



# Cape Cod National Seashore 2019 Shorebird Monitoring and Management Report

Natural Resource Report NPS/CACO/NRR—2021/2302





**ON THIS PAGE**

Least tern and chick  
NPS photo by Joan Miller

**ON THE COVER**

Piping plover chick  
NPS photo by Keegan Burke

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# **Cape Cod National Seashore 2019 Shorebird Monitoring and Management Report**

Natural Resource Report NPS/CACO/NRR—2021/2302

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## Executive Summary

Cape Cod National Seashore (CACO) manages the protection of federal and state listed beach-nesting shorebirds (piping plover [*Charadrius melodus*], least tern [*Sternula antillarum*], and American oystercatcher [*Haematopus palliatus*]), and various migrating shorebird species following procedures outlined in the 2018 Shorebird Management Plan/EA and associated Finding of No Significant Impact (FONSI) (NPS 2018). This report summarizes monitoring results from the 2019 field season.

Piping plover, least tern, and American oystercatcher nesting and brood-rearing behaviors were monitored over 43 miles of coastline from Provincetown to Orleans, Massachusetts.

### Piping plover:

- 88 breeding pairs were observed (third highest number of pairs since 2003)
- 151 chicks fledged (highest number of fledged chicks since 2008); 63 pairs successfully fledged at least one chick
- Park-wide average productivity = 1.72 chicks fledged/pair (USFWS Northeastern piping plover population annual recovery target rate is 1.5 chicks fledged/pair)
- Depredation accounted for 60% of nest failures
- Predominant nest predators were Eastern coyote and corvids (American crow and fish crow)
- Predator exclosures were installed around a total of 70 nests. Exclosures improved nest success from a hatch rate of 14% for unexclosed to 89% for exclosed nests. Exclosures reduced predation rates from 54% for unexclosed nests to 4% for exclosed nests.

### Least tern:

- Nine colonies were established from Eastham to Provincetown
- 171 breeding pairs were observed (highest since 2012)
- 39 chicks fledged
- Average productivity = 0.23 chicks fledged/breeding pair
- Depredation, mainly by coyote, was the principal cause of egg loss
- Cause of chick loss is difficult to determine, but depredation by coyote was often suspected

### American oystercatcher:

- One pair nested at Jeremy Point, Wellfleet
- Two nests were laid, first hatched and the second was depredated

- Productivity = 0 chicks fledged/breeding pair
- Depredation by coyote was the main cause of egg loss
- Cause of chick loss is unknown, but depredation by coyote was suspected

### **Staging migrating shorebirds:**

- Large mixed-species flocks including those with up to approximately 2,500 individuals of the federally endangered roseate tern (*Sterna dougallii*) and the state-listed species of concern common tern (*Sterna hirundo*), were observed throughout the park mid-July through October
- Large mixed flocks of up to 1,000 individuals including red knot, semipalmated sandpipers, piping plovers, black-bellied plovers, semipalmated plovers, sanderlings, and other shorebird species were observed throughout the park mid-July through October

### **Human Disturbance**

- 121 pedestrian violations were documented (minimum easement), combination of individuals observed inside the symbolic fenced area and fresh pedestrian tracks from a recent violation.
- 276 dogs off leash were documented from April through September (130 in the South District and 146 in the North District). Unleashed dogs were encountered most frequently at Lecount Hollow (31), Longnook (26), and Newcomb Hollow (25).
- 257 pet violations, pets in designated “No Pet” areas, were documented. The majority of the incidents were physically observed or by observations of fresh pet tracks in “No Pet” areas.
- At least 5 instances of vehicles driving in closed areas in areas of Coast Guard Truro, Race Point South and Race Point North, 2 of which drove past unfledged chicks.
- 3 piping plover chick deaths can be attributed to human disturbance, 2 of which were noncompliance issues of a pet in a no pet area and a vehicle driving in closed area.

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## List of Terms, Small Glossary, Acronyms, or Contacts

**Brood-** *A family unit of adults and chicks. Also, the act of sheltering chicks beneath the adult as a form of protection.*

**Buffer-** *The distance between the shorebird activity and the fenceline or vehicle. Established to reduce the amount of disturbance to the birds to breed, feed, and shelter.*

**Complete/Incomplete nest-** *A complete nest is a nest that has reached its full potential egg number or active incubation is observed and no further eggs are added to the clutch. An incomplete nest is a nest that is lost before it reaches the full clutch. Complete nests typically are four eggs but may be less depending on whether eggs were lost before completion or the capacity of the female (some birds lay less eggs towards the end of the season).*

**Depredation-** *The loss of eggs due to predator.*

**Exclosure-** *A tool used to protect piping plover nests from predation. Typically made of a circular wire cage, held into the sand by posts or rebar, and covered with netting on top. Exclosures are a useful tool to keep predators from getting to the eggs but are more visible.*

**Fledge-** *The stage in a chick's life when the feathers and wing muscles are sufficiently developed for flight as well as the act of raising chicks to a fully-grown state by the chick's parents. For purposes of data collection and management decisions, a chick is fully fledged when it is observed in sustained flight over 15 meters regardless of age.*

**Flexible Management-** *A management strategy in which there is a reduction or elimination of protective measures in specific high-visitation areas to accommodate visitor use, in exchange for increased protective measures elsewhere.*

**ORV-** *Off Road Vehicle*

**Oversand Corridor-** *Vehicle driving on the beach areas.*

**Productivity-** *the rate of production for a species or population over a given period of time. Productivity in this report is measured as the number of chicks fledged out of the number of breeding pairs at CACO.*

***Scrape***-Small, shallow depressions in the sand or gravel in which shorebirds and seabirds lay their eggs.

***Staging***-the act of resting, feeding, loafing by groups of birds in preparation for migration.

***Suitable Habitat***-Areas in which endangered and threatened species depend that provide the necessary features for nesting. For shorebirds, this typically includes areas of open sand, cobble, or dune above the high tide line that are unlikely to be washed by the tide.

***Symbolic Fencing***-A mechanism used to identify and protect shorebird nesting and staging habitat and provide a buffer between birds and human disturbance. Typically consists of 5 or 6-foot wooden posts with 'Area Closed-Bird Use Area' signs affixed to the posts and connected by a line of cotton twine.

***Take***- From Section 3(18) of the Federal Endangered Species Act: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

## Introduction

Cape Cod National Seashore (CACO) provides approximately 43 miles of prime habitat for beach-nesting birds that breed on beaches used by millions of human visitors every year. Some of the species are listed by federal and state agencies as endangered, threatened, or of special concern, such as piping plover, least tern, and American oystercatcher. Additional threatened and endangered species use CACO beaches as a staging ground to forage and build reserves during migratory stopovers: the roseate tern, common tern, and red knot. CACO manages the beaches with the goal of increasing shorebird productivity while providing for visitor access and recreation. Management practices include those designed to keep people out of nesting areas (e.g. temporary beach closures, off-road-vehicle restrictions, symbolic fencing and signs) and those designed to reduce predation on birds (e.g. predator exclosures around nests and pet restrictions). These practices are adjusted day-to-day and are informed by ongoing monitoring.

CACO encompasses a matrix of private, federal and town-owned lands with varying beach management and natural resource protection practices. In order to achieve continuity in beach regulations and make signage and management less confusing to the general public, CACO regularly communicates and coordinates with adjacent landowners.

CACO shorebird staff monitor the timing, survival, and reproductive success of shorebirds throughout the breeding season (spring-fall). This document summarizes biological data for three species of breeding shorebirds. It also summarizes observations of other species of shorebirds that use CACO as a staging ground during their annual migration.

# Shorebird Protection and Monitoring Methods

## General Nest Habitat Protection

Habitat assessments were conducted prior to the onset of the breeding season in order to identify suitable habitat for beach-nesting shorebirds. Those assessments and historic nesting locations were used to demarcate pre-nesting areas closed to recreational activities. Symbolic fencing, wooden posts connected by string and signs (“bird use area”) to prohibit entry, were installed around these sites before nesting activity was observed. These closures helped to minimize habitat disturbance in potential breeding areas and enabled birds to establish territories and nests in their preferred habitat. The closures were modified throughout the season in order to maintain a sufficient buffer around nests and to provide adequate protection for staging areas used by migratory birds (NPS 2012).

## General Monitoring Methods

CACO follows the monitoring and protection methods outlined in the U.S. Fish & Wildlife Service (USFWS) *Piping Plover Atlantic Coast Population Revised Recovery Plan* (1996), a protocol designed specifically for CACO (Erwin 2003), and *The Massachusetts Tern and Piping Plover Handbook: A Manual for Stewards* (Blodget and Melvin 1996) for nesting least terns. To inform decisions regarding daily operations that affect shorebird management and protection and that are not addressed by these two documents, CACO staff also consult the 2018 Shorebird Management Plan and Standard Operating Procedure (SOP).

Shorebirds were monitored in 27 survey units at CACO from Provincetown to Orleans. Survey units were established for logistical purposes and do not necessarily represent ecologically meaningful differences. Beaches are divided into two districts, again for logistical purposes. The North District (ND) includes all CACO beaches located in Provincetown and Truro (Figure 1): Wood End/Long Point (WELP), Herring Cove (HC), Hatches Harbor (HAH), Race Point (RP), Race Point North (RPN), Race Point South (RPS), Mission Bell (MIB), Exit 9 (E9), Armstrong (ARM), High Head (HH), Head of the Meadow (HOM), Coast Guard Truro (CGT), Longnook (LN) and Ballston north section (BAB). The South District (SD) includes all CACO beaches located in Eastham and Wellfleet (Figure 2): Coast Guard Beach Eastham (CGE), Nauset Light Beach (NL), Marconi Beach (MB), Marconi Station (MS), LeCount Hollow (LH), White Crest (WC), Cahoon Hollow (CH), Newcomb Hollow (NH), Ballston Beach south section (BAB), Bound Brook (BB), Duck Harbor (DH), Great Island (GI), and Jeremy Point (JP). New Island in the town of Orleans is considered a SD site but in 2019 it was monitored and included in the town of Orleans data; there was no activity reported at New Island in 2019.

Monitoring began in early April. Field staff searched the beaches daily for signs of shorebird nesting activity (e.g., nesting behavior, nest scrapes, and concentrated tracks on the upper beach). Almost all nests were located before clutch completion, and thus hatch windows could be predicted with high accuracy. Shorebird nests, broods, and colonies were generally monitored every one to two days to ensure restrictions on visitor use were applied or lifted in a timely manner. Nests and broods in Off-Road Vehicle (ORV) corridors were monitored at least daily, and often twice a day. Symbolic

[illegible]

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## **Species-specific Methods**

### ***Piping Plover***

The piping plover was federally listed under the Endangered Species Act in 1986. Its breeding range extends from Newfoundland to North Carolina, and wintering range extends from North Carolina to the Bahamas and West Indies. The Atlantic coast piping plover population size began to decline in the late 1800's due to unregulated hunting and the millinery trade. The population rebounded with the introduction of the Migratory Bird Treaty Act in 1918; however, the population declined again due to beach development and increased recreational use of breeding habitat. The Atlantic coast population is currently listed as Threatened.

### **Monitoring Methods**

Brood monitoring is critical for understanding the fate of plover chicks including tracking chick movement, identifying causes of chick loss, and observing initial flights. Accordingly, shorebird technicians monitor the status of piping plover broods daily. Piping plover chicks are considered fledged when they are observed in sustained flight for at least 15 meters, irrespective of age (USFWS, 2015). In accordance with the Shorebird Management Plan, recreational restrictions are lifted when broods are determined to be fledged or are considered lost after not being observed for five consecutive days.

Nest loss and egg loss events were recorded independently due to the potential for multiple causes for egg loss from one nest (e.g. two different predators, unviable eggs). Documenting the cause of chick mortality presents additional challenges compared to nest loss because chicks are highly mobile, hard to track, hide from potential predators such as pedestrians and dogs, and may go unobserved for days at a time.

### **Predator Management**

In addition to the symbolic fencing installed around suitable habitat, CACO staff installed predator exclosures around some piping plover nests. These exclosures were designed to protect nests from predatory birds and mammals (crows, coyotes, foxes, etc.). They were made of metal wire cages approximately four feet in height and seven feet in diameter, buried in the sand and stabilized with wood posts or rebar. The top of the exclosure is covered with bird netting, with holes no bigger than half an inch, secured to the metal cage. To minimize the risk of nest abandonment and adult mortality, the majority of exclosures were installed only after egg incubation began, where vegetation did not hinder the bird's detection of approaching threats (e.g., predators), and where the risk of overwash by waves and sand was low (Darrah, 2017). Initial exclosure usage in the North and South District was evaluated using *Piperex*; a decision support tool for exclosure use; the frequency of exclosing was then adjusted throughout the season based on nest success in particular areas.

### ***Least Terns***

The least tern is listed by the Massachusetts Division of Fisheries and Wildlife (MDFW) as a species of special concern and as a Bird of Conservation Concern by the USFWS. The Massachusetts least tern population size increased from 1985 to 2001, declined for several years, and then increased sharply after 2006. However, because initial counts were often conducted using inferior survey techniques and less inclusive survey coverage area than recent years, early increases in numbers do

not necessarily indicate increasing populations (Thompson et. al 1997). Since 1985, numbers of nesting least terns in Massachusetts have ranged from 2,109 to 4,309 pairs with an average of 2,960 pairs (Mostello 2019). In the mid-1970s – 1980s, the population of nesting least terns at CACO generally ranged from 200- 600 pairs.

#### Monitoring Methods

Due to concerns of predators keying into human scents or visual clues during monitoring activities in the nesting areas (e.g., footprints leading up to a nest), visual estimates of least tern colony size were made from outside the symbolic fencing several times per week (i.e., a count of incubating adults, and unfledged chicks). Nests or chicks present within or in proximity to the ORV beach driving corridor were monitored daily. Shorebird staff occasionally walked through colonies to obtain better estimates of numbers of nests and chicks than could be obtained from more distant visual observations. The number of pairs in each colony was reported based on pairs present and incubating adult counts during two standard periods defined by Massachusetts Division of Fisheries and Wildlife (“A-count” from June 5-20 and “B-count” after June 20). Similar to plovers, least terns are considered fledged when they are observed in sustained flight for at least 15 meters.

#### **American Oystercatchers**

The American oystercatcher is designated a Species of High Concern and is one of the most uncommon species of breeding shorebirds in North America due to a restricted range, small population size, widespread habitat loss, and threats during the breeding and non-breeding seasons (Brown et al. 2001, USFWS 2008). The American oystercatcher population has undergone a substantial range expansion along the Atlantic Coast, reaching Massachusetts in 1969. The northward range expansion may be a re-colonization of formerly occupied habitat (Forbush 1912). The eastern U.S. population of oystercatchers was estimated by Brown et al. (2005) at about 11,000 birds in 2003. In 2011, observers reported totals of > 418 adults and > 202 pairs of American Oystercatchers at 110 sites in Massachusetts (Melvin, 2012) but the American oystercatcher is still an uncommon bird at CACO.

#### Monitoring Methods

Monitoring for American Oystercatcher nests and chicks is similar to methods for piping plovers. Due to the small population size at Cape Cod National Seashore, American Oystercatchers are often monitored daily. Nest loss and egg loss events were recorded independently due to the potential for multiple causes for egg loss from one nest (e.g. two different predators, unviable eggs). In accordance with the Shorebird Management Plan, recreational restrictions are lifted when broods are determined to be fledged or are considered lost after not being observed for five consecutive days. In the majority of cases, the cause of chick loss is unknown.

