port District and San Diego County Regional Airport Authority least tern nesting sites, 2014.

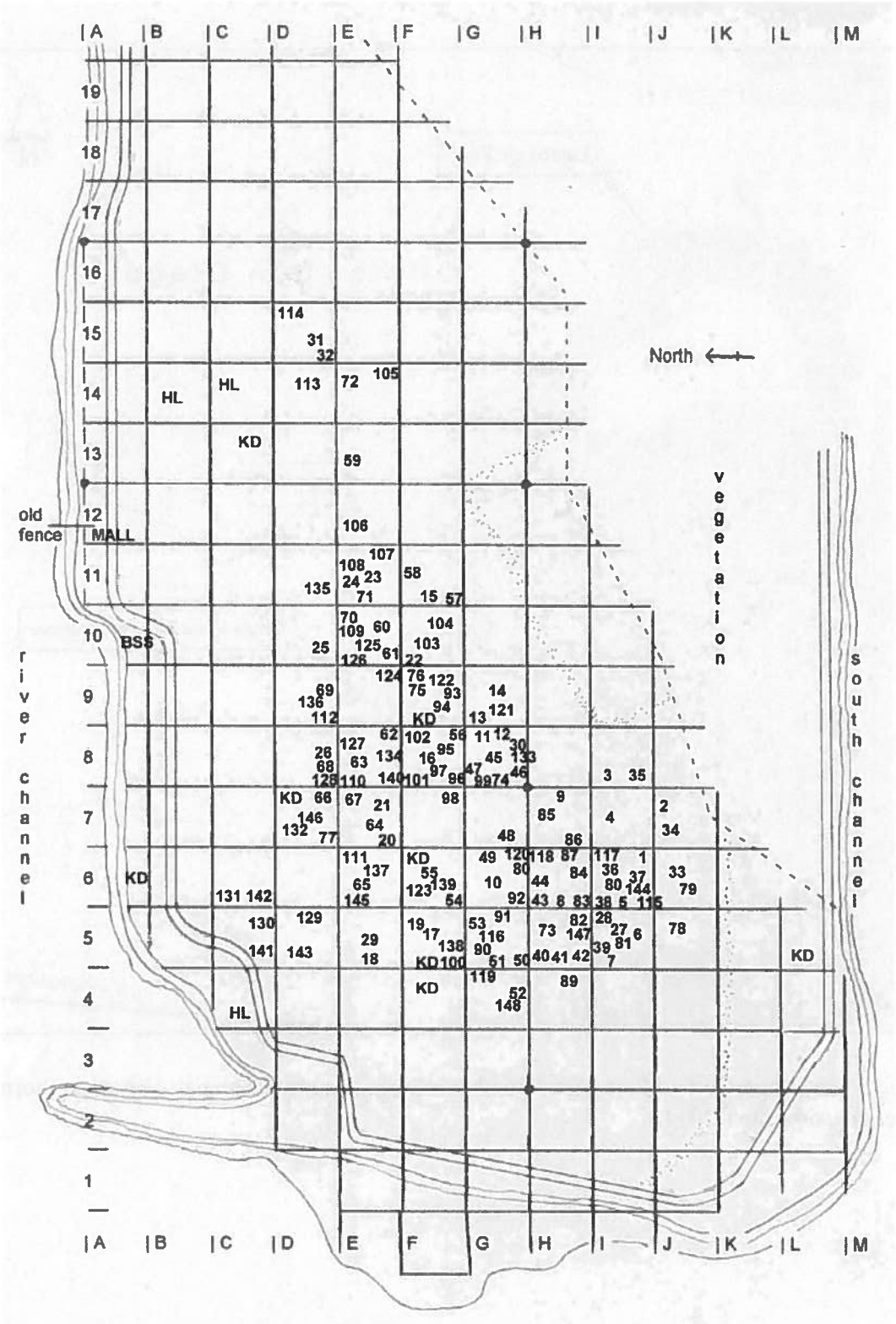


Figure 2. Least tern nest distribution, D Street Fill, 2014.

Figure 3. Least tern breeding chronology, D Street Fill, 2014.

