PIPING PLOVER (Charadrius melodus) MONITORING AT CAPE LOOKOUT NATIONAL SEASHORE

2017 SUMMARY REPORT

Mouth of Soundside Creek on Portsmouth Flats. NPS 2017.

NATIONAL PARK SERVICE
CAPE LOOKOUT NATIONAL SEASHORE
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Abstract

A total of 27 pairs of piping plovers were recorded at Cape Lookout National Seashore (CALO) in 2017. The birds at CALO accounted for 63% of the nesting pairs in North Carolina. Twenty four pairs nested on North Core Banks and three pairs on South Core Banks. Egg-laying was initiated on April 21st and a total of 44 nests were documented. Thirteen nests hatched and 4 chicks fledged. Productivity was 0.15 chicks fledged per nesting pair. No broods foraged at the oceanside in 2017.

Introduction

The piping plover is listed as a federal threatened species by the U.S. Fish and Wildlife Service (1985). Piping plover monitoring at CALO began with a baseline study in 1989 (Fraser *et al*, 1990). The park is a significant nesting area, containing 63% of the nesting pairs in the state of North Carolina (Schweitzer, 2017). CALO also serves as a wintering and migratory site. There are three designated wintering critical habitat units within the seashore. Monitoring focuses on documenting reproductive success, implementing methods to increase the productivity of this threatened species, and non-breeding use surveys. This report contains a summary of monitoring results for 2017, comparisons to results from previous years, and discussions based on long-term monitoring of piping plovers at CALO.

Site Description

Cape Lookout National Seashore is located in the southern Outer Banks of North Carolina between Ocracoke and Beaufort Inlets. The seashore was divided into four barrier islands at the beginning of the 2017 breeding season. The northernmost island, North Core Banks (NCB), was 18 miles long, extending from Ocracoke Inlet to Old Drum Inlet. Middle Core Banks (MCB) extended from Old Drum Inlet to Ophelia Inlet at four miles in length. For reporting purposes MCB is treated as part of NCB, representing breeding pairs from Ocracoke Inlet to Ophelia Inlet, mile 0 to mile 22.7. South Core Banks (SCB) extends southward from Ophelia Inlet almost 24 miles to Barden Inlet. The Core Banks have a northeast to southwest orientation and exhibit a low profile landscape. Shackleford Banks (SB), is 9 miles long and has an east-west orientation with a higher dune system and larger areas of vegetation. All islands in the park are subject to constant and dramatic change by the actions of wind and waves.

Methods

Bird sanctuary signs were used to close all known piping plover nesting habitat to pedestrian and vehicular entry by April 1. Beginning in early April, nesting areas were surveyed daily for territorial pairs and nests. Potential habitat outside posted areas was monitored and posted as necessary with a minimum 150 foot buffer distance from nest scrapes and nests. Locations of nests were recorded and monitored daily until they hatched or were lost. The *Interim Protected Species Management Plan/ Environmental Assessment* (IPSMP), March 2006, developed for CALO provides guidance for monitoring and management (National Park Service 2006).

Nests were protected with predator exclosures if the topography of the location was suitable and monitoring was sufficient. Exclosures were circular, 10 feet in diameter, made of 4”x 2” mesh wire fence anchored with steel rebar and were topped with ¾” mesh bird netting. Use of predator exclosures and monitoring adhered to *the Piping Plover (Charadrius melodus) Atlantic Coast Population Revised Recovery Plan*, Appendix F (USFWS, 1996).

After nests hatched, broods were monitored daily until the chicks fledged or were lost. Ocean beach foraging protection zones were established while the chicks were present.

Counts of wintering and migrating piping plovers were made monthly from August to March. The counts were made near the 15th of each month in the non-nesting season. The ocean beach, inlets and soundside sandy beaches were surveyed. Banded birds were searched for on the 5th, 15th, and 25th of August, September, and October during the fall migration.

Results
Nesting Pairs

A total of 27 pairs of piping plovers attempted nesting at CALO in 2017, Table 1. Table 2 includes 2017 pair numbers and data back to 1989. Twenty four pairs nested on North Core Banks (NCB), and three pairs on South Core Banks (SCB). Birds nested in five distinct areas. Appendix 1 shows the results of the June census window pair count. The four mile area around Ophelia Inlet, from Plover Inlet to Old Drum Inlet, contained the highest number of nesting pairs.

Table 1. Number of Pairs by Occupied Nesting Areas in 2017.

ISLAND	NESTING AREA	*NUMBER OF PAIRS*
North Core Banks	Portsmouth Flats	6
North Core Banks	Old Drum Inlet	5
North Core Banks	New Drum Inlet	11
North Core Banks	Ophelia Island	2
South Core Banks	Plover/Ophelia Inlet	3

Table 2. Piping Plover Breeding Pairs at Cape Lookout National Seashore 1989-2017

	1989	1992	1993	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Ocracoke Inlet	0	2	0	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Portsmouth Flats	14	8	9	7	8	17	15	9	11	9	8	6	4	6	8	14	14	12	13	12	19	13	14	14	7	6
Kathryn-Jane Flats	7	11	9	12	11	10	8	2	1	1	2	1	1	2	1	3	0	1	0	0	0	0	0	0	1*	0
Old Drum Inlet	3	2	1	1	2	1	1	0	0	0	0	1	0	0	0	0	2	3	6	8	8	4	6	6	7	5
New Drum Inlet (NCB/MCB) Mile 21 to 22.29	4	5	9	10	6	3	2	3	1	2	2	2	2	3	3	5	6	5	8	8	10	12	13	10	7	11
New Drum Inlet (SCB)/ Ophelia Island Mile 22.3 to 23	3	3	4	5	4	2	3	3	2	3	2	2	2	2	2	2	2	2	2	2	5	5	3	4	6	2
Plover Inlet/ Ophelia Inlet Mile 23 to 24	0	0	0	0	0	1	1	1	1	1	1	1	4	8	15	17	18	11	11	8	8	11	11	8	3	3
Cape Point	0	0	0	0	0	0	0	1	0	0	0	0	0	4	3	2	3	2	2	1	0	0	0	0	0	0
Power Squadron Spit	3	2	3	2	2	1	2	1	0	0	0	1	0	1	1	2	1	1	1	1	0	0	0	1	0	0
Shackleford Banks														1	0	0	0	0	0	0	0	0	0	0	0	0
CALO Total	34	33	35	39	35	36	32	21	16	16	15	14	13	27	33	45	46	37	43	41	51	45	47	43	30	27

*Portsmouth Flats and Kathryn-Jane Flats shared one pair.

Nests

There were 44 nesting attempts made in 2017 (Appendix 2). The earliest nest initiation was on April 21st and the latest was on June 30th. Forty nests were on NCB and four were on SCB. Of the 44 nests, 17 were re-nests. Thirteen nests hatched and 4 chicks fledged from 3 different broods. The average clutch size was 2.66 eggs and 27 of 104 known eggs hatched. Productivity for CALO was 0.15 chicks fledged per nesting pair (Table 3 & Appendix 3). Refer to Figures 2-5 for detailed maps of nests and nesting sites, (2014 DOQQ base layers).

