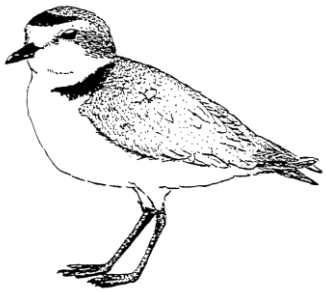

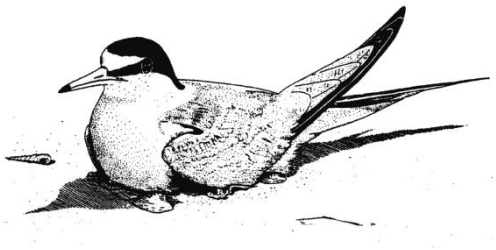

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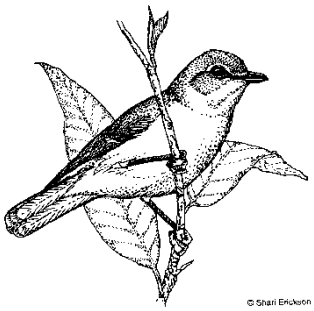

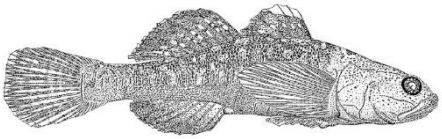

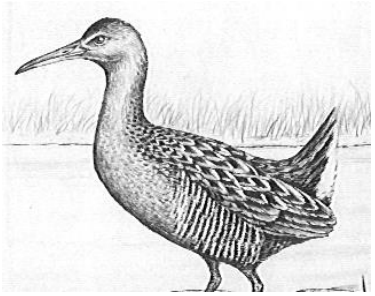

February 2019

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Recommended citation:

US Navy. 2019. Naval Base Ventura County Point Mugu 2018 Biological Opinion Report to U.S. Fish and Wildlife Service. *Prepared by* the U.S. Navy, Point Mugu, California. 87 Pages.

Executive Summary

Six federally listed species are found year-round or seasonally at NBVC Point Mugu, including salt marsh bird's-beak (*Chloropyron maritimum* subsp. *maritimum*), light-footed Ridgway's rail (*Rallus obsoletus levipes)*, formerly light-footed clapper rail *Rallus longirostris levipes*), western snowy plover (*Charadrius alexandrinus nivosus*), California least tern (*Sterna antillarum browni*), least Bell's vireo (*Vireo bellii pusillus*), and tidewater goby (*Eucyclogobius newberryi*).

The 2018 annual monitoring report for federally listed species covers activities under the Programmatic Biological Opinion for Ongoing Operations (8-8-15-F-5R) at the Naval Base Ventura County [NBVC] Point Mugu, signed 25 September 2015. This report also fulfills the reporting requirements of the Biological Opinion for the Bird/Animal Aircraft Strike Hazard Program at NBVC Point Mugu (8-8-14-F-5R), the Countermeasures Testing and Training Program (8-8-13-F-47), and also provides all requisite data under the conditions of endangered species recovery permit (#TE-066621-9). A summary of the 2018 status of listed species populations and monitoring activities at NBVC Point Mugu is below.

- The salt marsh bird's-beak [SMBB] population declined from 0.9 acres in 2017 to 0.54 acres in 2018 but remains higher than the low of 0.1 acres in 2016. The success of SMBB appears closely tied to rainfall and the prolonged drought the region experienced was a likely a main factor in the decline observed over recent year.
- No tidewater gobies were encountered or surveyed for in 2018.
- The first documented nesting pair of least Bell's vireos was confirmed near the Las Posas Gate at NBVC Point Mugu in 2016 and a potentially breeding individual was documented at the former Golf Course in 2017. A minimum of three males were documented singing within territories in 2018 at Las Posas North, Bat Box, and Dirt Road sites. At least two of these are suspected of nesting due to their extended presence during the breeding season.
- Seven breeding pairs and seven unpaired male light-footed Ridgway's rails were documented in 2018. This is lowest estimate since five pairs were recorded in 2008 and a significant drop from the peak of 23 pairs in 2013. The rangewide population also declined in 2018.
- By several metrics, the 2017 snowy plover breeding season was the most successful in nearly a decade. The trend continued in 2018 with very comparable final results. While the number of nests initiated in 2018 (n=140) was slightly lower than 2017 (n=148), the number of hatched nests were similar (n=87 vs n=88 in 2017) and the proportion hatched (62.14%) in 2018 was the highest since 2009. The number of concurrently active breeding pairs continues to slowly increase with 43 documented in 2018, which is both a slight increase from 2017 (n=41) and a new high. Finally, in both 2017 and 2018, 99 adults were observed during the breeding bird survey, which are the highest totals recorded since regular monitoring began in 1991.
- California least terns had a slightly improved year in 2018 compared to 2017. A total of 291 nests were documented in 2018. Despite the presence of fewer overall nests compared to previous years [2017: n=377; 2016: n=361), the number of hatched nests in 2018 (n=116) was very similar to 2017 (n=125). Furthermore, the estimated total fledglings appeared to increase in 2018, with a range of 61 to 72 fledglings calculated (2017: 27-51; 2016: 54-86). Once again, predation took a significant toll on productivity. A total of 102 (35.5%) nests were predated.

- There were no documented impacts to listed species during 2018 due to Navy operational activities.
- The Bird/Animal Aircraft Strike Program disturbed 20 least terns foraging near the airfield during 2018.
- No Countermeasures Testing and Training occurred during 2018.

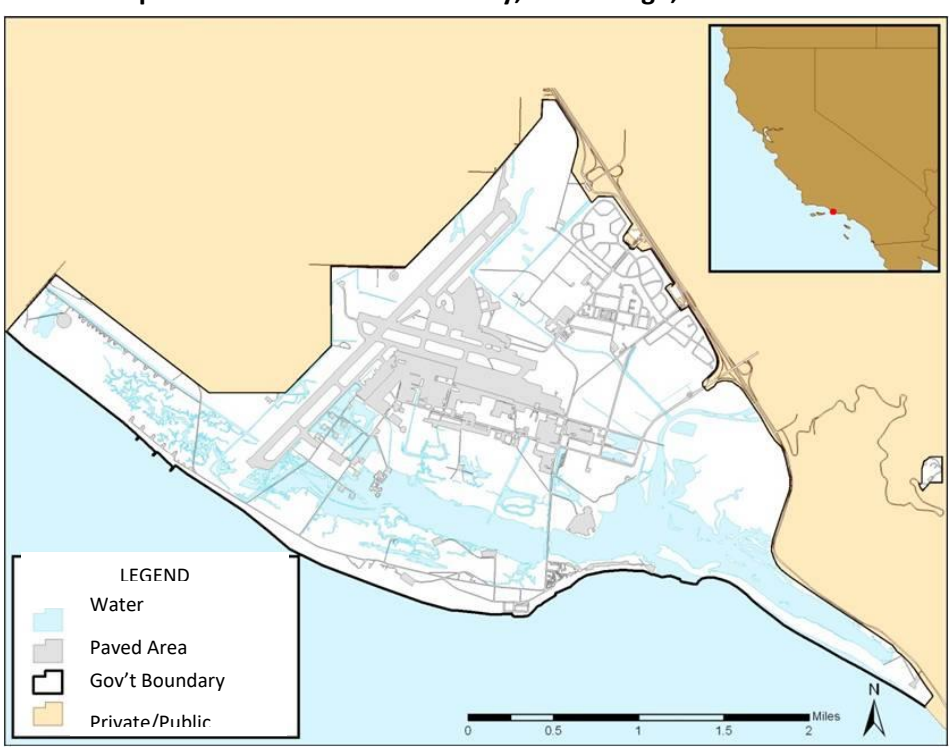
INTRODUCTION

This constitutes the 2018 annual monitoring report for federally listed species as required under the Endangered Species Act of 1973, as amended, and the Programmatic Biological Opinion for Ongoing Operations (8-8-15-F-5R) at the Naval Base Ventura County [NBVC] Point Mugu, signed 25 September 2015. This biological opinion supersedes the previous agreement (1-8-99-F-24) from June 6, 2001. This report also fulfills the reporting requirements of the Biological Opinion for the Bird/Animal Aircraft Strike Hazard Program at NBVC Point Mugu (8-8-14-F-5R), the Countermeasures Testing and Training Program (8-8-13-F-47), and also provides all requisite data under the conditions of endangered species recovery permit (#TE-066621-9).

Six federally listed species are found year-round or seasonally at NBVC Point Mugu, including salt marsh bird's-beak (*Chloropyron maritimum* subsp. *maritimum*), light-footed Ridgway's rail (*Rallus obsoletus levipes*, formerly light-footed clapper rail), western snowy plover (*Charadrius alexandrinus nivosus*), California least tern (*Sterna antillarum browni*), least Bell's vireo (*Vireo bellii pusillus*), and tidewater goby (*Eucyclogobius newberryi*).

NBVC Point Mugu (Figure 1) is comprised of 4,490 acres on the coast of southern California, eight miles southeast of Port Hueneme, California. There are approximately 2,200 acres of jurisdictional delineated wetlands, including the largest functioning salt marsh in coastal southern California. Mugu Lagoon, an estuarine coastal salt marsh, provides food, nesting, sheltering, breeding, and nursery habitat for numerous invertebrate, fish, bird, and plant species. These habitat types are composed of intertidal mudflats and sand flats, intertidal salt marsh, tidal creeks, and salt pannes. Approximately 6.5 miles of coastline provides nesting habitat for beach nesting birds. Other habitats found on NBVC Point Mugu include drainage ditches, uplands, disturbed, and developed areas (Keeny, 1998).

Figure 1. Installation Map – Naval Base Ventura County, Point Mugu, California.

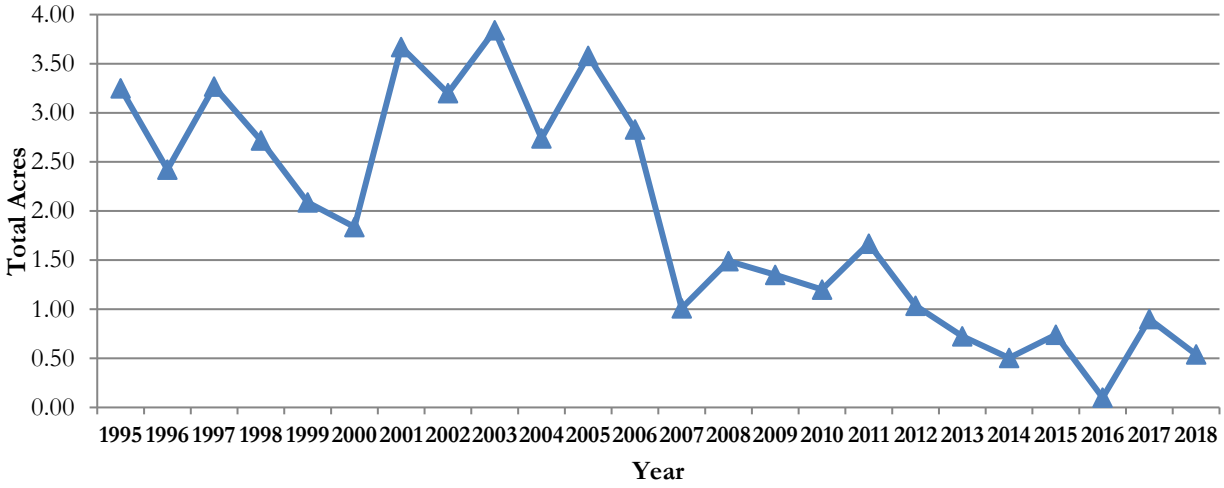


Salt Marsh Bird's-Beak

The U.S. Fish and Wildlife Service [Service or USFWS] listed salt marsh bird's-beak [SMBB] as endangered in 1978. The population at NBVC Point Mugu, which is one of only six remaining, has been mapped since listing. While the habitat at NBVC Point Mugu is relatively protected from human-related disturbance and there are few impacts due to Navy operations, historic mapping data indicate a general decline of SMBB on the installation. Changes in mapping strategy can account for some of the reduction in acreage compared to surveys in the 1970s and 1980s. Extended drought was likely a driving factor in the decline observed in recent years.

From 2004-2006, the population ranged in size from 2.74 to 3.58 acres; from 2007-2012, the population ranged in size from 1.01 to 1.68 acres. In 2013, the distribution dropped below one acre for the first time and continued to decline to a record low of 0.1 acres in 2016. Following a winter with increased rainfall, the population expanded to 0.9 acres in 2017 (Figure 2). This was the first appreciable increase since 2011. The calculated acreage in 2017 is directly comparable to the low recorded in 2016 as the same mapping protocol was used both years. In 2018, the population decreased to 0.54, almost half of the 2017 acreage.

Figure 2. Salt Marsh Bird's-Beak Total Acreage, NBVC Point Mugu, 1995-2018.



Population Mapping

Population mapping of SMBB was conducted as near as possible to peak flowering to collect data on distribution and abundance. All of the SMBB occurrences at NBVC Point Mugu are assumed to interbreed and are thus a "population." The use of "occurrence" is based on the definitions used by the San Diego Management and Monitoring Program [SDMMP] and California Natural Diversity Database [CNDDB] definitions of an Element Occurrence, which use distance to determine whether occurrences are unique. However, the NBVC mapping protocol uses a smaller distance to identify unique occurrences than the quarter-mile rule used by SDMMP and CNDDB: occurrences at NBVC Point Mugu were considered separate if the distance between their closest parts is equal to or greater than six feet.

Points and polygons were mapped according to the following rules: (1) polygon data were collected for individual sprigs or clumps of individual sprigs occurring together and covering an area greater than approximately 1 square foot; (2) separate polygons were mapped when the distance between occurrences was greater than 6 feet; (3) point data was collected for sprigs occurring in isolation covering less than 1 square foot. All points and polygons were mapped using a handheld geographic positioning system (GPS) device with sub-meter accuracy (Trimble GeoExplorerXH).

Abundance was tracked by visually estimating cover within each polygon using eight cover classes, as follows: (1) <1%, (2) 1 to <5%, (3) 5 to <10%, (4) 10 to <25%, (5) 25 to <35%, (6) 35 to <50%, (7) 50 to <75%, and (8) 75 to 100%. Points were given a value of 100 percent cover. Visual cover estimates were used instead of density counts due to the growth habit and fragile nature of SMBB. The growth habit of SMBB results in individual plants that may have one or multiple flowering stems. As a result, it is difficult to identify individual plants in the field without manually manipulating the plants to differentiate lateral shoots and branches from the main stem.

Phenology was tracked by visually estimating senesced cover in points and polygons using the same cover classes. Cover and phenology data were documented using a tablet loaded with an Excel file.

In 2018, a total of 0.54 acres of SMBB was located and mapped (Figure 3 / Figure 4) compared to 0.9 acres in 2017, and 0.10 acres in 2016 (Figure 2). Overall, the occurrences were in similar locations as in 2017, but had less cover. Germination and first flowering started later than recorded in 2017. The flowering period in 2018 ranged from May through November compared to April through October in 2017. The peak of the flowering season occurred in late August and by the end of September, most of the plants had turned brown.

Tetra Tech, Inc. conducted SMBB population mapping 7-8 August 2018. A second mapping effort was conducted by Tidal Influence on 23-24 August 2018, for comparison and for testing replication of the mapping protocol. Mapping results were comparable between the two efforts, with points and polygons mapped similarly. However, additional flowering occurred later in August, resulting in a greater number of polygons recorded during the second mapping effort.

Habitat Assessment

Following several years of planning with the Service, a long-term monitoring program based on the Monitoring Protocol for Rare Plant Occurrences on Conserved Lands in Western San Diego County (2015) was implemented as a pilot study in 2016. The program involves annually assessing permanent sampling areas (established in 2016) that correspond with piezometers installed for the SMBB hydrology study. Data collected within the sampling plots includes the following: species and cover; density counts of SMBB; photo-documentation; and an assessment of habitat and threats. Data were collected in 2017 and 2018 with no significant difference in vegetation cover or composition between years. The protocol was revised and terms clarified during the 2018 season. The Navy will determine how often the plots will be visited after analyzing the 2017–2019 data.

Habitat Characteristics

A USFWS grant has supported multi-year research examining hydrology and soil characteristics of seven active and eight previously occupied SMBB sites in order to understand the parameters required for maintaining healthy populations. These included such data as soil salinity, water salinity (if present), soil moisture, depth to water table, plant species composition, plant density, presence of insects or

insect parasitism, and tidal connectivity. Preliminary results from data collected October 2015-April 2016 are summarized in Table 1. Hydrology studies were conducted again in summer 2018 and will continue through early 2019. The hydrology study assessed the same parameters as the 2015-2016 study (depth to groundwater and water quality). Tetra Tech, Inc. and Tidal Influence are performing piezometer sampling during the rainy season: once a month and post major rain event.

Table 1. Salt Marsh Bird's-Beak Habitat Characteristics

Characteristic	Currently Active Site	Historic or Declining Site
Soil	Coarse (loamy sand to sandy loam)	Fine (clay loam or silty clay loam)
Soil Salinity	Declined	Increased or unchanged
Soil Organic Matter	Lower	Higher
Soil pH	Higher (increased over period)	Lower (increased over period)

Soil and hydrology information will be used in identifying potential management actions and priorities, including pinpointing the best locations for establishing new populations that are hydrologically similar to existing sites, and locations that may become more suitable or have the potential for long-term stability in the face of sea level rise. Depending on funding availability, future plans include increasing the number of piezometers and the purchase more sensitive salinity meters to conduct more thorough data collection.

Seed Bank Study

In 2016, seeds were collected from the NBVC Point Mugu, Oxnard, Morro Bay, and Carpinteria Salt Marsh populations to be stored at the Santa Barbara Botanical Gardens [SBBG] and the National Center for Genetic Resources Preservation (Fort Collins, CO). Seed collection was conducted at NBVC Point Mugu on 25 October 2016. Five occurrences were visited and seeds were successfully collected by maternal family (i.e., individual plant) at four of these sites. No seeds were collected at the fifth population, which was small and may have been negatively affected by seed collection. Conservation seed collections were also made on 21 August 2017 by permitted SBBG biologists (USFWS Native Endangered and Threatened Species Recovery permit TE-094893-2) from four sites at NBVC Point Mugu.

In October 2017, SBBG collected soil core samples to determine the extent of seed dispersal and seed bank densities. Five cores were collected from each of seven sampling locations. Soil samples were taken both within the occurrence and from a distance outside of the polygon. Three of these locations are also pollinator study sites. One of the seven locations is a site where SMBB is expected to occur but has never been documented. In 2018, SBBG continued to germinate the seeds. Preliminary data suggest that the soil seed bank density at NBVC Point Mugu is high compared to norther San Francisco Bay (Hopkins and Parker 1984). The summary report will be finalized early in 2019.

Genetics and Genomic Sequencing

In September 2017, sample analysis began as part of a range-wide SMBB genomic sequencing project conducted by the US Geological Survey [USGS]. During the growing season, 15 individual genetic samples were collected from populations throughout the range, for a total of approximately 330 samples range-wide. The NBVC Point Mugu population, as with each of the other sites, appears to be a distinct genetic population and possibly most closely related to the Morro Bay population. A separate report is expected in 2019 addressing these population findings in more detail.

A key concern in restoration is determining the appropriate balance between retaining local adaptation and maximizing overall diversity to avoid negative inbreeding effects and retain the ability to respond to future environmental change. The results of this analyses will provide insight in the population genetic structure, aid in estimating the scale over which adaptation may occur (e.g., what constitutes a local population genetically distinct from others), and provide information on the distribution of genetic diversity across individuals, occurrences, and populations.

Pollinator Surveys

No pollinator surveys were conducted in 2018. However, additional details on the result of the 2017 insect surveys were received since the last report and are included here. The surveys were conducted at NBVC Point Mugu to document insect visitation and pollination of SMBB, and the insect species occurring in the surrounding vegetation. Surveys were conducted in selected areas of SMBB growth and in surrounding vegetation, out to a buffer of approximately 20 meters from the SMBB population. Methods and results are summarized below.

Tetra Tech conducted four surveys in the summer of 2017 (5 July, 28 July, 31 July, and 10 August). Survey methods included passive visual observation, photo documentation, and capture using sweep netting. Video footage of SMBB pollinators was taken by the onsite Tetra Tech biologist and analyzed by the entomologist that conducted the surveys. Approximately 20 minutes of video footage was reviewed and a total of 28 passive observation and photo-documentation hours were conducted at SMBB flowering patches.

Two species of bees were observed pollinating SMBB: metallic sweat bee (Halictidae – *Lasioglossum* subgenus *Dialictus* sp.), and long-horned bee (Apidae – Tribe Eucerini, *Melissodes* sp.). Though this study was not quantitative, *L. Dialictus* were observed to be the most abundant SMBB pollinator. Larger bees were observed in the vicinity of SMBB, such as Apidae – Tribe Emphorini, *Diadasia bituberculata* and Tribe Anthophorini, *Anthophora* subgenus *Micranthophora* sp., but were not documented visiting SMBB at the time of the field study. Nineteen species were added to the NBVC Point Mugu invertebrate inventory; four of these were captured during sweep netting, mounted as voucher specimens, and delivered to NBVC Point Mugu.

Future studies could include continuing the methodology employed in the 2017 study (observation time coupled with photo-documentation) and researching the habitat requirements of pollinators recorded to date at NBVC Point Mugu.

Navy-Related Impacts

No Navy-related impacts were documented to SMBB populations during 2018. Hunting blinds with significant amounts of SMBB growing nearby were closed. Herbicide spraying does not occur during SMBB season when the plants are above ground.

Summary

The SMMB population ranged from 2-3 acres from 1992–2006, dropped to one acre from 2007-2012, and has been less than one acre since 2013. The 2016 survey had the lowest distribution yet recorded. The population increased in 2017 following a wet winter but decreased by almost half in 2018 (Figure 2). However, the 2018 distribution remained greater than the 2016 low. Mapping protocols continued

to be refined in 2016-2018 in order to more accurately depict the population boundaries, population densities and total plant area coverage.

Timing and amount of rainfall is considered an important factor in SMBB recruitment. Rainfall conditions have not been ideal since 2006. El Niño conditions during the winter of 2015/2016 were predicted to bring significant amount of rainfall, but the rain totals were much lower than anticipated and were not sufficient to noticeably benefit the population. However, the 2016/2017 winter had frequent, consistent rain events making it likely that the corresponding increase in SMBB population may have been related to fresh water. The 2017/2018 winter season had lower than normal precipitation (40% of normal values) and decreased cover of SMBB in 2018 compared to 2017, further suggesting a correlation between precipitation and SMBB. The 2018/2019 winter is on track to be one of wettest in recent years and it shall be interesting to document the impact on SMBB in the next season.

The severe decline of SMBB observed over the past decade may be due in part to climate conditions affecting SMBB germination, growth, and vigor, as well as the habitats that support SMBB pollinators. The implementation of several new protocols since 2016, including analysis of microhabitat factors, seed collection, pollinator surveys, and documentation of the density and health of patches should begin to provide insight and identify potential management actions that can be undertaken in order to re-stabilize and increase the population.

Figure 3. Salt Marsh Bird's-Beak Distribution (West), NBVC Point Mugu, 2018.

Author: AL. Date: 12/17/2018
Data Source: TetraTech Databases
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Figure 4 Salt Marsh Bird's-Beak Distribution (East), NBVC Point Mugu, 2018.