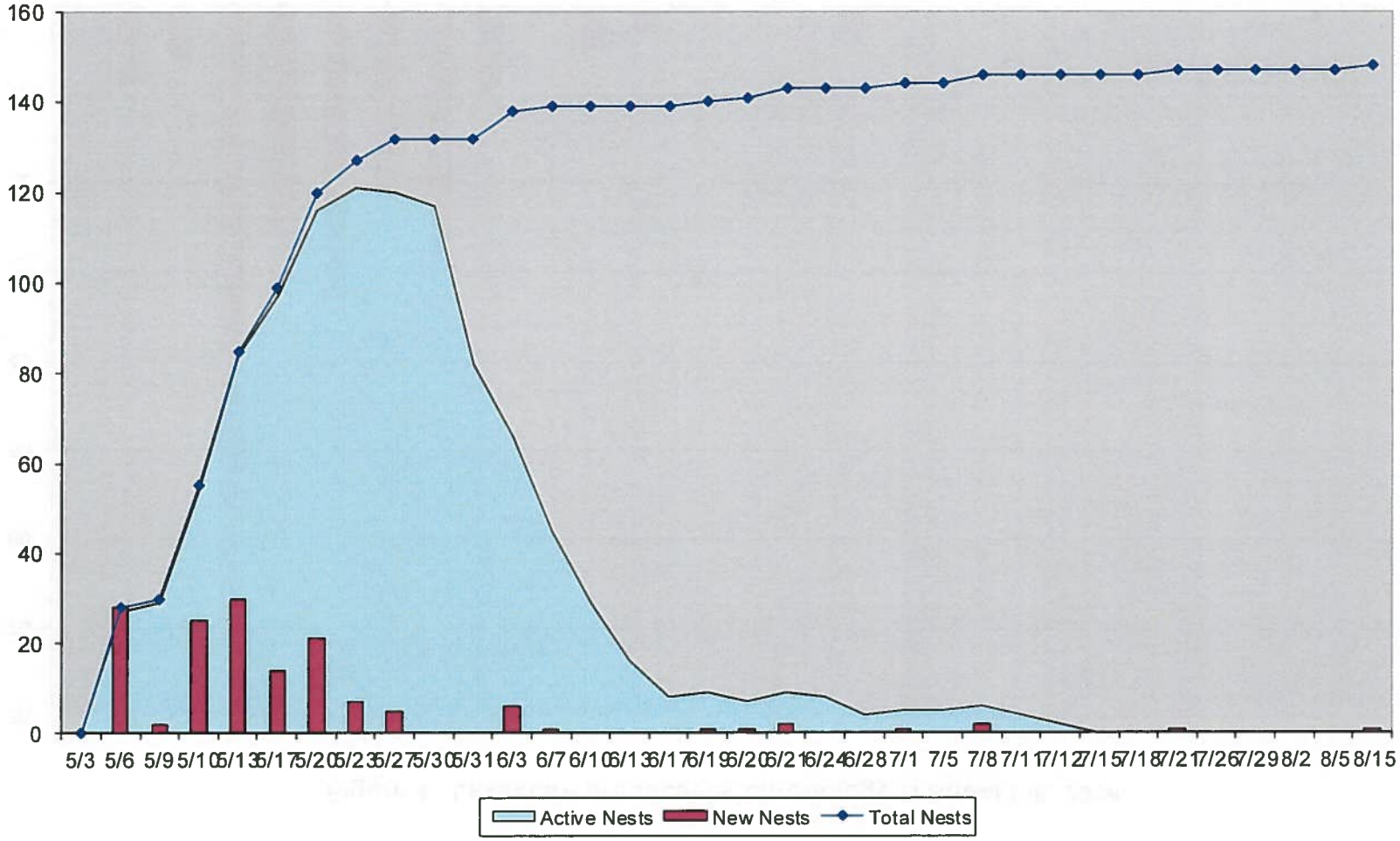
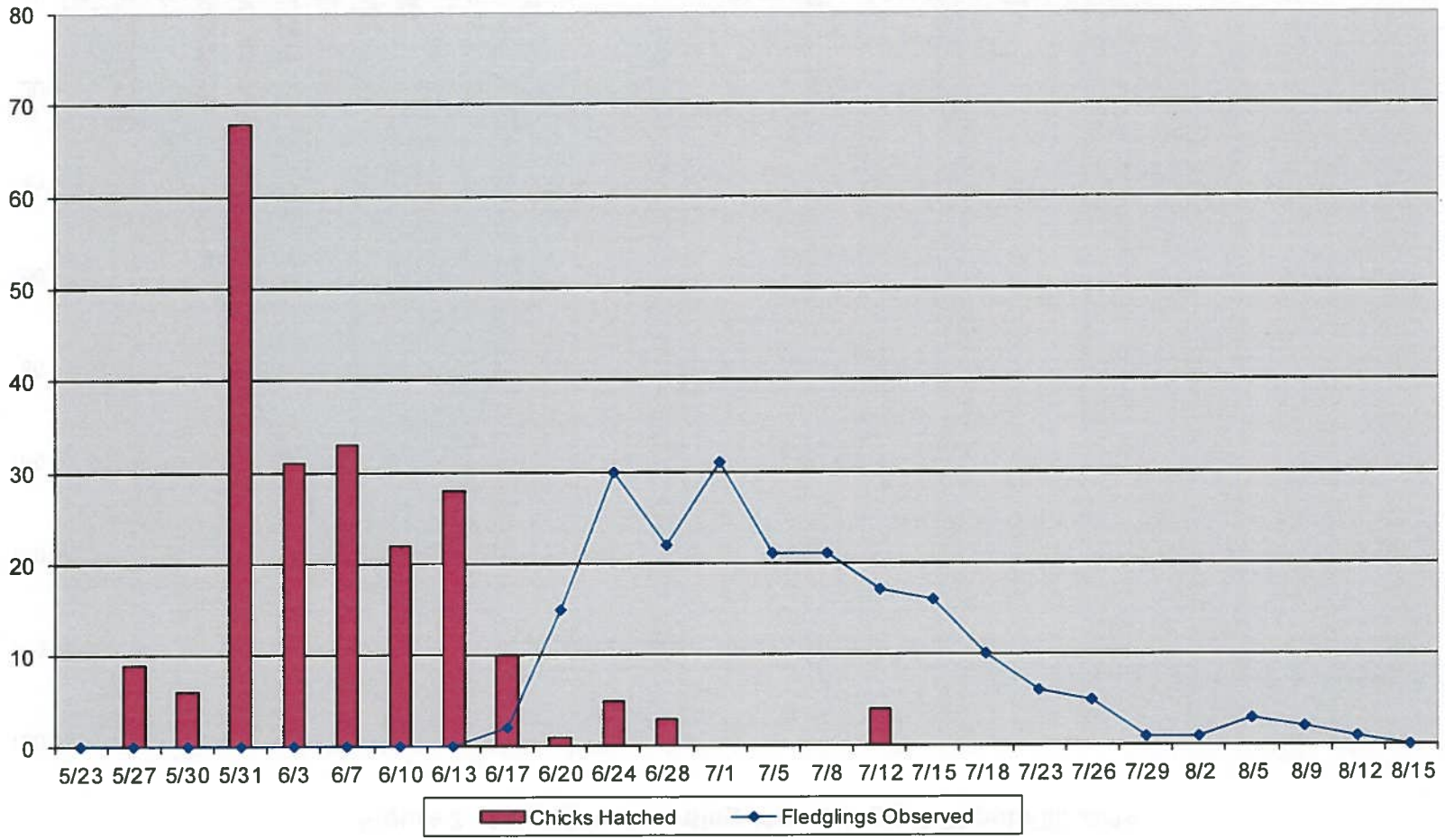


Figure 4. Least tern productivity chronology, D Street Fill, 2014.



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

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 2014.

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 late February through August, 2014, by Robert Patton, Matt Sadowski, Jennifer Jackson, Lea Squires, Brian Foster, and Elizabeth Copper. Mayra Garcia and staff of SDIA Environmental Affairs assisted at Lindbergh Field, and Brian Collins of Sweetwater Marsh NWR also monitored at D Street Fill.

Least terns were observed from 15 April through 12 August 2014 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, 335 nests were established from 6 May to 21 July. At least 85 to 109 young are estimated to have fledged from the sites, with productivity limited primarily by predation. Other limiting factors included nest abandonment, most likely related to disturbances from predators, and by unexplained mortality suspected possibly to be related to locally reduced prey availability.

Snowy plovers were observed foraging adjacent to the D Street Fill pre-season from January through mid-March, and post-season in October. A maximum number of 74 plovers were recorded foraging on the tidal flats, but there were no sightings near potential nesting habitat. Snowy plovers were recorded only twice at CVWR this season with one roosting in late May and one in mid-August.

