



Cape Cod National Seashore 2021 Shorebird Monitoring and Management Report

Natural Resource Data Series NPS/CACO/NRDS—2024/1403





ON THIS PAGE

Least tern adult feeding chick.

NPS / KEEGAN BURKE

ON THE COVER

Piping Plover chick.

NPS / KEEGAN BURKE

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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), as well as the 2021 Biological Opinion. This report summarizes monitoring results from the 2021 field season.

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

Piping plover

- 113 breeding pairs were observed (highest number of pairs to date) CACO had the highest number of breeding pairs observed in 18 years of monitoring (Table 2, Figure 5). Similar observations were reported across the Atlantic Coast breeding population (MassWildlife 2022). 145 chicks fledged; 68 pairs successfully fledged at least one chick.
- Park-wide average productivity = 1.28 chicks fledged/pair (lowest productivity since 2015); USFWS Northeastern piping plover population annual recovery target rate is 1.5 chicks fledged/pair.
- Depredation accounted for 46% of nest failures and environmental factors (overwash, sanding over) accounted for 39% of nest failures. This was the lowest % of nests lost to depredation since 2007, and the highest % of nests lost to environmental factors since 2007.
- Predominant nest predators were Eastern coyote and corvids (American crow and fish crow)
- Predator exclosures were installed around a total of 98 nests. Exclosures improved nest success from a hatch rate of 15% for unexclosed to 70% for exclosed nests. Exclosures reduced predation rates from 57% for unexclosed nests to 10% for exclosed nests.
- In 2021, CACO has the highest number of breeding pairs observed in 18 years of monitoring, 21 pairs more than in 202 (Table 2, Figure 5). This follows a similar trend observed among sites in the Atlantic Coast breeding population which saw overall an increase in almost 200 pairs from 794.5 pairs in 202 to 967 pairs in 2021 (MassWildlife 2022).
- Productivity and fledge rates at CACO were the lowest since 2015.

Least tern

- Least terns nested at a total of 13 sites from Eastham to Provincetown (divided into 17 colonies, multiple colonies at Wood End and Armstrong)
- 270 breeding pairs were observed (highest number of pairs since 2004)
- 24 chicks fledged (lowest number of chicks fledged since 2015)
- Average productivity = 0.09 chicks fledged/breeding pair (lowest productivity since 2014)
- Depredation (mainly by coyote), overwash, and human disturbance were the principal causes of egg loss.

- Cause of chick loss is difficult to determine, but depredation by coyote and human disturbance was often suspected.

American oystercatcher

- Two pairs were present at Jeremy Point, Wellfleet throughout the breeding season.
- One nest was laid by one pair, a nest attempt was never located for the other pair.
- Two chicks fledged, productivity = 1.00 chicks fledged/breeding pair

Staging, migrating terns and shorebirds

- Large mixed-species flocks of approximately 3500 individuals, consisting of federally endangered roseate terns (*Sterna dougallii*) and the state-listed species of concern common terns (*Sterna hirundo*), were observed throughout the park mid-July through September
- 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

The following observations are a minimum estimate based on the collection of data on some days, but not all, by shorebird staff in 2021:

- 108 pedestrian violations were documented, combination of individuals observed inside the symbolic fenced area and fresh pedestrian tracks from a recent violation.
- 500 dogs off leash were documented from April through mid-October (271 in the South District and 229 in the North District). Unleashed dogs were encountered most frequently at Newcomb Hollow (64), Herring Cove (63), Lecount Hollow (46), Marconi Beach (37), and Coast Guard Truro (35).
- 389 pet violations, pets in designated “No Pet” areas, were documented from April through mid-October. Most of the incidents were physically observed or secondarily by observations of fresh pet tracks in “No Pet” areas. Dogs in “No Pets” areas were encountered most frequently at Coast Guard Truro (50), Race Point (42), Longnook (37), and Newcomb Hollow (35).
- At least 5 instances of vehicles driving in closed areas at Race Point South, Race Point North, Mission Bell, and Head of the Meadow. In addition, over 9 instances of vehicles driving into the symbolic fencing and 1 instance of a vehicle getting stuck in front of an active nest (nest was lost the following day).

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List of Terms

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 on 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 including roseate terns, common terns, and red knots. 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 and pets 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. 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 terns and 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 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 (“Area Closed: 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 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). To inform decisions regarding daily operations that affect shorebird management and protection and that are not addressed by these three documents, CACO staff also consult the 2018 Shorebird Management Plan, and 2021 Biological Opinion (signed in July of 2021).

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 distinct areas. 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 2021 it was monitored and included in the town of Orleans data; the town reported no activity at New Island in 2021.

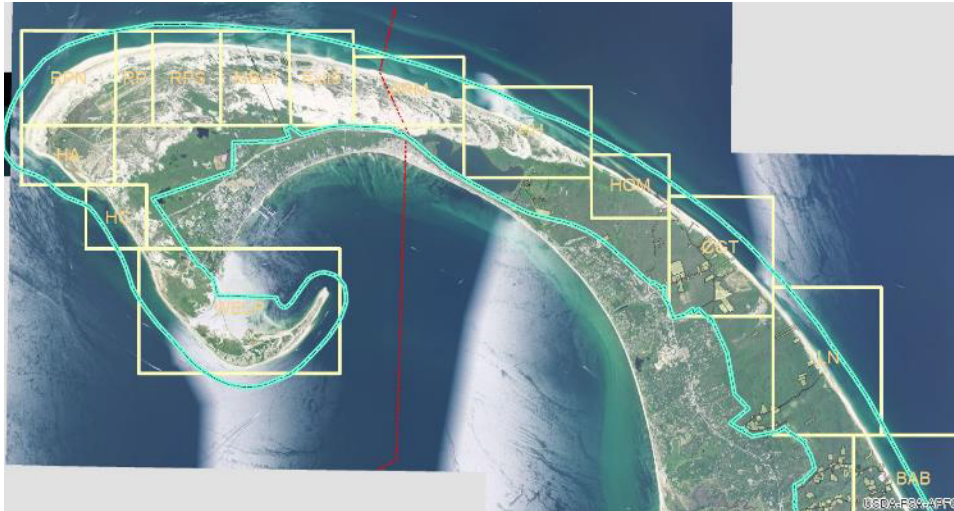


Figure 1. North District Survey Unit Map, Woodend/Long Point to Ballston.



Figure 2. South District Survey Unit Map, Ballston to Coast Guard Eastham.

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). 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 in areas of high visitation. Nests and broods in Off-Road Vehicle (ORV) corridors were monitored at least daily, and sometimes twice a day. Symbolic fencing was adjusted in response to breeding or staging behaviors. To minimize disturbance, observations were made through binoculars from a distance ranging from 5 to 30 meters.

Typically, almost all nests are located before clutch completion, and thus hatch windows could be predicted with high accuracy. In 2021, 19 nests were located after completion (9% of total nests laid) due to the large number of nesting pairs in the park. Comparatively in 2020, 29 nests were found after completion (19%) and two broods for which a nest was never found primarily due to low staffing levels due to COVID-19. Locating nests or broods after completion makes predicting hatch dates, fledge dates, and informing management decisions much more difficult.

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 under the Endangered Species Act.

Monitoring Methods

Monitoring methods include observations from afar and careful walkthroughs of the habitat to locate scrapes, nests, and chicks. Potential breeding pairs are monitored throughout the season. Once a nest is found, the nest is monitored every 1 to 5 days (depending on location) until hatch. Chicks are then monitored until fledged. Brood monitoring is critical for understanding the fate of plover chicks including tracking chick movement, identifying timing/causes of chick loss, and observing initial flights. Accordingly, shorebird technicians monitor the status of piping plover broods daily when staffing allows. 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 field days.

Nest 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, or unviable eggs). Chick loss was documented, when possible, but unknown for most. 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

CACO staff use predator exclosures as a protection tool for piping plover nests. These exclosures were designed to protect nests from predatory birds and mammals (crows, coyotes, foxes, etc.). They were made of welded metal wire with 2 inch wide and 4-inch-high openings, ranging from four to six

feet in height and ten feet in diameter, buried in the sand and stabilized with wood posts or rebar. The top of the enclosure is covered with bird netting, with holes no bigger than half an inch, secured to the metal wire. In a typical season, to minimize the risk of nest abandonment and adult mortality, enclosures are installed after nest completion, where vegetation does not hinder the bird's detection of approaching threats (e.g., predators), and where the risk of overwash by waves and sand is low (Darrah, 2017). In 2021, nests were enclosed once egg incubation was observed, regardless of whether the clutch was complete or not. This was a continued practice from 2020 to try and avoid nest predation before staff could return to the site. Adjustments to enclosures were made at several sites in 2021 in response to historical and observed predator behavior. For example, a thicker netting was used at Coast Guard, Eastham, Marconi Beach, Marconi Station, and Duck Harbor in response to crows getting into enclosures in 2020. Also, the height of some enclosures was increased in response to coyote and/or fox observations at sites such as Race Point North, Race Point, and Wood End. Initial enclosure usage was guided by the use of *Piperex*; a decision support tool for enclosure use; the frequency of enclosing was then adjusted throughout the season based on nest success in particular areas and the ability of staff to get to the site with sufficient people to install the enclosure.