Author: AL. Date: 12/17/2018
Data Source: TetraTech Databases
This map is government property, not to be reproduced or distributed without concurrence from the Naval Base Ventura County Environmental Division.

Tidewater Goby

Tidewater goby is a fish endemic to California in the family Gobiidae. The current geographic range of tidewater goby is from northern San Diego County to Del Norte County (three miles south of the California-Oregon border). Although the range of tidewater goby across California has not changed significantly over time, their overall population has become fragmented along the coast (Service, 2008). Presently, 23 (17%) of the 134 documented localities are considered extirpated and 55 to 70 (41 to 52 percent) of the localities are naturally so small or have been so degraded over time that long-term persistence is uncertain (Service, 2005).

Tidewater goby was designated as endangered by the Service on 7 March 1994 (Service, 1994). NBVC Point Mugu surveyed for tidewater goby in November of 1993 but none were documented. On 22 November 2000, the Service published a Final Rule designating 10 coastal stream segments in Orange and San Diego Counties as critical habitat. On 3 March 2008, the Service published a revised Final Rule to include critical habitat within the entire geographic range. The revised critical habitat includes land in Del Norte, Humboldt, Mendocino, Sonoma, Marin, San Mateo, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura, and Los Angeles Counties (Service, 2008), but did not include Calleguas Creek (which feeds into Mugu Lagoon). Tidewater goby is primarily threatened by modification and loss of habitat as a result of coastal development, channelization of habitat, and diversions of water flows (Service, 2005).

Prior to 2011, the last recorded observation of tidewater goby in Calleguas Creek was on 6 June 1940 (CNDDB, 2011; Oneal & Pareti, 2011). On 20 July 2011, San Marino Environmental Associates with assistance from Bon Terra Consulting, CALTRANS, and NBVC conducted a survey to fulfill endangered species survey requirements for a proposed project to remove sediment built up adjacent to the SR-1 Bridge at the Las Posas Road Interchange. A total of 11 gobies were documented during the first seine sweep of the survey conducted along a 500 foot stretch of the Calleguas Creek channel (Oneal & Pareti, 2011; Figure 5). Surveys ceased once presence was established.

While the 2011 survey determined the presence of tidewater gobies at the property line of NBVC, the extent of their distribution at the base was unclear. Having this information is important for determining whether future projects or research are likely to have impacts to tidewater goby and require a consultation with the Service. In 2013, USGS staff characterized water bodies in terms of their potential to support tidewater gobies and to determine where tidewater gobies occur, if at all, in Mugu Lagoon and its tributaries on base. It was previously suggested that Mugu Lagoon provides suboptimal habitat and that tidewater gobies have been extirpated due to incompatible physical aspects of the system, or because they were outcompeted or preyed on by species already present (Lafferty, 2014).

The 2013 survey was conducted between Calleguas Creek and the mouth of Mugu Lagoon and on two inflows to Mugu Lagoon, Oxnard Drains 2 and 3. A total of 2,923 fish representing 11 species were captured at 21 sites, but no tidewater gobies were found (Figure 5). One individual was captured outside the NBVC property line, north the SR-1 bridge, where gobies were documented in 2011. Sampling occurred during the peak abundance period of tidewater goby and they are usually very abundant when present in a system (Lafferty, 2014). While the goby population at this site may fluctuate from year to year, the habitat is not ideal. Therefore, it is unlikely that NBVC currently supports tidewater gobies in a biologically significant way, but rather there may be a small, dynamic

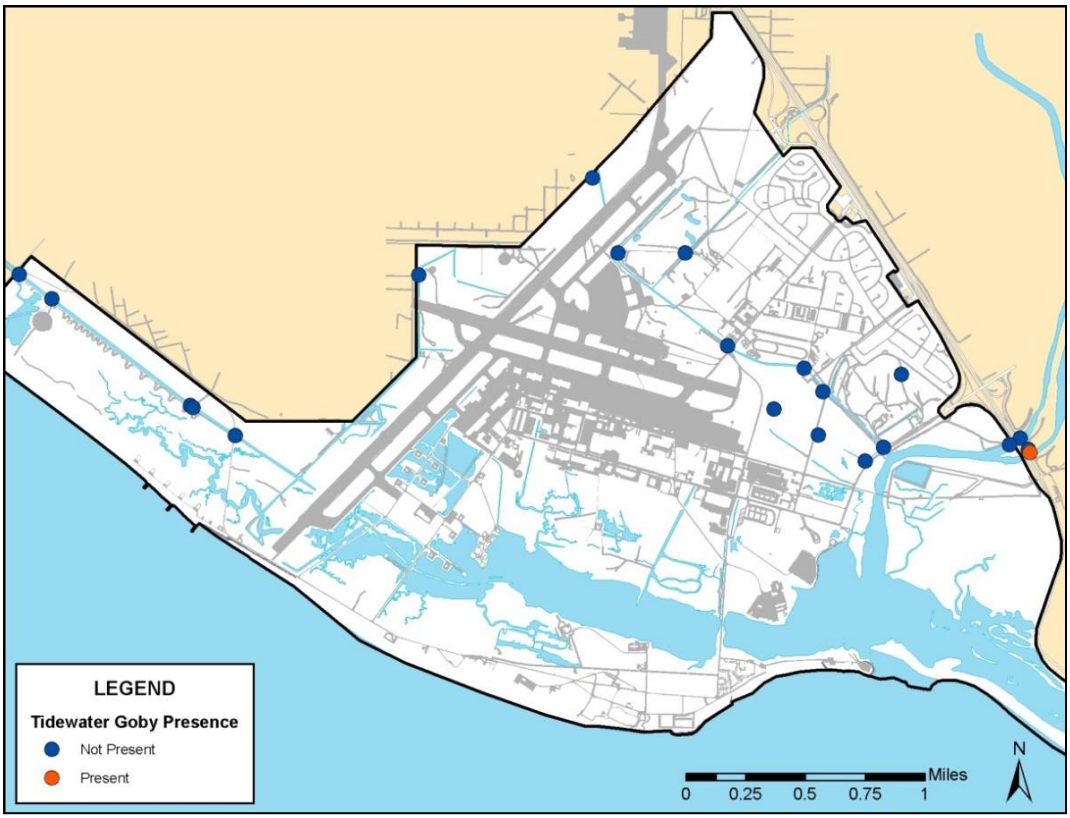
population at the edge of the installation. No surveys specifically targeting gobies were conducted in 2014-2018.

Although gobies are unlikely to be encountered, several protective measures have been implemented for contractors performing surveys in the wetlands. Contractors and researchers are educated about potential for gobies to be present and instructed to look for gobies first when seining or fish trapping. Additionally, no fish surveys or research occurs at the fenceline near Calleguas Creek in the area where gobies may be present.

Fishery surveys are conducted annually by the University of California – Santa Barbara throughout the spring and summer in the Central Basin and on the west side of Calleguas Creek within Mugu Lagoon. These surveys are part of a long-term monitoring program in which Mugu Lagoon serves as a reference site for the San Onofre Nuclear Generating Station wetland restoration efforts. Since the surveys were not conducted in appropriate habitat for tidewater gobies, none were expected or encountered at their sampling sites in 2018.

Fisheries surveys were also completed at NBVC's wetland restoration areas, along with monitoring vegetation, soil, invertebrate community, and avian use within these sites. These surveys are required by the Army Corps of Engineers to monitor progression of restoration and to demonstrate the functionality of the wetlands for future inclusion in the wetland mitigation bank. No tidewater gobies were expected or encountered during these surveys in 2018.

Figure 5. Tidewater Goby Survey Locations, NBVC Point Mugu.



Navy-Related Impacts

No Navy-related impacts to tidewater gobies were documented in 2018.

Summary

At this time, it is unlikely that NBVC currently supports a population of tidewater gobies in a biologically significant way. Intensive sampling was conducted in 2013 during the period when, if present, they would have been very abundant. No gobies were detected on base during that survey and only one individual was captured outside the NBVC Point Mugu property line, suggesting a limited population at that location. No additional surveys targeting tidewater gobies were conducted in 2018 or are currently planned. NBVC will continue to manage known occupied habitat to ensure no adverse impacts to gobies or their habitat from Navy or research activities.

Least Bell's Vireo

The least Bell's vireo was listed as endangered by the Service in June 1986, due to habitat loss restricting the vireo's breeding range and nest parasitism by the brown-headed cowbird (*Molothrus ater*), which reduced nesting success within much of the remaining breeding habitat. The least Bell's vireo's range extends from coastal California to Baja California, Mexico, and east towards Death Valley. Approximately 36,000 acres in southern California was designated as critical habitat in 1994 and the draft recovery plan was implemented in 1998. Due to lack of riparian habitat at NBVC Point Mugu, no critical habitat was designated. Small patches of willows are present on base, but they are not associated with any freshwater streams, where vireos are most commonly found breeding. Once described as one of the most abundant birds in the state of California, by 1986, the least Bell's vireo population was estimated at 300 pairs. The population increased to 1,300 pairs by 1996 and 2,500 pairs in 2004.

A least Bell's vireo was first observed at NBVC Point Mugu in 2001. There were no additional sightings reported until 2009. At that time, four individuals were heard vocalizing adjacent to Las Posas Rd, suggesting possible attempts to establish nesting territories. In 2010, one individual was seen and heard vocalizing at Alumni Park (Figure 6). One individual was also detected at the Runway willow patch in 2010 and 2011. All of these vireos remained only a few days before moving on. The Runway willow patch was removed in 2012 due to airfield clearance requirements.

No vireos were documented during surveys from 2012-2014, except for one deceased individual found outside a building in 2014. Two individuals were documented in April-May 2015; one at the Las Posas North patch and the other at the former Golf Course, but did not remain to breed. In April-June 2016, extended vireo activity at the Las Posas North site suggested a breeding pair may have been actively incubating or caring for chicks. This was the first substantial indication of nesting least Bell's vireos at NBVC Point Mugu. In 2017, the Las Posas North patch was unoccupied, but at least one singing male was heard at the Dirt Road site between April-June 2017 again suggesting an active nesting territory. Only passive listening surveys occurred; no nest searching was conducted. Habitat in this area primarily consists of coyote bush, myoporum, and non-native annuals, which is not typically preferred by vireos (Figure 6).

In 2018, passive surveys were conducted at Las Posas North and South, Alumni Park, PM Bldg 55, Golf Course, Bat Box, and Dirt Road (Figure 6) on thirty-nine dates from 19 March–9 July 2018. Not all sites were surveyed on each date. A minimum of three individual least Bell's vireo were documented

during the 2018 survey period. One male was heard singing at the Los Posas North patch on five occasions between 19 April – 18 May 2018. It is unlikely this individual bred. A second vireo was heard at the Bat Box twelve times between 23 April – 3 July 2018. The third was heard at the Dirt Road ten times between 23 April – 29 June. Due to their extended presence during the breeding season, it is suspected the vireos at these two sites had nests, but this was not confirmed.

Navy-Related Impacts

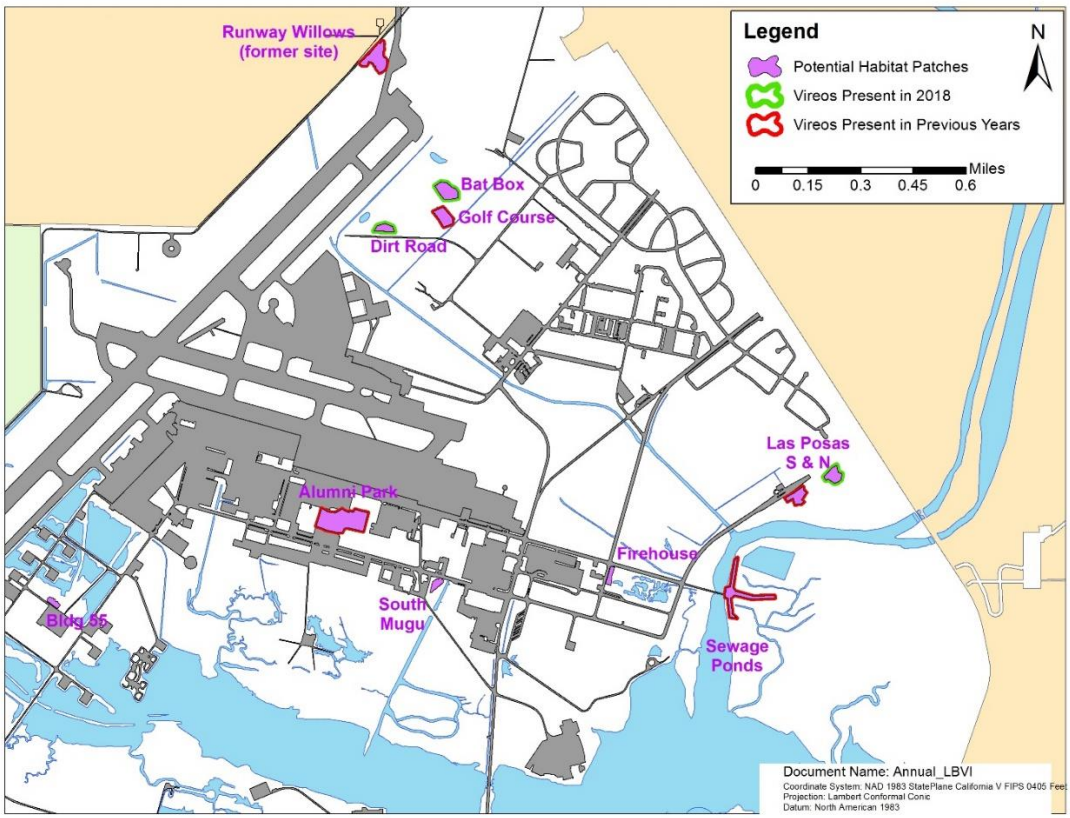
There were no Navy-related impacts to least Bell's vireo or their habitat in 2018.

Summary

Passive surveys have been conducted annually since 2010. In 2016, there was the first compelling evidence of breeding at NBVC Point Mugu at the Las Posas North patch. No vireos were heard vocalizing at that location in 2017, but at least one singing male was present at the Dirt Road patch during the breeding season and may have potentially nested. The territory at the Las Posas North patch where a pair is believed to have successfully bred in 2016 did not appear occupied in 2017. In 2018, at least three different vireos were heard vocalizing: one at the Las Posas North patch and two in different locations within the former Golf Course: Dirt Road and Bat Box. It is suspected that these individuals may have nested due to their extended presence.

Passive surveys in appropriate habitat will continue in order to document the presence of vireos.

Figure 6. Least Bell's Vireo Survey Locations, NBVC Point Mugu, 2018.



Light-Footed Ridgway's Rail

Light-footed clapper rails were listed as endangered in 1970, with a range extending from Santa Barbara County, CA to San Quintín Bay, Mexico (Service, 1970). The most recent 5-year review of the species' status was completed in 2009 (Service, 2009) and a notice of the initiation of new 5-year review was published in 2013 (Service, 2013). In 2014, the light-footed clapper rail, along with both the other large rails of the western United States were taxonomically reclassified and renamed by the American Ornithologist Union (Chesser et al., 2014); the southern California subspecies is now referred to as the light-footed Ridgway's rail (*Rallus obsoletus levipes*). Although formal recognition by the Service of this nomenclatural change is still pending, the new name is in common usage.

Rails, year-round residents at NBVC Point Mugu, are dependent upon coastal salt marsh habitat, which is rare within southern California. Considering the combined acreages of marshes that are regularly occupied, the vegetated marsh and most closely associated habitats at Mugu Lagoon represent more than 25% of potential rail habitat in California. The marsh is subject to nearly full tidal action in the central and eastern arms, with an amplitude of about 9 ft. The tides are dampened by constrictions at Laguna Road and farther west, resulting in a tidal amplitude of only 4 - 5 ft. The wetland vegetation is dominated by pickleweed (*Salicornia virginica*) with scattered stands of spiny rush (*Juncus acutus* ssp. *leopoldii*), critical for rail nest placement (Zembal, 2019).

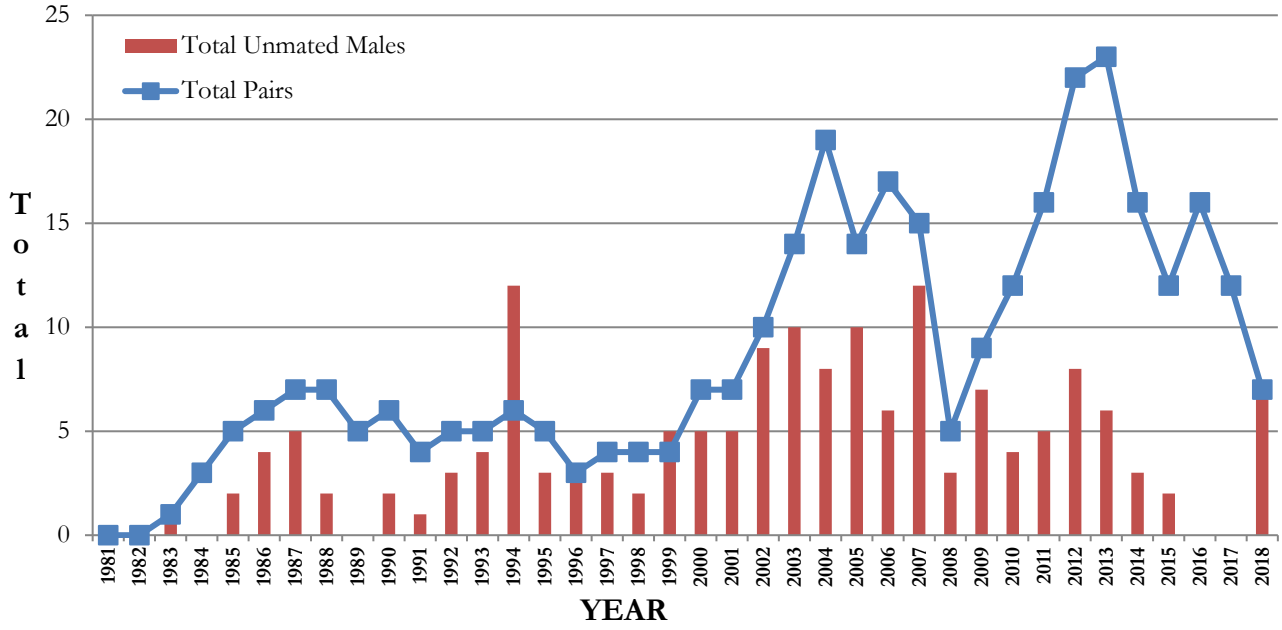
Population Monitoring

Rails were primarily monitored by Huntington Beach Wetland Conservancy [HBWC] in 2018. The population census was conducted on five dates in 2019: 3 May, 23 May, 9 June, 30 June and 21 June. The population assessment involved approximately 125 hours of systematic field observations by two to six participants (Zembal, 2019).

A minimum of seven breeding pairs and seven unattached males were detected in 2018 (Figure 8; Appendix B). Additionally, an eighth advertising male was heard just off base (Figure 8) in a seasonal pond, but is not included in the installation totals. Breeding evidence, territorial behavior, or vocalizations were documented in 6 of 7 territories (Zembal, 2019).

The statewide rail population, which had been showing an increasing trend since 2012, declined in 2018. Of 30 California wetlands surveyed in 2018, 19 sites supported a total of 356 pairs (Appendix B). The NBVC Point Mugu subpopulation was the 11th largest (Zembal, 2019). After doubling in size between 2001 and 2003, the rail population fluctuated between 14 and 19 breeding pairs from 2003 – 2007. The population has begun increasing again after a range-wide decline in 2008. The NBVC Point Mugu population has decreased from the high of 23 pairs detected in 2013; 7 pairs are the lowest that have been documented since 2008 (Figure 7).

Figure 7. Light-footed Ridgway's Rail Population, NBVC Point Mugu, 1981-2018.



Reproductive Success

Due to the difficulty of locating rail nests deep within spiny rush, nesting data is often more heavily weighted on evidence of nesting, such as evidence of chick feeding, chick observations, brood nests, and vocalizations.

Four incubation nests were documented in three territories in 2018. Pair #2 had four eggs and showed evidence of successful hatching. However, there were signs that several eggs may have been depredated following a partial hatch. A second nest in the territory was empty but a juvenile was photographed in August in a nearby raft (R22) suggesting a successful hatch. Pair #3's nest held one egg when found, then eventually four eggs. Based on chick evidence, at least some hatched. The nest from Pair #4 was predated, likely by a large mammal. All four incubation nests were in spiny rush. No brood nests were found in 2018 (Zembal, 2019; Table 3).

Food remnants indicative of chick feeding are among the most common evidence of successful reproductive activity. Adults feeding young chicks will break apart small crabs that they would swallow whole for themselves. Small, dismembered crabs left in the marsh at regular feeding spots, tracks of young and adult rails, downy feathers and regurgitated pellets are all useful indicators of chick feeding. Chicks were in evidence in four territories including an adult vigorously posturing and vocalizing in defense of unseen chicks in Territory #7. Chick signs observed included: downy feathers, small chick-sized regurgitated pellets, the smaller tracks of chicks amongst adult tracks on the adjacent mudflats, and chick feeding (Zembal, 2019; Table 3).

To provide additional nesting habitat, a total of ten floating nest platforms (Figure 8) were placed in the marsh in 2008-2009; this included two rafts adjacent to Calleguas Creek and eight in the West Basin. Seven of these rafts were functioning in 2018 and each was checked a maximum of four times during the breeding season. Three rafts, including two near Calleguas Creek (R09/R10) and one near Laguna Road (R08), are now defunct. In both 2008 and 2009, one raft (R07) resulted in a hatched

nest. No incubation nests were observed on rafts from 2010 – 2018. However, rafts have been used for brood nests several times, including twice in 2014 (R05, R07), once in 2015 (R03), and twice in 2016 (R05, R07) (Table 2, Zembal, 2018).

In 2015, grant funding was received from the USFWS Coastal Partner's program to deploy fifteen additional nest platforms. These rafts were built in cooperation with the Girl Scouts of America, USFWS, and NBVC staff. Each contained a motion-activated camera inside to monitor their use by rails or other species. The platforms were initially installed from January through March 2016 and have been deployed for three breeding seasons. At the end of each season, the memory cards are retrieved and photos are reviewed. No incubation or brood nests have been documented on the platforms, but several have recorded rail activity. Three platforms (R19- R21) had visits by rails between March and August 2016. In 2017, six platforms (R17-R22) had activity. In 2018, four platforms (R19-R22) had visits ranging from 1 to 22 occasions. A juvenile was photographed at R22 (Table 2, Zembal, 2019).