Table 3. Piping Plover Nesting Success at CALO 2000-2017

Year	# Nests	# Pairs	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
				#	%	#	%	#	%	(Chicks/pair)
2000	18	16	65	12	67%	43	66%	8	19%	0.5
2001	19	16	64	8	42%	24	38%	5	21%	0.31
2002	20	15	65	13	65%	43	66%	4	9%	0.27
2003	15	14	55	7	47%	23	42%	6	26%	0.43
2004	13	13	44	11	85%	37	84%	12	32%	0.92
2005	31	27	105	24	77%	69	66%	23	33%	0.85
2006	37	33	125	29	78%	87	70%	29	33%	0.88
2007	58	45	173	29	50%	79	46%	11	14%	0.24
2008	57	46	179	31	54%	88	49%	9	10%	0.20
2009	45	36	145	24	53%	83	57%	30	36%	0.83
2010	58	43	204	34	59%	98	48%	31	32%	0.72
2011	48	41	157	35	73%	102	65%	37	36%	0.90
2012	66	51	207	36	54%	98	47%	29	30%	0.57
2013	52	45	173	30	58%	97	56%	47	48%	1.04
2014	57	47	190	28	49%	88	46%	9	10%	0.19
2015	56	43	209	32	57%	105	50%	34	32%	0.79
2016	41	30	133	13	32%	23	17%	5	22%	0.17
2017	44	27	104	13	30%	27	26%	4	15%	0.15

Predator Exclosures

In 2017, predator exclosures were used to protect 8 (18%) nests. Of the nests with exclosures 5 (62%) hatched, 3 were lost to weather. Predator exclosures were not used on 36 (82%) nests due mainly to the inaccessibility of MCB. Of the nests without exclosures 8 hatched (22%). Twenty-eight nests didn't hatch; nineteen were lost to unknown reasons, four were lost to weather/ flooding, three nests were lost to ghost crab predation, one nest was lost to feral cat predation and one was abandoned. Table 4 shows likely causes of nest losses for all nests.

Table 4. Likely Causes of Piping Plover Nest Losses in 2017.

NESTING AREA	# NESTS	# LOST	PREDATORS	STORM	ABANDONED	UNKNOWN
Portsmouth Flats	11	8	2	2	0	4
Old Drum Inlet (NCB)	9	7	2	1	0	4
New Drum Inlet (NCB)	18	13	0	2	1	10
Ophelia Island (NCB)	2	1	0	0	0	1
Plover Inlet (Mile 23.6)	4	2	0	2	0	0
Total	44	31	4	7	1	19

Beach Protection Zones and Brood Foraging

The area between Ophelia Inlet and Ramp 24 (Figure 5), 1 mile in length, was established as a protection zone, the only vehicle use was by NPS monitors, for piping plover chicks from June 18th to July 18th. The protection zone began the day of hatch of the first nest at Ophelia Inlet (SCB) and remained in place until the last chick was fledged, confirmed lost, or moved out of area.

Zero broods foraged on the ocean beach in 2017. Chicks foraged on soundside beach, sand flats, mudflats and ephemeral pools in areas off-limits to vehicles and in most cases all entry.

Non-breeding Piping Plover Surveys

Surveys in 2017 were incomplete and the three mile Middle Core Banks section proved difficult to access. Old Drum Inlet was open and prevented access to survey MCB for most of 2017. MCB was only censused in September, October and December. Table 5 lists this year's counts. Appendix 4 lists non-breeding counts from 2011-2017.

Table 5. Non-Nesting Piping Plover Counts at Cape Lookout National Seashore, 2017.

	January	*February*	*March*	*August*	*September*	*October*	*November*	*December*
NCB	7			46	68*	24*	8	11*
SCB	0			0	2	22	1	4
SB	2			8		14	11	10
Total	**9**			**54**	**70**	**60**	**20**	**25**

Includes MCB

Banded Piping Plovers

Eight-five observations of 47 individual non-breeding banded birds were made in the park in 2017. Birds were re-sighted during migration and over wintering from the Great Lakes and Atlantic Coast populations; and banded from Michigan, Wisconsin, New Jersey, New Brunswick, Newfoundland, Prince Edward Island, Quebec, and Bahama. Virginia Tech research staff banded eight breeding adults from seven nests and recaptured five adults from five nests at New Drum, Old Drum, and Portsmouth Flats nesting sites in 2017. There were 25 (46%) banded breeding adults and 29 (54%) breeding adults that were unbanded in the nesting population in 2017. Of the 27 nesting pairs, 18 pairs (67%) had at least one individual of the pair banded, while 9 pairs (33%) were unbanded.

Discussion

Nesting Habitat

The habitat at New Drum Flats and Old Drum Flats/Inlet continues to provide excellent nesting and foraging opportunities in the breeding season. This high quality nesting habitat from Old Drum to Plover Inlet contained 78% (21 pairs) of the nesting pairs in 2017. Portsmouth Flats, another important area, continued to provide nesting habitat on NCB for six pairs (22%). The north tip of NCB at Ocracoke Inlet continues to erode and there was little nesting habitat available. There was no breeding activity documented. Cape Point, Power Squadron Spit, and Kathryn-Jane flats did not attract nor hold nesting pairs in 2017.

Pair Numbers

The number of breeding pairs in the seashore decreased from 30 in 2016 to 27 in 2017. This is the fifth year of declining breeding pairs from the high of 51 pairs in 2012 This may be the result of high nest predation rates and low productivity in recent years. Yet there still is a long term 27-year trend of increasing pairs at CALO (Appendix 3), ranging from a low of 13 pairs in 2004 to a high of 51 pairs in 2012. Since 2006 with the implementation of the IPSMP the average number of pairs has been 40 pairs with a range of 51 to 27 pairs.

Nest Success

2017 brought record low hatch success for piping plover nests in the park, only 30% of the nests and 17% of the eggs hatched successfully. The seven weather related nest losses accounted for 22% of total losses. Documented ghost crab predation took three nests and one was lost to feral cat predation. Nineteen (61%) nests losses were recorded as unknown and are the highest on record since implementation of the IPSMP. The unknown nest losses in 2016, 2015 2014, 2013, 2012, 2011, 2010, 2009, 2008, and 2007

respectively were 15, 13, 10, 12, 11, 1, 3, 5, 7, and 3. This unknown nest loss rate reflects the reduced monitoring ability due to difficult access on MCB from 2012 to 2017.

Predator exclosures have generally been effective in increasing hatch success. From 1997-2017, 70% of the nests protected with exclosures hatched, compared with a 37% hatch rate of the nests left unprotected. In 2017, predator exclosures use was down to only 8 nests (18%) and the lowest on record since 1997. There was no use of predator exclosures on MCB this year. Predator exclosures were not used on MCB nests due to uncertainty of monitoring ability.

Fledging Success

The fledging success for piping plovers at CALO was 0.15 chicks fledged per nesting pair in 2017 (Appendix 3, Chart 2). This is the second lowest productivity rate on record. Only the 1999 productivity rate of 0.11 was lower. The actual number of chicks fledged was 4 fledglings. The productivity this year was below the long term average. The average fledge rate from 2000-2017 is 0.55 chicks per breeding pair (Table 3).