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 repaired plastic mesh chick barriers and covers over stormdrains. Ocean Blue also capped with coarse sand the site of the previous Ryan taxiway that had separated the two halves of oval 03-S. 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 August one to three days per week. Additional monitoring was conducted associated with adjacent construction activities. 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 15 April 2014. They were observed each visit after that through 23 July. At least 100 nests were initiated by 90 to 99 estimated pairs between 6 May and 17 June. The maximum number of concurrently active nests was 89 on 27 May, and 89 nests with one brood of chicks on 29 May. At least 95 nests were established in the main nesting oval 03-S, three nests in oval 02-S, and two nests in oval 04-S.

At least 113 chicks from 65 nests hatched successfully. It is estimated that 36 to 46 chicks reached fledgling age and 30 to 41 young survived to fledge from the site. Eight eggs from seven nests were depredated, one by ants the others suspected by corvids, with common ravens scavenging 36 additional previously abandoned eggs. The outcome of ten nests with 14 eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. Seventeen nests with 24 eggs were abandoned pre-term, and four single-egg and three two-egg clutches failed to hatch and were abandoned after prolonged incubation of 36 to 47 days. One egg each at eight nests failed to hatch and was abandoned after the other egg in its clutch hatched successfully.

One fledglings and 18 chicks were found with no obvious cause of death. One fledgling was crushed by a vehicle on the adjacent perimeter road. One adult was observed being taken from the site by peregrine falcon, one was taken to Project Wildlife where it subsequently died of injuries suspected to have been caused by peregrine falcon, and a peregrine was observed taking an adult or large chick from the site. Two fledglings, a large chick/fledgling, and four chicks were observed being depredated by peregrine falcons. One to two additional chicks were suspected of being depredated by peregrines when a peregrine was seen leaving the site with small prey and when one was flushed from a nest where chicks had been previously but could not be found afterward. Piles of feathers of one to two other fledglings indicated additional peregrine predation. Four chicks were seen taken by Cooper's hawk. Nest abandonment and chick mortality coincided with regular disturbance and documented predation by Cooper's hawk and peregrine falcon, as well as disturbance and possible predation by gulls, common raven, and American crows. Although no other definitive

evidence of chick depredation was found, the lack of observations, recaptures, fledglings, and attentive adults indicates that up to 38 to 50 more chicks were likely preyed on. Other potential predators observed in the area included opossum, rats, California ground squirrel, great blue heron, black-crowned night-heron, red-tailed hawk, and European starling.

D Street Fill & Sweetwater Marsh NWR

Through late February, U.S. Fish and Wildlife Service staff applied herbicide to invasive plant species; and in mid- to late March, 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 late February through August one to three days per week.

Least terns were first observed at the D Street Fill on 15 April 2014. They were observed each visit after that through 12 August. At least 148 nests were initiated by 125 to 129 estimated pairs between 6 May and 21 July. The maximum number of concurrently active nests was 121 on 23 May, and the maximum number of concurrently active nests and broods was 120 nests with five broods of chicks on 27 May.

At least 224 chicks from 126 nests hatched successfully. It is estimated that 36 to 42 chicks reached fledgling age and 28 to 36 survived to fledge from the site. The outcome of two nests with two eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. At least three northern harriers were observed consistently within the colony coinciding with depredation of two nests with two eggs. One egg was damaged when the adult was depredated on the nest apparently by peregrine falcon. Sixteen nests with 23 eggs were abandoned pre-term, one single-egg nest and one two-egg nest were abandoned following prolonged incubation, and five eggs failed to hatch and were abandoned after the other egg in each clutch hatched successfully.

Seven fledglings and 59 chicks were found with no obvious cause of death. One additional chick was found dead being scavenged by ants, but whether ants contributed to its mortality could not be determined. The bones and feathers of two large chick/fledglings were found but it could not be determined whether they had been depredated or not. One adult was observed being taken by a red-tailed hawk, another by a peregrine falcon, and piles of feathers of four to seven additional adults suggested predation by peregrines. Tracks at the bill, forehead, and feathers of a depredated adult indicated predation by a large owl, and feathers possibly from a second adult suggested predation by either a large owl or peregrine. One chick was observed being taken by a northern harrier and a second was suspected when a harrier with small unidentified prey was seen from a distance leaving the nesting area. Three chicks were observed being taken by an American kestrel. One fledgling carcass was found with trauma to the head and either kestrel or peregrine falcon were suspected to be 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 114 to 122 chicks coincided with documented depredation and daily disturbances to the colony by northern harrier, American kestrel, and peregrine falcon, and visits by Cooper's hawk, red-tailed hawk, and barn owl. Other potential predator species observed in the area included great blue heron, great egret, black-crowned night-heron, gulls, gull-billed tern, great horned owl, common raven, American crow, European starling, western meadowlark, opossum, rats, California ground squirrel, coyote, feral cat, striped skunk, raccoon, and gopher snake.

There were no western snowy plovers documented at D Street Fill during the peak of nesting season from mid-April to mid-August, and no nests were established by snowy plovers this season. Up to 74 plovers were observed foraging on adjacent mudflats during ebbing or low tides prior to nesting season and at least 24 post-season. Band combinations observed included origins elsewhere in San Diego County and captive-reared individuals from Project Wildlife.

Chula Vista Wildlife Reserve

Prior to early April 2013 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 late February through August one to three days per week. Predator management was conducted by

USDA Wildlife Services staff.

Least terns were first observed at Chula Vista Wildlife Reserve on 15 April 2014, and on each visit through 25 July. One fledgling was observed on 12 August. At least 87 nests were initiated by 80 to 86 estimated pairs between 10 May and 20 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 was 80 on 27 May, and maximum number of concurrently active nests and broods was 80 on 31 May including 77 nests and three broods.

At least 142 chicks from 75 nests hatched successfully. It is estimated that 23 to 36 chicks reached fledgling age and 23 to 27 young survived to fledge from the site this season. The outcome of one nest with two eggs was uncertain, but lack of evidence of hatching or chick presence indicates probable depredation. Two eggs from one nest were depredated along with the adult by a barn owl. Four eggs from three other nests were depredated but species responsible could not be determined. Nine nests were abandoned pre-term, and three were abandoned after the other egg in each clutch hatched successfully. One previously abandoned egg was depredated/scavenged but species responsible could not be determined.