Table 2. Light-footed Ridgway's Rail Raft Usage, NBVC Point Mugu

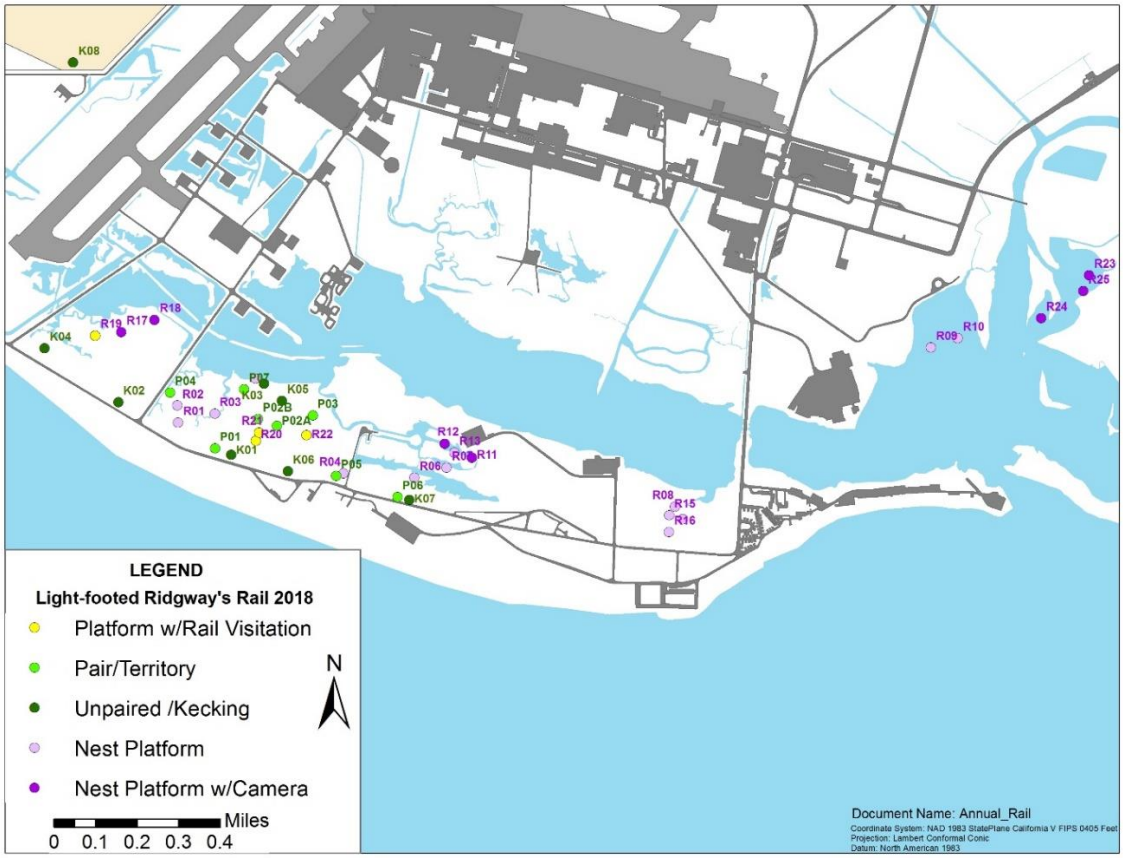
RAFT ID	YEARS DEPLOYED	CAMERA	2008	2009	2012	2013	2014	2015	2016	2017	2018
R01	2009 - 2018	No					Visit	Visit			
R02	2009 - 2018	No									
R03	2009 - 2018	No						Brood Nest			
R04	2009 - 2018	No			Visit						
R05	2008 - 2018	No	Visit		Brood Nest	Brood Nest	Brood Nest		Brood Nest	Brood Nest	
R06	2009 - 2018	No									
R07	2008 - 2018	No	Hatched Nest	Hatched Nest	Brood Nest	Visit	Brood Nest		Brood Nest		
R08	2008 –2015	No	Visit		Visit						
R09	2008 –2015	No									
R10	2008 –2015	No									
R11	2016 –2018	Yes									
R12	2016 –2018	Yes									
R13	2016 –2018	Yes									*Camera offline*
R14	2016 –2018	Yes									*Camera offline*
R15	2016 –2018	Yes									*Camera offline*
R16	2016 –2018	Yes									*Camera offline*
R17	2016 –2018	Yes								Visit	
R18	2016 –2018	Yes								Visit	
R19	2016 –2018	Yes							Visit	Visit	Visit
R20	2016 –2018	Yes							Visit	Visit	Visit
R21	2016 –2018	Yes							Visit	Visit	Visit
R22	2016 –2018	Yes								Visit	Visit
R23	2016 –2018	Yes									
R24	2016 –2018	Yes									
R25	2016 –2018	Yes									

Table 3. Light-footed Ridgway's Rail Reproductive Activity, NBVC Point Mugu, 2018.

Territory #	1	2	3	4	5	6	7
Nest Cover*	-	J	J	J	-	-	-
# Eggs	-	4, 0	4	P	-	-	-
Hatch Evidence	X	X, X	-	-	X	-	Adult
# Chicks (or Evidence)	X	-	X	-	X	-	X
Chick-feeding	X	-	X	-	X	-	X
Duet Heard	X	X	X	-	X	X	X
Adults Seen	X	-	-	-	-	-	X

Note: Cover refers to nest placement or dominant vegetation in that territory.
J = *Juncus acutus*; *F = Frankenia*
X = Yes/Positive Evidence; - (dash) = None Observed / Not Detected
Sh = Small egg fragments indicating hatched eggs; bn = Brood nest
Adult = Adult defending chicks P= Predated

Figure 8. Light-footed Ridgway's Rail Territories and Nesting Platforms, NBVC Point Mugu, 2018.



Population Enhancement and Band Re-sightings

There were sightings of adult rails in two of seven territories in 2018 (Zembal, 2019).

As part of a population enhancement program, a total of 107 captive-reared individuals were released at NBVC Point Mugu from 2001- 2009. No rails have been released since 2009 and no banded birds were observed in 2018. Nine years have passed since the last captive-reared banded rails were released at the NBVC Point Mugu; this exceeds expected average longevity for this species in the wild. The current rail population is assumed to consist only of unbanded birds.

There have been occasional sporadic reports of rails elsewhere in Ventura County. Broadcast call counts were conducted at the Ormond Beach Nature Conservancy (TNC) property and at the Ventura River Mouth in 2013, but no vocalizations were heard. Extended drought dried out these areas of potential habitat in 2014 -2015, therefore no surveys were attempted. An unattached male rail was heard vocalizing on the TNC property 5 April 2016, but was not heard during a subsequent survey on 5 May 2016. The habitat had dried up by May so the rail likely left the area. No surveys were conducted in 2017-18. Rails were also occasionally seen on the Ormond Beach property which is connected to NBVC Point Mugu by the canal at Arnold Rd. Up to two breeding pairs have been documented in that area in past but there were no territories were documented in 2018. One male was heard advertising in a temporary pond near the Perimeter Road fenceline in 2018 (Figure 8).

Mortality and Predation

Predation, particularly by raptors, likely has a large impact on the rail population at NBVC Point Mugu. Nine different species of birds of prey are regularly observed, including at least five that have been known or have been suspected of preying on rails: peregrine falcons (*Falco peregrinus*), red-tailed hawks (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), short-eared owls (*Asio flammeus),* and great-horned owls (*Bubo virginianus*). Additionally, the remains of adult rails found in 2014, 2017, and 2018 appeared to have been left by an unknown medium- to large-size mammal, most likely coyotes (*Canis latrans).*

Predator management occurs throughout the year. Actions focused on the removal of mammalian predators in the marsh, such as coyotes, Virginia opossums (*Didelphis virginiana*), and raccoons (*Procyon lotor*). Raptor are primarily harassed and relocated but occasionally lethally removed. No raptors were relocated or lethally removed in 2018 specifically for the benefit of rails.

Management Actions

The majority of the sea fig has been removed from rail areas over the past ten years, with only a few sections requiring re-treatment. However, multiple unoccupied areas of high marsh continue to be treated and may provide valuable future habitat in the face of potential sea level rise.

Navy-Related Impacts

No Navy-related impacts to light-footed Ridgway's rails were documented in 2018.

Summary

The range-wide rail population dropped from an estimated 514 pairs in 2017 to 256 pairs in 2018. This continues a decline from the peak of 656 pairs estimated in 2016. The population at NBVC Point Mugu has also declined with only seven pairs estimated in 2018, which is the lowest estimate since

five pairs were recorded in 2008 and is a significant drop since it reached a peak of 23 pairs in 2013 (Figure 7).

It is important to note that the small population size could be influenced by the inherent difficulties in monitoring these secretive birds, which are typically not highly vocal. Calling frequency and detection can be influenced by a variety of factors, such as weather and nest status. Furthermore, Bui et al (2015) found that over 60% of radio-marked California Ridgway's rails (*Rallus obsoletus obsoletus*) located within 200 m of observers were not detected during call-count surveys. Given the large size of the study area at NBVC Point Mugu and the nature of rails, it is possible that more individuals are present in landscape than are detected over the course of the season.

Given the low population density, even limited predation can have a significant impact on the overall population. The potential for predation pressure remains high. Some stands of spiny rush, which are most desirable for rail nesting are being overtaken and smothered by thick growth of alkali heath (*Frankenia salina*) and pickleweed.

A total of 22 supplemental platforms are currently distributed throughout rail habitat at NBVC Point Mugu. Repeated rail visitation at camera-equipped rafts suggests the rails may be amenable to using the platforms for either incubation or brood nests in the future. The cameras have already begun to provide valuable insight into both rail and predator activity and should continue to be a useful management tool.

Appendix B *provides a more detailed account of the light-footed Ridgway's rail population status at Point Mugu during 2018.*

Western Snowy Plover

In 1993, the western snowy plover was listed by the USFWS as threatened and by the California Department of Fish and Wildlife [CDFW] (formerly California Department of Fish and Game [CDFG]) as a species of special concern (Service 2006, 2007). The Service designated the coastal population of snowy plovers as threatened in 1993, with critical habitat designated in 1995. Designation of critical habitat at NBVC Point Mugu was exempted in 2005, as an Integrated Natural Resource Management Plan provided appropriate protection to their habitat. Snowy plovers are present year-round at NBVC Point Mugu.

The main recovery criterion for the western snowy plover is maintaining a range-wide average of 3,000 breeding adults for 10 years across the six recovery units (Service 2007). The overall goal for Recovery Unit 5 [RU5] is 1200 breeding individuals. Within that unit, the management potential for NBVC Point Mugu subpopulation is estimated as 110 breeding individuals (Service, 2007). The subpopulation breeding management goals are approximately 20% higher than recovery criteria subpopulation sizes.

Window Surveys

Winter and breeding season window surveys are conducted in conjunction with the annual Western Snowy Plover RU5 surveys. Additional surveys are conducted throughout the year when conditions are favorable.

Window surveys may not detect all birds and are not directly comparable to intensive studies conducted on color-banded populations. A correction factor can be applied to the data in order to account for differences in survey efficiency. Currently, the best range-wide estimate of the correction factor is 1.3 (Service, 2007).

A total of 99 adult plovers were observed at Point Mugu during the rangewide breeding surveys in both 2017 and 2018. This is the highest number of adults recorded since regular monitoring began in 1991. When the correction factor is applied, the breeding season window survey totals have been above the management potential for four years (Figure 9). A minimum of 43 concurrently active nests were recorded in 2018, making it the second year in row that over 40 pairs were documented. The uncorrected window survey result of 99 plovers is comparable to the estimate of 86 individuals based on total peak active nests. Considering that some plovers may have been in between nests or already rearing chicks during the peak of concurrent nesting it is reasonable that this estimate would be slightly lower than the window survey total. Their similarity suggests that most breeding adults are being counted during the summer window survey and the correction factor may be overestimating the population. However, both are values are presented to provide a range for reference.

The wintering population is highly variable (Figure 9). As they are not tied to nesting beaches, wintering plovers may spend more time foraging or roosting in Mugu Lagoon or on other local beaches, making it more difficult to obtain accurate estimates of their abundance. The 2018 survey resulted in a minimum of 80 individuals, which the highest count since 88 plovers were documented during the 2013 survey.

Figure 9. Western Snowy Plover Adults Observed during Annual Recovery Unit Surveys, NBVC Point Mugu.

Band Sightings

Eleven individual plovers with colored leg-bands were identified on at least 26 occasions in 2018 (Table 4). However, several individuals were associated with nests and were also seen on other days during the incubation period.

A male plover, [y]b:bg, was captured by a trail camera at nest R10 on Ormond East. The nest was located on 26 April 2018 and successfully hatched 3 chicks on 28 May 2018.

A female plover, tw:[O]w, was observed on multiple occasions incubating nest R28 on Ormond East. The nest was located on 4 June 2018 and successfully hatched 3 chicks on 30 June 2018. She was uncooperative on numerous attempt to see her bands, therefore the 'O' remains unconfirmed and pending a match.

A male plover, Sb:pr, was seen throughout the year, primarily on Holiday Beach. He was observed incubating nest H32 on Holiday. The nest was located on 18 June 2018 and successfully hatched 3 chicks on 18 July 2018. Typically, the majority of banded plovers observed on the installation are from northern sites between Vandenberg Air Force Base and San Francisco. However, this individual, banded at Coronado, has been observed throughout 2017 and 2018. Coronado used pink [p] anodized Service bands on the upper left leg, but the color completely faded on the bands to a silver [S] shade.

Table 4. Sightings of Banded Western Snowy Plovers, NBVC Point Mugu, 2018.

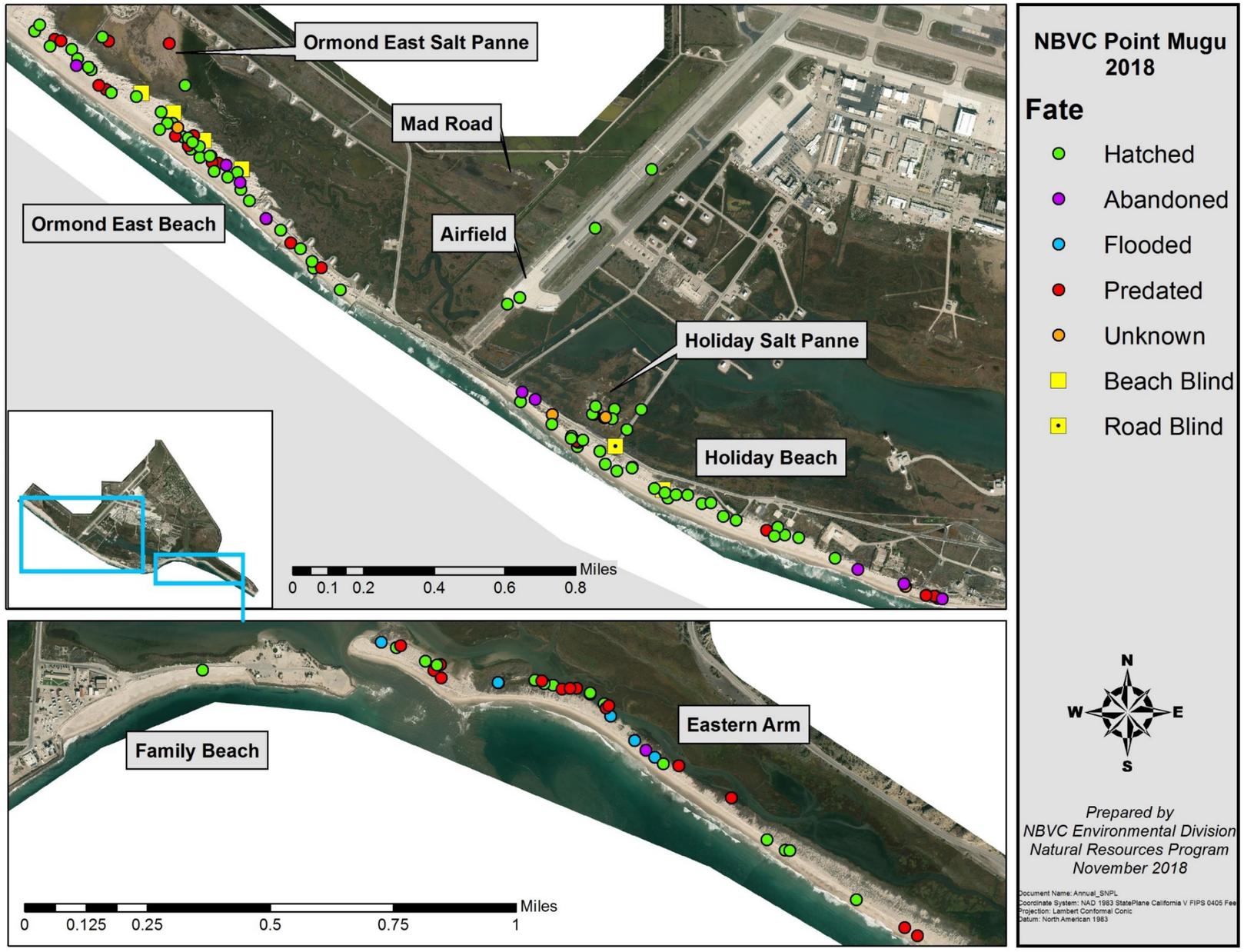
Observation Location	Date	Left Leg	Right Leg	Sex	Year Banded	Age Banded	Location Banded
Ormond East	5/29/2018	[y]b	bg	Male			*[pending match]*
Ormond East Salt Panne	11/19/2018	ao	gk		2018	Chick	Naval Base Coronado SeaWorld Release
Ormond East Salt Panne	11/21/2018						
Ormond East	11/26/2018						
Family Beach	11/1/2018	gg	oy		2018	Chick	Oceano Dunes
Eastern Arm	11/26/2018						
Eastern Arm	5/22/2018	no	ry	Female			*[pending match]*
Eastern Arm	3/28/2018	nr	nr				*[pending match]*
Eastern Arm	3/28/2018						
Eastern Arm	4/4/2018						
Eastern Arm	4/9/2018						
Eastern Arm	4/18/2018						
Eastern Arm	4/18/2018	Pa	sr				*[pending match]*
Eastern Arm	5/22/2018	pa	wr				*[pending match]*
Ormond East	7/18/2018						
Eastern Arm	11/26/2018						
Holiday Beach	1/4/2018	Sb	pr	Male	2016	Chick	Coronado [San Diego]
Holiday Beach	1/22/2018						
Holiday Beach	3/5/2018						
Holiday Beach	3/14/2018						
Holiday Beach	4/26/2018						
Holiday Beach	6/18/2018						
Holiday Beach	12/19/2018						
Ormond East	6/4/2018	tw	[O]w	Female			*[pending match]*
Ormond East	7/19/2018	vv	ag		2018	Chick	Oceano Dunes
Ormond East Salt Panne	12/19/2018	wr	wa	Male	2018	Chick	North Marina Dunes Monterey Bay

Color Codes: (capital letter indicate ABOVE knee): **A**QUA **B**LUE **G**REEN **L**IME **O**RANGE **P**INK BROW**N** **R**ED **V**IOLET **Y**ELLOW BLAC**K** **S**ILVER(metal) **W**HITE
[brackets] indicate color identification is tentative

Table 5. Western Snowy Plover Nest Fates, NBVC Point Mugu, 2018.

			EGG FATE							NEST FATE						PREDATOR TYPE					
Snowy Plover Nest Location	Total Nests	Total Eggs	Hatch	Abandon	Wash Out	Unknown	Failed - Other	Predated	Chicks Seen	Nest Hatch (Full or Partial)	Abandon	Wash Out	Unknown	Failed - Other	Predated	Raven	Unknown Avian	Coyote	Opossum	Unknown	Unknown Small mammal
Ormond East	49	135	85	9	0	5	1	35	28	31	4	0	2	0	12	3	2	0	0	7	0
Ormond East Salt Panne	4	10	6	0	0	0	0	4	3	2	0	0	0	0	2	0	0	0	0	2	0
Holiday Beach	38	106	72	19	0	6	0	9	12	26	6	0	2	0	4	2	0	0	0	2	0
Holiday Salt Panne	9	25	23	1	0	1	0	0	6	8	0	0	1	0	0	0	0	0	0	0	0
Runway	4	13	12	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Mad Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Arm	35	94	40	4	16	0	0	34	13	15	1	5	0	0	14	11	0	3	0	0	0
Family Beach	1	3	3	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
Total	**140**	**386**	**241**	**34**	**16**	**12**	**1**	**82**	**65**	**87**	**11**	**5**	**5**	**0**	**32**	**16**	**2**	**3**	**0**	**11**	**0**
Percent of Total			**62.44%**	**8.81%**	**4.15%**	**3.11%**	**0.26%**	**21.24%**	**16.84 %**	**62.14%**	**7.86%**	**3.57%**	**3.57%**	**0.00%**	**22.86%**						

Figure 10. Western Snowy Plover Nest Locations and Fates, NBVC Point Mugu, 2018.



Reproductive Success

Nests searches were performed one to three times per week by two to four nest searchers spreading out over the beach, walking slowly in a serpentine pattern (zigzag). Once nests were found, the coordinates were mapped using ArcPad on an AshTech Mobile Mapper 10 and each nest was marked with a numbered tongue depressor to allow the status to be tracked until inactive. Surveys began on 20 March 2018 and the last occurred on 13 August 2018.

Plovers nested on Holiday Beach, Ormond East, Eastern Arm, two salt pannes, on L Avenue (adjoining the Holiday Salt Panne), and along the airfield (Figure 10). A nest was also documented for first time on Family Beach. Plovers did not nest on Pad Alpha, Pad Bravo, Mad Road, or on the north ramp of the airfield in 2018.

The first snowy plover nest was found on 23 March 2018, the first nest hatched on 27 April 2018, the last hatched on 10 August 2018. A minimum of 140 plover nests were initiated during the 2018 season. Of those, 87 hatched (62.14%), 32 were predated (22.86%), 11 were abandoned (7.86%), 5 washed out (3.57%), and 5 had unknown fates (3.57%, Table 5). A minimum of 43 pairs of plovers were calculated to be breeding by concurrently active nests.

Regular monitoring of western snowy plovers at NBVC Point Mugu began the mid-1990s. The results of 2018 season was very similar to the 2017 season, which broke several breeding season records including: most nests initiated (2017: n=148; 2018: n=140), most nests hatched (2017: n=88; 2018: n=87), most pairs calculated by concurrently active nests (2017: n=41, 2018: n=43), and most adults counted during breeding survey (2017: n=99, 2018: n=99).

Of particular note was the first successful nest on Family Beach. Family Beach is the only beach on the installation open for recreation. Flocks of plovers regularly winter there but they move to other sites during the breeding season. The nest was found on 19 April 2018 with three eggs and was subsequently roped off with symbolic fencing to protect it from foot traffic. Three chicks hatched on 7 May 2018. Being the only plovers present on the beach, it was possible to track their status despite the fact that they were not banded. On 10 May 2018, a red-tailed hawk showed extreme interest in the family causing the male to conduct a distraction display. The hawk was hazed away, and three chicks were observed until 11 May 2018. On 12 May 2018, a previously scheduled US Marine Corps recruitment event took place on the far western end of Family Beach. After that date, only two chicks were seen. The plovers hatched and spent the majority of their time on the eastern end of the beach, so the absence of the third chick, particularly in the first week of life and after a hawk had shown interest, was not considered to be linked to the event. The remaining two chicks were observed daily until 13 June 2018, at which point they reached fledgling stage.

Predation

Since the late 90's, common ravens (*Corvus corax*) have had an increasing presence in coastal Ventura County. This has resulted in significant impacts on the outcome for snowy plover breeding season at NBVC Point Mugu (Table 6).

