# Western Snowy Plovers and California Least Terns on the Guadalupe-Nipomo Dunes National Wildlife Refuge 2016 Breeding Season Final Report

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## Summary

This report summarizes western snowy plover (plover) and California least tern (tern) monitoring on the Guadalupe-Nipomo Dunes National Wildlife Refuge (Refuge) during the 2016 breeding season. Monitoring for breeding activities was conducted on coastal beaches and adjacent dunes by Thomas Applegate (Wildwing Recovery Permit # TE-823990-4) under contract to the U.S. Fish and Wildlife Service.

Plovers were monitored between April 6 and August 30, 2016. Twenty-nine field surveys were conducted during the period. Tern monitoring was conducted concurrently with plover monitoring during the time that breeding terns would be expected to be present. Thirty-five plover nests and no tern nests were discovered on the Refuge during the breeding season. The first known nest was initiated on approximately April 2, and the last on approximately July 13. Twenty-one nests hatched, and produced 51 chicks. Of the remaining 14 nests, 6 were lost to predators, 3 were abandoned, 2 were destroyed by unknown causes, and the fates of 3 nests were not determined. The first known hatch occurred on approximately May 1, and the last hatch occurred on August 2. May 28 was the earliest expected fledge date for the 2016 chicks, and the last date for expected fledging was approximately August 29. Color banding of chicks did not occur on the Refuge in 2016, so chick survival information was not collected.

## Introduction

The Pacific coast population of western snowy plovers (*Charadrius nivosus nivosus*), nest near tidal waters of the Pacific Ocean, on coastal sand beaches and dunes, adjacent bays, and coastal river bars, along the Washington, Oregon, California, and Mexico coastlines. The current known breeding range is from Damon Point, Washington to Bahia Magdalena, Baja California, Mexico. Snowy plovers that nest inland at alkaline lakes, ponds and river bars in the western states are not considered part of the coast population. The U.S. Fish and Wildlife Service (USFWS) designated the Pacific Coast population as "Threatened" on March 5, 1993 (Federal Register 58(42)12864-12874) under provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

California least terns (*Sterna antillarum brownii*) utilize suitable breeding habitat from Baja California, Mexico to the San Francisco Bay area in California. Terns nest on open sand, sand-shell beaches, and sand-fill sites where little to no vegetation exists. Breeding colonies are typically located within close proximity to estuaries or waterways where birds forage for small fish. Terns tolerate a considerable range in colony sizes. Some colonies have hundreds of birds, while some pairs nest alone or with only a few other

pairs. The species was given both state and federal endangered status in 1970 (Federal Register 35 (106)8491-8498) under the provisions of the Endangered Species Conservation Act of 1969 (16 USC 851 *et seq*.). Terns may be present in breeding areas from mid May through August, and are absent the remainder of the year.

The Refuge was established on August 1, 2000 by the USFWS and contains suitable breeding habitat for plovers and terns, and wintering habitat for plovers. Prior to 2000, some sporadic, non-intensive surveys by various individuals were conducted on the now Refuge. While plover nesting was documented, no data from this earlier period has been cited in this report. Monitoring of plovers and terns began on the Refuge in March 2001, and documented that the Refuge supported a plover breeding population (Barr and Machado, 2001). In 2002, a more intensive monitoring program using standardized monitoring methods was initiated and continued through 2013. Monitoring did not occur in 2014 or 2015. Monitors have not documented tern nesting on the Refuge even though suitable habitat exists. Terns traverse the Refuge, forage offshore, regularly nest 3 miles to the north at Oceano Dunes State Vehicular Recreation Area (ODSVRA), and periodically nest 2 miles south at Rancho Guadalupe Dunes Preserve (RGDP).

The plover breeding season begins on March 1 and ends on September 30. Nest initiations can begin in early March, but typically the first nests are not initiated until late March or early April. The last nests are initiated by mid July, and hatch by mid August, with the chicks fledging by mid September. Plovers are present year round on the Refuge.

## Study Area

The Refuge is located in southwestern San Luis Obispo County, California and is part of the 18 mile Guadalupe-Nipomo Dunes Complex that stretches from Point Sal in Santa Barbara County to Pismo Beach in San Luis Obispo County. The 2,553–acre Refuge includes approximately 1.8 linear miles of beach and other habitats suitable for breeding and wintering plovers (Appendix 1). Breeding habitat consists of coastal beach strand, unvegetated and partially vegetated foredunes, sand blowouts, and active sand sheets. Breeding habitat extends north of the Refuge on Oceano Dunes State Vehicular Recreation Area, and south through the Guadalupe Restoration Project, Rancho Guadalupe Dunes Preserve, and the Leroy Trust property.

Open sand beaches on the Refuge vary in width from approximately 50 to 150 feet, and vary seasonally. Beaches are typically littered with detritus in the form of logs, branches, plant debris, kelp, rock, shells, and human litter. Foredune habitat consists of low sand hillocks and small dunes with blowouts leading to the backdunes. The foredunes are

vegetated with native and non-native plants, and the backdunes vary from open sand expanses to heavily vegetated areas. Strong west and northwesterly winds are common on the Refuge in spring, but generally decrease as the season progresses.