#### **Post Breeding/Staging Shorebirds**

##### **Background**

In late summer/early fall, thousands of migrating shorebirds congregate on mudflats and beaches along CACO to feed and rest. While dozens of species use CACO during migration, three of the most notable are the federally endangered roseate tern, state-listed common tern, and the federally threatened red knot. Nauset Marsh, Coast Guard Beach in Eastham, Jeremy Point, Hatches Harbor,

Herring Cove marsh, Race Point North and Wood End/Long Point are particularly important sites, as they represent the most important staging areas for these birds on Cape Cod (Hadden 2001, Trull et al. 1999, Jedrey et al. 2010).

### **Management Methods**

Areas that have been historically important to nesting, staging and migratory shorebirds such as Coast Guard, Eastham, Jeremy Point, and Hatches Harbor were closed to pets from April 1<sup>st</sup>-October 15<sup>th</sup>. As in past years, sections of upper beach and intertidal zone with concentrations of staging and migrating shorebirds or nurseries were posted with symbolic fencing and/or signs to reduce human disturbance throughout CACO. In addition, to reduce disturbance to migratory and staging shorebirds, areas were closed to pets when greater than 100 migratory birds were observed in an area. Interpretive and “No Pet” signs were installed on metal channel posts placed throughout the marsh at Hatches Harbor and Herring Cove South. Additional signage for oversand corridor users on pet restrictions were installed at Hatches Harbor spit for the newly implemented pet closure from April 1<sup>st</sup>-October 15<sup>th</sup>. These management practices are guided by the 2018 Shorebird Management Plan, 2007 ORV Environmental Assessment/Finding of No Significant Impact and the 1993 *Appendix A: Guidelines for Managing Recreational Use of Beaches to Protect Piping Plovers, Terns, and Their Habitats in Massachusetts* (Blodget and Melvin 1996).

Beaches where staging and migrating shorebirds required signage in 2019 included: Coast Guard Beach in Eastham, Jeremy Point, Race Point North, Head of the Meadow, Herring Cove, High Head, Armstrong, and Hatches Harbor. Additional areas which had smaller flocks but required signage were Race Point South, Exit 9, Coast Guard Truro, and Duck Harbor.

# Results

## Piping Plover Nesting

The first piping plovers were observed at Head of the Meadow and Armstrong Beach on March 21<sup>st</sup>. They were present at most beaches by early April and continued to arrive until mid-June. The total number of breeding pairs was determined by the number of pairs observed nesting or exhibiting territorial or nesting behavior for at least two weeks. Most plovers departed by late August, although some remained through September and late October.

The first nests were found on April 25<sup>th</sup> at Race Point (1 nest) and Race Point North (2 nests). Peak nesting occurred the week of June 9<sup>th</sup> – June 15<sup>th</sup>, with a high of 74 nests at one time on June 13<sup>th</sup> (Figure 3). Nests with eggs were present from April 25<sup>th</sup> to July 31<sup>st</sup>. Hatching dates ranged from May 31<sup>st</sup> to July 31<sup>st</sup> (Figure 3). Most nests were located along the backshore and areas of sparse vegetation along the foredune. Nesting results are summarized in Table 1. Eighty-eight breeding pairs laid 151 nests (equaling 507 total eggs), of which 78 (52%) were lost and 73 (48%) hatched. Of those that were lost, 36 nests (46%) were lost before full incubation began. Re-nests accounted for 42% of the total nests (Table 2). Hatch success of re-nests was approximately 25% higher than first nests (63% vs 38%).

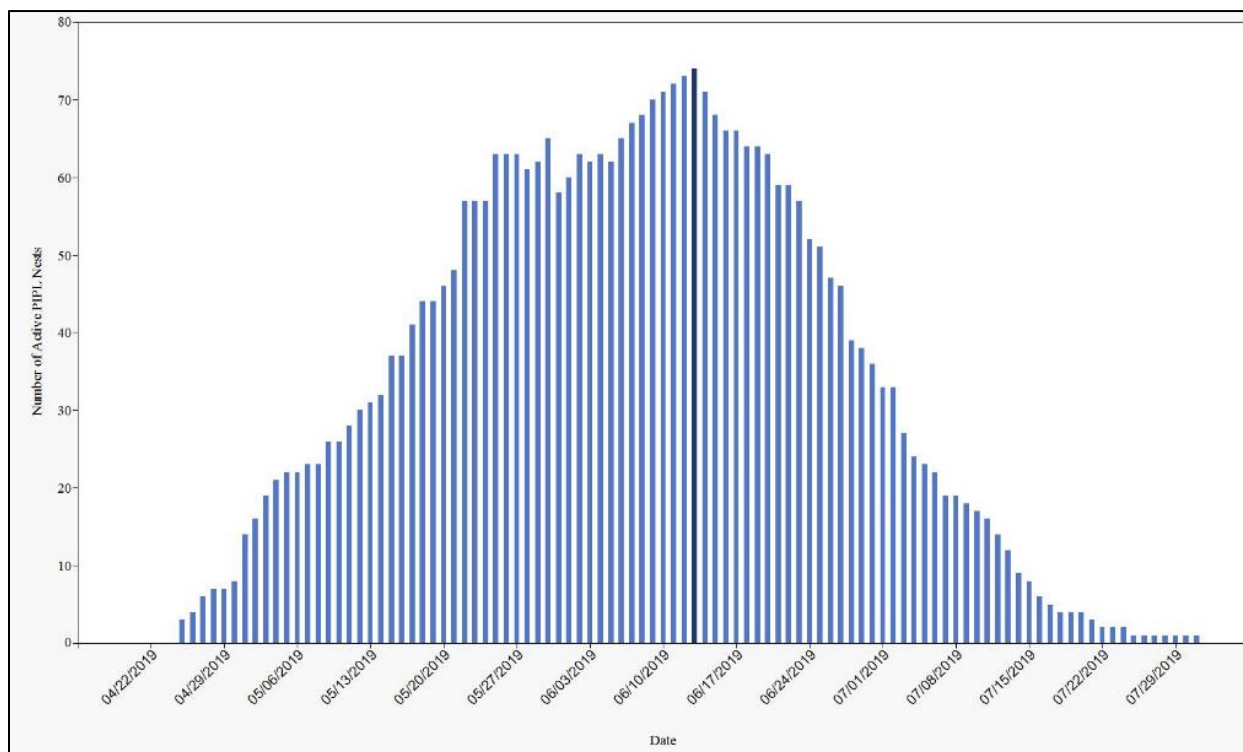


Figure 3. Number of active piping plover (*Charadrius melodus*) nests by date at CACO.

Of the 88 breeding pairs, 63 fledged at least one chick, and 25 pairs (28%) had zero productivity (9 pairs had complete brood losses and 16 failed to hatch any eggs). That is an improvement from 2018

when 44 pairs (45%) had zero productivity. In 2019, the South District had a total of 16 pairs (50% of the total 32 pairs) that had zero productivity compared to the North District that had a total of 9 pairs (16% of the total 56 pairs) that had zero productivity. North Districted beaches had approximately twice as many breeding pairs and nests and roughly three times the number of chicks fledged.

A total of 507 eggs were laid, of which 50% hatched (Table 1). Of the 253 failed eggs, 22 (9%) were unviable. All unviable eggs were dissected and revealed only partial development and yolk. Among total nest failures (in which all eggs were lost), predation was the most common cause for egg loss (54%), followed by overwash (19%), unknown causes (10%), abandonment (9%), and unviable (9%) (Table 3). Most predation of eggs was by Eastern coyote (63%) and crows (26%), though ravens and other unknown predators contributed to egg loss (Table 4). Of the 151 nests with eggs laid, 115 made it to clutch completion and the incubation stage (76%). The other 36 nests were lost before clutch completion (24%).

The average incubation time for nests was 26 days, calculated from the date the first egg in the clutch hatched. One nest at Race Point North hatched after at least a 36-day incubation; it was found with four eggs on May 20<sup>th</sup> so potentially could have been incubating for longer.

Table 1. Summary of piping plover (*Charadrius melodus*) nest success at CACO, 2019.

| Site                        | Pairs     | Nests      | Eggs laid  | Nests hatched | Eggs hatched | Chicks fledged | Hatch rate <sup>1</sup> | Fledge rate <sup>2</sup> | Productivity <sup>3</sup> |
|-----------------------------|-----------|------------|------------|---------------|--------------|----------------|-------------------------|--------------------------|---------------------------|
| Ballston Beach              | 0         | 1          | 1          | 0             | 0            | 0              | 0%                      | 0%                       | 0.00                      |
| Bound Brook                 | 3         | 3          | 12         | 2             | 5            | 3              | 42%                     | 60%                      | 1.00                      |
| Cahoon Hollow               | 0         | 0          | 0          | 0             | 0            | 0              | 0%                      | 0%                       | 0.00                      |
| Coast Guard (Eastham)       | 8         | 14         | 47         | 7             | 23           | 10             | 49%                     | 43%                      | 1.25                      |
| Duck Harbor                 | 2         | 3          | 12         | 1             | 4            | 3              | 33%                     | 75%                      | 1.5                       |
| Great Island                | 4         | 4          | 14         | 2             | 8            | 6              | 57%                     | 75%                      | 1.50                      |
| Jeremy Point                | 5         | 7          | 27         | 3             | 6            | 3              | 22%                     | 50%                      | 0.60                      |
| Lecount Hollow              | 0         | 0          | 0          | 0             | 0            | 0              | 0%                      | 0%                       | 0                         |
| Marconi Beach               | 3         | 3          | 11         | 2             | 6            | 1              | 55%                     | 17%                      | 0.33                      |
| Marconi Station             | 5         | 12         | 38         | 4             | 14           | 4              | 37%                     | 29%                      | 0.80                      |
| Nauset Light                | 0         | 1          | 4          | 0             | 0            | 0              | 0%                      | 0%                       | 0.00                      |
| Newcomb Hollow              | 2         | 4          | 13         | 2             | 7            | 7              | 54%                     | 100%                     | 3.50                      |
| New Island                  | 0         | 0          | 0          | 0             | 0            | 0              | 0%                      | 0%                       | 0.00                      |
| White Crest                 | 0         | 0          | 0          | 0             | 0            | 0              | 0%                      | 0%                       | 0                         |
| <b>South District Total</b> | <b>32</b> | <b>53</b>  | <b>182</b> | <b>23</b>     | <b>73</b>    | <b>37</b>      | <b>40%</b>              | <b>51%</b>               | <b>1.16</b>               |
| Armstrong                   | 6         | 9          | 32         | 6             | 22           | 15             | 69%                     | 68%                      | 2.50                      |
| Coast Guard (Truro)         | 1         | 2          | 5          | 1             | 1            | 1              | 20%                     | 100%                     | 1.00                      |
| Exit 9                      | 2         | 6          | 19         | 2             | 8            | 8              | 42%                     | 100%                     | 4.00                      |
| Hatches Harbor              | 2         | 3          | 12         | 2             | 8            | 3              | 67%                     | 38%                      | 1.50                      |
| Herring Cove                | 1         | 1          | 4          | 1             | 4            | 4              | 100%                    | 100%                     | 4.00                      |
| Head of the Meadow          | 5         | 10         | 28         | 5             | 19           | 16             | 68%                     | 84%                      | 3.20                      |
| High Head                   | 4         | 4          | 16         | 4             | 13           | 8              | 81%                     | 62%                      | 2.00                      |
| Longnook                    | 1         | 1          | 3          | 1             | 3            | 1              | 100%                    | 33%                      | 1.00                      |
| Mission Bell                | 1         | 3          | 6          | 1             | 4            | 3              | 67%                     | 75%                      | 3.00                      |
| Race Point                  | 4         | 10         | 30         | 4             | 15           | 8              | 50%                     | 53%                      | 2.00                      |
| Race Point North            | 15        | 23         | 81         | 14            | 49           | 28             | 60%                     | 57%                      | 1.87                      |
| Race Point South            | 5         | 8          | 28         | 5             | 20           | 11             | 71%                     | 55%                      | 2.20                      |
| Wood End/ Long Point        | 9         | 18         | 61         | 4             | 15           | 8              | 25%                     | 53%                      | 0.89                      |
| <b>North District Total</b> | <b>56</b> | <b>98</b>  | <b>325</b> | <b>50</b>     | <b>181</b>   | <b>114</b>     | <b>56%</b>              | <b>63%</b>               | <b>2.04</b>               |
| <b>Grand Totals</b>         | <b>88</b> | <b>151</b> | <b>507</b> | <b>73</b>     | <b>254</b>   | <b>151</b>     | <b>50%</b>              | <b>59%</b>               | <b>1.72</b>               |

<sup>1</sup>Total number of eggs hatched /total number of eggs laid.

<sup>2</sup>Total number of chicks fledged/ total number of eggs hatched.

<sup>3</sup>Total number of chicks fledged/ total number of nesting pairs.

Table 2. Summary of piping plover (*Charadrius melodus*) nesting parameters by year from 2003-2019 at CACO

| Year          | # Pairs   | # Nests Laid | # Successful Nests (%) <sup>1</sup> | % Renests <sup>2</sup> | # Eggs Laid | # Eggs Hatched (%) <sup>3</sup> | # Chicks Fledged (%) <sup>4</sup> | Productivity <sup>5</sup> |
|---------------|-----------|--------------|-------------------------------------|------------------------|-------------|---------------------------------|-----------------------------------|---------------------------|
| 2003          | 84        | 121          | 54 (45%)                            | 31%                    | 450         | 189 (42%)                       | 130 (69%)                         | 1.55                      |
| 2004          | 85.5      | 115          | 59 (51%)                            | 26%                    | 425         | 220 (52%)                       | 124 (56%)                         | 1.45                      |
| 2005          | 77        | 118          | 48 (41%)                            | 35%                    | 378         | 163 (43%)                       | 87 (53%)                          | 1.13                      |
| 2006          | 74        | 96           | 70 (73%)                            | 23%                    | 336         | 233 (69%)                       | 122 (52%)                         | 1.65                      |
| 2007          | 82        | 113          | 66 (58%)                            | 25%                    | 368         | 233 (63%)                       | 146 (63%)                         | 1.78                      |
| 2008          | 85        | 109          | 70 (64%)                            | 21%                    | 386         | 243 (63%)                       | 157 (65%)                         | 1.85                      |
| 2009          | 83        | 108          | 54 (50%)                            | 20%                    | 362         | 186 (51%)                       | 60 (32%)                          | 0.72                      |
| 2010          | 85        | 115          | 68 (59%)                            | 26%                    | 386         | 235 (61%)                       | 136 (58%)                         | 1.60                      |
| 2011          | 82        | 110          | 61 (55%)                            | 25%                    | 378         | 210 (56%)                       | 90 (43%)                          | 1.10                      |
| 2012          | 99        | 212          | 27 (13%)                            | 53%                    | 636         | 72 (11%)                        | 30 (42%)                          | 0.30                      |
| 2013          | 85        | 173          | 30 (17%)                            | 51%                    | 532         | 100 (19%)                       | 46 (46%)                          | 0.54                      |
| 2014          | 68        | 121          | 38 (31%)                            | 45%                    | 375         | 129 (34%)                       | 52 (40%)                          | 0.76                      |
| 2015          | 73        | 113          | 41 (36%)                            | 39%                    | 388         | 143 (37%)                       | 64 (45%)                          | 0.88                      |
| 2016          | 66        | 95           | 48 (51%)                            | 31%                    | 344         | 169 (49%)                       | 124 (73%)                         | 1.88                      |
| 2017          | 66        | 114          | 53 (46%)                            | 42%                    | 386         | 176 (46%)                       | 119 (68%)                         | 1.80                      |
| 2018          | 98        | 180          | 66 (37%)                            | 46%                    | 573         | 221 (39%)                       | 139 (63%)                         | 1.42                      |
| 2019          | 88        | 151          | 73(48%)                             | 42%                    | 507         | 254(50%)                        | 151(59%)                          | 1.72                      |
| <b>mean</b>   | <b>81</b> | <b>127</b>   | <b>54 (46%)</b>                     | <b>34%</b>             | <b>424</b>  | <b>187 (46%)</b>                | <b>105 (55%)</b>                  | <b>1.30</b>               |
| <b>median</b> | <b>83</b> | <b>115</b>   | <b>54 (48%)</b>                     | <b>31%</b>             | <b>386</b>  | <b>189 (49%)</b>                | <b>122 (56%)</b>                  | <b>1.45</b>               |
| <b>min</b>    | <b>66</b> | <b>95</b>    | <b>27 (13%)</b>                     | <b>20%</b>             | <b>336</b>  | <b>72 (11%)</b>                 | <b>30 (32%)</b>                   | <b>0.30</b>               |
| <b>max</b>    | <b>99</b> | <b>212</b>   | <b>73 (73%)</b>                     | <b>53%</b>             | <b>636</b>  | <b>254 (69%)</b>                | <b>157 (73%)</b>                  | <b>1.88</b>               |