The Plover Inlet site had the highest fledge success in the seashore. There were three nesting pairs that produced one fledgling for a productivity of 0.33. Portsmouth flats with six pairs that produced two fledglings and a fledge success of 0.33 was the second highest site for productivity. Site by site reproductive successes for 2017 can be compared in Table 6.

Table 6. Differences in Reproductive Success between Major Nesting Areas in 2017.

Nesting Area	Hatch Success	Fledge Success
Portsmouth Flats	27%	0.33 chicks per pair
Old Drum Flats/Inlet	22%	0.00 chicks per pair
New Drum Flats	28%	0.09 chicks per pair
Ophelia Island	50%	0.00 chicks per pair
Plover Inlet	50%	0.33 chicks per pair

Predators

There were documented coyote (*Canis latrans*) tracks on SCB in the Cape Point, Power Squadron Spit, and Plover Inlet area in the summer. This may explain the lack of piping plover pairs and productivity at these sites. Although no piping plover nest losses were attributed to coyotes, coyote predation nest losses were recorded at 47 American oystercatcher nests on SCB. Documented raccoon and feral cat (*Felis catus*) tracks at

nest sites continue to be a concern. One nest was taken by feral cat on NCB. In 2017 no attempts were made to dig into predator exclosures by raccoons or other mammals. Numerous river otter (*Lontra canadensis*) tracks were documented at the Ophelia and New Drum Flats nesting areas

Human Disturbance

Posted closures for bird nesting areas were not always respected by park visitors. Biological Science Technicians recorded 14 pedestrians in bird nesting areas and 12 vehicles in bird nesting closures in 2017. Dogs were also a potential source of disturbance to nesting birds. Resource management staff documented 37 dogs off leash during the bird nesting season in 2017.

Non-nesting piping plovers

CALO continues to be an important migration stopover location and wintering site for piping plovers. Figure 7 illustrates non-breeding piping plover observations and critical habitat units. In 2017, 415 birds were recorded during 137 observations of piping plovers in the seashore during the non-nesting season. The area on NCB near Ocracoke Inlet again had high numbers of birds in spring and fall migrations. There were 85 banded birds re-sight observations (20%) out of the 415 non-breeding birds recorded. There were 47 banded individuals identified.

US Fish and Wildlife Service (USFWS) Biological Opinion and Recovery Goals

The USFWS provided CALO a biological opinion that included four performance measures for the Interim Protected Species Management Plan; 1) 25 or more pairs, 2) at least one nest per breeding pair, 3) a productivity rate of 0.75 or greater, and 4) at least once monthly winter plover surveys. Twenty seven breeding pairs were found in CALO in 2017 surpassing the target of 25 or more pairs of performance measure one. Twenty seven pairs produced 44 nests (1.6 nest per pair) surpassing the target of at least one nest per breeding pair of performance measure two. The 27 nesting pairs produced 4 fledglings for a fledge rate of 0.15, well below the target of 0.75 of performance measure three. The fledge rate was below the 1996 USFWS recovery plan goal of 1.50 (USFWS 1996). Non breeding plover surveys at CALO were not conducted once monthly from August until March failing to meet performance measure four. CALO is part of the Atlantic Coast southern recovery unit of North Carolina, Virginia, Maryland, and Delaware as defined by the USFWS recovery plan. The goal of the southern recovery unit is to increase and maintain for five years a total of 400 pairs. The southern recovery unit has not yet reached 400 pairs.

Conclusion

In 2017, piping plovers on Cape Lookout National Seashore continued their use of the habitat for breeding, migration, and wintering throughout the year. Nest success was a record low and fledgling success was the second lowest on record. Breeding pairs declined. Predation played a major negative role during the breeding season. In addition the low use of predator exclosures impacted the breeding success rates. The area from Ophelia Inlet to Old Drum Inlet and Portsmouth Flats contained the majority of breeding activity. Although the 2017 breeding season was unsuccessful, the long term trends for pair numbers and productivity are still trending upward.

Management Recommendations

1) Continue banding effort with Virginia Tech research staff on North Core Banks in order to understand movements and improve breeding pair monitoring.

2) Increase enforcement of dog on leash law throughout the year to minimize disturbance to piping plovers that are present year round.

3) Increase qualified monitoring staff to six monitors to ensure IPSMP daily monitoring requirements are met.

4) Increase use of predator exclosures on MCB where the majority of pairs breed.

5) Remove mammalian predators prior to the breeding season at nesting sites.

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Literature Cited

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Appendix 1- 2017 PIPING PLOVER WINDOW CENSUS

2017 Piping Plover breeding census results: June 1-9

North Core Banks: 24 pairs, 2 singles

Ocracoke Inlet	0
Portsmouth Flats	6 pairs, 2 singles
Old Drum Inlet	5 pairs
New Drum Inlet	10 pairs
Ophelia Island	3 pairs

South Core Banks: 3 pairs, 2 singles

Plover Inlet	3 pairs
Cape Point	0
Power Squadron Spit	0

Shackleford Banks: 0 piping plovers

Cape Lookout National Seashore: 27 pairs, 4 single birds

Appendix 2- 2017 PIPING PLOVER NEST DATA

NORTH CORE BANKS 2017

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS (abbreviated)
01	01	18.46	21-Apr	3	N/A	N/A	0	0	Nest failed: 04/29 – ghost crab
02	02	21.93	28-Apr	3	N/A	N/A	0	0	Nest failed: 05/31 - cause unknown
03	03	21.57	3-May	4	N/A	31-May	3	0	Brood failed : 6/10-unknown, by day 3
04	04	21.65	3-May	4	N/A	27-May	3	0	Brood failed: 6/10-unknown, day 5
05	05	22.00	3-May	2	N/A	UNK	1	1	Chick re-appeared as fledgling
06	06	22.06	3-May	2	N/A	N/A	0	0	Nest failed: 05/27-unknown
07	01	18.42	8-May	3	8-May	3-Jun	3	0	Brood failed: 6/15-unknown, day 8
08	07	2.97	8-May	3	10-May	N/A	0	0	Nest failed :5/24-flooded
09	08	3.22	8-May	1	N/A	N/A	0	0	Nest failed: 05/13 - unknown
10	09	19.36	9-May	2	N/A	N/A	0	0	Nest failed: 06/10 -unknown
11	10	2.35	9-May	2	N/A	N/A	0	0	Nest failed:5/13-unknown
12	11	21.80	9-May	1	N/A	N/A	0	0	Nest failed: 5/16- unknown
13	12	22.16	9-May	4	N/A	N/A	0	0	Nest failed: 5/31-flooding
14	13	22.16	9-May	2	N/A	N/A	0	0	Nest failed:5/16-unknown
15	14	2.14	11-May	4	12-May	3-Jun	4	0	Brood failed: 6/9-unknown, day 3
16	15	19.14	16-May	3	N/A	N/A	0	0	Nest failed:5/28-unknown
17	11	21.82	16-May	2	N/A	N/A	0	0	Nest failed:5/27-abandoned
18	16	3.00	17-May	2	N/A	N/A	0	0	Nest failed: 5/18-unknown
19	17	19.16	19-May	4	N/A	N/A	0	0	Nest failed: 5/31- unknown
20	10	2.36	24-May	2	N/A	N/A	0	0	Nest failed: 5/26-flooding
21	18	19.00	27-May	1	N/A	N/A	0	0	Nest failed: 5/31-unknown
22	19	22.47	27-May	3	N/A	UNK	1	0	Brood failed: 6/28-unknown, day 2
23	20	21.81	27-May	2	N/A	N/A	0	0	Nest failed: 5/31- flooding
24	10	2.35	28-May	3	N/A	N/A	0	0	Nest failed: 6/6-unknown
25	06	22.16	3-Jun	4	N/A	N/A	0	0	Nest failed: 6/22-unknown
26	21	3.62	9-Jun	2	N/A	N/A	0	0	Nest failed: 6/11-ghost crab
27	20	21.80	10-Jun	3	N/A	N/A	0	0	Nest failed: 7/2-unknown
28	22	22.18	10-Jun	4	N/A	N/A	0	0	Nest failed: 7/19-unknown