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 protection of terns is required under the Massachusetts Endangered Species Act, as well as was agreed upon in the Negotiated Regulation (Cape Cod National Seashore 1996)) and 2006 EA for modification of ORV access. 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 to 1980s, the population of nesting least terns at CACO generally ranged from 200 to 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 when possible. 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 5th to 20th and "B-count" after June 20th). Similar to plovers, least terns are considered fledged when they are observed in sustained flight for at least 15 meters. In accordance with the Shorebird Management Plan, recreational restrictions are lifted when chicks are determined to be fledged or are considered lost after not being observed for five consecutive days. In most cases, the cause of chick loss is unknown.

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 CACO, 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, or 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 most 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 Beach (Eastham), Jeremy Point, and Hatches Harbor were closed to pets from April 1st to October 15th. 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 birds, 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 on the spit and 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 1st to October 15th. These management practices are guided by the 2018 Shorebird Management Plan, 2007 ORV Environmental Assessment/Finding of No Significant Impact, 2021

Biological Opinion 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 2021 included: Coast Guard Beach in Eastham, Jeremy Point, Race Point North, Mission Bell, Exit 9, Marconi Station, Head of the Meadow, Herring Cove, Coast Guard Truro, High Head, Armstrong, and Hatches Harbor.

Results

Piping Plover Nesting

The first piping plovers were observed at Coast Guard Beach (Eastham) on March 21st. They were present at most beaches by early April and continued to arrive until mid-June. Scraping was observed as early as the last week of March (March 26th at Coast Guard Eastham and March 30th at Race Point North). 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 nest was found on May 1st at Ballston Beach (initiation date of April 25th). Peak nesting occurred June 6th to June 12th, with a high of 94 nests at one time on June 7th (Figure 3). Nests with eggs were present from April 25th to July 25th. Hatching dates ranged from June 2nd to July 25th (Figure 4). The first nest to hatch was at Duck Harbor and the last nest to hatch was at Coast Guard Truro. Hatch dates in 2021 were earlier for first hatch and one week later for last hatch, making the 2021 nesting season longer than in 2020. This resulted in later successful hatching nests. The average incubation time for nests was 26 days, calculated from the date the first egg in the clutch hatched. All successful piping plover nests that were found hatched between 23 to 32 days in 2021. Most nests were located on the berm with no vegetation (within a 2-meter radius).

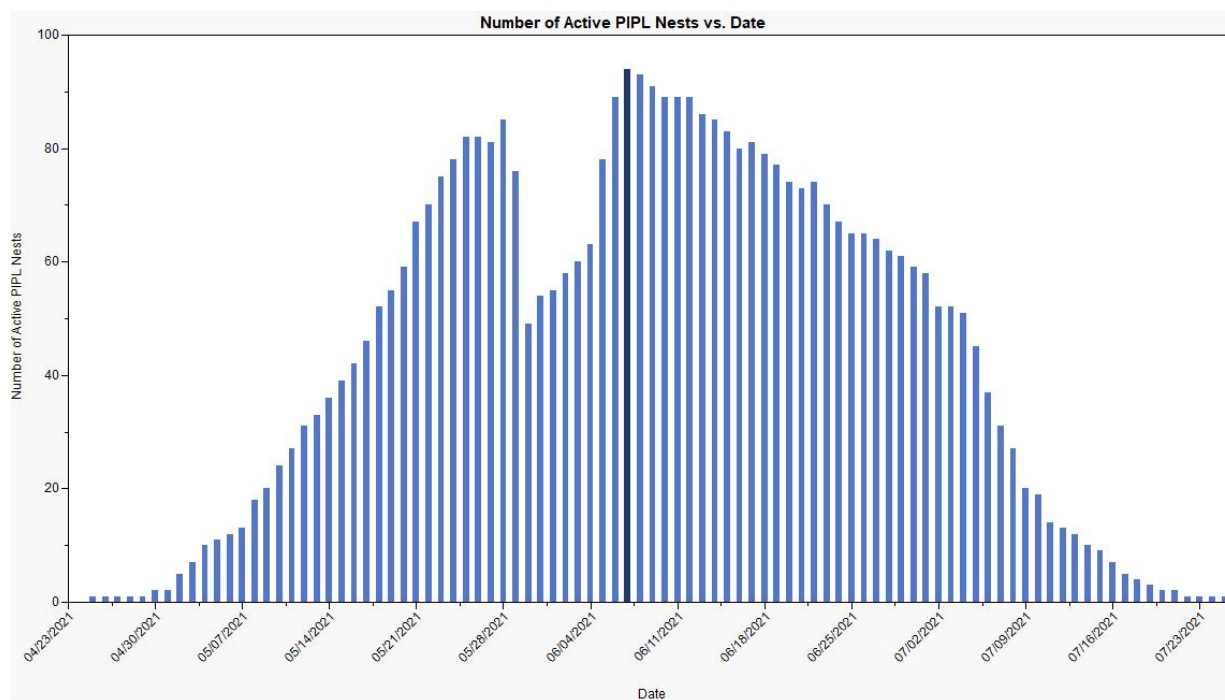


Figure 3. Total Number of Active Piping Plover nests by date in 2021.

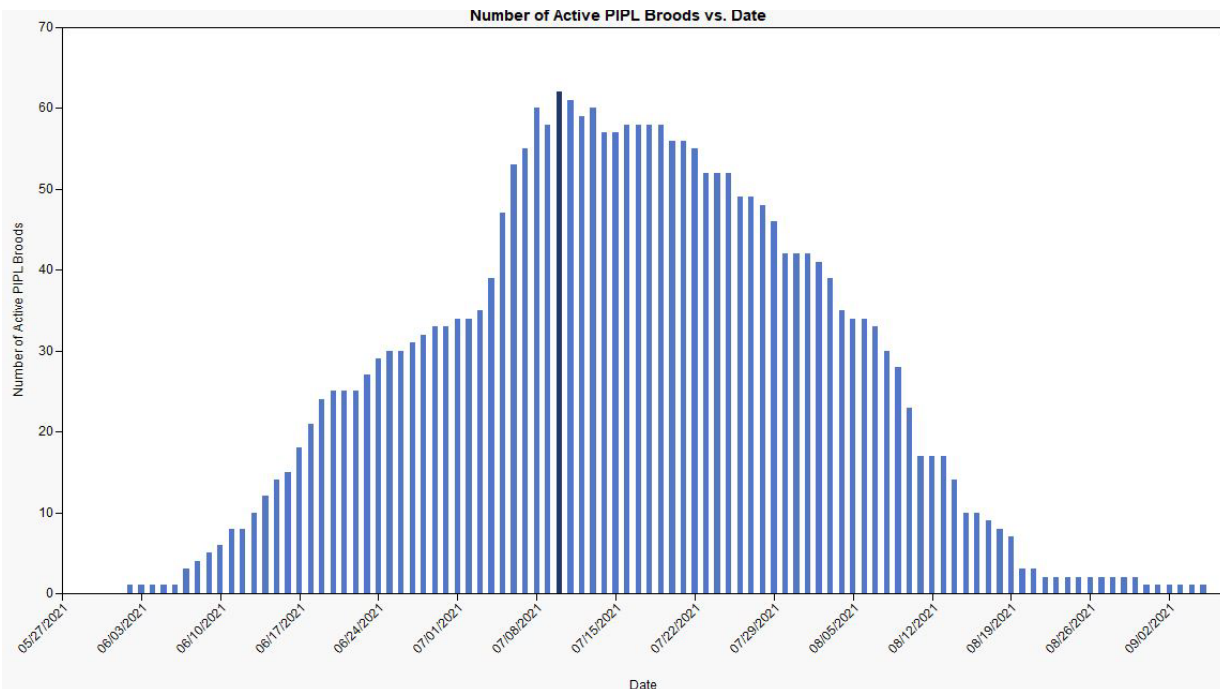


Figure 4. Number of active piping plover (*Charadrius melodus*) broods by date at CACO, 2021.