<sup>1</sup> % = number of successful nests/total number of nests

<sup>2</sup> % = number of renests (including continuation nests)/total number of nests

<sup>3</sup> % = number of eggs hatched/total number of eggs laid

<sup>4</sup> % = number of chicks fledged/number of eggs hatched

<sup>5</sup> % = number of chicks fledged/number of nesting pairs

Table 3. Summary of piping plover (*Charadrius melodus*) nest loss, and cause of nest loss from 2003-2019 at CACO.

| Year        | # Unsuccessful Nests | Number of nests lost by cause (Percentage of total lost) |                   |                |               |                          |                   | Percent depredated by species |            |           |           |           |                  |           |           |
|-------------|----------------------|----------------------------------------------------------|-------------------|----------------|---------------|--------------------------|-------------------|-------------------------------|------------|-----------|-----------|-----------|------------------|-----------|-----------|
|             |                      | # Overwash/Sanding Over (%)                              | # Abandonment (%) | # Unviable (%) | # Unknown (%) | # Other <sup>1</sup> (%) | # Depredation (%) | Crows                         | Coyote     | Gull      | Skunk     | Fox       | Unknown Predator | Grackle   | Raven     |
| 2003        | 67                   | 13 (19%)                                                 | 16 (24%)          | 0 (0%)         | 0 (0%)        | 5 (7%)                   | 33 (49%)          | 15%                           | 27%        | 12%       | 15%       | 0%        | 30%              | 0%        | 0%        |
| 2004        | 56                   | 15 (27%)                                                 | 13 (23%)          | 0 (0%)         | 0 (0%)        | 0 (0%)                   | 28 (50%)          | 43%                           | 21%        | 11%       | 7%        | 0%        | 18%              | 0%        | 0%        |
| 2005        | 70                   | 33 (47%)                                                 | 11 (16%)          | 1 (1%)         | 0 (0%)        | 4 (6%)                   | 21 (30%)          | 24%                           | 29%        | 10%       | 0%        | 0%        | 38%              | 0%        | 0%        |
| 2006        | 26                   | 8 (31%)                                                  | 4 (15%)           | 0 (0%)         | 3 (12%)       | 0 (0%)                   | 11 (42%)          | 82%                           | 0%         | 0%        | 0%        | 0%        | 18%              | 0%        | 0%        |
| 2007        | 47                   | 24 (51%)                                                 | 12 (26%)          | 0 (0%)         | 2 (4%)        | 0 (0%)                   | 9 (19%)           | 44%                           | 22%        | 0%        | 0%        | 0%        | 33%              | 0%        | 0%        |
| 2008        | 39                   | 8 (21%)                                                  | 8 (21%)           | 1 (3%)         | 1 (3%)        | 0 (0%)                   | 21 (54%)          | 43%                           | 5%         | 5%        | 19%       | 0%        | 29%              | 0%        | 0%        |
| 2009        | 54                   | 16 (30%)                                                 | 9 (17%)           | 1 (2%)         | 2 (4%)        | 1 (2%)                   | 25 (46%)          | 68%                           | 4%         | 4%        | 0%        | 0%        | 24%              | 0%        | 0%        |
| 2010        | 47                   | 3 (6%)                                                   | 2 (4%)            | 1 (2%)         | 3 (6%)        | 0 (0%)                   | 38 (81%)          | 74%                           | 5%         | 0%        | 0%        | 0%        | 21%              | 0%        | 0%        |
| 2011        | 49                   | 8 (16%)                                                  | 9 (18%)           | 1 (2%)         | 2 (4%)        | 0 (0%)                   | 29 (59%)          | 83%                           | 10%        | 0%        | 0%        | 0%        | 7%               | 0%        | 0%        |
| 2012        | 185                  | 55 (30%)                                                 | 9 (5%)            | 0 (0%)         | 13 (7%)       | 5 (3%)                   | 103 (56%)         | 34%                           | 40%        | 0%        | 0%        | 5%        | 21%              | 0%        | 0%        |
| 2013        | 143                  | 28 (20%)                                                 | 7 (5%)            | 0 (0%)         | 2 (1%)        | 2 (1%)                   | 103 (72%)         | 23%                           | 30%        | 0%        | 0%        | 5%        | 40%              | 1%        | 0%        |
| 2014        | 83                   | 16 (19%)                                                 | 5 (6%)            | 0 (0%)         | 4 (5%)        | 0 (0%)                   | 58 (70%)          | 33%                           | 16%        | 0%        | 0%        | 10%       | 41%              | 0%        | 0%        |
| 2015        | 72                   | 17 (24%)                                                 | 8 (11%)           | 1 (1%)         | 0 (0%)        | 1 (1%)                   | 45 (63%)          | 33%                           | 33%        | 0%        | 0%        | 9%        | 25%              | 0%        | 0%        |
| 2016        | 47                   | 7 (15%)                                                  | 4 (9%)            | 1 (2%)         | 2 (4%)        | 1 (2%)                   | 32 (68%)          | 38%                           | 25%        | 0%        | 0%        | 3%        | 28%              | 0%        | 0%        |
| 2017        | 61                   | 17 (28%)                                                 | 6 (10%)           | 2 (3%)         | 6 (10%)       | 0 (0%)                   | 30 (49%)          | 63%                           | 13%        | 0%        | 0%        | 0%        | 23%              | 0%        | 0%        |
| 2018        | 114                  | 9 (8%)                                                   | 3 (3%)            | 3 (3%)         | 8 (7%)        | 1 (1%)                   | 90 (79%)          | 62%                           | 23%        | 0%        | 0%        | 2%        | 11%              | 1%        | 0%        |
| 2019        | 78                   | 15 (19%)                                                 | 9 (12%)           | 0 (0%)         | 7 (9%)        | 0 (0%)                   | 47 (60%)          | 30%                           | 51%        | 0%        | 0%        | 0%        | 17%              | 0%        | 2%        |
| <b>Tot.</b> | <b>1238</b>          | <b>292</b>                                               | <b>135</b>        | <b>12</b>      | <b>55</b>     | <b>20</b>                | <b>723</b>        | <b>47%</b>                    | <b>21%</b> | <b>2%</b> | <b>2%</b> | <b>2%</b> | <b>25%</b>       | <b>0%</b> | <b>0%</b> |

<sup>1</sup>Other in 2016, nest sanded over during high winds; Other in 2018, nest crushed by gull.

Table 4. Summary of piping plover (*Charadrius melodus*) egg loss, and cause of egg loss from 2016-2019 at CACO.

| Year | # Eggs lost | Number of eggs lost by cause (Percentage of total lost) |                  |          |          |                    |           | Percent depredated by species (Percentage of total predated) |             |        |        |        |                     |         |        |
|------|-------------|---------------------------------------------------------|------------------|----------|----------|--------------------|-----------|--------------------------------------------------------------|-------------|--------|--------|--------|---------------------|---------|--------|
|      |             | Overwash/<br>Sanding<br>Over                            | Abandon-<br>ment | Unviable | Unknown  | Other <sup>1</sup> | Predation | Crows                                                        | Coyote      | Gull   | Skunk  | Fox    | Unknown<br>Predator | Grackle | Raven  |
| 2016 | 175         | 25 (14%)                                                | 12 (7%)          | 10 (6%)  | 13 (7%)  | 0 (0%)             | 115 (66%) | 45<br>(39%)                                                  | 29<br>(25%) | 0 (0%) | 0 (0%) | 4 (3%) | 37 (32%)            | 0 (0%)  | 0 (0%) |
| 2017 | 211         | 56 (24%)                                                | 12 (5%)          | 31 (13%) | 14 (6%)  | 0 (0%)             | 98 (42%)  | 62<br>(63%)                                                  | 12<br>(12%) | 0 (0%) | 0 (0%) | 0 (0%) | 24 (24%)            | 0 (0%)  | 0 (0%) |
| 2018 | 352         | 22 (6%)                                                 | 10 (3%)          | 34 (10%) | 23 (7%)  | 4 (1%)             | 259 (74%) | 161<br>(62%)                                                 | 65<br>(25%) | 0 (0%) | 0 (0%) | 7 (3%) | 22 (8%)             | 4 (2%)  | 0 (0%) |
| 2019 | 253         | 47 (19%)                                                | 22 (9%)          | 22 (9%)  | 26 (10%) | 0 (0%)             | 136 (54%) | 36<br>(26%)                                                  | 86<br>(63%) | 0 (0%) | 0 (0%) | 0 (0%) | 10 (7%)             | 0(0%)   | 4 (3%) |

<sup>1</sup>Other in 2016, nest sanded over during high winds; Other in 2018, nest crushed by gull.

### **Banded Plovers**

Four banded piping plovers nested at CACO this season. One female bird was banded as a chick on August 4<sup>th</sup>, 2013 at Spring Hill Beach in Sandwich, MA. It has returned to nest at CACO several seasons since banding and has fledged a total of 12 chicks from 2015-2019 at Armstrong Beach. In 2019 it fledged three chicks on July 25<sup>th</sup>.

The second female piping plover green flag '9KA' nested at Race Point South in 2019 and fledged 4 chicks on July 27<sup>th</sup>. It was banded by Virginia Tech in North Carolina on August 8<sup>th</sup>, 2018, with an estimated hatch of 2017 or earlier. It is the first time being observed at CACO.

The third female, green flag '6EY' on upper left and blue band upper right, nested at Coast Guard Beach in Eastham in 2019 and fledged 2 chicks on August 15<sup>th</sup>. It was banded May 26<sup>th</sup>, 2016 as a second-year female at South Monomoy. This is the first year it has been observed breeding at CACO.

One male, green flag 'ETM' on upper left and metal band upper right, nested at Bound Brook but lost its nest to coyote on May 29<sup>th</sup>, 2019. The pair was not seen again in this location but observed displaying nesting behavior at Fishers Beach further north, on non-NPS property. It was banded at Cumberland Island National Seashore on October 7<sup>th</sup>, 2017. This is the first year it has been observed breeding at CACO.

### **Exclosure Results**

There were 115 nests that reached completion (refer to glossary for nest complete definition). Predator exclosures were installed around 68 of these complete nests; the remaining 47 were unexclosed (Table 5). Exclosures significantly increased the rate of hatching success (89% vs 14%) and decreased the rate of predation (54% vs. 4%). Only 11% of exclosed nests were lost with the highest cause for loss being abandonment (50%) followed by predation (37.5%) and overwash (12.5%) (Table 6). No adult mortalities were associated with exclosure use in 2019, however, the loss of four chicks could be attributed most likely to a raven targeting the exclosure and predated the chicks as they exited the exclosure.

Table 5. Piping plover (*Charadrius melodus*) Exclosure Nest Loss results, CACO, 2019.

| <b>Predator Management Type</b> | <b>Total Number of Nests</b> | <b>Total Number of Nests Lost</b> |
|---------------------------------|------------------------------|-----------------------------------|
| Nests Exclosed (Complete)       | 68                           | 6                                 |
| Nests Exclosed (Incomplete)     | 2                            | 2                                 |
| Nests Unexclosed (Complete)     | 47                           | 36                                |
| Nests Unexclosed (Incomplete)   | 34                           | 34                                |

Table 6. Cause of piping plover (*Charadrius melodus*) nest loss, CACO, 2019

| Cause of failure | Exclosed (Complete) | Exclosed (Incomplete) | Unexclosed (Complete) | Unexclosed (Incomplete) |
|------------------|---------------------|-----------------------|-----------------------|-------------------------|
| Depredated Total | 2                   | 1                     | 22                    | 22                      |
| Coyote           | 0                   | 0                     | 16                    | 8                       |
| Crow             | 2                   | 0                     | 4                     | 8                       |
| Fox              | 0                   | 0                     | 0                     | 0                       |
| Unknown predator | 0                   | 1                     | 1                     | 6                       |
| Raven            | 0                   | 0                     | 1                     | 0                       |
| Overwash         | 1                   | 0                     | 7                     | 7                       |
| Abandoned        | 3                   | 1                     | 1                     | 4                       |
| Unknown          | 0                   | 0                     | 6                     | 1                       |
| Unviable         | 0                   | 0                     | 0                     | 0                       |
| Crushed          | 0                   | 0                     | 0                     | 0                       |
| Sanded Over      | 0                   | 0                     | 0                     | 0                       |

Hatch rate per completed nest was significantly higher among exclosed nests than unexclosed nests (91% vs. 23%). Exclosed nests accounted for a higher proportion of all fledglings this season than unexclosed nests (87% versus 13% respectively).

### ***Fledging Results***

Of 254 eggs that hatched from 88 breeding pairs, a total of 151 chicks fledged (fledge rate = 59%) resulting in an overall productivity rate of 1.72 chicks fledged/breeding pair (Table 1). Fledging dates in 2019 ranged from July 7<sup>th</sup> to August 30<sup>th</sup>. Active broods of unfledged chicks were present on CACO beaches from May 31<sup>st</sup> until August 31<sup>st</sup>, with the peak number of 58 broods occurring the third week in July (Figure 4). The average number of days, from hatch to fledge, was 34 in 2019 (35.3 days in the ND and 32 days in the SD). Out of the 73 nests that hatched successfully, fledge rates for re-nests were higher than fledge rates for first nest attempts, 65% and 53% respectively.

A total of 103 chicks were confirmed lost this season; 67 chicks in the North District and 36 chicks in the South Districts. Of the 103 chicks lost, 14 of the chicks were found dead. The causes of death for the 14 chicks found were attributed to: crushed by vehicle in closed area (1), crushed by pedestrian (1), dog (1), and unknown cause (11).