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS (abbreviated)
29	04	21.60	13-Jun	3	N/A	N/A	0	0	Nest failed: 6/27-unknown
30	23	22.69	14-Jun	1	N/A	N/A	0	0	Nest failed: 6/28-unknown
31	21	3.31	15-Jun	2	N/A	N/A	0	0	Nest failed: 6/17-ghost crab
32	03	21.54	16-Jun	2	N/A	N/A	0	0	Nest failed: 6/22-unknown
33	11	21.79	16-Jun	2	N/A	N/A	0	0	Nest failed: 6/22-unknown
34	24	22.09	16-Jun	3	N/A	30-Jun	3	0	Brood failed: 7/11-unknown, day 2
35	15	18.93	22-Jun	3	N/A	N/A	0	0	Nest failed: 6/27-cat
36	18	19.10	22-Jun	3	N/A	19-Jul	2	0	Brood failed: 8/23-unknown, before day 6
37	17	19.16	22-Jun	3	N/A	N/A	0	0	Nest failed:7/11-unknown
38	11	21.78	1-Jul	3	N/A	27-Jul	2	0	Brood failed: 8/23-unknown, before day 6
39	10	1.65	2-Jul	4	3-Jul	14-Jul	3	0	Brood failed: 8/1-unknown, day 10
40	14	1.58	25-Jul	UNK	N/A	UNK	2	2	Chicks fledged on 8/15

24 nesting pairs, 40 nests, 11 hatched nests, 3 chicks fledged

SOUTH CORE BANKS 2017

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS (abbreviated)
1	1	23.57	18-May	4	24-May	N/A	N/A	0	Nest Failed 5/30 flooding
2	2	23.62	20-May	4	24-May	19-Jun	4	1	Chick fledged on 7/18, day 29
3	3	23.69	24-May	4	30-May	N/A	N/A	0	Nest failed 6/25, unknown.
4	1	23.63	13-Jun	4	14-Jun	7-Jul	4	0	Brood failed 7/13 , cause unknown

3 nesting pairs, 4 nests, 2 hatched nests, 1 chick fledged

Appendix 3. Chart 1 Piping Plover Nesting and Chart 2 Piping Plover Productivity.

Chart 1. Piping Plover Nesting at Cape Lookout National Seashore

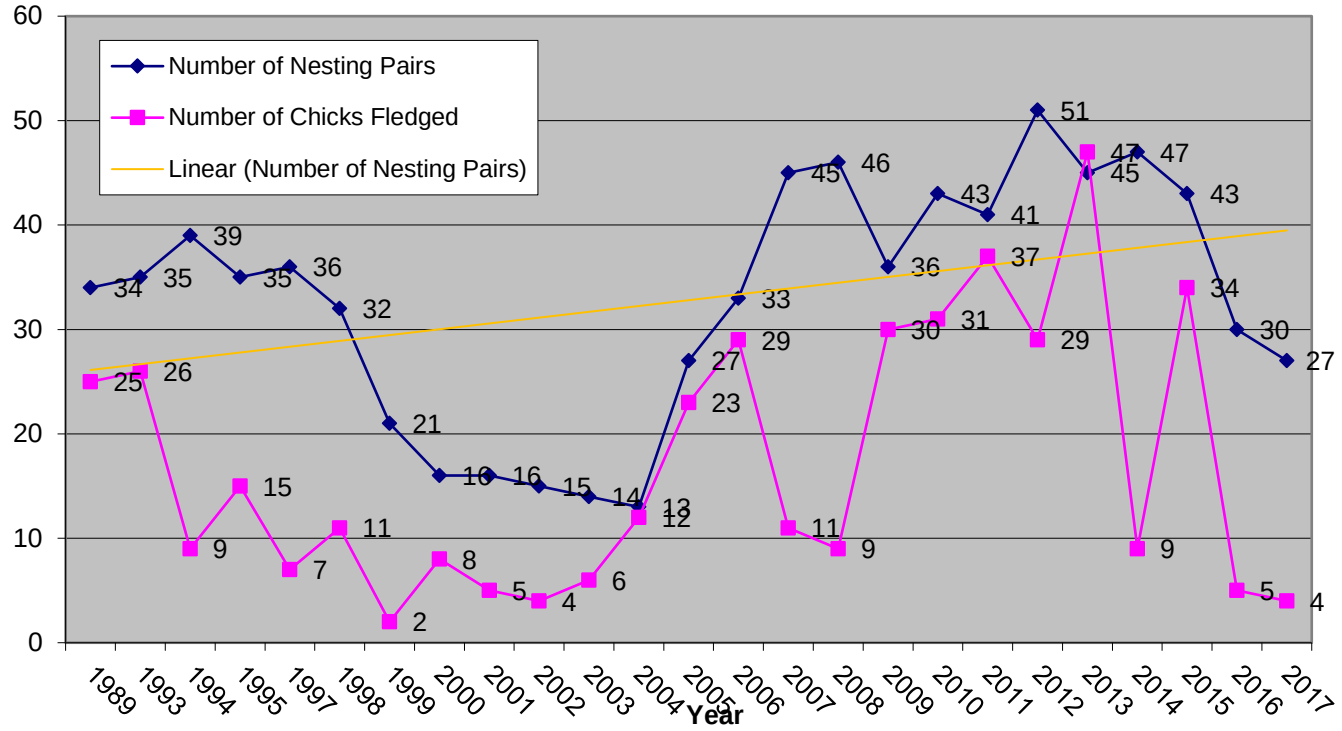
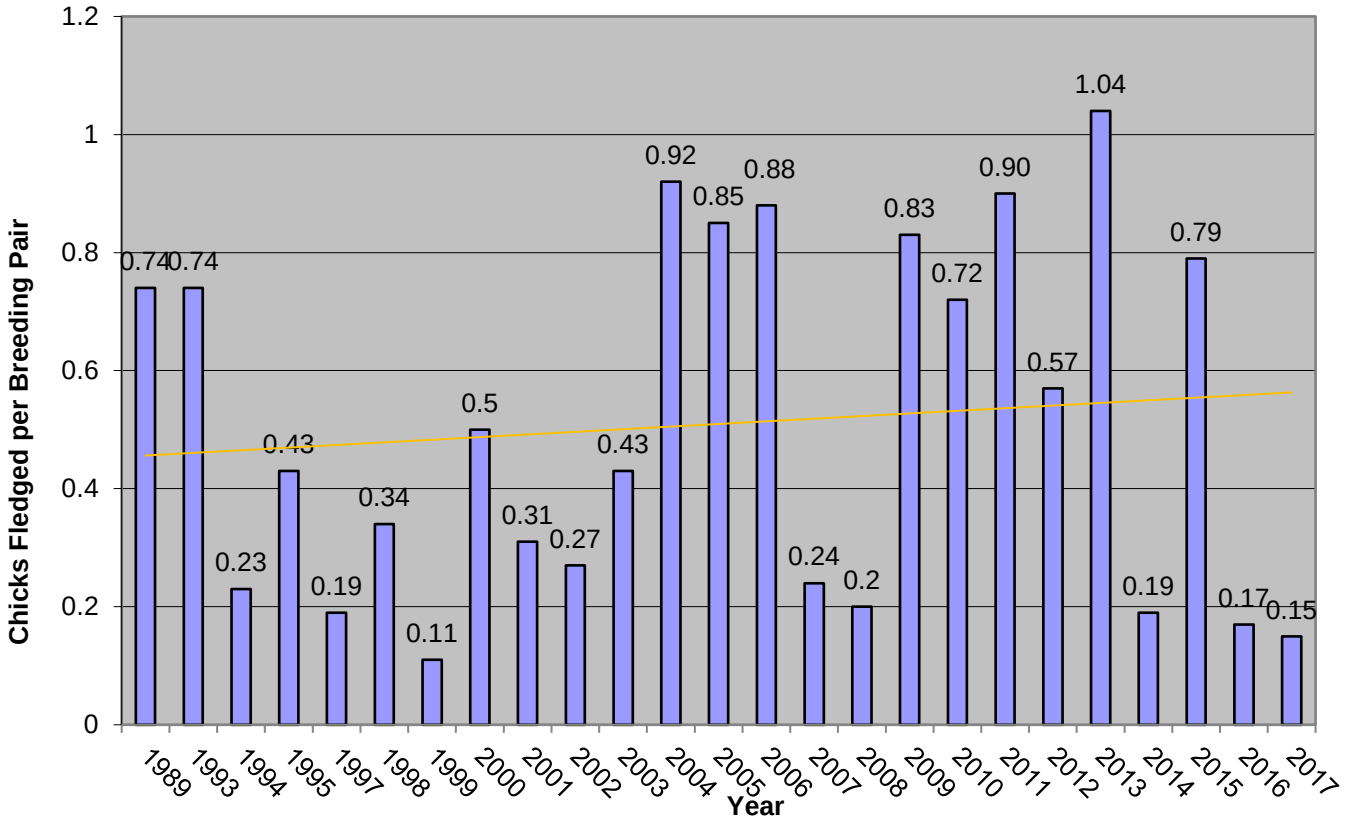


