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

2016 SUMMARY REPORT

Old Drum Inlet 12/10/2016. NPS 2016.

NATIONAL PARK SERVICE
CAPE LOOKOUT NATIONAL SEASHORE
131 CHARLES STREET
HARKERS ISLAND, NC 28531

Abstract

A total of 30 pairs of piping plovers were recorded at Cape Lookout National Seashore (CALO) in 2016. The birds at CALO accounted for 70% of the nesting pairs in North Carolina. Twenty seven pairs nested on North Core Banks and three pairs on South Core Banks. Egg-laying was initiated on April 27th and a total of 41 nests were documented. Thirteen nests hatched and 5 chicks fledged. Productivity was 0.17 chicks fledged per nesting pair. Two broods foraged at the oceanside in 2016.

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 70% of the nesting pairs in the state of North Carolina (Schweitzer, 2016). 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 2016, 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 2016 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 30 pairs of piping plovers attempted nesting at CALO in 2016, Table 1. Table 2 includes 2016 pair numbers and data back to 1989. Twenty seven pairs nested on North Core Banks (NCB), and three pairs on South Core Banks (SCB). Birds nested in six distinct areas (Figure 1. * one pair nested at two different sites). 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 2016.

ISLAND	NESTING AREA	NUMBER OF PAIRS
North Core Banks	Portsmouth Flats	7
North Core Banks	Kathryn-Jane Flats	1*
North Core Banks	Old Drum Inlet	7
North Core Banks	New Drum Inlet	7
North Core Banks	Ophelia Island	6
South Core Banks	Plover/Ophelia Inlet	3

Table 2. Piping Plover Breeding Pairs at Cape Lookout National Seashore 1989-2016

	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
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
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
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*
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
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
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
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
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
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
Shackleford Banks														1	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

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

Nests

There were 41 nesting attempts made in 2016 (Appendix 2). The earliest nest initiation was on April 27th and the latest was on June 27th. Thirty seven nests were on NCB and four were on SCB. Of the 41 nests, 11 were re-nests. Thirteen nests hatched and 5 chicks fledged from 5 different broods. The average clutch size was 3.24 eggs and 23 of 133 known eggs hatched. Productivity for CALO was 0.17 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 2000-2016

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

Predator Exclosures

In 2016, predator exclosures were used to protect 8 (20%) nests. Of the nests with exclosures 8 (100%) hatched. Predator exclosures were not used on 33 (80%) nests due mainly to the inaccessibility of MCB. Of the nests without exclosures 5 hatched (18%). Twenty eight nests didn't hatch; fifteen were lost to unknown reasons, nine were lost to weather/ flooding, three nests were lost to unknown predation and one nest was lost to raccoon. Table 4 shows likely causes of nest losses for all nests.

Table 4. Likely Causes of Piping Plover Nest Losses in 2016.

NESTING AREA	# NESTS	# LOST	PREDATORS	STORM	ABANDONED	UNKNOWN
Portsmouth Flats	9	6	1	2	0	3
Kathryn-Jane Flats	1	0	0	0	0	0
Old Drum Inlet (NCB)	9	5	1	1	0	4
New Drum Inlet (NCB)	8	7	0	2	0	5
Ophelia Island (NCB)	10	9	1	4	0	4
Plover Inlet (Mile 23.6)	4	1	1	0	0	0
Total	41	28	4	9	0	15

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 May 30th to June 22nd and from July 20th to July 30th. A second ocean beach protection zone was posted from Old Drum Inlet to mile 18.34, from June 8th to July 12th for one brood that foraged on a narrow beach segment. A third ocean beach protection zone for piping plover chicks was posted on July 12th to July 18th at mile 6.15 to mile 5.80. The protection zones began the day of hatch of the first nest at Ophelia Inlet (SCB) or when chicks were present on the ocean beach and remained in place until the last chick was fledged, confirmed lost, or moved out of area.

Two broods foraged on the ocean beach in 2016. One brood (NCB nest 27) hatched and briefly occupied the oceanside of Kathryn-Jane Flats. The second brood (NCB nest 8) hatched and foraged on a narrow beach segment at Old Drum Inlet. All other 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 2016 covered most of the seashore from January to December with the exception of the three mile Middle Core Banks section. Old Drum Inlet was open and prevented access to survey MCB for most of 2016. MCB was only censused in January, February, and December. The January International Piping Plover Census counted 35 piping plovers and covered the entire seashore. The August counts were not conducted on the Core Banks due to heavy sea turtle hatching workload and staff shortage. Table 5 lists this year's counts. Appendix 4 lists non-breeding counts from 2010-2016.

Table 5. Non-Nesting Piping Plover Counts at Cape Lookout National Seashore, 2016.

	January	**February**	**March**	**August**	**September**	**October**	**November**	**December**
NCB	10*	15*	2		30	10	2	0*
SCB	16	13	15		17	31	20	2
SB	9	9	8	10	25	3	1	1
Total	**35**	**37**	**25**	**≥ 10**	**72**	**44**	**23**	**3**

*Includes MCB

Banded Piping Plovers

Forty five observations of 28 individual non-breeding banded birds were made in the park in 2016, Appendix 5. Birds were re-sighted during migration and over wintering from the Great Lakes, Great Plains and Atlantic Coast populations; and banded from Michigan, New Jersey, North Dakota, New Brunswick, Newfoundland, Quebec, and Bahama. Virginia Tech research staff banded 17 breeding adults from 14 nests at Ophelia Island, New Drum, Old Drum, and Portsmouth Flats nesting sites in 2016.

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 77% (23 pairs) of the nesting pairs in 2016. Portsmouth Flats, another important area, continued to provide nesting habitat on NCB for 7 pairs (23%). Power Squadron Spit habitat attracted one territorial pair, but nesting was not documented. The north tip of NCB at Ocracoke Inlet continues to erode and there was little nesting habitat available. There was no breeding activity documented in 2016. Kathryn-Jane flats did attract one re-nest by a banded pair from Portsmouth Flats. Cape Point did not attract nor hold nesting pairs in 2016.