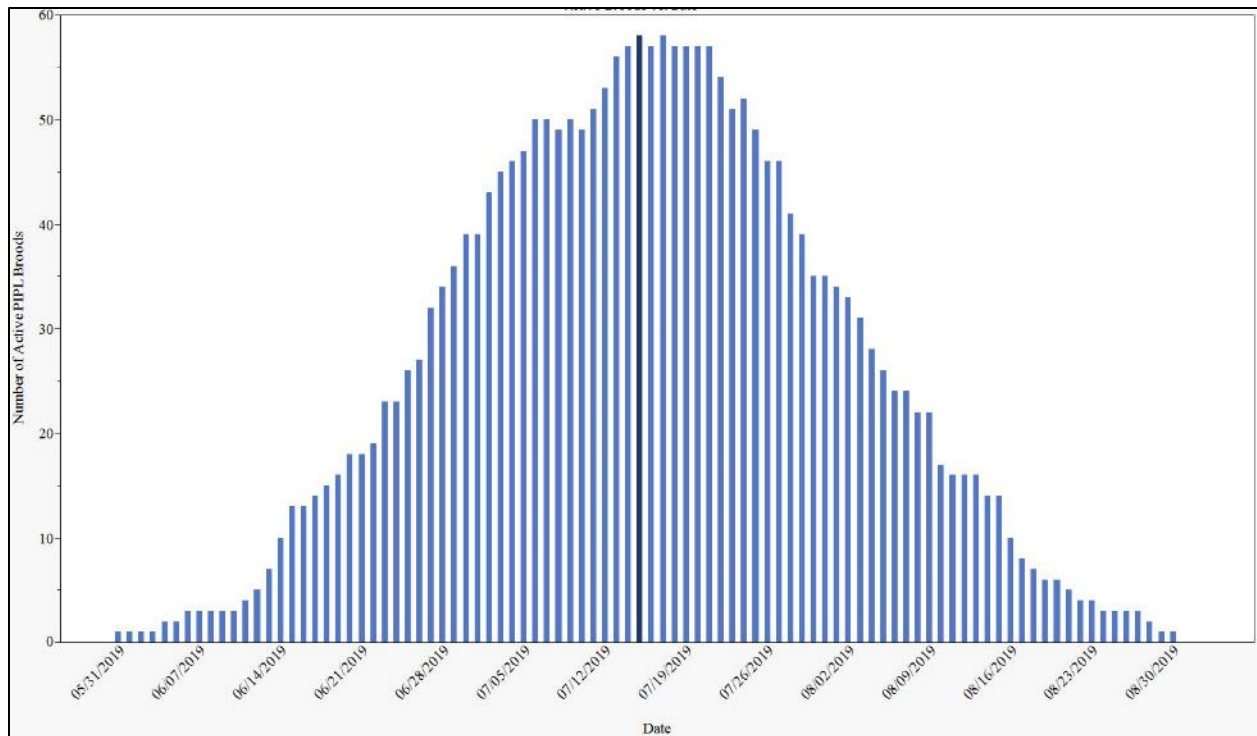


Figure 4. Number of active piping plover (*Charadrius melodus*) broods by date at CACO.

### Least Tern Nesting

In 2019 least terns returned to CACO beaches during the second and third weeks of May. The first least tern nests were found on May 29<sup>th</sup> at Head of the Meadow and Armstrong. Most were incubating eggs by early June. Re-nesting attempts continued throughout late August. The highest number of incubating adults was 171 with total breeding pair counts of 196 for the “A” count and 177 for the “B” count (Table 7). Colony sizes fluctuated throughout the season but most were relatively small with fewer than 50 pairs. Jeremy Point, Race Point North and Armstrong supported the largest colonies with high incubating counts of 40, 32, and 25 incubating adults, respectively (Table 7).

Chicks began hatching in late June (the first hatch was June 24<sup>th</sup> at Jeremy Point). The first least terns fledged July 20<sup>th</sup> at Armstrong and the last fledged during the first week in September at Race Point South (Exit 9 brood). The 171 pairs produced 39 chicks yielding a productivity of 0.23 chicks/pair from CACO beaches in 2019 (Table 7). Over the past thirteen years (2007 – 2019), the least tern population at CACO fluctuated between a high of 268 pairs in 2011 and a low of 52 pairs in 2016 (Table 8).

Table 7. Least tern (*Sternula antillarum*) breeding pair counts and fledging success, CACO, 2019.

| Site                        | A Count <sup>1</sup> | B Count <sup>2</sup> | Incubating Adult Count <sup>3</sup> | # Chicks Fledged |
|-----------------------------|----------------------|----------------------|-------------------------------------|------------------|
| Armstrong                   | 26                   | 35                   | 25                                  | 8                |
| Ballston                    | 0                    | 0                    | 0                                   | 0                |
| Bound Brook                 | 0                    | 0                    | 0                                   | 0                |
| Cahoon Hollow               | 0                    | 0                    | 0                                   | 0                |
| Coast Guard Beach (Eastham) | 15                   | 15                   | 15                                  | 9                |
| Coast Guard Beach (Truro)   | 0                    | 9                    | 9                                   | 1                |
| Duck Harbor                 | 0                    | 0                    | 0                                   | 0                |
| Exit 9                      | 0                    | 1                    | 1                                   | 1                |
| Great Island                | 0                    | 0                    | 0                                   | 0                |
| Head of the Meadow          | 23                   | 15                   | 15                                  | 3                |
| High Head                   | 0                    | 0                    | 0                                   | 0                |
| Jeremy Point                | 40                   | 4                    | 40                                  | 0                |
| Lecount Hollow              | 0                    | 0                    | 0                                   | 0                |
| Marconi Beach               | 0                    | 0                    | 0                                   | 0                |
| Marconi Station             | 28                   | 18                   | 13                                  | 1                |
| Nauset Light Beach          | 0                    | 0                    | 0                                   | 0                |
| Newcomb Hollow              | 0                    | 0                    | 0                                   | 0                |
| Race Point North            | 55                   | 53                   | 32                                  | 11               |
| Race Point                  | 6                    | 11                   | 11                                  | 1                |
| Race Point South            | 3                    | 16                   | 10                                  | 4                |
| White Crest Beach           | 0                    | 0                    | 0                                   | 0                |
| Wood End/Long Point         | 0                    | 0                    | 0                                   | 0                |
| <b>TOTAL</b>                | <b>196</b>           | <b>177</b>           | <b>171</b>                          | <b>39</b>        |

<sup>1</sup> "A-Counts" are taken within the state census window, on June 15-16

<sup>2</sup> "B-Counts" are taken outside the state census window; after June 20

<sup>3</sup> "Incubating Adult Counts" are highest counts of incubating adults observed at a particular site for the whole season

### American Oystercatcher Nesting

Observations of American oystercatchers have been low at CACO with between one and five pairs nesting in the park over the last 13 seasons (2007-2019) (Table 9). Nesting has been observed only in the South District at Jeremy Point in Wellfleet, Coast Guard Beach in Eastham, and New Island in Orleans. One American oystercatcher pair nested at CACO in 2019 at Jeremy Point. The first oystercatcher nest was found on May 13<sup>th</sup> with three eggs. This nest hatched between May 26<sup>th</sup> and May 28<sup>th</sup> with two chicks observed on May 28<sup>th</sup>. On May 29<sup>th</sup> no chicks were observed. Likely

depredation occurred for the remaining egg and chicks but was not confirmed. The pair initiated their second nest on June 9<sup>th</sup> and completed it by June 11<sup>th</sup> with two eggs. The nest was depredated by coyote on June 27<sup>th</sup>. Productivity for American oystercatchers was zero in 2019 (Table 9).

Table 8. Least Tern (*Sternula antillarum*) Productivity at CACO, 2007-2019.

| Year | # Nesting Pairs | # Chicks Fledged | Productivity | Primary Cause of Loss |
|------|-----------------|------------------|--------------|-----------------------|
| 2007 | 86              | 40*              | 0.45*        | overwash, canids      |
| 2008 | 89              | <136*            | >1*          | overwash, coyote      |
| 2009 | 236             | 25               | 0.11         | overwash, coyote      |
| 2010 | 226             | 26               | 0.12         | coyote                |
| 2011 | 268             | 99               | 0.37         | coyote                |
| 2012 | 257             | 66               | 0.26         | coyote                |
| 2013 | 138             | 2                | 0.01         | coyote                |
| 2014 | 77              | 7                | 0.09         | coyote                |
| 2015 | 122             | 19               | 0.16         | coyote                |
| 2016 | 52              | 39               | 0.75         | coyote                |
| 2017 | 142             | 69               | 0.49         | overwash, coyote      |
| 2018 | 140             | 41               | 0.29         | coyote                |
| 2019 | 171             | 39               | 0.23         | coyote                |

Table 9. American Oystercatcher (*Haematopus palliatus*) Productivity at CACO, 2007-2019.

| Year | # Nesting Pairs | # Chicks Fledged | Productivity | Primary Cause of Loss     |
|------|-----------------|------------------|--------------|---------------------------|
| 2007 | 5               | 3                | 0.60         | overwash, unk. predator   |
| 2008 | 5               | 5                | 1.00         | unk. predator, crow       |
| 2009 | 1               | 0                | 0.00         | unk. predator             |
| 2010 | 2               | 0                | 0.00         | coyote                    |
| 2011 | 2               | 0                | 0.00         | coyote                    |
| 2012 | 3               | 0                | 0.00         | coyote, gull              |
| 2013 | 3               | 0                | 0.00         | overwash, coyote, unknown |
| 2014 | 2               | 0                | 0.00         | coyote, unk. predator     |
| 2015 | 2               | 3                | 1.50         | coyote, unk. predator     |
| 2016 | 2               | 3                | 1.50         | coyote, unk. predator     |
| 2017 | 2               | 2                | 1.00         | overwash, coyote          |
| 2018 | 1               | 0                | 0.00         | coyote                    |
| 2019 | 1               | 0                | 0.00         | coyote                    |

## **Post-Breeding Shorebirds**

### ***General Results***

The following results are estimates because CACO staff does not systematically collect data on numbers of individual staging migrant species. Field staff monitor and report general locations of large flocks > 50, and report estimates of numbers and individual species.

Flocks of common and roseate terns were observed staging throughout the park from mid-July to early October in 2019. Mixed flock high counts for CACO sites include approximately: 600 at Race Point South, 500 at Race Point North, 1,000 at Hatches Harbor, 2000 at High Head, 2,500 at Armstrong, 2,000 at Head of the Meadow, 400 at Exit 9, 100 at Wood End/Long Point, 50 at Mission Bell, 300 at Coast Guard Truro, 1,000 at Jeremy Point, 50 at Newcomb Hollow and 2,000 at Coast Guard Eastham. Nurseries of Least terns were present on CACO beaches from mid-July to early September.

### ***Roseate Tern***

Researchers estimate that approximately 70% of the entire Northwest Atlantic breeding population of roseate terns and their fledglings use CACO beaches from mid-July through October for staging (Jeff Spendelow, USGS personal communication, 5 November 2018). During staging, roseate terns must build up fat reserves required for their long migration to South America (more than 7,000 km). Survival of young roseate terns depends on parental care, both on staging grounds after they have fledged, as well as throughout migration. Disturbance to staging areas can cause flocks to flush and young birds to be separated from their parents. Even if this displacement is only temporary, it forces both adults and young to expend valuable energy stores needed for their long migration.

The Northwest Atlantic roseate tern population has declined more than 20% since 2000, despite extensive management efforts at breeding colony sites. Studies confirm that most mortality of this species takes place away from breeding sites, during migration or on wintering grounds. However, little information is available about causes of death during these periods. Results from a 20-year study of adult survival, and a review of recent productivity data, strongly suggest that post-fledging survival during the first year of life could be a major factor limiting population recovery (Lebreton et al. (2003), Nisbet & Spendelow (1999), Spendelow et al. (2008, 2010), USFWS (2010), and Spendelow et al. 2014 unpublished data).

### ***Common Tern***

The common tern is listed by the Massachusetts Division of Fisheries and Wildlife (MDFW) as a Species of Special Concern. In Massachusetts, from 1985 to 2003, common tern numbers rose steadily in Massachusetts. Since then, however, the population has been stable at about 16,000-17,000 pairs. Since 1985, population size has ranged from 6,483 to a high of 18,059 pairs in 2017 (Mostello 2019).

No common terns nested at CACO in 2019. Many were observed in mixed flocks from July to October.

### **Red Knot**

The Rufa red knot (*Calidris canutus rufawas*) was listed as a threatened species under the Endangered Species Act in 2014, with critical habitat designations identified in 2015. CACO provides essential staging and foraging habitat for red knots, which can be found in the greatest numbers during fall migration (mid-July through October), using sandy ocean beaches and tidal mudflats to feed and rest. Historically, the greatest concentrations of red knots within CACO have been observed in Eastham at Coast Guard Beach and Nauset Marsh, along the ocean beach in Truro and Provincetown, and in Hatches Harbor. There was one flock of approximately 30 red knots observed on CACO beaches in 2019 at Coast Guard Eastham.

### **Piping Plovers and Least Terns**

CACO shorebird biologists not only monitor piping plover and least tern nesting areas, but also feeding, staging, roosting, and nursery areas. Groups of post-breeding piping plovers were observed in late summer, feeding and resting throughout the park; most notably at Armstrong Beach, where groups of up to 22 piping plovers were observed in late July through the end of October. Smaller groups of migrating piping plovers were observed including thirteen at Wood End breach on July 30<sup>th</sup>, seven at Coast Guard Truro on August 20<sup>th</sup> and eight on September 3<sup>th</sup>, five at High Head on August 20<sup>th</sup>, eleven at Race Point North on August 22<sup>nd</sup>, eleven at Exit 9 on August 25<sup>th</sup>, and 9 at Coast Guard Eastham on July 22<sup>nd</sup>. Least tern nurseries were observed starting in late July until mid-September at Coast Guard Truro (20-30 individuals), Race Point South (10-75 individuals), Race Point (50 individuals), Race Point North (30-100 individuals) Wood End/Long Point (20-25 individuals), Hatches Harbor (20-60 individuals), Race Point North (4-100 individuals), Coast Guard Eastham (20-50 individuals) and Jeremy Point (25-130 individuals). Symbolic fencing and/or interpretive signs were installed to protect least terns and piping plovers still using critical habitat later in the breeding season.

## Discussion

### Piping Plovers

The observed productivity rate of 1.72 chicks fledged per breeding pair was just above the species recovery target of 1.5 and is consistent with a multi-year pattern of annual fluctuations above and below the target (Table 2). The five-year average productivity in 2019 is just above the target rate at 1.54; this has not been reached since 2010 when the five-year productivity average was 1.52 (Figure 5).

Over the last 16 years, the top three factors causing nest failure have been predation, overwash, and abandonment (Table 3). Predation has consistently been the greatest cause of nest failure during that time frame, including in 2019 although it decreased from 2018 from 79% nests lost to 60% nests lost (Table 3). The reduced rate of predation may be due to the higher number of exclosures installed this year (70 in 2019 versus 58 in 2018). The fledge rate is on a slight decline from a peak in 2016-2017 (68-73%), possibly due to the higher number of pairs observed over the last two years (Table 2).