Chart 2. Piping Plover Productivity with Simple Linear Regression Line at CALO



Appendix 4. Monthly counts of non-nesting piping plovers 2011-2017.

Date	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
January-11	6	2	7	15
February-11	7	0	8	15
March-11	12	8	13	33
August-11	81	26	0	107
September-11	29	8	20	57
October-11	26	19	6	51
November-11	7	3	11	21
December-11	2	4	11	17
January-12	0	2	5	7
February-12	0	2	10	12
March-12	5	1	?	≥6
August-12	82	32	4	118
September-12	112	7	9	128
October-12	0	3	12	15
November-12	3	7	5	15
December-12	6	6	2	14
January-13	?	4	3	7
February-13	4	0	10	14
March-13	5	9	4	18
August-13	93	6	15	114
September-13	115	15	23	153
October-13	17	?	?	≥17
November-13	6	5	5	16
December-13	12	3	4	19
January-14	0	12	0	12
February-14	0	0	9	9
March-14	7	42	4	53
August-14	98	44	9	151
September-14	69	12	1	82
October-14	12	12	0	24
November-14	13	6	4	23
December-14	4*	14	3	21
January-15	2	9	4	15
February-15				
March-15	?	21	19	40
August-15	95	15	15	125
September-15	42	20	8	70
October-15	17	3	14	34
November-15	0	4	8	12
December-15	5	18	2	25
January-16	10	16	9	35
February-16	15	13	9	37
March-16	2	15	8	25
August-16			10	≥10
September-16	30	17	25	72
October-16	10	31	3	44
November-16	2	20	1	23
December-16	0	2	1	3
January-17	7	0	2	9
February-17				
March-17				
August-17	46	0	8	54
September-17	68	2		70
October-17	24	22	14	60
November-17	8	1	11	20
December-17	11	4	10	25