CALO participated in the United States Geological Survey (USGS) “IPlover” nest habitat data collection and sea level rise model study for the third year. The study seeks to forecast the impact of sea level rise on piping plover nesting habitat. All 41 nests and 18 random points were uploaded into the database by using the mobile “IPlover” application on smartphones.

Pair Numbers

The number of breeding pairs in the seashore decreased from 43 in 2015 to 30 in 2016. This may be the result of persistent and reoccurring flooding of nesting habitat in April and May. There 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 42 pairs with a range of 51 to 30 pairs.

Nest Success

2016 brought record low hatch success for piping plover nests in the park, only 32% of the nests and 17% of the eggs hatched successfully. The nine weather related nest losses accounted for 32% of total losses. Unknown predation took three nests and one was lost to raccoon predation. Fifteen (54%) nests losses were recorded as unknown and are the highest on record since implementation of the IPSMP. The unknown nest losses in 2015 2014, 2013, 2012, 2011, 2010, 2009, 2008, and 2007 respectively were 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 2016 and due to reduced monitoring staff in 2015 and 2016.

Predator exclosures have generally been effective in increasing hatch success. From 1997-2016, 70% of the nests protected with exclosures hatched, compared with a 39% hatch rate of the nests left unprotected. In 2016, predator exclosures use was down to only 8 nests (20%) 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 0.17 chicks fledged per nesting pair in 2016 (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 5 fledglings. The productivity this year was below the long term average. The average fledge rate from 2000-2016 is 0.58 chicks per breeding pair (Table 3).

The Old Drum Inlet site had the highest fledge success in the seashore. There were seven nesting pairs that produced 3 fledglings for a productivity of 0.43. Portsmouth flats with 7 pairs that produced 2 fledglings and a fledge success of 0.28 was the second highest site for productivity. Site by site reproductive successes for 2016 can be compared in Table 6.

Table 6. Differences in Reproductive Success between Major Nesting Areas in 2016.

Nesting Area	Hatch Success	Fledge Success
Portsmouth Flats	44%	0.28 chicks per pair
Old Drum Flats/Inlet	44%	0.43 chicks per pair
New Drum Flats	12%	0.00 chicks per pair
Ophelia Island	10%	0.00 chicks per pair
Plover Inlet	75%	0.00 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 21 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 raccoon on NCB. In 2016 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 25 pedestrians in bird nesting areas and 23 vehicles in bird nesting closures in 2016. Dogs were also a potential source of disturbance to nesting birds. Resource management staff documented 77 dogs off leash during the bird nesting season in 2016.

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 2016, 331 birds were recorded during 94 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. The area from Old Drum Inlet flats to Ophelia Inlet also had high numbers of birds in August and September. The 2016 International Piping Plover Census documented 35 birds in January. Only 52 banded birds (16%) of the 331 non-breeding bird were recorded. There were 28 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. Thirty breeding pairs were found in CALO in 2016 surpassing the target of 25 or more pairs of performance measure one. Thirty pairs produced 41 nests (1.3 nest per pair) surpassing the target of at least one nest per breeding pair of performance measure two. The 30 nesting pairs produced 5 fledglings for a fledge rate of 0.17, 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 conducted at least, in part, once monthly from August until March to partially 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 2016, 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. Weather 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 2016 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.

Prepared by: Jon Altman

Literature Cited

Fraser J.D, J.L McConnaughey, S.D. Coutu, and J.P. Loegering. 1990 Piping Plover Distribution and Reproductive Success on Cape Lookout National Seashore. Unpublished report.

National Park Service. 2006. Interim Protected Species Management Plan/ Environmental Assessment. Cape Lookout National Seashore, North Carolina.

Schweitzer, Sara. 2016. 2016 Breeding Season Report for the Piping Plover in North Carolina. North Carolina Wildlife Resources Commission, North Carolina.

U.S. Fish and Wildlife Service. 1985. Determination of Threatened and Endangered status of the Piping Plover. Federal Register 50:50726-50734.

U.S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*) Atlantic Coast Population Revised Recovery Plan. Regional Office, Hadely, Massachusetts

Appendix 1- 2016 PIPING PLOVER WINDOW CENSUS

2016 Piping Plover breeding census results: June 1-9

North Core Banks:	26 pairs, 2 singles
Ocracoke Inlet	0
Portsmouth Flats	8 pairs, 2 singles
Old Drum Inlet	6 pairs
New Drum Inlet	7 pairs
Ophelia Island	5 pairs

South Core Banks:	4 pairs, 1 single
Plover Inlet	3 pairs
Cape Point	0
Power Squadron Spit	1 pair, 1 single

Shackleford Banks: 0 piping plovers

Cape Lookout National Seashore: 30 pairs, 3 single birds

Appendix 2- 2016 PIPING PLOVER NEST DATA

NORTH CORE BANKS 2016

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS (abbreviated)
1	1	2.2	27-Apr	4	none	N/A	0	0	Nest failed: 05/22 - cause unknown
2	2	22.54	30-Apr	4	none	N/A	0	0	Nest failed: 05/07 - cause unknown
3	3	19.19	1-May	2	none	17-May	2	1	Fledged 1 chick; last seen day 25;
4	4	22.72	7-May	4	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
5	5	21.55	7-May	4	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
6	6	22.22	7-May	4	none	N/A	0	0	Nest failed: 05/26 - cause unknown
7	7	2.3	11-May	2	none	N/A	0	0	Nest failed: 05/22 - flooded
8	8	18.46	12-May	3	16-May	10-Jun	3	1	Fledged 1 chick; last seen 07/11 with strong flight;
9	9	22.75	15-May	3	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
10	10	22	15-May	4	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
11	11	18.9	16-May	1	none	N/A	0	0	
12	2	22.5	19-May	4	none	N/A	0	0	Nest failed: 05/29 - unknown mammal predator
13	12	22.79	25-May	4	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
14	13	1.48	26-May	3	none	N/A	0	0	Nest failed: 06/04 - cause unknown
15	11	18.97	27-May	3	none	N/A	0	0	unknown nest predator
16	14	19.29	27-May	3	none	N/A	0	0	Nest failed: 06/11 - cause unknown
17	15	19.37	27-May	4	none	11-Jun	1	1	Fledged 1 chick; last seen 07/07;
18	16	22.67	28-May	4	none	N/A	0	0	Nest failed: 06/08 - weather (Tropical Storm Colin)
19	17	21.67	28-May	4	none	N/A	0	0	Nest failed: 06/17 - cause unknown
20	18	3.21	10-Jun	4	none	N/A	0	0	Nest failed: 06/12 - cause unknown