Since 2014, USDA Wildlife Services has been contracted to provide full-time predator management at NBVC Point Mugu. In addition to trapping, shooting, and hazing, USDA is the only agency permitted to use the corvicide DRC-1339. Up to seven pre-baited platforms are erected at a time in

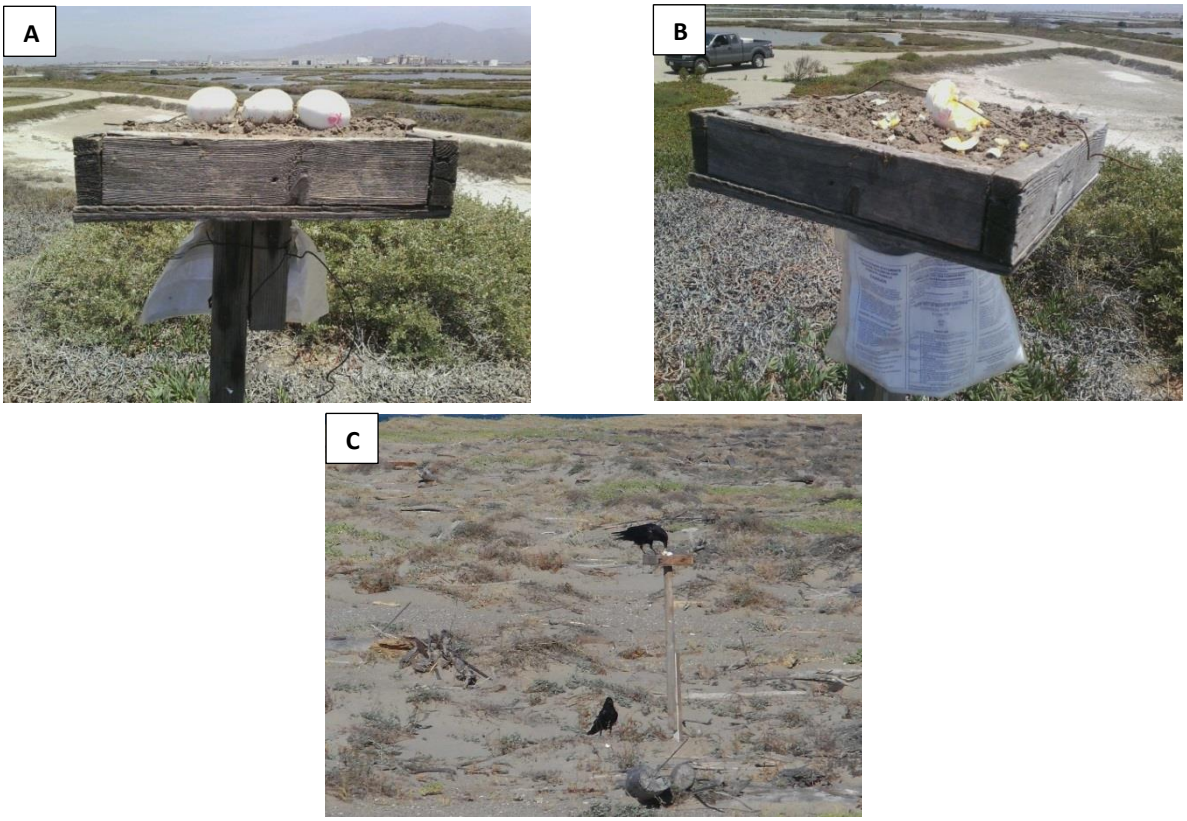
areas with documented raven activity (Figure 11). If ravens consumed the pre-bait, eggs containing DRC-1339 were wired onto the platform, which was then closely monitored until the ravens returned.

In 2016, padded leg-hold traps were used to specifically target individual ravens actively attempting to consume nests. Traps were set next to decoy plover nests (with old plover, quail, or chicken eggs) or a nest marker (ie: tongue depressor) set well away from an active plover nest. Between 2012 -2016, at least 45 of 94 plover nests consumed by ravens also had their nest marker (tongue depressor) pulled out and tossed on the ground. Five ravens were captured at decoy nests and a sixth was captured while trying to remove a nest marker. After the sixth raven was neutralized, no additional snowy plover nests were lost to ravens in 2016. In total, of the 37 snowy plover nests predated in 2016, 20 (54.1%) were consumed by ravens. Since pulling out nest markers may be a learned behavior, Natural Resources staff were hopeful that the removal of ravens exhibiting this behavior would result in a positive impact on the 2017 season. Indeed, in 2017, only 5 plover nests were lost to ravens--the lowest number and percentage of losses caused by ravens since 2009 (Table 6). Unfortunately, the results were short-lived. Ravens activity increased in 2018 and caused significant losses, mainly to California least terns, but 16 plover nests were also predated.

Table 6 Raven Predation of Western Snowy Plover Nests, NBVC Point Mugu 2009-2018.

Year	Total # Snowy Plover Nests	Total # Nests Predated	Total # Predated by Ravens	% Total Predations by Ravens
2018	140	32	16	50.0%
2017	148	29	5	17.2%
2016	110	37	20	54.1%
2015	129	32	21	65.6%
2014	123	36	9	25.0%
2013	116	47	15	31.9%
2012	111	41	29	70.7%
2011	113	28	6	21.4%
2010	135	36	8	22.2%
2009	88	12	6	50.0%

Figure 11. Platforms – A) intact pre-baited eggs, B) consumed eggs, and C) common ravens visiting a platform



Plovers also face challenges from other species. Weather conditions frequently erase predator tracks which often serve as the primary method of identifying the source of losses. Of the 32 depredated nests in 2018, 13 did not have enough evidence to be attributed to specific predators but were assigned to categories of 'unknown avian', 'unknown small mammal', or simply 'unknown predator' (Table 5). This was very similar to 2017 results. Ravens, northern harriers, and owls have been the most common avian egg predators at NBVC Point Mugu. Of potential terrestrial predators, opossums and California ground squirrels (*Otospermophilus beecheyi*) frequently cause losses and may have been responsible for some of the plover nests attributed to 'unknown' predators this season. Long-tailed weasels (*Mustela frenata*), which have an established population at NBVC Point Mugu, were confirmed to be present on the nesting colonies for the first time in 2017, but as of yet, no losses have been definitively attributed to weasels.

Tidal Barricades

Inevitably, each year snowy plover nests are washed out by high tides, at times only days before hatching. Nests in danger of potentially being washed out are barricaded. Barricades require up to five minutes to assemble and consist of large pieces of driftwood placed 5-10 feet away from the nest. The driftwood is generally placed in a U-shape to direct water around and away from the nest. Once Natural Resources staff vacates the area, plovers have been observed to quickly resume normal incubation of their nests. The fates of these nests have been tracked since 2011 to determine the effectiveness in minimizing these losses and boosting productivity. Nests were barricaded prior to 2011, but outcomes of these nests were not specifically tracked.

A total of 103 nests were barricaded from 2011-2018 (Table 7); including 14 in 2018. Of the 2018 barricaded nests, 8 (57.1%) hatched at least one egg. In total, 53 (51.5%) of the barricaded nests over the years have hatched; those that ultimately washed out (*n*=27, 26.2%) were typically impacted by extremely high surf that could not be diverted by a small barricade. There is no evidence to suggest barricaded nests were abandoned or targeted by predators at a higher proportion than non-barricaded ones. The increased depredation in 2013 and 2016 appeared to be a function of the overall high predation pressure during those seasons.

Although barricades do not save nests during the most severe storm-related surges or extreme high tide events, they appear to be useful in minimizing loss associated with the normal variation in tides. Often, slowing down the water only slightly can mean the difference between success and failure. In multiple instances, adult plovers have relocated some, or all, of their eggs from their barricaded nests that were hit by tides and continued to incubate. In these cases, the barricades stopped enough of the water to allow the adults to recover their eggs. Given the right conditions, plover eggs can hatch despite being temporarily being exposed to tidal action and washed out of the nest.

Snowy plovers face many challenges to the recovery of their population; barricading is a simple, useful, and non-invasive tool in preventing nest loss due to tidal action which also has the potential to increase fledgling rates. There is some concern that providing assistance to plovers that have chosen poor nesting locations will only encourage them to continue to select sub-optimal sites in upcoming seasons. While that remains a possibility, barricades are a management action which carries very little risk to the either the adult plover or their current clutch of eggs and has resulted in hatching which may have not otherwise occurred.

Table 7. Fates of Barricaded Western Snowy Plover Nests, NBVC Point Mugu.

Year	# Barricaded	# Hatched	# Washed Out	# Predated	# Abandoned
2018	14	8	4	1	1
2017	13	6	5	1	1
2016	18	8	5	5	0
2015	13	8	4	0	1
2014	15	11	4	0	0
2013	16	4	4	8	0
2012	8	3	1	1	3
2011	6	5	0	1	0
TOTAL	**103**	**53**	**27**	**17**	**6**
	Percent of Total	**51.5%**	**26.2%**	**16.5%**	**5.8%**

Navy-Related Impacts

There were no Navy-related impacts to western snowy plovers due to human activities at NBVC Point Mugu in 2018, although there were several situations in which potential impacts were successfully avoided.

Four plover nests were located on the shoulders of the runway and airfield in 2018. These nests are difficult to cordon off from traffic because signage and barricades can present hazards to aircraft. On 17 May 2018, a nest was found in section that was scheduled to be repaved as part of a long-planned

maintenance. Natural Resources staff coordinated with the Airfield Manager to provide guidance on avoiding the nest and utilizing an appropriate buffer to minimize disturbance. Ultimately, the paving was delayed for unrelated reasons and the nest successfully hatched by 5 June 2018.

On 21 May 2018, an Army Reserve Unit initiated a pre-deployment training exercise located at the Skeet Range adjoining Holiday Beach. This training had not gone through the proper approval process via the Project Review Board and several relevant parties had not been notified. The Army personnel were instructed by Natural Resources staff to avoid the beach and shoreline due to the presence of breeding snowy plovers. It was later determined that a group of individuals had in fact accessed the beach at some point. While they were only a few hundred feet from an active plover nest, they did not approach it closely on foot and the topography of the beach likely blocked them from being visible from the nest, which continued to be incubated and was not impacted.

In June 2018, an EOD operation was conducted to dispose of leaking JATO bottles. The EOD activity is described in detail the Explosive Ordinance Disposal (EOD) Operations section.

Finally, on 7 August 2018, one egg from Ormond East Beach nest 48 was brought to the Santa Barbara Zoo, which has snowy plover egg incubation and chick-rearing facilities. The nest was observed on 2 August 2018 in the process of hatching with two chicks and one egg present. During a survey nearly a week later, on 7 August 2018, the third and final egg, which had already been abandoned by the adults, showed signs of hatching activity and the chick could be heard chirping. The chick hatched that afternoon while in the incubator at the Zoo. Unfortunately, the chick very weak and unable to stand on its own and passed away by the next morning.

The abandonment of the egg and death of the chick did not have a Navy- or human-related cause, but it is documented here as the first occasion in which NBVC Point Mugu transported an egg to the Santa Barbara Zoo facility. Had the chick survived, it would have been banded and released on a local beach after reaching fledgling stage.

Summary

By several metrics, the 2017 snowy plover breeding season was the most successful in nearly a decade. The trend continued in 2018 with very comparable final results. While the number of nests initiated in 2018 (n=140) was slightly lower than 2017 (n=148), the number of hatched nests were similar (n=87 vs n=88 in 2017) and the proportion hatched (62.14%) in 2018 was highest since 2009. The number of concurrently active breeding pairs continues to slowly increase with 43 documented in 2018, which is both a slight increase from 2017 (n=41) and a new high. Finally, in both 2017 and 2018, 99 adults were observed during the breeding bird survey which are the highest totals recorded since regular monitoring began in 1991.

Eastern Arm was particularly productive the past few years, with the second most initiations and most hatched nests out of the three main colonies in 2017, but it did not fare as well in 2018. It had the fewest nests of the three main beaches and the most predation. Conversely, Ormond East, which was previously a stronghold but has struggled in recent years, once again had the most nests and the most hatches in 2018 (Table 5).

It is important to note that chicks are not banded at Point Mugu; therefore, the actual number of chicks fledged per male is unknown. However, given the high number of hatched nests, it is likely that the number of fledglings also improved in 2018.

While environmental factors such as extreme wind and tide events can result in high rates of nest loss and abandonment, they had minimal impacts during the 2018 nesting season.

Predation continues to have the largest effect on snowy plover productivity. Overall predation rates remain higher than desired and reduction will be a continuing process. This is not unexpected given the particular management challenges caused by avian predators. The use of DRC-1339 on ravens has served to improve hatch rates. Control methods continue to evolve as new threats arise.

California Least Tern

The California least tern was listed as endangered by the Service in June 1970. Least terns are only present at NBVC Point Mugu during the breeding season (mid-April through mid-Aug.); wintering south of the United States. NBVC Point Mugu is a Type 1 colony, as it is entered to collect nesting data for population monitoring rather than being monitored from outside the colony. Least terns forage off-shore and in tidally inundated areas throughout Mugu Lagoon.

Reproductive Success

Beaches were searched regularly for snowy plover nests prior to the arrival of the least terns; after terns arrived on 26 April 2018, the focus shifted to searching for both plover and tern nests. Nests searches were performed one to three times per week by two to four nest searchers spreading out over the beach, walking slowly in a serpentine pattern (zigzag). Once nests were found, the coordinates were mapped using ArcPad on an AshTech Mobile Mapper 10; each nest was marked with a numbered tongue depressor to allowing tracking during subsequent surveys. A lollipop stick was placed on the edge of the nest and sunk in the sand, a short red straw was placed approximately 6 ft away to help relocate the scrape and to determine nest fate at the end of the season.

In 2018, least terns nested on Ormond East, Holiday Beach, Holiday Salt Panne and Eastern Arm (Figure 12).

The first tern nests were initiated on 14 May 2018. A minimum of 291 nests were established (Table 8). Of these nests: 116 hatched (39.86%), 46 were abandoned (15.81%), 102 were predated (35.05%), 4 washed out (1.37%), and 23 (7.90%) had unknown fates (Table 8). The first nests began hatching on 14 June 2018 and the last nest hatched on 26 July 2018.

Ormond East Colony

Between 2001-2012, Ormond East colony was the largest of the sub-colonies at NBVC Point Mugu and would often support over 90% of the California least tern nests on the installation. Since 2013, the colony has been plagued by predation and other environmental factors resulting in erratic production and near total colony failures both 2013 and 2015. After those events, colony dynamics began shifting at NBVC Point Mugu. In four of the past six years, Holiday Beach had similar or more nests than Ormond East.

In 2016, a low of 120 nests were initiated on the Ormond East colony; of these, 51 hatched (42.50%). This was more than twice the number that hatched in 2015 (*n*=19), despite 53 fewer nests attempts. The improving trend continued in 2017 with 82 (49.40%) of 166 nests hatching. (Appendix A).

In 2018, a total of 218 nests were documented. This was the first time more than 200 nests were initiated on the colony since 2013. But, of these only 85 nests, or 38.99% hatched. Eighty-five nests (38.99%) were predated, one washed out (0.46%), 26 were abandoned (11.93%), and 21 (9.63%) had unknown fates. Nest results are presented in Table 8.

Despite the presence of 52 more nests than 2017, only 3 more nests hatched in 2018 compared to that year. This is directly attributable to the tripling of the predation rate from 2017 (*n*=26) to 2018 (*n*=85). Raven predation, which experienced a lull in 2017, increased significantly in 2018. Of the depredated nests, 45 were taken by ravens. Additional nests were assigned to either unknown avian (*n*=12) or unknown (*n*=19) predators. Many of these could have also potentially also been depredated by ravens. Often even moderate winds may obscure tracks and evidence. Several nests were also depredated by coyotes (*n*=7) and opossums (*n*=2).

The majority of the predation occurred early in the season, primarily during the week of 4 June 2018. Terns are not banded at this site, making it difficult to determine for certain, but most of the pairs appeared to re-nest afterwards. During the first wave, nests were generally located on the on the eastern half of the beach, whereas the second wave of nests were concentrated on the western half. Very little predation was documented after mid-to-late June, and these later nests had improved hatching success.

Once hatching began, the Ormond East colony was primarily monitored from blinds overlooking the beach. From 6 June to 23 July 2018, staff and volunteers watched the colony for approximately 271.07 hours. While in the blinds, observers documented hatching, conducted chick and fledgling counts, and monitored for predator activity. Additional details are provided in the Mortality, Predation, and Piracy section.

Holiday Beach Colony

Only 58 nests were documented on Holiday Beach in 2018, this is the fewest recorded since 2011 when 30 nests were present. Of the 58 nests, 25, or 43.10%, hatched. Ten (17.2%) were predated, three washed out (5.17%), 18 were abandoned (31.03.7%), and two (3.44%) had unknown fates. Nest results are presented in Table 8.

For several years, the Holiday Beach sub-colony experienced high hatch rates and low predation. Some of the success appeared linked to failures at Ormond East Beach. In 2015, the majority of nests were initiated during the same early season timeframe as a large predation event on the Ormond East colony which made it difficult to determine if re-nesting occurred. In 2016, the most notable losses on Ormond East occurred after a high tide event, by which time Holiday Beach already had nearly twice as many nests, demonstrating that it was the initial preferred nesting area for many terns that year.

Early in the 2017 breeding season, Holiday Beach was once again appeared to be the preferred nesting area. The bulk of the terns nested on the western end of beach, near the intersection of Beach and L Streets. In past years, this compact area was easily defensible by the terns and by NBVC's predator

manager and experienced minimal losses. However, the colony was decimated by predators early in 2017. In total 86 nests were depredated (52.12%), 50 during one event on 8 June 2017.

Afterwards, the Ormond East colony had three times the number of new nests initiated, suggesting least terns were avoiding re-nesting on Holiday Beach. This may also be why the reproductive effort on Holiday Beach in 2018 was only a third of the previous year. The terns may have continued to seek alternate sites for nesting. Furthermore, the terns that did nest on Holiday Beach appeared to avoid the area near Beach and L Streets where the colony had previously been centered. Instead, 32 (55.17%) of the nests were clustered further east, on a 750-ft stretch of shoreline between L Avenue and the Coreopsis Patch Pad (Figure 12).

A blind was positioned on a dune with a view of this cluster and it was monitored in conjunction with Holiday Salt Panne from a roadside vehicle between 22 June 2018 and 1 August 2018 for a total of 58.33 hours.

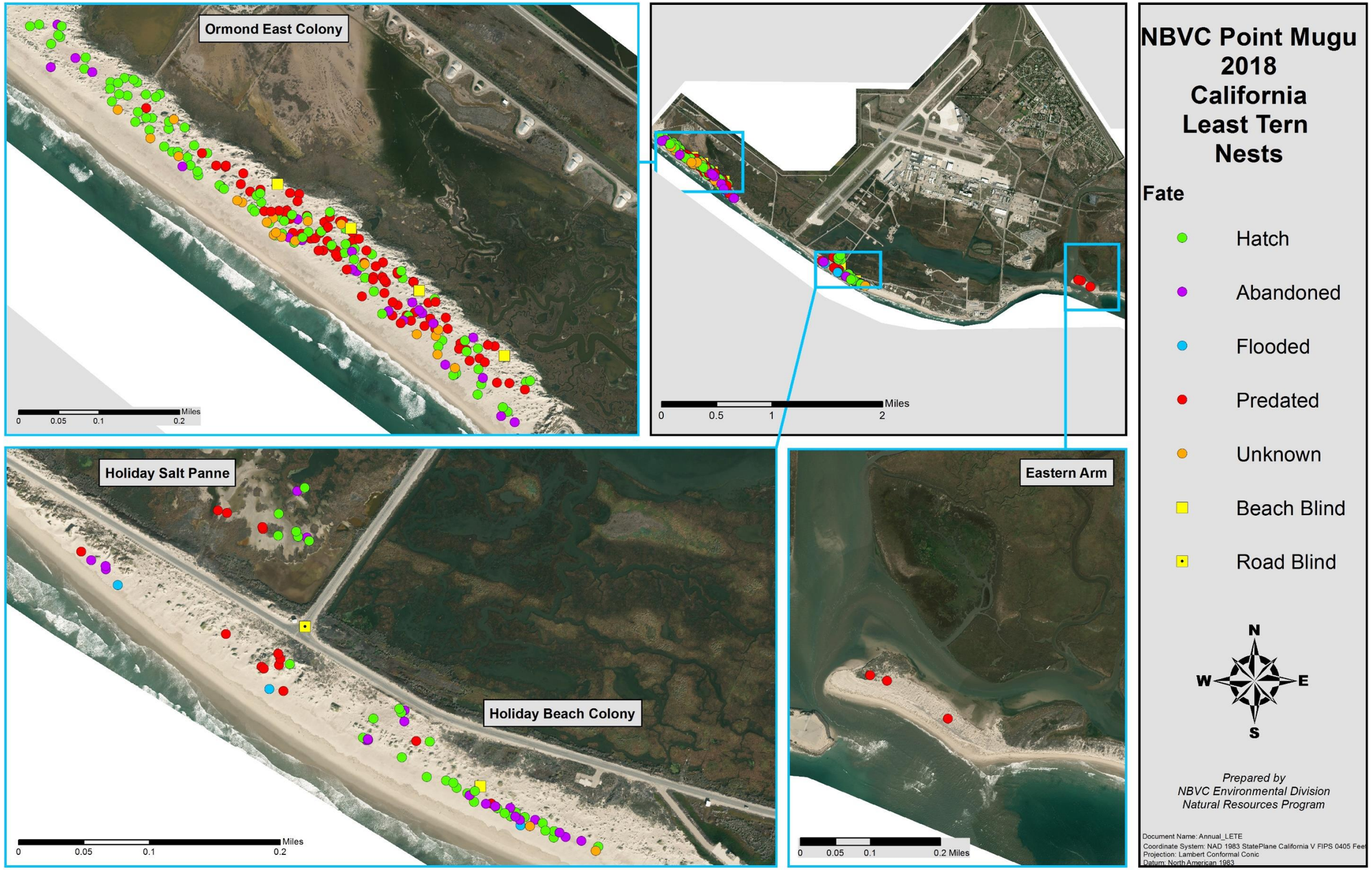
Additional details are provided in the Mortality, Predation, and Piracy section.

Table 8. California Least Tern Nest Fates, NBVC Point Mugu, 2018.

			EGG FATE						NEST FATE				
Location of Least Tern Nests	Total Nests	Total Eggs	Hatched	Abandon	Wash Out	Unknown	Predated	Chicks Seen	Hatch (Full or Partial)	Abandon	Wash Out	Unknown	Predated
Ormond East	218	365	148	40	1	33	143	54	85	26	1	21	85
Holiday Beach	58	90	40	27	5	3	15	23	25	18	3	2	10
Holiday Salt Panne	12	18	10	3	0	0	5	8	6	2	0	0	4
Eastern Arm	3	5	0	0	0	0	5	0	0	0	0	0	3
Total	**291**	**478**	**198**	**70**	**6**	**36**	**168**	**85**	**116**	**46**	**4**	**23**	**102**
Percent of Total			**41.42%**	**14.64%**	**1.26%**	**7.53%**	**35.15%**	**17.78%**	**39.86%**	**15.81%**	**1.37%**	**7.90%**	**35.05%**

			PREDATOR TYPE								
Location of Least Tern Nests	Total Nests	Total Predated	Raven	Owl	Unknown Avian	Coyote	Opossum	Ground Squirrel	Unknown Mammal	Unknown	Whimbrel
Ormond East	218	85	45	0	12	7	2	0	0	19	0
Holiday Beach	58	10	2	0	3	0	0	0	2	2	1
Holiday Salt Panne	12	4	0	0	0	0	0	0	0	4	0
Eastern Arm	3	3	2	0	0	0	1	0	0	0	0
Total	**291**	**102**	**49**	**0**	**15**	**7**	**3**	**0**	**2**	**25**	**1**
Percent of Total			**16.84%**	**0.00%**	**8.93%**	**4.17%**	**1.79%**	**0.00%**	**1.19%**	**14.88%**	**0.60%**

Figure 12. California Least Tern Nest Locations and Fates, NBVC Point Mugu, 2018.



