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

2009 SUMMARY REPORT

Predator exclosure on Portsmouth Flats near cedar tree snag. NPS Photo

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Abstract

A total of 37 pairs of piping plovers nested or held a territory at Cape Lookout National Seashore (CALO) in 2009. The birds at CALO accounted for 70% of the nesting pairs in North Carolina. Twenty two pairs nested on North Core Banks and fourteen pairs on South Core Banks. Egg-laying was initiated on April 26th and a total of 45 nest attempts were documented. Twenty four nests hatched and 30 chicks fledged. Productivity was 0.83 chicks fledged per nesting pair. Six broods foraged on the oceanside and three broods moved and foraged out on the open beach. Significant habitat changes include the natural closing of Old Drum Inlet and New Drum Inlet in March 2009.

Introduction

The piping plover is listed as a federal threatened species by the U.S. Fish and Wildlife Service. Piping plover monitoring at CALO began with a baseline study in 1989. The park is a significant nesting area, containing 70% of the nesting pairs in the state of North Carolina. CALO is also an important 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 2009, 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 Beaufort and Ocracoke Inlets. With the natural closing of Old Drum and New Drum Inlets in March 2009 the seashore is currently divided into three barrier islands. The northernmost island, North Core Banks (NCB) is now approximately 23 miles long, extending from Ocracoke Inlet to Ophelia Inlet. South Core Banks (SCB) extends southward from Ophelia Inlet to almost 24 miles to Barden Inlet. The Core Banks have a northeast to southwest orientation and exhibit a low profile landscape. The third island, 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 searched at least three times per week for territorial pairs and nests. Potential habitat outside posted areas was monitored and posted as necessary with a minimum 150 foot buffer distance from scrapes and nests. The locations of nests were recorded, and the nests were monitored daily until they hatched or were lost. The Interim Protected species Management Plan/ Environmental Assessment, March 2006, developed for CALO provides guidance for monitoring and management.

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. Exclosures were topped with ¾" mesh bird netting. Because of high rates of losses to raccoons, nest exclosures were sometimes constructed before the clutch was complete.

After nests hatched, broods were monitored daily until the chicks fledged or were lost. Any ocean beach foraging areas were closed to vehicle traffic while the chicks were present.

The area between Ophelia Inlet and Ramp 24, 1 mile in length, was completely closed to vehicles (except for NPS monitors) from May 21 to July 24. A second ocean beach closure to vehicles was established on the west side of Cape Point, 0.45 mile in length, from May 11 to August 24. The third ocean beach closure to vehicles was established from New Drum Inlet creek to Ophelia Inlet, 0.40 mile in length, from May 30 to July1. A forth ocean beach closure to vehicles was posted from mile 2.8 to mile 1.8, from June 2 to June 18 for the hatching of the beach berm nests. The closures began the day of expected hatch of the first nest on the area and remained in place until the last chick was fledged, confirmed lost, or moved out of area.

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

Results

Nesting Pairs

A total of 37 pairs of piping plovers nested or held a territory at CALO in 2009 (Table 1 and 2). One male individual was also recorded. Twenty two pairs nested on North Core Banks (NCB), and fourteen pairs on South Core Banks (SCB). On NCB one non-nesting pair occupied a territory at Ophelia Island. A single male was present at Portsmouth flats, but didn't attract a mate. Birds nested in eight distinct areas (Figure 1). The area around Ophelia Inlet contained the highest number of nesting pairs. The birds at CALO accounted for 70% of the nesting pairs in North Carolina in 2009.

Table 1. Number of Pairs by Nesting Areas

ISLAND	NESTING AREA	NUMBER OF PAIRS
North Core Banks	Portsmouth Flats	12
North Core Banks	Kathryn-Jane	1
North Core Banks	Old Drum Inlet	3
North Core Banks	New Drum Inlet	5
North Core Banks	Ophelia Island	2
South Core Banks	Plover/Ophelia Inlet	11
South Core Banks	Cape Point	2
South Core Banks	Power Squadron Spit	1

Table 2. Piping Plover Breeding Pairs at Cape Lookout National Seashore 1989-2009

	1989	1992	1993	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ocracoke Inlet	0	2	0	2	2	1	0	1	0	0	0	0	0	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
Kathryn-Jane Flats	7	11	9	12	11	10	8	2	1	1	2	1	1	2	1	3	0	1
Old Drum Inlet	3	2	1	1	2	1	1	0	0	0	0	1	0	0	0	0	2	3
New Drum Inlet (NCB/MCB) Mile 21 to 22	4	5	9	10	6	3	2	3	1	2	2	2	2	3	3	5	6	5
New Drum Inlet (SCB)/ Ophelia Island Mile 22 to 23	3	3	4	5	4	2	3	3	2	3	2	2	2	2	2	2	2	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
Cape Point	0	0	0	0	0	0	0	1	0	0	0	0	0	4	3	2	3	2
Power Squadron Spit	3	2	3	2	2	1	2	1	0	0	0	1	0	1	1	2	1	1
Shackleford Banks														1	0	0	0	0
CALO Total	34	33	35	39	35	36	32	21	16	16	15	14	13	27	33	45	46	37

Nests

There were 45 nesting attempts made in 2009. The earliest nest initiation was believed to be on 26 April and the latest on 10 July. Twenty seven nests were on NCB and 18 on SCB. Of the 45 nests 9 were re-nests. Refer to Figures 2-8 for detailed maps of nests and nesting sites, 2009 DOQQ base layer. Twenty four of the nests hatched and thirty chicks were fledged from seventeen different broods. The average clutch size was 3.29 eggs and 83 of 145 eggs hatched. Productivity for CALO was 0.83 chicks fledged per nesting pair (Table 3 and Appendix 4).

Table 3. Piping Plover Nesting Success at CALO 1989-2009

YEAR	NESTING PAIRS	NESTS	CHICKS FLEDGED	FLEDGE RATE
1989	34	56	25	0.74
1992	33	39 (NCB only)	7 (NCB only)	0.25
1993	35	56	26	0.74
1994	39	66	9	0.23
1995	35	43	15	0.43
1997	36	41	7	0.19
1998	32	39	11	0.34
1999	21	22	2	0.09
2000	16	18	8	0.50
2001	16	19	5	0.33
2002	15	20	4	0.27
2003	14	15	6	0.43
2004	13	13	12	0.92
2005	27	31	23	0.85
2006	33	37	29	0.88
2007	45	58	11	0.24
2008	46	57	9	0.20
2009	36	45	30	0.83

Predator Exclosures

In 2009, predator exclosures were used to protect 36 (80%) nests. Twenty three (64%) of the nests with exclosures hatched. Six nests with predator exclosures were lost to flooding, one nest lost to high winds, one nest lost to ghost crab predation, and five nests lost for unknown reasons. Predator exclosures were not used on 9 nests. Of these one nest hatched, two was lost to ghost crabs, one nest was lost to unknown cause, two nests were lost to raccoon predation, two were lost to weather, and one was abandoned (Appendix 1). Table 4 below shows likely causes of nest losses for all nests. The predator column includes 3 ghost crabs losses and 2 raccoon losses.

Table 4. Likely Causes of Piping Plover Nest Losses in 2009.