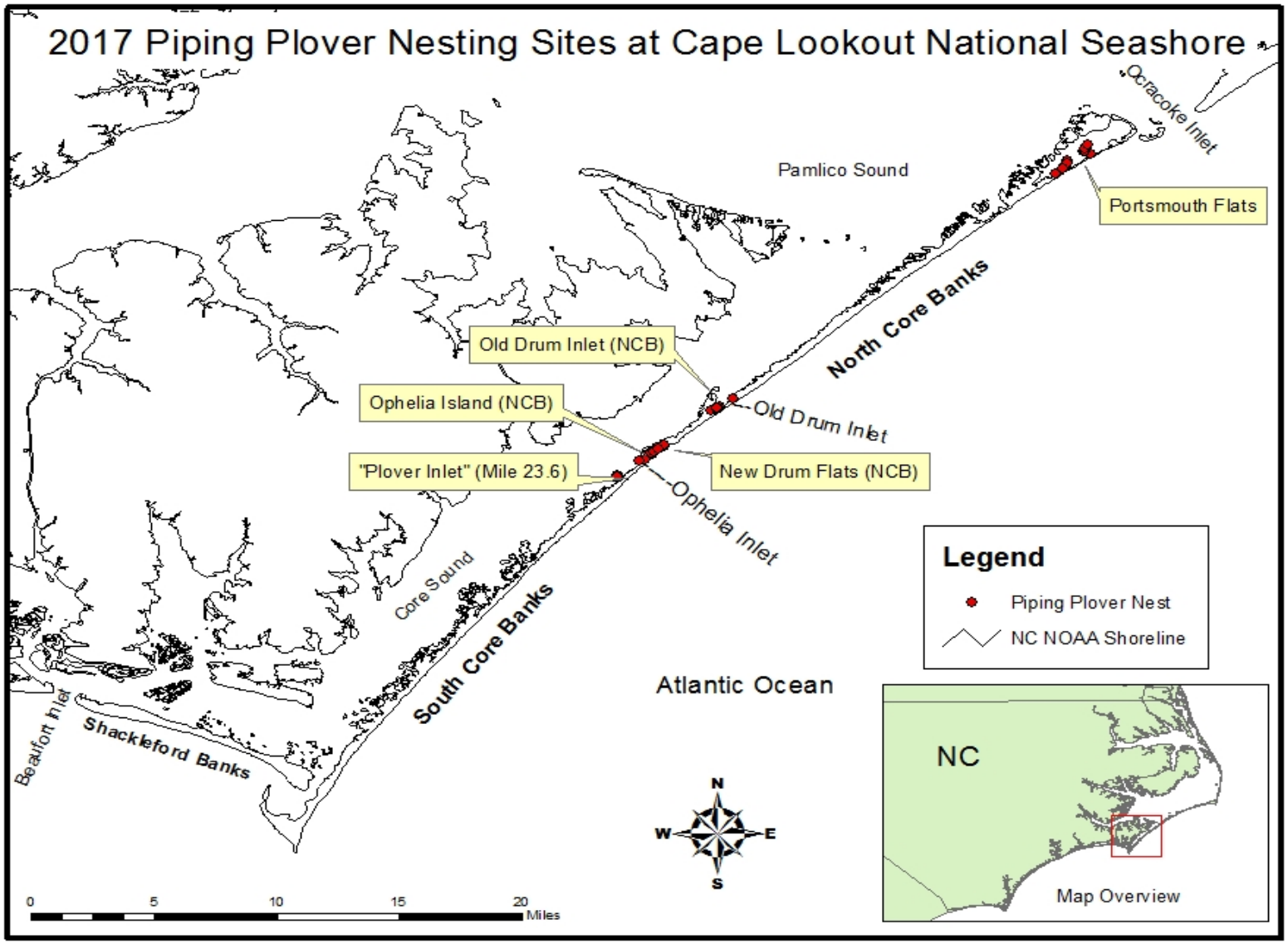


Figure 1. Map of 2017 Occupied Piping Plover Nesting Sites at Cape Lookout National Seashore.

Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 2. Portsmouth Flats Nesting Site

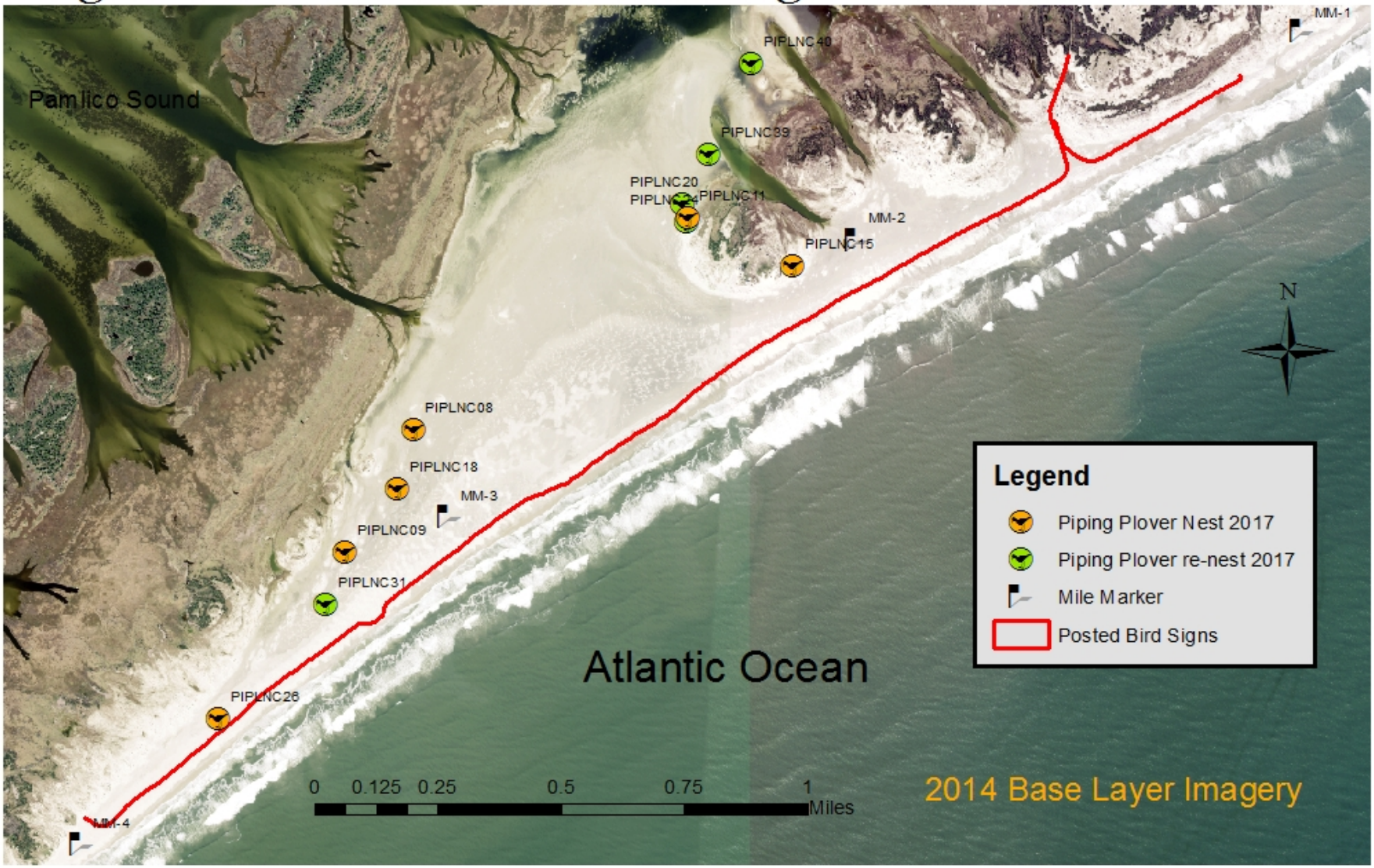


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Figure 3. Old Drum Inlet Nesting Site