Holiday Salt Panne Colony

The Holiday Salt Panne has been used as a nesting location since 2007. The total number of nests has ranged from 2 – 34 during that timeframe. From 2015-2017, the site was very consistent with between 20-22 nests and 12-15 hatches each of those years. Activity dropped in 2018. A total of 12 nests were documented, six of which hatched (50%).

During very high tides, the salt panne can become inundated with water, but is otherwise good nesting habitat. In late 2015, work began to replace the M Avenue culvert and repair failed culverts on L Avenue which created a sink hole in the road. The M Avenue culvert was replaced in 2016 but the L Avenue repair has been continually delayed. In the meantime, L Avenue has been closed to traffic for over two years, which has resulted in snowy plovers beginning to nest in the middle of this road section. Should the project, which includes box culverts replacing smaller pipes, be completed, the Holiday Salt Panne is expected to receive more regular influxes of water and its suitability as a nesting area may diminish. Nest results are presented in Table 8.

Eastern Arm Colony

Prior to 2016, when 16 of 38 nests (43.1%) hatched, no least tern nests were successful on Eastern Arm since 2009, when 5 of 23 (21.7%) hatched. Nests were initiated every year since then, with the exception of 2012 and 2015. All of these nests failed due to predation, flooding, or abandonment. The terns typically nest on the western tip of the barrier beach, which has high exposure to wind and wave action and is difficult to protect from predators.

The negative trend continued in 2017, 3 of 26 nests (11.5%) hatched. Nineteen (73.1%) nests were washed out, 17 during a high tide event. In 2018, only three nests were attempted. All were predated in less than a week: two by ravens and one by an opossum. Afterwards, no additional nests were initiated. Full nest results are presented in Table 8.

While snowy plovers have been increasingly successful on this beach, this is not the case for the least terns. This may be due to difference in their breeding behavior and nest site preference. Plovers are distributed across the entire length of the nearly two-mile long beach, whereas the terns are concentrated solely on the western tip. There are several sections of the beach prone to tide-related flooding and the location of the tern colony is among them.

Chicks and Fledglings

Surveys of tern chicks and fledglings were conducted throughout the nesting season by personnel monitoring the Ormond East and Holiday Beach colonies from blinds. Visible chicks were counted and assigned to size categories during surveys conducted in the course of an observation shift. Totals provided a general index of juveniles present on the colony; the values varied daily based on the location, visibility of chicks, and number of observers.

On Holiday Beach, pre-fledge chicks peaked on 15 July 2018 (n=12); the first fledglings were observed on 2 July 2018; and peaked on 23 July 2017 (n=8). On Holiday Beach Salt Panne, pre-fledge chicks peaked on 18 July 2018(n=4); the first fledglings were observed on 24 July 2018; and peaked on 24 July 2018(n=1). On Ormond East Beach, pre-fledge chicks peaked on 2 July 2018 (n=16); the first fledglings were observed on 6 July 2018; and peaked on 7 July 2018 (n=2).

It must be noted that due to the tern's distribution on Ormond Beach, the daytime chick and fledgling count totals were unusually low. Few, if any, chicks or fledglings were visible from the blinds after early July. Typically, chick activity near the blinds is reflective of overall productivity, but that was not the case in the 2018 season. The majority of the tern family groups appeared to relocate to the shoreline and wave-slope after the chicks hatched. While adults could be seen actively coming and going from the shoreline area, the juveniles were not visible or easily counted from the blinds. Evening fledgling surveys, reported below, were conducted on the shoreline and were far more successful in documenting juveniles this season.

The California Least Tern Working Group standard protocol recommends beginning fledgling counts 2-3 weeks after the first fledglings are observed and holding subsequent surveys at 2-3 week intervals. Least terns at NBVC Point Mugu nest several weeks later than other sites and typically in a single wave. The vast majority of individuals depart less than a month after the first fledglings are observed. Due to the very compressed season, spacing surveys so far apart would provide an underestimate of fledgling productivity.

In past years, the fledgling protocol included counts at 15-minute intervals from dusk until dark once or twice per week by one to three observers on Holiday Beach and Ormond East Beach positioned in the blinds or on the shoreline. The overall fledgling estimates were determined by using high counts from surveys conducted a minimum of eight days apart. Fledglings were categorized as young fledglings (FY) with brownish plumage and older fledglings (FO) with grayish plumage; older fledgling were only included in the overall total during the first survey of the season for calculation Method 1 (Table 9). A minimum of eight days allowed most of the FY to transition to FO before the next subsequent survey, lessening the chance of double counting individual juveniles while at the same time maximizing the ability to obtain a more accurate index of overall productivity. In calculation Method 2 (Table 9), the maximum totals of both FY and FO from all surveys were combined.

In 2018, the protocol was adjusted due to concerns about potential impacts to the birds on the shoreline by the presence of surveyors in stationary positions for several hours. In addition to the large clusters of least terns, there were many snowy plovers, including young chicks present, particularly on the shoreline of Ormond East. First, staff experimented with counting fledglings while walking the shoreline as in a standard snowy plover window survey. However, it proved difficult to keep track of the totals once the tern flushed and were in flight. Furthermore, it was challenging to differentiate young and old fledglings in flight at a distance. Ultimately, the protocol was adjusted so that observers were stationary on the shoreline just before dusk and spent a maximum of one hour on-site to get a high count of fledglings. As always, surveys were not conducted if conditions were too cold or windy. Totals were still tallied using previously described methods.

Table 9. Total Least Tern Fledglings Observed, NBVC Point Mugu, 2018.

Location	Evening Fledge Survey Method 1	Evening Fledge Survey Method 2
Ormond East Beach	45	53
Holiday Beach	16	19
TOTAL	**61**	**72**

Fledgling counts were conducted between 16 July - 8 August 2018. This resulted in an estimated minimum of 61-72 fledglings produced at NBVC Point Mugu. Terns chicks are not banded on the installation; therefore this is the only method available to estimate fledgling production. While there can be substantial difficulty in obtaining accurate counts of unbanded least terns, these two calculation methods have been used since 2009 at NBVC Point Mugu and thus do provide a good comparative index of productivity on the installation. There was not a high rate of chick mortality observed and, anecdotally, prey availability seemed adequate, therefore both estimates of the fledgling recruitment are likely to be conservative.

The 2017 estimate (27-51 fledglings) was the lowest since NBVC Point Mugu experienced a total breeding failure in 2013 (Appendix A). By comparison, the 2018 results show a substantial improvement in fledgling totals despite slightly fewer nests (n=116 vs n=124 in 2017) and eggs (n=198 vs n=211 in 2017) hatching in 2018.

Mortality, Predation, and Piracy

Predation continues to have significant impacts on California least tern productivity. Over a hundred nest were depredated in three of the each of the last five years, representing between 26.43 – 35.05% of total nests each of those years.

In 2018, 102 nests (35.05%) were depredated, including at least 49 attributed to common ravens. This is the highest number of raven losses since 2013, when they depredated 55 nests. In three of the past five years, five or fewer least tern nests were lost to ravens. But depending on the timing of raven activity, in some years the snowy plovers are hit harder, and vice versa.

Intensive ground squirrel, opossum, and mesopredator control efforts have reduced overall mammalian predation in recent seasons. There are still occasional spikes, particularly in coyote or opossum activity, that have had substantial negative impacts, but they were fairly minimal in 2018.

Overall, avian predators continue to be more problematic than terrestrial predators. Avian predators can quickly strike and leave the area without being easily observed, particularly on the edges of the colonies, and will target eggs, juvenile, and adults. However, identification of predators is a constant challenge on windswept beaches where the evidence can be ephemeral and quickly erased. Even terrestrial predators are difficult to identify and many nests continue to be lost to unidentified predators. The use of trail cameras has had mixed success in identifying predators and their usage continues to be refined.

Forster's terns (*Sterna forsteri*) nest in the marsh adjacent to the Ormond East colony and can be an indicator of food availability. In years when prey resource availability is lower, the rate of piracy attempts by Forster's terns appears increase. Only two unsuccessful piracy attempts by Forster's terns were observed in 2018. Anecdotally, there appeared to be enough forage fish available to allow both species to successfully provision their young without the Forster's terns resorting to regularly pirating fish from the smaller least terns. Piracy is more common on Ormond East, which is in close proximity to the Forster's tern colony.

Navy-Related Impacts

No Navy-related impacts to California least terns were documented in 2018. However, 20 least terns were disturbed by BASH activities to disperse other bird species near the airfield. See BIRD/ANIMAL AIRCRAFT STRIKE HAZARD (BASH) PROGRAM for more details.

Summary

A total of 291 California least tern nests were documented at Naval Base Ventura County in 2018. This is lower than 2017 (*n*=377) and 2016 (*n*=361). Despite the presence of fewer nests overall, the number of hatched nests in 2018 (*n*=116) was very similar to 2017 (*n*=125), but both years had fewer than 2016 (*n*=205).

Once again, predation took a significant toll on productivity. A total of 102 (35.5%) of nests were predated. The majority (*n*=85) were lost on the Ormond East colony, primarily during the week of 4 June 2018. Wind erased many of the tracks, but common ravens were responsible for the bulk of the take. Since most of the predation occurred quite early in the season, it appears most pairs re-nested. Very little predation was documented after mid-to-late June, which contributed to the success of later season nests.

The two main colonies, Ormond East and Holiday Beach, had a nearly identical number of nests in 2017 (*n*=166 and *n*=165, respectively). However, that season, Holiday Beach experienced severe predation. Afterwards, the terns appeared to shift to Ormond East to re-nest where they did fairly well. In 2018, Ormond East was the preferred colony from the start of the season. Despite the significant early season predation, the majority of the terns continued to nest on Ormond East. The colony ultimately had 218 nests compared to 58 total for Holiday Beach. While they remained on Ormond East to re-nest, the majority of the second wave nests were on the western half of the beach, whereas the earlier nests and losses were concentrated on the eastern portion.

Total fledglings appeared to increase in 2018 with an estimated 61 to 72 fledglings (2017: 27-51; 2016: 54-86). It was more difficult than usual to count of chicks / fledglings from the blinds on Ormond East. Generally, daily counts are conducted from the blinds, but this season, very few chicks were visible after they hatched and totals were extremely low. Most of the terns seemed to move to the shoreline and wave-slope as chicks became more mobile. While the heightened shoreline activity was very obvious, young chicks were not visible to observers from the blinds. Only when the shoreline was accessed during formal fledgling counts was it confirmed that the terns had indeed grouped together and there was significant presence of juveniles concentrated in that area.

The fledgling per pair ratio continues to be below the statewide average and the goal of 1 fledgling/pair stated in the recovery plan (Service 1985b). Unlike many other tern colonies, the nesting areas at NBVC Point Mugu are not contained by fences or physical barriers. Given the lack of banding, unrestricted movement of fledglings, and the size of the nesting area and marshes at NBVC Point Mugu, it is very difficult to obtain an accurate estimate of fledgling rates. Therefore, the annual fledgling estimate is considered an index to compare productivity among years at NBVC Point Mugu. The estimate may not be comparable to other sites with different colony attributes or fledging monitoring procedures.

Diet likely plays a major role in the overall productivity of the colony. Diet samples have been collected from NBVC Point Mugu during incubation stage and chick-rearing stage since 2013. In

2013, terns primarily consumed high quality rockfish and anchovy but it is possible that these were located at too great a distance for terns to forage effectively or at the rate needed to raise young (Robinette, 2014 LETE meeting) contributing to poor fledgling success. In 2014, terns consumed more anchovies, but lower quality brackish species were still present a large proportion of the diet (Robinette, 2015 LETE meeting). These brackish species, while not as nutritious, may have been located close to the colony, improving fledgling success. In 2016 and 2017, terns had a diverse diet consisting of anchovy, rockfish, silver side smelt, killifish, and fish larvae (Robinette, 2018 LETE meeting). A variety of food items in the tern diet is generally troubling sign and an indicator of potentially low productivity. This suggests that there might not have been consistent prey. Terns may have been either working hard to find food or finding smaller pockets of a variety of species available. This trend has been observed at other Southern California colonies. Overall, fish populations have been declining in the Southern California Bight since the 1970s.

Diet samples collected in 2018 are currently in the process of being analyzed by Point Blue. Given the increase in total fledglings in 2018, the results will provide valuable insight into this year's foraging conditions and if diet quality impacted the success rate. Although the overall hatch rate was only 40.5%, the chicks that hatched seem to have fared fairly well and anecdotal observations suggest that food resources were ample. Terns were observed frequently provisioning young that were present, suggesting nearby food sources.

While food resources and predation continues to be the primary limiting factors in productivity, environmental conditions such as severe wind events and unusually high tide can also play a significant role in driving the successes and failures of the California least terns at NBVC Point Mugu. These types of events did not occur in 2018.

PREDATOR MANAGEMENT

In fulfillment of the NBVC Point Mugu Predator Management Plan for protection of listed species, USDA-APHIS Wildlife Service conducted predator management on the installation in 2018 under the terms and conditions of NBVC's federal depredation permit (MB-117501-0). All trapping activities were in accordance with all applicable laws and regulations, which include the Endangered Species Act (16 U.S.C. §1531-44), the Migratory Bird Treaty Act (16 U.S.C. §703-712) (Migratory Bird Depredation Permit number MB189470-1 and amendments), Title 14, section 465.5 of the California Code of Regulations and Wildlife Services Directive 2.450, sections 3a through 3d.

Predator management activities primarily included the monitoring and removal of known and potential predators for the protection of the California least tern, the western snowy plover and the light-footed Ridgway's rail. These efforts were undertaken in areas designated sensitive habitat or identified as corridors. Any captured non-target animals that did not pose a realistic threat, based on observations by the predator manager and NBVC Natural Resources staff were released. Any predator trapped and considered a realistic threat was dispatched or relocated.

Predator management activities in 2018 resulted in 2,259 cage trap-nights (targeting mesopredators), 1,069 padded-jaw foot-hold trap-nights (targeting coyotes, mesopredators, and common ravens), and 890 Conibear trap-nights (targeting ground squirrels). The compound DRC-1339 avicide was used to target common ravens. Placement and usage were based on predator observations and sign found, including tracks, trails, droppings and predation events A summary is provided below in Table 10.

Table 10. Location and Species Removed by Predator Management, NBVC Point Mugu, 2018.

Species	Holiday Beach / Salt Panne	Ormond East / Salt Panne	Eastern Arm	Mad Road	Total
California Ground Squirrel	40	10	0	3	**53**
Virginia Opossum	11/(+16juv)	4/(+31juv)	1/(+10juv)	2/(+9juv)	**18 / (+66 Juv)**
Western Gull ***(Larus occidentalis)***	0	3	0	0	**3**
Coyote	0	4	1	0	**5**
Cottontail Rabbit^ ***(Sylvilagus audubonii)***	0	0	0	2 ^	**2**
American Crow ***(Corvus brachyrhynchos)***	0	5	0	0	**5**
Common Raven	3	9	11	0	**23**
Domestic Dog ***(Canis lupus familiaris)***	0	0	1*	0	**1**
Totals	70	66	24	16	**176**
*to Ventura County Animal Services | ^released on site | #relocated					

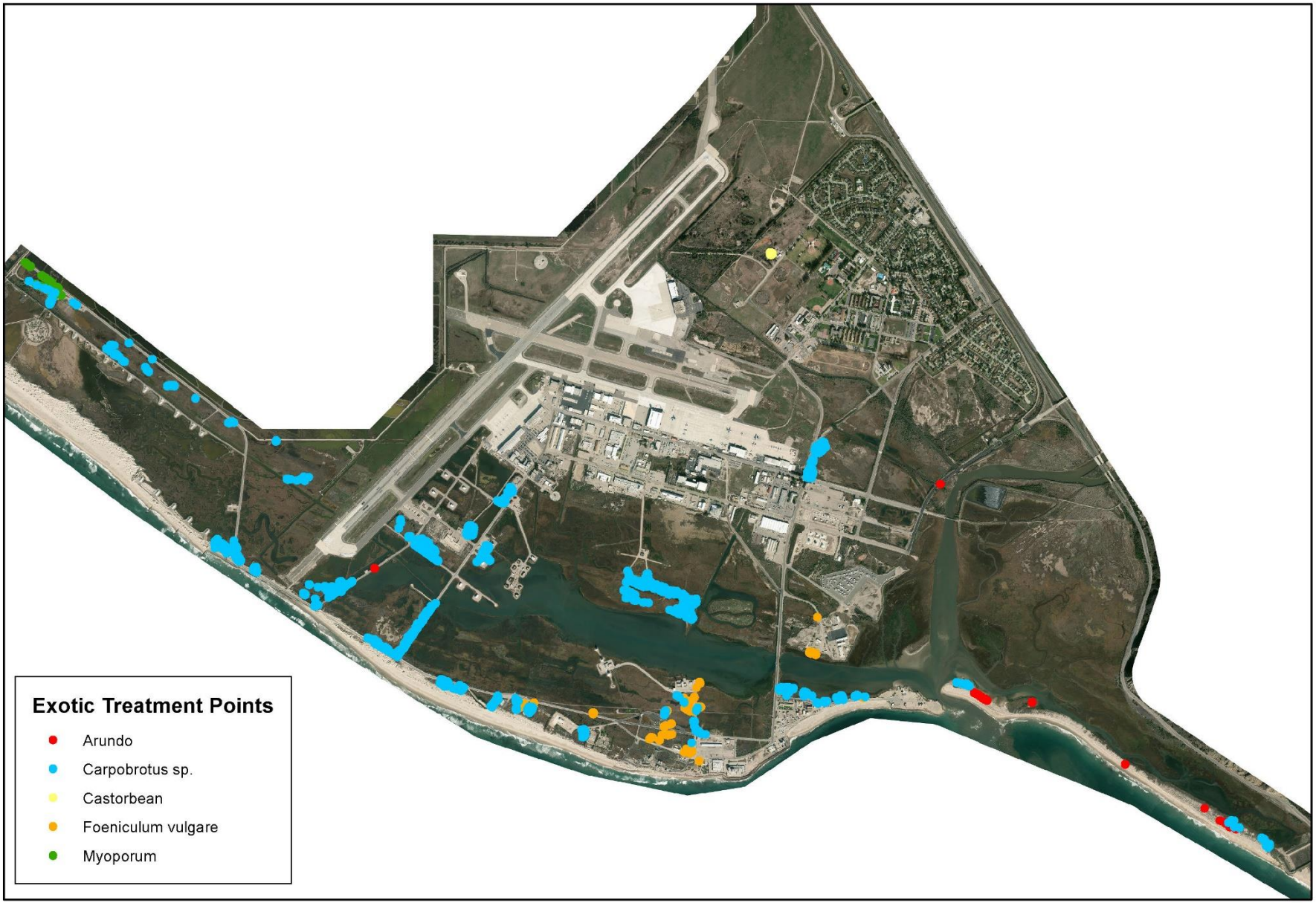
INVASIVE PLANTS

Invasive plants were removed or chemically treated in sensitive areas to restore and enhance habitat for listed species. Beaches are being restored to improve habitat for the California least tern and western snowy plover and marsh habitats are being enhanced for light-footed Ridgway's rails.

Throughout the year, NBVC staff conducted routine, ongoing monitoring and removal of several invasive plant species by hand-pulling or spraying. Target species include, but are not limited to: sea fig, pampas grass (*Cortaderia* spp), sweet fennel (*Foeniculum vulgare)*, castor bean (*Ricinus communis)*, pepperweed (*Lepidium latifolium*), Brazilian pepper tree (*Schinus terbinthifolius)*, tamarisk (*Tamarix* spp), African daisy (*Osteospermum ecklonis)*, bull thistle (*Cirsium vulgare)*, and *Plecostachys serpyllifolia*. Due to past control and careful monitoring, *Plecostachys serpyllifolia* is currently restricted to a limited zone at NBVC Point Mugu. However, Ormond Beach, the public beach which shares the westernmost perimeter fenceline with NBVC Point Mugu, has multiple acres of this species. Some removal was conducted at that site, but prevailing winds blow toward NBVC Point Mugu, creating the possibility of it spreading to a larger area on Navy property. As a preventative measure, the fenceline is periodically monitored for new growth.

ACS Habitat Management, Inc (ACS) was contracted to identify and control non-native, invasive plant species at NBVC Point Mugu. ACS used herbicide application and mechanical methods to combat the spread annual and perennial invasive species treatments occurred from 11-13 September 2018. Species treated and locations are provided in Figure 13.

Figure 13. Invasive Plant Control Efforts, NBVC Point Mugu, 2018.



TO 0032 Point Mugu Exotic Treatment 2018

ADDITIONAL BIOLOGICAL OPINION REQUIREMENTS

- ✓ No MK117 or MK23 Jet Assisted Take-off bottles (JATO) were removed from rail habitat between L and M Street in 2018. UXO technicians are now required to oversee collection and disposal of JATO bottles, which resulted in significant funding and contracting requirements and created a backlog of bottles to remove. Another removal effort is expected in 2019. Since 2016, 416 MK117 and 3 MK23 JATO bottles have been disposed.

NAVY ACTIVITIES

Point Mugu Airshow

There was no airshow held at NBVC Point Mugu in 2018

Explosive Ordinance Disposal (EOD) Operations

Due to transfer of EOD operational staff to China Lake, detonations no longer regularly occur at NBVC Point Mugu unless the ordnance cannot be safely moved to another location for disposal.

In May 2018, 18 JATO bottles were found leaking fuel in Building 88 at NBVC Point Mugu. An emergency action to dispose of them was required due to the hazards presented. The bottles were deemed not safe to be moved off base, so they were ignited at the on-base disposal site.

Disposal occurred on 29-30 June 2018. The bottles were secured in a blockhouse and were individually ignited with approximately 30-40 minutes between ignitions. Since the bottles were immobilized, only sound and smoke occurred while the excess jet fuel was burned off.

The nearest snowy plover was nest situated approximately 1,200 feet from the disposal site. A Reconyx trail camera was placed at the nest the day before the detonations began (28 June 2018), and was set to take photos once a minute to document plover behavior before, during, and after the disposal operations. On that day prior, the plover was documented intermittently incubating and was often off the nest. During the detonation events, the plover flushed from the nest for an average of two minutes and a maximum of five minutes after each event. This resulted in a total of 30-90 extra minutes off the nest during the two-day period. The weather was mild and therefore the additional time away from nest was unlikely to be harmful to eggs. The plover continued to incubate the nest in the days after the disposals concluded. Ultimately, the nest did not hatch, but was not considered related to the EOD operation considering the plover continued to tend the nest afterward and the disruption was intermittent and for brief periods.

Snowy plovers at NBVC Point Mugu are often exposed to noises which may temporarily disrupt them, but observations suggest that, in general, they appear acclimated to these activities and nest outcomes do not seem to be affected. Throughout the nesting season, targets with two JATO bottles are launched approximately 2,000 feet from plover and tern nesting areas, with target flying directly over nesting areas at approximately 300-500 feet, but they continue to successfully nest in those areas each year. The nest in question was also located 500 feet from the firing range which has regular training and gunfire. But again, nests in this area have had similar hatch rates as those further away.

Countermeasures Testing and Training

This section covers the reporting requirement of the Countermeasures Testing and Training Program (8-8-13-F-47) biological opinion. No Countermeasure activities such as small arms firing, directed energy, lasers, or missile launches occurred during 2018.

Black Dart

No Black Dart operations were held in 2018

Surface Launches

Surface launches conducted from Point Mugu in 2018 are summarized below.