21	11	18.95	11-Jun	4	none	10-Jul	2	0	Brood failed: 07/21, cause unknown;
22	7	2.34	12-Jun	4	none	N/A	0	0	Nest failed: 06/16 - Raccoon predation
23	19	1.95	12-Jun	2	none	N/A	0	0	Nest failed: 06/16 - possible flooding
24	4	22.72	13-Jun	4	none	10-Jul	3	0	Brood failed: 07/12 - cause unknown;
25	20	22.18	13-Jun	4	none	12-Jul	1	0	Brood failed: 07/17 - cause unknown
26	21	22.26	13-Jun	1	none	N/A	0	0	Nest failed: 06/17 - cause unknown
27	13	5.99	16-Jun	4	17-Jun	12-Jul	1	0	Brood failed: 07/14 - cause unknown
28	22	19	17-Jun	3	none	N/A	0	0	Nest failed: 06/27 - cause unknown
29	23	19.09	17-Jun	3	none	N/A	0	0	Nest failed: 06/20 - cause unknown
30	24	21.76	17-Jun	2	none	N/A	0	0	Nest failed: 07/04 - cause unknown
31	25	21.82	17-Jun	3	none	N/A	0	0	Nest failed: 06/27 - cause unknown
32	26	2.44	19-Jun	3	25-Jun	18-Jul	1	0	Brood failed: 07/24 - cause unknown
33	19	1.95	24-Jun	4	29-Jun	20-Jul	2	1	Fledged 1 chick; last seen day 25;
34	12	22.77	24-Jun	3	none	N/A	0	0	Nest failed: 07/01 - cause unknown
35	27	2.44	24-Jun	3	29-Jun	18-Jul	2	1	Fledged 1 chick; last seen day 27;
36	17	22.65	24-Jun	3	none	N/A	0	0	Nest failed: 06/27 - cause unknown
37	21	22.61	27-Jun	4	none	N/A	0	0	Nest failed: 07/10 - cause unknown

27 nesting pairs, 37 nests, 10 hatched nests, 5 chicks fledged

SOUTH CORE BANKS 2016

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS (abbreviated)
01	01	23.74	7-May	3	14-May	9-Jun	2	0	Brood failed 6/15, cause unknown
02	02	23.69	7-May	4	10-May	1-Jun	2	0	Brood failed 6/16, cause unknown
03	02	23.68	19-Jun	3	none	N/A	N/A	0	Nest failed 6/22, unknown predator.
04	03	23.65	24-Jun	1	1-Jul	20-Jul	1	0	Brood failed 7/30, cause unknown