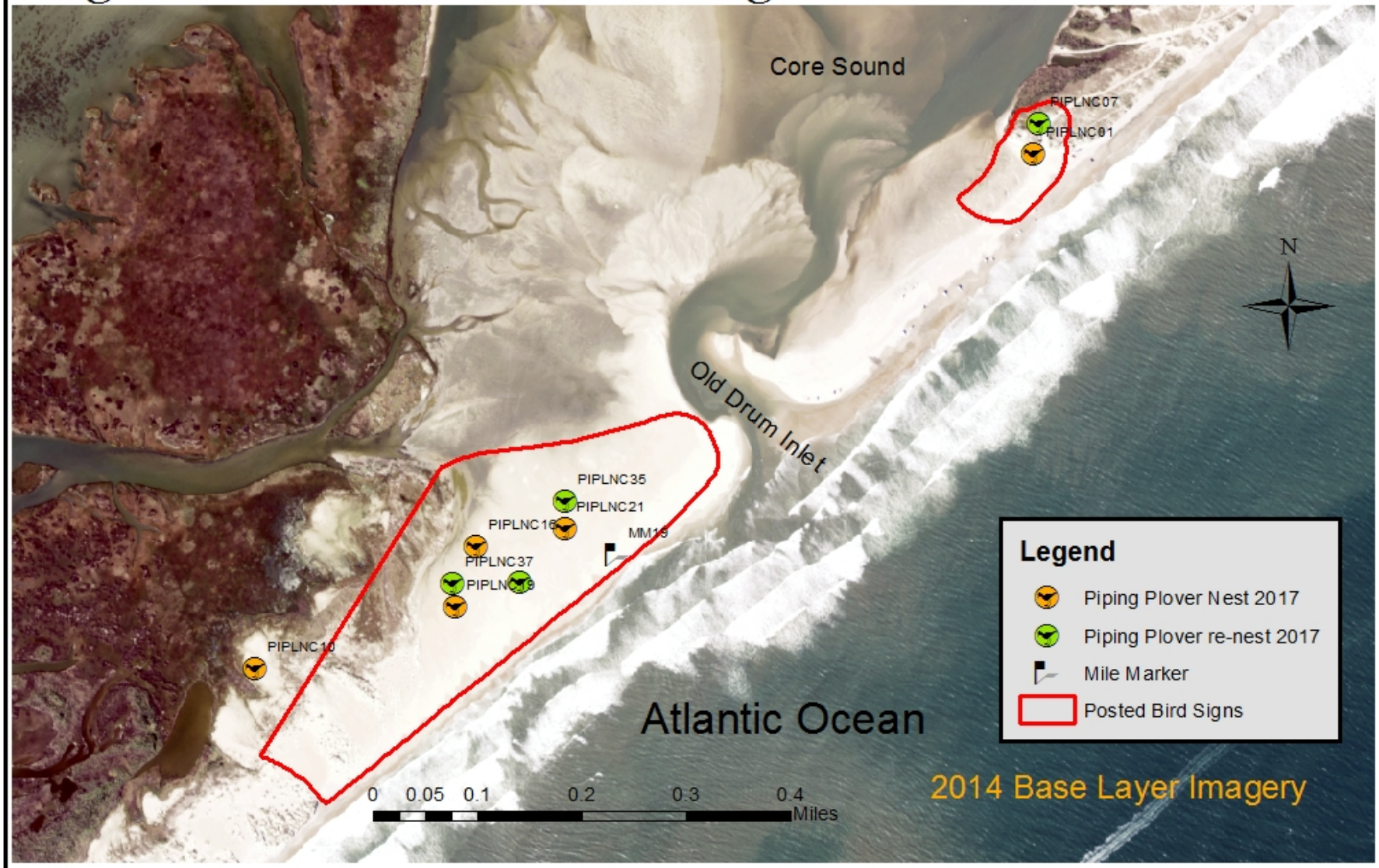

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Figure 4. New Drum Flats and Ophelia Island Nesting Site