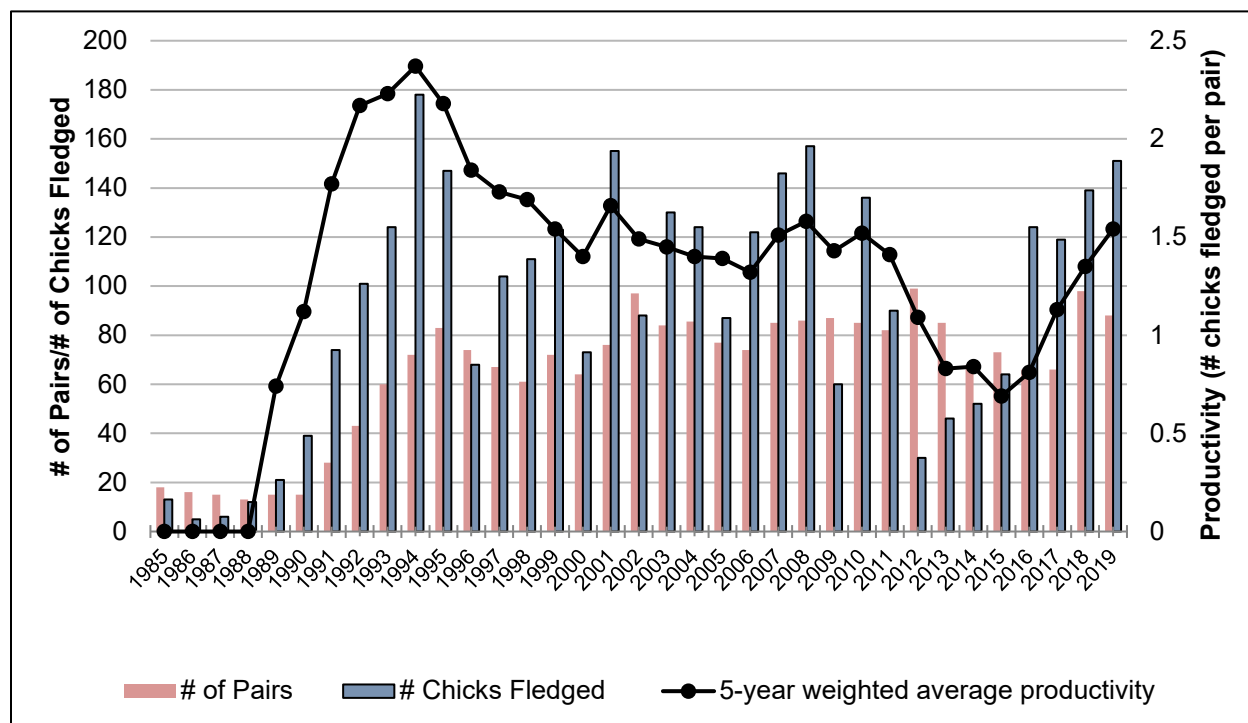


Figure 5. Number of piping plover (*Charadrius melodus*) pairs, chicks fledged, and overall productivity (chicks fledged/nesting pair) from 1985-2019 at CACO.

The use of predator exclosures around piping plover nests in 2019 resulted in reduced nest depredation. Although exclosure use has become a common tool for piping plover protection efforts, there is concern that the use of exclosures may make nest locations known to the public as well as increase the number of adult mortalities, abandonments, and depredations. Depredations of exclosed nests may be caused by predators learning to associate the exclosure structure with a food supply.

There were two instances of crows ripping the netting on top of exclosures and eating the eggs in the South District. There also was an instance of suspected chick loss around an exclosure by a raven. Coyotes dug around five exclosures in the North District at Wood End/Long Point. The coyotes were unable to get into the exclosure, however two of the nests were abandoned and the pairs left the area shortly after. The other three nests managed to hatch after the holes around the exclosures were filled in. Despite these issues, our results strongly indicate that exclosures substantially increase nest success and reduce predation but have little or no effect on abandonment, or on adult mortality.

This season staff observed a number of dead, sick, or injured piping plover chicks throughout the park. Through mid-July, eleven piping plover chicks were found recently dead in both districts. One chick was observed very lethargic and could barely move and died soon afterward in the field. It is unclear whether this “dieoff” of chicks was due to the heat or some other cause. The chicks that were found sick or recently dead and in good condition were sent to the USGS National Wildlife Health Center (NWHC) for necropsy. The results of the necropsy of five chicks showed: one with bacterial pneumonia, one undetermined, one unsuitable for necropsy, one with intestinal coccidiosis, and one with avian pox and emaciation.

Other injured piping plovers include a chick at Coast Guard Truro, a fledge at Exit 9 and a chick at Duck Harbor. The chick at Coast Guard Beach in Truro required intervention after staff observed it hopping on one foot for several days. The chick was caught and found to have hair tightly tied around its toes and foot, causing the loss of circulation (Figure 6). The hair was successfully removed and the chick survived to fledge at 41 days old. A piping plover fledge at Exit 9 was observed with what appeared to be a tumor on one of its wings. The fledged bird could still fly, however could not lift above a few inches off the ground (Figure 7). The fledged bird was successfully caught and transported to Wildcare for evaluation. Unfortunately, the bird died while waiting to be evaluated. The bird was sent to NWHC for necropsy and found that the fledged bird was emaciated and had a neoplasm caused by a severe case of avian pox. The injured chick at Duck Harbor was 15 days old, observed with a broken tarsus. It was still being tended by adults but mostly immobile, it was not observed again.



Figure 6. Image of piping plover chick with hair wrapped around toe decreasing circulation(NPS photo by Colleen Andrews).



Figure 7. Piping plover chick with growth (neoplasm) on its wing (NPS photo by Leila Al-daqa).

There were also instances of “stunted” chicks, or chicks that appeared very small for their age. One chick at Armstrong beach appeared 2 weeks old when it was last seen at 23 days old. Another chick at Race Point North also appeared about 2 weeks old, when it was last observed at 33 days old (Figure 8). The Race Point North chick was eventually located in the wrack line deceased several days later (cause of death unknown but appeared to have been raptor related). Both chicks were unable to fly when last observed, despite being close to or over the age of 25 days because of their size and development.

In 2019, CACO had the third highest number of breeding pairs observed in fifteen years of monitoring (Table 2, Figure 5). Further investigation is needed to determine factors influencing the number of pairs in a given season. This could be due to higher productivity during the last two seasons along the U.S. Atlantic Coast and at CACO. Recovery and viability of piping plover populations requires both an increase in abundance and a sustained level of annual productivity.



Figure 8. Race Point North “stunted” chick. Photo was taken on 8/13/19 when the chick was 31 days old (hatched on 7/13/2019). Chick has characteristics more closely aligned with 14-day old piping plover (NPS photo by Leila Al-daqa).

### **Least Terns**

The total number of breeding pairs of least terns observed in 2019 was slightly higher than 2018 (140). The five-year running average number of pairs for 2015-2019 was 125. The number of fledged chicks had been trending upward from a low of 2 fledges in 2013 to a high of 69 fledges in 2017

(Figure 9). Since 2017 however, there has been a decreasing trend with number of fledges from 69 in 2017 to 39 in 2019. In 2019 least terns nested at 10 different sites at CACO but 72% (28 out of 39) of chicks fledged at just three locations; Race Point North (11), Coast Guard Eastham (9) and Armstrong (8). Least terns are relatively long-lived, meaning the effect of poor productivity on population status is delayed. Thus, annual reproductive success is just as critical an indicator of least tern's population stability as annual numbers of individuals counted (Thompson et. al 1997).

The number of breeding pairs seems to be on the rise since 2016, however the number of chicks fledged remains low with productivity over the past five years averaging 0.38 chicks fledged/breeding pair. Low numbers of breeding pairs may be due to low productivity in recent years, intense predation on eggs and chicks, and the fragmentation of colonies due to human disturbance at prime nesting areas. With the seemingly increasing numbers of predators (Eastern coyote and two species of crow) in the area, more robust protective measures may be required in the future. In addition, the narrowing of beaches and increased frequency of late spring/summer storms limits the available habitat and makes nesting areas more vulnerable to wash-overs.

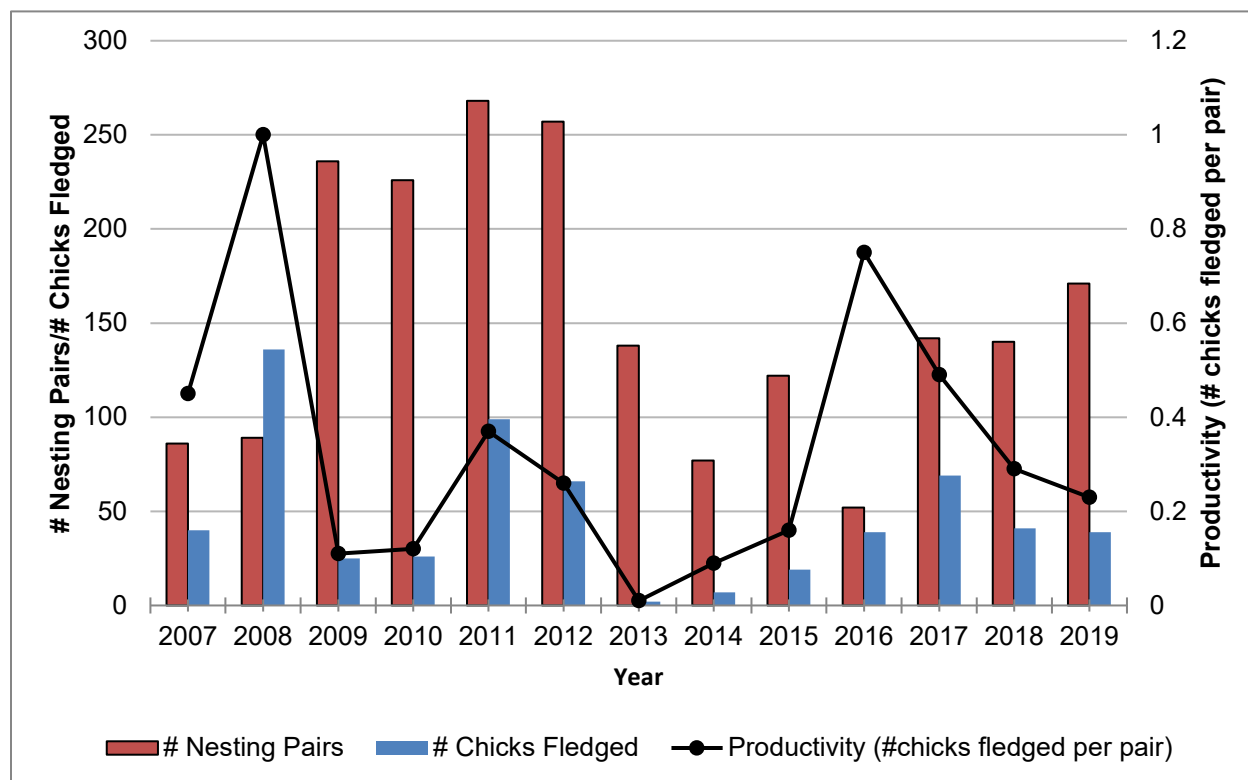


Figure 9. Least tern (*Sternula antillarum*) breeding pairs, chicks fledged and productivity (chicks fledged/nesting pair), by year from 2003-2019 at CACO.

This season several large predation events occurred which limited least tern productivity. In late-June, the colony at Jeremy Point was reduced from approximately 40 pairs to nine and Marconi Station was reduced from approximately 17 pairs to four. In mid-July, the Wood End/Long Point colony was reduced from approximately 100 individuals and 24 incubating adults to 20 individuals

and 2 incubating adults in one week. A similar occurrence was observed at Race Point North within the same time frame, reducing a colony of approximately 39 pairs to six pairs. All instances were due to coyote predation. Field observations of physical tracks, scat, and individuals of Eastern coyote within the least tern colonies at CACO suggest the coyotes visited colonies almost daily and preyed on nests or chicks. Eastern coyotes may develop search patterns that are highly effective in locating ground nesting bird nests in open habitat.

Determining the cause of chick mortality is more difficult than attributing causes of nest loss. Chicks move, are difficult to track, and can hide and go unobserved for days, but it is likely that the same species (mainly Eastern coyotes) that are preying on eggs are also preying on chicks. The high frequency of visitation to colonies by predators combined with daily human disturbances adds stress to nesting least terns and may be responsible for late re-nesting efforts into August, movement onto sub-standard nesting habitat, and fragmentation of colonies.

The colonial defensive strategy used by adult terns as a means of protecting eggs and chicks is called ‘mobbing’. Adult terns react as a group to any perceived threat that comes close to the colony and use mobbing and defecating on intruders to deter potential predators from the area. Colony sizes at CACO have decreased perhaps to the point where there are insufficient numbers of adults to mob and successfully deter predators away from a nesting area. Colony fragmentation may also occur when pedestrian access paths are made through the tern’s preferred nesting habitat, possibly dividing the colony up into smaller, less effective groups to deter predators.

### **American Oystercatcher**

American oystercatchers were first recorded nesting on CACO beaches in 2002. Since then, 1-5 pairs have nested in the South District each year. Between 2007 – 2019, productivity fluctuated between zero and 1.5 chicks fledged/breeding pair (Table 9, Figure 10). Eastern coyote predation has been the main cause of nest loss and the likely cause of chick loss when nests have hatched. American oystercatchers are a long-lived species that benefits from high annual adult survival and variable annual productivity. The latter could be considered a benefit because modeling results have shown that as variability in productivity decreases, the probability of population decline increases (Davis 1999).

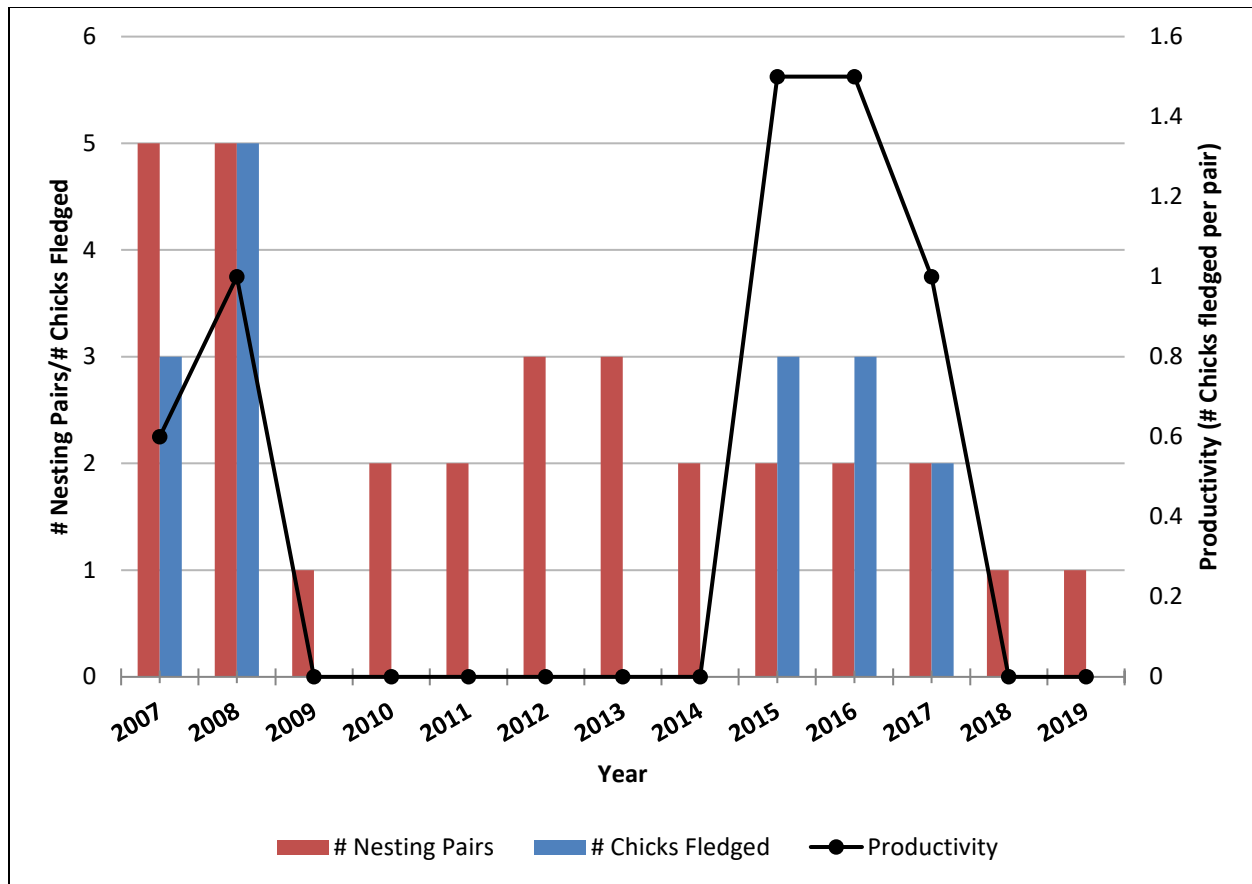


Figure 10. American Oystercatcher (*Haematopus palliatus*) breeding pairs, chicks fledged, and productivity, by year from 2007-2019 at CACO.