The suitability of breeding habitat varies with density of vegetation and seasonal beach erosion. Non-native invasive plants adversely affected habitat in many areas. The dominant native plant species within plover breeding habitat on the Refuge are sand verbena (*Abronia latifolia, A. maritima*), beach saltbrush (*Atriplex leucophylla*), beach morning glory (*Calystegia soldanella*), and beach bur (*Ambrosia chamissonis*). Dominant non-native invasive species are sea rocket (*Cakile maritima*), European beachgrass (*Ammophila arenaria*) and sea fig (*Carpobrotus chilensis*).

## Methods

### Western Snowy Plovers

Plover monitoring was conducted in suitable habitat from April 6 to August 30, 2016. Five surveys were conducted in April, 6 in May, 7 in June, 5 in July, and 6 in August. In an attempt to avoid frequent high afternoon winds, most surveys were conducted during morning and early afternoon hours. Late in the season when high winds became less frequent, some afternoon surveys were conducted. All surveys were conducted on foot. Access was from Rancho Guadalupe Dunes Preserve 2 miles south of the Refuge. Each survey involved 8 to 12 miles of walking.

An attempt was made to locate all plover nests. “Nests” include scrapes containing 1 or more eggs, and empty scrapes with convincing evidence that one or more eggs had been present. Empty scrapes without evidence of eggs or chicks, and single "dumped" eggs were not counted as nests. Nests were consecutively numbered and all pertinent information including location, and number of eggs was recorded. Regular subsequent visits to each known nest were made, and the nest status was recorded. Nests were not physically marked: their locations were recorded using existing landmarks. In late August nest locations were recorded using GPS equipment.

Nest fates were determined by evidence at the sites. Those disappearing before their expected hatch date were examined for probable cause of loss. Empty nests near or past their expected hatch date were checked for chicks in the vicinity of the nest, displaying adults, eggshell pips in the nest, a flattened nest area, or for evidence of predators or other causes of loss. Hatch dates were estimated by known or estimated egg laying dates, and were projected 31 days after clutch initiation (Warriner et.al., 1986). Eggs in

nests that were found containing 3 eggs were floated to determine estimated initiation and hatch dates. Nest exclosures were not used during the 2016 season.

As part of a coordinated range-wide survey, a snowy plover census was conducted on May 20. This yearly census is coordinated by the U.S. Fish and Wildlife Service and is scheduled to occur when the population is expected to be stable and consist primarily of breeding plovers. Census data includes plover age, sex, location, the number and size of accompanying chicks, and color-bands.

### California Least Terns

Tern monitoring was conducted concurrently with plover monitoring. Searches for least terns began in mid May and extended through late August. When least terns were observed, their numbers, location and activities were recorded. Least terns did not nest on the Refuge in 2016 so nest data was not recorded.

## Results

### Western Snowy Plovers

#### Population

A plover population census was conducted on May 20. Fourteen adult plovers and 3 chicks were observed on the Refuge. Five adults were males, 8 were females and 1 adult was of an undetermined sex. Three adult females were color banded. Bands were PV:YG, VV:RG, NO:PB (Appendix 2).

Late May population censuses have been conducted 12 times between 2002 and 2016 (Table 1, Figure 1). The number of plovers observed on these censuses is not considered the total number using the Refuge since they are not easily detected due to the expansive topography and the evasiveness and mobility of plovers. Nest data shows that at the time of the census, approximately 11 pairs (22 plovers) were nesting on the Refuge.

The number of nesting snowy plovers on the Refuge was estimated bi-weekly from active nest data. The estimate includes only nesting plovers and does not include breeding birds that were rearing broods or in the process of nest initiations. A peak number of 16 nesting pairs were present in late May (Table 2).

**Table 1. Number of adult plovers observed during breeding season range-wide window surveys 2002–2009, 2011-2013, and 2016.**

| Year | Total Adult | Male | Female | Adult Unk. Sex | Unknown Age |
|---|---|---|---|---|---|
| 2016 | 14 | 5 | 8 | 1 | 0 |
| 2013 | 9 | 3 | 6 | 0 | 0 |
| 2012 | 14 | 6 | 8 | 0 | 0 |
| 2011 | 27 | 13 | 14 | 0 | 0 |
| 2009 | 14 | 9 | 5 | 0 | 0 |
| 2008 | 25 | 14 | 11 | 0 | 0 |
| 2007 | 7 | 4 | 3 | 0 | 0 |
| 2006 | 32 | 17 | 13 | 2 | 0 |
| 2005 | 25 | 12 | 11 | 2 | 0 |
| 2004 | 31 | 15 | 14 | 2 | 0 |
| 2003 | 26 | na* | na* | na* | na* |
| 2002 | 18 | 8 | 9 | 0 | 1 |
| Total | 242 | 106 | 102 | 7 | 1 |

*data not available.

**Figure 1. Number of adult plovers observed during breeding season range-wide window surveys 2002-2009, 2011-2013, and 2016.**