Nesting results are summarized in Table 1. A total of 113 breeding pairs laid 207 nests (equaling 647 total eggs), of which 122 nests (59%) were lost and 85 nests (41%) hatched. Of those that were lost, 58 nests (48%) were lost before complete (refer to glossary for nest complete definition). Re-nests accounted for 46% (95) of the total nests laid (Table 2). Renest success was higher for renests than first attempts (47% vs. 36%). Of the 113 breeding pairs, 68 pairs (60%) fledged at least one chick, and 45 pairs (40%) had zero productivity (17 pairs had complete brood losses and 28 pairs failed to hatch any eggs).

A total of 647 eggs were laid, of which 285 (44%) hatched (Table 1). Of the 362 failed eggs, predation was the most common cause for egg loss (40%). Most predation of eggs was by crow (60%) and Eastern coyote (24%), though other unknown predators contributed to egg loss (Table 4). Overwash was the next major cause of nest and egg loss (33%), followed by failure to hatch (8%), abandonment (7%), sanded over (7%), and unknown causes (5%). Of the eggs that failed to hatch, 17 were documented unviable and 11 were documented as unknown reason. All eggs documented as unviable were dissected after the nest was no longer active (adults no longer tending for minimum of five days) and revealed only partial development and yolk. 550 total eggs were laid in complete nests in 2021, as opposed to 384 in 2020 and 442 in 2019 (Table 3).

Table 1. Summary of piping plover (*Charadrius melodus*) nest success at CACO, 2021.

Site	Pairs	Nests	Eggs laid	Nests hatched	Eggs hatched	Chicks fledged	Hatch rate ¹	Fledge rate ²	Productivity ³
Ballston Beach	3	5	18	2	7	5	39%	71%	1.67
Bound Brook	1	1	4	1	3	3	75%	100%	3.00
Cahoon Hollow	1	1	4	0	0	0	0%	0%	0.00
Coast Guard (Eastham)	7	8	32	4	14	6	44%	43%	0.86
Duck Harbor	7	8	26	6	19	7	73%	37%	1.00
Great Island	7	15	41	4	13	12	32%	92%	1.71
Jeremy Point	6	8	27	4	13	6	48%	46%	1.00
Lecount Hollow	1	1	2	0	0	0	0%	0%	0.00
Marconi Beach	0	3	7	0	0	0	0%	0%	0.00
Marconi Station	5	13	39	3	10	4	26%	40%	0.80
Nauset Light	0	0	0	0	0	0	0%	0%	0.00
Newcomb Hollow	1	3	7	1	3	2	43%	67%	2.00
New Island	0	0	0	0	0	0	0%	0%	0.00
White Crest	0	0	0	0	0	0	0%	0%	0.00
South District Totals	39	66	207	25	82	45	40%	55%	1.15
Armstrong	9	18	60	8	30	12	50%	40%	1.33
Coast Guard (Truro)	10	18	51	5	17	10	33%	59%	1.00
Exit 9	2	5	15	2	7	3	47%	43%	1.50
Hatches Harbor	3	4	13	3	11	8	85%	73%	2.67
Herring Cove	2	3	12	1	4	2	33%	50%	1.00
Head of the Meadow	5	10	32	5	15	8	47%	53%	1.60
High Head	5	10	30	4	12	2	40%	17%	0.40

¹ Total number of eggs hatched /total number of eggs laid.

² Total number of chicks fledged/ total number of eggs hatched.

³ Total number of chicks fledged/ total number of nesting pairs.

Table 1 (continued). Summary of piping plover (*Charadrius melodus*) nest success at CACO,2021.

Site	Pairs	Nests	Eggs laid	Nests hatched	Eggs hatched	Chicks fledged	Hatch rate ¹	Fledge rate ²	Productivity ³
Longnook	1	5	15	1	2	2	13%	100%	2.00
Mission Bell	5	11	35	4	14	2	40%	14%	0.40
Race Point	4	5	14	3	6	4	43%	67%	1.00
Race Point North	15	28	84	12	40	21	48%	53%	1.40
Race Point South	2	6	15	2	7	2	47%	29%	1.00
Wood End/ Long Point	11	18	64	10	38	24	59%	63%	2.18
North District Totals	74	141	440	60	203	100	46%	49%	1.35
Grand Totals	113	207	647	85	285	145	44%	51%	1.28

¹ Total number of eggs hatched /total number of eggs laid.

² Total number of chicks fledged/ total number of eggs hatched.

³ Total number of chicks fledged/ total number of nesting pairs.

Table 2. Summary of piping plover (*Charadrius melodus*) nesting parameters by year from 2003 to 2021 at CACO.

Year	# Pairs	# Nests Laid	# Successful Nests (%) ¹	% Renests ²	# Eggs Laid	# Eggs Hatched (%) ³	# Chicks Fledged (%) ⁴	Productivity ⁵
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

¹ % = number of successful nests/total number of nests.

² % = number of renests (including continuation nests)/total number of nests.

³ % = number of eggs hatched/total number of eggs laid.

⁴ % = number of chicks fledged/number of eggs hatched.

⁵ % = number of chicks fledged/number of nesting pairs.

Table 2 (continued). Summary of piping plover (*Charadrius melodus*) nesting parameters by year from 2003 to 2021 at CACO.

Year	# Pairs	# Nests Laid	# Successful Nests (%) ¹	% Renests ²	# Eggs Laid	# Eggs Hatched (%) ³	# Chicks Fledged (%) ⁴	Productivity ⁵
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
2020	92	149	69 (46%)	39%	460	238 (52%)	171 (72%)	1.86
2021	113	207	85 (41%)	46%	647	285 (44%)	145 (51%)	1.28
mean	83	133	57 (45%)	35%	438	195 (46%)	110 (55%)	1.33
median	84	115	59 (46%)	35%	386	210 (49%)	124 (56%)	1.45
min	66	95	27 (13%)	20%	336	72 (11%)	30 (32%)	0.30
max	113	212	85 (73%)	53%	647	285 (69%)	171 (73%)	1.88

¹ % = number of successful nests/total number of nests.

² % = number of renests (including continuation nests)/total number of nests.

³ % = number of eggs hatched/total number of eggs laid.

⁴ % = number of chicks fledged/number of eggs hatched.

⁵ % = 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 to 2021 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 ¹ (%)	# Depredation (%)	Crows	Coyote	Gull	Skunk	Fox	Unknown Predator	Grackle	Raven	Unknown Avian
2003	67	13 (19%)	16 (24%)	0 (0%)	0 (0%)	5 (7%)	33 (49%)	15%	27%	12%	15%	0%	30%	0%	0%	0%
2004	56	15 (27%)	13 (23%)	0 (0%)	0 (0%)	0 (0%)	28 (50%)	43%	21%	11%	7%	0%	18%	0%	0%	0%
2005	70	33 (47%)	11 (16%)	1 (1%)	0 (0%)	4 (6%)	21 (30%)	24%	29%	10%	0%	0%	38%	0%	0%	0%
2006	26	8 (31%)	4 (15%)	0 (0%)	3 (12%)	0 (0%)	11 (42%)	82%	0%	0%	0%	0%	18%	0%	0%	0%
2007	47	24 (51%)	12 (26%)	0 (0%)	2 (4%)	0 (0%)	9 (19%)	44%	22%	0%	0%	0%	33%	0%	0%	0%
2008	39	8 (21%)	8 (21%)	1 (3%)	1 (3%)	0 (0%)	21 (54%)	43%	5%	5%	19%	0%	29%	0%	0%	0%
2009	54	16 (30%)	9 (17%)	1 (2%)	2 (4%)	1 (2%)	25 (46%)	68%	4%	4%	0%	0%	24%	0%	0%	0%
2010	47	3 (6%)	2 (4%)	1 (2%)	3 (6%)	0 (0%)	38 (81%)	74%	5%	0%	0%	0%	21%	0%	0%	0%
2011	49	8 (16%)	9 (18%)	1 (2%)	2 (4%)	0 (0%)	29 (59%)	83%	10%	0%	0%	0%	7%	0%	0%	0%
2012	185	55 (30%)	9 (5%)	0 (0%)	13 (7%)	5 (3%)	103 (56%)	34%	40%	0%	0%	5%	21%	0%	0%	0%
2013	143	28 (20%)	7 (5%)	0 (0%)	2 (1%)	2 (1%)	103 (72%)	23%	30%	0%	0%	5%	40%	1%	0%	0%
2014	83	16 (19%)	5 (6%)	0 (0%)	4 (5%)	0 (0%)	58 (70%)	33%	16%	0%	0%	10%	41%	0%	0%	0%
2015	72	17 (24%)	8 (11%)	1 (1%)	0 (0%)	1 (1%)	45 (63%)	33%	33%	0%	0%	9%	25%	0%	0%	0%
2016	47	7 (15%)	4 (9%)	1 (2%)	2 (4%)	1 (2%)	32 (68%)	38%	25%	0%	0%	3%	28%	0%	0%	0%
2017	61	17 (28%)	6 (10%)	2 (3%)	6 (10%)	0 (0%)	30 (49%)	63%	13%	0%	0%	0%	23%	0%	0%	0%
2018	114	9 (8%)	3 (3%)	3 (3%)	8 (7%)	1 (1%)	90 (79%)	62%	23%	0%	0%	2%	11%	1%	0%	0%
2019	78	15 (19%)	9 (12%)	0 (0%)	7 (9%)	0 (0%)	47 (60%)	30%	51%	0%	0%	0%	17%	0%	2%	0%
2020	80	9 (11%)	11 (14%)	0 (0%)	11 (14%)	0 (0%)	49 (61%)	45%	35%	4%	0%	0%	16%	0%	0%	0%
2021	122	48 (39%)	11 (9%)	0 (0%)	7 (6%)	0 (0%)	56 (46%)	66%	20%	0%	0%	0%	13%	0%	0%	2%
Tot.	1440	349	157	12	73	20	828	48%	22%	2%	2%	2%	24%	0.1%	0.1%	0.1%

