



Cape Cod National Seashore 2023 Shorebird Monitoring and Management Report



Piping plover chick foraging.

NPS / JOEY NEGREANN

Cape Cod National Seashore 2023 Shorebird Monitoring and Management Report

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Abstract

Cape Cod National Seashore (CACO) plays a crucial role in the conservation of federally and state-listed shorebird species, including the piping plover (*Charadrius melodus*), least tern (*Sternula antillarum*), American oystercatcher (*Haematopus palliatus*), and common tern (*Sterna hirundo*). Monitoring efforts extended along over 50 miles of coastline from Provincetown to Eastham, Massachusetts, focusing on nesting and brood-rearing behaviors.

For the piping plover, 143 breeding pairs were recorded, resulting in 245 nests containing 770 eggs; 97 nests hatched successfully, producing 141 fledglings and an average productivity of 0.99 chicks per pair. Nest losses were mainly attributed to predation and environmental factors, prompting the installation of predator exclosures around 117 nests. The least tern saw 196 breeding pairs with 15 chicks fledged, resulting in a low productivity of 0.08 chicks per pair, primarily affected by predation and human disturbances. Four pairs of American oystercatchers were observed, with productivity of 0.25 chicks per pair; losses were due to predation and abandonment. Two common tern pairs nested, but they were unsuccessful, yielding a productivity of 0.0.

Additional focus on staging and migrating shorebirds revealed the presence of various species, including roseate terns, red knots, and semipalmated sandpipers, with observations noted from mid-July through October. This report describes the monitoring efforts implemented by Cape Cod National Seashore to assess the status of shorebird populations. Data collected on shorebird breeding numbers as well as the status of migrating birds are included. In addition, the report describes the management approaches implemented by Cape Cod National Seashore to protect at-risk species while continuing to provide beach access for visitors.

List of Terms

Brood: A family unit of adults and chicks.

Buffer: The distance between the shorebird activity and the fence line. Established to reduce the amount of disturbance to the birds to breed, feed, and shelter.

Depredation or Predation: The loss of egg(s), chick(s), or adults 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.

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 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. 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 that endangered and threatened species depend on, which 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-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.

Unviable: An egg that failed to hatch, likely undeveloped.

Executive Summary

Cape Cod National Seashore (CACO) manages the protection of federal and state listed beach-nesting and migratory shorebirds, including the piping plover (*Charadrius melodus*), least tern (*Sternula antillarum*), American oystercatcher (*Haematopus palliatus*), and common tern (*Sterna hirundo*). Shorebird and seabird nesting and brood-rearing behaviors were monitored on over 50 miles of coastline from Provincetown to Eastham, Massachusetts.

Piping Plover

- 143 breeding pairs were monitored throughout the season.
- 245 nests were laid; 770 eggs were laid. A total of 97 nests hatched.
- Nest loss was primarily due to depredation, followed by environmental factors.
- Predator exclosures were installed around 117 nests.
- 141 chicks fledged; 68 pairs successfully fledged at least one chick, 27 pairs had full brood loss, 46 pairs failed to hatch any chicks.
- Productivity equaled 0.99 chicks fledged per pair.

Least Tern

- 196 breeding pairs were monitored throughout the season.
- Nest loss was primarily due to depredation, overwash, and human disturbance.
- 15 chicks fledged.
- Productivity equaled 0.08 chicks fledged per pair.

American Oystercatcher

- 4 breeding pairs were monitored throughout the season.
- Nest loss was due to predation and abandonment.
- 1 chick fledged, 1 pair successfully fledged at least one chick, 2 pairs had full brood loss, 1 pair failed to hatch any chicks.
- Productivity equaled 0.25 chicks fledged per pair.

Common Tern

- 2 pairs of common terns were monitored throughout the season.
- No nests were observed to have hatched.
- Productivity equaled 0.00 chicks fledged per pair.

Staging and Migrating Shorebirds

- Mixed-species flocks consisting of roseate terns (*Sterna dougallii*) and common terns were observed throughout the park mid-July through September. CACO staff resighted approximately 145 color-banded terns to contribute to data collection on migratory/staging ground importance.
- Mixed groups of migratory shorebirds 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.
- Uncommon sightings include black skimmer, Arctic tern, whimbrel, little gull, lesser black-backed gull, black-legged kittiwake, golden plover, and black tern.

Human Disturbance

- Shorebird staff documented violations regarding human disturbance on nesting territories, nests, and chicks. Data are collected anecdotally during site visits.
 - 47 vehicle violations, including vehicles driving in closed areas in the ORV corridor, vehicles driving into and dismantling symbolic fencing, and fat-tire bikes in closed areas.
 - Over 700 pet violations, including pets in closed areas, pets off leash, and pets harassing wildlife.
 - 213 pedestrian violations, mainly including walking through closed areas.
 - 17 natural resource violations, including finding unextinguished fires on the beach in the morning, finding firework remnants, and making sculptures in closed areas.
 - 4 instances of drones or kites flying in closed areas.
 - 32 instances of symbolic fencing being tampered with (non-vehicle-related).

Acknowledgments

Cape Cod National Seashore would like to acknowledge all of those who contributed to the shorebird monitoring program including seasonal biological technicians, Leila Al-Daqa, Alice Stitzer, Allie Nowicki, and Zoe Dibble; and ACE interns Katherina Wilkins, Erika Maercklein, Maddi Johnson, and Sophie McCormack. We would also like to thank our Law Enforcement Park Rangers for their continued support of the shorebird staff and monitoring program. We would also like to express our deepest thanks to our shorebird volunteer, Adele Sullivan.



An American oystercatcher adult with two chicks exiting the nest cup.

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Introduction

Cape Cod National Seashore (CACO or “the park”) provides approximately 50 miles of prime nesting and foraging habitat for beach-nesting birds. The same beaches also provide recreational opportunities for millions of human visitors every year. Some bird species are listed by federal and state agencies as endangered, threatened, or of special concern, such as piping plover, least tern, American oystercatcher, and common tern. 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 visitor access and recreation.

Management practices include (1) 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 (2) 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 federal, private, 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 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 four species of breeding shorebirds: piping plover, least tern, common tern, and American oystercatcher. It also summarizes observations of other species of terns and shorebirds that use CACO as a staging ground during their annual migration.

General Nest Habitat Protection

As required by the Endangered Species Act and CACO Shorebird Environmental Assessment (EA) (NPS 2018), suitable habitat for breeding piping plovers must be protected prior to the breeding season. The goal of habitat protection is to minimize habitat disturbance in potential breeding areas and enable birds to establish territories and nests in their preferred habitat. 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) was installed around these sites before nesting activity was observed. 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).

Methods

General Monitoring Methods

CACO follows the monitoring and protection methods outlined in the U.S. Fish and Wildlife Service (USFWS) *Piping Plover Atlantic Coast Population Revised Recovery Plan* (USFWS 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, CACO staff also consult the 2018 Shorebird Management Plan (NPS 2018), 2022 Shorebird Management SOP (NPS 2022), and 2021 Biological Opinion (USFWS 2021).

Shorebirds and migratory birds were monitored in 25 survey units at CACO from Provincetown to Eastham (Figure 1). Survey units were established for logistical purposes and do not necessarily represent ecologically distinct areas.

Monitoring began in early April. Field staff searched the beaches daily for signs of shorebird nesting activity. To minimize disturbance, observations were made through binoculars or scopes from a distance ranging from 5 to 50 meters. Monitoring methods included searching for territory, nests, chicks, and fledglings outside the symbolic fencing and by walk-throughs of the habitat. 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). Chicks were monitored for age, behavior, and location until fledged. 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. In accordance with the Shorebird Management Plan, recreational restrictions were lifted when broods were determined to be fledged or were considered lost after not being observed for five consecutive field days.

Monitoring of breeding shorebirds continued through August and early September, while monitoring of staging and migratory birds went through October. Staging and migratory birds were monitored when flocks greater than 100 were observed and required management, or when staffing and time allowed for observations of resighted bands. Nurseries were also monitored and protected from disturbance and monitored until birds left for migration. In accordance with the Shorebird Management Plan, recreational restrictions were lifted when nurseries and/or staging terns were no longer in use of the area for several observation days. Symbolic fencing was adjusted in response to breeding or staging behaviors and removed when birds were no longer using the area.

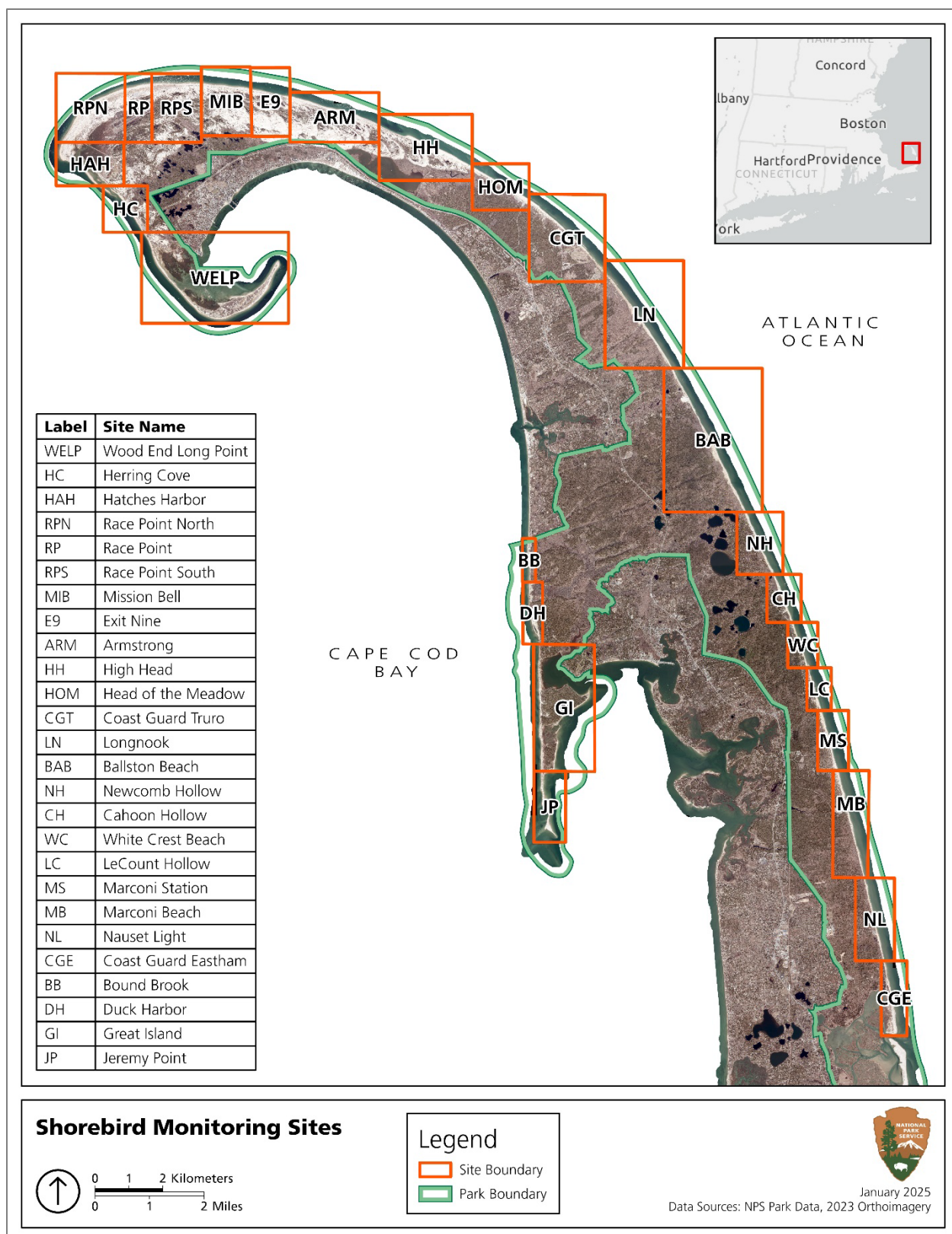


Figure 1. Map of shorebird nesting units within Cape Cod National Seashore.
NPS / CACO

Species-Specific Methods—Piping Plover

Monitoring Methods

Monitoring methods include observations from a distance and careful walk-throughs of the habitat to locate scrapes, nests, and chicks. Potential breeding pairs are monitored throughout the season. Once a nest was found, the nest was monitored every 1 to 5 days (depending on management complexity of site) until hatch. 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). If a nest hatches, chicks were 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. Chick loss was documented, when possible. Piping plover chicks were considered fledged when they were observed in sustained flight for at least 15 meters, irrespective of age (USFWS 2015). In accordance with the Shorebird Management Plan, recreational restrictions were lifted when broods were determined to be fledged or considered lost after not being observed for five consecutive field days.

Predator Management

Predator management for piping plovers was completed by using exclosures. Exclosures are designed to protect nests from predatory birds and mammals (crows, coyotes, foxes, etc.). Exclosures are circular metal wire fences with 2-inch-wide and 4-inch-high openings, five feet in height and ten 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 one-quarter inch, secured to the metal wire.

To minimize nest abandonment and adult mortality, exclosures are installed after nest completion, where vegetation does not hinder the bird's detection of approaching threats and where the risk of overwash by waves and sand is low (Darrah and Cohen 2017). Occasionally, exclosures were installed prior to nest completion in an area of high predator activity and adults have been observed actively incubating the nest.

Initial exclosure usage was guided using *Piperex*; a decision support tool for exclosure use which analyzes historical site-specific data to determine probability of hatch success using exclosures at sites. The frequency of exclosing was then adjusted throughout the season based on nest success at each site, predator activity, and staffing.

Flexible Management

Flexible management was implemented twice in 2023; once each at Race Point and Race Point South. Flexible management reports are sent to USFWS following each field season. In addition to flexible management use, CACO implemented at least 20 drive-throughs and high tide closures to allow continued recreation and access while providing protection for nests.

Species-Specific Methods—Least and Common Terns

Least terns were monitored typically from outside the symbolic fencing by conducting incubating adults or total adult counts. Incubating counts estimate number of terns incubating an active nest (as determined by observation of actively sitting on presumed nest). High counts estimated total number

of adults in the area, including those flying overhead. Walk-throughs of the colony were conducted when needed for census or to inform management. Chicks were monitored from hatch to fledge at least twice a week. Least terns were considered fledged when they were observed in sustained flight for at least 15 meters.

Nests or chicks present within or in proximity to the ORV beach driving corridor were monitored daily when possible.

Nurseries were monitored while surveying for breeding and migratory birds. Symbolic fencing remained in place if specific sections of beach were regularly used by least terns and their recently fledged young.

Species-Specific Methods—American Oystercatchers

Monitoring for American oystercatchers' nests and chicks is similar to methods for piping plovers. Due to the small population size at CACO, American oystercatchers' nests and chicks were often monitored 2–4 times a week from hatch until fledge. American oystercatchers were considered fledged when they were observed in sustained flight for at least 100 meters.

Methods—Post-Breeding/Staging Shorebirds

Monitoring for staging and migratory birds included estimating flock sizes, species composition, age and at times resighting bands. Since flocks greater than 100 staging birds require signage and potential recreational management, areas that were historic staging areas and/or heavily used by recreationalists were monitored more regularly. Migratory and staging birds were monitored using binoculars and scopes from 5 to 50 meters to reduce risk of disturbance.

Data Collection and Quality Control

Data were collected using ArcGIS Field Maps using smartphones and tablets. Field crews also documented all nest checks in writing on nest cards. Data collected using field maps allowed for improved communication across staff as those data sync with ArcGIS Online allowing staff with access to those layers to see the status of nests and breeding colonies. Data collected using Field Maps are downloaded as an Excel spreadsheet at the end of the season and those data are compared against data recorded on nest cards.

In addition, field data for piping plovers and least terns are also recorded in a state-managed database system used to track the status of these species across the Commonwealth of Massachusetts. This system is also used by the U.S. Fish and Wildlife Service to gather data and information on the status of piping plovers in Massachusetts.

Prior to submitting or sharing, all data must be reviewed for quality and certified. Data checking is a crucial process that ensures the accuracy, quality, and reliability of data before it is analyzed or used for decision-making. This process typically involves several key steps, including validation, verification, data cleaning and certification. Validation checks the data against predefined rules or formats to ensure it adheres to specified criteria, such as data type and range. Verification involves cross-referencing the data with original sources to confirm its correctness, while data cleaning entails

identifying and correcting errors or inconsistencies, such as duplicates or missing values. Finally, data certification confirms that the data sets have gone through all the required QA/QC steps and is ready for publication. The tasks of verification, validation, and certification are divided among different staff which improves data integrity by allowing multiple individuals familiar with the data to conduct separate reviews. Ultimately, thorough data checking helps to maintain high data integrity and supports informed decision-making based on reliable information.

Results

Piping Plover

Nesting

The first piping plovers were observed at Coast Guard Eastham on 20 March. They were present at most beaches by early April and continued to arrive until mid-June. Scraping was observed as early as 20 March at Coast Guard Eastham. 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. CACO staff observed a total of 143 breeding pairs in 2023. Most plovers departed by late August, although some remained through October.