NESTING AREA	# NESTS	# LOST	PREDATORS	STORM	ABANDONED	UNKNOWN
Portsmouth Flats	15	8	4	4	0	0
Kathryn-Jane Flats	1	1	0	0	1	0
Old Drum Inlet (NCB)	5	2	0	2	0	0
New Drum Inlet (NCB)	5	1	0	0	0	1
Ophelia Island (NCB)	1	0	0	0	0	0
Plover Inlet (Mile 23.6)	14	7	1	2	0	4
Cape Point	2	0	0	0	0	0
Power Squadron Spit	2	2	0	2	0	0
Total	45	21	5	10	1	5

Brood Foraging

Six broods foraged on the ocean beach in 2009. Five of these broods were observed foraging on both the oceanside and soundside at Plover/Ophelia Inlet and Old Drum Flats. One brood at the Cape Point foraged at both the west oceanside and the ephemeral pool on the upper beach. Two broods at the Portsmouth Flat ponds foraged at the ponds and out on the open beach. One brood at New Drum Inlet creek foraged out on a narrow open beach sand flat and the soundside. All other chicks foraged on soundside beach, sand flats, mudflats and ephemeral pools in areas closed to vehicles and in most cases all entry.

Predator Control

In cooperation with North Carolina State University 149 raccoons **(***Procyon lotor*) were removed from South Core Banks in December 2008 and April 2009 as part of an experimental removal study.

Non-nesting Piping Plover Surveys

Surveys in 2009 did not include the area from south of Old Drum Inlet to the north side of Ophelia Inlet from January to March. After the inlets closed in late March we were able to survey all of NCB down to Ophelia Inlet from August to December and thus the entire seashore. Table 5 below list this year's counts. Appendix 3 lists non-nesting counts from 2003-2009. Figure 9 illustrates non-breeding piping plover observations and critical habitat units.

Table 5. Non-Nesting Piping Plover Counts at Cape Lookout National Seashore, 2009.

	January	February	March	August	September	October	November	December
NCB	6	2	10	83	144	22	18	12
SCB	18	9	17	26	33	19	12	14
SB	13	12	?	2	10	13	12	23
Total	**37**	**23**	**≥27**	**111**	**187**	**54**	**42**	**49**

Banded Piping Plovers

Thirty five observations of sixteen banded birds were made in the park in 2009 (Table 6). Wintering birds from the endangered Great Lakes breeding population were recorded in the seashore throughout the non-breeding season, except March 2009.

Table 6. Band Combinations of Piping Plovers Observed at CALO, 2009.

ID	DATE	LEFT LEG-TOP	LEFT LEG-BOTTOM	RIGHT LEG-TOP	RIGHT LEG-BOTTOM	ISLAND	COMMENTS
1	1/14	orange flag	yellow/orange, blue	USFWS-metal	red	SB	Great Lakes bird, captive reared
1	2/24	orange flag	yellow/orange, blue	USFWS-metal	red	SCB	Great Lakes bird
1	5/27	orange flag	yellow/orange, blue	USFWS-metal	red	SCB	Great Lakes bird, leg injured
2	8/4	USFWS-metal	orange	orange flag	yellow, yellow	SCB	Great Lakes bird
3	8/8	USFWS-metal	light blue	orange flag, green	blue/orange/blue	SCB	Great Lakes bird
3	8/9	USFWS-metal	light blue	orange flag, green	blue/orange/blue	SCB	Great Lakes bird
4	8/9	orange	-	USFWS-metal	black/orange/black	SCB	Great Lakes bird, present in 2008
5	8/9	USFWS-metal	red/orange	orange	-	SCB	Great Lakes bird, unsure combination
2	8/10	USFWS-metal	orange	orange flag	yellow, yellow	SCB	Great Lakes bird
6	8/10	orange flag	blue, red	USFWS-metal	green/orange/green	SCB	Great Lakes bird, unsure combination
7	8/10	orange	-	USFWS-metal	orange, yellow	SCB	Great Lakes bird
8	8/14	USFWS-metal	red	orange flag	yellow, red	NCB	Great Lakes bird, present 2007&2008
3	8/17	USFWS-metal	light blue	orange flag, green	blue/orange/blue	SCB	Great Lakes bird
6	8/19	USFWS-metal	green/orange/green	orange flag	blue, red	SCB	Great Lakes bird, unsure combination
2	8/19	USFWS-metal	orange	orange flag	yellow, yellow	SCB	Great Lakes bird
6	8/29	orange flag	green/orange/green	USFWS-metal	blue, red	SCB	Great Lakes bird, unsure combination
8	8/29	orange flag	red, blue	USWFS-metal	yellow	SCB	Great Lakes bird, possible light blue
3	8/30	USFWS-metal	light blue	orange flag, green	blue/orange/blue	SCB	Great Lakes bird
3	8/31	USFWS-metal	light blue	orange flag, green	blue/orange/blue	SCB	Great Lakes bird
9	9/3	USFWS-metal	red	orange	-	SCB	Great Lakes bird
5	9/5	USFWS-metal	red/orange	orange flag	-	SCB	Great Lakes bird, unsure combination
8	9/5	USFWS-metal	red	orange flag	yellow, red	NCB	Great Lakes bird, present 2007&2008
10	9/5	-	-	-	USFWS-metal	NCB	single metal band

ID	DATE	LEFT LEG-TOP	LEFT LEG-BOTTOM	RIGHT LEG-TOP	RIGHT LEG-BOTTOM	ISLAND	COMMENTS
6	9/13	orange flag	blue, red	USFWS-metal	green/orange/green	SCB	Great Lakes bird, unsure combination
2	9/13	USFWS-metal	orange	orange flag	yellow, yellow	SCB	Great Lakes bird
8	9/16	USFWS-metal	red	orange flag	yellow, red	NCB	Great Lakes bird, present 2007&2008
11	10/14	USFWS-metal	orange	orange	red	NCB	Great Lakes bird
12	10/15	orange flag	missing left foot	USFWS-metal	red	SCB	Great Lakes bird
5	10/15	USFWS-metal	red/orange/red	orange	-	SCB	Great Lakes bird, unsure combination
13	11/16	orange	light blue	USFWS-metal	orange/light blue	NCB	Great Lakes bird
14	11/16	USFWS-metal	red	orange	red	NCB	Great Lakes bird
9	11/16	USFWS-metal	red	orange	-	NCB	Great Lakes bird
15	11/17	USFWS-metal	orange/blue	orange	-	SCB	Great Lakes bird
11	12/14	USFWS-metal	orange	orange	red	SCB	Great Lakes bird
16	12/14	orange	-	USFWS-metal	light green/ orange/light green	SCB	Great Lakes bird

Discussion

Nesting Habitat

The natural inlet closing process at Old Drum and New Drum Inlets has created good nesting habitat at those sites. As these inlets migrated to the southwest large sand flats developed in their wake. The closing of Old Drum inlet this year allowed for increased monitoring, from once weekly to daily, of the New Drum flats and Ophelia Island sites. It also allowed public beach traffic to drive and recreate at these sites. The area has been limited to boat traffic for the last ten years. The mudflats on the soundside side of these former inlets and recently created Ophelia Inlet continue to be productive for piping plovers and used by many other shorebird species. On the north end of SCB at Ophelia Inlet a large open sand flat has developed over the last two years. As revegetation has taken hold of much the northern end of SCB nesting pairs have moved to this new sand flat and out to the oceanside in front of the dunes. Three nests were located in front of the dunes on the oceanside from mile 23 to mile 24. Each of these nests required enlarging the original bird closure to give the 150 feet buffer. This high quality nesting habitat from Old Drum to Plover Inlet contained 57% (21pairs) of the nesting pairs in 2009. Another important area, Portsmouth flats continued to provide nesting habitat on NCB for 12 pairs (32%). In 2009, there were three nests that were located out on the beach berm at Portsmouth Flats. A large ephemeral pool, intertidal flats, and sand flat supported two nesting pairs at Cape Point. Although heavily revegetated Kathryn-Jane flats did attract one nesting pair in 2009. Power Squadron spit only contained one nesting pair. In May Ocracoke Inlet briefly held a single territorial piping plover and a single snowy plover. Nest scrapes were made and defended by both birds, but were abandoned. The piping plover left the area while the snowy plover remained and foraged for the summer.