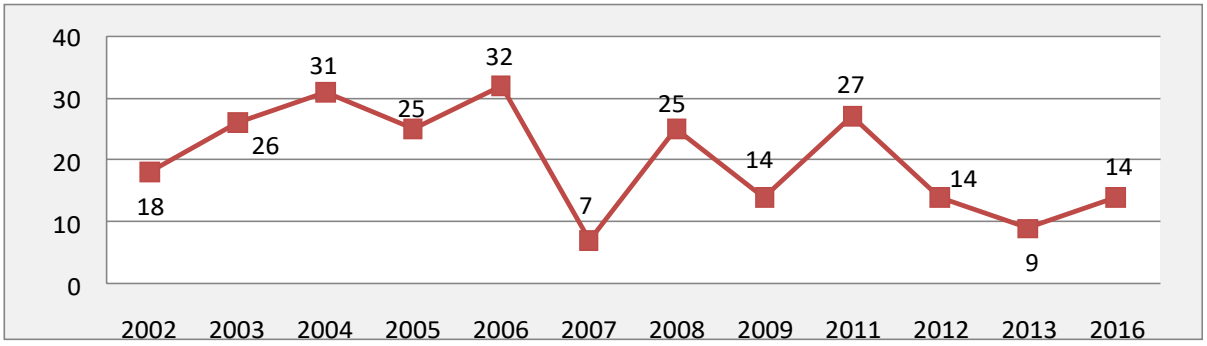



**Table 2. Estimated number of breeding snowy plover pairs on the Refuge in 2016.**

| March | | April | | May | | June | | July | | August | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late |
| 0 | 0 | 3 | 9 | 14 | 16 | 15 | 15 | 11 | 7 | 3 | 0 |

## Nesting

Thirty-five plover nests were located during the 2016 breeding season (Appendix 1, Figure 2). The first known nest was initiated on approximately April 2 and the last on approximately July 13. Nine nests were initiated in April, 10 in May, 13 in June, and 3 nests were initiated in July (Table 3).

**Figure 2. Total number of snowy plover nests initiated during the 2002 through 2013 and 2016 breeding seasons.**

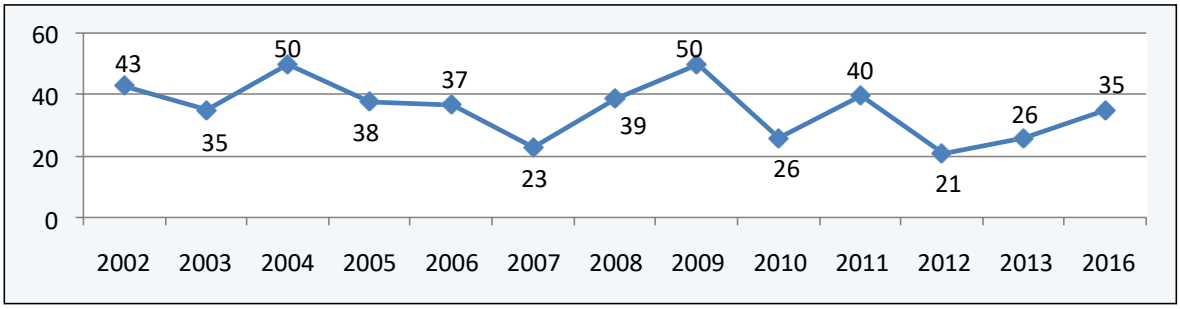



**Table 3. Number of nest initiations by month during the 2002-2013 and 2016 breeding seasons*.**

| Year | March | April | May | June | July | Total |
|---|---|---|---|---|---|---|
| 2016 | 0 | 9 | 10 | 13 | 3 | 35 |
| 2013 | 1 | 14 | 2 | 4 | 5 | 26 |
| 2012 | 0 | 3 | 10 | 7 | 1 | 21 |
| 2011 | 4 | 11 | 16 | 9 | 0 | 40 |
| 2010 | 3 | 8 | 9 | 5 | 1 | 26 |
| 2009 | 5 | 18 | 13 | 7 | 7 | 50 |
| 2008 | 4 | 6 | 12 | 15 | 2 | 39 |
| 2007 | 2 | 5 | 6 | 5 | 5 | 23 |
| 2006 | 0 | 14 | 8 | 11 | 4 | 37 |
| 2005 | 1 | 9 | 13 | 13 | 2 | 38 |
| 2004 | 1 | 9 | 11 | 26 | 1 | 48 |
| 2003 | 4 | 4 | 7 | 17 | 2 | 34 |
| 2002 | 2 | 7 | 14 | 14 | 6 | 43 |
| Total | 27 | 117 | 131 | 146 | 39 | 460 |
| Mean | 2 | 9 | 10 | 11 | 3 | 35 |

*Nests with known or estimated initiation dates only.

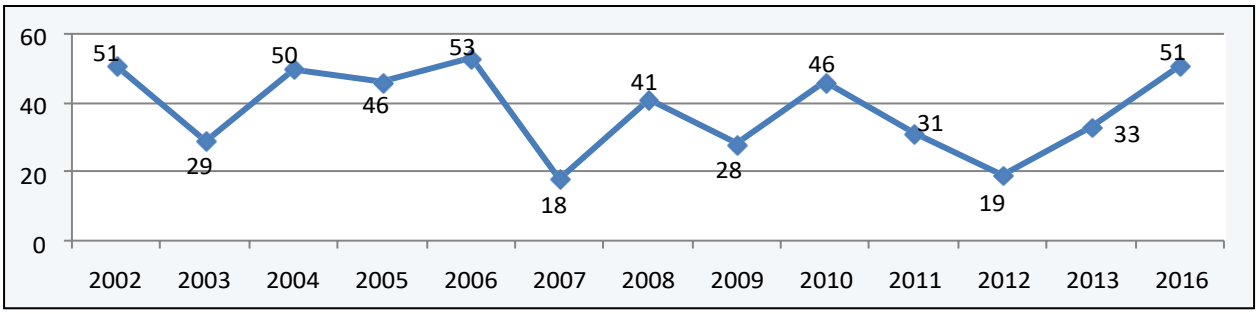
The fates of 32 nests were determined (Table 4). Twenty-one nests hatched (60%), 6 were lost to predators (17%), 2 were destroyed by undetermined causes (6%), and 3 nests were abandoned (9%). The fates of 3 nests were not determined (9%). The completion status of all 35 nests was established. All nests contained 3 egg clutches, producing 105 eggs, and resulting in an average clutch size of 3.0.