3 nesting pairs, 4 nests, 3 hatched nests, 0 chicks fledged

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

Chart 1. Piping Plover Nesting at Cape Lookout National Seashore

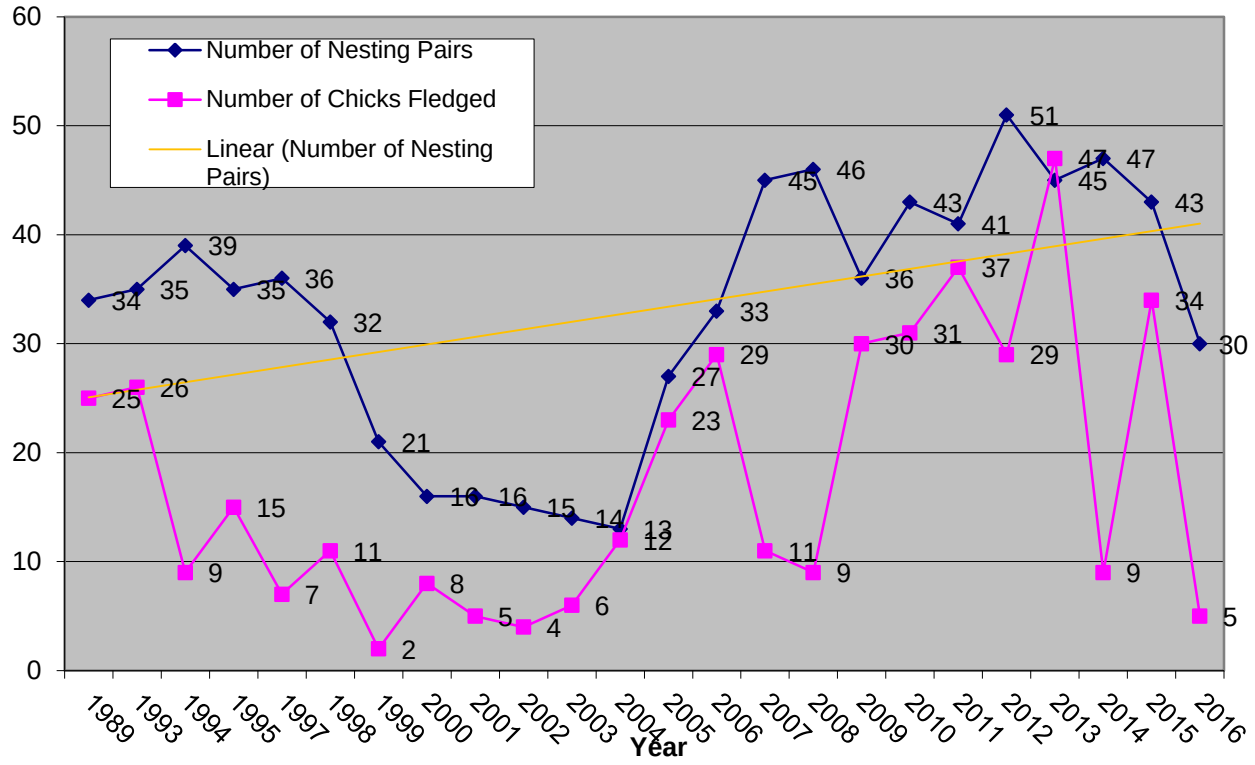
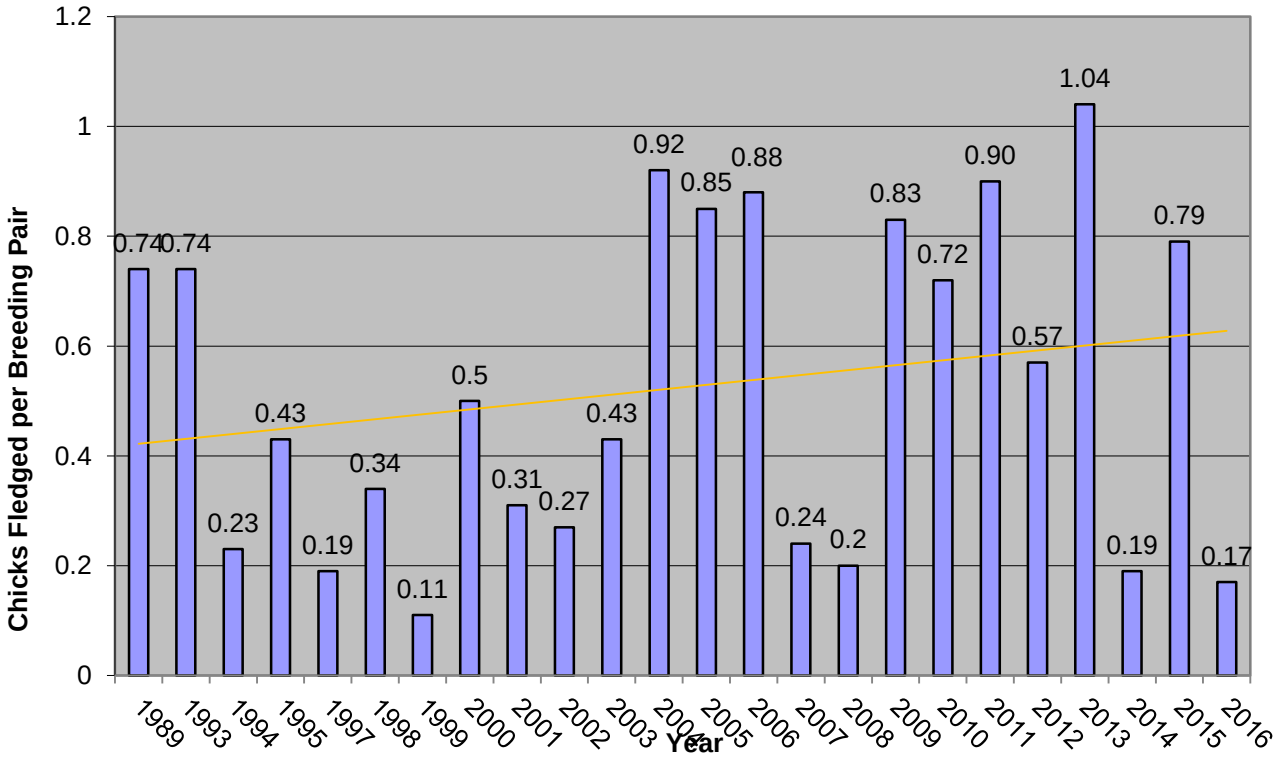


Chart 2. Piping Plover Productivity with Simple Linear Regression Line.



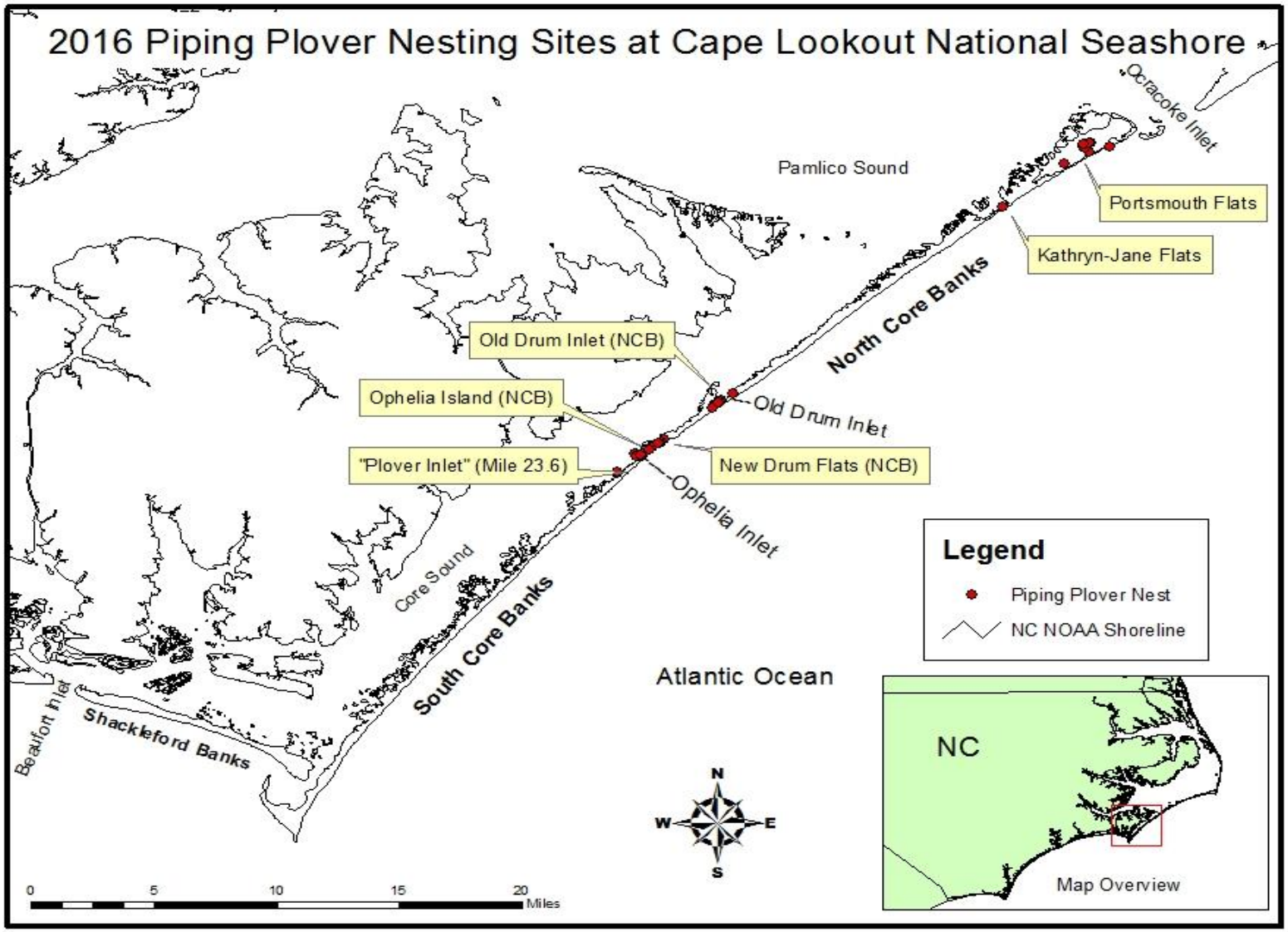
Appendix 4. Monthly counts of non-nesting piping plovers 2010-2016.