Pair Numbers

The number of breeding pairs in the seashore decreased from the record high of 46 in 2008 down to 37 in 2009. This may be due to low productivity in 2007 and 2008. The fledging success was only 0.24 (11 fledglings) in 2007 and 0.20 (9 fledglings) in 2008. The pair losses primarily occurred at Plover Inlet on the north end of SCB which lost 7 pairs from 2008. The area has revegetated since the scouring effects of Hurricanes Isabel (2003) and Ophelia (2005). It appears that the habitat can no longer support the density of pairs it did in 2007 and 2008.

In addition to the 36 nesting pairs in the park, a non-nesting pair was recorded at Ophelia Island during the breeding census (Appendix 2). It was observed occupying a territory, but no nest was found.

Nest Success

2009 brought low hatch success for piping plover nests in the park. Only 53% of the nests and 57% of the eggs hatched successfully. The ten weather related nest losses accounted for 48% of total losses. These weather losses were primarily related to strong winds in May that buried nests in sand or flooded nests. Predation took five (24%) nests, three were ghost crab predation and two were raccoon predation. One (5%) nest was abandoned. Five (23%) nest losses were recorded as unknown. Nest hatch success by area for the time period of 1998 to 2009 is presented in Table 7.

In 2009, predator exclosures were effective in protecting nests from all predators except for one nest lost to ghost crabs. Since 1997, at least 32 nests protected by exclosures have lost eggs to ghost crabs. At Ophelia Island and New Drum flats we were able to deploy predator exclosures on all known nests in 2009 due to ease of access and daily monitoring. In previous years we were limited to once weekly visits that limited the use of predator exclosures. Predator exclosure use was increased from 54% in 2008 to 80% in 2009. There were no observations of raccoons circling or digging at predator exclosures on SCB or NCB.

Predator exclosures have generally been effective in increasing hatch success. From 1997-2009, 66% of the nests protected with exclosures hatched, compared with 39% of the nests left unprotected.

Fledging Success

The fledging success for piping plovers at CALO was the forth highest recorded for the seashore at 0.83 chicks fledged per nesting pair in 2009. Though the nesting pair count dipped this year, productivity was high. The actually number of chicks fledged, 30 fledglings, is the highest on record for CALO.

Traditionally unproductive, Portsmouth Flats in 2009 produced the most fledglings with 14 fledglings from 12 pairs for productivity of 1.17. In 2008, only one fledgling and 0.07 productivity was recorded for Portsmouth Flats. The Old Drum Flats nesting site grew from one nesting pair in 2008 to 3 nesting pairs in 2009. The three pairs hatched three nests and produced 1 fledgling for a productivity of 0.33. The New Drum site, which includes old Ophelia Island, had six nests and fledged 6 chicks for a productivity of 1.00 in 2009. At the Plover Inlet site nine fledglings were produced from 11 pairs for a fledge success of 0.82. Kathryn-Jane Flats, Cape Point and Power Squadron Spit had no fledgling success in 2009. These site by site reproductive successes for 2009 can be compared to the long term averages in Table 7. In 2009 Portsmouth Flats and New Drum had a significantly higher fledge success than the 12 year average for these same sites.

In 2009 the oceanside and open beach foraging areas contributed to the high fledgling success. At Plover Inlet (mile 23.6) seven chicks from 4 broods foraged both on the oceanside and soundside. Five of these chicks fledged. At Cape Point one brood of three chicks foraged on the west ocean tide line before being lost. At Old Drum two chicks from one brood foraged at both the oceanside and soundside. The two chicks were only seen once on the oceanside and the one chick that fledged from this site was last spotted on the soundside. At Portsmouth Flats, mile 2 area, two chicks from two broods foraged out on the open beach and both chicks fledged. Similarly three chicks from one brood used the open beach of the New Drum Inlet area and one chick fledged there. Chicks at the above areas received ocean beach closures or expanded open beach closures except for the two chicks at Old Drum Flats due to non-reporting of the oceanside foraging event. It was later found described in the datasheet notes.

Table 7. Differences in Reproductive Success between Major Nesting Areas for the Period of 1998-2009.

Nesting Area	Hatch Success	Fledge Success
Portsmouth Flats	44%	0.33 chicks per pair
Kathryne-Jane Flats	47%	0.61 chicks per pair
Old Drum Flats	57%	0.28 chicks per pair
New Drum& Ophelia Island	65%	0.44 chicks per pair
Plover Inlet	65%	0.82 chicks per pair
Cape Point	82%	0.20 chicks per pair

Predators

Although there has been some suspect tracks and scat on NCB, red fox (*Vulpes vulpes*) continues to be absent in the seashore in 2009. There has been no confirmed evidence and no impacts to piping plovers. Raccoon and feral cat tracks at nest sites continue to be a concern. Two nests were taken by raccoon. Nest 7 on SCB at Plover Inlet was in a grassy location and not suitable for a predator exclosure. Nest 20 at Portsmouth Flats on NCB was taken before the predator exclosure could be erected. In 2009 no attempts were made to dig into predator exclosures by raccoons. This has been a concern on SCB in previous years.

Human Disturbance

Posted closures for bird nesting areas were not always respected by park visitors. In 2009 a record of violations was maintained by natural resource staff in order to enter these records into the case incident system. There were 53 records of pedestrians or footprints within bird closures and 20 records of vehicles or tracks within bird closures. These numbers are conservative since footprints and tire tracks disappear, before they are recorded, after moderate wind, tide changes, and or rain. Law enforcement rangers issued 1 citation for pedestrian in bird area and 6 citations for vehicles in bird areas.

Dogs were also a potential source of disturbance to nesting birds. An effort to document, educate, and enforce the seashore's leash law was continued in 2009. A local press release and posted signs informed the public of the seashore's leash law. In 2009 a total of 132 observations of dogs on or off leash were recorded by natural resource staff. One hundred two dogs (73%) were on leash and 37 dogs (27%) were off leash and in violation of the park's leash law. Law enforcement rangers issued 29 dogs off leash citations and 8 written warnings. In 2009 there was an increased law enforcement staff presence on the beach.

Non-nesting piping plovers

CALO continues to be an important migration stopover location and wintering site for piping plovers. In 2009, 530 observations of piping plovers were recorded 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. In addition this year the area from Old Drum Inlet flats to Ophelia Inlet had high numbers of birds. On NCB 83 piping plovers were counted in August and 144 in September. These counts represent the highest numbers recorded in the seashore since counts began in 2000. Sixteen banded piping plovers from the endangered Great Lakes population were re-sighted in 2009

US Fish and Wildlife Service Biological Opinion

The USFWS provided CALO a biological opinion that included four performance measures for the Interim Protected Species Management Plan. Thirty seven breeding pairs were found in CALO in 2009 surpassing the target of 25 or more pairs of performance measure 1. Thirty seven pairs produced 45 nests (1.2 nest per pair) surpassing the target of at least one nest per breeding pair of performance measure 2. The 36 nesting pairs produced 30 fledglings for a fledge rate of 0.83, which is above the target of 0.75 of performance measure 3. Winter plover surveys at CALO were conducted at least once monthly from August until March to meet performance measure 4.

Conclusions

2009 was a record year for piping plover fledgling success at CALO. The majority of the fledglings were produced from North Core Banks at two sites, Portsmouth Flats and New Drum. Typically unproductive, Portsmouth Flats had a record year with the highest fledge success in the last 12 years. These chicks foraged primarily on open wet sand flats near pools of water. Weather may have played a role at this site and others this year. 2009 was a cool and wet nesting season. Not too wet to completely flood the flats, but wet enough to support abundant prey for the chicks. The relatively cool weather may also have reduced the heat stress level. The timing of weather events in the reproductive cycle is important and may have aligned just right for the chicks at Portsmouth Flats.