- ✓ Building PM-55*
  - 37 BQM-34S launches
  - 70 BQM-74E launches
  - 8 SSAT BQM-177A launches
  - 7 NATS target launches

    *Includes launches between October-December 2017, as well as 2018
- ✓ Pad Alpha (Holiday Beach)
  - 0 launches
- ✓ Pad Bravo (Holiday Beach)
  - 0 launches
- ✓ Pad Charlie (Holiday Beach)
  - 2 12 SSM launches
    - 21 August 2018
    - 24 September 2018
  - 2 88 SSM launches
    - 2 October 2018
    - 10 October 2018

Pads Alpha, Bravo, and Charlie are adjacent to Holiday Beach. Only Pad Charlie was used for launches in 2018 and all took place during the non-nesting season. Launches from PM-55 occurred throughout the year.

BIRD/ANIMAL AIRCRAFT STRIKE HAZARD (BASH) PROGRAM

This section covers the reporting requirement of the Biological Opinion for the Bird/Animal Aircraft Strike Hazard Program [BASH] at NBVC Point Mugu (1-8-06-F-13). No snowy plovers or rails were observed to be disturbed or incidentally harassed during 2018. Approximately 20 California least terns foraging near the airfield were temporarily disturbed due to BASH program hazing activities in 2018. No significant impacts, disturbance, or take of listed species was documented during 2018.

Pyrotechnics and were used approximately 100 times along Taxiway Alpha, L and M Avenues from 1 January 2018 to 31 December 2018 to harass waterfowl and wading birds from the area. During the nesting season from mid-March to early-August, pyrotechnics were used 50 times adjacent to listed species habitat. During these actions, no light-footed Ridgway's rails or western snowy plovers were heard vocalizing or observed being disturbed. Least terns occasionally foraged intermixed within flocks of Forster's or other bird species. It is estimated that approximately 20 foraging California least terns were temporarily displaced due to pyrotechnics on the west side of RWY 3/21. The terns left

the wetlands adjacent to the airfield and foraged elsewhere in the marsh. The temporary exclusion from this area would not have caused a significant effect to their foraging efficiency given the availability of nearby suitable areas.

Four snowy plover nests were found on the Approach of Runway 3 in 2018 (

Figure 10). All nests hatched.

To reduce potential aircraft strikes three American kestrels (*Falco sparverius*), five red-tailed hawks, and two great horned owls (*Bubo virginianus*) frequenting the airfield were captured, banded, and relocated away from NBVC Point Mugu in 2018. Red-tailed hawks and kestrels also received an auxiliary numbered color-band. Additional birds were captured, banded, and relocated away from the California Air National Guard facility, which is adjoins NBVC Point Mugu and shares a runway. These included: three Cooper's hawks (*Accipiter cooperii*), eight red-tailed hawks, two American kestrels, six great horned owls, and five barn owls (*Tyto alba*).

One damaging airstrike was recorded in 2018. This included:

- ✓ Brasilia strike of an American coot (*Fulca Americana*) ($0 damage cost)

REFERENCES

ACS Habitat Management (2017). Invasive Plant Removal at Naval Base Ventura County, CA. Contract # N62473-13-D-4813/0008. Oceanside, CA, 28 pp.

Bui, T.D., J.Y. Takekawa, C.T. Overton, E.R. Schultz, J.M. Hull, and M.L. Casazza. (2015). Movements of radio-marked California Ridgway's rails during monitoring surveys: implications for population monitoring. *Journal of Fish and Wildlife Management (6)1:227-237.*

Chesser, T.R., R.C. Banks, C. Cicero, J.L. Dunn, A.W. Kratter, I.J. Lovette, A.G. Navarro-Sigüenza, P.C. Rasmussen, J.V. Remsen, Jr., J.D. Rising, D.F. Stotz, and K. Winker. (2014). Fifty-Fifth Supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk: October 2014, Vol. 131, No. 4, pp. CSi-CSxv.*

CNDDB. (2011, July 30). California Natural Diversity Database Records of Occurrence for Point Mugu. Sacramento, CA.

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

Hopkins, DR and VT Parker. (1984). A study of the seed bank of a salt marsh in northern San Francisco Bay. *American Journal of Botany* 71: 348–355.

Jaques, L. J., C.S. Strong, and T.W. Keeney. (1996). *Brown pelican roosting patterns and responses to disturbance at Mugu Lagoon and other nonbreeding sites in the Southern California Bight.* National Biological Service, Technical Report No. 54, 62 pp.

Keeny, T.W. (1998). *Mugu Lagoon: A description of current habitat types of a salt marsh estuary.* Point Mugu, CA: Unpublished manuscript, Naval Air Station.

Lafferty, K. D. (2014). Distribution of the endangered tidewater goby, *Eucyclogobius newberry*, and potential habitat, within the Mugu Lagoon and associated water bodies. Santa Barbara, CA , 20 pp.

Lincoln, P . (1986). Pollinator Effectiveness and Ecology of Seed Set in *Cordylanthus maritimus* subsp. *maritimus* at Point Mugu, CA.

Oneal, A. S., and J.S. Pareti. (2011). *Results of the Tidewater Goby Survey for the State Route 1/Calleguas Creek Project Site Located West of Camarillo in Unincorporated Ventura County, California.* Ventura, CA: Letter Report to: Chris Kofron, USFWS (13 Sept 11).

Rand, M. (2002). Hazard Assessment of Resmethrin: I. Effects and fate in aquatic systems. *Ecotoxicology*, 11:101-111.

San Diego Management and Monitoring Program. 2015. Management Strategic Plan (MSP)

Monitoring Protocol for Rare Plant Occurrences on Conserved Lands in Western San Diego County. Prepared for the San Diego Association of Governments, San Diego. Version 03.05.2015.

Service, U.S. Fish and Wildlife. (1970). Appendix D - United States List of Endangered Native Fish and Wildlife. *Federal Register, 35*, 16047-16048.

Service, U.S. Fish and Wildlife. (1985). Recovery Plan for the Light-footed Clapper Rail. Portland, Oregon. 121 pp.

Service, U.S. Fish and Wildlife. (1985b). Recovery Plan for the California Least Tern, *Sterna antillarum brownii*. Portland, Oregon. 112 pp.

Service, U.S. Fish and Wildlife (1994). Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Tidewater Goby. *Federal Register , 59* (24), 5494-5498.

Service, U.S. Fish and Wildlife. (2015, September 25). Programmatic Biological Opinion for Ongoing Activities at NBVC, California (8-8-15-F-5R).

Service, U.S. Fish and Wildlife. (2001, June 6). Programmatic Biological Opinion for Ongoing Activities at NBVC, California (5090 Ser PW420/075)(1-8-99-F-24).

Service, U.S. Fish and Wildlife. (2006). California Least Tern (*Sternula antillarum brownii*) 5-Year Review Summary and Evaluation. Carlsbad, CA. 35 pp.

Service, U.S. Fish and Wildlife. (2007). Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*) Volume 1: Recovery Plan. Sacramento, CA. 290 pp.

Service, U.S. Fish and Wildlife. (2008). Endangered and Threatened Wildlife and Plants: Revised Designation of Critical Habitat for the Tidewater Goby (Eucyclogobius newberryi); Final Rule. *Federal Register , 73* (21), 5920-6006.

Service, U.S. Fish and Wildlife. (2009). Light-footed clapper rail (*Rallus longirostris levipes*) 5-Year Review: Summary and Evaluation. Carlsbad, California. 26 pp.

Service, U.S. Fish and Wildlife. (2013). Initiation of 5-Year Reviews of 56 Species in California and Nevada; request for information. *Federal Register, 78*(62), 19510-19514.

Zembal, R. (2006). *Salt marsh bird's-beak establishment project 2005: Naval Air Station Point Mugu.* California State University Long Beach Foundation, 9 pp.

Zembal. R. (2019). *Light-footed Ridgway's Rail Population Status and Management at Mugu Lagoon, Naval Base Ventura County Point Mugu, California, 2018*. Huntington Beach Wetlands Conservancy, 27 pp.

Zembal, R., S. Hoffman, and J. Konecny (2009). *Status and Distribution of the Light-footed Clapper Rail in*

California. Sacramento, CA: California Department of Fish and Game, Wildlife Management, Nongame Wildlife Unit Report, 2009-01, 19 pp.

Appendix A

Threatened and Endangered Species 5-year Comparison

Salt Marsh Bird's-Beak

	Current	Previous 5 Years				
	2018	**2017**	**2016**	**2015**	**2014**	**2013**
Total Acreage	0.54	0.9	0.1	0.74	0.504	0.725

Light-footed Clapper Rail

	Current	Previous 5 Years				
	2018	**2017**	**2016**	**2015**	**2014**	**2013**
Estimated Pairs	7	12	16	12	16	23
Number of unmated males	7	0	0	2	3	6
Territories with nesting evidence	6	8	15	9	14	17
First Nest Search	3-May	22-Apr	16-Apr	6-Apr	10-Apr	20-Apr
Last Nest Search	21-Jul	11-Aug	23-Jul	31-Jul	15-Aug	9-Jul
Nest Search Field Hours	125	59	56	83	115	110

Western Snowy Plover

	Current	Previous 5 Years				
	2018	**2017**	**2016**	**2015**	**2014**	**2013**
First Nest	23-Mar [EA]	17-Mar [OE/EA]	21- Mar [OE]	23-Mar [OE/Hol]	24-Mar [OE/Hol]	26-Mar [OE]
First Chicks	27-Apr [EA:H] 30-Apr [EA:CH]	18-Apr [EA:H] 20-Apr [OE:CH]	29-Apr [EA:CH]	23-Apr [Hol:H] 27-Apr [Hol:CH]	16-Apr [EA: H] 24-Apr [Hol: CH]	2-May [OE]
Peak # Active Nests	43	41	32	35	32	29
Date Peak Active Nests	8-May	21-Apr	21-Apr	Week of 25-May	27-May / 2-Jun	10-Jun
Total Nest Attempts	140	148	110	129	123	116
Total (%) Hatched	87 62.14%	88 59.50%	50 45.45%	76 58.91%	63 51.22%	44 37.90%
Total Predated	32	29	37	32	36	47
Total Abandoned	11	13	10	8	17	9
Total Washed Out	5	15	12	9	6	14
Total Unknown Fate	5	3	0	3	1	1
Total Human Loss	0	0	0	0	0	1
Total Failed - Other	0	0	1	0	0	0
Total Eggs Produced	386	401	292	349	322	313
Total Eggs Hatched	241	232	129	201	162	117
Total Eggs Predated	82	80	104	85	94	127
Total Eggs Abandoned	34	46	29	26	45	22
Total Eggs Washed Out	16	34	26	26	15	42
Total Eggs Unknown Fate	12	8	2	11	6	3
Total Eggs Human Loss	0	0	0	0	0	2
Total Eggs Failed - Other	1	1	2			
Total Chicks Seen	65	35	18	62	45	25
Last Hatch	10-Aug	8-Aug [EA]	1-Aug [EA]	5-Aug	18-Aug	31-Jul

California Least Tern

	Current	Previous 5 Years				
	2018	**2017**	**2016**	**2015**	**2014**	**2013**
Arrival Date	26-Apr	24-Apr	18-Apr	27-Apr	14-Apr	22-Apr
First Scrapes	-	-	-	-	-	-
First Nests	14-May	22-May	16-May	14-May	19-May	9-May
First Hatch Date	14-Jun	12-Jun	6-Jun	8-Jun	12-Jun	18-Jun
Last Hatch Date	26-Jul	1-Aug	18-Jul	24-Jul	21-Jul	5-Jul
Departure Date	Mid-Aug	mid-Aug	-	early Aug	mid-late Jul	early July
Date of Last Sighting	8-Sept	mid-Aug	11-Aug	19-Aug	13-Aug (Hol)	-
Estimated Breeding Pairs			338-361	323-441	447-465	288-361
Total Nest Attempts	291	377	361	473	465	345
Total nests Ormond East	218	166	120	173	365	166
Total nests Holiday Beach	58	165	182	278	65	164
Total Nests Holiday SP	12	20	21	22	10	11
Total Nests Eastern Arm	3	26	38	0	25	5
Nest Fates						
Total (%) Hatched	116 39.86%	124 33.16%	205 56.80%	196 41.44%	315 67.74%	12 3.47%
Total Predated	102	115	14	125	43	77
Total Abandoned	46	58	53	86	104	202
Total Washed Out	4	47	55	4	2	45
Total Unknown Fate	23	32	30	54	1	9
Total Failed-Other	0	0	4	0	0	0
Total Eggs Produced	478	610	644	806	805	488
Total Eggs Hatched	198	211	368	351	543	20
Total Eggs Predated	168	178	26	204	77	104
Total Eggs Abandoned	70	86	96	124	181	295
Total Eggs Washed Out	6	76	102	7	2	56
Total Eggs Unknown Fate	36	59	46	88	2	12
Total Eggs Failed - Other	0	0	6	0	0	0
Total Chicks Seen in Nest	85	83	139	146	226	5
First Fledglings	2-Jul	4-Jul	4-Jul	1-Jul	2-Jul	N/A
Total Fledglings	61-72	27-51	56-86	116-150	127	0
Ormond East	45-53	16-23	10-12	5	97	0
Holiday Beach	16-19	7-24	29-59	111-145	30	0
Eastern Arm	0	3	15	0	0	0
Date Last Full Walking Surveys	21-Jun	22-Jun	-	15-Jun (Hol)	12-Jun	N/A
Blind Start Date	6-Jun	6-Jun	7-Jun	31-May	3-Jun	N/A
Blind End Date	1-Aug	4-Aug	23-Jul	9-Aug	29-Jul	N/A
Total Daytime Blind Hours	329.4	315	269.8	550	500.5	N/A

Appendix B

Light-footed Ridgway's Rail Population Status and Management at Mugu Lagoon, Naval Base Ventura County Point Mugu, California, 2018

Light-footed Ridgway's Rail
Population Status and Management at Mugu Lagoon, Naval Base Ventura County Point Mugu, California, 2018

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Abstract
The 2018 population assessment of the Mugu Lagoon subpopulation of the Light-footed Ridgway's Rail (*Rallus obsoletus levipes)*, a state- and federal-listed endangered species, was conducted on five dates between May 3 and July 21, 2018, at Naval Base Ventura County (NBVC) Point Mugu (Figures 1 and 2). The American Ornithologist Union taxonomically reclassified and renamed this subspecies of rail, formerly the Light-footed Clapper Rail (*Rallus longirostris levipes)* (Chesser et al. 2014).

The 2018 surveys for Light-footed Ridgway's Rails at NBVC Point Mugu included call count surveys, nest searches, and observations. The surveys resulted in a minimum population estimate of seven pairs of breeding Light-footed Ridgway's Rails and seven advertising males on base, and one from off base. This is the same number of breeding pairs documented at NBVC Point Mugu in 2000 and 2001, and the lowest number detected since 2008 when only five pairs were documented. The largest number of breeding pairs documented for this subpopulation was 23 pairs in 2013. In 2018, evidence of breeding activity and territorial behavior manifested by vocalizations was observed in six of the seven breeding territories. Four incubation nests were found in three territories, two showed signs of at least partially successful hatches; one nest held one egg when found and increased to four eggs, some of which hatched; another nest also held four eggs, the fate of which was unclear. The fourth nest was predated. There were other indicators of successful hatches in another three territories including: evidence of chick-feeding; chick signs including downy feathers, chick pellets, and tracks; and adults were observed displaying chick-defense behavior in one territory. In summary, there was evidence of hatching or chicks in five territories (1, 2, 3, 5, and 7) and a predated incubation nest in Territory #4. A juvenile was photographed on a raft in Territory #2 in June and August, indicated successful breeding there early and late in the season.

Five artificial nesting platforms (rafts) were placed in the Point Mugu marsh in 2008 and 2009 for a total of 10 rafts. Fifteen additional camera-equipped rafts were placed by the Navy in 2016. Three of the original rafts are defunct for a current total of 22 rafts. Rafts 5 and 7 both held active brood nests in 2016. Two to six of the newer rafts generated photo evidence of Light-footed Ridgway's Rail visitation in 2016, 2017, and 2018, but no nesting has occurred on a new raft. Rafts are shown on Figures 5, 6, and 7.

Surveys in 2018 resulted in sightings of Light-footed Ridgway's Rails in two of the seven breeding territories. These sightings did not include unobstructed views of the legs to determine the presence of bands. No banded rails have been seen since 2012.

Introduction

The purpose of the 2018 Light-footed Ridgway's Rail Population Status and Management study was to determine the current population status and develop data on nesting activity of Light-footed Ridgway' Rails at Naval Base Ventura County (NBVC) Point Mugu (Figures 1 and 2), (also known as "Point Mugu" or "Mugu Lagoon"), and implement or recommend management strategies for this state- and federal-listed endangered species. This project is part of a statewide cooperative monitoring effort with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife. This project also conforms to the population monitoring requirements of the Biological Opinion on Ongoing Operations at NBVC Point Mugu (8-8-15-F-5R), issued in May 2016. This report summarizes the results of the 2018 population and nest monitoring for Light-footed Ridgway's Rails at NBVC Point Mugu.

The Light-footed Clapper Rail, along with the other two large rails of the western U.S. (California and Yuma), was taxonomically reclassified and renamed by the American Ornithologist Union and ascribed to the Ridgway's Rail (*Rallus obsoletus)* (Chesser et al. 2014). The common name for our southern California subspecies should soon be formally and legally adopted by the wildlife agencies in recognition of this nomenclatural change. For the purposes of this report, Light-footed Ridgway's Rail or "rail," is used.

The Light-footed Ridgway's Rail is a state- and federal-listed endangered species that is resident in coastal wetlands in southern California and northern Baja, California, Mexico. Loss and degradation of habitat threaten the continued existence of this species, although management efforts now offer some promise of eventual recovery. Annual surveys of the endangered Light-footed Ridgway's Rail have been ongoing in California since 1980. In 2008, there was a range-wide population crash with only 234 pairs of Light-footed Ridgway's Rails detected in 15 marshes. However, state population numbers were on the rise in the 2000s until 2017; population numbers further declined in 2018 (Figure 3). In 2013, the Point Mugu subpopulation was the sixth largest subpopulation in California and the largest on record since recordkeeping began in 1980, with 23 pairs (Zembal et al. 2013).

From 2001 through 2009, 107 Light-footed Ridgway's Rails were bred in zoological facilities, banded, and released into Mugu Lagoon. This was done to bolster the numbers of rails and to enhance the genetic makeup of this northern-most subpopulation. Release of banded Light-footed Ridgway's Rails into Mugu Lagoon last occurred in 2009.

Study Area

NBVC Point Mugu is located in southwestern Ventura County on a 1,821 hectare (4,500 acre) property about 13 kilometers (8 miles) west of the Los Angeles County line (Figures 1 and 2). There are 866 hectares (2,139 acres) of jurisdictional wetlands at Point Mugu (U.S. Army Corps of Engineers 2011 delineation), including the largest existing salt marsh in coastal southern California. Considering the combined areas of marshes that are regularly occupied, the vegetated marsh and closely associated habitats at Mugu Lagoon represent more than 25 percent of the Light-footed Ridgway's Rail's potential habitat base in California. The marsh is subject to nearly full tidal action in the Central Basin and Eastern Arm, with a tidal amplitude of approximately nine feet. The tides are dampened by

constrictions at Laguna Road and farther west, resulting in a tidal amplitude of only four to five feet. The wetland vegetation is dominated by pickleweed (*Salicornia pacifica*), with scattered stands of spiny rush (*Juncus acutus* subsp. *leopoldii*) that are critical for Light-footed Ridgway's Rail nest placement. Descriptions of all the marshes recently occupied by Light-footed Ridgway's Rails are available (USFWS 1985; Zembal and Massey 1981).

Methods

The basic technique used in assessing Light-footed Ridgway's Rail abundance, distribution, and breeding condition at Point Mugu was to systematically walk the edge of the marsh while mapping spontaneous Light-footed Ridgway's Rail calls. Playbacks of recorded "dueting" calls were routinely used to elicit responses. Nest searching and seeking observations of young Light-footed Ridgway's Rails from the road edges were also employed.

Observation of breeding but infrequently calling Light-footed Ridgway's Rails in such a large study area would be very difficult without the use of playbacks. Although Light-footed Ridgway's Rails do not always respond to a playback, they are more responsive in less dense subpopulations (like at Mugu Lagoon) and they will usually respond vocally or physically when the callback is played in close proximity to a reproductive individual (Zembal personal observation). When used only once per year at Mugu Lagoon, and with minimal repetition, playbacks yield good results. Unmated rails, for example, often respond at considerable distances and may approach the tape. Isolated single Light-footed Ridgway's Rails often approach very closely and remain in the vicinity unless displaced.

Calling frequency and the detection of calls are also influenced by the observer's hearing ability and experience with the calls, the stage of breeding of individual pairs, rail density, and weather conditions (Zembal and Massey 1987). Surveys that are attempted on stormy or windy days are repeated if results are unsatisfactory. High winds are common at Mugu Lagoon and hamper the ability to hear Light-footed Ridgway's Rails calling downwind of the observer but may help carry calls issuing from upwind. When calling frequency is high, with many rounds of calling as adjacent pairs respond to one another, it is possible to map the rails accurately and move on to survey much of the occupied marsh in one day.

Surveys of spontaneously vocalizing Light-footed Ridgway's Rails were usually conducted in the two hours before dark, but some were done at first light, up to about two hours after sunrise. In the past, early morning and late evening surveys have been comparable, although evening calling by Light-footed Ridgway's Rails is more prolonged and often ends with one or more flurries of intense calling (Zembal et al. 1989). Surveys of low-density populations using playback of recorded calls can be productive at any time of day.

In assessing the Light-footed Ridgway's Rail population, duets and some single "clapperings" were treated as territories. Since advertising singles are not indicative of an occupied territory with reproductive potential at the time of the survey, they are not included in the population total. However, a single "clappering" is as good an indicator of

a territory as a duet, when advertising is not heard later from the same territory. During a 2- to 4-hour census period, pairs often dueted from territories where only single pair members had called earlier. Locations where only singles were heard calling at Point Mugu were further investigated with nest searching and additional observations to better document the breeding status of the individuals.

In addition to hearing duets emanating from the marsh, the most common evidence of successful reproductive activity is food remnants left in territories, indicative of chick feeding. Adults feeding young chicks will break open and tear apart small crabs; the adults will always swallow small crabs whole when only feeding themselves. Holes are pecked into the carapace of the crab and tiny bill-tip quantities of crabmeat are delivered bit-by-bit to the chicks. Small dismembered crabs are left in the marsh at regular feeding spots. The nature of the excavated crabs and other evidence at these regular feeding sites indicate that chicks were fed recently. The crabs are small in size and broken open, usually with one hole through the top of the carapace. Crab limbs that the adult did not swallow (as they typically do when not raising chicks) are usually strewn about, and tracks and droppings of young and adults are often observed. Sometimes downy feathers and regurgitated pellets from chicks are also present.

Nest searching in the marsh has been important in recent years since calling frequency has become increasingly poor. Nest searches are conducted along the edges of dense spiny rush stands, mostly in the Western Arm of the lagoon. Much of the Eastern Arm was also walked slowly, with intermittent broadcast of a recorded duet call; high marsh berms and isolated old beach ridges are explored for trails and other potential signs of rail occupancy. Nests that are occupied by incubating or brooding adults are not disturbed unless the rail is accidentally flushed upon initial discovery of the nest. This type of disturbance is carefully avoided in order not to put the rail in harm's way at this vulnerable time of year. The goal is to find nests that have recently hatched so that evidence of the hatch can be detected, particularly the tiny egg chips that are invariably present in the nest immediately following a successful hatch.