Date	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
January-10	17	8	11	36
February-10	8	5	11	24
March-10		10	6	≥16
August-10	125	23	4	152
September-10	70	32	17	119
October-10	35	13	4	52
November-10	8	19	9	36
December-10	4	3	6	13
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

Appendix 5. Non-Breeding Banded Piping Plover Observations at CALO in 2016.

Initial Date	Upper Left Leg	Lower Left Leg	Upper Right Leg	Lower Right Leg	Island	Comments: population, state, park code, (other re-sight dates at CALO)
1/26/2016	metal	orange green	Yf (V90)	white green	SCB	North Dakota (11/6-12/15, 3/9/16)
1/29/2016	orange	none	metal	light blue	MCB	Great Lakes, MI SLBD (8/18/15, 2/28-3/1/2016)
1/29/2016	metal	none	orange	yellow	MCB	Great Lakes (2/28-3/1/2016)
1/29/2016	orange	light blue	metal	orange/light blue	MCB	Great Lakes (2/28/2016)
1/29/2016	metal	red	orange flag	blue blue	MCB	Great Lakes, MI, SLBD (2/28-3/1/2016)
2/29/2016	Gf (4YX)	none	blue	none	SB	
2/29/2016	Gf (VUH)	none	blue	none	SB	
3/1/2016	metal	green/orange/green	orange	none	SCB	Great Lakes, APIS (1/2015, 4/2015, 12/15/2015)
3/9/2016	green black	none	red	light blue	SCB	New Jersey, 2015 (10/3-11/1/2016)
9/9/2016	metal	none	Bf (41)	none	NCB	Canada,NL 2015 (9/24-9/26/2016)
9/9/2016	Gf (H10)	none	orange	none	NCB	
9/9/2016	Gf (YAM)	none	orange	none	NCB	
9/9/2016	Gf (39J)	none	orange	none	NCB	
9/9/2016	Gf (8C5)	none	orange	none	NCB	
9/11/2016	metal	none	Bf (C6)	none	NCB	Canada, NB
9/11/2016	Gf (H1C)	none	orange	none	NCB	
9/21/2016	metal	none	Bf (LO)	none	NCB	Canada, Quebec
9/15/2016	metal	none	Bf (YE)	none	SB	Canada, NB
9/24/2016	Gf (5MP)	none	orange	none	SCB	CALO, NC 2015
9/24/2016	Gf (715)	none	orange	none	SCB	
9/25/2016	green light blue	none	orange yellow	none	NCB	New Jersey, 2015 (9/21-26/2016)
9/25/2016	Gf (392)	none	orange	none	NCB	CALO, NC 2015
9/25/2016	Gf (9MO)	none	orange	none	NCB	
9/25/2016	Gf (YEN)	none	orange	none	NCB	
9/25/2016	orange flag	light blue/red yellow	metal	yellow	NCB	Great Lakes
9/26/2016	Gf (MHY)	none	orange	none	NCB	
10/3/2016	metal	green	orange flag	black yellow	SCB	Great Lakes (8/7?, 11/1)
10/12/2016	Gf (9NO)	none	orange	none	NCB	