¹ "Other" in 2016, nest sanded over during high wind; "Other" in 2018, nest crushed by gull.

Table 4. Summary of piping plover (*Charadrius melodus*) egg loss, and cause of egg loss from 2016 to 2021 at CACO.

Year	Number of eggs lost by cause (Percentage of total lost)							Percent depredated by species (Percentage of total predated)								
	# Eggs lost	Overwash/ Sanding Over	Abandonment	Unviable	Unknown	Other ¹	Predation	Crows	Coyote	Gull	Skunk	Fox	Unknown Predator	Grackle	Raven	Unknown Avian Predator
2016	175	25 (14%)	12 (7%)	10 (6%)	13 (7%)	0 (0%)	115 (66%)	45 (39%)	29 (25%)	0 (0%)	0 (0%)	4 (3%)	37 (32%)	0 (0%)	0 (0%)	0 (0%)
2017	211	56 (24%)	12 (5%)	31 (13%)	14 (6%)	0 (0%)	98 (42%)	62 (63%)	12 (12%)	0 (0%)	0 (0%)	0 (0%)	24 (24%)	0 (0%)	0 (0%)	0 (0%)
2018	352	22 (6%)	10 (3%)	34 (10%)	23 (7%)	4 (1%)	259 (74%)	161 (62%)	65 (25%)	0 (0%)	0 (0%)	7 (3%)	22 (8%)	4 (2%)	0 (0%)	0 (0%)
2019	253	47 (19%)	22 (9%)	22 (9%)	26 (10%)	0 (0%)	136 (54%)	36 (26%)	86 (63%)	0 (0%)	0 (0%)	0 (0%)	10 (7%)	0 (0%)	4 (3%)	0 (0%)
2020	222	25 (11%)	29 (13%)	9 (4%)	17 (8%)	16 (9%)	126 (57%)	54 (43%)	48 (38%)	7 (6%)	0 (0%)	0 (0%)	17 (13%)	0 (0%)	0 (0%)	0 (0%)
2021	362	146 (40%)	25 (7%)	17 (5%)	19 (5%)	11 (3%)	144 (40%)	86 (60%)	35 (24%)	0 (0%)	0 (0%)	0 (0%)	19 (13%)	0 (0%)	0 (0%)	4 (3%)

¹ “Other” in 2016, nest sanded over during high winds; “Other” in 2018, nest crushed by gull; “Other” in 2020 and 2021, eggs failed to hatch but were not able to check for viability.

Banded Plovers

No banded plovers nested at CACO in 2021 or 2020. In comparison, four banded birds nested at CACO in 2019 and two in 2018, one of which had nested at CACO for several seasons in a row from 2015 to 2019.

Exclosure Results

There were 149 nests that reached completion (refer to glossary for nest complete definition). Predator exclosures were installed around 94 of these complete nests; the remaining 55 were unexclosed (Table 5). The percentage of nests exclosed was roughly the same between districts; North District had 48% exclosed and the South District 47% exclosed in 2021. Exclosures significantly increased the rate of nest hatching success (70% vs 15%) and decreased the rate of predation (57% vs. 10%). Only 29 (30%) exclosed nests were lost with the highest cause for loss being overwash (41%) followed by sanded over (24%), and abandonment (21%) (Table 6). This was slightly higher percentage lost than in 2020 and almost double the percent lost in 2019. Hatch rate per completed nest was significantly higher among exclosed nests than unexclosed nests (73% vs. 29%). Exclosed nests accounted for a higher proportion of all fledglings this season than unexclosed nests (77% vs. 23%), However, the fledge rate for complete nests was higher for unexclosed nests than exclosed (59% vs 49%).

Table 5. Piping plover (*Charadrius melodus*) exclosure nest loss results, CACO, 2021.

Predator Management Type	Total Number of Nests	Total Number of Nests Lost
Nests Exclosed (Complete)	94	25
Nests Exclosed (Incomplete)	4	4
Nests Unexclosed (Complete)	55	39
Nests Unexclosed (Incomplete)	54	54

Table 6. Cause of piping plover (*Charadrius melodus*) nest loss, CACO, 2021.

Cause of failure	Exclosed (Complete)	Exclosed (Incomplete)	Unexclosed (Complete)	Unexclosed (Incomplete)
Depredated	3	0	24	29
Coyote	0	0	8	3
Crow	0	0	14	23
Fox	0	0	0	0
Unknown	3	0	1	3
Gull	0	0	0	0
Unknown Avian	0	0	1	0
Overwash	11	1	12	16
Abandoned	4	2	0	5
Unknown	1	0	3	3
Unviable	0	0	0	0

Table 6 (continued). Cause of piping plover (*Charadrius melodus*) nest loss, CACO, 2021.

Cause of failure	Exclosed (Complete)	Exclosed (Incomplete)	Unexclosed (Complete)	Unexclosed (Incomplete)
Crushed	0	0	0	0
Sanded Over	6	1	0	1

Fledging Results

Of 285 eggs that hatched from 113 breeding pairs, a total of 145 chicks fledged (fledge rate = 51%) resulting in an overall productivity rate of 1.28 chicks fledged/breeding pair (Table 1). Active broods of unfledged chicks were present on CACO beaches from June 2nd until September 5th. The peak number of broods occurred from July 8th to July 13th, with a high of 62 broods on July 10th (Figure 4). Fledging dates in 2021 ranged from July 6th to September 5th. Beaches with the highest fledging success rates were Bound Brook and Great Island for the South District and Longnook and Hatches Harbor for the North District. Beaches with the lowest fledging success rates (where nests hatched) were Duck Harbor and Marconi Station for the South District, High Head and Mission Bell for the North District. Out of the 85 nests that hatched successfully, fledge rates for re-nests were similar to fledge rates for first nest attempts, 48% and 54% respectively.

The average age to fledge in 2021 was 34.6 days. The North District averaged 35 days, and the South District averaged 32 days. Beaches which had the highest average fledge ages per district were Head of the Meadow (39.5 days) and High Head (39 days) for the North District and Great Island (32.8 days) for the South District. Sites which had the lowest average fledge ages per district were Exit 9 (29.3) for the North District and Newcomb Hollow (27) for the South District. Chicks typically fledge between 30 and 35 days from CACO beaches, although it is not uncommon for there to be a number of chicks fledging outside of this age window.

A total of 140 chicks were confirmed lost this season: 103 chicks in the North District and 37 chicks in the South District. Of the 140 chicks lost, all were lost to unknown causes. Chick survival in 2021 was more than double what was lost in 2020 (67 total lost). The North District alone had the same number of chicks lost in 2021 as the entire park in 2019. Beaches with highest numbers of chicks lost were Race Point North (19) and Armstrong (18) for the North District; Duck Harbor (12) and Coast Guard Eastham (8) for the South District.

Least Tern Nesting

In 2021 least terns returned to CACO beaches during the second and third full weeks of May. The first least tern was observed on May 9th at Coast Guard Eastham in the South District and May 13th at Race Point in the North District. The first least tern nests were found on May 28th at Coast Guard Eastham in the South District and May 23rd at Head of the Meadow in the North District.