Two fledglings, one large chick/fledgling, and 34 chicks were found dead of undetermined causes. One adult was depredated at the nest by a barn owl, one by either a barn owl or a peregrine falcon, one was observed depredated by a peregrine, and feather piles from three others indicated additional peregrine predation. The band of one depredated chick was recovered in a regurgitated pellet in the gull-billed tern colony at South San Diego Bay saltworks. One chick was found depredated with trauma to its back but species responsible could not be determined. Two fledglings were observed being depredated by a peregrine falcon, and remains of seven others indicated predation by peregrines. 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 67 to 71 chicks coincided with repeated hunting of the site by peregrine falcons, and visits by northern harrier, American kestrel, and gull-billed tern. Other potential predator species observed in the area included great blue heron, great egret, osprey, Cooper's hawk, red-tailed hawk, gulls, Caspian tern, common raven, coyote, striped skunk, feral cat, California ground squirrel, and rats.

Snowy plovers were recorded only twice at CVWR this season with one roosting during high tide on 27 May and one on 12 August. Gull-billed terns nested for the third time at CVWR, establishing seven nests on the northwest dike; and elegant terns nested for the second time with five nests on the southwest jetty. Forster's terns established at least 315 nests, the majority of which were on the southwest jetty, with smaller sub-colonies on the northwest and northwest central dikes. Black skimmers nested for the second time at CVWR this season with 23 nests established on the northwest and northwest central dikes. Osprey successfully fledged young from the nesting platform adjacent to the east dike again this season, and a second pair began nest construction on the north end of the southwest jetty.

Appendix C. Summary of California least tern breeding at San Diego Unified Port District and San Diego County Regional Airport Authority sites, 2014.

	SDIA-LF	D St Fill	CVWR
Date terns first observed	4/15	4/15	4/15
Date terns last seen	7/23	8/12	8/12
Date of first nest	5/6	5/6	5/10
Date last nest found	6/17	8/15	6/20
Date last nest established	6/17	7/8	6/20
Date of first hatch	5/29	5/27	5/31
Date of last hatch	6/24	7/12	6/28
Date of first fledgling	6/17	6/17	6/20
Estimated number of pairs	90-99	125-129	80-86
Total number of nests	100	148	87
Total number of eggs	180	260	166
Clutch size:			
1 egg	20	36	8
2 egg	80	112	79
3 egg	0	0	0
4 egg	0	0	0
unknown (min. 1 egg)	1	0	0
Average clutch size	1.80	1.76	1.91
No. of nests hatching young*	65	126	75
Total number of eggs hatched	113	224	142
Estimated number of fledglings	34-46	28-36	23-27
Number of chicks banded	99	145	107
Number of adults banded	2	3	1
Uncertain outcome			
Nests*	10	2	1
Eggs	14	2	2
Documented Mortality			
Preyed upon			
Nests*	7	3	4
Eggs**	8	3	6
Chicks	9-10	4-7	2
Fledglings	3-4	1	9
Adults	2	7-11	6
Human disturbance			
Nests*	0	0	0
Eggs	0	0	0
Chicks	0	0	0
Fledglings	1	0	0
Adults	0	0	0
Other causes			
Nests*			
Abandoned (pre-term)	17	16	9
Failed to hatch (incubated to term)	15	7	3
Died hatching	2	0	0
Damaged (eggshell thinning)	0	0	0
Flooded	0	0	0
Eggs			
Abandoned (pre-term)	24	23	13
Failed to hatch (incubated to term)	18	8	3
Died hatching	3	0	0
Damaged (eggshell thinning)	0	0	0
Flooded	0	0	0
Chicks	18	59-62	35
Fledglings	1	7	2
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, 2003-2014.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Date terns first observed	4/16	4/20	4/21	4/19	4/23	4/22	4/21	4/20	4/19	4/16	4/22	4/15
Date terns last seen	8/1 (8/12 bay)	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
Date of first nest	5/8	5/11	5/4	5/15	5/15	5/16	5/10	5/4	5/10	5/8	5/13	5/6
Date last nest found	6/28	7/6	7/5	8/1	7/11	7/18	8/11	7/20	7/19	7/3	8/6	6/17
Date last nest established	6/28	7/6	7/5	7/18	7/11	7/18	7/2	7/2	6/24	7/3	7/16?	6/17
Date of first hatch	5/29	6/1	5/31	6/13	6/10	6/6	6/2	6/2	5/31	5/31	6/7	5/29
Date of last hatch	7/9	7/1	7/19	8/1	7/18	7/21	7/7	7/15	7/5	7/6	7/16	6/24
Date of first fledgling	6/17	6/28	6/20	7/8	7/2	6/30	6/22	6/22	6/21	6/21	7/2	6/17
Estimated number of breeding pairs	45-50	65-70	121-150	114	120-127	122-124	136	110	66-76	96-124	90-95	90-99
Total number of nests	53	76	157	131	135	139	145	116	78	130	114	100
Total number of eggs	96	126	278	207	238	238	268	211	141	197	159-166	180
Clutch Size												
1 egg	10	27	39	55	33	43	26	23	15	63	64-71	20
2 egg	43	48	115	76	101	94	116	91	126	67	42-49	80
3 egg	0	1	3	0	1	1	2	2	0	0	0	0
4 egg	0	0	0	0	0	1	1	0	0	0	1	0
Average clutch size	1.83	1.66	1.77	1.53	1.76	1.71	1.85	1.82	1.81	1.54	1.42-1.46	1.80
No. of nests hatching young*	43	42	128	81	93	112	103	88	66	84	80	65
Total number of eggs hatched	80	78	221	124	156	193	183	161	118	136	109	113
Estimated number of fledglings	35-46	10-17	45-85	54-65	34-42	115-128	36-38	29-38	11-15	36	34	34-46
Number of chicks banded	71-72	62	183	120	116	167	138	144	93	110	85	99
Number of adults banded	0	0	0	0	0	12	3	12	7	0	1	2
Uncertain outcome												
Nests*	1	14	2	4	3	3	9	3	1	9	3	10
Eggs	1	19	4	7	5	3	16	4	2	9	3-7	14
Documented Mortality												
Preyed upon:												
Eggs**	0	5	3	56	24	14	11	11	0	6	5	8
Chicks	2	8	15	8	15	2	0	5	23	3	8	9-10
Fledglings	0	0	11	13-14	3-4	1	3	3	7	0	1	3-4
Adults	1	0	1	4-8	1-2	2	2	3	1	1	6	2
Other than preyed upon:												
Eggs												
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	3	1	15	8	13	20	12	10	9	2	4	18
Died hatching	0	0	0	0	1	0	0	1	0	1	0	3
Abandoned (pre-term)	9	23	16	12	40	9	46	23	12	42	38	24
Flooded	0	0	0	0	0	0	0	0	0	0	0	0
Chicks	7	15	21	1	12	19	46	36	10	47	13	18
Fledglings	6	0	10	1	3	5	2	6	0	3	4	1
Adults	3	0	1	0	1	0	0	2	1	1	0	0
Nests												
Human damaged*	0	0	0	0	0	0	0	0	0	0	0	0
Preyed upon*	0	5	2	37	18	11	7	8	0	5	5	7
Failed to hatch*	3	1	15	8	13	16	11	9	8	2	4	15
Abandoned (pre-term)*	7	16	16	10	26	8	31	18	9	35	27	17
Flooded	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-2. Summary of California least tern breeding at D Street Fill, 2005-2014.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Date terns first observed	4/19	4/19	4/19	4/18	4/22	4/22	4/21	4/16	4/19	4/12	4/16	4/15
Date terns last seen	8/14	8/26	8/1	8/14	8/20	8/13	7/28	7/30	8/15	8/6	8/13	8/12
Date of first nest	5/8	5/18	5/10	5/16	5/15	5/10	5/8	5/4	5/6	5/5	5/7	5/6
Date last nest found	7/8	7/20	7/8	7/11	8/20	7/18	8/11	6/29	7/2	7/10	7/23	8/15
Date last nest established	7/8	7/20	7/8	7/11	7/17	7/16	6/27	6/29	7/2	7/10	7/22	7/8
Date of first hatch	6/3	6/8	6/4	6/9	6/8	6/3	5/29	5/25	5/27	5/26	6/1	5/27
Date of last hatch	7/8	7/13	6/28	7/25	7/24	7/22	7/14	7/2	7/8	7/3	7/19	7/12
Date of first fledgling	6/24	7/6	6/28	7/4	6/30	6/24	6/19	6/15	6/21	6/22	6/25	6/17
Estimated number of breeding pairs	62-85	77-94	77-97	88-94	100-115	133-135	129	117	100-113	78-93	96-113	125-129
Total number of nests	91	111	101	100	130	148	132	119	116	114	144	148
Total number of eggs	148	163	161	140	214	262	229	227	217	162	215	260
Clutch Size												
1 egg	34	59	42	60	47	34	35	11	15	66	73	36
2 egg	57	52	58	40	82	114	97	108	101	48	71	112
3 egg	0	0	1	0	1	0	0	0	0	0	0	0
Average clutch size	1.63	1.47	1.59	1.40	1.65	1.77	1.73	1.91	1.87	1.42	1.49	1.76
No. of nests hatching young*	58	71	79	74	91	124	110	83	97	47	114	126
Total number of eggs hatched	100	105	122	98	160	223	189	158	174	65	174	224
Estimated number of fledglings	12-19	4-17	9-17	18-29	25-28	17-24	19-29	15-27	25-32	9	23-32	28-36
Number of chicks banded	69	52	79	52	83	129	122	86	112	41	108	145
Number of adults banded	0	0	0	0	0	5	0	4	2	7	1	3
Uncertain outcome												
Nests*	3	19	3	5	5	6	11	27	2	16	5	2
Eggs	6	23	5	7	9	8	16	51	4	20	7	2
Documented Mortality												
Preyed upon:												
Eggs**	5	5	11	14	14	2	0	5	14	21	1	3
Chicks	1	7	8	2	9-12	11	8-11	14	4-7	6	4-8	4-7
Fledglings	2	0	1	1	4	0	1	1	1	0	3	1
Adults	5-6	0	1	1	2	0	5	1	3-4	0	0	7-11
Other than preyed upon:												
Eggs												
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	3	4	7	6	3	9	8	5	6	4	3	8
Died hatching	2	0	0	0	0	0	2	0	3	0	3	0
Abandoned (pre-term)	32	26	16	16	28	20	14	8	16	52	27	23
Flooded	0	0	0	0	0	0	0	0	0	0	0	0
Chicks	16	10	17	8	7	12	12	28	40	16	54-58	59-62
Fledglings	4	0	1	0	5	0	0	11	9	0	11	7
Adults	1	0	1	0	0	0	0	0	0	1	0	0
Nests												
Human damaged*	0	0	0	0	0	0	0	0	0	0	0	0
Preyed upon*	3	5	7	10	11	2	0	3	9	14	1	3
Failed to hatch*	3	4	7	6	3	6	8	4	6	4	3	7
Abandoned (pre-term)*	26	22	12	13	24	16	11	5	11	40	22	16
Flooded	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