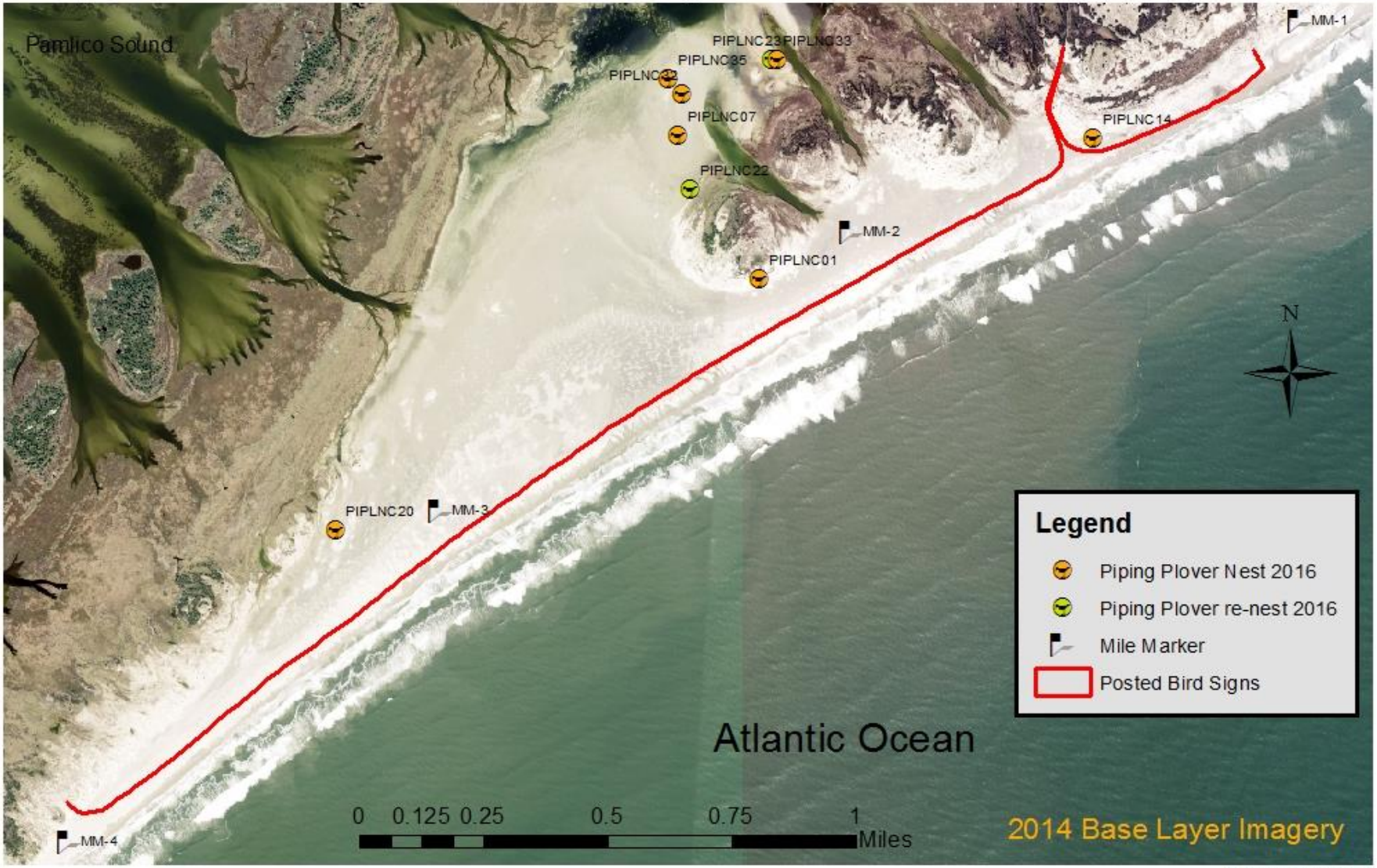
Figure 1. Map of 2016 Occupied Piping Plover Nesting Sites at Cape Lookout National Seashore.



Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 2. Portsmouth Flats Nesting Site



Produced by Natural Resource Management Division

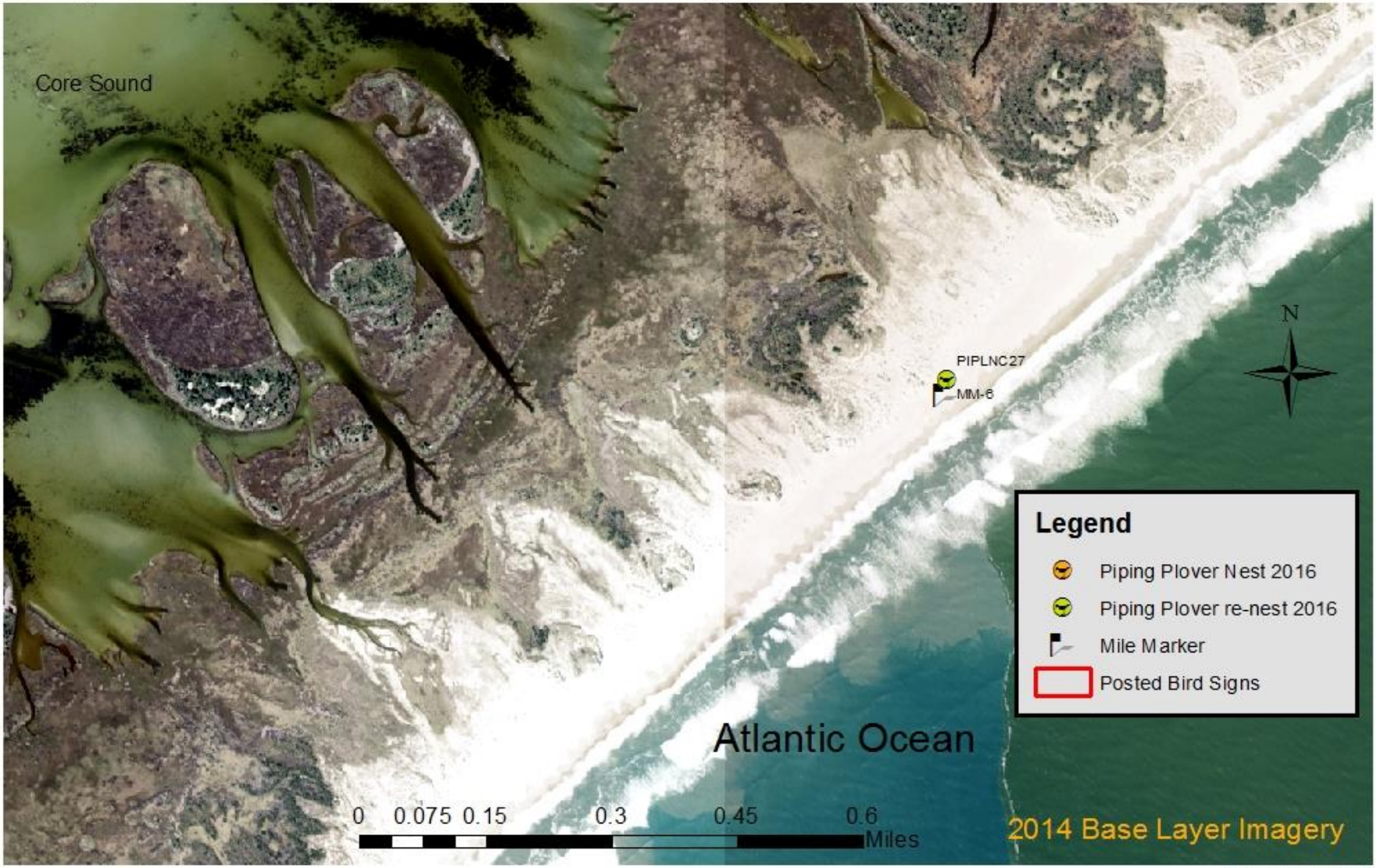
December 2016

FILE:2016_PIPL.mxd

Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 3. Kathryn-Jane Flats Nesting Site