The first nest was found on 23 April at Bound Brook. Nests with eggs were present from 22 April to 27 July. Peak nesting occurred late-May to mid-June, with a high of 106 active nests at one time on 1 June (Figure 2). Hatch dates ranged from 25 May to 27 July (Figure 2). The first and last nest to hatch were at Armstrong. The average incubation time for nests was 27 days, calculated from the date the first egg in the clutch hatched. Most successful piping plover nests that were found hatched between 22 and 32 days in 2023.

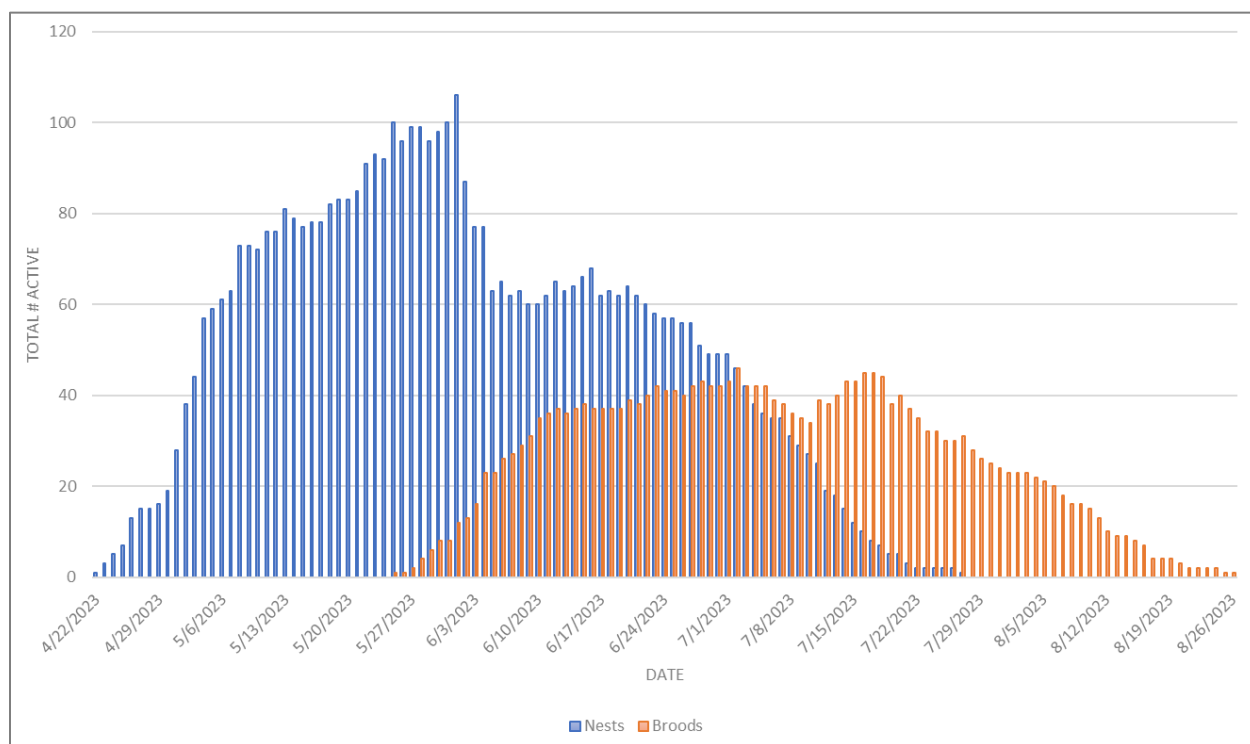


Figure 2. Number of active piping plover nests and broods by date at Cape Cod National Seashore in 2023.

NPS / CACO

Nesting results are summarized in Table 1. A total of 245 nests were found in 2023. Of the 245 nests that were found, 148 nests (60%) were lost and 97 nests (40%) hatched. Re-nests accounted for 42% (104 nests) of the total nests laid (Table 2). Hatch success was higher for first attempts than renests (48% vs. 32%). Bound Brook had the highest hatch rate in 2023 (75%).

Typically, almost all nests are located before clutch completion, and thus hatch windows could be predicted with high accuracy. In 2023, 28 nests were located after completion (11% of total nests laid) due to the large number of nesting pairs in the park. Locating nests or broods after completion makes predicting hatch dates, fledge dates, and informing management decisions much more difficult. The 245 nests that were found equated to 770 eggs laid. 324 eggs hatched into chicks; this was the highest number of eggs hatched in 20 years of monitoring at CACO.

Table 1. Summary of piping plover nesting sites at Cape Cod National Seashore in 2023.

Site	Total Breeding Pairs	Total Nests	Total Eggs Laid	Total Nests Hatched	Total Eggs Hatched	Total Chicks Fledged	Nest Success ^A	Hatch Rate ^B	Fledge Rate ^C	Productivity ^D
Wood End/Long Point	14	28	84	6	18	7	0.21	0.21	0.39	0.50
Herring Cove	2	3	11	2	7	2	0.67	0.64	0.29	1.00
Hatches Harbor	4	8	21	3	12	4	0.38	0.57	0.33	1.00
Race Point North	10	15	51	8	29	16	0.53	0.57	0.55	1.60
Race Point	7	13	41	4	10	4	0.31	0.24	0.40	0.57
Race Point South	3	10	21	2	8	5	0.20	0.38	0.63	1.67
Mission Bell	–	11	27	4	13	13	0.36	0.48	1.00	2.17
Exit 9	4	6	22	2	6	1	0.33	0.27	0.17	0.25
Armstrong	14	31	89	9	29	5	0.29	0.33	0.17	0.36
High Head	10	15	52	10	28	13	0.67	0.54	0.46	1.30
Head of the Meadow	5	7	22	4	15	6	0.57	0.68	0.40	1.20
Coast Guard Truro	7	9	36	6	21	8	0.67	0.58	0.38	1.14
Longnook	3	4	12	1	3	3	0.25	0.25	1.00	1.00
Ballston Beach	4	5	18	2	4	4	0.40	0.22	1.00	1.00
Newcomb Hollow	4	7	23	3	12	6	0.43	0.52	0.50	1.50
Cahoon Hollow	1	3	12	0	0	0	0.00	0.00	0.00	0.00
White Crest	0	0	0	0	0	0	0.00	0.00	0.00	0.00
LeCount Hollow	1	1	4	0	0	0	0.00	0.00	0.00	0.00
Marconi Station	6	6	20	4	14	9	0.67	0.70	0.64	1.50

^A Nest Success = Total Nests Hatched / Total Nests.

^B Hatch Rate = Total Eggs Hatched / Total Eggs Laid.

^C Fledge Rate = Total Chicks Fledged / Total Eggs Hatched.

^D Productivity = Total Chicks Fledged / Total Breeding Pairs.

Table 1 (continued). Summary of piping plover nesting sites at Cape Cod National Seashore in 2023.

Site	Total Breeding Pairs	Total Nests	Total Eggs Laid	Total Nests Hatched	Total Eggs Hatched	Total Chicks Fledged	Nest Success ^A	Hatch Rate ^B	Fledge Rate ^C	Productivity ^D
Marconi Beach	3	6	17	0	0	0	0.00	0.00	0.00	0.00
Nauset Light	0	0	0	0	0	0	0.00	0.00	0.00	0.00
Coast Guard Eastham	7	13	45	7	24	6	0.54	0.53	0.25	0.86
Bound Brook	2	2	8	2	6	4	1.00	0.75	0.67	2.00
Duck Harbor	9	11	41	7	25	5	0.64	0.61	0.20	0.56
Great Island	7	15	42	5	19	13	0.33	0.45	0.68	1.86
Jeremy Point	10	16	51	6	21	7	0.38	0.41	0.33	0.70
Parkwide Totals	143	245	770	97	324	141	0.40	0.42	0.44	0.99

^A Nest Success = Total Nests Hatched / Total Nests.

^B Hatch Rate = Total Eggs Hatched / Total Eggs Laid.

^C Fledge Rate = Total Chicks Fledged / Total Eggs Hatched.

^D Productivity = Total Chicks Fledged / Total Breeding Pairs.

Table 2. Summary of piping plover nesting parameters by year from 1993 to 2023 at Cape Cod National Seashore. An en-dash (–) = no data.

Year	Total Breeding Pairs	Total Nests	Total Re-nests	Total Eggs Laid	Total Eggs Hatched	Total Chicks Fledged	Renest Rate ^A	Mean Clutch Size ^B	Hatch Rate ^C	Fledge Rate ^D	Egg Success ^E	Productivity ^F
1993	60	75	15	269	179	124	0.20	3.59	0.67	0.69	0.46	2.07
1994	72	105	33	338	226	178	0.31	3.22	0.67	0.79	0.53	2.47
1995	83	114	31	395	242	147	0.27	3.46	0.61	0.61	0.37	1.77
1996	77	116	39	389	148	68	0.34	3.35	0.38	0.46	0.17	0.88
1997	67	107	40	266	126	104	0.37	2.49	0.47	0.83	0.39	1.55
1998	61	–	–	–	–	110	–	–	–	–	–	1.80
1999	72	82	10	289	225	123	0.12	3.52	0.78	0.55	0.43	1.71
2000	64	121	57	415	154	73	0.47	3.43	0.37	0.47	0.18	1.14
2001	76	88	12	317	223	155	0.14	3.60	0.70	0.70	0.49	2.04
2002	97	141	44	428	175	88	0.31	3.04	0.41	0.50	0.21	0.91
2003	84	121	37	450	189	130	0.31	3.72	0.42	0.69	0.29	1.55
2004	85.5	115	30	425	220	124	0.26	3.70	0.52	0.56	0.29	1.45
2005	77	118	41	378	163	87	0.35	3.20	0.43	0.53	0.23	1.13
2006	74	96	22	336	233	122	0.23	3.50	0.69	0.52	0.36	1.65
2007	85	113	22	368	233	143	0.19	3.26	0.63	0.61	0.39	1.68
2008	86	109	22	386	244	158	0.20	3.54	0.63	0.65	0.41	1.84
2009	87	109	25	367	190	60	0.23	3.37	0.52	0.32	0.16	0.69
2010	85	115	30	386	236	137	0.26	3.36	0.61	0.58	0.35	1.61

^A Renest Rate = Total Renests / Total Nests.

^B Mean Clutch Size = Total Eggs Laid / Total Nests.

^C Hatch Rate = Total Eggs Hatched / Total Eggs Laid.

^D Fledge Rate = Total Chicks Fledged / Total Eggs Hatched.

^E Egg Success = Total Chick Fledged / Total Eggs Laid.

^F Productivity = Total Chicks Fledged / Total Breeding Pairs.

Table 2 (continued). Summary of piping plover nesting parameters by year from 1993 to 2023 at Cape Cod National Seashore. An en-dash (–) = no data.

Year	Total Breeding Pairs	Total Nests	Total Re-nests	Total Eggs Laid	Total Eggs Hatched	Total Chicks Fledged	Renest Rate ^A	Mean Clutch Size ^B	Hatch Rate ^C	Fledge Rate ^D	Egg Success ^E	Productivity ^F
2011	82	110	47	374	207	90	0.43	3.40	0.55	0.43	0.24	1.10
2012	99	212	108	636	72	30	0.51	3.00	0.11	0.42	0.05	0.30
2013	85	173	89	532	100	46	0.51	3.08	0.19	0.46	0.09	0.54
2014	68	121	54	375	129	52	0.45	3.10	0.34	0.40	0.14	0.76
2015	73	113	44	388	143	64	0.39	3.43	0.37	0.45	0.16	0.88
2016	66	95	29	344	169	124	0.31	3.62	0.49	0.73	0.36	1.88
2017	66	114	48	386	175	119	0.42	3.39	0.45	0.68	0.31	1.80
2018	98	180	82	573	221	139	0.46	3.18	0.39	0.63	0.24	1.42
2019	88	151	64	507	254	151	0.42	3.36	0.50	0.59	0.30	1.72
2020	92	149	58	460	238	171	0.39	3.09	0.52	0.72	0.37	1.86
2021	113	207	95	647	285	145	0.46	3.13	0.44	0.51	0.22	1.28
2022	117	171	55	591	305	189	0.32	3.46	0.52	0.62	0.32	1.62
2023	143	245	104	770	324	141	0.42	3.14	0.42	0.44	0.18	0.99

^A Renest Rate = Total Renests / Total Nests.

^B Mean Clutch Size = Total Eggs Laid / Total Nests.

^C Hatch Rate = Total Eggs Hatched / Total Eggs Laid.

^D Fledge Rate = Total Chicks Fledged / Total Eggs Hatched.

^E Egg Success = Total Chick Fledged / Total Eggs Laid.

^F Productivity = Total Chicks Fledged / Total Breeding Pairs.

Nest Loss

Out of the 245 nests laid, 148 nests failed. The main cause of nest failure was depredation with 87 nests lost, followed by overwash (37), and abandonment (19) (Tables 3–5). In 2023, the park experienced a storm event and subsequent high tide surges in early June that wiped out 35 nests and likely some broods too. This storm required symbolic fencing repairs along about 40 miles of seashore. The number of nests depredated doubled from 2022 with the main causes being crow (59% of nests), coyote (25%), and unknown predator (14%). In 21 years of monitoring, depredation continues to be the largest cause of nest loss for piping plover nests.

On occasion, adult plovers are lost unrelated to their nesting status. On 22 July, staff found an injured adult piping plover, captured it, and brought it to the local wildlife rehabilitator. It was examined and found to have a shattered leg; the individual was humanely euthanized. On 16 May, an adult piping plover was found deceased in the ORV corridor in a tire track. It was determined to have been killed by a predator, likely avian. The nearby nest was not abandoned, it was not determined if this individual had an active nest at the time.

Table 3. Summary of piping plover nest loss and cause of nest loss from 2003 to 2023 at Cape Cod National Seashore. In 2010, one nest was lost to multiple causes, 2 eggs to crow and 2 eggs to overwash. In both 2012 and 2018 nests lost due to “other” were trampled by gulls. In 2022, two nests were lost to multiple causes: first nest had 2 eggs lost to overwash and 1 egg to coyote, second nest had 1 egg lost to unknown reasons and 2 eggs to coyote. In 2023, one nest was lost to multiple causes, 2 eggs lost to crow and 2 eggs lost to abandonment.

Year	Total Nests	Total Failed Nests	Total Abandonment	Failure to Hatch: Unviable	Mortality of Both Adults	Multiple Causes	Other	Overwash / Flooding	Total Predation	Run Over	Sanded Over	Substrate Collapse	Trampling	Unknown Cause	Vandalism
2003	121	67	15	0	0	0	0	9	38	0	5	0	0	0	0
2004	115	56	13	0	0	0	0	15	27	0	0	0	0	1	0
2005	118	69	11	1	0	0	0	20	25	0	11	1	0	0	0
2006	96	26	4	0	0	0	0	3	11	0	5	0	0	3	0
2007	113	46	15	0	0	0	0	18	10	0	3	0	0	0	0
2008	109	40	8	1	0	0	0	4	24	0	3	0	0	0	0
2009	108	54	8	1	0	0	0	17	27	0	1	0	0	0	0
2010	115	47	2	1	0	1	0	2	39	0	2	0	0	0	0
2011	110	49	9	1	0	0	0	8	29	0	0	0	0	2	0
2012	212	185	9	0	0	0	2	55	103	0	0	2	1	13	0
2013	173	143	7	0	0	0	0	24	103	0	4	3	0	2	0
2014	121	83	5	0	0	0	0	14	58	0	2	0	0	4	0
2015	113	72	9	1	0	0	0	15	45	0	2	0	0	0	0
2016	95	47	4	1	0	0	0	7	32	0	1	0	0	2	0
2017	114	61	6	2	0	0	0	17	30	0	0	0	0	6	0
2018	180	114	3	3	0	0	1	9	90	0	0	0	0	8	0
2019	151	78	9	0	0	1	0	15	47	0	0	0	0	7	0
2020	149	80	11	0	0	0	0	9	49	0	0	0	0	11	0
2021	207	122	11	0	0	0	0	40	56	0	8	0	0	7	0
2022	171	79	8	0	0	1	0	17	42	0	0	0	0	11	0
2023	245	148	19	0	0	1	0	37	87	0	0	0	0	5	0

Table 4. Summary of piping plover nests lost to abandonment from 2003 to 2023 at Cape Cod National Seashore. In 2003 and 2007–2013 nests lost to abandonment data were not further broken down.

Year	Total Nests	Total Failed Nests	Total Abandonment	Abandonment Type			
				Adult Mortality	Human Disturbance	Predator Disturbance	Unknown
2003	121	67	15	3	–	–	–
2004	115	56	13	3	0	0	10
2005	118	69	11	0	0	0	11
2006	96	26	4	1	0	0	3
2007	113	46	15	2	–	–	–
2008	109	40	8	4	–	–	–
2009	108	54	8	0	–	–	–
2010	115	47	2	0	–	–	–
2011	110	49	9	0	–	–	–
2012	212	185	9	0	–	–	–
2013	173	143	7	0	–	–	–
2014	121	83	5	0	0	0	5
2015	113	72	9	3	0	1	5
2016	95	47	4	0	3	0	1
2017	114	61	6	0	0	0	6
2018	180	114	3	0	0	0	3
2019	151	78	9	0	1	4	4
2020	149	80	11	0	0	3	8
2021	207	122	11	0	0	0	11
2022	171	79	8	1	1	3	3
2023	245	148	19	2	0	6	11

Table 5. Summary of piping plover nests lost to predation at Cape Cod National Seashore from 2003 to 2023.