Approximately half the colonies had eggs being incubated by early June, while the other half did not form until late June/early July. The highest number of incubating adults at all sites was 270 with total breeding pair counts of 175 for the “A” count and 270 for the “B” count (Table 7). This was an increase in approximately 150 pairs from 2020. Colony sizes fluctuated throughout the season, but

most were relatively small with 50 or fewer pairs (Wood End Long Point had a high of 68 nesting pairs that were divided between 4 colonies, none larger than 50 pairs). Race Point North, Coast Guard Eastham, and Coast Guard Truro supported the largest colonies with high incubating counts of 50, 32, and 25 incubating adults, respectively (Table 7).

Table 7. Least tern (*Sternula antillarum*) breeding pair counts and fledging success, CACO, 2021.

Site	A Count ¹	B Count ²	Incubating Adult Count ³	# Chicks Fledged
Armstrong	18	22	22	2
Ballston	0	0	0	0
Bound Brook	0	0	0	0
Cahoon Hollow	0	0	0	0
Coast Guard Beach (Eastham)	48	32	32	1
Coast Guard Beach (Truro)	25	25	25	2
Duck Harbor	0	0	0	0
Exit 9	0	5	5	0
Great Island	0	0	0	0
Hatches Harbor	0	0	0	0
Head of the Meadow	10	20	20	3
High Head	5	3	3	0
Jeremy Point	0	0	0	0
Lecount Hollow	0	0	0	0
Marconi Beach	0	1	1	0
Marconi Station	7	14	14	0
Mission Bell	0	15	15	0
Nauset Light Beach	0	0	0	0
Newcomb Hollow	0	0	0	0
Race Point North	50	50	50	10
Race Point	5	10	10	0
Race Point South	2	5	5	0
White Crest Beach	0	0	0	0
Wood End/Long Point	5	68	68 ⁴	6
TOTAL	175	270	270	24

¹ "A-Counts" are taken within the state census window, on June 15th to 16th.

² "B-Counts" are taken outside the state census window; after June 20.

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

⁴ 68 pairs divided among 4 different colonies at this site.

Chicks began hatching in late June and early July; the first hatch was June 24th at Coast Guard Truro. The first least terns fledged July 15th at Coast Guard Truro and the last fledged August 24th at Race Point North. Only 1 chick hatched and fledged in the South District at Coast Guard Eastham. The 270 pairs fledged 24 chicks yielding a productivity of 0.09 chicks/pair from CACO beaches in 2021 (Table 7). Over the past fifteen years (2007–2021), the least tern population at CACO fluctuated between a high of 268 pairs in 2011 (besides the high count of 270 pairs in 2021) and a low of 52 pairs in 2016 (Table 8). The average number of pairs over this time span is 160 pairs and average number of fledges over this time span is 44. Least tern fledges and productivity were below average in 2021. Productivity in 2021 was the lowest it has been at CACO since 2014.

Table 8. Least tern (*Sternula antillarum*) productivity at CACO, 2007–2021.

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
2020	121	35	0.29	coyote
2021	270	24	0.09	Coyote, overwash, human disturbance

* Estimate.

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 15 seasons (2007–2021) (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. Two American oystercatcher pairs were present during the breeding season at CACO in 2021 at Jeremy Point. The first pair initiated their nest on approximately May 4th, the nest hatched both eggs on June 2nd, and fledged two chicks on July 20th at 47 days old. A nest attempt was never located for the second pair who was present at Jeremy Point from late April to July. Productivity for American oystercatchers was 1.00 in 2021 (Table 9).

Table 9. American oystercatcher (*Haematopus palliatus*) productivity at CACO, 2007–2021.

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
2020	2	1	0.5	crow
2021	2	2	1.00	N/A

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 when staffing and time allow.

Flocks of common and roseate terns were observed staging throughout the park from early July to early October in 2021. Mixed flock high counts for CACO sites include: ~40 at Race Point South, ~40 Race Point/Old Harbor, ~3500 at Race Point North, ~1,000 at Hatches Harbor/Herring Cove marsh, ~800 at Herring Cove, ~1000 at High Head, ~2500 at Armstrong, ~800 at Head of the Meadow, ~600 at Exit 9, ~200 at Wood End/Long Point, ~1000 at Mission Bell, ~1000 at Coast Guard Truro, ~50 at Longnook, ~500 at Jeremy Point, ~70 at Newcomb Hollow, ~100 at Ballston, 60 at Duck Harbor, ~100 at Marconi Station, and ~300 at Coast Guard Eastham/Nauset Marsh.

Roseate Tern

Roseate terns were present in mixed flocks from July through October at CACO beaches. 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.

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 to 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 2021. Many were observed in mixed flocks from July through October. One pair was observed copulating at Race Point North but scrapes and a nest were never located.

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. In 2021, there were no flocks of red knots observed on CACO beaches, but several were observed foraging at Jeremy Point (15 total) and Race Point North (2 total). It was once common to observe large flocks towards the end of the summer throughout the park; the drop in presence of red knots is a concern for this species as CACO is an important foraging and migratory site.

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 20 piping plovers were observed in late August. At least 10 piping plovers were observed at Armstrong Beach until September 24th and 5 until the last day of field monitoring on October 13th. Groups of up to 13 piping plovers also were observed at Wood End up to August 21st, with at least 4 remaining at the breach area until mid-September. Smaller groups of migrating piping plovers were observed including 11 at Ballston on July 1st, 9 at Jeremy Point on August 7th, 8 at Hatches Harbor on July 29th, 7 at Race Point North on August 23rd, and 5 at Bound Brook on August 15th.

Least tern nurseries and migrants were observed starting in early July until mid-September at Coast Guard Truro (40–100 individuals), Head of the Meadow (5–75 individuals), Armstrong (4–100 individuals), Mission Bell (50 individuals), Race Point South (3–40 individuals), Race Point (25–100 individuals), Race Point North (30–200 individuals), Hatches Harbor (3–40 individuals), Wood End/Long Point (3–40 individuals), Coast Guard Eastham (10–64 individuals), Marconi Station (13–75 individuals), and Jeremy Point (20–25 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.

Shorebird Productivity Results

Piping Plovers

The observed productivity rate of 1.28 chicks fledged per breeding pair was below the species recovery target of 1.5 and is the lowest productivity since 2015. The five-year average productivity in 2021 is still above the target rate at 1.62, likely a result of higher productivity the last five years prior to 2021.

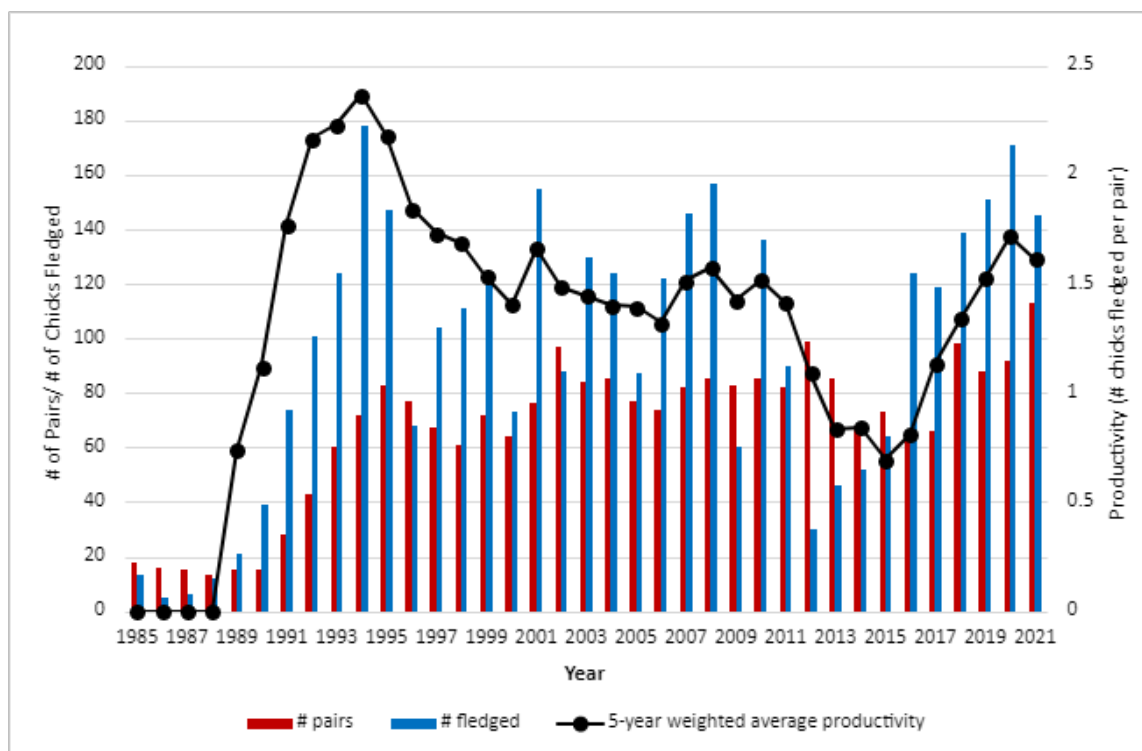


Figure 5. Number of piping plover (*Charadrius melodus*) pairs, chicks fledged, and overall productivity (chicks fledged/nesting pair) from 1985 to 2021 at CACO.