Produced by Natural Resource Management Division

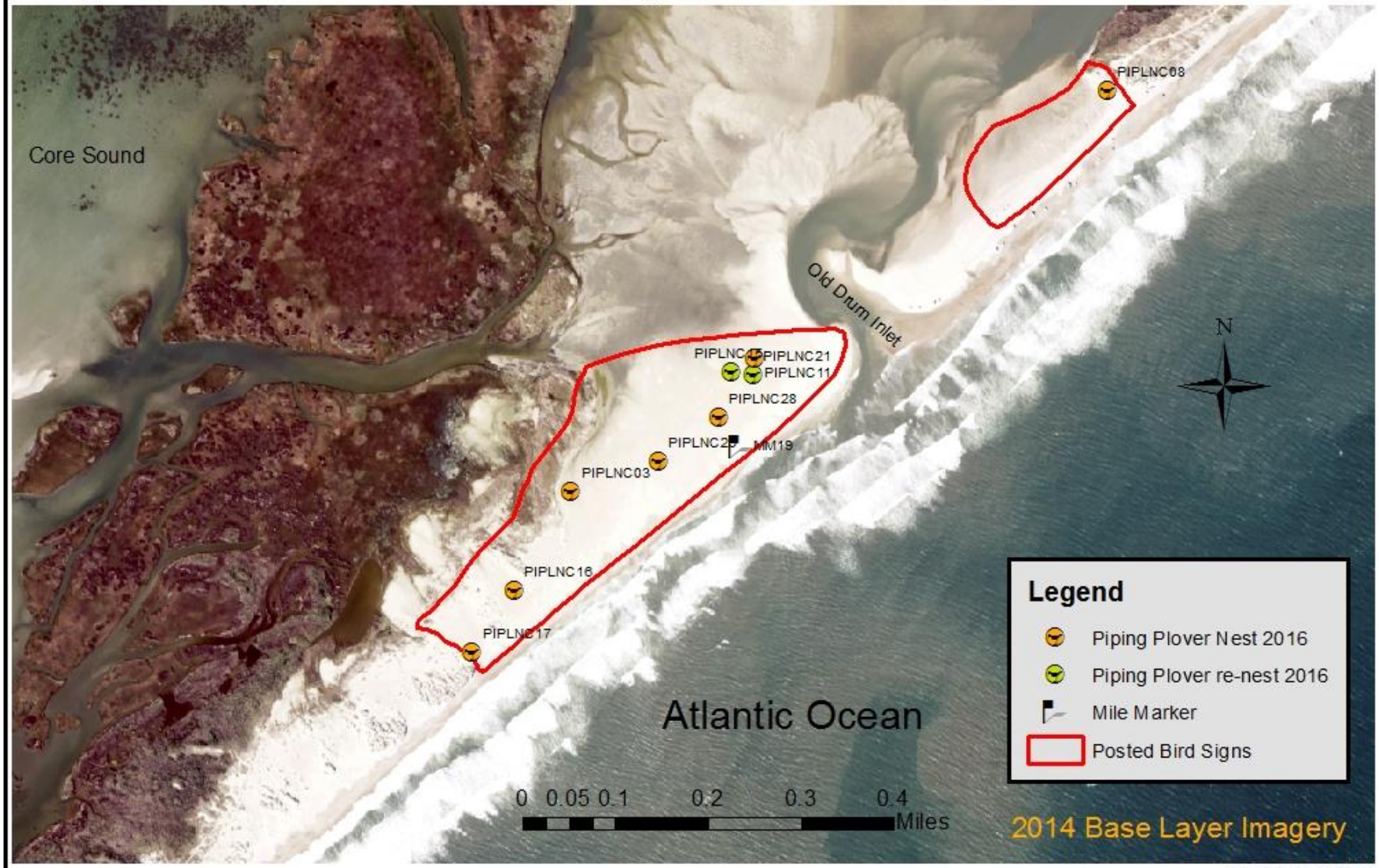
December 2016

FILE:2016_PIPL.mxd

Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 4. Old Drum Inlet Nesting Site