Threats to American oystercatchers during the breeding and non-breeding seasons include direct habitat loss, recreational disturbance, increases in predators, potential contamination of food resources, and alteration of habitat through beach stabilization. Unfortunately, the relative impact of each threat on oystercatcher population is poorly understood (Schulte et al. 2007).

At CACO, boat recreation at Jeremy Point is a major source of disturbance to incubating oystercatchers. In addition, while dogs are prohibited seasonally on Jeremy Point, shorebird monitors observe dogs (often unleashed) brought in by boaters. Unleashed dogs pose a serious threat to unfledged oystercatcher chicks, which are larger and lack the cryptic coloration of other ground-nesting shorebird species, making them more noticeable to predators and domestic dogs.

### Human Disturbance and Violations

Park staff do their best to manage beach habitat to reduce impacts on shorebirds but it is impossible to prevent violations. Human disturbance and violation observations are recorded during the season. Documented cases included pedestrians inside the symbolic fencing, removal of symbolic fencing and/or vandalized fencing at Coast Guard Truro, Armstrong, and Race Point. People were observed hanging items on the symbolic fencing (towels, trash, etc.), throwing items into the fencing, flying kites above or into fencing, and chasing birds.

Vehicles were observed backing into and/or knocking over fencing as well as noncompliance with drive-thru areas (i.e. vehicles parking in “no-stopping” area, driving >5 mph, driving below the berm and getting stuck, and having dogs in a no pets area). While dogs off leash appear to be declining from previous years, dogs in ‘No Pets’ areas were consistently observed on an almost a daily basis in both districts. It is hard to say definitively whether any of these violations led to nest abandonment or reduced productivity but instances like these do affect behavior which can impact nest success.

## **Education and Outreach**

Educating the public about impacts threatening nesting and staging shorebirds is important for garnering local support for management and protection efforts, thereby facilitating shorebird recovery. Along with day to day impromptu field interactions with visitors by shorebird staff, over 1,550 visitor contacts were made by shorebird technicians and interns in the field during regular monitoring duties.

Five volunteers donated a total of 3,360 hours to CACO's shorebird management program in 2019. Volunteers assisted biological technicians and park staff with fencing and field observations from April through August.

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## Appendix A. Maps of 2019 Piping Plover, Least Tern, and American Oystercatcher Nest Sites at Cape Cod National

Figures A1 through A26 contain maps of nesting outcomes for three shorebird species.

### South District: Ballston Beach

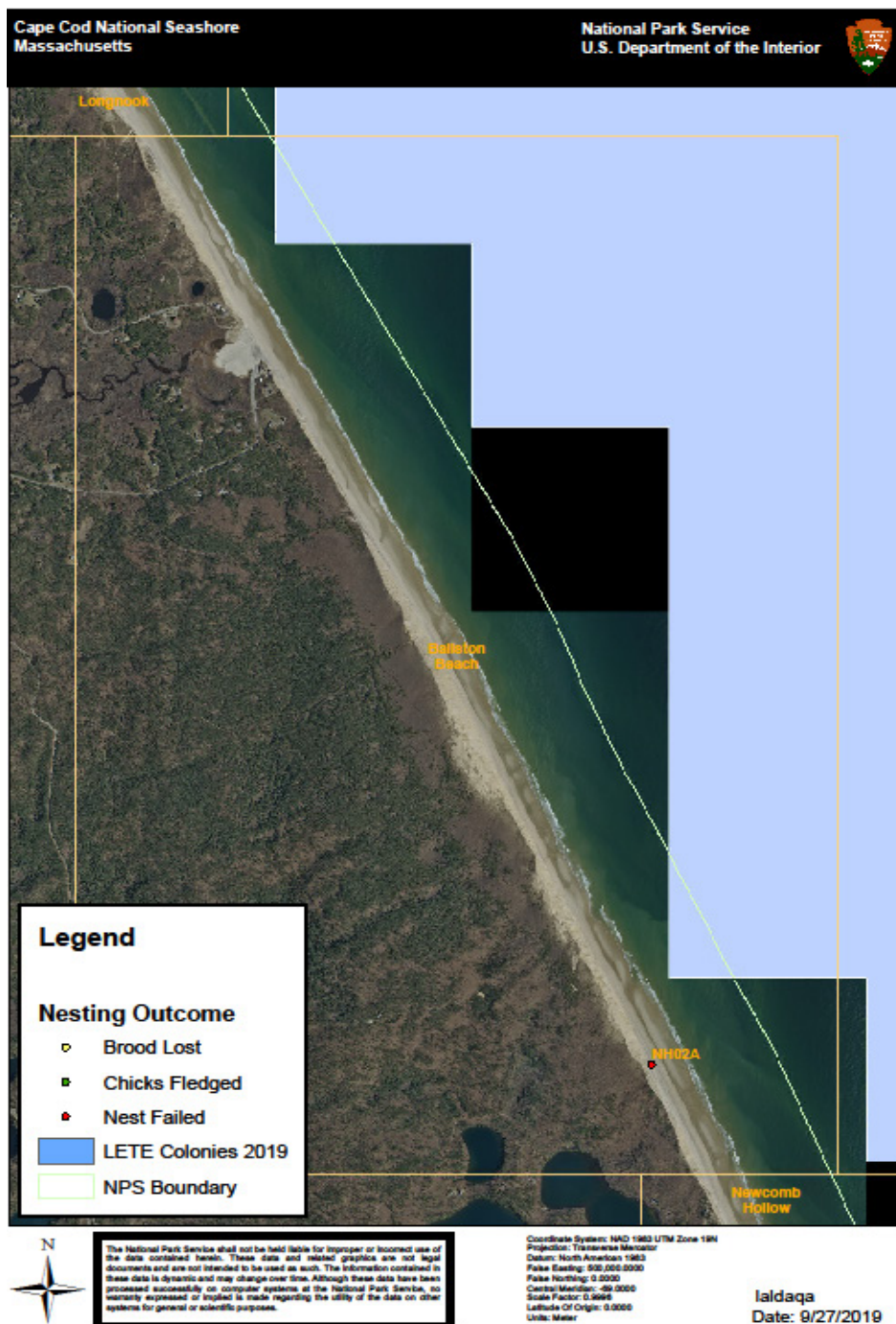


Figure A1. Map of nesting outcome at Balston Beach.

## South District: Bound Brook



Figure A2. Map of nesting outcome at Bound Brook.

## South District: Cahoon Hollow

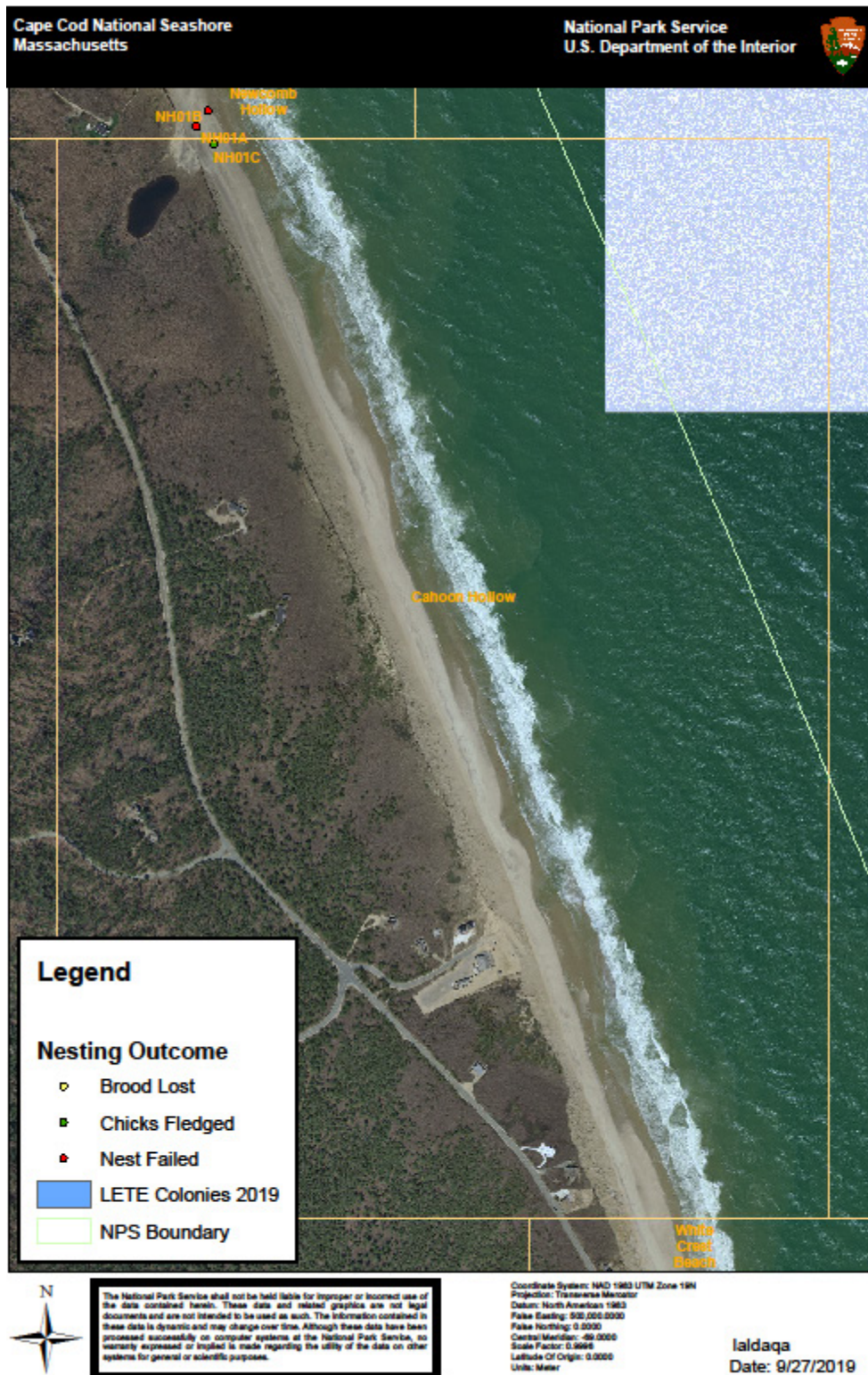


Figure A3. Map of nesting outcome at Cahoon Hollow.

## South District: Coast Guard Eastham



Figure A4. Map of nesting outcome at Coast Guard Eastham.

## South District: Duck Harbor



Figure A5. Map of nesting outcome at Duck Harbor.

## South District: Great Island



Figure A6. Map of nesting outcome at Great Island.

## South District: Jeremy Point



Figure A7. Map of nesting outcome at Jeremy Point.

## South District: LeCount Hollow



Figure A8. Map of nesting outcome at LeCount Hollow.

## South District: Marconi Beach



Figure A9. Map of nesting outcome at Marconi Beach.

## South District: Marconi Station

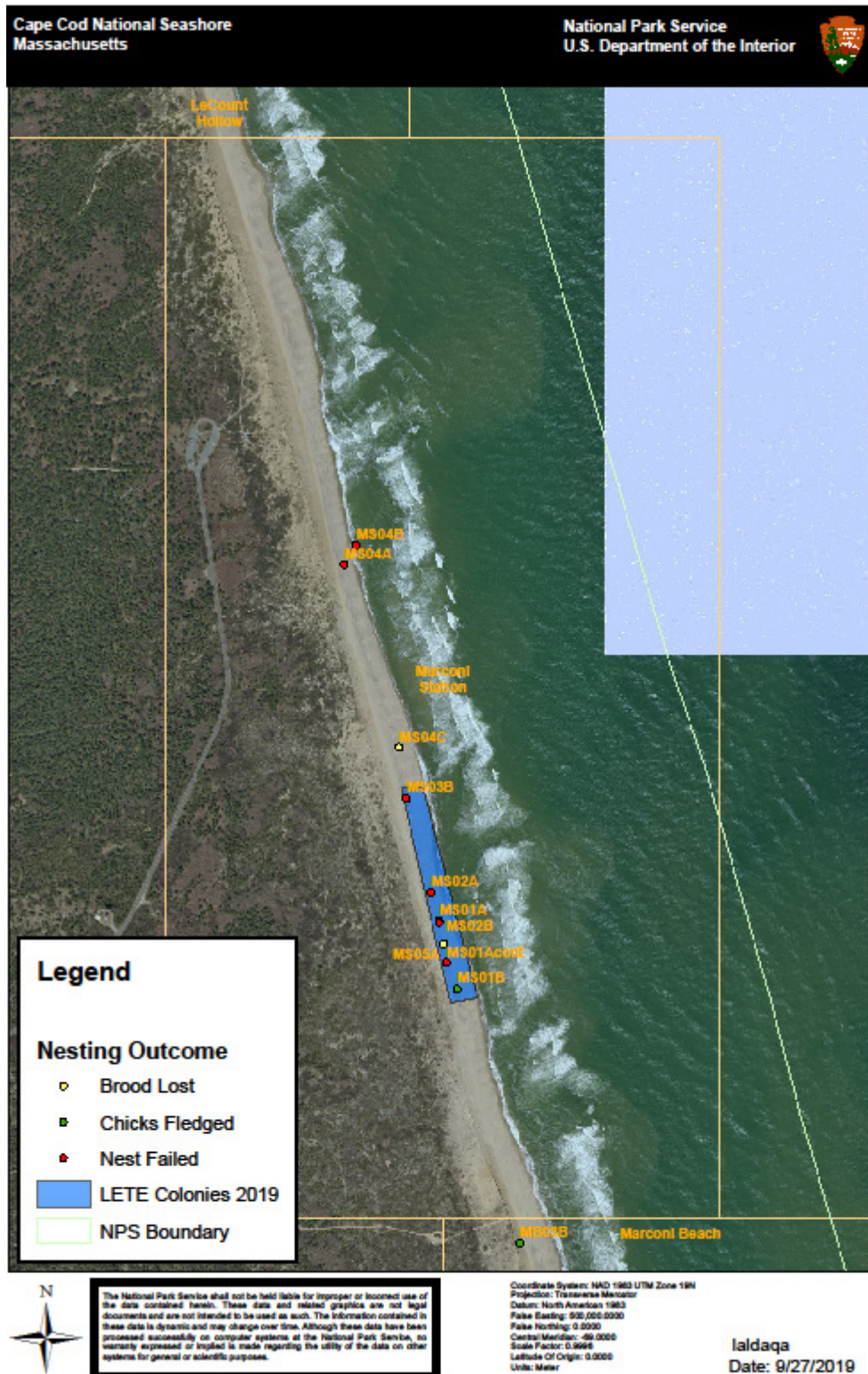


Figure A10. Map of nesting outcome at Marconi Station.