In 2021, there were eight instances of “stunted” chicks, or a chick that appeared very small for their age. One at Jeremy Point, two at Coast Guard Truro, one at Hatches Harbor, one at Race Point North, one at Head of the Meadow (was rehabbed), one at Wood End Long Point and one at Armstrong (Figure 6). One chick at Coast Guard Truro did not make it to fledge but the rest of the stunted chicks observed throughout the park in 2021 did. The chicks at Jeremy Point, Coast Guard Truro, and Wood End were among the last nests to hatch for the season; they fledged at 37 days, 43 days, and 48 days old respectively which is far greater than the average fledge time of 34.6.



Figure 6. 2021 Stunted chick from Hatches Harbor brood (pictured left). Siblings from the same brood exhibiting longer tails and more developed flight feathers. (Right and below). All photos taken of this brood were on the same day August 14th, 2021. (Photos by Leila Al-Daqa, NPS)

Least Terns

The total number of breeding pairs of least terns observed in 2021 was ~150 pairs higher than in 2020 (Figure 7).

In 2021 least terns nested at 17 different sites at CACO with 2/3 of chicks fledged at just two locations: Race Point North (10) and Wood End Long Point (6).

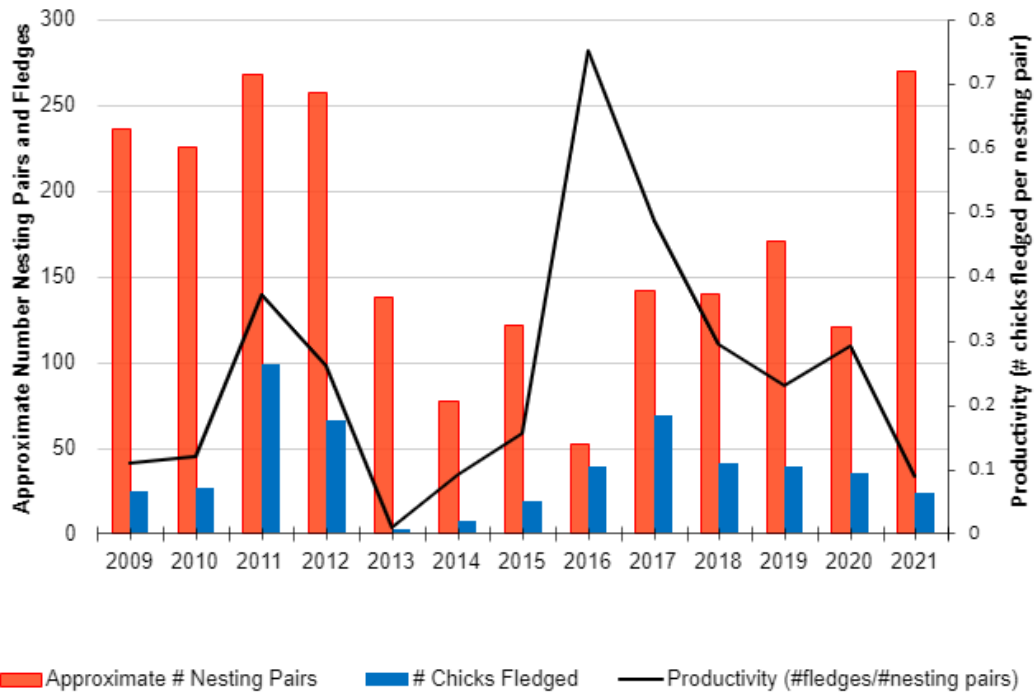


Figure 7. Least tern (*Sternula antillarum*) breeding pairs, chicks fledged and productivity (chicks fledged/nesting pair), by year from 2009 to 2021 at CACO.

American Oystercatcher

American oystercatchers were first recorded nesting on CACO beaches in 2002. Since then, 1 to 5 pairs have nested in the South District each year. Between 2007 and 2021, productivity fluctuated between zero and 1.5 chicks fledged/breeding pair (Table 9, Figure 8).

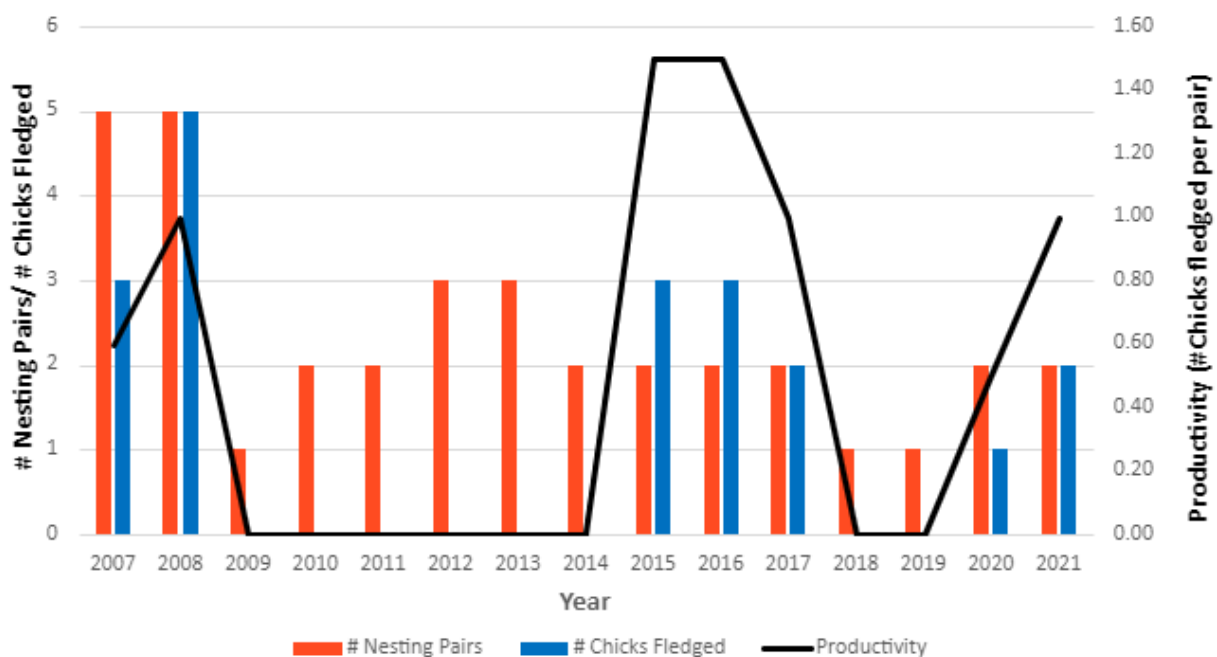


Figure 8. American oystercatcher (*Haematopus palliatus*) breeding pairs, chicks fledged, and productivity.