Fifty-one chicks hatched from the 21 successful nests. Twelve nests hatched 3 chicks, 6 nests hatched 2 chicks, and 3 nests hatched 1 chick. The number of chicks hatched yearly from 2002 through 2013 and 2016 is compiled in Figure 3.

**Table 4. Total number and percent of snowy plover nests and their fates during the 2002 through 2013 and 2016 breeding seasons.**

| Year | Total Nests | Hatch | Destroyed Predator | Destroyed Unknown | Abandoned | Surf | Wind | Unknown Fate |
|---|---|---|---|---|---|---|---|---|
| 2016 | 35 | 21 60% | 6 17% | 2 6% | 3 9% | 0 0% | 0 0% | 3 9% |
| 2013 | 26 | 13 50% | 5 19% | 0 0% | 6 23% | 2 8% | 0 0% | 0 0% |
| 2012 | 21 | 8 38% | 4 19% | 0 0% | 8 38% | 1 5% | 0 0% | 0 0% |
| 2011 | 40 | 13 33% | 17 43% | 0 0% | 10 25% | 0 0% | 0 0% | 0 0% |
| 2010 | 26 | 17 65% | 4 15% | 1 4% | 1 4% | 2 8% | 0 0% | 1 4% |
| 2009 | 50 | 11 22% | 20 40% | 9 18% | 6 12% | 1 2% | 2 4% | 1 2% |
| 2008 | 39 | 15 38% | 14 36% | 1 3% | 5 13% | 0 0% | 1 3% | 3 7% |
| 2007 | 23 | 7 30% | 6 26% | 2 9% | 7 30% | 0 0% | 0 0% | 1 5% |
| 2006 | 37 | 18 49% | 13 35% | 3 8% | 0 0% | 2 5% | 1 3% | 0 0% |
| 2005 | 38 | 21 55% | 9 24% | 4 10% | 1 3% | 2 5% | 1 3% | 0 0% |
| 2004 | 50 | 17 34% | 22 44% | 4 8% | 5 10% | 1 2% | 0 0% | 1 2% |
| 2003 | 35 | 10 29% | 21 60% | 2 5% | 1 3% | 0 0% | 1 3% | 0 0% |
| 2002 | 43 | 18 42% | 15 35% | 4 9% | 4 9% | 0 0% | 0 0% | 2 5% |
| Mean | 35.6 | 14.5 | 12.0 | 2.5 | 4.4 | 0.8 | 0.5 | 0.9 |

**Figure 3. Number of snowy plover chicks hatched 2002 through 2013 and 2016.**



A total of 463 snowy plover nests have been documented on the Refuge over the past 13 monitored breeding seasons (Table 5). Of these, 189 have hatched, resulting in an overall hatch rate of 41%. At least 496 chicks hatched during the period. The depredation rate for the period was 34%, 7% were destroyed by unknown causes, 12 % were abandoned, 2% were lost to surf, and 1% were lost to wind. Fates of 3% of the total nests were undetermined.

**Table 5. Combined total number of nests, fates, and percents by fate from 2002 through 2013 and 2016.**

| Years | Hatch | Dest. Pred. | Dest. Unk. | Aband. | Surf | Dest. Wind | Unk. Fate | Total Nests |
|---|---|---|---|---|---|---|---|---|
| 2002 thru 2016 | 189 | 156 | 32 | 57 | 11 | 6 | 12 | 463 |
| Percent | 41% | 34% | 7% | 12% | 2% | 1% | 3% | 100% |

## Brood Movement and Fledging

Because color banding of chicks did not occur on the Refuge in 2016 specific brood movement and chick survival rates could not be determined. Since broods are evasive by nature they were rarely seen during the breeding season, but indications of brood presence was common. Broods used both beach and foredune habitats, and were most often observed west of the foredunes in beach habitat. Broods often moved into the foredunes in response to the monitors' presence.

The earliest expected fledge date for 2016 chicks was approximately May 28 and the last fledging was expected to occur about August 29. The first unbanded fledgling was observed on June 21, and unbanded fledglings were observed on most surveys after that date.

## Banded Plovers

One banded plover nested on the Refuge. This was a female banded GA:RB at ODSVRA. This bird was associated with nest number R01. Two other banded plovers were seen near nests but nesting could not be confirmed. Banded fledglings were first observed on June 30. A list of banded plover sightings is compiled in Appendix 2.

## Predators

Predators destroyed at least 6 (17%) of the 35 nests this season (Table 6). The only documented predators were gulls of undetermined species. One nest was lost to an unidentified avian predator that may have been a gull, but the tracks were too faint to verify that. Three nests were lost to unidentified predators: at one nest both coyote and gull tracks were present, at another there was spilled egg and shell but wind had erased the predator tracks, and at the remaining nest, wind had erased the predator tracks.