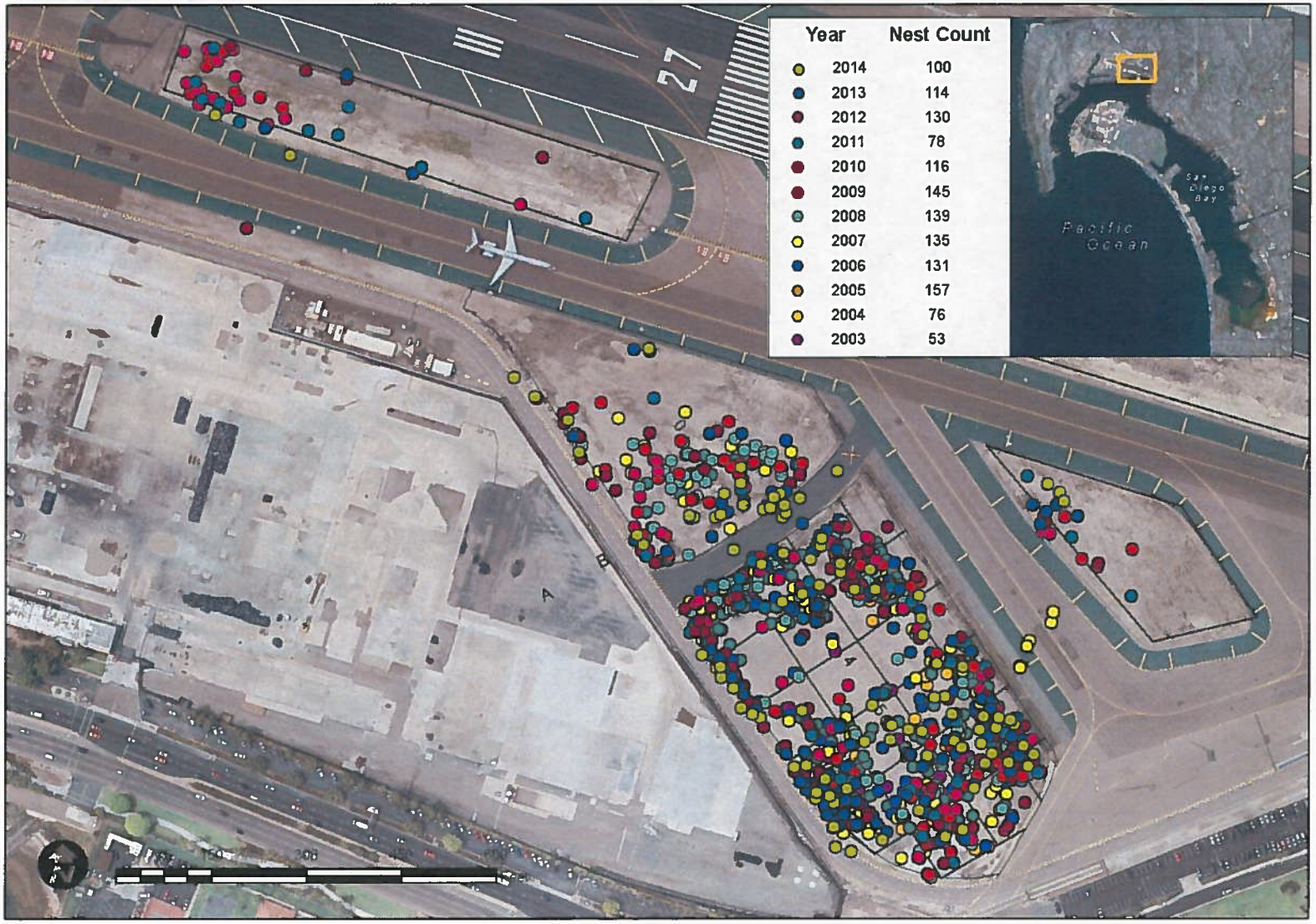
Appendix C-3. Summary of California least tern breeding at Chula Vista Wildlife Reserve, 2003-2014.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Date terns first observed	4/24	4/20	4/26	4/21	4/23	4/9	4/24	4/22	4/19	4/12	4/13	4/15
Date terns last seen	8/14	9/5	7/29	8/14	8/15	8/29	8/4	8/2	8/24	9/13	8/19	8/12
Date of first nest	5/15	5/15	5/17	5/30	5/15	5/16	5/12	5/11	5/13	5/12	5/13	5/10
Date last nest found	7/1	7/13	7/1	7/4	7/10	7/8	7/10	6/29	7/19	7/10	7/2	6/20
Date last nest established	7/1	7/13	7/1	7/4	7/3	7/8	7/10	6/29	7/16	7/10	7/2	6/20
Date of first hatch	6/5	6/5	6/10	6/20	6/8	6/6	6/2	6/1	6/3	6/2	6/4	5/31
Date of last hatch	7/16	7/24	7/1	7/22	7/20	7/26	7/24	7/2	7/18	7/31	7/16	6/28
Date of first fledgling	6/24	7/13	7/5	8/4	7/17	8/15	6/23	6/29	6/21	6/29	6/25	6/20
Estimated number of breeding pairs	22-25	30-48	44-53	12-13	33-39	28	37	32	34-47	29-37	58-66	80-86
Total number of nests	31	66	57	15	46	33	48	40	53	64	79	87
Total number of eggs	52	103	101	25	81	60	86	76	100	98	129	166
Clutch Size												
1 egg	10	30	13	5	11	7	11	4	6	30	29	8
2 egg	21	35	44	10	35	25	36	36	47	34	50	79
3 egg	0	1	0	0	0	1	1	0	0	0	0	0
Average clutch size	1.68	1.56	1.77	1.66	1.76	1.82	1.79	1.9	1.89	1.53	1.63	1.91
No. of nests hatching young*	10	47	40	9	24	18	22	21	39	36	66	75
Total number of eggs hatched	18	73	74	17	42	32	40	41	75	55	106	142
Estimated number of fledglings	6-8	11-18	2	2	0	2	4-5	2	12-19	18-20	32-39	23-27
Number of chicks banded	15	44	46	10	23	16	18	16	40	43	94	107
Number of adults banded	0	0	0	0	0	7	5	7	1	2	4	1
Uncertain outcome												
Nests*	7	11	3	2	0	11	16	5	10	9	0	1
Eggs	11	13	5	3	0	17	28	10	15	11	0	2
Documented Mortality												
Preyed upon:												
Eggs**	11	0	9	3	36	6	8	21	4	9	2	6
Chicks	1	2	1	0	2	2	2	8-9	5-7	5	1-2	2
Fledglings	0	0	0	0	0	1	0	0	1	2	2	9
Adults	0	1-2	0	1	0	0	0	0	3	2-3	3	6
Other than preyed upon:												
Eggs												
Human Damaged	0	0	0	0	0	0	0	0	0	0	0	0
Failed to hatch (incubated to term)	2	3	5	0	1	4	3	0	1	1	9	3
Died hatching	0	1	0	0	0	1	2	0	0	0	0	0
Abandoned (pre-term)	10	13	8	2	2	0	5	2	5	22	12	13
Flooded	0	0	0	0	0	0	0	0	0	0	0	0
Chicks	0	1	5	0	0	0	2	1	2	3	28-29	35
Fledglings	0	0	0	0	0	0	0	1	0	0	3	2
Adults	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
Preyed upon*	8	0	6	3	21	4	7	11	2	6	1	4
Failed to hatch*	1	2	5	0	1	4	5	0	1	1	8	3
Abandoned (pre-term)*	7	9	7	2	2	0	4	2	4	17	10	9
Flooded	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