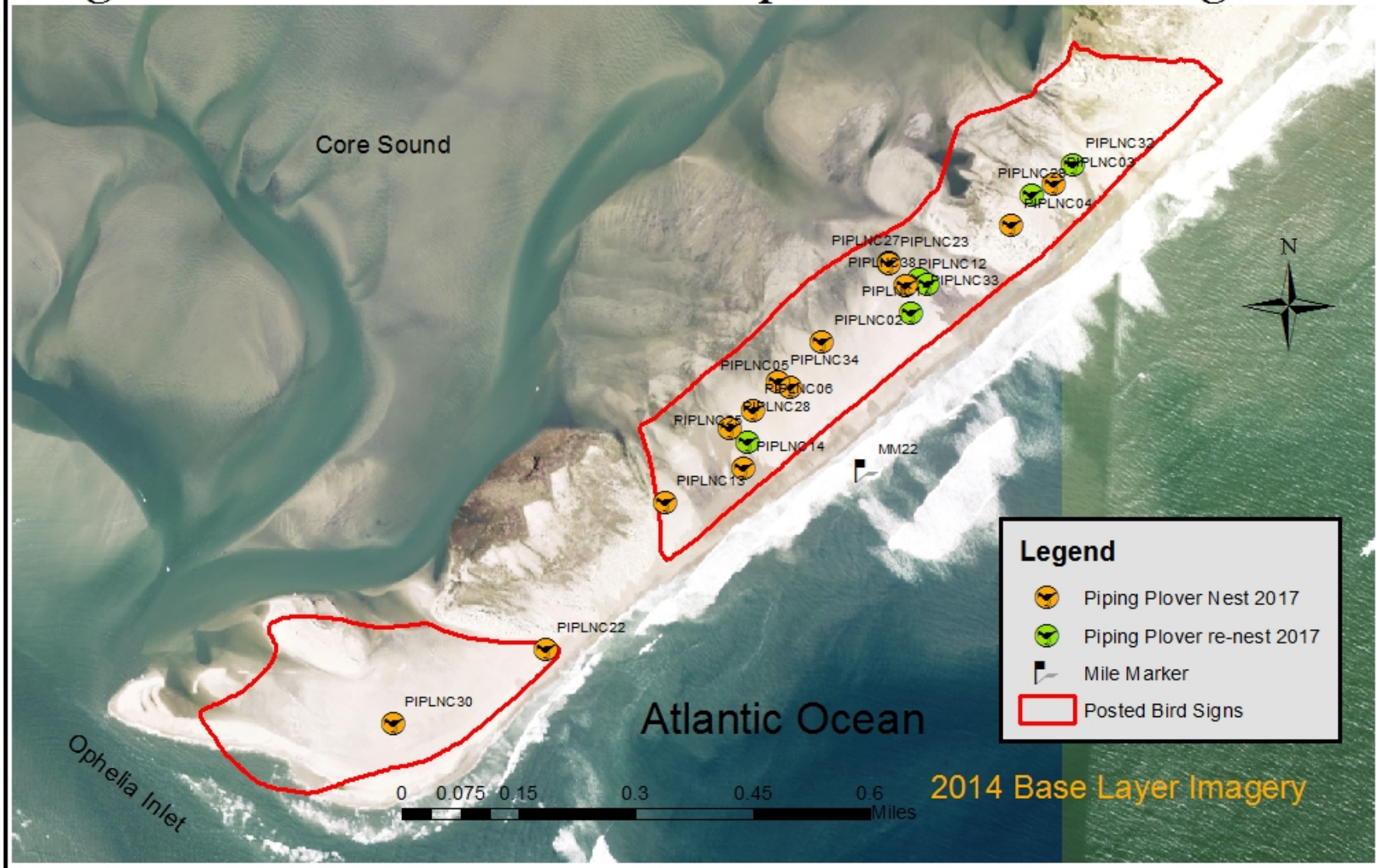

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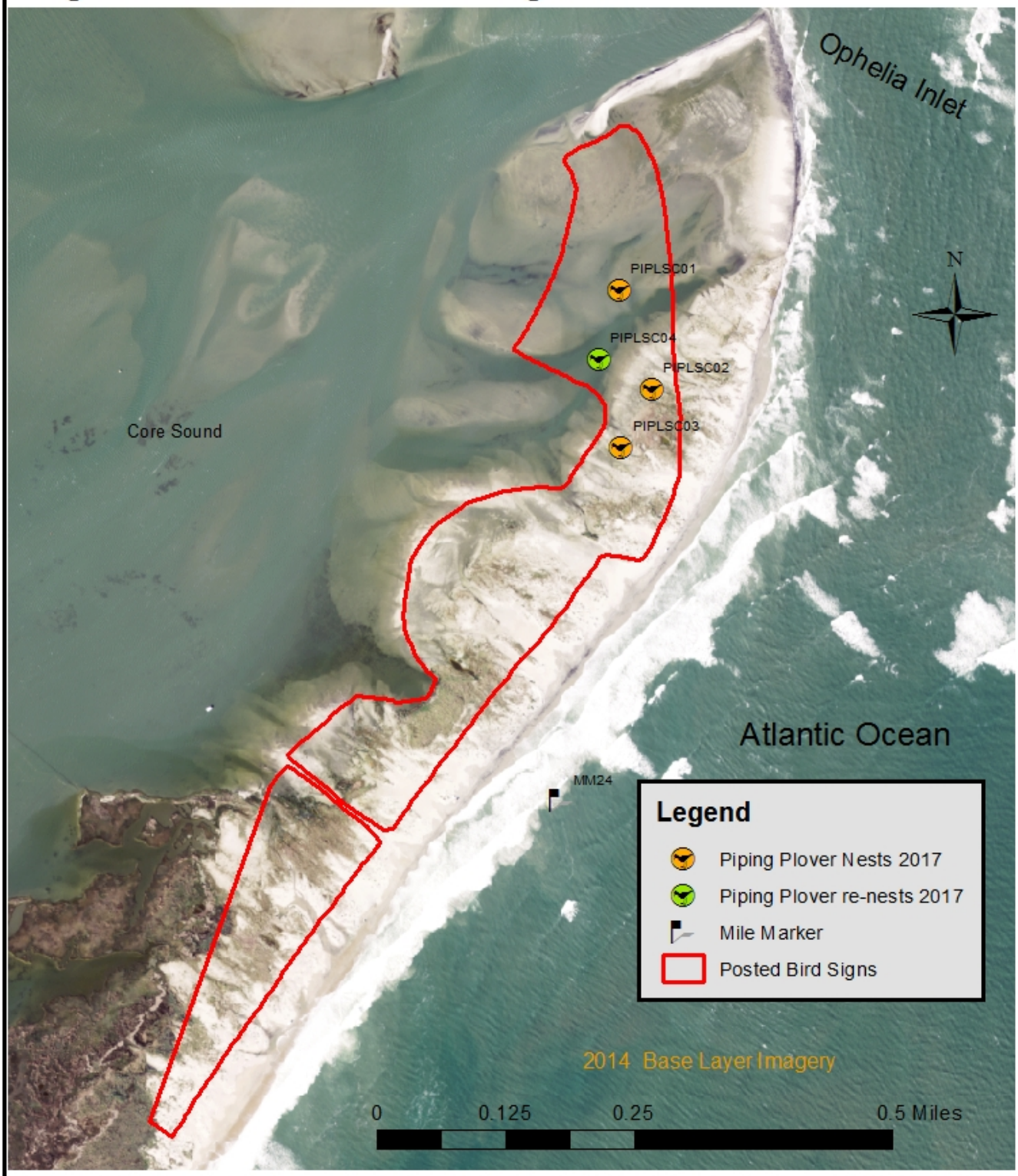
Figure 5. Plover Inlet Nesting Site



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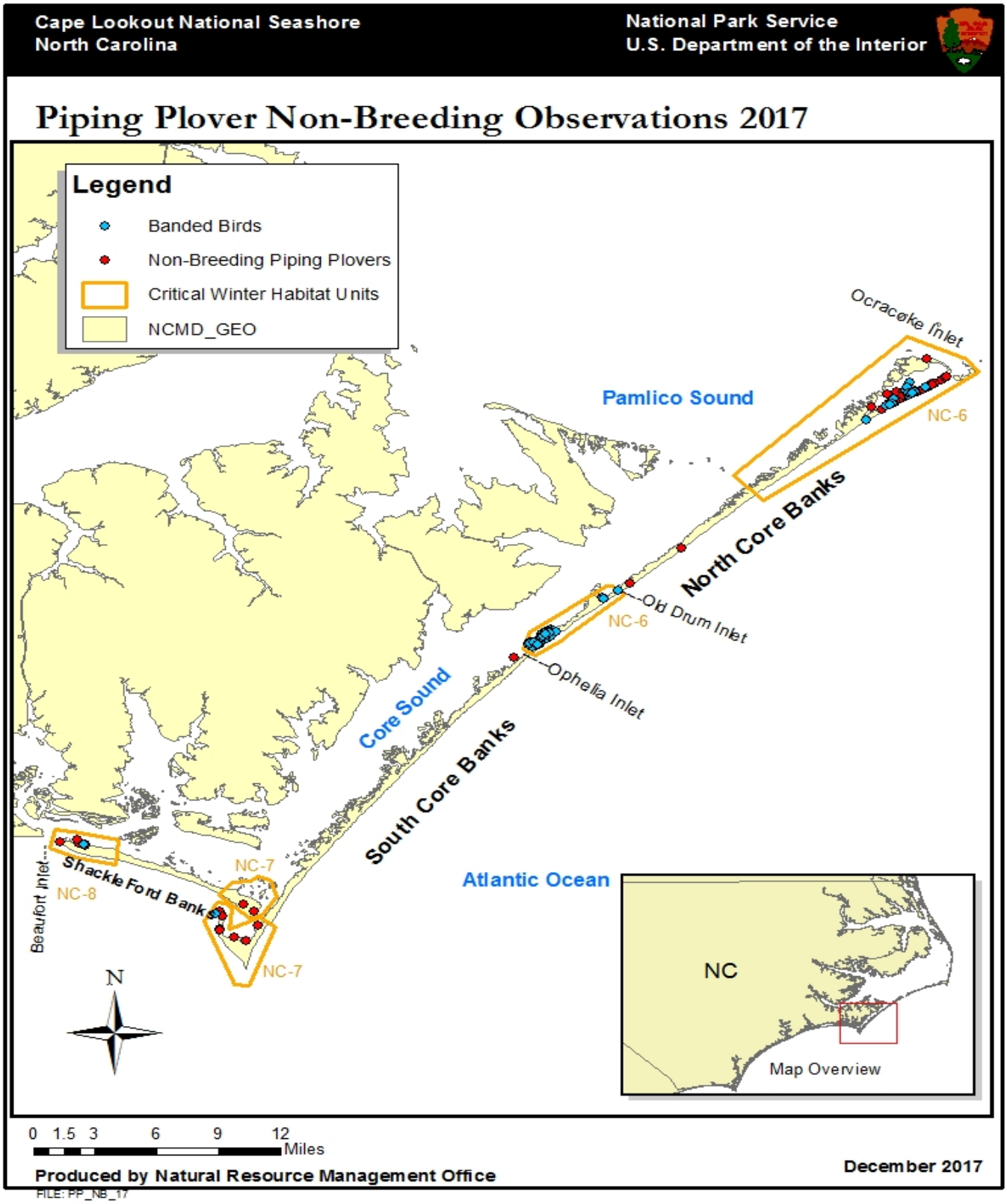
Figure 6. Map of Non-Breeding Observations, Critical Winter Habitat Units and Banded Bird re-sights.