This same weather pattern negatively effected the growing nesting population at Old Drum Flats. Two nests were flooded out by the cool north winds that pushed soundside water against the banks. For much of the summer the soundside mudflats were flooded by north winds. This may explain the increased foraging use of the ocean intertidal zone at Plover Inlet in 2009, in addition to the marsh vegetation crowding.

Given the unpredictable weather patterns and piping plover breeding behavior monitoring and management should allow for these dynamic changes. Further study of the environmental/weather's role in reproductive success is needed.

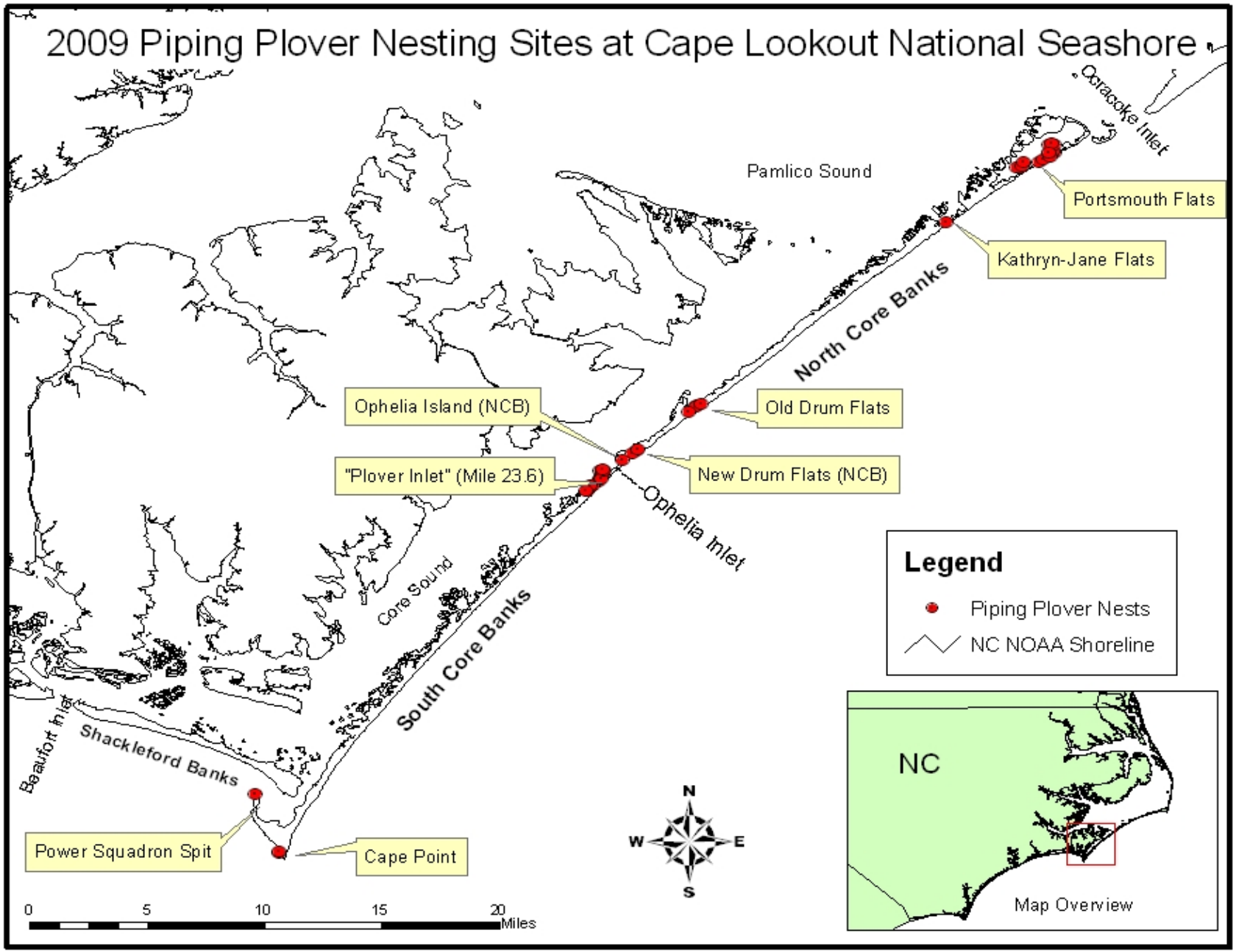

Figure1. Map of 2009 Piping Plover Nesting Sites at Cape Lookout National Seashore.

Appendix 1- 2009 PIPING PLOVER NEST DATA

NORTH CORE BANKS

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS
1	1	18.73	29-Apr	4	4-May	na	0	0	flooded by high tide and strong northwest winds on 5/18-5/20, nest closer to soundside
2	2	21.56	29-Apr	4	4-May	31-May	4	1	fledged at day 31, foraged on soundside
3	3	1.8	30-Apr	1	na	na	0	0	egg buried by strong winds, confirmed lost on 5/6, nest located out of original sign line
4	4	2.93	30-Apr	1	na	na	0	0	lost to ghost crab on 5/6, northwest of cedar tree snag on back flat
5	5	1.86	30-Apr	4	4-May	na	0	0	nest sanded in 6/2, nest located on back flat of north pond
6	6	2.43	4-May	4	6-May	3-Jun	2	2	nest on beach berm, closed beach for 2 weeks, chicks went west, 0.4 mile from nest
7	7	2.23	4-May	1	na	na	0	0	nest out on beach berm, sand blown over nest 5/11
8	3	1.76	4-May	3	6-May	2-Jun	3	1	chick foraged outside closure, closure expanded 6/18, fledged 6/30-30 days
9	8	1.97	6-May	3	13-May	5-Jun	3	1	nest on beach berm, closed beach for 2 weeks, chick on beach, Fledged 7/2-27 days
10	9	21.48	7-May	3	7-May	1-Jun	3	2	fledged on 7/2, day 32
11	10	21.56	7-May	4	7-May	3-Jun	4	0	1 chick last seen on 6/18 at day 15, not seen after
12	11	18.63	11-May	4	16-May	na	0	0	nest flooded 5/20
13	12	1.69	12-May	4	12-May	2-Jun	4	4	nest and chicks at west of north pond, fledged at day 29 on 7/1
14	13	3.19	12-May	4	13-May	2-Jun	3	2	fledged at day 28 on 7/1, chicks foraged on back flat and open sand flats
15	14	3.27	12-May	3	13-May	9-Jun	3	3	chicks in glasswort on backside of flats
16	15	6.65	13-May	2	na	na	0	0	nest at 2eggs, adults abandoned nest, sanded in by 6/6
17	16	21.76	14-May	4	14-May	4-Jun	4	2	chicks foraged along soundside and sand flats
18	17	1.78	20-May	2	na	na	0	0	found 2 broken eggs, yolk still present, 20 feet from nest scrape, lost on 5/20 to GC
19	18	3.13	21-May	3	23-May	2-Jun	3	1	fledged at day 31 on 7/1 at lower beach, foraged on sand flat as a chick
20	19	1.95	23-May	1	na	na	0	0	lost to raccoon on 5/29
21	20	22.3	30-May	?	na	30-May	3	1	missed nest, beach closure, dead chick on day 26, 1 chick fledged at day 29 on 6/27
22	19	1.97	2-Jun	4	6-Jun	na	0	0	nest flooded by high tides on 6/23
23	1	18.7	9-Jun	4	10-Jun	30-Jun	4	1	2 chicks at surf on 7/11, 1 chick fledged on

									soundside near green sign on 7/24, 24 days
24	21	21.5	17-Jun	4	20-Jun	na	0	0	adults moved nest twice within nest predator exclosure, area was very wet, lost by 7/14
25	11	18.4	21-Jun	4	21-Jun	8-Jul	4	0	chicks seen near dunes on north end of flats, chicks lost by 7/16-unknown fate
26	22	19.07	25-Jun	2	5-Jul	22-Jul	1	0	chick foraged on soundside at Old Drum creek, lost after day 7-unknown fate-7/29
27	4	2.95	1-Jul	4	2-Jul	na	0	0	7/7 2 eggs predated by ghost crab, 7/9 0 eggs-ghost crab