Year	Total Nests	Total Failed Nests	Total Predation	Predation Types														
				Coyote	Crow	Domestic Dog	Fox	Grackle	Gull	Mink	Otter	Raptor	Raven	Skunk	Unknown Avian	Unknown Canid	Unknown Predator	Unknown Small Mammal
2003	121	67	38	4	5	0	0	0	4	0	0	0	0	5	5	5	10	0
2004	115	56	27	6	12	0	0	0	3	0	0	0	0	2	0	0	4	0
2005	118	69	25	6	5	0	0	0	2	2	0	1	0	0	0	0	8	1
2006	96	26	11	0	9	0	0	0	0	0	0	0	0	0	0	0	2	0
2007	113	46	10	2	4	0	0	0	0	0	0	0	0	0	0	0	4	0
2008	109	40	24	1	9	0	0	0	2	0	0	0	0	4	0	0	8	0
2009	108	54	27	2	18	0	0	0	1	0	0	0	0	0	0	0	6	0
2010	115	47	39	3	28	0	0	0	0	0	0	0	0	0	0	0	8	0
2011	110	49	29	3	24	0	0	0	0	0	0	0	0	0	0	0	2	0
2012	212	185	103	41	35	0	5	0	0	0	0	0	0	0	0	1	21	0
2013	173	143	103	31	24	0	5	1	0	0	0	0	0	0	0	1	41	0
2014	121	83	58	9	19	0	6	0	0	0	0	0	0	0	0	10	14	0
2015	113	72	45	15	15	0	4	0	0	0	0	0	0	0	0	3	8	0
2016	95	47	32	8	12	0	1	0	0	0	0	0	0	0	0	2	9	0
2017	114	61	30	4	19	0	0	0	0	0	0	0	0	0	0	0	7	0
2018	180	114	90	21	56	0	2	1	0	0	0	0	0	0	0	0	10	0
2019	151	78	47	24	14	0	0	0	0	0	0	0	1	0	0	0	8	0
2020	149	80	49	17	22	0	0	0	2	0	0	0	0	0	0	0	8	0
2021	207	122	56	11	37	0	0	0	0	0	0	0	0	0	1	0	7	0
2022	171	79	42	20	13	0	1	0	0	0	0	0	0	0	1	2	5	0
2023	245	148	87	18	44	1	0	0	0	0	0	0	0	0	2	0	21	0

Egg Loss

Egg loss followed similar trends as nest loss with most eggs lost to depredation (51%), followed by overwash (27%), abandonment (12%) including adult mortality (2%), unviable (8%), and unknown (2%) (Tables 6–8). A total of 770 eggs were laid of which 324 hatched and 446 were lost.

Table 6. Summary of piping plover egg loss and cause of egg loss from 2016 to 2023 at Cape Cod National Seashore.

Year	Total Eggs	Total Failed Eggs	Total Abandonment	Failure to Hatch—Unviable	Mortality of Both Adults	Other	Overwash/ Flooding	Total Predation	Run Over	Sanded Over	Substrate Collapse	Trampling	Unknown Cause	Vandalism
2017	386	210	19	28	0	0	56	89	0	0	0	0	18	0
2018	573	352	9	38	0	4	21	258	0	0	0	0	22	0
2019	507	253	20	27	0	0	47	133	0	0	0	0	26	0
2020	460	222	28	25	0	0	26	126	0	0	0	0	17	0
2021	647	362	24	29	0	0	121	143	0	26	0	0	19	0
2022	591	286	24	27	0	0	64	134	0	0	0	0	37	0
2023	770	446	53	34	0	0	121	228	0	0	0	0	10	0

Table 7. Summary of piping plover egg loss due to abandonment from 2017 to 2023 at Cape Cod National Seashore.

Year	Total Eggs	Total Failed Eggs	Total Abandonment	Abandonment Type			
				Adult Mortality	Human Disturbance	Predator Disturbance	Unknown
2017	386	210	19	0	0	0	19
2018	573	352	9	0	0	0	9
2019	507	253	20	0	4	11	5
2020	460	222	28	0	0	11	17
2021	647	362	24	0	0	0	24
2022	591	286	24	4	3	11	6
2023	770	446	53	7	4	18	24

Table 8. Summary of piping plover egg loss due to predation from 2017 to 2023 at Cape Cod National Seashore.

Year	Total Eggs	Total Failed Eggs	Total Predation	Predation Type														
				Coyote	Crow	Domestic Dog	Fox	Grackle	Gull	Mink	Otter	Raptor	Raven	Skunk	Unknown Avian	Unknown Canid	Unknown Predator	Unknown Small Mammal
2017	386	210	89	12	57	0	0	0	0	0	0	0	0	0	0	0	20	0
2018	573	352	258	65	161	0	7	4	0	0	0	0	0	0	0	0	21	0
2019	507	253	133	83	36	0	0	0	0	0	0	0	4	0	0	0	10	0
2020	460	222	126	48	54	0	0	0	7	0	0	0	0	0	0	0	17	0
2021	647	362	143	34	86	0	0	0	0	0	0	0	0	0	4	0	19	0
2022	591	286	134	68	36	0	4	0	0	0	0	0	0	0	4	7	15	0
2023	770	446	228	53	115	0	0	0	0	0	0	0	0	0	4	4	52	0

Exclosures

A total of 117 exclosures were installed around nests in 2023; the highest number of exclosures in a season. Exclosures increased the rate of nest hatching success from 22% for unexclosed nests to 59% for exclosed nests (Table 9). They also successfully decreased the rate of predation from 80% loss due to predation to 15%. The highest cause of nest loss for exclosed nests was due to overwash (26), followed by abandonment (14) and predation (7). Despite successes in increasing hatching, there were at least 2 adult mortalities associated with exclosures, as well as 12 additional abandonments (Table 10).

Table 9. Piping plover nest loss based on predator management at Cape Cod National Seashore in 2023.

Predator Management Type	Total Nests	Total Nests Lost
Nest Exclosed	117	48
Nest Unexclosed	128	100

Table 10. Causes of piping plover nest loss based on predator management at Cape Cod National Seashore in 2023.

Nest Loss Cause	Nest Loss Cause: Detail	Nest Exclosed	Nest Unexclosed
Abandonment	Total	14	5
	Adult Mortality	2	0
	Human Disturbance	0	0
	Predator Disturbance	6	0
	Unknown	6	5
Failure to Hatch—Unviable	Total	0	0
Mortality of Both Adults	Total	0	0
Multiple Causes	Total	1	0
Other	Total	0	0
Overwash / Flooding	Total	26	11
Predation	Total	7	80
	Coyote	4	14
	Crow	1	43
	Domestic Dog	0	1
	Fox	0	0
	Gull	0	0
	Mink	0	0
	Otter	0	0
	Raptor	0	0
	Raven	0	0
	Skunk	0	0

Table 10 (continued). Causes of piping plover nest loss based on predator management at Cape Cod National Seashore in 2023.

Nest Loss Cause	Nest Loss Cause: Detail	Nest Exclosed	Nest Unexclosed
Predation (continued)	Unknown Avian	0	0
	Unknown Canid	0	2
	Unknown Predator	0	0
	Unknown Small Mammal	2	19
Run Over	Total	0	0
Sanded Over	Total	0	0
Substrate Collapse	Total	0	0
Trampling	Total	0	0
Unknown Cause	Total	0	0
Vandalism	Total	0	5

Fledging

A total of 141 chicks fledged from 143 breeding pairs at CACO in 2023. Active broods of unfledged chicks were present on CACO beaches from 25 May until 26 August. The peak number of broods occurred on 2 July with 46 active broods (Figure 2). Fledging dates in 2023 ranged from 23 June to 26 August.

Beaches with the highest fledging success rates (100%) were Mission Bell, Longnook, and Ballston. Beaches with the lowest fledging success rates (where nests hatched) were Exit 9 and Armstrong (both 17%). Out of the 97 nests that hatched successfully, fledge rates for re-nests were similar to fledge rates for first nest attempts, 40% and 45% respectively.

The average age to fledge in 2023 was 32 days. Days to fledge ranged from 25 to 39 days. Over the last several years, staff have observed chicks with developmental delays at several sites. The site with the highest average fledge age was Armstrong (39 days). The site with the lowest average fledge age was Bound Brook (25 days). Chicks typically fledge between 30 and 35 days from CACO beaches, although it is not uncommon for there to be several chicks fledging outside of this age window. A total of 21 chicks fledged over 35 days of age in 2023. The oldest chick to fledge was 51 days old at Armstrong.

A total of 183 chicks were lost this season. Of the 183 chicks lost, all were lost to unknown causes, although some chicks were found dead on site and observations suggested death by exposure. On 14 July, staff received notice of a piping plover chick being taken off the Newcomb Hollow beach the night prior. A well-meaning park visitor thought the chick was in danger from rain, collected it, and brought it to a local wildlife rehabilitator. Upon receiving the chick and examining it they found there was no issue and contacted the park to release it back to its rightful brood. It was successfully reunited with its brood, but unfortunately the entire brood was lost a few days later.

Productivity

Of the 143 breeding pairs, 68 pairs (48%) fledged at least one chick, and 75 pairs (52%) had zero productivity. Of the pairs with zero productivity, 29 pairs had complete brood loss and 46 pairs failed to hatch any eggs. 143 pairs hatched 324 eggs and fledged 141 chicks for a total productivity of 0.99 chicks fledged per pair. The observed productivity rate of 0.99 chicks fledged per breeding pair is below the species recovery target of 1.50 (Figure 3).

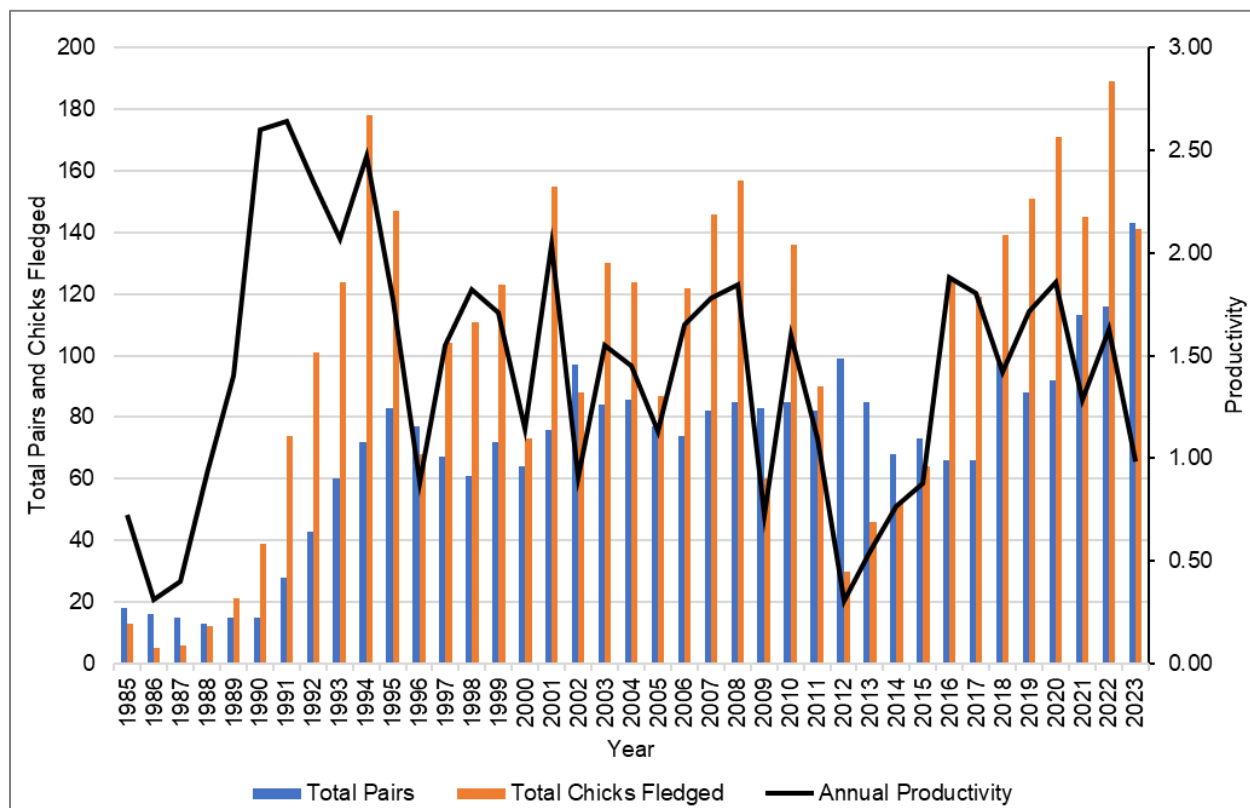


Figure 3. Piping plover pairs, chicks fledged, and annual productivity at Cape Cod National Seashore from 1985 to 2023.

NPS / CACO

Least Tern

Nesting

In 2023, least terns returned to CACO beaches in early May. The first least tern nest was found on 28 May at Coast Guard Eastham. Least terns continued to nest until mid-August. The highest number of nesting pairs was 196 (Table 11). This was an increase of 2 pairs from 2022 (Table 12). Colony sizes fluctuated throughout the season, but most were relatively small with 40 or fewer pairs. High Head, Jeremy Point, and Race Point North supported the largest colonies (Table 11).

Chicks began hatching in early July; the first documented hatch was 4 July at Race Point. Least terns continued to incubate nests through August.

Table 11. Summary of least tern nesting sites at Cape Cod National Seashore in 2023.

Site	A Count (6/5–6/19)	B Count (6/20–7/31)	Total Breeding Pairs	Total Chicks Fledged	Productivity ^A
Wood End/Long Point, Breach	0	1	1	0	0.00
Wood End/Long Point, South	0	0	0	0	0.00
Wood End/Long Point, North	0	0	0	0	0.00
Wood End/Long Point, Pilgrim	0	3	3	0	0.00
Hatches Harbor	0	9	9	0	0.00
Race Point North	52	28	28	6	0.21
Race Point	16	8	8	0	0.00
Race Point South	0	8	8	0	0.00
Mission Bell	0	1	1	1	1.00
Exit 9	0	0	0	0	0.00
Armstrong, North	12	24	24	3	0.13
Armstrong, South	3	4	4	0	0.00
High Head	24	40	40	3	0.08
Head of the Meadow	3	20	20	2	0.10
Coast Guard Truro	1	8	8	0	0.00
Ballston	0	0	0	0	0.00
Newcomb Hollow	0	0	0	0	0.00
Cahoon Hollow	0	0	0	0	0.00
White Crest Beach	0	0	0	0	0.00
LeCount Hollow	0	0	0	0	0.00
Marconi Station	0	3	3	0	0.00
Marconi Beach	0	0	0	0	0.00
Nauset Light Beach	0	0	0	0	0.00
Coast Guard Eastham	5	4	4	0	0.00
Bound Brook	0	0	0	0	0.00
Duck Harbor	0	0	0	0	0.00
Great Island	0	0	0	0	0.00
Jeremy Point, Islands	13	27	27	0	0.00
Jeremy Point, Proper	3	8	8	0	0.00
Parkwide Total	132	196	196	15	0.08

^A Productivity = Total Chicks Fledged / Total Breeding Pairs.

Table 12. Summary of least tern nesting parameters by year from 2007 to 2023 at Cape Cod National Seashore.

Year	Total Breeding Pairs	Total Chicks Fledged	Productivity ^A	Primary Cause of Loss
2007	86	40	0.47	overwash, canids
2008	89	136	1.53	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
2022	195	49	0.25	coyote, overwash, human disturbance
2023	196	15	0.08	human disturbance, predation

^A Productivity = Total Chicks Fledged / Total Breeding Pairs.

Fledging

The first least tern chicks fledged on 30 July and the last fledged on 1 September both at Race Point North. In 2023, least terns nested at 15 different sites at CACO but only successfully fledged chicks from 5 sites: Race Point North (6), Mission Bell (1), Armstrong (3), Head of the Meadow (3), and Coast Guard Truro (2).

On 6 August, a least tern chick was found injured in the Head of the Meadow main pathway. It was captured and brought to the local wildlife rehabilitator. A few days later it was released back into the colony. The colony was very small, only one active chick at the time; after an hour the reintroduced chick was accepted and adults started bringing it fish. The chick successfully fledged on 24 August.

Nurseries

Least tern nurseries and migrants were observed starting in early July until mid-September at Race Point North (50 individuals), Race Point (45 individuals), Race Point South (100 individuals), High Head (10 individuals), and Head of the Meadow (40 individuals).

Symbolic fencing and interpretive signs, including no pet signs, were maintained to protect least terns and their young still using critical habitat later in the breeding season.