## South District: Nauset Light

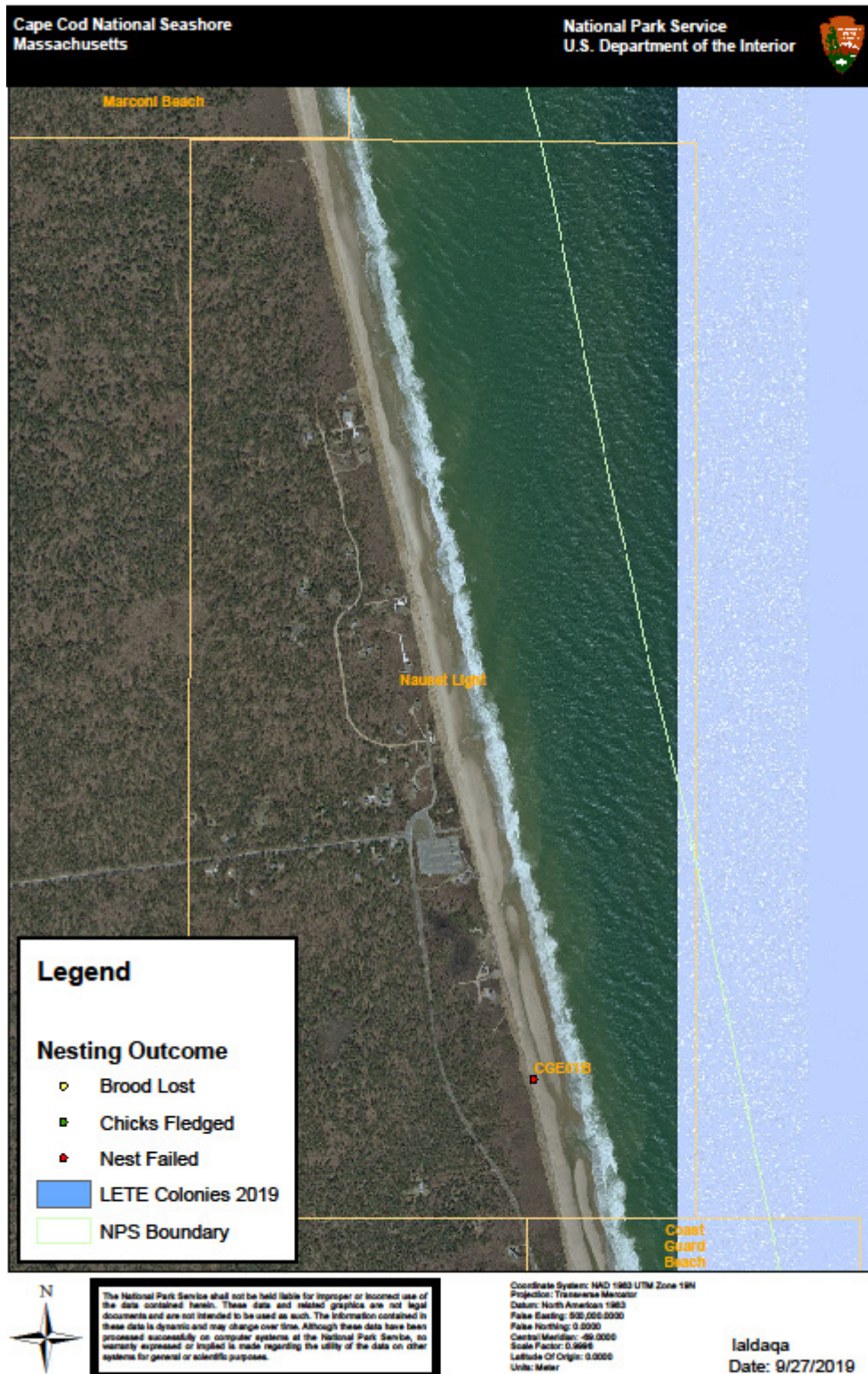


Figure A11. Map of nesting outcome at Nauset Light.

## South District: Newcomb Hollow

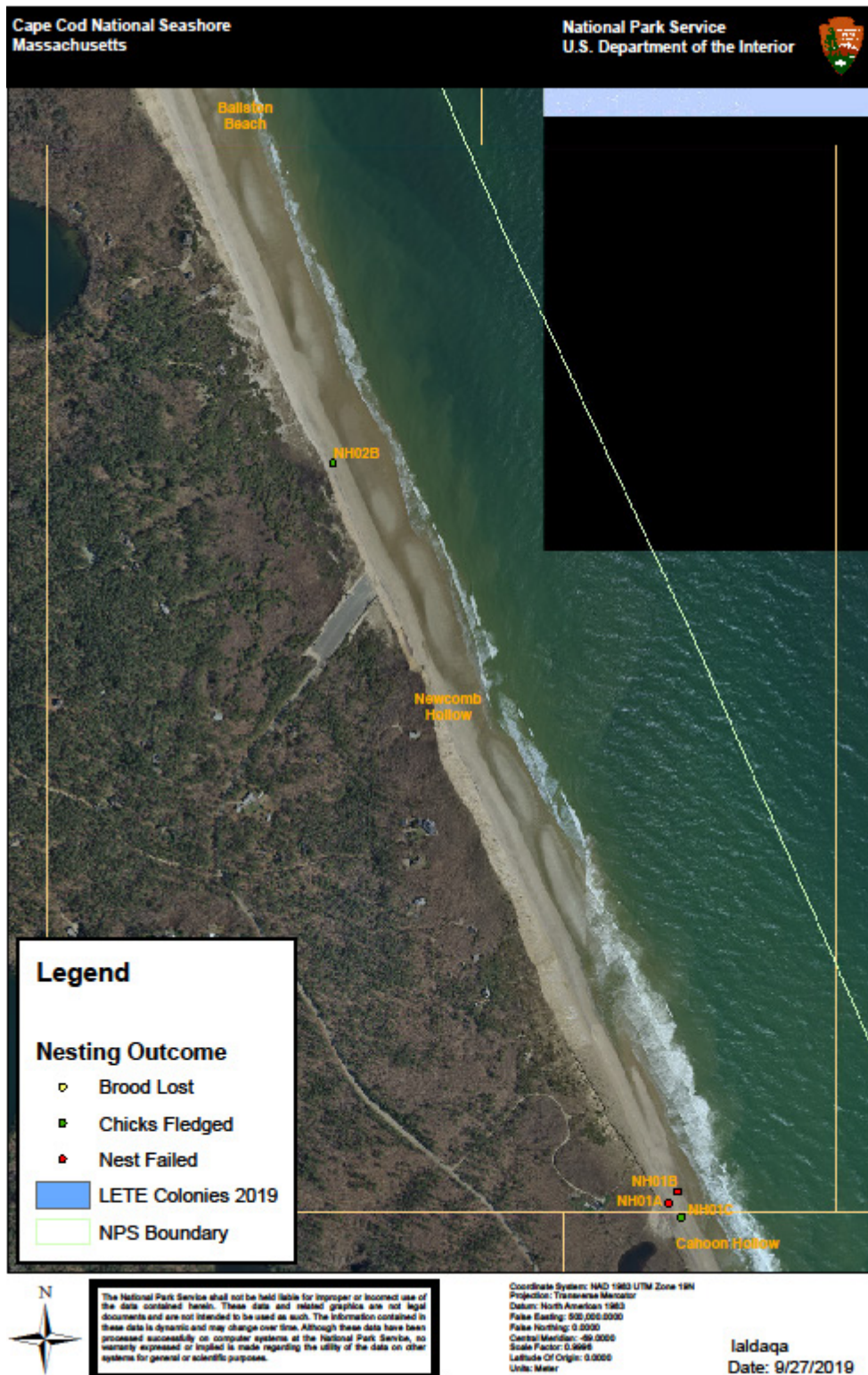


Figure A12. Map of nesting outcome at Newcomb Hollow.

## South District: White Crest



Figure A13. Map of nesting outcome at White Crest.

### North District: Armstrong

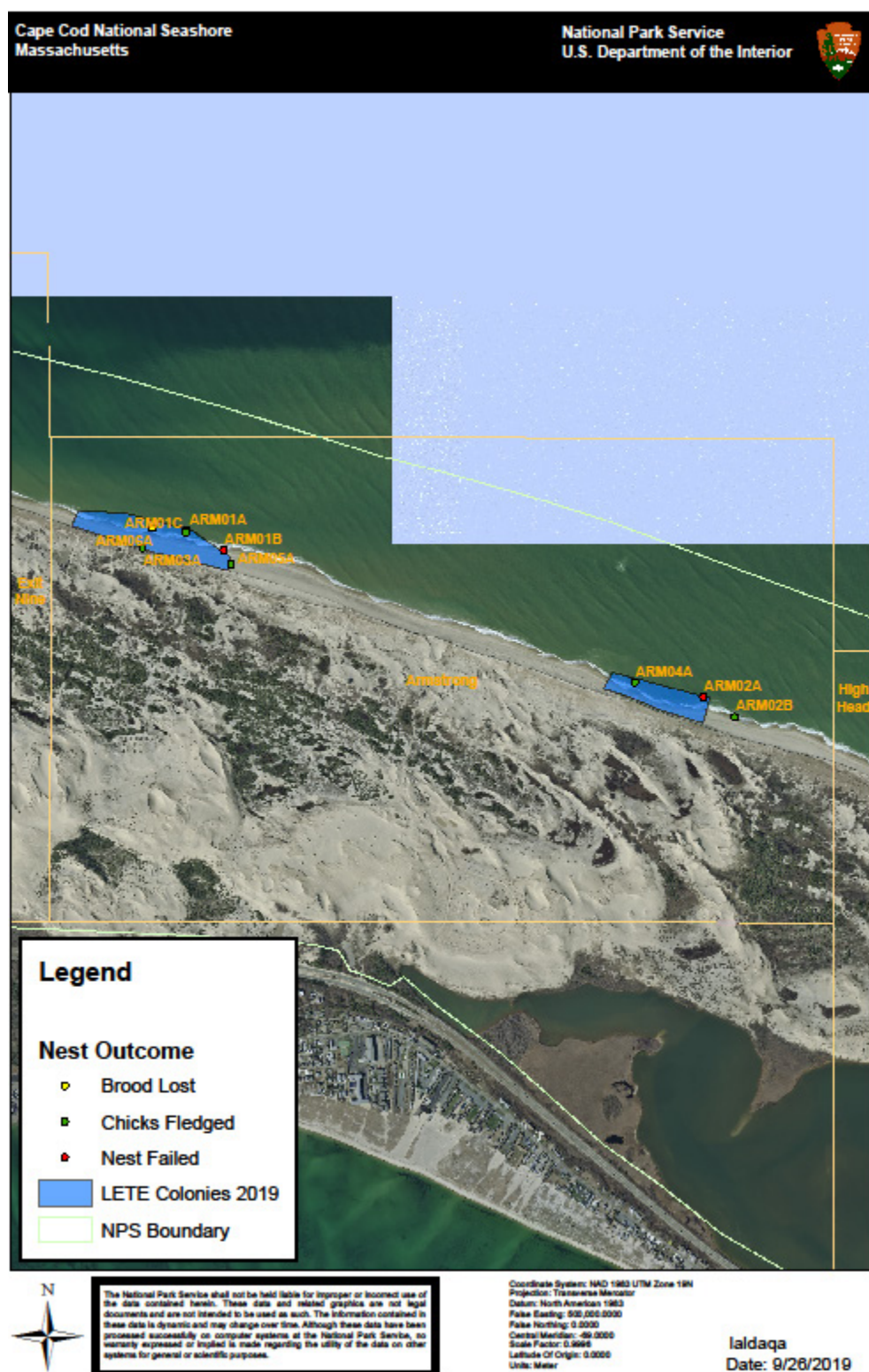


Figure A14. Map of nesting outcome at Armstrong.

## North District: Coast Guard Truro



Figure A15. Map of nesting outcome at Coast Guard Truro.

## North District: Exit 9

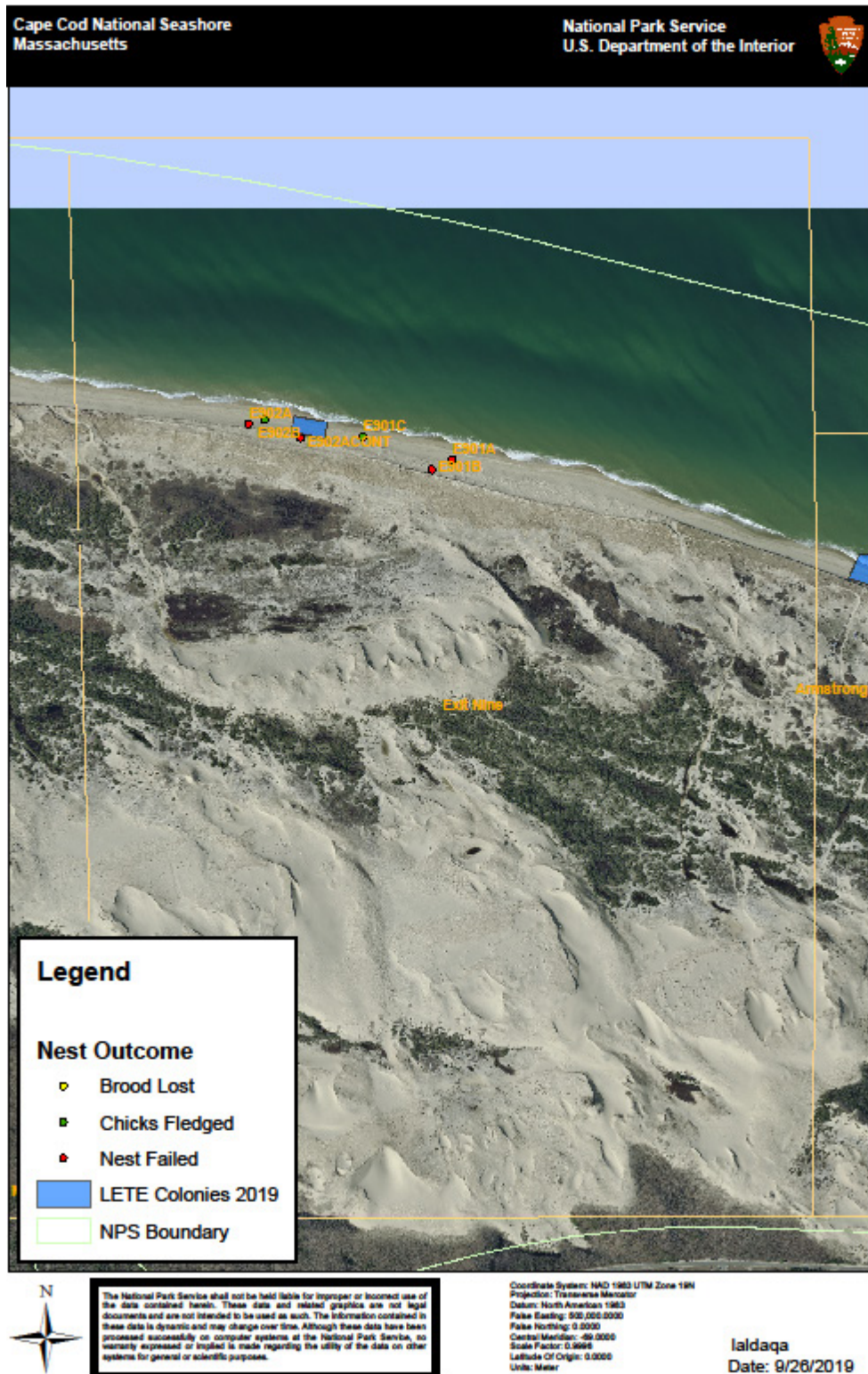


Figure A16. Map of nesting outcome at Exit 9.

## North District: Hatches Harbor



Figure A17. Map of nesting outcome at Hatches Harbor.

## North District: Herring Cove



Figure A18. Map of nesting outcome at Herring Cove.