Nest searches were conducted at NBVC Point Mugu on every visit during the breeding season in 2018. Much of the available habitat was searched carefully for nests at least once in the area of South M Avenue to the vicinity of South G Avenue (Figures 5 and 6). High ground, rafts, and the vicinities of calling rails in past years in the Central Basin and Eastern Arm of Mugu Lagoon were also investigated (Figure 7). Monitoring focused on high ground and spiny rush stands. Known active nests were approached to within 20 yards and checked with binoculars to determine occupancy. If an incubating rail was detected, the monitor left the site and the incubating rails were not disturbed. Visits to known nests were postponed if potential predators were present in the area. Nesting success was defined as the hatching of at least one egg, and confirmed by the presence of tiny, clean eggshell fragments in the nest, the presence of chicks, chick pellets, or downy feathers on or near the nests, or the presence of a brood nest. Light-footed Ridgway's Rails build brood nests near incubation nest sites which they use to brood newly hatched chicks. Brood nests are built in the open and defined by the presence of pellets, downy feathers, or crab remnants in the nest. An unsuccessful hatch was defined as an obviously destroyed nest, the presence

of yolk in eggshell fragments with no other evidence of successful hatch, or abandonment or loss of eggs before the expected hatch date. Not all sections of the marsh were visited on each trip, in part to avoid potentially excessive disturbance of nesting Light-footed Ridgway's Rails.

Seven of the ten original artificial nesting rafts at Point Mugu were checked a maximum of four times during the breeding season. The more accessible rafts were checked most frequently. New burlap covers were placed on the seven rafts in the Western Arm in 2014 and repaired as needed in 2018. Three of the ten original rafts were never used and are defunct. A natural resources stewardship project funded by the USFWS in cooperation with Navy and the Girl Scouts of the U.S.A., provided 15 new artificial nesting rafts equipped with motion-activated trail cameras in the spring of 2016. The addition of the new rafts brought the total to 22 artificial nesting rafts at Point Mugu. These new rafts were placed throughout Mugu Lagoon (Figures 5, 6, and 7). The new rafts were examined closely enough during the season to see if a nest was inside but not so closely as to trigger the camera. After the nesting season, Navy staff reviewed thousands of photos from the rafts to document rail visitation to the interior of the rafts.

Results

The 36th consecutive annual census of Light-footed Ridgway's Rails in Mugu Lagoon was conducted on May 3 and 23, June 9 and 30, and July 21, 2018. The population assessment of the Mugu Lagoon subpopulation and additional observations included approximately 125 field hours over five dates between May 3 and July 21 and involved two to six participants.

Observations were focused in areas of past documented rail use on the south side of the Western Arm from about 20th Street and Beach Road to just west of South M Avenue, on each of the four dates in May and June. The May and June survey visits included periodic broadcast of rail calls in the attempt to elicit responses and slowly walking the marsh from Beach Road to the lagoon, examining each of the spiny rush stands, old beach ridges, abandoned road fills, cover on any higher ground, the rafts and environs, as well as cordgrass (*Spartina foliosa*) patches for signs of rail activity. Playback of calls was used on the two dates in May in the Central Marsh and Western Arm off Perimeter Road, and between Laguna Road and South G Avenue. Rail calls were broadcast on the two May dates toward the north side of the Western Arm from various access points behind the buildings off 13th Street from L Street to Laguna Road (Figure 2). The Eastern Arm was checked again on 30 June.

<u>Population Assessment</u>

A total of seven breeding pairs and seven advertising males were detected at NBVC Point Mugu in 2018 (Table 1) (Figures 4 through 6). This is higher than the recent low of five pairs in 2008, a year of state-wide population crash from which most of the subpopulations recovered (Figure 3) but is the lowest count since then; once again, as in 2008, many of the subpopulations in 2018 were smaller state-wide. The Mugu subpopulation was at recent highs in 2012 with 22 pairs and in 2013 with 23 pairs.

Table 1: Number of Light-Footed Ridgway's Rails Detected in Mugu Lagoon, 1980–2018

Year	Breeding Pairs	Unmated Males	Year	Breeding Pairs	Unmated Males
1980	NS	NS	2000	7	5
1981	0	0	2001	7	5
1982	NS	NS	2002	10	9
1983	1	1	2003	14	10
1984	3	0	2004	19	8
1985	7	0	2005	14	10
1986	6	4	2006	17	6
1987	7	5	2007	15	12
1988	7	2	2008	5	3 (+)
1989	5	0	2009	9	7
1990	6	2	2010	12	4
1991	4	1	2011	16	5
1992	5	3	2012	22	8
1993	5	4	2013	23	6
1994	6	12	2014	16	3
1995	5	3	2015	12	2
1996	3	3	2016	16	0
1997	4	4	2017	12	0
1998	4	2	2018	7	7
1999	4	5			

Notes: NS = No survey was conducted.
(+) = An advertising female was also heard.

The significance of the Mugu Lagoon subpopulation is better understood in the context of the current status and distribution of the entire population. The statewide counts conducted in 2018 involved up to 14 observers in each of 30 marshes and approximately 502 field hours over 45 dates between February 20 and July 21. Of 30 wetlands surveyed during the 2018 statewide counts, 19 wetlands held 356 pairs of Light-footed Ridgway's Rails manifesting breeding readiness (Zembal et al. 2018). The Point Mugu subpopulation was the eleventh largest subpopulation in California in 2018 (Zembal et al. 2018).

Monitoring Nesting Sites

Calling by Light-footed Ridgway's Rails during the 2018 season was very sporadic and responses to the playback of a pair's duet were generally by individual pairs, rarely invoking additional calling from neighboring rails. However, over the season, six of the seven pairs were documented by their vocalizations and additional evidence of rail activity gathered through observations made during nest searches. Signs of rail breeding activities and rail sightings were pursued throughout the wetland leading to additional observational evidence in five territories (Table 2) (Figures 5 and 6). Duets were recorded from six of the seven breeding pairs at least once, and there were seven locations from which incidents of prolonged "kecking" by single males was heard on base and one incident off base.

Although in past years there has been evidence of rail use of the Central Marsh and Eastern Arm, there was no detection of rail activity in either location in 2017 or 2018 (Figure 7).

Table 2: Light-Footed Ridgway's Rail Reproductive Activity at Mugu Lagoon, 2018

Pair #	Nest Cover	# Eggs	Hatch Evidence	Chicks or Evidence	Chick Feeding	Duet Heard	Adults Seen
1	-	-	X	X	X	X	X
2	J	4, 0	X, X	-	-	X	-
3	J	4	-	X	X	X	-
4	J	P	-	-	-	-	-
5	-	-	X	X	X	X	-
6	-	-	-	-	-	X	-
7	-	-	Ad	X	X	X	X

Notes: Ad = Adult defending chicks
J = *Juncus acutus*; P = Predated
X = Yes/Positive encounter.
– = None observed, as noted in field notes.

Surveys conducted in 2018 resulted in the discovery of only four nests including two nests in Pair #2's territory (Territory #2) and all were incubation nests (Table 2). The timing of activity in Pair #2's territory and proximity indicated that both nests were probably by the same pair. The first nest of Pair #2 had four eggs and showed evidence of successful hatching; however, the vicinity of that nest also had egg shells strewn about that were yolk-stained, a sign that one or two of the eggs were depredated, apparently following a partial hatch. The second nest was empty when found and could not be re-found but a juvenile photographed in the nearest artificial nesting raft in August indicated a successful hatch of a late clutch. The nest of Pair #3 held one egg when found, then eventually four eggs, at least some of which hatched based on chick evidence. The nest of Pair #4 was predated; the mashed remains of a nest, eggs, and adult feathers in Territory #4 indicated depredation by a large mammal. All four incubation nests were in spiny rush, including the two nests with eggs outside the nests (a dump egg) found in Territory #2 brood. nests constructed of spiny rush stems and other materials and built out in the open marsh are the best sign of successful hatching; none were found in 2018. This does not bode well for the chances of good recruitment this year, coupled with the partial predation observed in Territory #2, Territory #3, and the total predation in Territory #4. All that notwithstanding, chicks were in evidence in four territories including an adult vigorously posturing and vocalizing in defense of unseen chicks in Territory #7. Other chick signs observed included downy feathers, small chick-sized regurgitated pellets, the smaller tracks of chicks amongst adult tracks on the adjacent mudflats, and chick feeding. There was some evidence of chick feeding off the berm near M Street but no other corroborative evidence of breeding there, so this was not counted as a separate territory. There was far less breeding activity and fewer rails observed in the marsh in 2017 compared to 2016, and 2018 had less than any previous season since 2008.

In 2012 and 2013, in the area of marsh from South L Avenue to the vicinity of South M Avenue, there were five or six nesting pairs and at least two or three males; in 2014 there was a maximum of four pairs and one male; 2015 had three pairs; 2016 and 2017 had only one pair each year; and 2018 had none (Figure 5). This reduction could have been partly ascribable to the prolonged residence of a Short-eared Owl (*Asio flammeus)* on the smaller spiny rush berm east of South M Avenue (Figure 5). In 2016, a Great Horned Owl (*Bubo virginianus)* was on the same berm along with the remains of a dead adult Light-footed Ridgway's Rail. In the area of South L Avenue to South J Avenue, there was a recent low of only 7 breeding territories and an unmated male in 2015; 12 breeding territories were documented in 2016; 11 territories in 2017; and 6 breeding territories and 4 males in 2018 (Figure 5). In past seasons there has been nesting north of where South J Avenue used to terminate in the marsh, across the main channel where nests, usually with eggs, have been observed in a very small spiny rush patch annually since 2009 up to 2016. In 2016, there were two territories north of the big channel off far north South J Avenue, but only one there in 2017, and none in 2018; the small spiny rush patch there has greatly declined in vigor and the cordgrass patch that was used in 2016 was unused in 2017 and 2018. There was one territory and a male in 2018 between South J Avenue and Le Mar Balls (Figure 6), where there were two territories in 2014 and 2016; only a male in 2015; and no detectable rail activity in 2017. There was also no rail activity detected in the Central Basin or Eastern Arm (Figure 7). One or two territories have been documented in the freshwater marsh along Perimeter Road near the Ormond Beach entrance in several recent years but not in 2017 or 2018. Eight observations of "kecking" were mapped (Figures 5, 6, and 8), seven on base and one off base. However, they were not as persistent throughout the season as the typical advertising male found elsewhere at Point Mugu or marshes outside Point Mugu; since there was never any evidence of additional breeding activity associated with the locations of these calls, no additional breeding territories were ascribed to them.

Banding and Re-Sightings

There were infrequent sightings of adult Light-footed Ridgway's Rails in seven territories at NBVC Point Mugu in 2017 but only two sightings, one each in two territories in 2018. The sightings in 2018 did not include good looks at one or both legs, so no bands were seen. The most recent known sighting of a banded rail in the vicinity of Mugu was of one found dead on October 8, 2015, north of Point Mugu in Fillmore, less than two weeks after a release in the Seal Beach National Wildlife Refuge (NWR) on September 25, 2015. The person who reported this rail has been unreachable for more detail, despite attempts at communication over the last three years. This person took the time to report the band to the banding lab but has not answered subsequent inquiries for detail. This is the only known case of a banded rail travelling north to the vicinity of Mugu; there are three probable and one well-documented case of banded rails travelling from Mugu to more southern wetlands.

In 2017 there were additional sightings of adult Light-footed Ridgway's Rails at three of the 15 nesting rafts placed in the marsh in 2016. Sightings occurred in 2017 between March and August, at nest rafts 19, 20, and 21. Visitation was documented and recorded via motion-activated trail cameras placed inside the artificial nesting rafts (Figure 9). In 2017, there were signs of raft visitation outside of rafts 20 and 21, and pellets inside. In 2018,

rails were photographed inside rafts 21 and 22 in the vicinity of Pair #2 (Figure 8). At least two of the rails photographed were juveniles, indicating successful breeding in June and August and at least one unfound nest.

Discussion

Population Assessment

The Point Mugu subpopulation of Light-footed Ridgway's Rails fluctuated between one and seven pairs for nearly 20 years (1983–2001 [Table 1]), until management efforts fostered some growth. Since doubling in size between 2001 and 2003, the Point Mugu subpopulation fluctuated between 14 and 19 breeding pairs from 2003 to 2007 (Table 1 and Figure 4). The decreased numbers recorded in 2008 at NBVC Point Mugu reflected a statewide population crash (Figure 3); some recovery occurred in 2009 and better recovery in 2010 and the years since, in part due to the discovery in 2010 of a new location of nesting activity in the far northwest corner of the marsh (Figure 8). This portion of the study area has a well-developed freshwater marsh that was occupied by three nesting Light-footed Ridgway's Rails first detected in 2010 along a drainage channel that parallels Perimeter Road. This site had not been regularly surveyed for Light-footed Ridgway's Rails until rail breeding activity was observed by local birders just off base at Ormond Beach; this area was subsequently added to the annual survey route. There were three pairs detected off Perimeter Road in 2010, a single nesting pair and one male in 2011, two pairs in 2012, 2013 (one pair just off base), and 2015, one pair in 2014 and 2016, but none in 2017 or 2018. The many years of low rainfall and reductions in local runoff have greatly reduced the seasonal longevity of the fresh water marsh.

Spring 2018 came in gradually without the usual hot spell marking an abrupt end to the winter. The rails range-wide did not vocalize well or consistently as a result; breeding readiness seemed to trickle in without good synchronicity within most rail subpopulations. Call count results were hit or miss all spring and early summer and there was never a good round of calling heard at Mugu. This has sometimes been the case in the past as well but is usually compensated with additional observations of breeding activity. The extremely low level of observed activity in the Mugu Marsh in 2018 is alarming.

The Point Mugu subpopulation in 2013 was at an all-time high of 23 pairs, the sixth largest subpopulation in California; in 2014 and 2015, it was the eighth largest subpopulation in California with 16 and 12 pairs, respectively; Point Mugu ranked ninth in 2016; and tenth and eleventh in 2017 and 2018, respectively (Zembal et al. 2013, 2014, 2016, 2017, 2018).

Management and Monitoring of Nesting Rafts

Though the lack of natural nesting cover was thought to be a limiting factor for Light-footed Ridgway's Rails at Point Mugu, artificial nesting rafts placed in the marsh in 1988 were never used over the several years they were maintained and monitored. Rafts were tried again in 2008 when five additional rafts were deployed: three in the Western Arm and two in the Central Basin (Figures 5 through 7). The three rafts in the Western Arm were placed in some of the highest quality cordgrass patches available. During the 2008 breeding season, all three rafts showed evidence of visitation by Light-footed Ridgway's Rails and the pair east of South J Avenue successfully nested on Raft 7, near Le Mar Balls.

An adult incubating a clutch of eight eggs was observed several times in July 2008, and the clutch hatched by July 28, 2008. In 2009, another clutch of eight eggs was found on this same raft and it also hatched. There has been no evidence of Light-footed Ridgway's Rail use of the rafts in the Central Basin. On May 13, 2009, five additional rafts were deployed: four between South L Avenue and South J Avenue, and one just east of South J Avenue. Although no eggs were observed on any raft from 2010 through 2015, there was evidence of rail usage of four of the rafts in 2012 (Rafts 4, 5, 7, and 8) including a nest on Raft 7, composed of the quack grass that was used originally to cover the raft basket. Raft 5 also held a nest that was used for brooding chicks in 2013. In 2014, Rafts 5 and 7 both held brood nests, and Raft 1, which was full of dismembered crab remains, was used as a brooding shelter. The nest on Raft 7 was taken over by a rat; that nest and the rat droppings were subsequently removed from the raft. Although rats are potential predators of eggs left unattended, the rails are probably able to deal effectively with these introduced rodents. Raft 3 held abundant evidence of use for brooding young in 2015, including crab remains, small pellets, downy feathers, and nearby chick tracks. Raft 5 again held a brood nest in 2017.

Use of the 15 newly placed rafts was examined by motion-activated camera photos that captured periodic visitation to six rafts, comprising two clusters of three rafts each over 125 dates in March through September 2017. Rafts 17–19 are between South L and South M Avenues and rafts 20–22 are north of Nike Zeus (Figure 5). In 2018 there were rails photographed on 31 dates on four rafts; all but one were in the cluster north of Nike Zeus. The rails explored but no nesting occurred on any raft in 2016–2018. At least two of the rails photographed in rafts 20 and 21 in 2018 were juveniles, corroborating evidence of successful breeding by Pair #2 in both June and August. Rails nesting at Point Mugu usually place incubation nests on the top and side of spiny rush, allowing them good cover but also good visibility. Better mimicking of these cover qualities might make the rafts more useful to the rails.

Banding and Re-Sightings

While there have been sightings of banded Light-footed Ridgway's Rails at Point Mugu in the past, the paucity of banded rail sightings was unexpected during the time that we were releasing rails; 107 rails bred in zoological facilities and banded were released into Mugu Lagoon between 2001 and 2009. The secretive nature of these birds hampers re-sightings, but based on the numbers, at least a few banded Light-footed Ridgway's Rail sightings would have been expected annually during those years; at this point in time, we are well beyond the life expectancy in the wild of even the most recently released individuals. Possible explanations for past non-detections are that the Light-footed Ridgway's Rails: (1) lost their bands (very unlikely); (2) did not survive; (3) did not stay in Mugu Lagoon; or (4) are now deceased (the rails would now be 9 to 17 years old).

Predation, in general, is the main controlling factor for Light-footed Ridgway's Rails in Mugu Lagoon. Raptors also appear to be the main predators of these rails range-wide. A significant portion of the Point Mugu marsh comprises good foraging habitat for raptors because the marsh canopy is low-growing and relatively open, and the substrate is often dry. Although most of the raptor kills would go unobserved well out in the marsh, predated

Light-footed Ridgway's Rails have been observed with regularity, with the most recent finds in 2014, 2016, 2017, and 2018. Finding a raptor-killed rail that was not outfitted with radio telemetry is somewhat remarkable given the relatively small number of rails and the large size of the Mugu wetland. At least two of three radio-fitted Light-footed Ridgway's Rails were depredated by raptors in 2006 (the third was eaten by an unidentified predator) (Zembal 2007); and in 2005, three of five radio-fitted Light-footed Ridgway's Rails were either depredated or scavenged by raptors, perhaps demonstrating that raptors are a much larger factor affecting the rail population at Point Mugu than is readily observable. Nine different birds of prey species are regularly observed in and adjacent to the marsh. These include at least three that have been known to prey on Light-footed Ridgway's Rails: Peregrine Falcon (*Falco peregrinus*), Red-tailed Hawk (*Buteo jamaicensis*), and Northern Harrier (*Circus cyaneus*). Additionally, the Short-eared Owl is a known predator of the smaller Northern Clapper Rail (*Rallus longirostris crepitans*). The past presence of a resident Short-eared Owl in the marsh in 2014 and 2015 may have led to rail depredation and the scarcity of current rail use of the habitat between South M and South L Avenues. Unfortunately, this same area may now have a resident Great Horned Owl and there was evidence of a mammal at least finishing off a rail carcass there in 2017 and nearby in 2018. The abundance of these raptors probably accounts for the heavy use of spiny rush stands by Mugu Lagoon Light-footed Ridgway's Rails, because these stands comprise the tallest, thickest, most formidable cover available. Other predators likely include mammals. The remains of adult rails found in 2014, 2017, and 2018 appeared to be left by an unknown medium- to large-size mammal. Mammalian predator sign is scarce in the marsh, presumably in part due to the active predator management program at NBVC Point Mugu. However, in recent years, coyotes (*Canis latrans)* have denned in the marsh on a spiny rush berm in the Western Arm.

Lastly, the lack of sightings between 2009 and 2018 of banded Light-footed Ridgway's Rails may be partly the result of many rails having vacated the Point Mugu area. Supporting evidence consists of the following observations:

- At least one female released at Point Mugu moved approximately 90 miles south to Upper Newport Bay, where she was photographed by Steve Metz on December 12, 2004, 106 days after being released in the Eastern Arm.

- A banded Light-footed Ridgway's Rail was photographed in the Seal Beach NWR on December 3, 2009. This bird had an anodized blue band on the left leg, indicating it may have been banded at Point Mugu in 2007. However, it could have come north from San Elijo Lagoon in San Diego County, the next closest release site of captive-bred Light-footed Ridgway's Rails in 2007.

- The most recent re-sighting of a banded Light-footed Ridgway's Rail from Mugu Lagoon was also the longest travel recorded for a banded Light-footed Ridgway's Rail released from Point Mugu: a female, dubbed "Amelia" (banded 1065-39863) was released at Point Mugu on August 25, 2009 and recaptured on November 4, 2010 at the Chula Vista Nature Center (Living Coast Discovery Center), having travelled 160 miles back to the place she was hatched and reared. She had been

courting a lone male from the outside of his pen, was paired with him after recapture, and produced many clutches of eggs and fledglings in this facility from 2011 through 2015. Amelia's mate died, and she was released to the Sweetwater Marsh NWR on June 9, 2015, after she was observed courting through the pen mesh walls with a wild male.

Since the release of rails bred in breeding facilities began in 2001, long-range movements of some of them well away from release sites have been documented. However, the last rail released in Mugu was in 2009, so that the timeframe for re-sighting banded, released rails from Mugu has already exceeded the expected average longevity of this rail in the wild. However, there is always the remote possibility of a banded rail moving north from a contemporary release location in San Diego or Orange Counties. An example of this is the report of a deceased banded rail whose band was retrieved near Fillmore, in Ventura County, after the rail was released in the Seal Beach NWR in 2015.

Observations, Conclusions, and Recommendations

The following observations, conclusions, and recommendations are offered, recognizing that the parameters of any of the suggested enhancements would need to be laid out first in enough detail to determine the cost/benefit to the Navy:

- Light-footed Ridgway's Rail eggs and juveniles reared in zoological facilities were released into Point Mugu in 1999, and from 2001 to 2009. The size of the Mugu Lagoon subpopulation doubled, and the genetic diversity presumably was enhanced greatly as a result. However, the Light-footed Ridgway's Rails are under heavy depredation pressure as indicated by the number of Light-footed Ridgway's Rails found dead and eaten, primarily by birds of prey. The depredation issue illustrates the importance of continuing predator monitoring and management.

- Perhaps because of the depredation pressure, the Light-footed Ridgway's Rails nest most abundantly and successfully in spiny rush. Spiny rush has been planted in efforts to establish additional nesting habitat; these efforts should continue and be expanded to include protection of existing spiny rush stands by pulling competitive plants from in and around the stands. All the stands of spiny rush that are most desirable for rail nesting (as indicated in part by past use) and located out in the marsh rather than on the edge, are in jeopardy. These plants are being overtaken and smothered by thick growth of mostly alkali heath and pickleweed. This may have been exacerbated by prolonged drought conditions, and many of the spiny rush stands used by rails in the past are nearly gone. Some of the most important stands (based on the regularity of past rail use) are comprised of severely weakened plants.

- The annual augmentation of the Mugu Lagoon Light-footed Ridgway's Rail subpopulation that occurred in 1999 and from 2001 to 2009 is likely responsible for the maintenance of the subpopulation at more than 15 breeding pairs for several years prior to 2008, and likely led to the record high counts in 2012 and 2013. The efforts also resulted in collateral benefits range-wide. Some of the Light-footed

Ridgway's Rails released at Point Mugu have moved and populated other wetland complexes in southern California. Monitoring should continue, and the Navy should also be recognized for past benefits to Light-footed Ridgway's Rails at locations beyond NBVC Point Mugu.