Productivity

There were 196 breeding pairs of least terns observed in 2023 (Figure 4). The 196 pairs fledged 15 chicks yielding a productivity of 0.08 chicks/pair from CACO beaches in 2023 (Table 11). Over the past seventeen years, the least tern population at CACO fluctuated between a high of 270 pairs in 2021 and a low of 52 pairs in 2016 (Table 12). Least tern fledges and productivity were below average in 2023. Productivity in 2023 was the lowest it has been at CACO since 2013. Least tern productivity has been declining at CACO since a spike in 2016. Low productivity has put the species on the list of conservation concern (USFWS 2008) which could mean listing in the future.

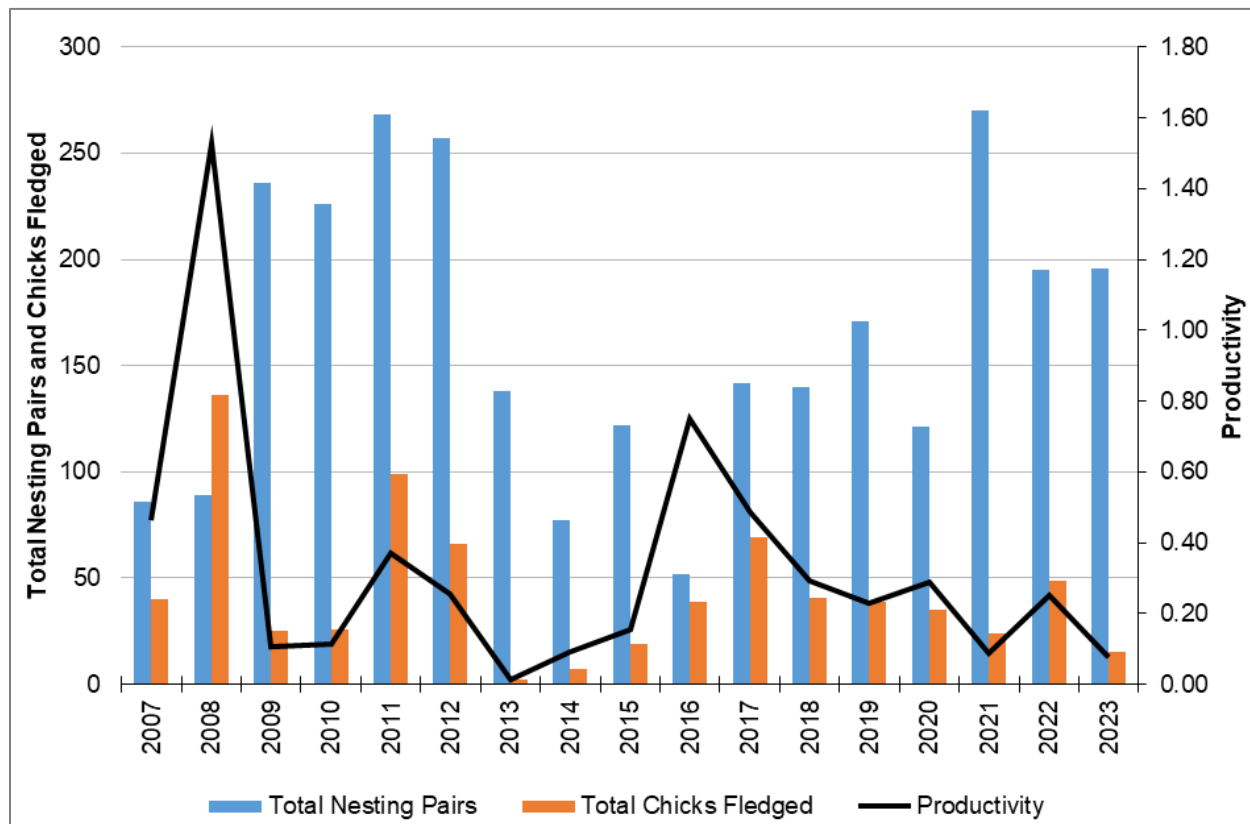


Figure 4. Least tern breeding pairs, chicks fledged and productivity (chicks fledged/nesting pair), by year from 2009 to 2023 at Cape Cod National Seashore.

NPS / CACO

American Oystercatcher

Nesting

Since 2006, Cape Cod National Seashore has supported no more than five nesting pairs of American oystercatchers in any given year. Nesting areas have fluctuated around the park. From 2006 to 2013, their nesting sites included Jeremy Point, Coast Guard Eastham and New Island. New Island is currently monitored by the Town of Orleans. From 2014 to 2023, they have only been documented nesting at Jeremy Point in Wellfleet. In 2023, American oystercatchers were documented nesting at a previously unmonitored area of Great Island, on the Wellfleet harborside.

In 2023, 4 American oystercatcher pairs were present during the breeding season at CACO. The first oystercatcher nest was found on 22 April at Jeremy Point. A total of ten nests were laid by four pairs, three nests hatched, only one was unsuccessful in fledging any chicks (Table 13). Of the 10 nests, 7 were lost. Two nests were overwashed, 4 nests were depredated (2 coyote, 2 unknown), and 1 nest was abandoned.

Table 13. Summary of American oystercatcher nesting parameters by year from 2006 to 2023 at Cape Cod National Seashore.

Year	Total Pairs	Total Nests	Total Renests	Total Eggs Laid	Total Eggs Hatched	Total Chicks Fledged	Renest Rate ^A	Mean Clutch Size ^B	Hatch Rate ^C	Fledge Rate ^D	Egg Success ^E	Productivity ^F
2006	4	4	0	12	10	2	0.00	3.00	0.83	0.20	0.17	0.50
2007	5	7	2	19	5	3	0.29	2.71	0.26	0.60	0.16	0.60
2008	5	6	1	16	10	4	0.17	2.67	0.63	0.40	0.25	0.80
2009	1	1	0	3	3	0	0.00	3.00	1.00	0.00	0.00	0.00
2010	3	5	2	16	2	0	0.40	3.20	0.13	0.00	0.00	0.00
2011	3	6	3	17	5	0	0.50	2.83	0.29	0.00	0.00	0.00
2012	3	6	3	15	5	0	0.50	2.50	0.33	0.00	0.00	0.00
2013	3	10	7	21	0	0	0.70	2.10	0.00	0.00	0.00	0.00
2014	2	4	3	8	4	0	0.75	2.00	0.50	0.00	0.00	0.00
2015	2	3	1	9	6	3	0.33	3.00	0.67	0.50	0.33	1.50
2016	2	4	2	10	6	3	0.50	2.50	0.60	0.50	0.30	1.50
2017	2	4	2	12	4	2	0.50	3.00	0.33	0.50	0.17	1.00
2018	1	2	1	6	2	0	0.50	3.00	0.33	0.00	0.00	0.00
2019	1	2	1	5	2	0	0.50	2.50	0.40	0.00	0.00	0.00
2020	2	2	0	6	3	1	0.00	3.00	0.50	0.33	0.17	0.50
2021	2	1	0	2	2	2	0.00	2.00	1.00	1.00	1.00	1.00
2022	3	6	3	14	2	0	0.50	2.33	0.14	0.00	0.00	0.00
2023	4	10	6	22	5	1	0.60	2.20	0.23	0.20	0.05	0.25

^A Renest Rate = Total Renests / Total Nests.

^B Mean Clutch Size = Total Eggs Laid / Total Nests.

^C Hatch Rate = Total Eggs Hatched / Total Eggs Laid.

^D Fledge Rate = Total Chicks Fledged / Total Eggs Hatched.

^E Egg Success = Total Chick Fledged / Total Eggs Laid.

^F Productivity = Total Chicks Fledged / Total Breeding Pairs.

Productivity

Three nests hatched but only one chick fledged, in 2023. American oystercatcher productivity was 0.25, in 2023. Between 2006 and 2023, productivity fluctuated between 0.00 and 1.50 chicks fledged/breeding pair (Figure 5).

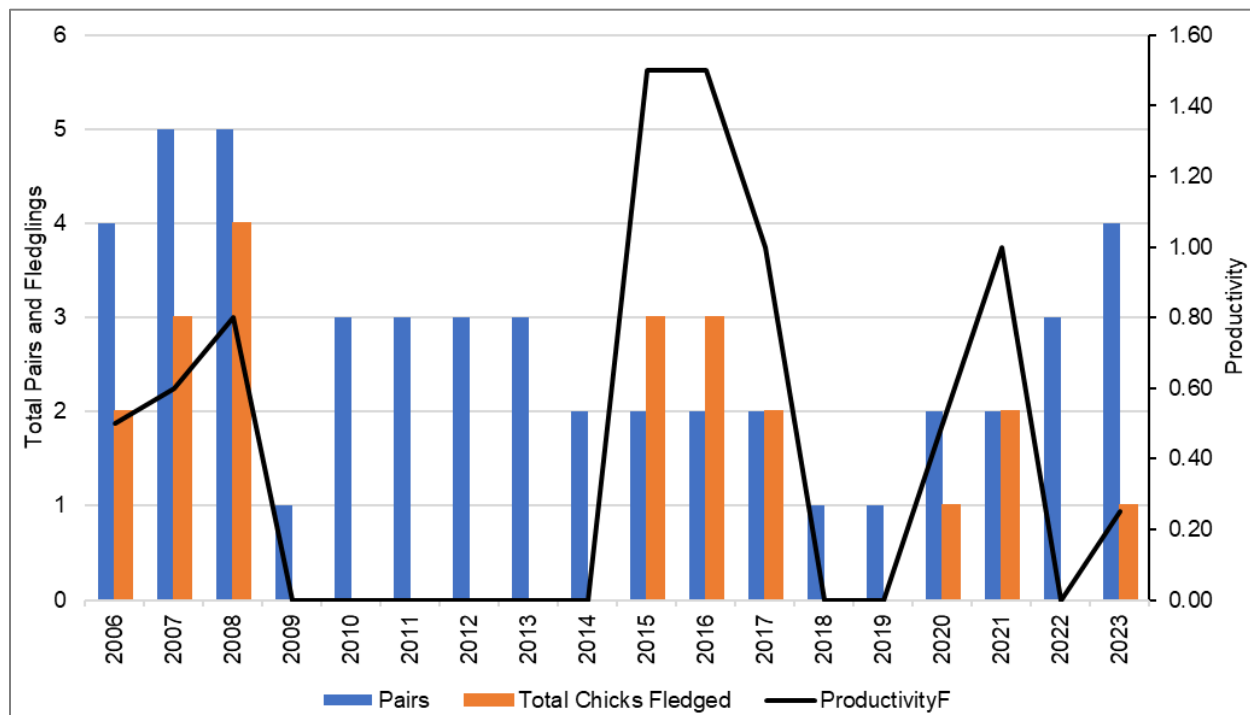


Figure 5. American oystercatcher breeding pairs, chicks fledged, and productivity, from 2006 to 2023 at Cape Cod National Seashore.

NPS / CACO

Migratory, Staging and Post-Breeding Shorebirds

General Staging Counts

The following results are estimates. Field staff monitor and report general locations of large flocks (greater than 50 individuals), and report estimates of numbers and individual species when conditions allow.

Areas with highest concentrations of mixed roseate and common tern flocks included Hatches Harbor and Herring Cove Marsh, High Head, and Jeremy Point (Table 14).

Table 14. Mixed tern flock estimated high counts by site at Cape Cod National Seashore in 2023.

Site	High Count
Wood End/Long Point	400
Herring Cove	200
Hatches Harbor	2000
Race Point North	500

Table 14 (continued). Mixed tern flock estimated high counts by site at Cape Cod National Seashore in 2023.

Site	High Count
Race Point	150
Race Point South	300
Mission Bell	400
Exit 9	150
Armstrong	350
High Head	800
Head of the Meadow	150
Coast Guard Truro	400
Longnook	0
Ballston Beach	0
Newcomb Hollow	0
Cahoon Hollow	0
White Crest	0
LeCount Hollow	0
Marconi Station	0
Marconi Beach	0
Nauset Light	0
Coast Guard Eastham	40
Bound Brook	0
Duck Harbor	0
Great Island	0
Jeremy Point	1500

Roseate Tern

In 1987, roseate terns were listed as a federally endangered species under the [Endangered Species Act of 1973](#). Researchers estimate that approximately 70% of the entire Northeast 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.

In 2023, Roseate terns were present in mixed flocks from July through October at CACO beaches. Visiting researchers conduct roost counts and resight banded individuals.

Common Tern

In Massachusetts, the common tern is listed as a Species of Special Concern. There were two nests documented at Jeremy Point in 2023 with a high count of 20 adults using the area. No nests hatched in 2023. Common terns used to nest frequently on New Island in Orleans, but a nest has not been found in almost a decade.

In 2023, a research project documenting common tern migration pathways partially occurred on park beaches. Two receivers were placed at roosting hot spots, during fall migration, to collect data from common terns with transmitters attached. Handling of birds did not occur in the park.

Red Knot

In 2014, rufa red knots (*Calidris canutus rufa*) were listed as a threatened species under the [Endangered Species Act of 1973](#), with proposed critical habitat designations identified in 2015 with in the park. 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 2023, red knots were on observed on only a few occasions; at Wood End/Long Point (2 total) and twice at Coast Guard Eastham (20–30 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, American Oystercatchers and Least Terns

Shorebird staff 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, where groups of up to 27 piping plovers were observed into mid-September. One piping plover was observed on 27 October, the last day staff were in the field. Nonbreeding and staging least terns congregated on park beaches through August and early September. American oystercatchers were observed at Jeremy Point through mid-September.

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Appendix A. Maps of 2023 Shorebird Nesting Sites at Cape Cod National Seashore

Figures 6–31 depict the spatial distribution and locations of documented shorebird nesting sites across Cape Cod National Seashore in 2023.

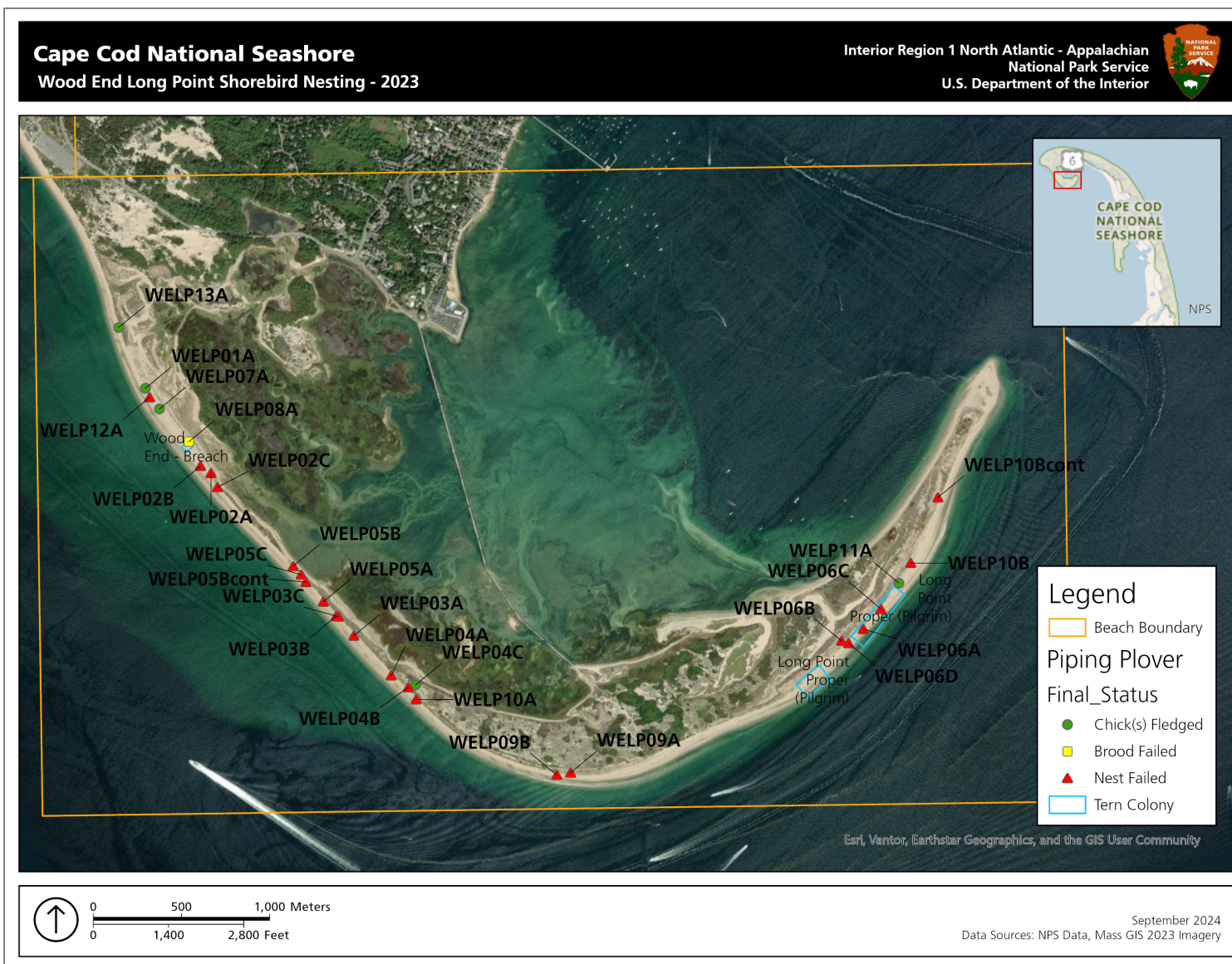


Figure 6. Shorebird nesting sites at Wood End Long Point, Cape Cod National Seashore, 2023.