22 nesting pairs, 27 nests, 15 hatched nests, 21 chicks fledged

Nest #	Pair #	MILE	DATE FOUND	CLUTCH SIZE	EXCLOSURE	HATCH DATE	EGGS HATCHED	# FLEDGED	COMMENTS
1	1	23.29	2-May	4	5-May	na	0	0	eggs gone at day 24 of incubation, unknown reason, no tracks, no chicks
2	2	24.12	2-May	4	6-May	4-Jun	4	0	chicks lost by 6/6, adults making scrapes on 6/6
3	3	47.25	4-May	3	12-May	na	0	0	nest flooded on 5/29
4	4	23.48	5-May	4	6-May	3-Jun	4	1	oceanside nest, chick foraged soundside and ocean, chick fledged on 6/27 at 23 days old
5	5	23.33	5-May	4	6-May	3-Jun	4	1	nest west of mile marker on big flat towards soundside, chick fledged on 7/7 at 33 days
6	6	23.23	5-May	4	6-May	6-Jun	4	3	nest west of MM, foraged on soundside mudflat, chicks fledged on 7/4 at 28 days
7	7	23.89	6-May	3	na	na	0	0	grassy nest location, no predator exclosure, raccoon tracks at nest, lost on 6/3
8	8	23.39	6-May	4	7-May	na	0	0	eggs missing from nest cup by 5/21, unknown, no chicks seen
9	9	23.21	6-May	4	7-May	3-Jun	4	2	chicks foraged soundside and ocean shoreline, fledged 2 chicks on 6/30 at 26 days
10	10	44.44	6-May	4	7-May	5-Jun	4	0	chicks foraged at ephemeral pool, chicks lost 6/10
11	11	44.48	6-May	4	7-May	3-Jun	4	0	chicks foraged at ephemeral pool and ocean shoreline, chicks lost by 6-18, one dead chick found at ephemeral pool on 6/18, unknown
12	12	23.77	12-May	3	14-May	30-May	3	2	oceanside nest, chick foraged soundside and ocean shoreline, fledged on 6/27 at 29 days
13	13	23.44	4-Jun	4	4-Jun	29-Jun	4	0	chicks foraged both on the soundside and ocean shoreline, chicks lost by 7/7
14	3	47.27	9-Jun	4	11-Jun	na	0	0	6/22 high tide flooded out nest
15	7	23.86	9-Jun	3	16-Jun	na	0	0	6/18 nest lost, unknown
16	14	23.22	11-Jun	4	12-Jun	na	0	0	nest west of mile marker on big flat, 6/23 high tides flooded nest
17	2	24.15	20-Jun	3	26-Jun	na	0	0	7/12 nest lost, eggs gone, unknown
18	14	23.29	14-Jul	1	na	na	0	0	7/14 found 1 egg outside of nearby scrape, egg cracked with a little yolk, 0.29 west of MM

14 nesting pairs, 18 nests, 9 hatched nests, 9 chicks fledged

2009 Piping plover breeding census results: June 1-9

North Core Banks: 23 pairs, 1 single

Portsmouth Flats	12 Pairs, 1 single
KJ/Whalebone Flats	1 pair
Old Drum Inlet	3 pair
New Drum Inlet	5 pair
Ophelia Island	2 pair

South Core Banks: 14 pairs

Plover Inlet	11 Pairs
Cape Point	2 Pairs
Power Squadron Spit	1 Pair

Shackleford Banks: 0 piping plovers

Cape Lookout National Seashore: 37 pairs, 1 single

Appendix 3. Monthly counts of non-nesting piping plovers 2003-2009

Date	North Core Banks	South Core Banks	Shackleford Banks	CALO Total
January-03	11	7	27	45
February-03	6	6	5	17
March-03	34	3	14	51
August-03	54	42	4	100
September-03	74	?	?	74+
October-03	28	12	7	47
November-03	7	14	7	28
December-03	6	10	7	23
January-04	0	10	9	19
February-04	0	15	12	27
March-04	16	3	29	48
August-04	49	14	6	69
September-04	50	15	13	78
October-04	18	11	18	47
November-04	13	7	16	36
December-04	16	4	12	32
January-05	26	5	6	37
February-05	0	1	6	7
March-05	7	0	10	17
August-05	29	14	1	44
September-05	44	25	6	75
October-05	18	3	9	30
November-05	4	2	9	15
December-05	2	2	2	6
January-06	3	5	9	17
February-06	0	0	10	10
March-06	0	21	7	28
August-06	16	22	6	44
September-06	27	7	5	38
October-06	22	6	7	35
November-06	14	0	8	22
August-07	46	46	11	103
September-07	52	27	2	81
October-07	18	26	17	61
November-07	12	8	22	42
December-07	10	9	14	33
January-08	0	2	11	13
February-08	0	6	10	16
March-08	6	6	10	22
August-08	41	28	17	86
September-08	16	20	10	46
October-08	25	9	20	54
November-08	11	4	9	24
December-08	9	7	8	24
January-09	6	18	13	37
February-09	2	9	12	23
March-09	10	17	?	≥27
August-09	83	26	2	111
September-09	144	33	10	187
October-09	22	19	13	54
November-09	18	12	12	42
December-09	12	14	23	49

Appendix 4. Chart 1 Piping Plover Nesting and Chart 2 Piping Plover Productivity.