**Table 6. Number of known-fate nests lost to predators on the Refuge in 2002-2009, 2011-2013, and 2016.**

| Predator | Number lost to predators | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2013 | 2012 | 2011 | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 | Total |
| Raven | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 5 | 9 | 0 | 17<br>10% |
| Crow | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6<br>4% |
| Coyote | 0 | 1 | 0 | 3 | 7 | 4 | 0 | 7 | 5 | 14 | 3 | 2 | 46<br>27% |
| Unidentified avian predator | 1 | 0 | 1 | 0 | 9 | 3 | 0 | 0 | 0 | 0 | 4 | 3 | 21<br>12% |
| Unidentified small mammal | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2<br>1% |
| Unidentified corvid species | 0 | 0 | 1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 14<br>8% |
| Great-tailed grackle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1<br>0.5% |
| Gull | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 6 | 1 | 0 | 0 | 0 | 11<br>7% |
| Unidentified predator | 3 | 4 | 0 | 4 | 8 | 5 | 4 | 0 | 3 | 6 | 7 | 6 | 50<br>30% |
| Feral Pig | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1<br>0.5% |
| Total lost<br>*known-fate nests | 6<br>4% | 5<br>3% | 3<br>2% | 17<br>10% | 27<br>16% | 14<br>8% | 6<br>4% | 13<br>8% | 9<br>5% | 26<br>15% | 27<br>16% | 16<br>9% | 169<br>100% |

Applegate observed one adult snowy plover depredated by a peregrine falcon: only the head and legs were left behind. The legs had color bands (WW:PV). The bird was banded at ODSVRA.

Coyote tracks were observed in breeding habitat on every survey and coyotes were seen on 3 occasions. Many times coyote tracks passed very close to active nests. While no

nests were positively identified as lost to coyotes, 2 nests could have been. One depredated nest had both coyote and gull tracks at it. The other nest was observed after its expected hatch date and coyote tracks, broken shell and spilled egg were evident, but the nest may have hatched and 1 or 2 eggs with only non viable egg(s) left behind.

Feral pig tracks were regularly observed in breeding habitat throughout the season. Their tracks were observed on the beach, foredune areas and backdunes. No nests were known to be lost to them this season.

Ravens, which have been a leading predator in the Dunes Complex in recent years, were observed only 1 time this season and no nests were lost to them. On June 2, a single raven was observed flying from south to north along the shoreline. The raven appeared to be traversing the site and not actively searching for plover nests or broods.

Other potential predators observed directly or by tracks this season were American kestrel (*Falco sparverius*), California gull (*Larus californicus*), Cooper's hawk (*Accipiter cooperii),* great blue heron (*Ardea herodius*), great horned owl (*Bubo virginianus*), Heermann's gull (*Larus heermanni*), merlin falcon (*Falco columbarius*), northern harrier *(Circus cyaneus),* peregrine falcon *(Falco peregrines*), red-tailed hawk (*Buteo jamaicensis*), ring-billed gull (*Larus delawarensis*), and western gull (*Larus occidentalis*).

### California Least Terns

Least terns did not nest on the Refuge in 2016. Terns were observed flying over the refuge during 4 surveys. The first terns were observed on July 20, when 2 were seen flying south over the backdunes. On July 26, 2 or more terns were heard over the backdunes. On July 29, 2 terns were seen flying south along the beach, 2 or more were heard over the foredunes, and 3 were seen flying south over the foredunes. On August 30, 1 or more terns were heard over the foredunes flying south.

## Human Activities Affecting Plovers and Terns

Refuge beaches offer recreation opportunities for the general public, with the most common activities being fishing and hiking. Due to difficult access to Refuge beaches, human use is relatively low. The Refuge has no onsite staff regulating beach use. To protect breeding plovers, breeding habitat is closed to the public a short distance above the mean high tide line from March 1 through September 30. Habitat closure signs are installed near the mean high tide line the length of the Refuge. There is no public access

from the east, north or south boundaries so signs were not installed there. Signs were triangular in shape and informed visitors of the seasonal closures. They were moved east or west as beach conditions changed, and the beach west of the signs remained open to the public throughout the breeding season.

Due to the infrequency of monitoring, an attempt to document all visitor use by tracks was not made since wind is likely to erase them between monitoring sessions. However, records of visitors present during surveys and trespass incidents either observed or noted by tracks were compiled. Most incidents of trespass were observed by tracks.
Visitors were observed during 7 surveys and totaled 21 people. Twelve of the visitors were hikers, and 9 were fishermen. None of the fishermen trespassed, but 6 of the hikers were observed entering the closed breeding habitat. Track evidence indicated 23 incidents of trespass involving 47 people. Most of the incursions into breeding habitat appeared to be by hikers. On many occasions tracks from fishermen were easily seen on the beach and most did not enter breeding habitat. Due to the common high winds it is likely that not all trespass incidents were documented.

On August 11 approximately 4 emergency vehicles accessed the beach from Rancho Guadalupe Dunes Preserve and traversed the Refuge for an emergency at Oso Flaco beach on ODSVRA. The vehicles left deep ruts and at one point entered and drove in a circle about 40 feet into breeding habitat.

Two low flying aircraft were observed over the Refuge. On June 10 a Navy turbine T34 aircraft flew from south to north along the beach at approximately 700 feet above ground level. On June 28, a Robinson helicopter flew from south to north at approximately 300 feet above ground level over the foredunes. Both were over breeding habitat.

No nests, plovers, or terns were known to have been destroyed, injured, or killed due to human activities during the 2016 breeding season.