Produced by Natural Resource Management Division

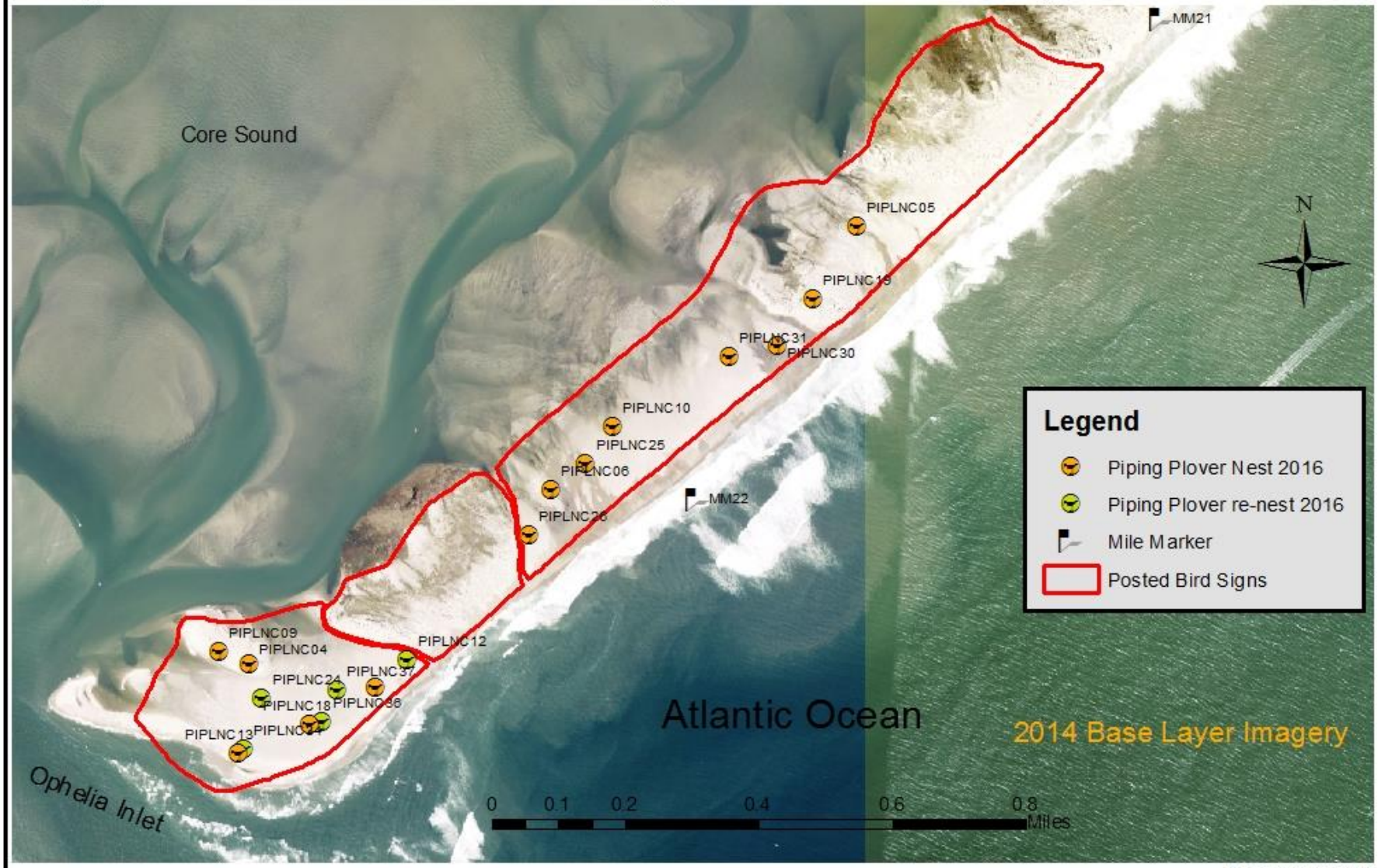
December 2016

FILE:2016_PIPL.mxd

Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 5. New Drum Flats and Ophelia Island Nesting Sites



Produced by Natural Resource Management Division

December 2016

FILE:2016_PIPL.mxd

Cape Lookout National Seashore
North Carolina

National Park Service
U.S. Department of the Interior

Figure 6. Plover Inlet Nesting Site

Produced by Natural Resource Management Division

December 2016

FILE: PIPL_2016_nests.mxd

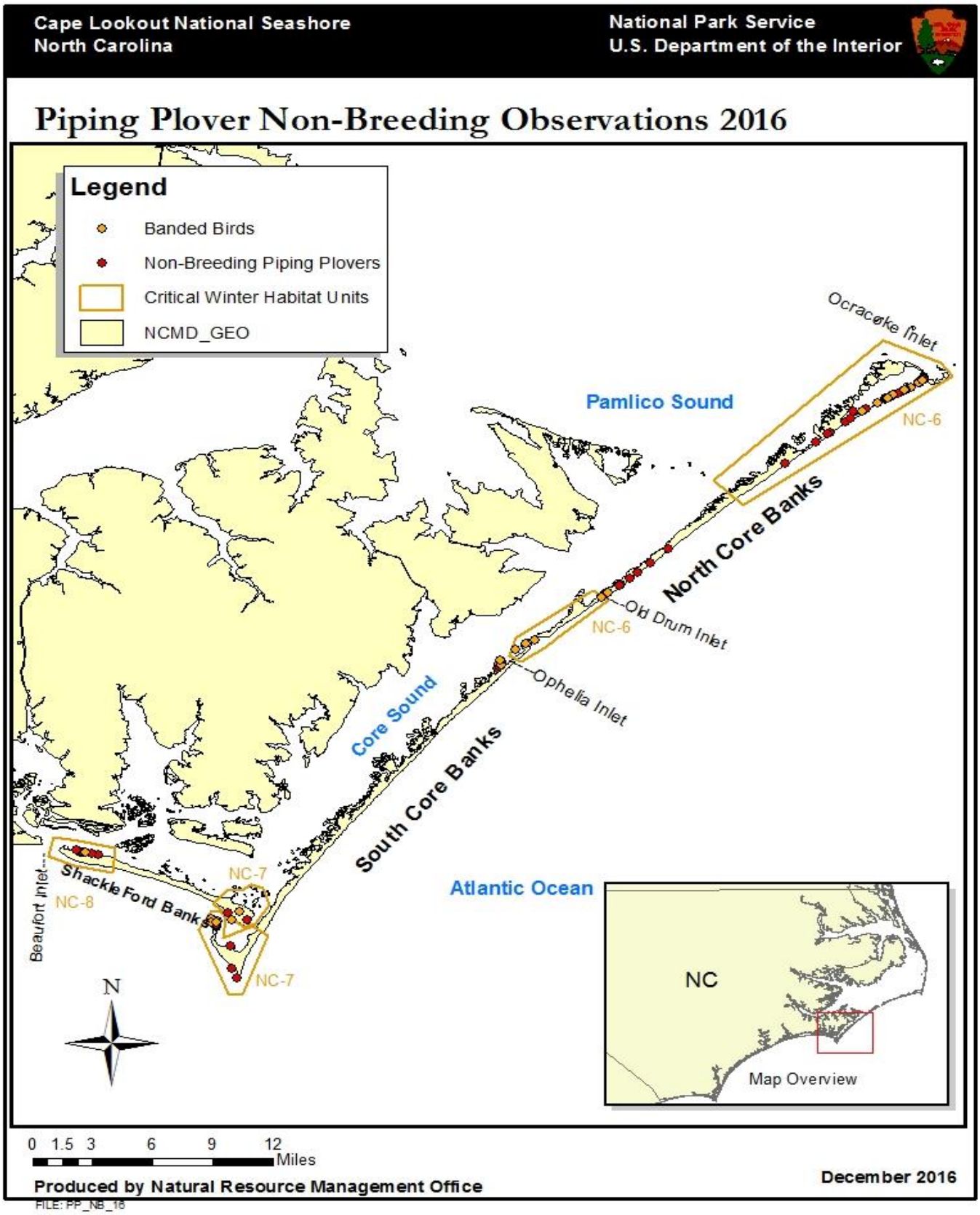



Figure 7. Map of Non-Breeding Observations, Critical Winter Habitat Units and Banded Bird re-sights.