Chart 1. Piping Plover Nesting at Cape Lookout National Seashore

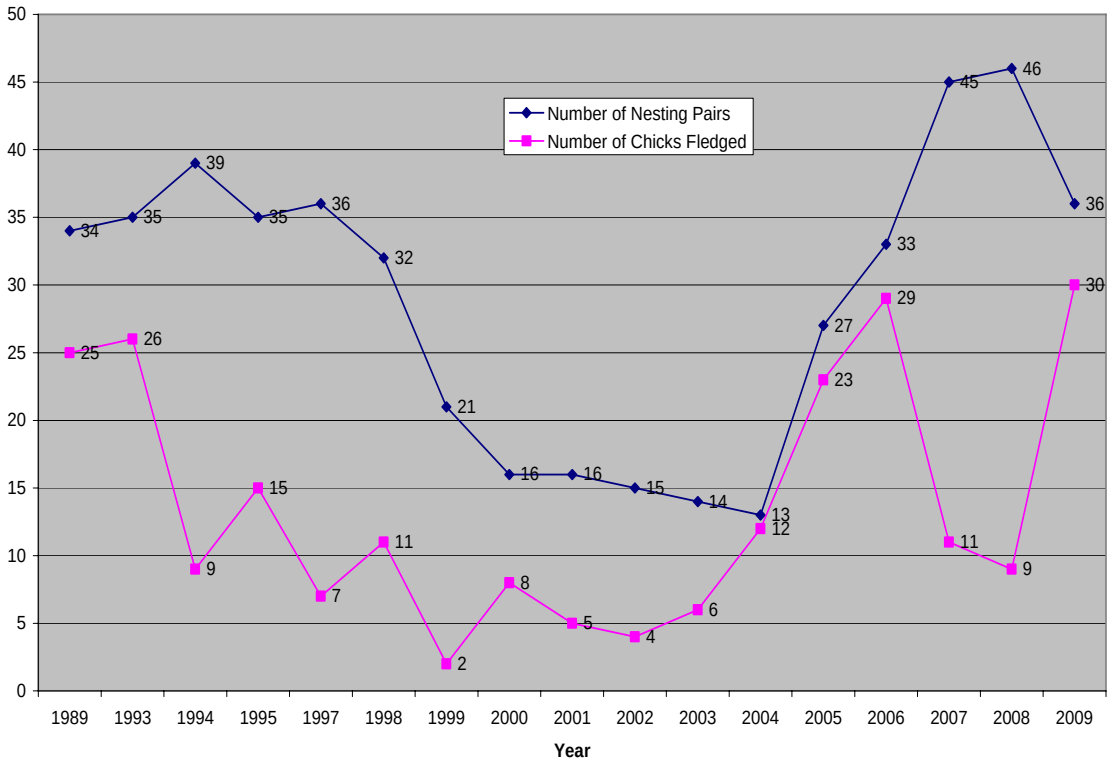

Chart 2. Piping Plover Productiviy

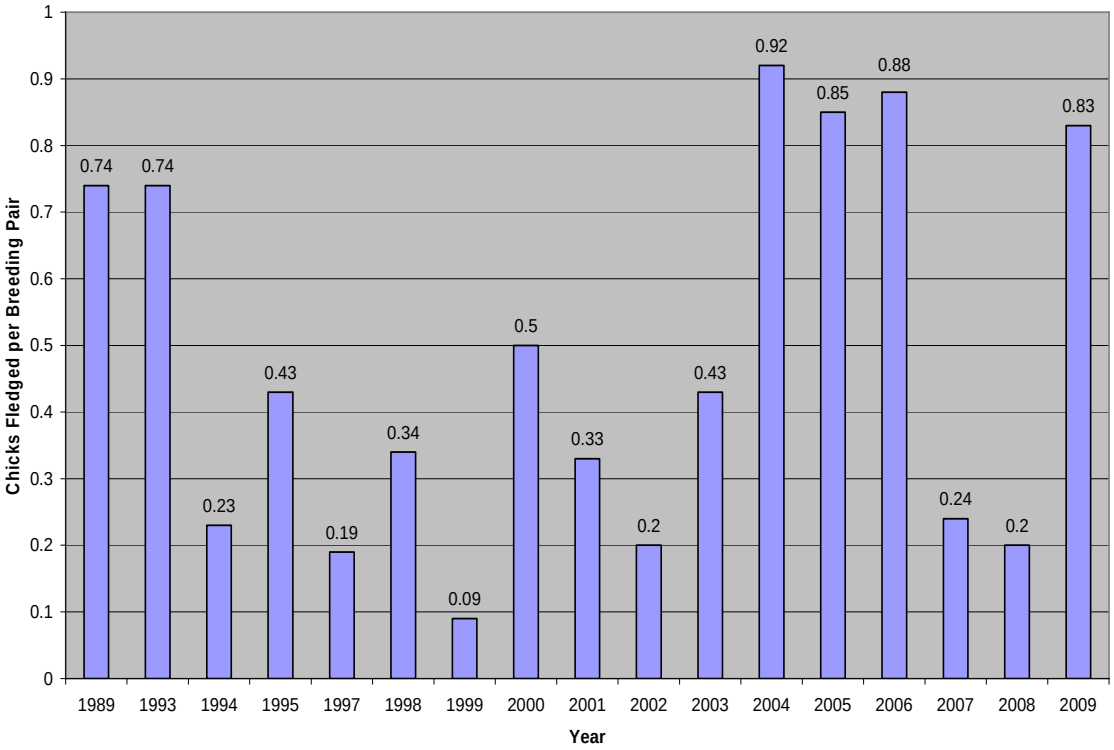

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Figure 2. North Portsmouth Flats Nesting Site

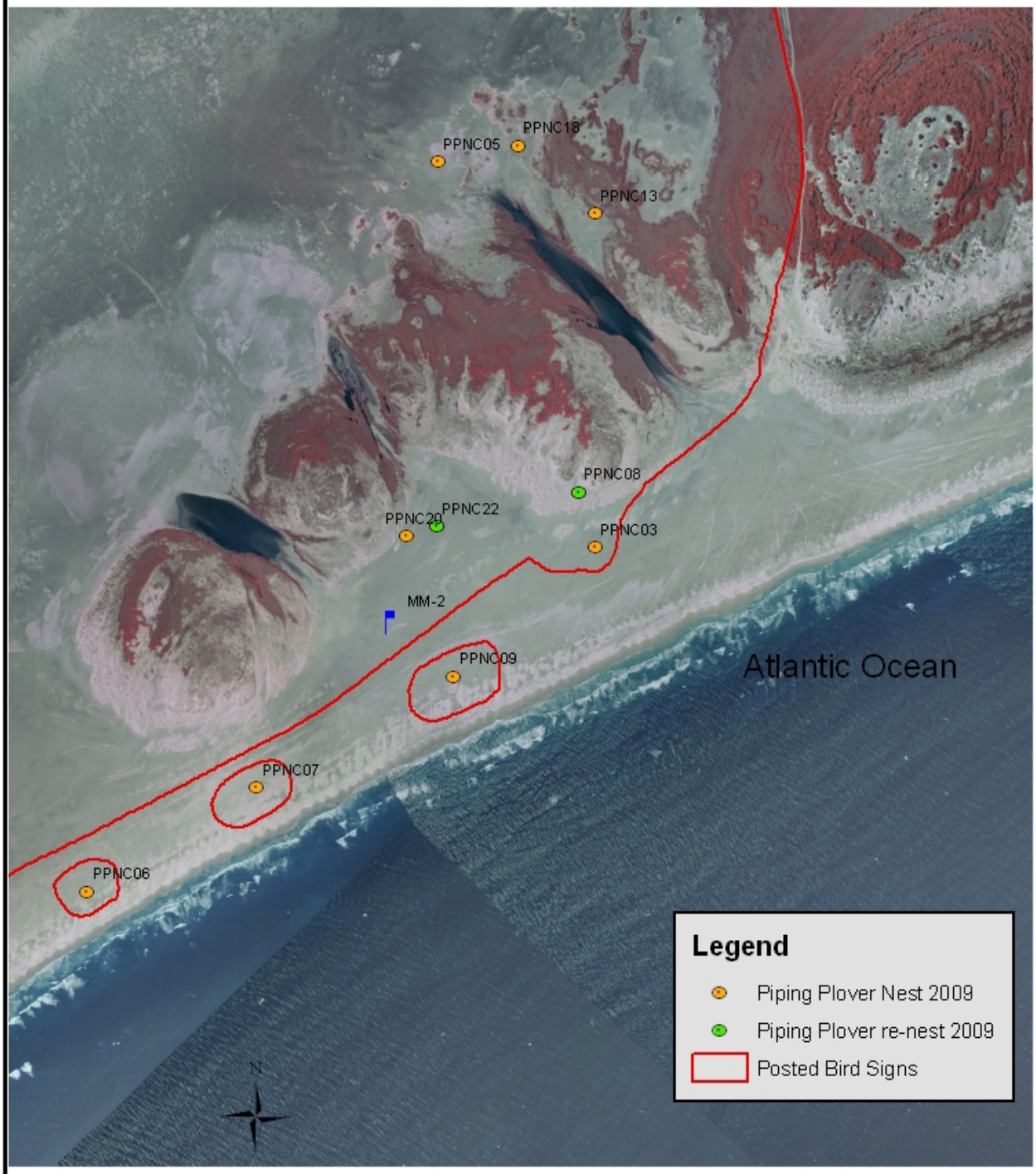

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Figure 3. South Portsmouth Flats Nesting Site