## Discussion

As in previous seasons, plovers utilized breeding habitat along the beaches, foredunes and into the blowouts. This year, the beach eroded back to the foredune edge in many places, leaving a steep bank up to 6 feet in height with little breeding habitat. Plovers avoided these areas and concentrated on wider beaches until nesting habitat returned. Three areas did not recover, the largest of which was on the southern third of the Refuge. These areas can be identified on the nest map (Appendix 1) by their lack of nests. In response to the lack of beach habitat during the early season, more plovers

nested in the foredunes during the early season, but by the end of the season, 27 (77%) nests had been located on the beach and 8 (23%) in the foredune blowouts.

No predator management activities occurred on the Refuge in 2016. Mini nest exclosures were not employed due to concern for adult mortalities in exclosures at some breeding sites including the Refuge in 2003. However, ODSVRA maintains an active predator management program throughout the breeding season and the Guadalupe Restoration Project was removing feral swine. Due to the close proximity of these sites, some incidental benefits or detriments of their activities may occur on the Refuge.

As stated, public use of the Refuge beach is relatively light due to difficult access, but visitors still regularly use it. While the closure signs are effective, they do not stop trespass into breeding habitat. Without a regulatory presence on the beach it is at the whim of the visitor whether they respect the closures or not. Track evidence indicated that hikers were the most likely to enter breeding habitat and at times traveled long distances behind the signs. On several occasions human tracks were near nests and on one occasion a person sat 30 feet from an active nest for what appeared to be a long period of time. The nest eventually hatched 2 chicks.

As noted in all previous monitoring seasons, least terns did not nest on the Refuge this year. Some suitable breeding habitat exists on the Refuge and terns may have historically nested on the site, but non native invasive plants may have altered the habitat. Without the presence of invasive plant species it is likely there would be much more suitable tern breeding habitat. There is a potential for a large breeding colony on the Refuge, and the improvement of nesting conditions and habitat should be taken into account while developing future management plans.

Snowy plover breeding habitat is negatively impacted by invasive plants as well. European beach grass and sea fig are the primary problematic species. Beach grass heavily impacts the northern half of the Refuge and is slowly moving south taking over both foredune and backdune habitat. Due to beach grass, there is little breeding habitat east of the beach on the northern third of the Refuge. Backdune habitat in the north central portion of the Refuge is dissected from the beach by beach grass. Plovers do not use those backdune areas, and we suspect that is likely due to poor access to the beach for broods. Eradicating beach grass in those areas could improve breeding habitat.

Sea fig is found throughout breeding habitat but affects the southern half of the Refuge most. Sea fig grows in the foredunes and appears to over stabilize the dunes causing them to grow in height and width, narrowing the blowouts between. Sea fig creates a constricted barrier between the beach and backdunes. Without sea fig there would be

more suitable breeding habitat between the foredunes and backdunes on the central portion of the Refuge, and deeper breeding habitat on the southern Refuge. Unlike areas affected by beach grass, there is more access for plovers into the backdunes on the southern half of the central backdunes, and plovers nested and utilized areas further from the beach in that area.

## Management Recommendations

Snowy plover and least tern monitoring on the Refuge since 2001 has shown that it is an important breeding site for snowy plovers and has unrealized potential for least terns. Monitoring efforts have identified trends, important nesting areas, and a range of predators and other factors that may affect nesting and fledging success. These data should continue to be used to implement management plans that will protect and enhance least tern and snowy plover populations.

The Refuge provides quality habitat, has relatively low human use, and the ability to direct management goals toward habitat improvements and increasing overall plover and tern populations. To increase productivity and reduce disturbance to snowy plovers on Refuge beaches, we present the following recommendations:

*1. Monitoring* - Each snowy plover breeding season is different. Data gathered since 2001 show that different predators, weather, beach conditions, and human activities affect the reproductive success of snowy plovers annually. We recommend that the Refuge continue to support ongoing, quality monitoring that addresses population, nesting, depredation, hatching and fledging success, and identifies other issues as they arise. Successful management of the site will depend on the use of these data to act as a basis for sound management practices.

*2. Predator management* – Although some nest loss to predators is to be expected during any breeding season, predators can have a catastrophic influence on breeding success. Predator management strategies can be developed to reduce the incidence of depredation on the Refuge. We recommend the development of a predator management strategy for future seasons.

*3. Habitat enhancement* - Exotic plants are a serious problem on the Refuge. European beach grass and sea fig are overtaking more nesting habitat each year. We recommend continued, aggressive winter eradication programs for these species.

*4. Public use management* – Continue to install habitat closure signs prior to the beginning of plover breeding seasons. The signs should continue to be placed along the entire length of the beach and remain in place for the entire breeding season. Continue to maintain the signs throughout the season moving them westward or eastward in response to changes in beach structure. Notify local organizations that may wish to conduct events on the Refuge that the habitat will be closed during the breeding season. An increased presence on the beach during the breeding season may discourage people from entering plover habitat.

*5. Recovery unit cooperative efforts* - Continue cooperative relationships with nearby breeding sites to accumulate valuable data for the management of the species on the Refuge and assist other breeding sites with shared information and resources. In addition, a cooperative and coordinated predator response effort would be beneficial for the Refuge as well as other breeding sites.