NPS / CACO

Cape Cod National Seashore
Herring Cove Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
National Park Service
U.S. Department of the Interior

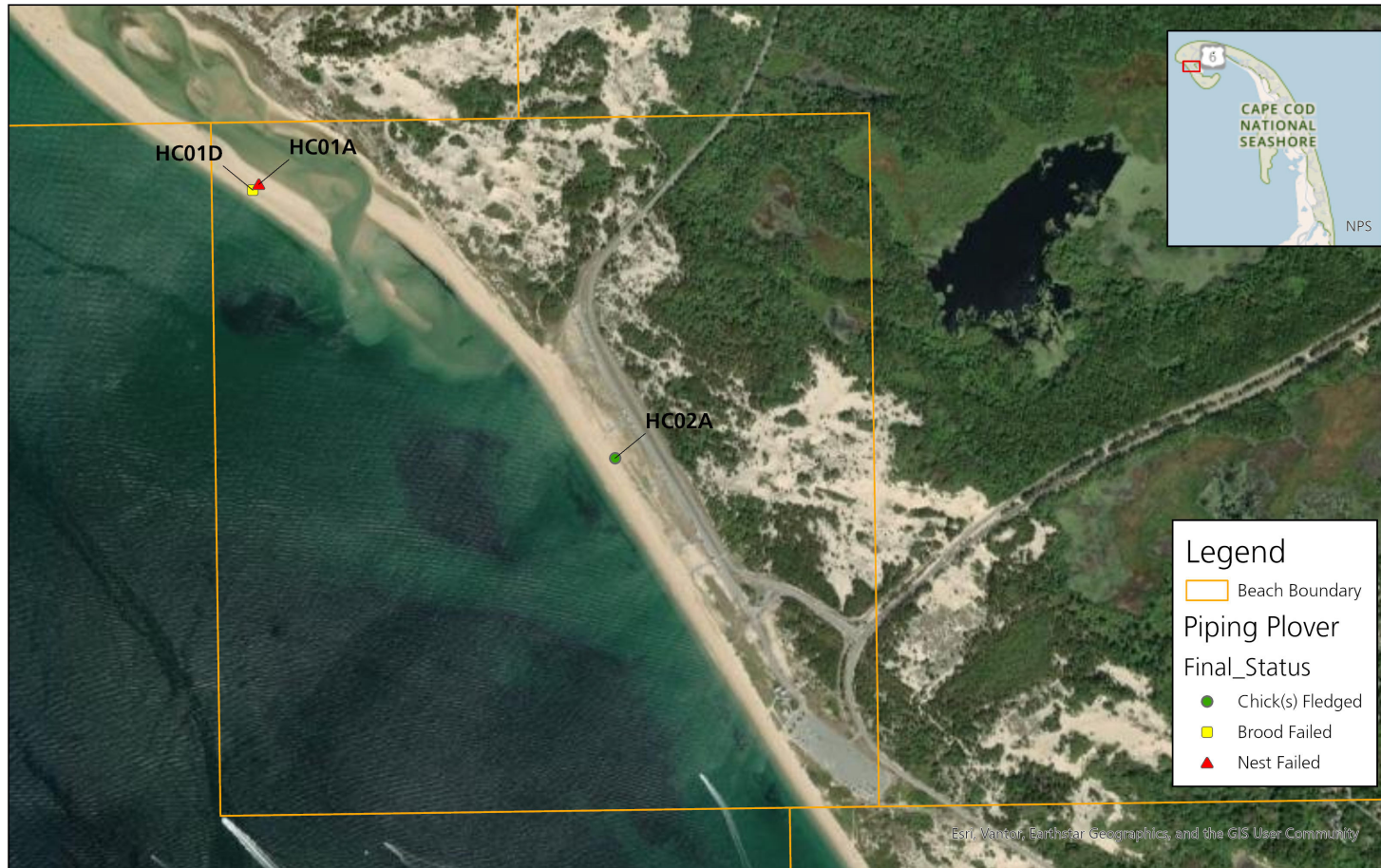


Figure 7. Shorebird nesting sites at Herring Cove, Cape Cod National Seashore, 2023.

NPS / CACO

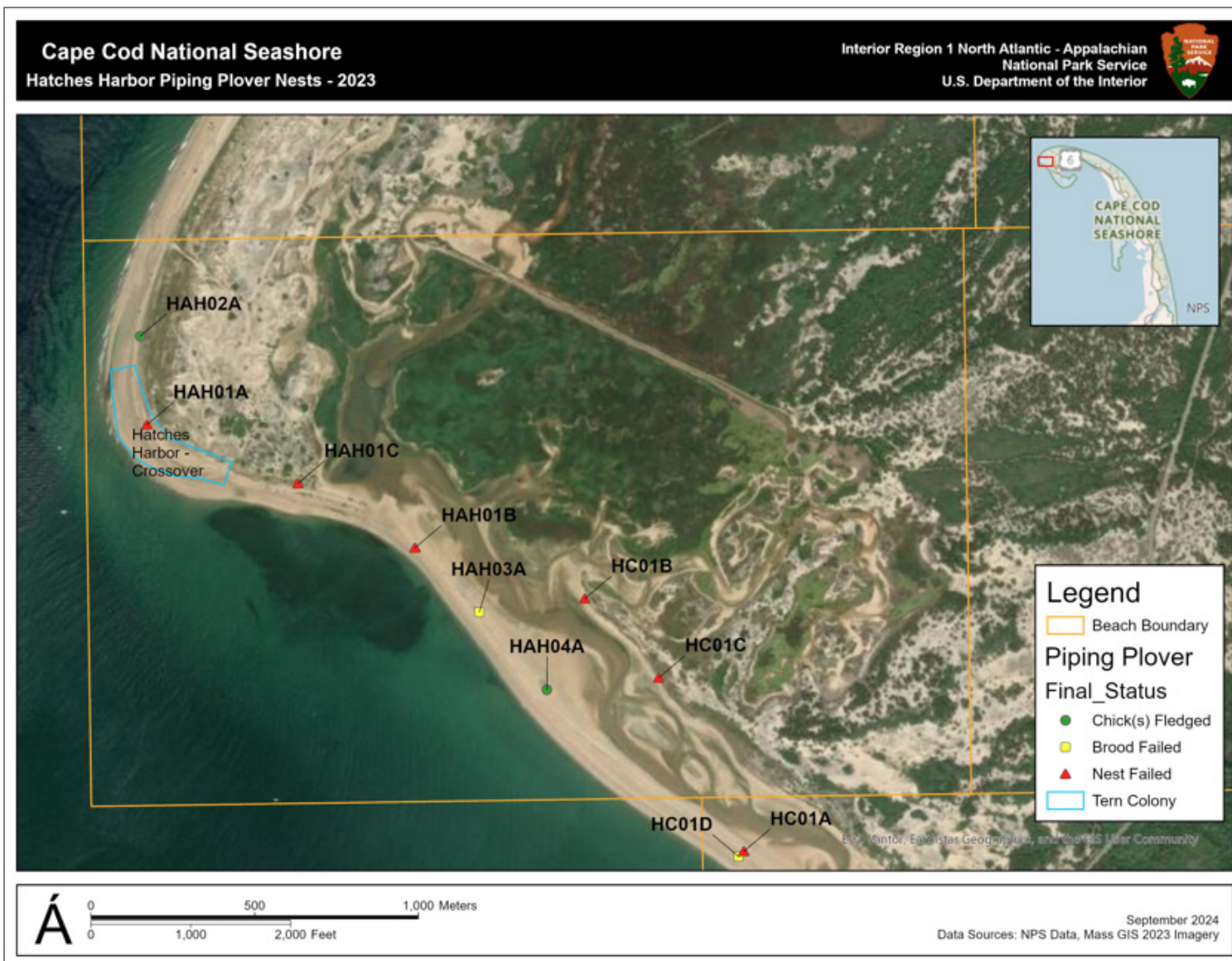


Figure 8. Shorebird nesting sites at Hatches Harbor, Cape Cod National Seashore, 2023.

NPS / CACO

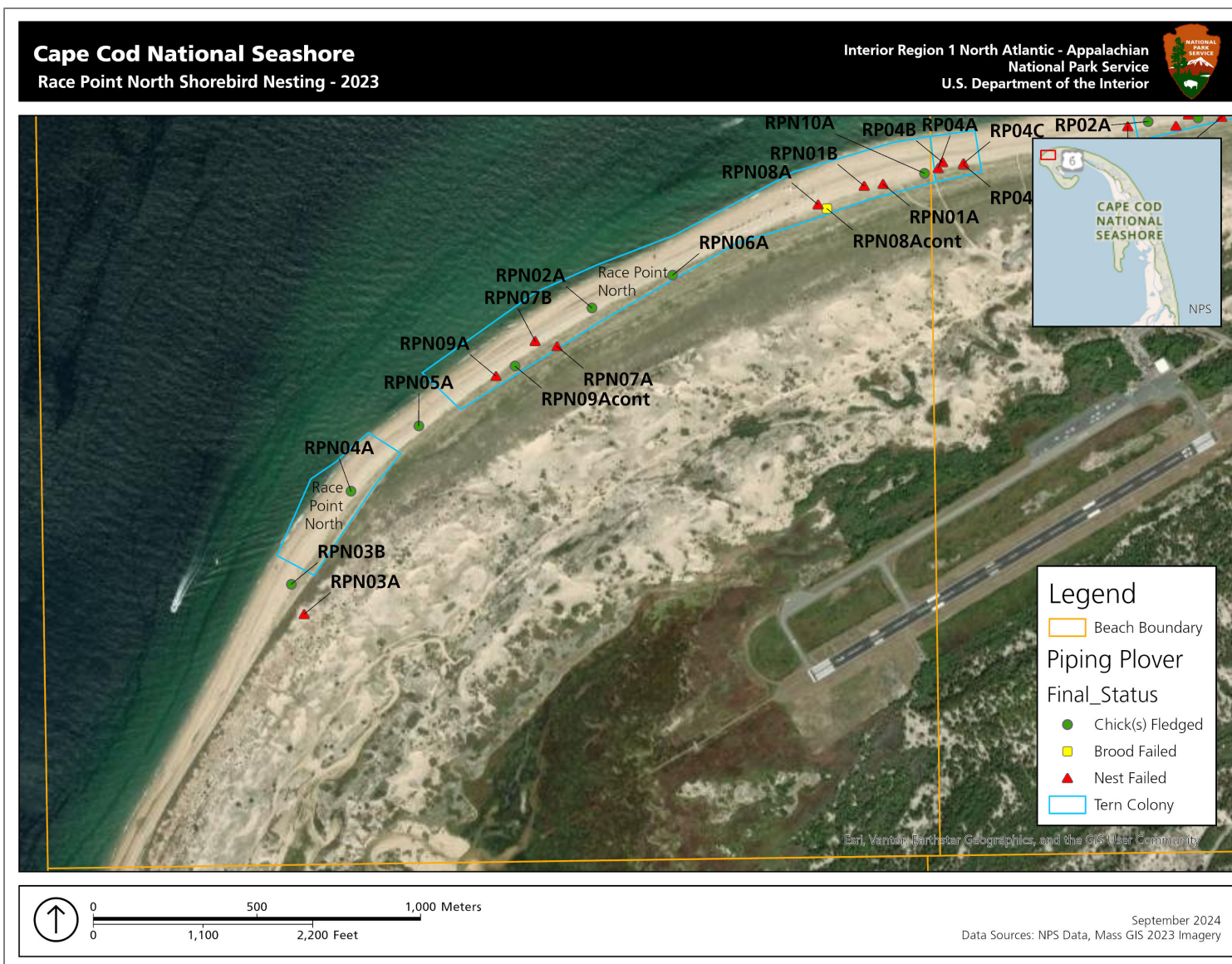


Figure 9. Shorebird nesting sites at Race Point North, Cape Cod National Seashore, 2023.

NPS / CACO

Cape Cod National Seashore
Race Point Shorebird Nesting - 2023

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Figure 10. Shorebird nesting sites at Race Point, Cape Cod National Seashore, 2023.
NPS / CACO

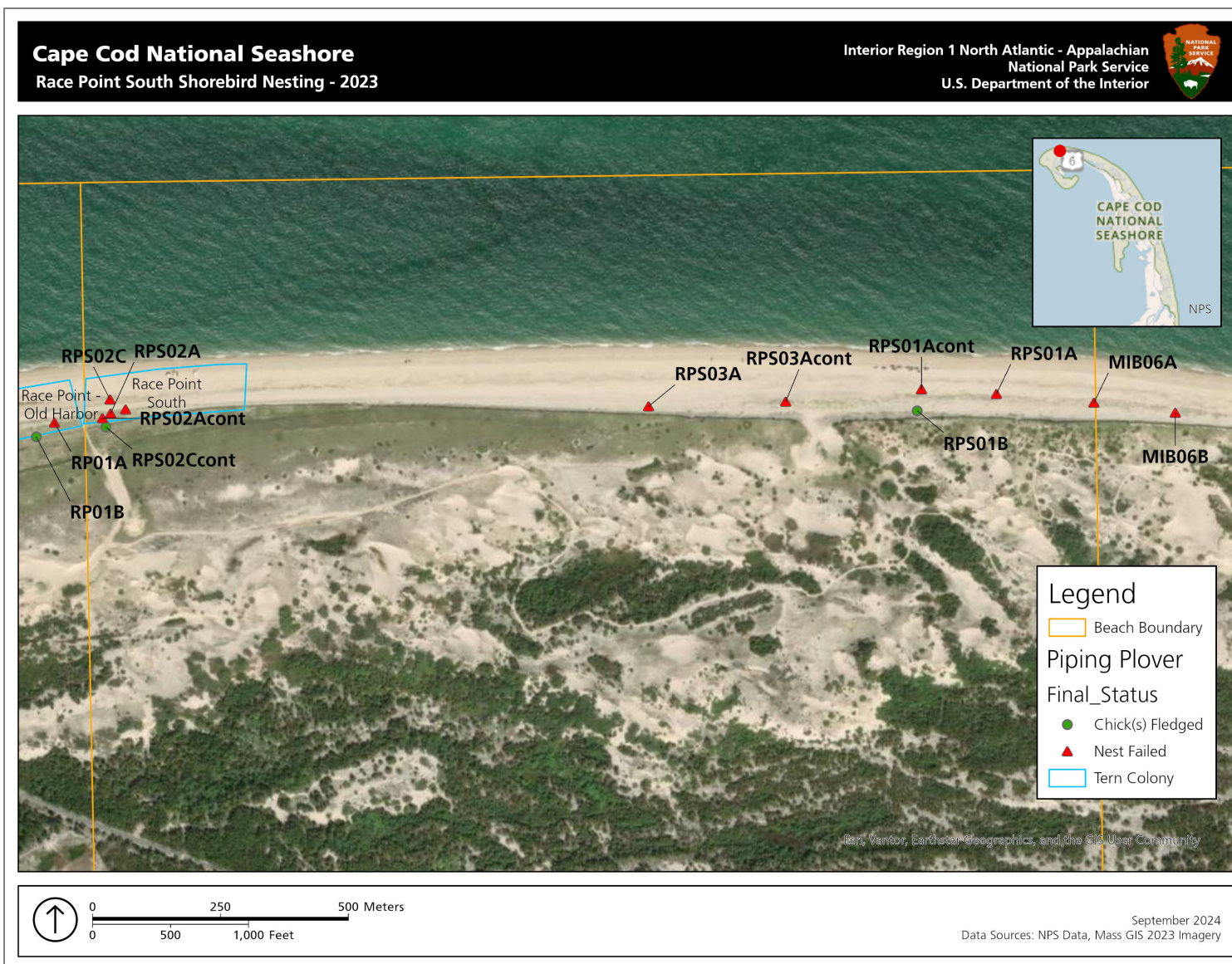


Figure 11. Shorebird nesting sites at Race Point South, Cape Cod National Seashore, 2023.