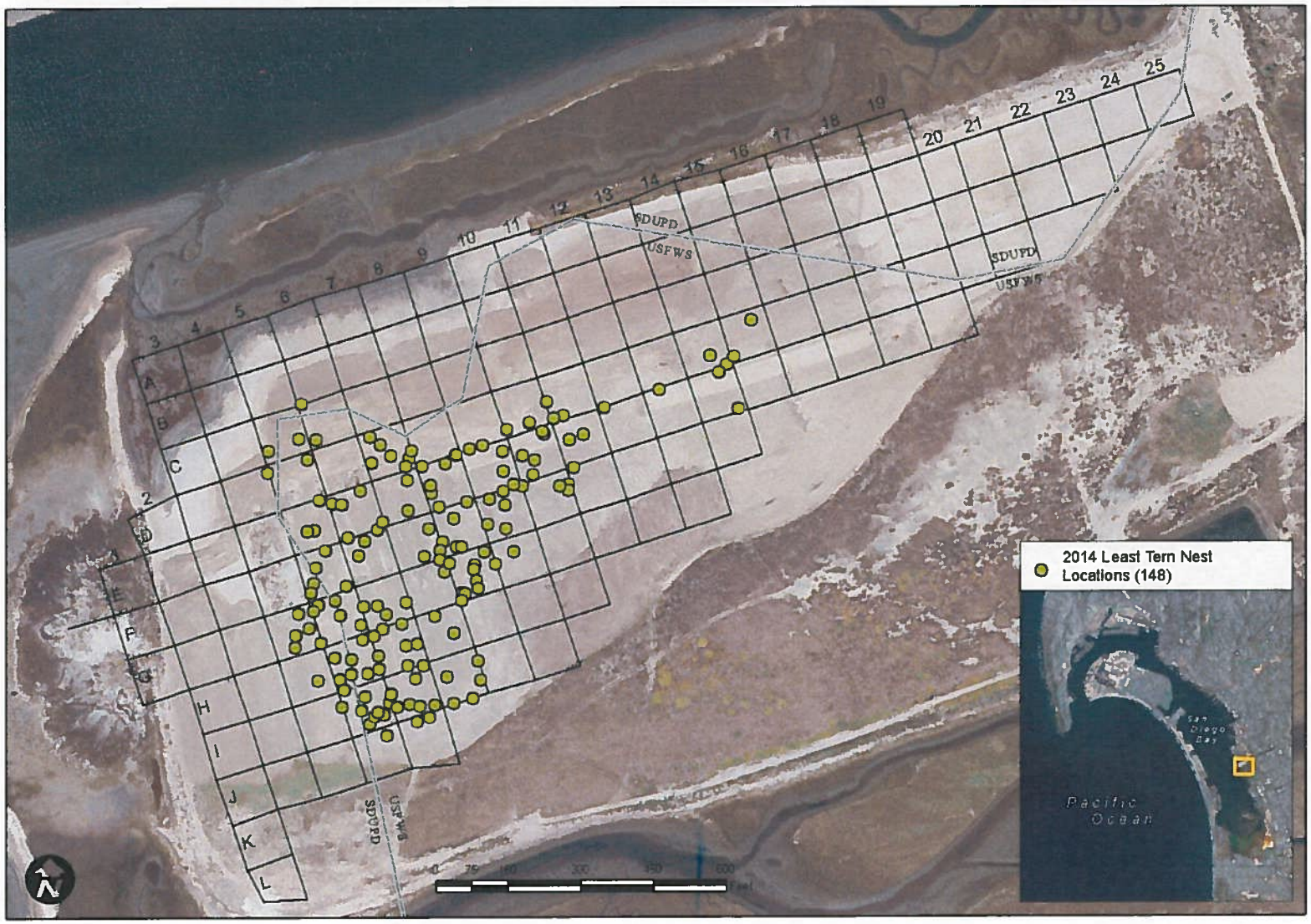
Least Tern Nests: San Diego International Airport 2003 - 2014