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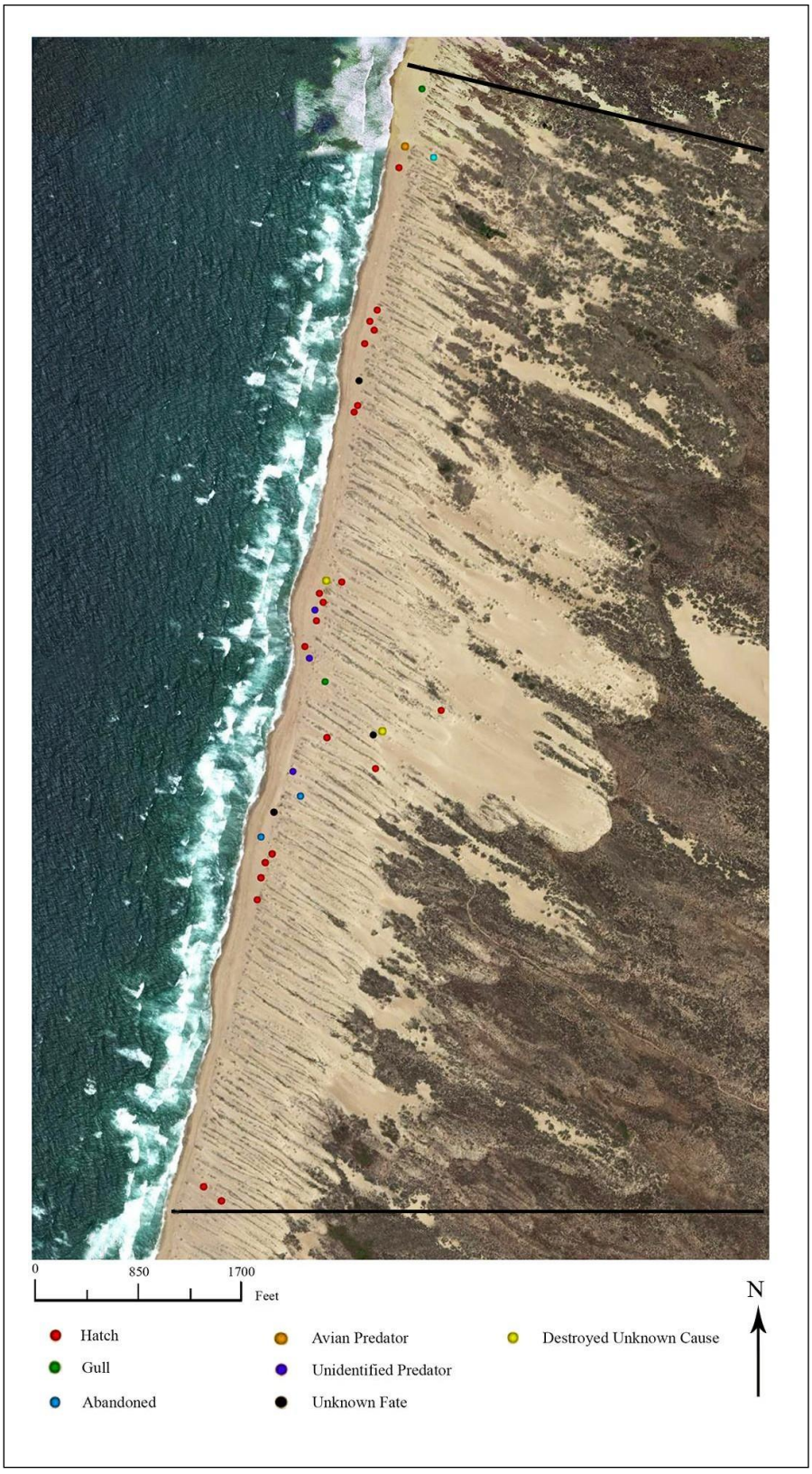
## Appendix 1. Snowy plover nest locations and fates during the 2016.



## Appendix 2. Color banded plovers on the Refuge during the 2016 breeding season.

| Date | Combo | Sex/Age | Natal Site |
|---|---|---|---|
| PG:BG | 4/19/16 | male | Oceano Dunes SVRA |
| PG:YY | 4/19/16 | male | Oceano Dunes SVRA |
| GA:RB | 4/19/16 | female | Oceano Dunes SVRA |
| PV:YG | 5/20/16 | female | Oceano Dunes SVRA |
| VV:RG | 5/20/16 | female | Oceano Dunes SVRA |
| NO:PB | 5/20/16 | female | Vandenberg AFB |
| NO:PB | 5/25/16 | female | Vandenberg AFB |
| VV:RG | 5/25/16 | female | Oceano Dunes SVRA |
| VG:YR | 6/10/16 | female | Oceano Dunes SVRA |
| VV:OB | 6/10/16 | male | Oceano Dunes SVRA |
| VV:BB | 6/21/16 | male | Oceano Dunes SVRA |
| VV:WG | 6/21/16 | female | Oceano Dunes SVRA |
| PV:YG | 6/28/16 | female | Oceano Dunes SVRA |
| WB:GG | 6/30/16 | female | Monterey Bay |
| PG:YB | 6/30/16 | female | Oceano Dunes SVRA |
| YB:YG | 6/30/16 | male | Monterey Bay |
| VV:RG | 6/30/16 | juvenile | Oceano Dunes SVRA |
| RV:WY | 7/6/16 | female | Humbolt |
| PG:YB | 7/6/16 | female | Oceano Dunes SVRA |
| NB:YG | 7/15/16 | male | Vandenberg AFB |
| VV:WR | 7/29/16 | juvenile | Oceano Dunes SVRA |
| RR:BW | 7/29/16 | juvenile | Oceano Dunes SVRA |
| BB:AY | 7/29/16 | juvenile | Oceano Dunes SVRA |
| GA:WW | 7/29/16 | juvenile | Oceano Dunes SVRA |
| GA:RV | 7/29/16 | juvenile | Oceano Dunes SVRA |
| WV:WY | 7/29/16 | male | Humbolt |
| BB:OV | 7/29/16 | juvenile | Oceano Dunes SVRA |