NPS / CACO

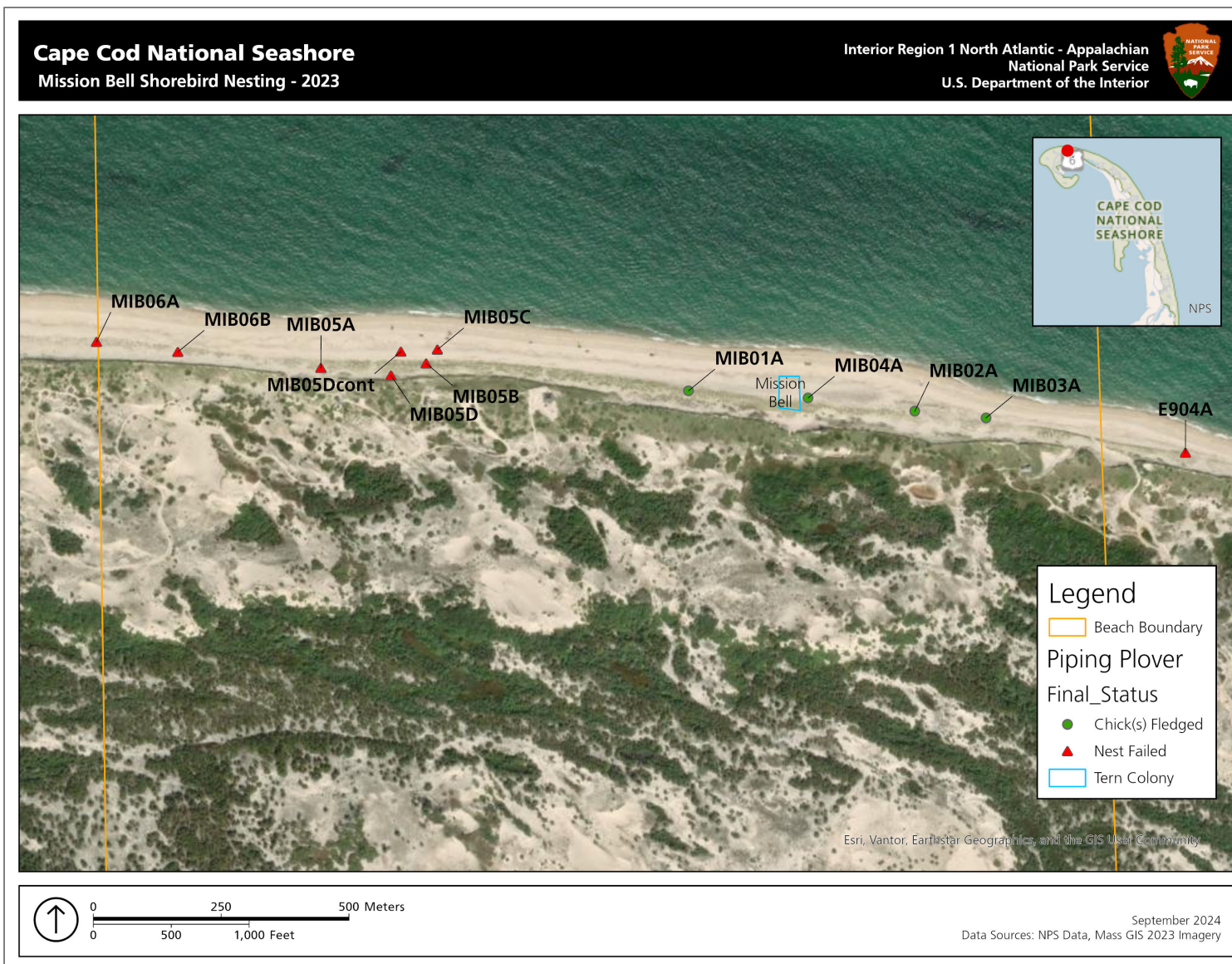


Figure 12. Shorebird nesting sites at Mission Bell, Cape Cod National Seashore, 2023.

NPS / CACO

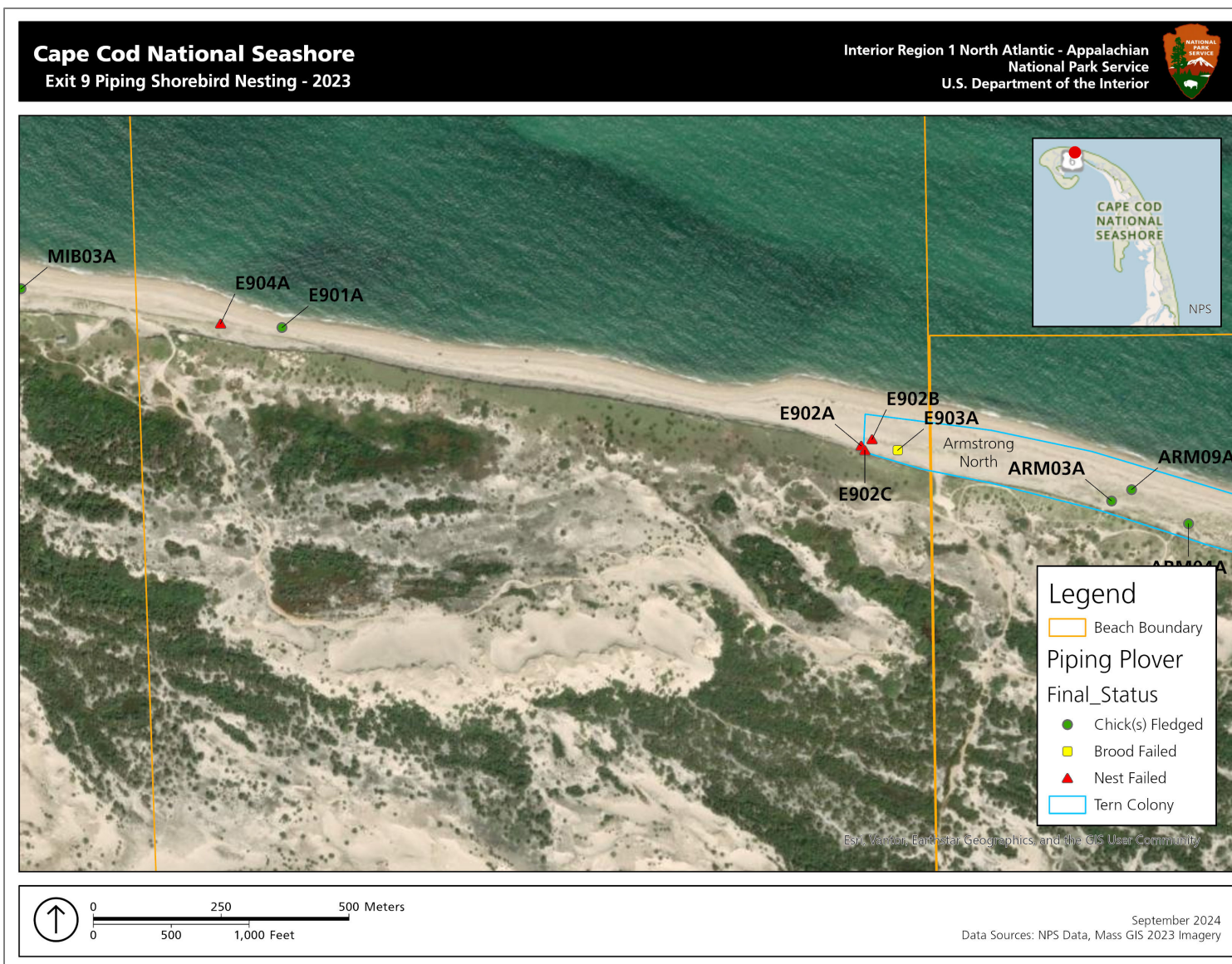


Figure 13. Shorebird nesting sites at Exit 9, Cape Cod National Seashore, 2023.

NPS / CACO

Cape Cod National Seashore
Armstrong Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
National Park Service
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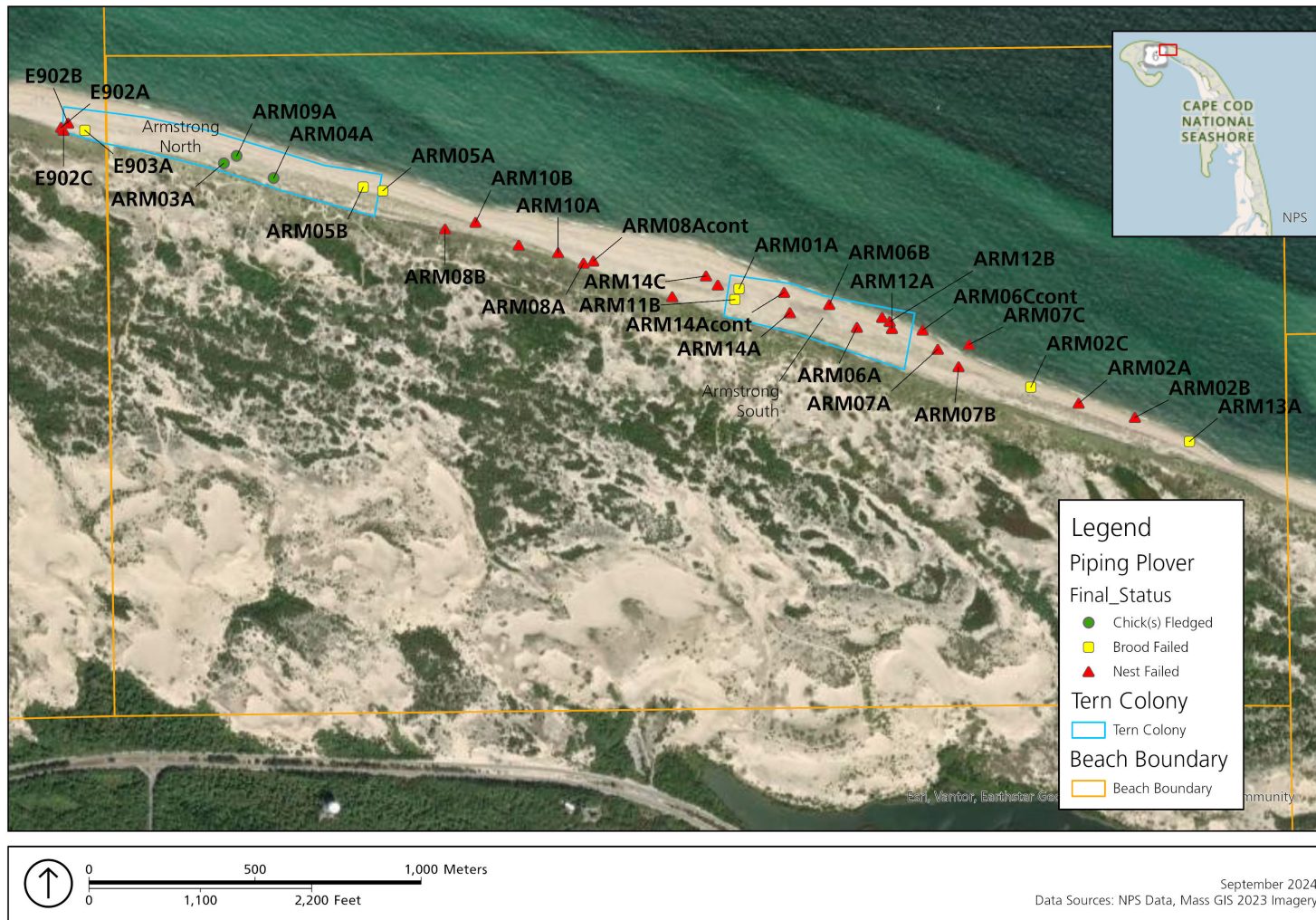


Figure 14. Shorebird nesting sites at Armstrong, Cape Cod National Seashore, 2023.

NPS / CACO

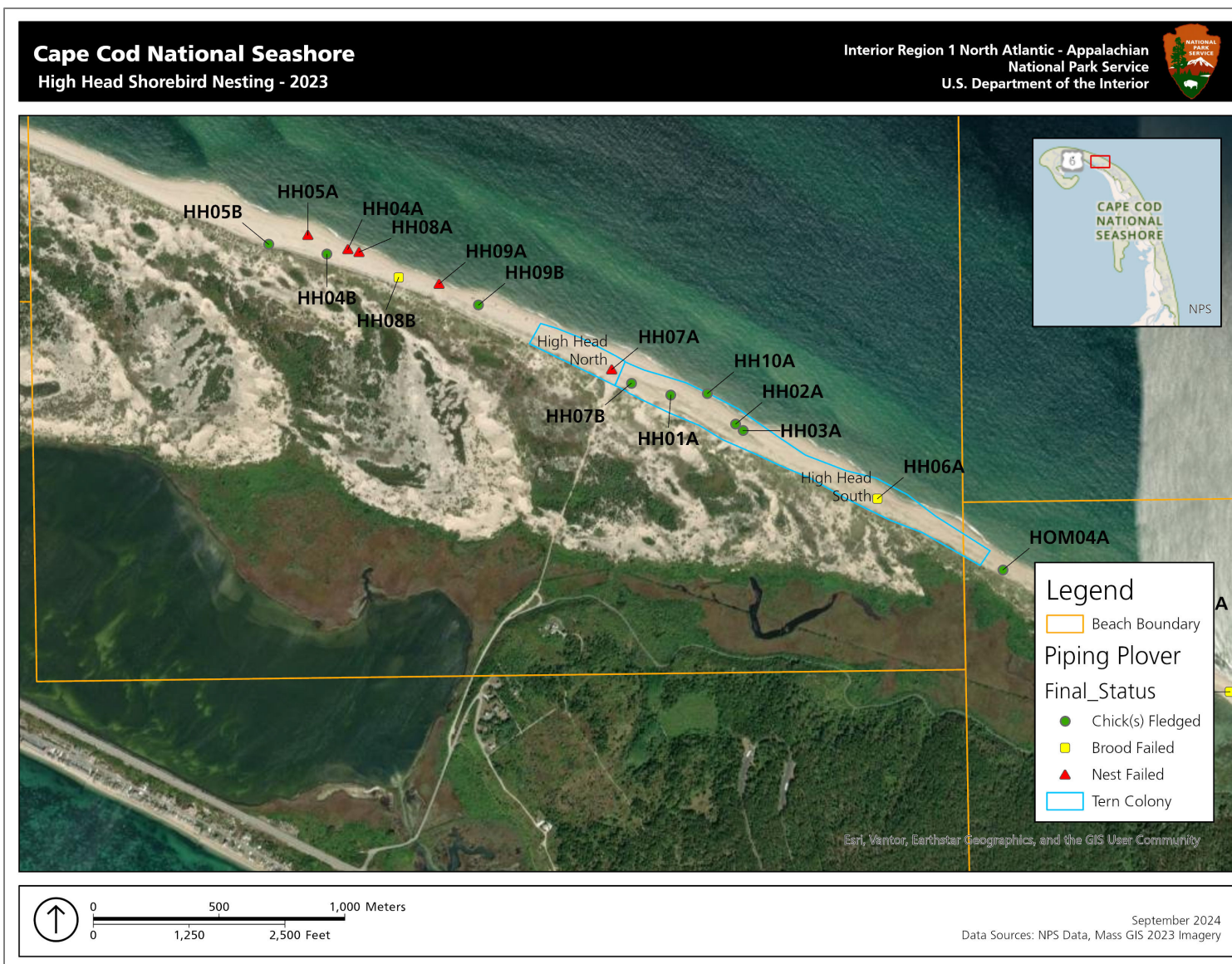


Figure 15. Shorebird nesting sites at High Head, Cape Cod National Seashore, 2023.

NPS / CACO

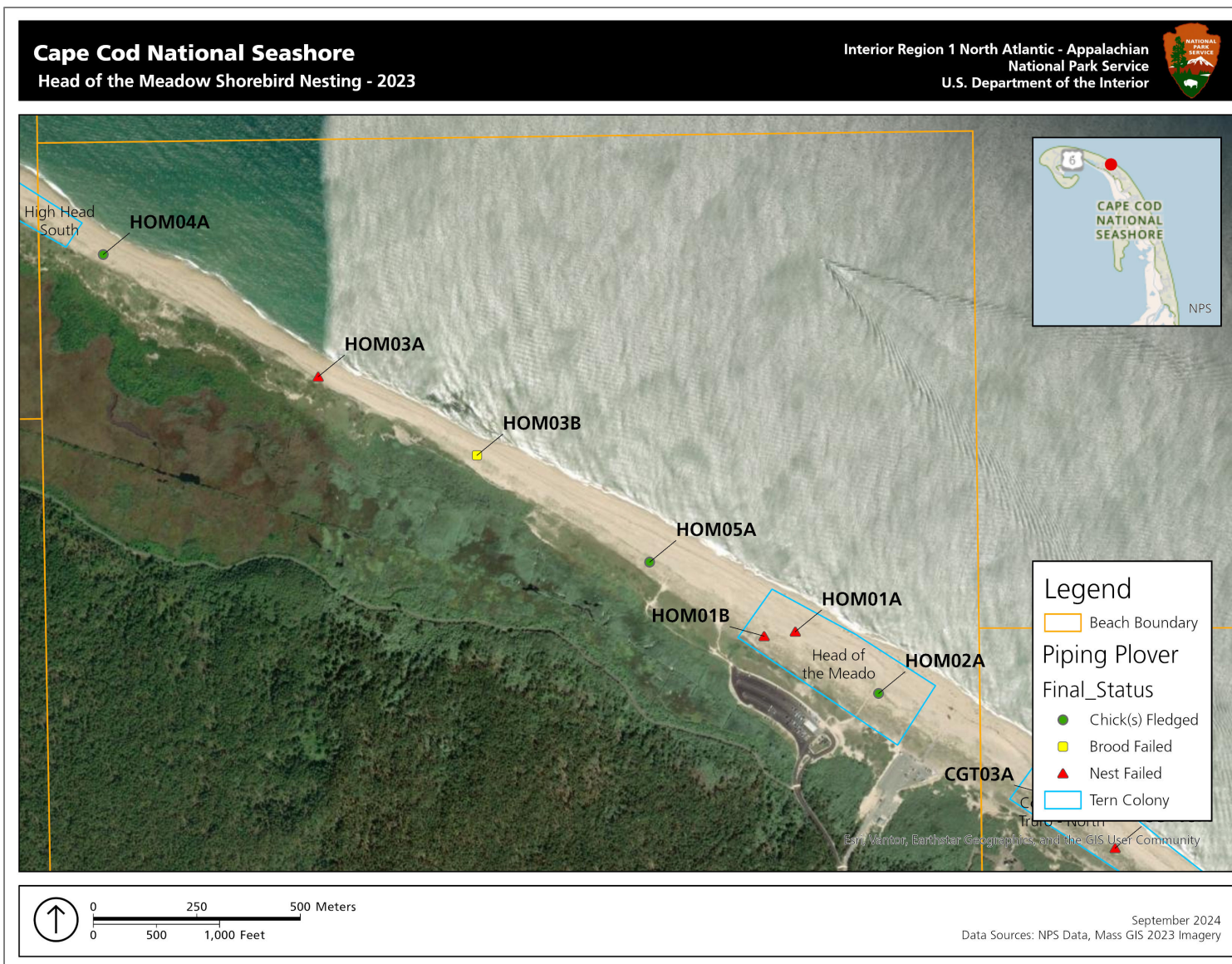


Figure 16. Shorebird nesting sites at Head of the Meadow, Cape Cod National Seashore, 2023.