## North District: Head of the Meadow

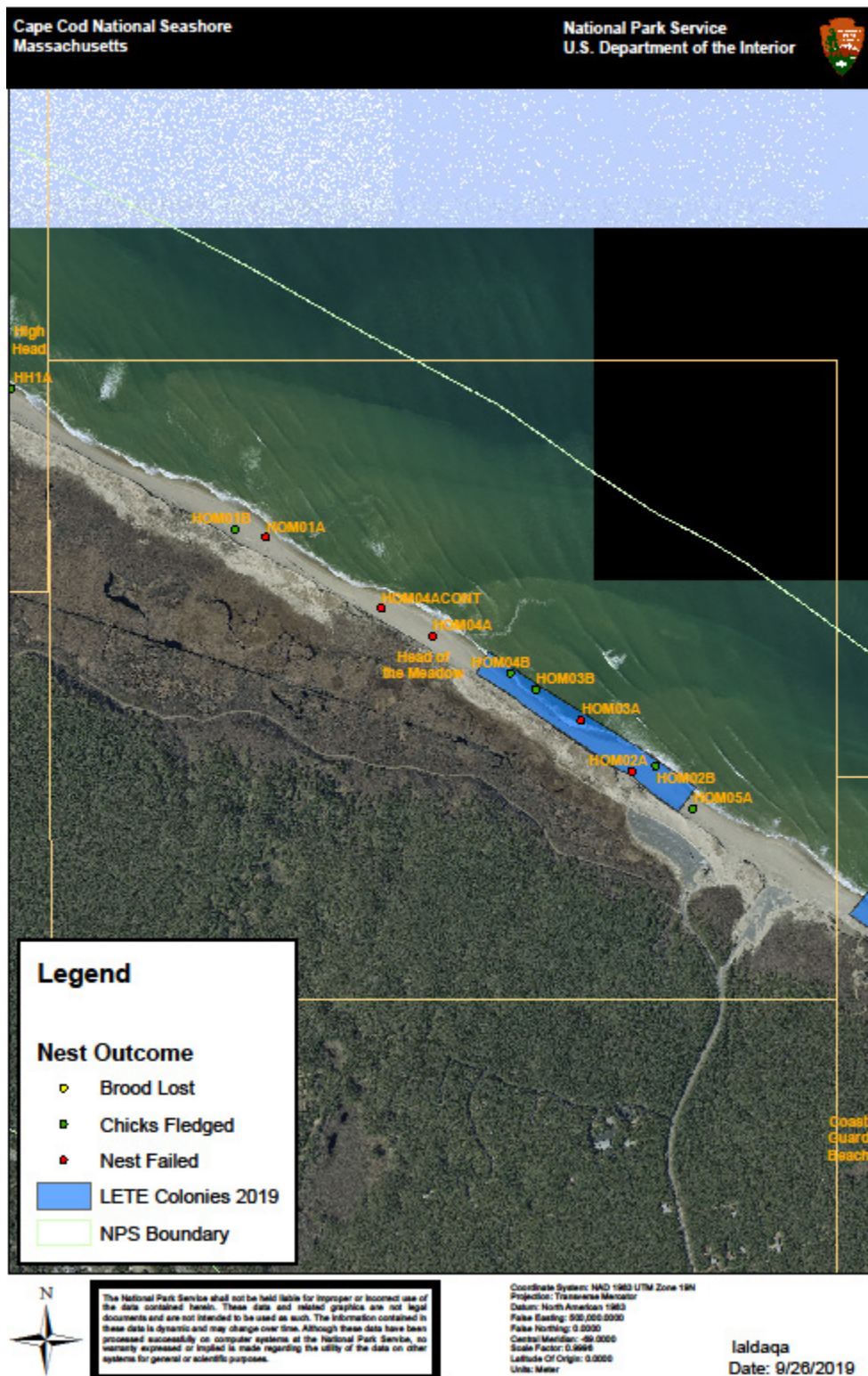


Figure A19. Map of nesting outcome at Head of the Meadow.

## North District: High Head

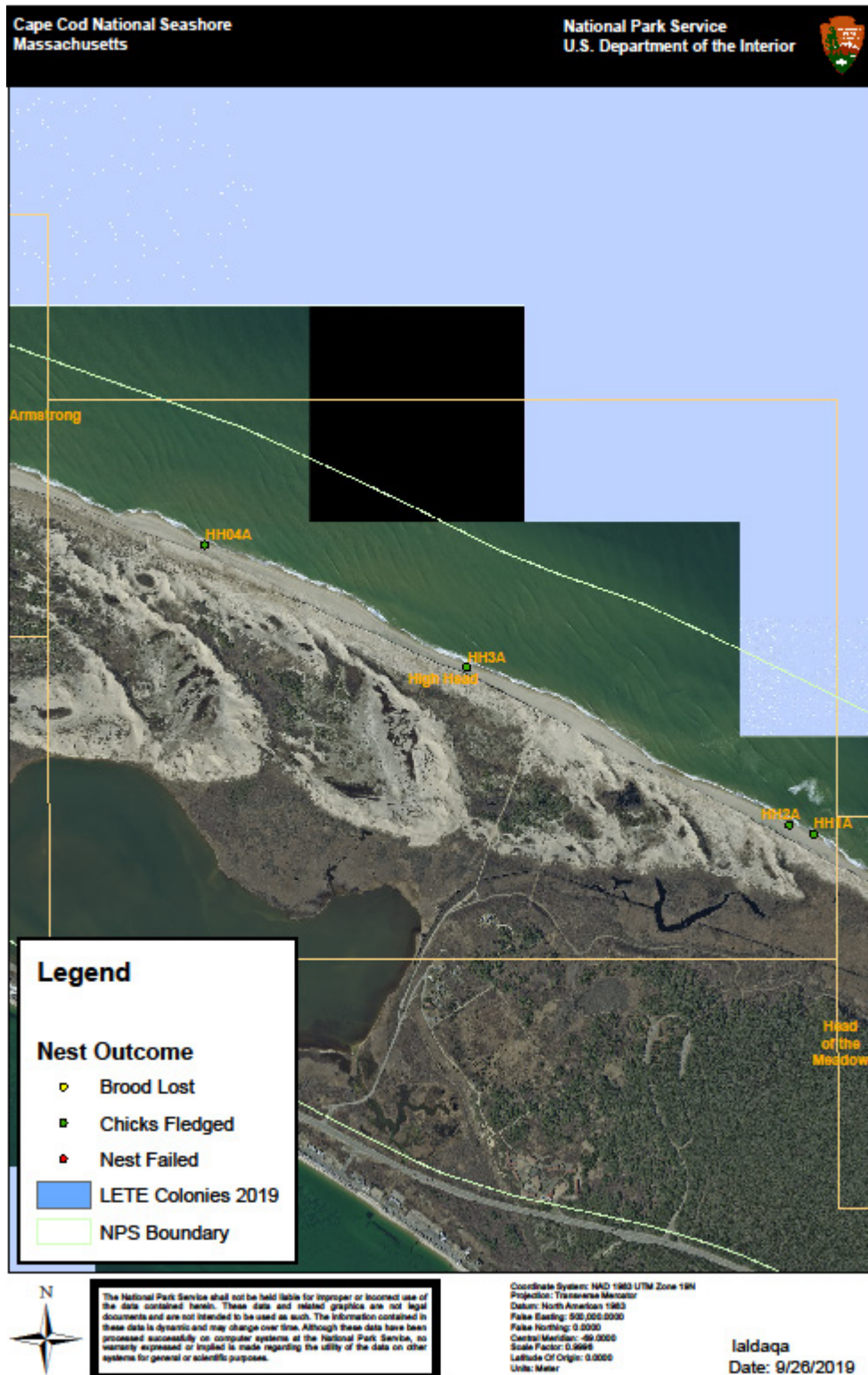


Figure A20. Map of nesting outcome at High Head.

### North District: Longnook



Figure A21. Map of nesting outcome at Longnook.

## North District: Mission Bell

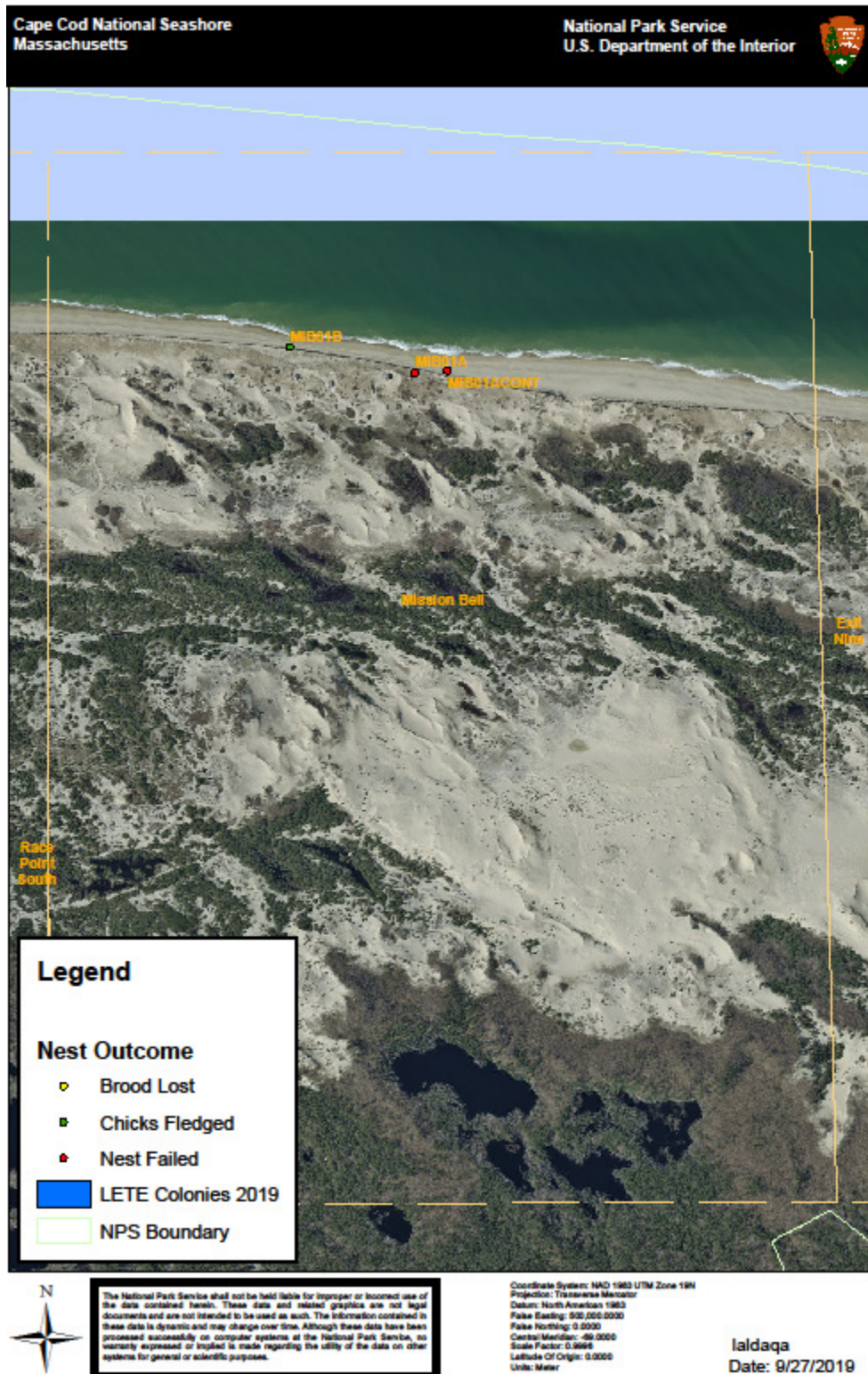


Figure A22. Map of nesting outcome at Mission Bell.

## North District: Race Point



Figure A23. Map of nesting outcome at Race Point.

## North District: Race Point North

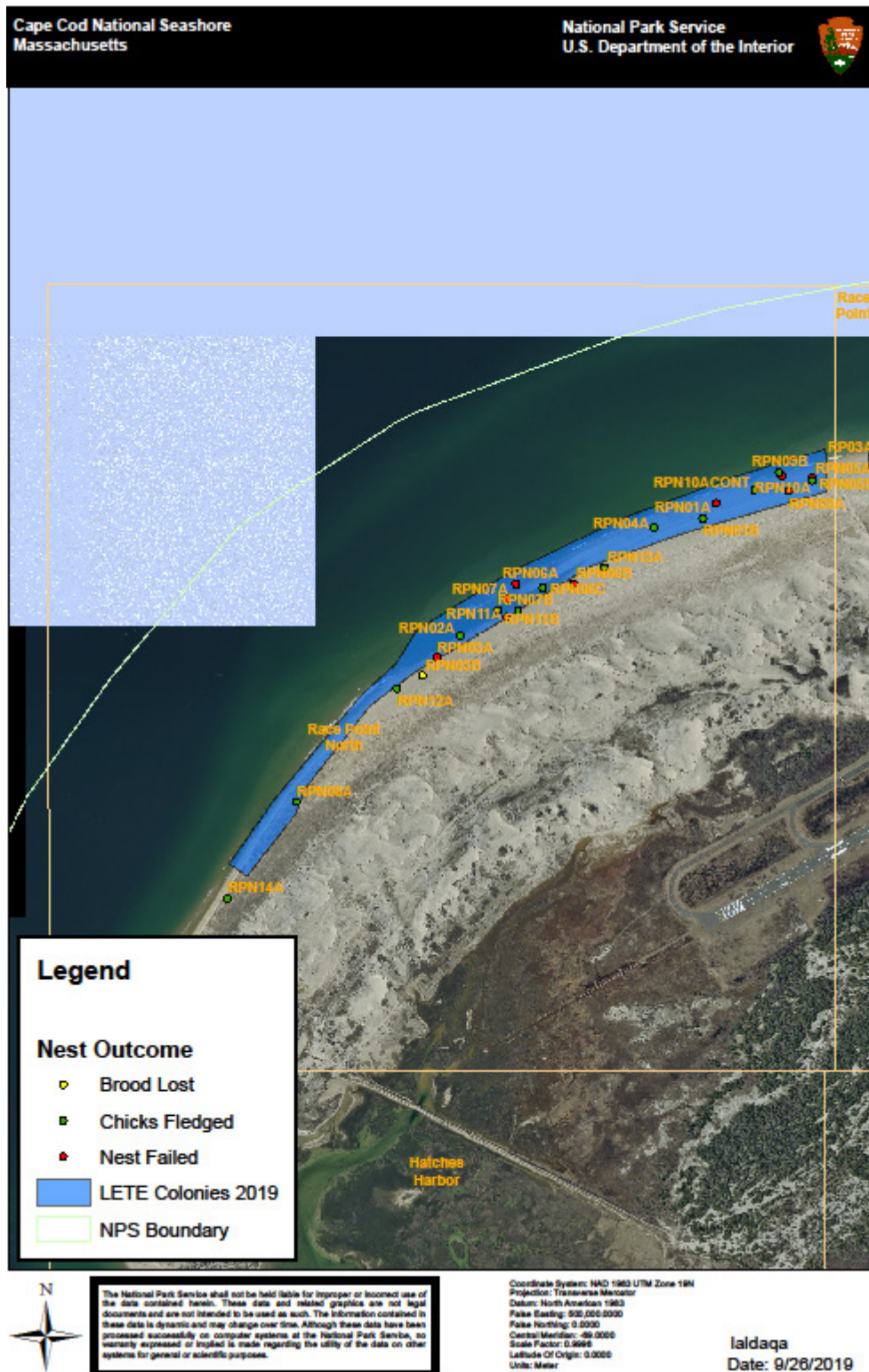


Figure A24. Map of nesting outcome at Race Point North.

## North District: Race Point South



Figure A25. Map of nesting outcome at Race Point South.

## North District: Wood End/ Long Point



Figure A26. Map of nesting outcome at Wood End/Long Point.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 609/177361, September 2021

National Park Service  
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