## Appendix 3. Refuge snowy plover 2016 breeding season nest data summary.

| Nest Number | Estimated Initiation Date | Final Number of Eggs | Estimated Hatch/ Loss Date | Fate | Number Hatched |
|---|---|---|---|---|---|
| R01 | 4/3/16 | 3 | 5/2/16 | hatch | 3 |
| R02 | 4/2/16 | 3 | 5/2/16 | hatch | 2 |
| R03 | 4/17/16 | 3 | 5/18/16 | hatch | 2 |
| R04 | 4/14/16 | 3 | 4/30/16 | abandoned | 0 |
| R05 | 4/20/16 | 3 | 5/21/16 | hatch | 2 |
| R06 | 4/30/16 | 3 | 5/30/16 | hatch | 2 |
| R07 | 4/30/16 | 3 | 5/30/16 | hatch | 1 |
| R08 | 4/23/16 | 3 | 5/23/16 | hatch | 1 |
| R09 | 4/23/16 | 3 | 5/25/16 | hatch | 2 |
| R10 | 5/6/16 | 3 | 6/5/16 | hatch | 3 |
| R11 | 5/9/16 | 3 | 6/8/16 | hatch | 3 |
| R12 | 5/9/16 | 3 | 6/8/16 | hatch | 3 |
| R13 | unk | 3 | 5/23/16 | unknown | 0 |
| R14 | 5/2/16 | 3 | 6/1/16 | hatch | 1 |
| R15 | 5/24/16 | 3 | 6/14/16 | unknown | 0 |
| R16 | 5/26/16 | 3 | 6/18/16 | abandoned | 0 |
| R17 | 5/9/16 | 3 | 6/8/16 | hatch | 3 |
| R18 | 5/29/16 | 3 | 6/28/16 | hatch | 3 |
| R19 | unk | 3 | 6/22/16 | gull | 0 |
| R20 | unk | 3 | 6/15/16 | abandoned | 0 |
| R21 | 6/7/16 | 3 | 7/6/16 | hatch | 3 |
| R22 | 6/16/16 | 3 | 7/15/16 | hatch | 3 |
| R23 | 6/15/16 | 3 | 6/22/16 | dest unk | 0 |
| R24 | 6/10/16 | 3 | 6/22/16 | avian pred | 0 |
| R25 | 6/20/16 | 3 | 7/10/16 | unk pred | 0 |
| R26 | 6/15/16 | 3 | 6/26/16 | unk pred | 0 |
| R27 | 6/15/16 | 3 | 7/14/16 | hatch | 3 |
| R28 | 6/20/16 | 3 | 7/19/16 | hatch | 3 |
| R29 | 6/25/16 | 3 | unk | unknown | unk |
| R30 | 6/28/16 | 3 | 7/28/16 | hatch | 2 |
| R31 | 6/28/16 | 3 | 7/17/16 | dest unk | 0 |
| R32 | 6/28/16 | 3 | 7/27/16 | unk pred | 0 |
| R33 | 7/4/16 | 3 | 8/2/16 | hatch | 3 |
| R34 | 7/2/16 | 3 | 8/1/16 | hatch | 3 |
| R35 | 7/13/16 | 3 | 8/1/16 | gull | 0 |
| **Total** | | 105 | | | 51 |

## Appendix 4. Other species observed or detected in breeding habitat on the Refuge during the 2016 breeding season.

### Birds

American pipit (*Anthus rubescens*)
Barn swallow (*Hirundo rustica*)
Black-bellied plover (*Pluvialis squatarola*)
Black phoebe (*Sayornis nigricans*)
Brewer's blackbird (*Euphagus cyanocephalus*)
California brown pelican *(Pelecanus occidentalis californicus)*
Caspian tern (*Sterna caspia*)
Elegant tern (*Sterna elegans*)
Forster's tern (*Sterna forsteri*)
Horned lark (*Eremophila alpestris*)
House finch (*Carpodacus mexicanus*)
Long-billed curlew (*Numenius americanus*)
Mourning dove (*Zenaida macroura)*
Osprey (*Pandion haliaetus*)
Royal tern (*Sterna maxima*)
Sanderling (*Calidris alba*)
Semipalmated plover (*Charadrius semipalmatus*)
Turkey vulture (*Cathartes aura*)
Western meadowlark (*Sturnella neglecta*)
Western sandpiper (*Calidris mauri*)
Whimbrel (*Numenius phaeopus*)
Willet (*Catoptrophorus semipamatus*)

### Mammals

California sea lion *(Zalophus califonianus)*
Lompoc kangaroo rat (*Dipodomys heermanni arenae*)
Mountain lion (*Puma concolor*)
Pocket gopher (*Thomomys* sp.)
Southern mule deer (*Odocoileus hemionus fuliginatus*)
Unidentified rodent(s)
White-footed deer mouse (*Peromyscus maniculatus*)