NPS / CACO

Cape Cod National Seashore

Coast Guard Truro Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
National Park Service
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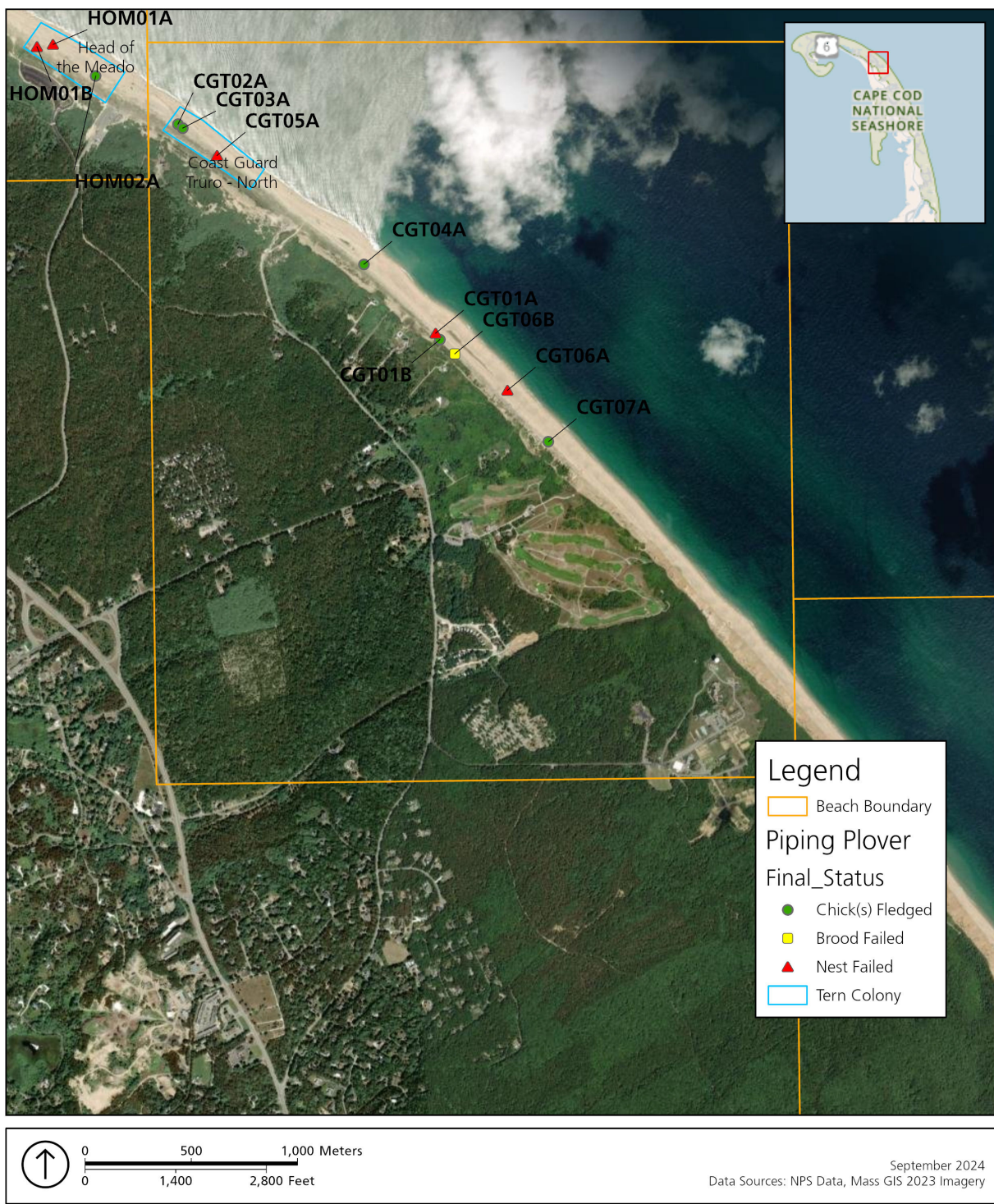


Figure 17. Shorebird nesting sites at Coast Guard Truro, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Longnook Piping Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
National Park Service
U.S. Department of the Interior

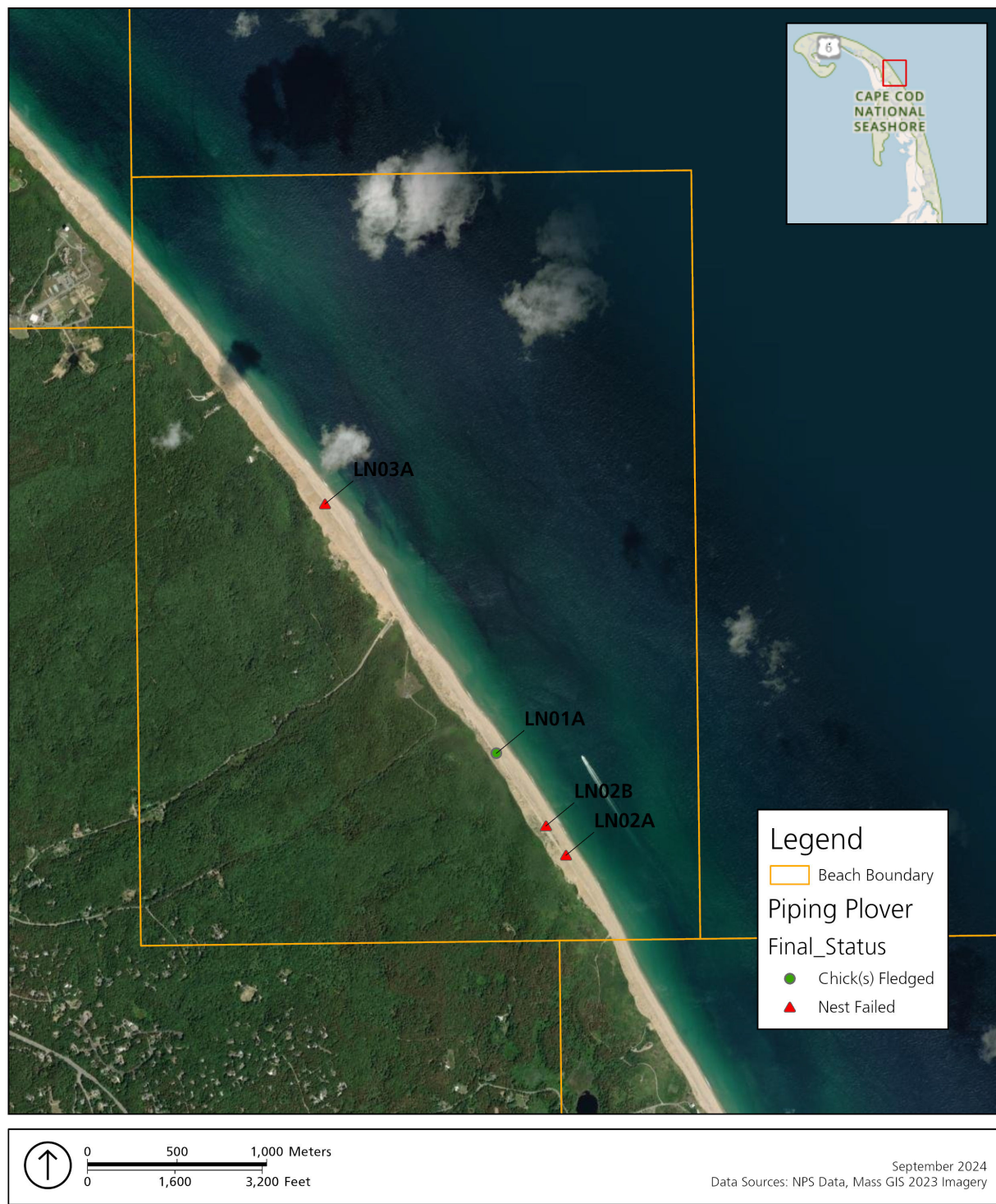


Figure 18. Shorebird nesting sites at Longnook, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Ballston Shorebird Nesting - 2023

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Figure 19. Shorebird nesting sites at Ballston, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore

Newcomb Hollow Shorebird Nesting - 2023

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Figure 20. Shorebird nesting sites at Newcomb Hollow, Cape Cod National Seashore, 2023.

NPS / CACO

Cape Cod National Seashore
Cahoon Hollow Shorebird Nesting - 2023

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Figure 21. Shorebird nesting sites at Cahoon Hollow, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
White Crest Shorebird Nesting - 2023

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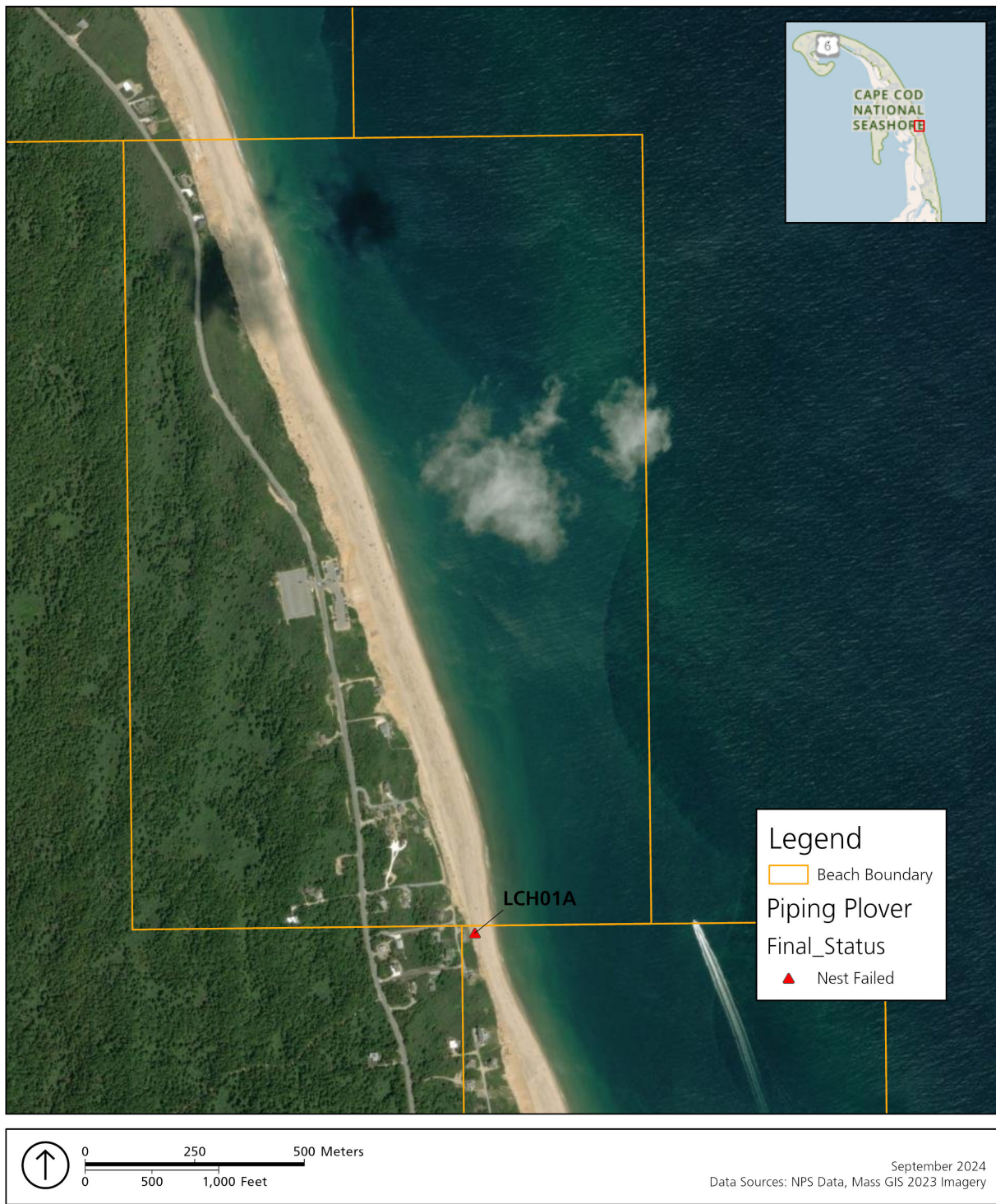


Figure 22. Shorebird nesting sites at White Crest, Cape Cod National Seashore, 2023.
NPS / CACO



Figure 23. Shorebird nesting sites at LeCount Hollow, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Marconi Station Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
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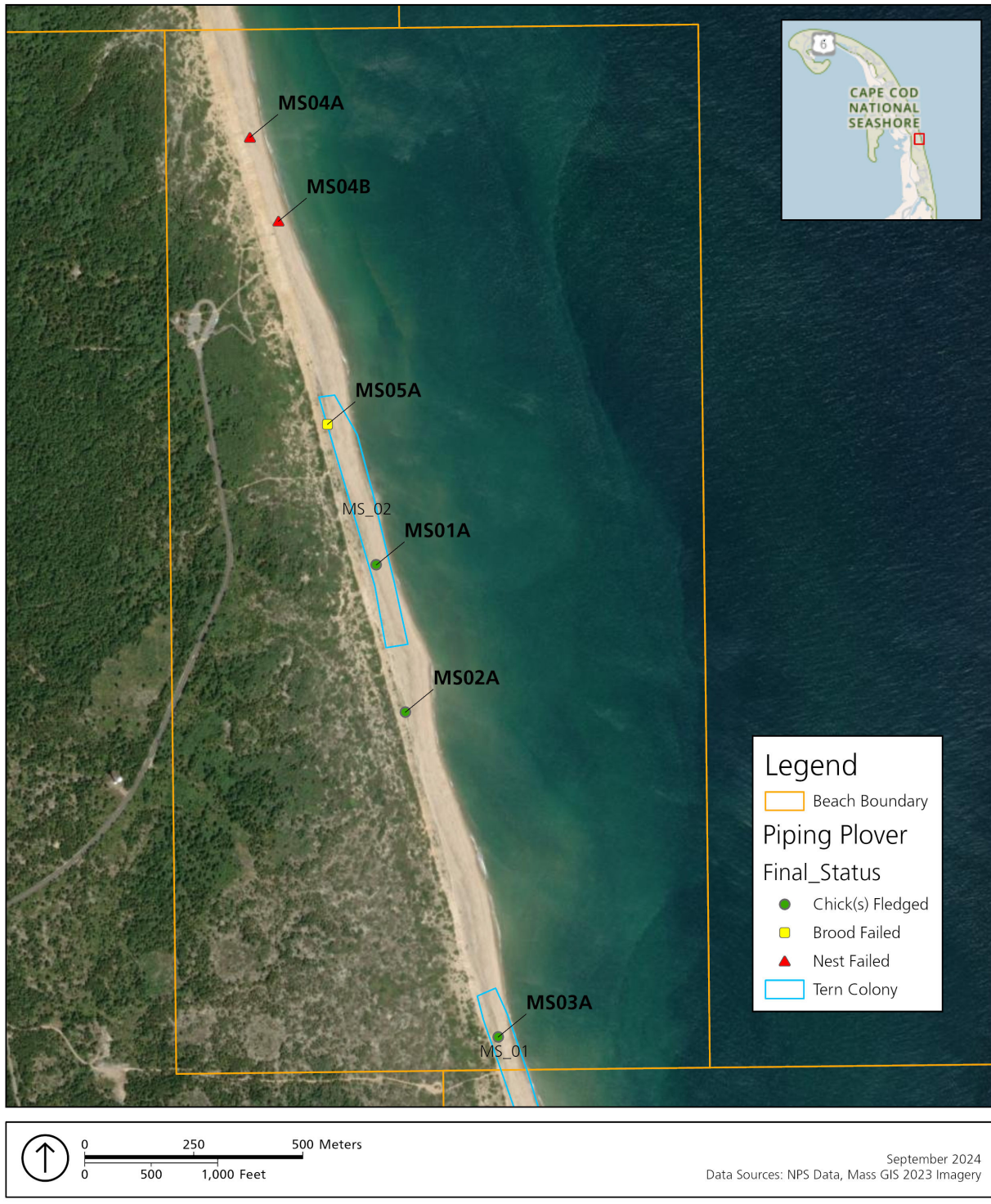