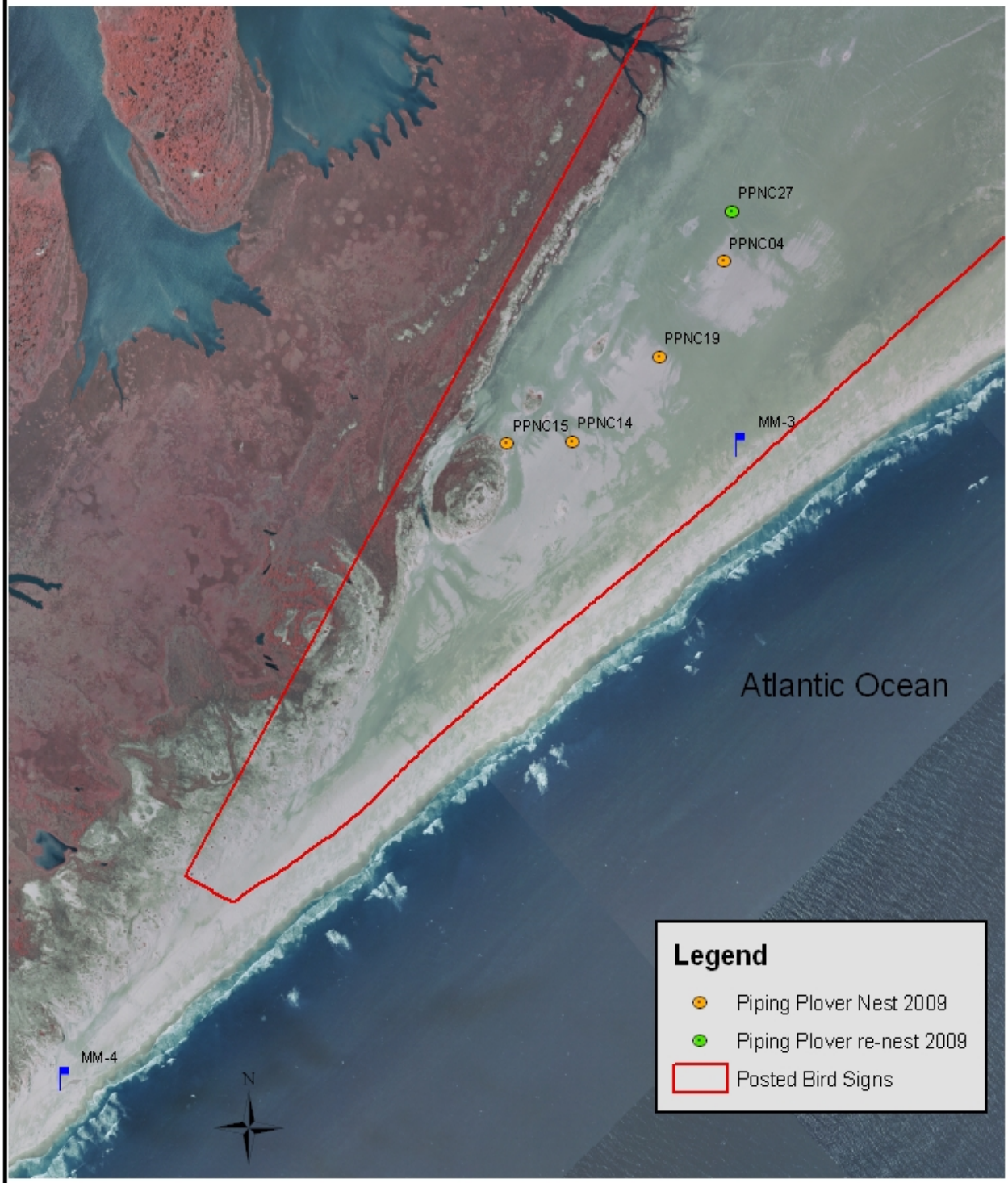

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Figure 4. Kathryn-Jane Flats Nesting Site

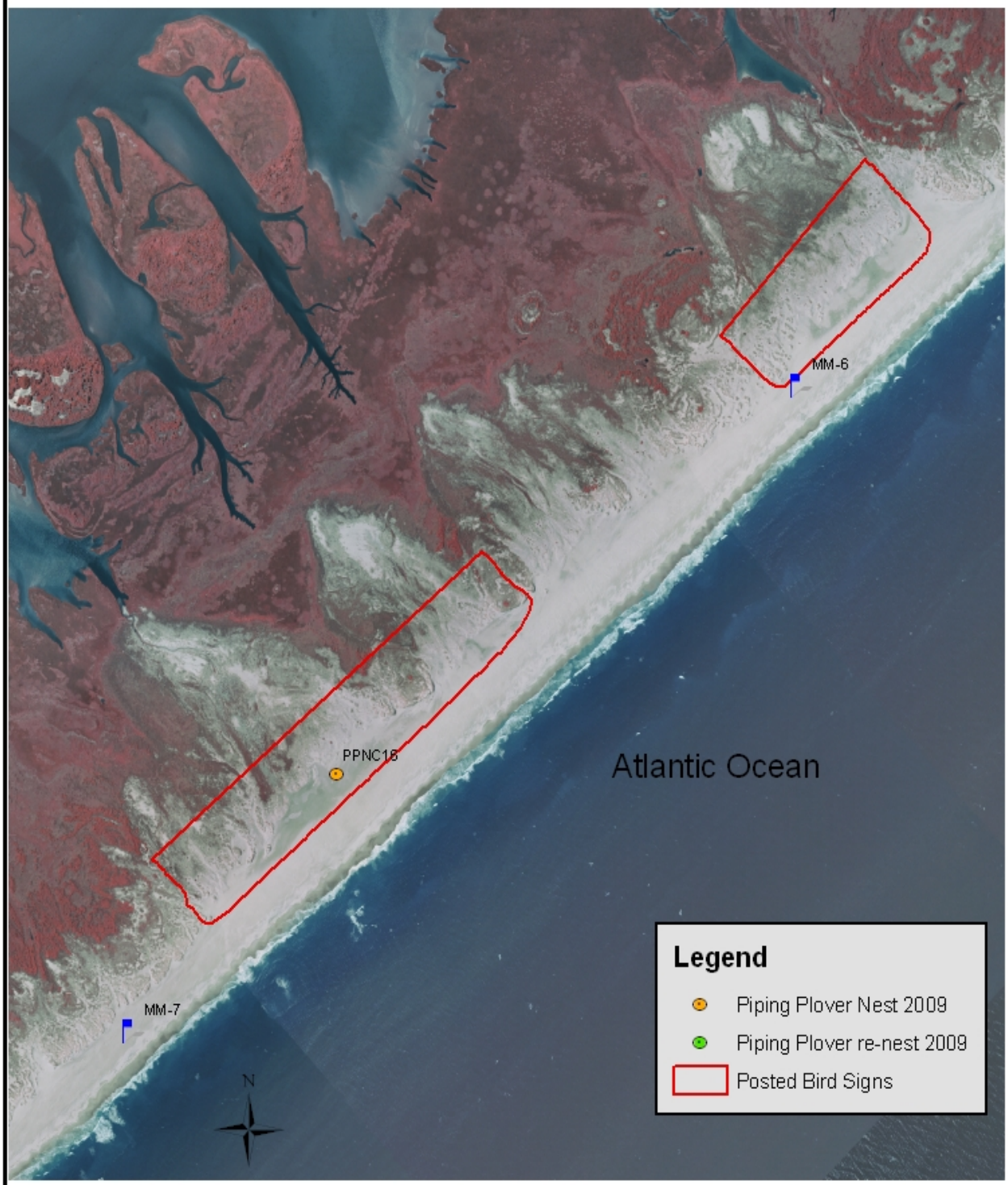

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Figure 5. Old Drum Flats Nesting Site