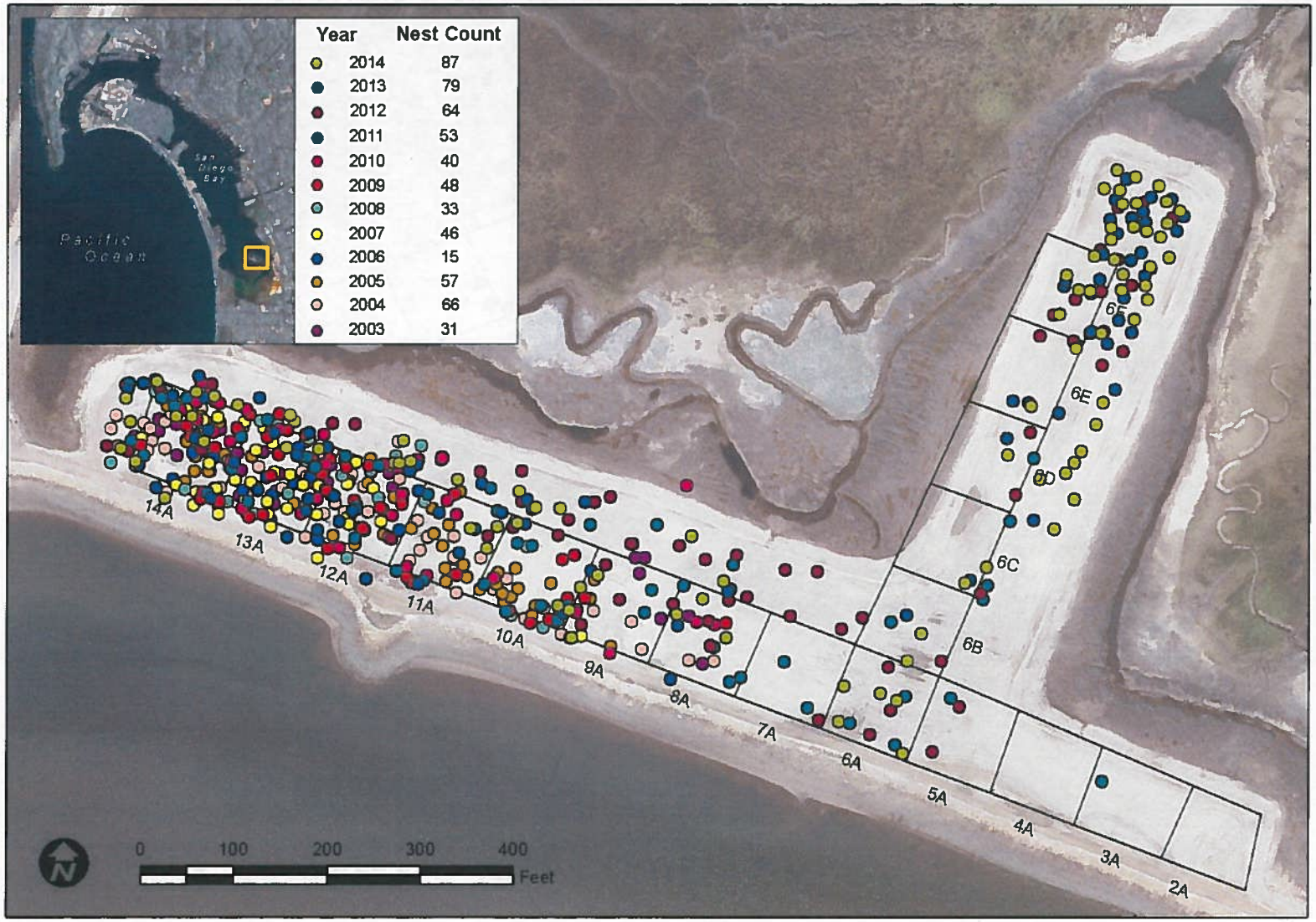
Least Tern Nests: San Diego International Airport 2014