Figure 24. Shorebird nesting sites at Marconi Station, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Marconi Beach Shorebird Nesting - 2023

Interior Region 1 North Atlantic - Appalachian
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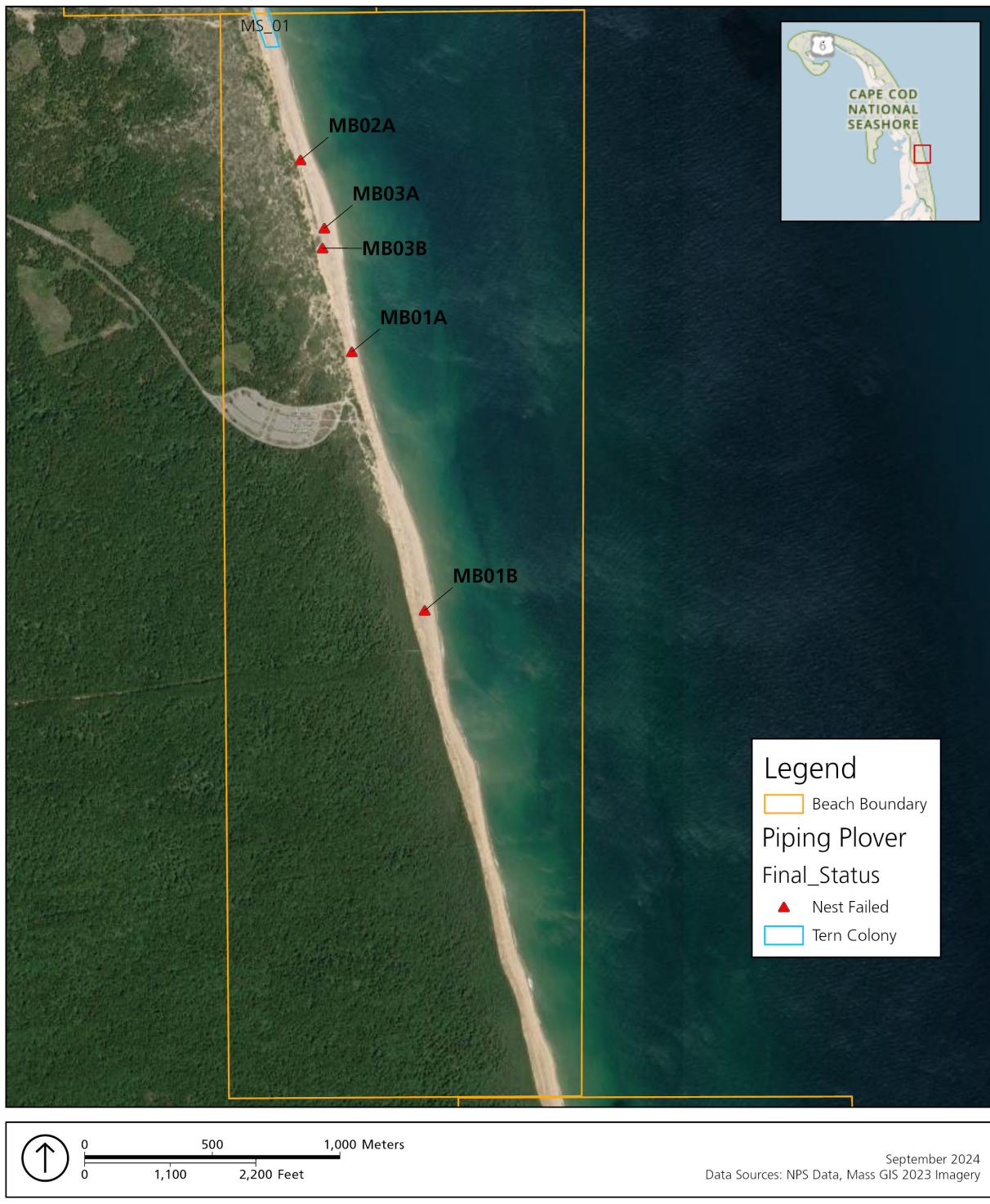


Figure 25. Shorebird nesting sites at Marconi Beach, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Nauset Light Shorebird Nesting - 2023

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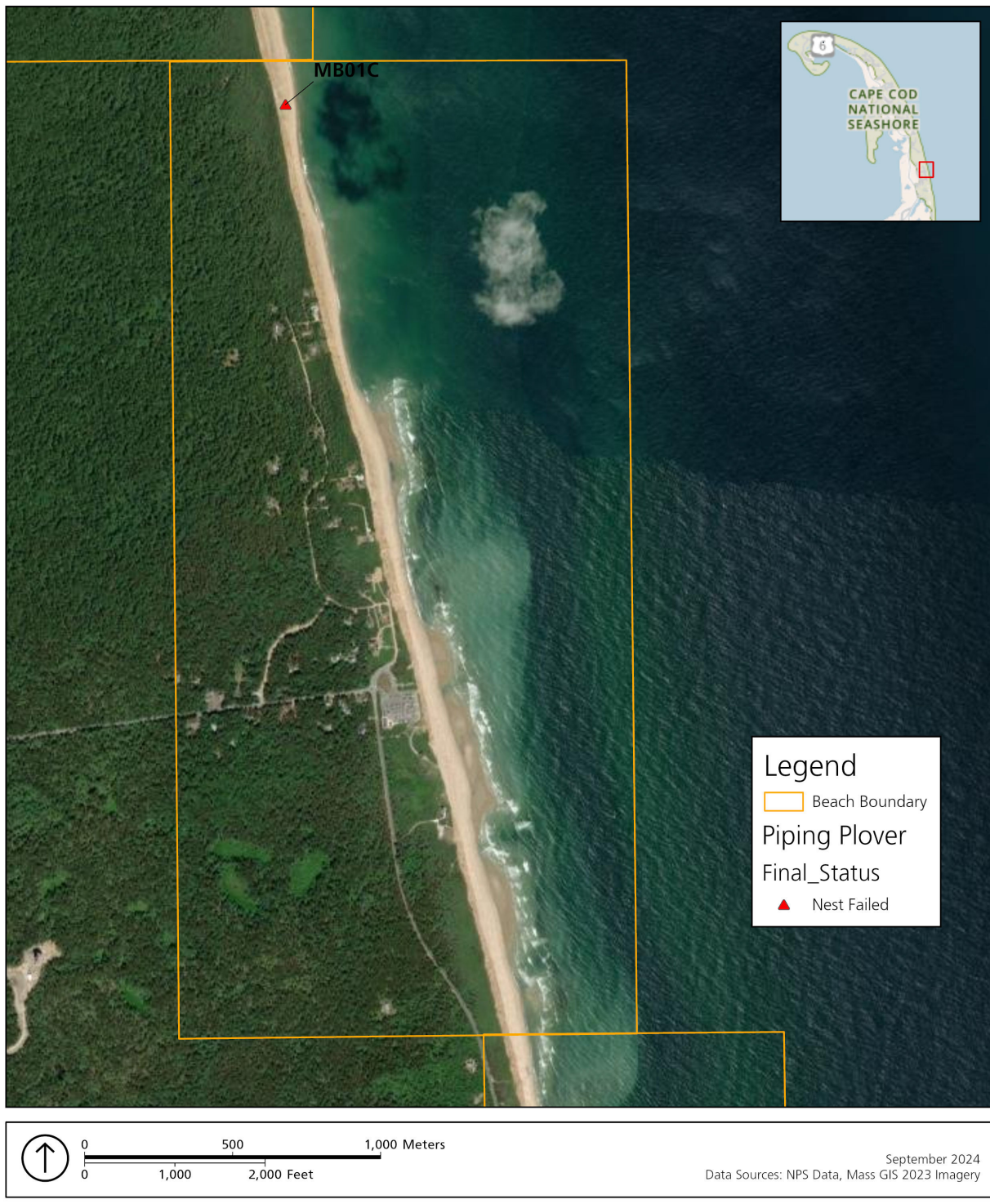


Figure 26. Shorebird nesting sites at Nauset Light, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Coast Guard Eastham Shorebird Nesting - 2023

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Figure 27. Shorebird nesting sites at Coast Guard Eastham, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Bound Brook Shorebird Nesting - 2023

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Figure 28. Shorebird nesting sites at Bound Brook, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Duck Harbor Shorebird Nesting - 2023

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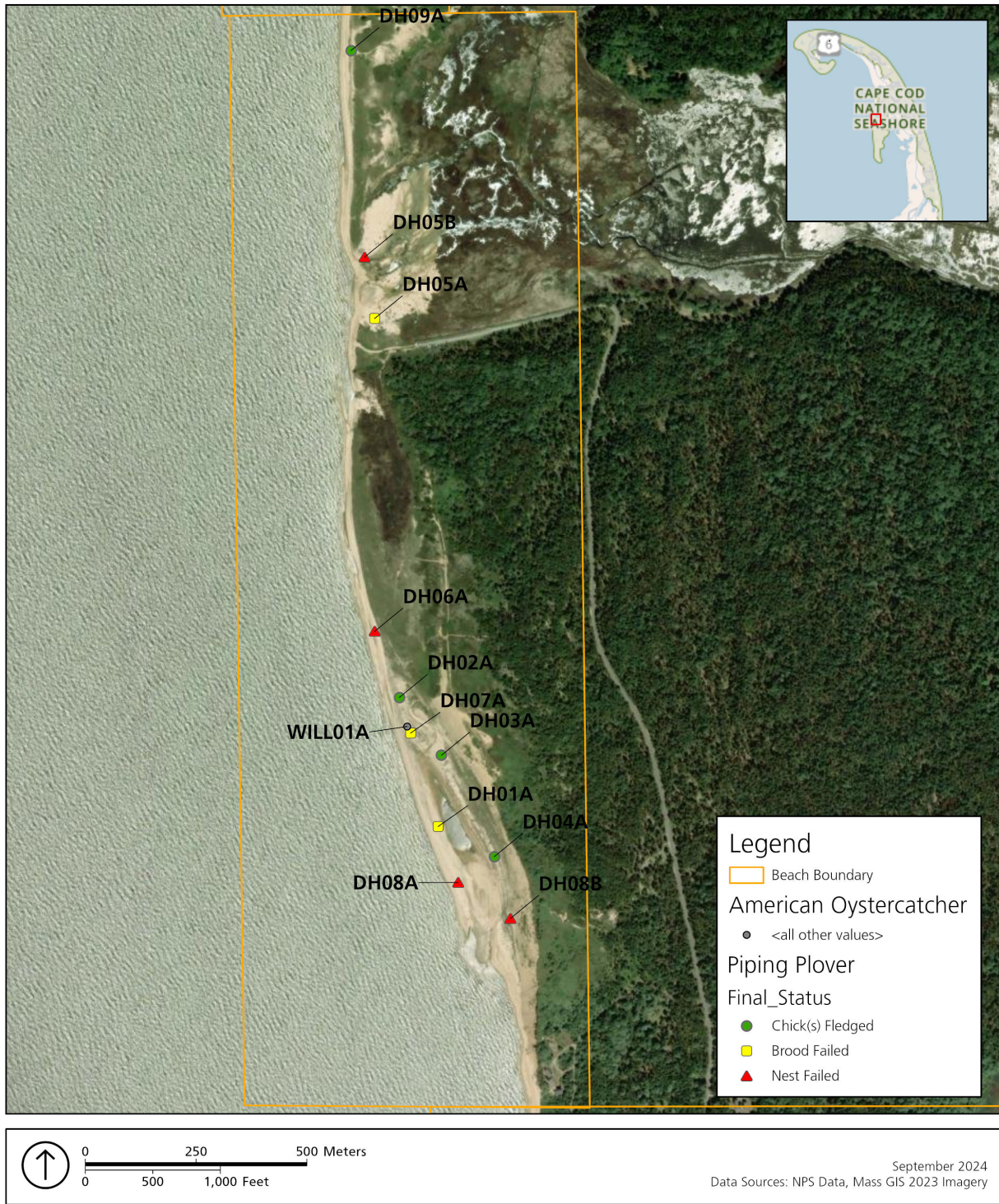


Figure 29. Shorebird nesting sites at Duck Harbor, Cape Cod National Seashore, 2023.
NPS / CACO



Figure 30. Shorebird nesting sites at Great Island, Cape Cod National Seashore, 2023.
NPS / CACO

Cape Cod National Seashore
Jeremy Point Shorebird Nesting - 2023

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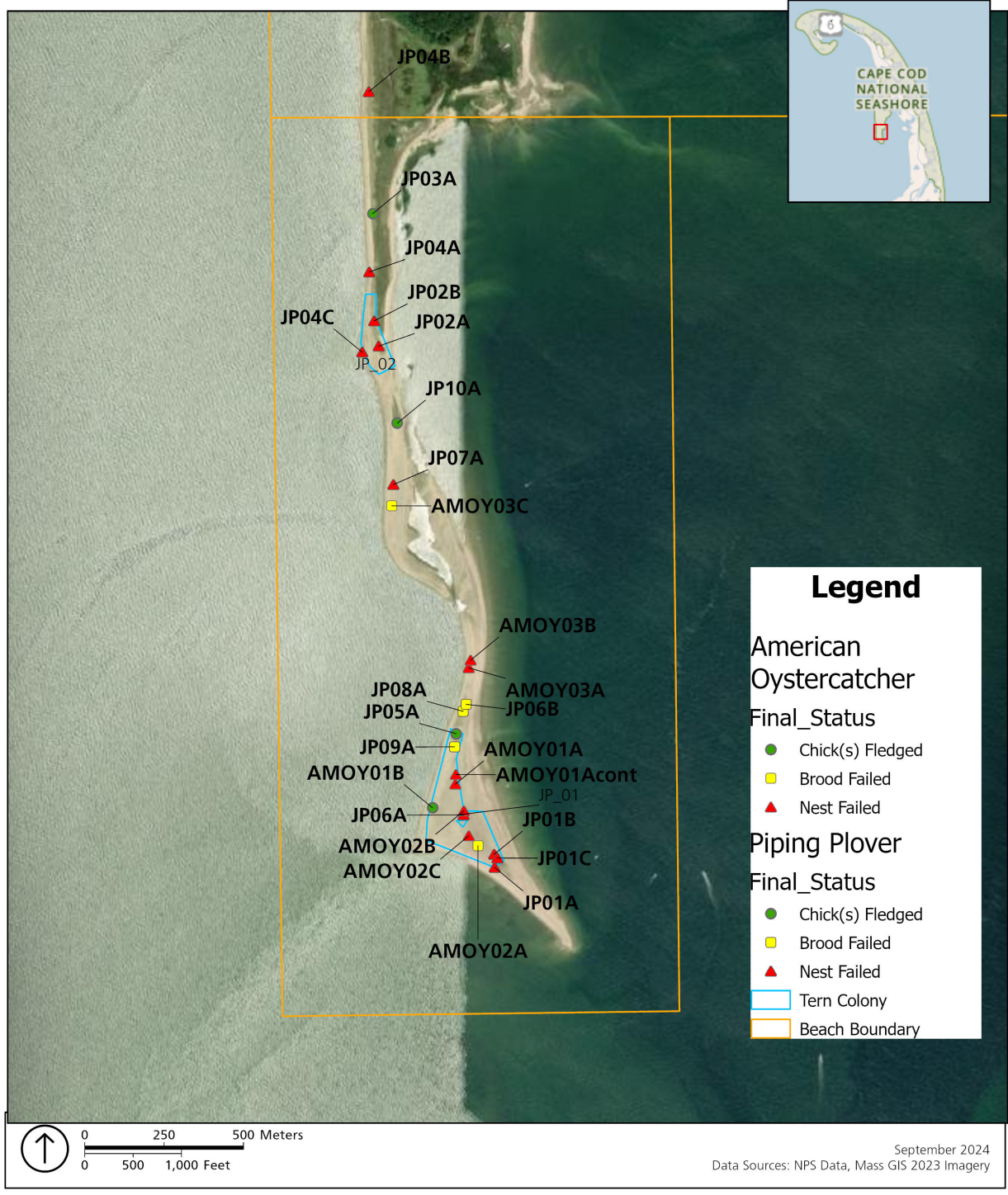


Figure 31. Shorebird nesting sites at Jeremy Point, Cape Cod National Seashore, 2023.
NPS / CACO

National Park Service
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