Literature Cited

- Blodget B. G and S. M Melvin. 1996. Massachusetts Tern and Piping Plover Handbook, a manual for stewards. Mass. Div. of Fisheries and Wildlife. Natural Heritage and Endangered Species Program. Westborough, MA.
- Brown, S, C. Hickey, B. Harrington, and R. Gill, Eds. 2001. The U. S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA.
- Brown, S. S. Shulte, B. Harrington, B. Winn, J. Bart, and M. Howe. 2005. Population size and winter distribution of Eastern American Oystercatchers. *The Journal of Wildlife Management*; 69(4):1538–1545.
- Cape Cod National Seashore; Off-Road Vehicle Use, 63 Fed. Reg. 9,143 (February 24, 1996)
- Darrah AJ, Cohen JB 2017. PiperEx: Piping Plover Decision Support Tool for Exclosure Use. <https://piplexclosuretool.shinyapps.io/decision/> <accessed spring 2018>
- Davis, M.B. 1999. Reproductive success, status and viability of American Oystercatcher (*Haematopus palliatus*). Unpublished M.Sc. thesis, University of Georgia, Athens, GA.
- DeRose-Wilson et al. 2018. Piping Plover Chick Survival Negatively Correlated with Beach Recreation. *The Journal of Wildlife Management*; 82(8):1608–1616.
- Erwin R. M. 2003 Waterbird monitoring protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and protected areas. A protocol for the Long term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. Unpublished report submitted to Cape Cod National Seashore, South Wellfleet, MA.
- Forbush, E.H.1912. *A history of the game birds, wildfowl and shore birds of Massachusetts and adjacent States*. Massachusetts State Board of Agriculture, Boston, Massachusetts.
- Hadden, S.W. 2001. Waterbird Inventory and Monitoring: Report on Protocol Implementation and Development at Cape Cod National Seashore. Unpublished report submitted to Cape Cod National Seashore, South Wellfleet, MA.
- Jedrey, E.L., R.J. Harris, and E.A. Ray. 2010. Roseate Terns – citizens of the world: the Canada to Cape Cod connection. *Bird Observer* 38:146–150.
- Lebreton, J.-D., J.E. Hines, R. Pradel, J.D. Nichols, and J.A. Spendelov. 2003. Estimation by capture-recapture of recruitment and dispersal over several sites. *Oikos* 101:253–254.
- Mass Wildlife Natural Heritage & Endangered Species Program Massachusetts Division of Fisheries & Wildlife. 2022. Summary of the 2021 Massachusetts Piping Plover Census. Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, Rte. 135, Westborough, MA 01581.

- Melvin, S.M. Summary of 2011 Census of American Oystercatcher in Massachusetts. 2012. Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife. Westborough, MA 01581.
- Mostello, C. S., K. Walker, A. Veinotte, and J. Longsdorf. 2019. Inventory of Terns, Laughing Gulls, and Black Skimmers Nesting in Massachusetts in 2017. Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, Rte. 135, Westborough, MA 01581.
- Murphy, S. P. 2010. Population dynamics of the American oystercatcher (*Haematopus palliatus*) near the northern limit of its range. PhD, City University of New York, New York, NY.
- National Park Service. 2007a. Environmental Assessment: Options for Managing ORV Access Cape Cod National Seashore. Wellfleet MA.
- National Park Service. 2007b. FONSI and alternative Selection for Options for managing ORV Access. Cape Cod National Seashore. Wellfleet MA.
- National Park Service 2012. Shorebird Management Standard Operating Procedures. Wellfleet, MA.
- National Park Service. 2018. Shorebird Management Plan Environmental Assessment. Cape Cod National Seashore, Wellfleet MA.
- Nisbet, I.C.T. and J.A. Spendelow. 1999. Contribution of research to management and recovery of the Roseate Tern: reviews of a twelve-year project. *Shorebirds* 22:239–252.
- Schulte, S., S. Brown, D. Reynolds, and the American Oystercatcher Working Group. 2007. Version 2.0. American Oystercatcher Conservation Action Plan for the United States Atlantic and Gulf Coasts.
- Spendelow, J.A., J.E.Hines, J.D. Nichols, I.C.T. Nisbet, C.S. Mostello, G.D. Cormons, H. Hays, and J.J. Hatch. 2010. Estimating adult breeding dispersal/fidelity at different geographic scales to evaluate restoration efforts for Roseate Terns. Invited oral presentation made at World Seabird Conference "Demography Session"; Victoria, British Columbia, Canada, 7–11 Sept. 2010.
- Spendelow, J.A., et al. 2014 MS. Breeding dispersal of Roseate Terns between colony sites in Massachusetts, New York and Connecticut, 1988–2009. Manuscript in preparation.
- Thompson, B.C., J.A. Jackson, J. Burger, L.A. Hill, E.M. Kirsch, and J.L. Atwood. 1997. Least Tern (*Sternula antillarum*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; the Birds of North America [Online]. Available at <http://bna.birds.cornell.edu.proxy-remote.galib.uga.edu/bna/species/290/doi:10.2173/bna.290>. Accessed Sept. 29, 2014.
- Trull, P., S. Hecker, M. J. Watson and I. C. T. Nisbet. 1999. Staging of Roseate Terns *Sterna Dougalli* in the Post-Breeding Period around Cape Cod, Massachusetts, USA. *Atlantic Seabird* 1(4): 145.

- U.S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast Population, revised recovery plan. USFWS. Hadley, Massachusetts.
- U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.
- U.S. Fish and Wildlife Service. 2015. Guidelines for managing recreational activities in piping plover breeding habitat on the U.S. Atlantic coast to avoid take under Section 9 of the Endangered Species Act; Addendum regarding timing of management to protect unfledged chicks. Northeast Region, U.S. Fish and Wildlife Service. March 9, 2015.

Appendix A. Maps of 2020 Piping Plover, Least Tern, and American Oystercatcher Nest Sites at Cape Cod National Seashore

South District



Figure A1. Ballston Beach.



Figure A2. Bound Brook.



Figure A3. Cahoon Hollow.



Figure A4. Coast Guard Eastham.



Figure A5. Duck Harbor.



Figure A6. Great Island.



Figure A7. Jeremy Point.

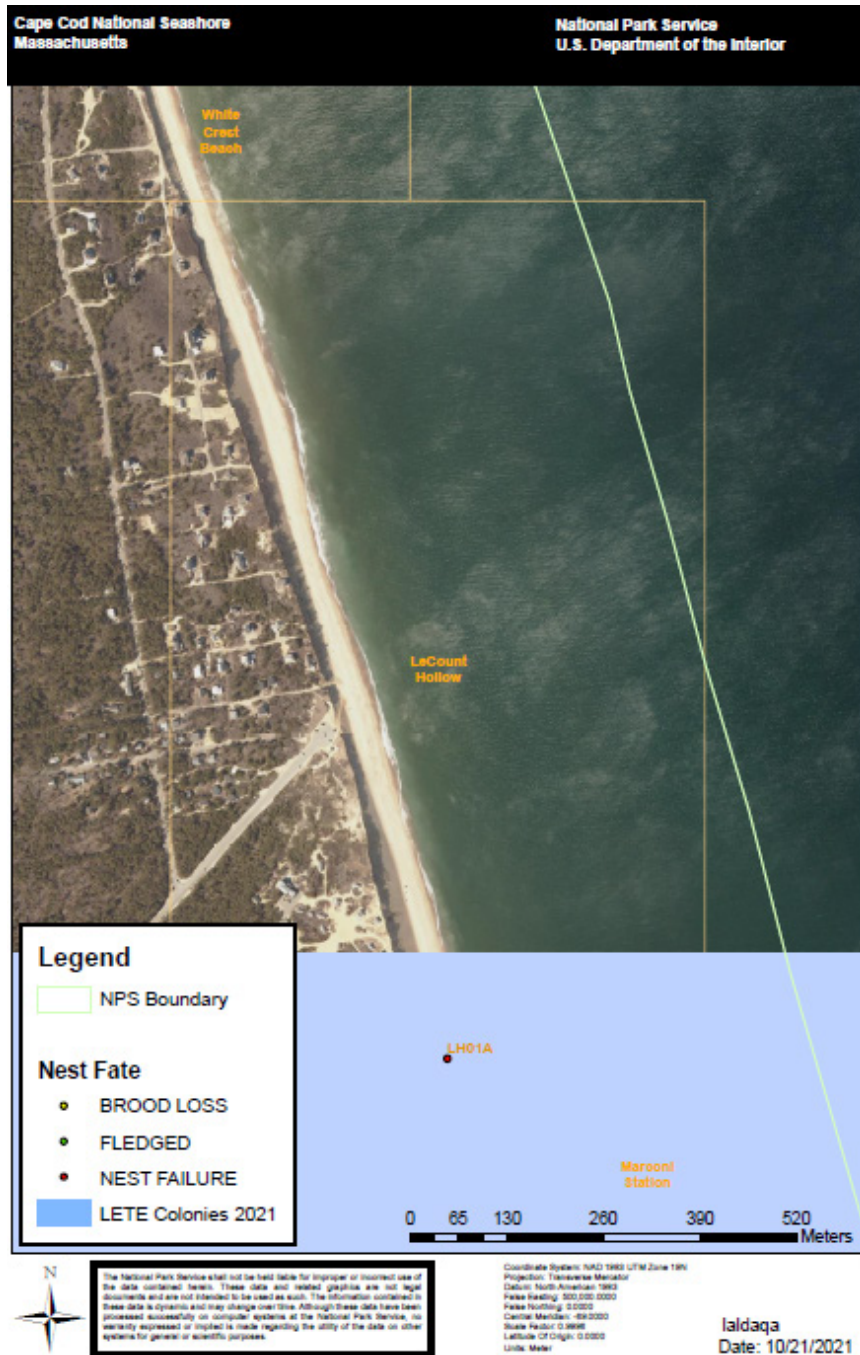


Figure A8. LeCount Hollow.