- Suitable nesting habitat appears to be quite limited at Point Mugu; therefore, efforts should be made to increase the amount and quality of habitat available. Besides the establishment and restoration of spiny rush, opportunities should be identified for establishing stands of fresh water marsh on the edge of the salt marsh. It should also be recognized that the largest Light-footed Ridgway's Rail subpopulations occur in those large wetlands with full tidal prisms. Projects should be identified and implemented to enhance tidal flushing in the Western Arm. With the identification in 2010 of a nesting area in freshwater marsh on the west side of the base off Perimeter Road, efforts should be made to foster the parameters accounting for the occurrence and continued viability of this habitat.

- Because Light-footed Ridgway's Rails are showing up in other freshwater wetlands in the vicinity of Point Mugu, efforts should be made to survey these areas to determine if Light-footed Ridgway's Rails from Mugu are dispersing and successfully breeding in additional freshwater wetlands in the Ventura County area.

- It became evident in 2012 that low rainfall leads to the premature drying of the freshwater marsh off Perimeter Road. In low rainfall years, artificial watering should be considered as a possible management tool to extend the viability of this habitat far enough into the breeding season to allow Light-footed Ridgway's Rails to raise their young.

- Finally, there is a large patch of underutilized habitat in the Central Basin and Eastern Arm of Point Mugu. These areas have an abundance of raptor hunting perches; large tree stumps have washed into the wetland during storm events and settled for decades in the marsh. Eliminating these perch points would increase the suitability of the Central Basin and Eastern Arm for Light-footed Ridgway's Rails.

Recommendation Summary

In summary, the following seven recommendations are offered for consideration:

1) Protect and expand rail nesting habitat by removing competing plants from existing spiny rush stands and by planting additional spiny rush.
2) Manage the freshwater wetlands at the far end of Perimeter Road by watering when needed, to keep them from drying before August.
3) Monitor tidal amplitude; implement management necessary to maintain or expand existing tidal amplitude and wetland acreage.
4) Continue predator management.
5) Continue monitoring and management of Light-footed Ridgway's Rails.
6) Remove old tree stumps and other raptor perches from the Central Basin and Eastern Arm.

7) Continue the maintenance and monitoring of the nesting rafts deployed for Light-footed Ridgway's Rails, but try different cover types.

Acknowledgements
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Literature Cited

Chesser Terry R., Richard C. Banks, Carla Cicero, Jon L. Dunn, Andrew W. Kratter, Irby J. Lovette, Adolfo G. Navarro-Sigüenza, Pamela C. Rasmussen, J. V. Remsen, Jr., James D. Rising, Douglas F. Stotz, and Kevin Winker. 2014. Fifty-Fifth Supplement to the American Ornithologists' Union *Check-list of North American Birds*. The Auk: October 2014, Vol. 131, No. 4, pp. CSi-CSxv.

U.S. Fish and Wildlife Service. 1985. Recovery Plan for the Light-footed Clapper Rail. Portland, OR. 121 pp.

Zembal, R., and B. W. Massey. 1981. A census of the Light-footed Clapper Rail in California. West. Birds 12: 8799.

Zembal, R., and B. W. Massey. 1987. Seasonality of vocalizations by Light-footed Clapper Rails. J. Field Ornith. 58: 41 – 48.

Zembal, R., B.W. Massey, and J.M. Fancher. 1989. Movements and activity Patterns of the Light-footed Clapper Rail. J. Wildl. Manage. 53: 39–42.

Zembal, R. 2007. Light-footed Clapper Rail population enhancement at Mugu Lagoon, Naval Base Ventura County, Point Mugu, California 2006. Contract Report, NAVFAC Agreement #N62473-06-LT-R0022. 24pp.

Zembal, R., S.M. Hoffman, and J. Konecny. 2013. Status and Distribution of the Light-footed Clapper Rail in California, 2013. CA. Report to U.S. Fish and Wildlife Service and CA Dept. Fish and Game, Sacramento, CA. 20 pp.

Zembal, R., S. Hoffman, and J. Konecny. 2014. Status and Distribution of the Light-footed Clapper Rail in California, 2014. Report to U.S. Fish and Wildlife Service and CA Dept. Fish and Game, Sacramento, CA. 21 pp.

Zembal, R., S.M. Hoffman, and John Konecny. 2016. Status and Distribution of the Light-footed Ridgway's (Clapper) Rail in California, 2016. California Department

of Fish and Wildlife, Wildlife Management, Nongame Wildlife Unit Report, 2016-04. Sacramento, CA 28 pp.

Zembal, R., S.M. Hoffman, and John Konecny. 2017. Light-footed Ridgway's (Clapper) Rail in California, 2017. Report to California Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. Sacramento and Carlsbad, CA 28 pp.

Zembal, R., S.M. Hoffman, and John Konecny. 2018. Light-footed Ridgway's (Clapper) Rail in California, 2017. Report to California Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. Sacramento and Carlsbad, CA 28 pp.

FIGURES

Legend

Duck Ponds

NBVC Point Mugu Boundary

N
W E
S

0 0.5 1
Miles

Naval Base Ventura County
Point Mugu, California

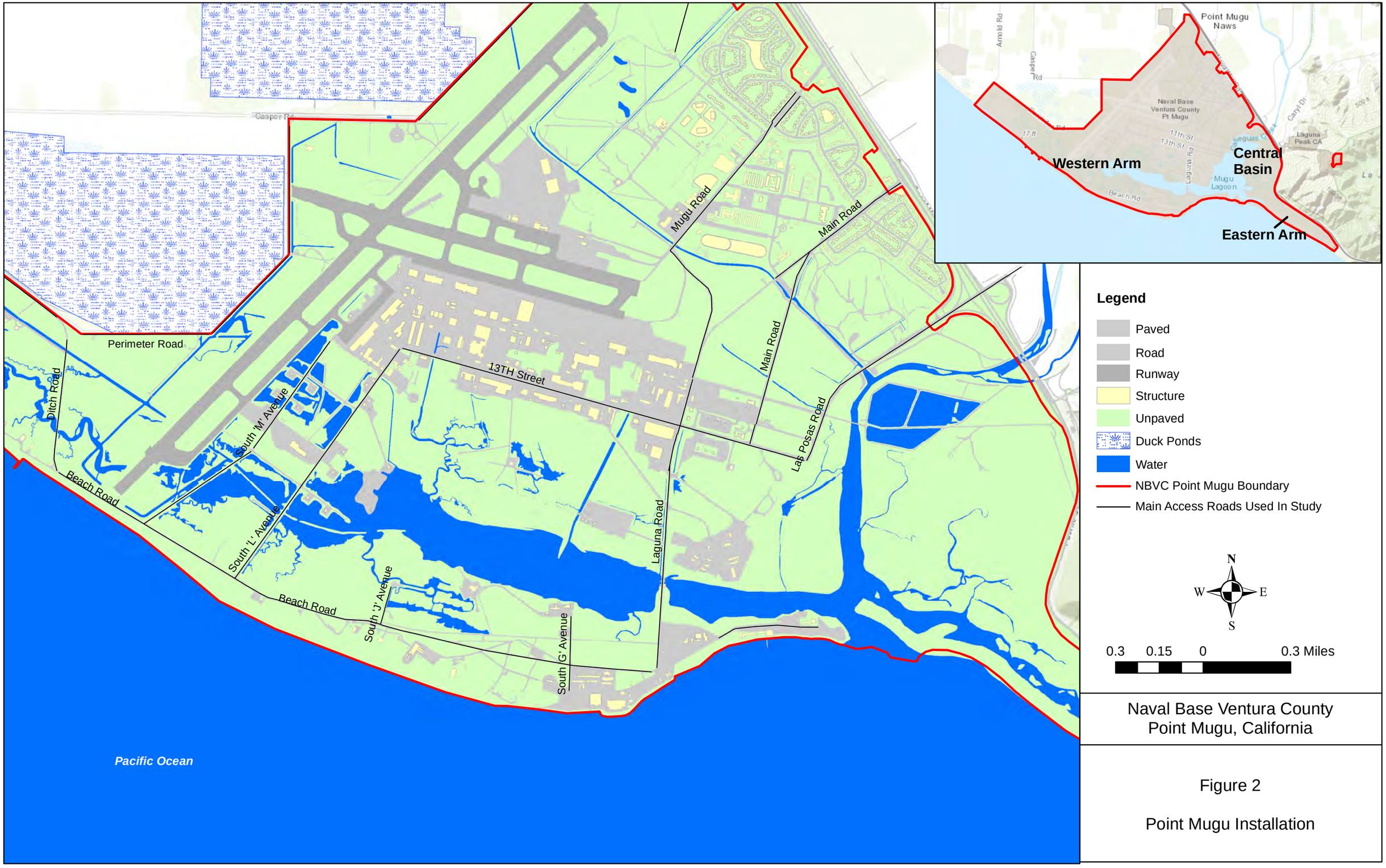
Figure 1

Regional Location Map

Author: GK. Date: 1/14/2019
Data Source: TetraTech Databases
This map is government property, not to be reproduced or distributed without concurrence from the Naval Base Ventura County Environmental Division.

Image Source Credits: ESRI World Street Map, 2018, World Imagery, 2018; Tetra Tech and Navy databases.

NBVC = Naval Base Ventura County



Naval Base Ventura County
Point Mugu, California

Figure 2

Point Mugu Installation

Map by A. Lortie.Fig2_LFCR2015.mxd
Data Source: ESRI and Tetra Tech, Inc.GIS databases

Image Source Credits: ESRI World Topographic Map, 2018; Tetra Tech and Navy databases.

NBVC = Naval Base Ventura County

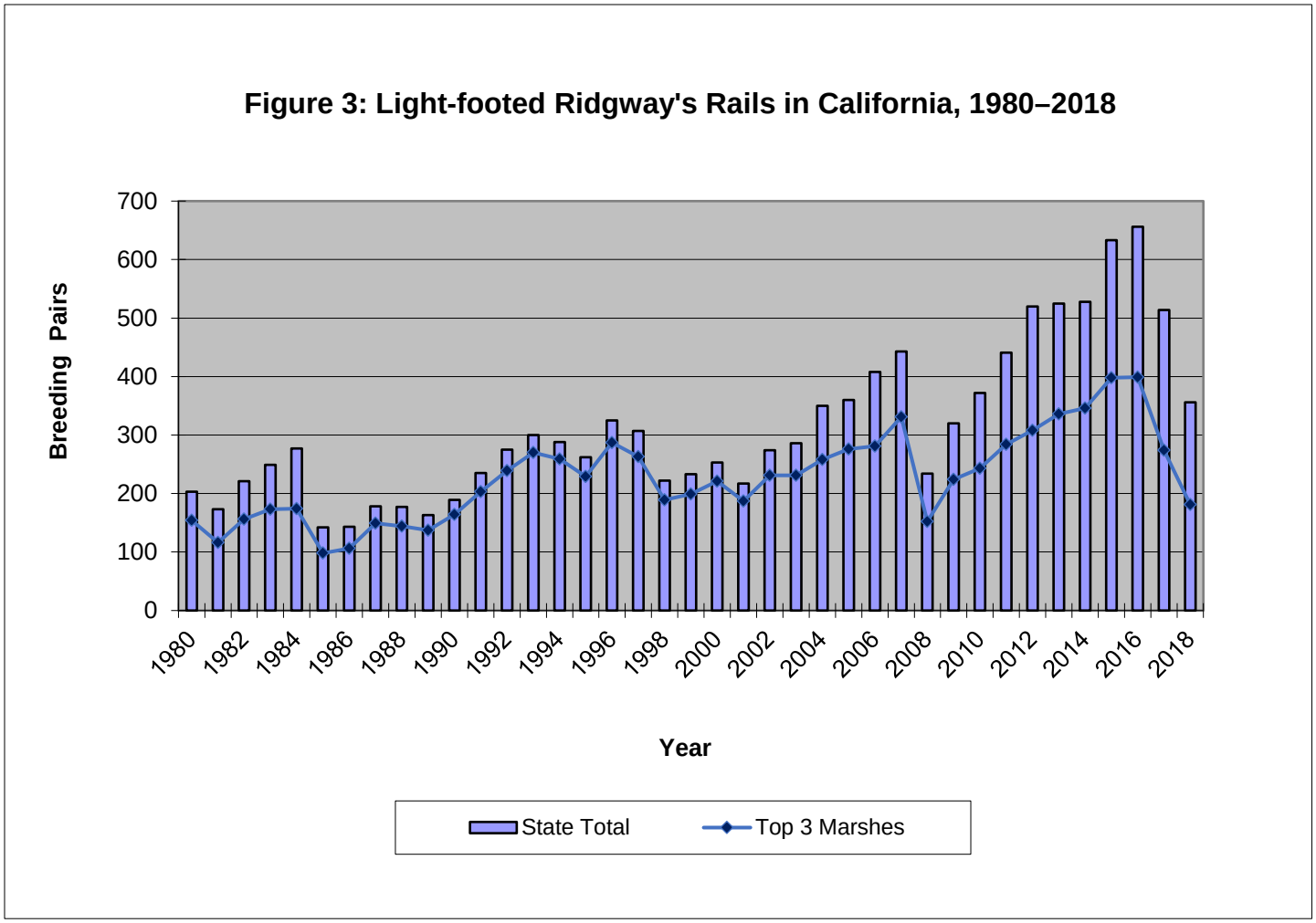
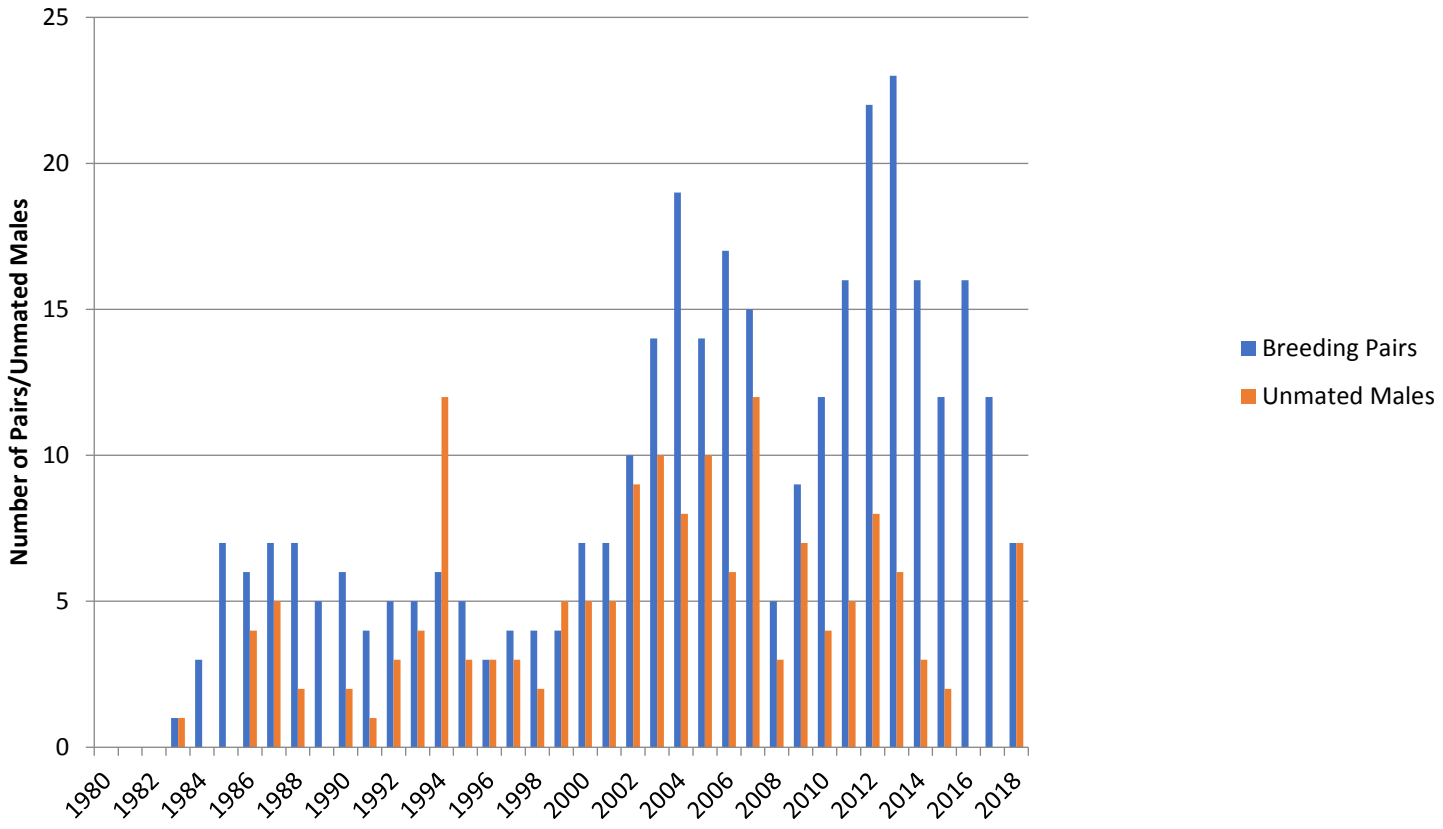
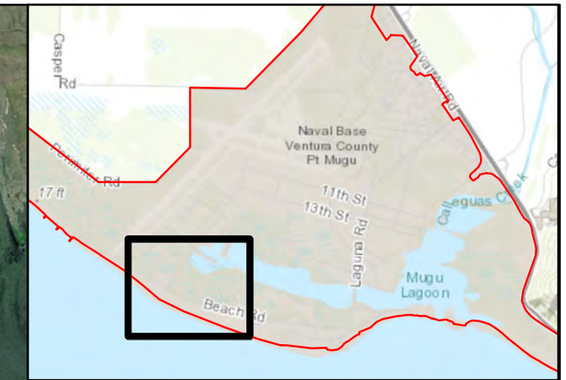


Figure 3: Light-footed Ridgway's Rails in California, 1980–2018
Breeding Pairs
700
600
500
400
300
200
100
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Year
State Total
Top 3 Marshes

Figure 4: Number of Light-footed Ridgway's Rails Detected in Mugu Lagoon, 1980–2018



Species Visits to Rafts									
Raft ID	Raft Name	Light-footed Ridgway's Rails				Other Species – 2018			
		Mar - Aug 2016	Sept 2016 - Mar 2017	Mar - Sept 2017	Dec-Nov 2018	Vole	Opossum	Long-tailed Weasel	Mallard
R17	Asgoth			13		X			
R18	Water Hut			11		X			X
R19	Por Huevos	5		24	1	X			
R20	Dr Blob	12	22	33		X	X	X	
R21	KB Cam	8	15	40	22	X			
R22	Rail Resort			4	4	X			
	Total Rail Visits	25	37	125	27				



Locator Map

Legend

- Kecking
- Pair #
- Raft
- Raft with Camera
- NBVC Point Mugu Boundary

N
W E
S

500 250 0 500 Feet

Naval Base Ventura County
Point Mugu, California

Figure 5
Breeding Light-footed Ridgway's Rails
Western Arm of Mugu Lagoon
East of Runway
2018

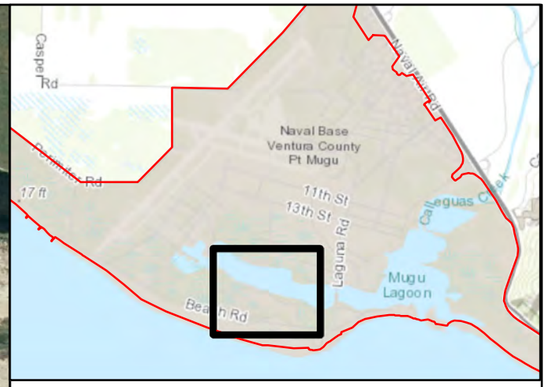
Map by A. Lortie.Fig5_LFCR2017.mxd
Data Source: Richard Zembal and Tetra Tech, Inc. GIS databases

Image Source Credits: ESRI World Topographic Map, 2018; Tetra Tech and Navy databases.

N2 = Nest #2
NBVC = Naval Base Ventura County

P = Pair

Species Visits to Rafts									
Raft ID	Raft Name	Light-footed Ridgway's Rails				Other Species – 2018			
		Mar - Aug 2016	Sept 2016 - Mar 2017	Mar - Sept 2017	Dec-Nov 2018	Vole	Opossum	Long-tailed Weasel	Mallard
R11	Cupcake					X			
R12	Team Band Co					X			
R13	Jadestar								
R14	Pipe Musket								
R15	Club Bob				4				
R16	Troxie								
	Total Rail Visits	0	0	0	4				



Locator Map

Legend

- Kecking
- Pair #
- Raft
- Raft with Camera
- NBVC Point Mugu Boundary

N
W E
S

450 225 0 450 Feet

Naval Base Ventura County
Point Mugu, California

Figure 6
Breeding Light-footed Ridgway's Rails
Western Arm of Mugu Lagoon
East of South J Avenue
2018

Map by A. Lortie.Fig6_LFCR2017.mxd
Data Source: Richard Zembal and Tetra Tech, Inc. GIS databases

Image Source Credits: ESRI World Topographic Map, 2018; Tetra Tech and Navy databases.

NBVC = Naval Base Ventura County
P = Pair

Locator Map

Legend

- Raft
- Raft with Camera
- NBVC Point Mugu Boundary

N
W E
S

900 450 0 900 Feet

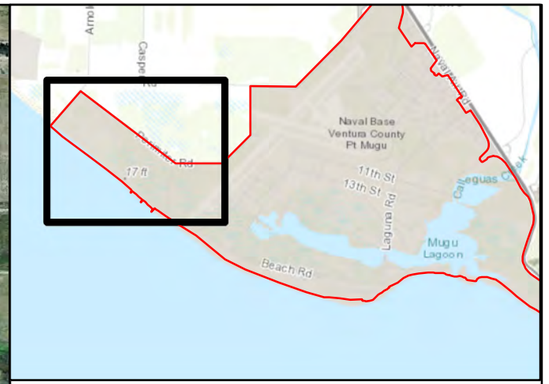
Naval Base Ventura County
Point Mugu, California

Figure 7
Breeding Light-footed Ridgway's Rails
Central Basin & Eastern Arm of
Mugu Lagoon
2018

Map by A. Lortie.Fig7_LFCR2017.mxd
Data Source: Richard Zembal and Tetra Tech, Inc. GIS databases

Image Source Credits: ESRI World Topographic Map, 2018; Tetra Tech and Navy databases.

NBVC = Naval Base Ventura County



Locator Map

Legend

- Kecking
- NBVC Point Mugu Boundary
- General Locations of Past Breeding

N
W E
S

900 450 0 900 Feet

Naval Base Ventura County
Point Mugu, California

Figure 8

Location of Past Breeding of Light-footed Ridgway's Rails in the Far Western Arm of Mugu Lagoon

Map by A. Lortie.Fig8_LFCR2017.mxd
Data Source: Richard Zembal and Tetra Tech, Inc. GIS databases

Image Source Credits: ESRI World Topographic Map, 2018; Tetra Tech and Navy databases.

NBVC = Naval Base Ventura County

Figure 9: Photograph of Juvenile Light-footed Ridgway's Rail Visiting Artificial Nesting Raft 22 at Mugu Lagoon, August 5, 2018