Least Tern Nests: D Street 2003 - 2014

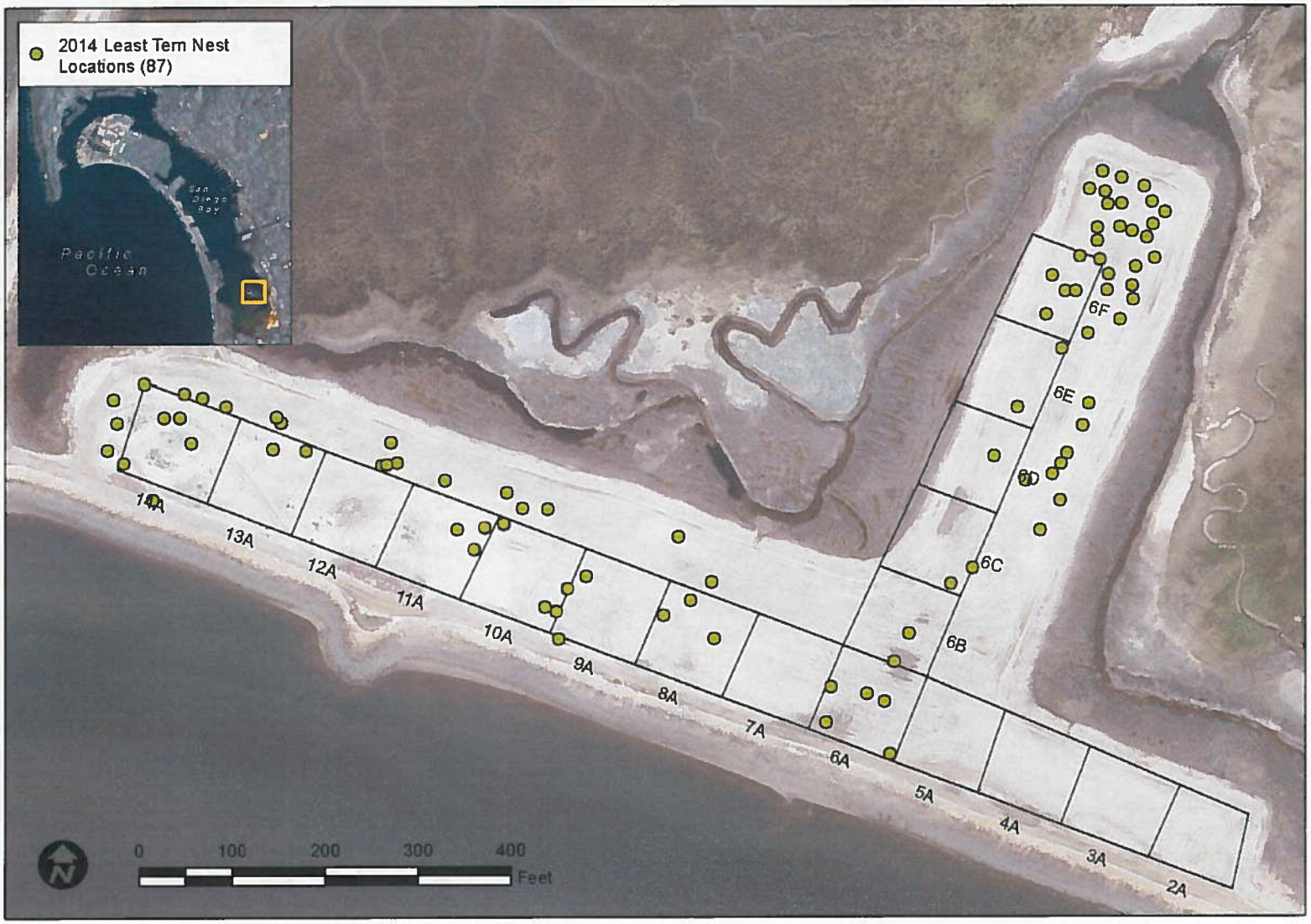
Least Tern Nests: D Street 2014



Least Tern Nests: Chula Vista Wildlife Reserve 2003-2014



Least Tern Nests: Chula Vista Wildlife Reserve 2014



Appendix D. Distribution of nests of California least tern and western snowy plover at D Street Fill, 1997-2014.

	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

Appendix E-1. Numbers of western snowy plovers and band combinations observed at D Street Fill, 2014.

Color code: B=blue, K=black, L=lime, P=pink, R=red, S=service, Y=yellow.

Date	Number of Plovers	Bands
1/20	0	(high tide)
1/20	74	(ebbing tide)
2/27	9	
3/11	9	KK-R/YB/P, S-L/K, S-X
3/13	18	KK-R/YB/P
3/17	1	
3/24	0	
4/13	0	
4/19	0	
4/23	0	
4/27	0	
5/6	0	
5/13	0	
5/20	0	
5/27	0	
6/3	0	
6/10	0	
6/17	0	
6/24	0	
7/8	0	
7/15	0	
7/22	0	
8/5	0	
8/12	0	
8/15	0	
8/21	0	
9/27	0	
10/8	24	

Appendix E-2. Western snowy plover band combinations observed at D Street Fill, 2014.
Color code: B=blue, K=black, L=lime, P=pink, R=red, S=service, Y=yellow.

Date(s)	Bands	Origin
3/11, 3/13	KK-R/YB/P	Project Wildlife captive-reared, 2013
3/11	S-L/K	Project Wildlife captive-reared, 2010; lost A band and K tape from S band
3/11	S-X	San Diego County