Figure A9. South District: Marconi Beach.



Figure A10. South District: Marconi Station.



Figure A11. Nauset Light.



Figure A12. Newcomb Hollow.



Figure A13. White Crest.

North District



Figure A14. Armstrong.



Figure A15. Coast Guard Truro.



Figure A16. Exit 9.



Figure A17. Hatches Harbor.

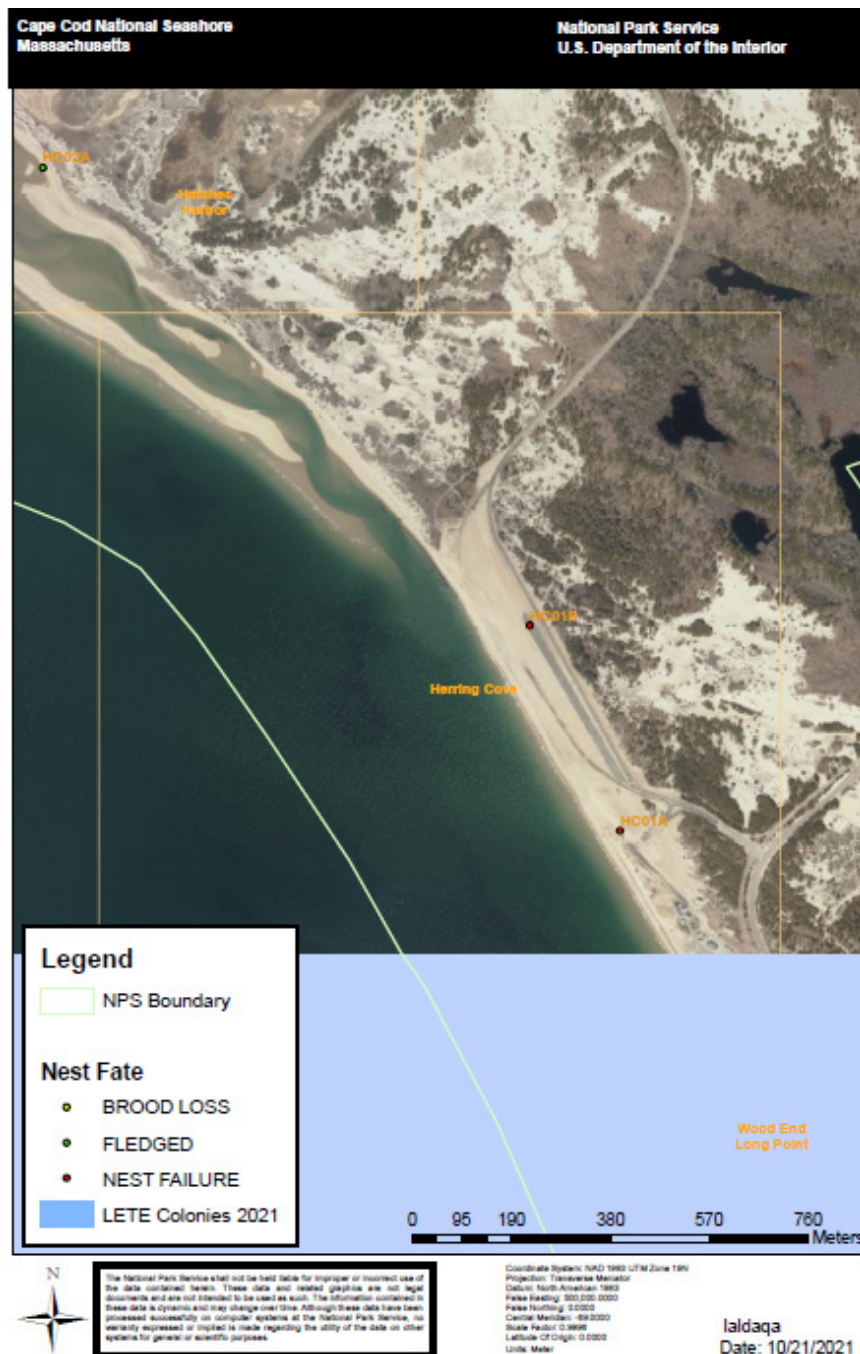


Figure A18. Herring Cove.



Figure A19. Head of the Meadow.





Figure A21. Longnook.



Figure A22. Mission Bell.



Figure A23. Race Point.

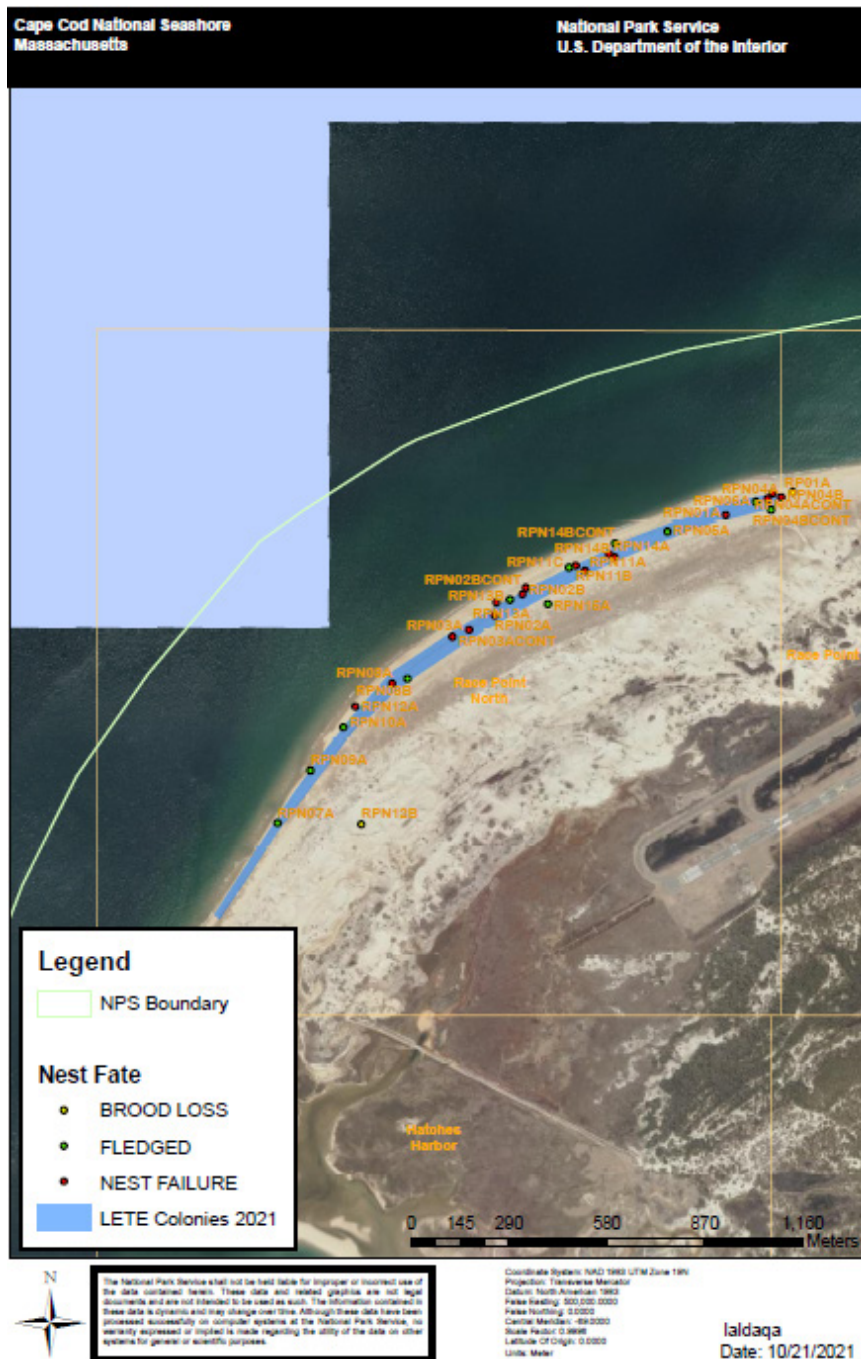


Figure A24. Race Point North.



Figure A25. Race Point South.



Figure A26. Wood End/ Long Point.

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