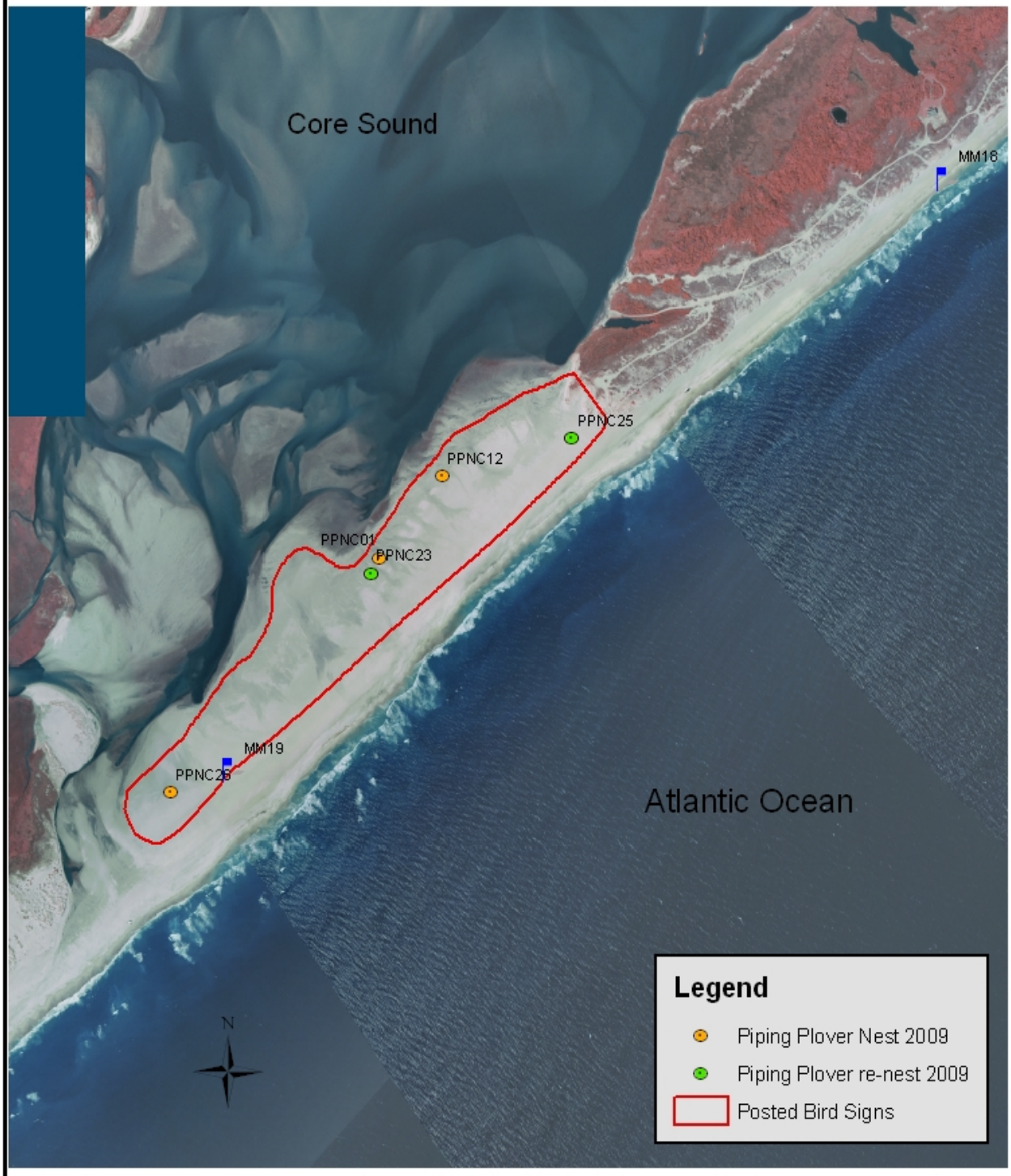

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Figure 6. New Drum Flats and Ophelia Island Nesting Site

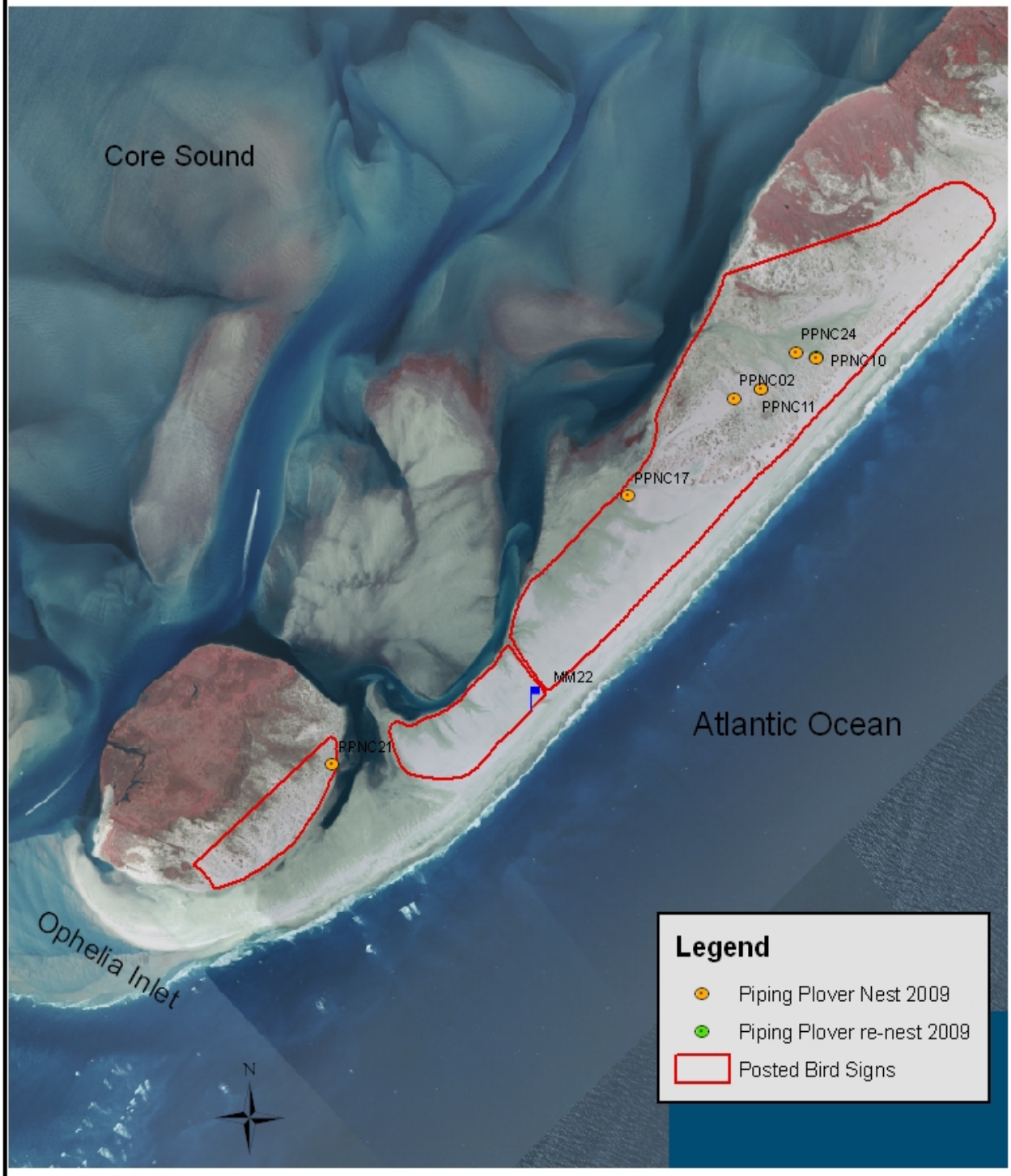

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Figure 7. Plover Inlet Nesting Site

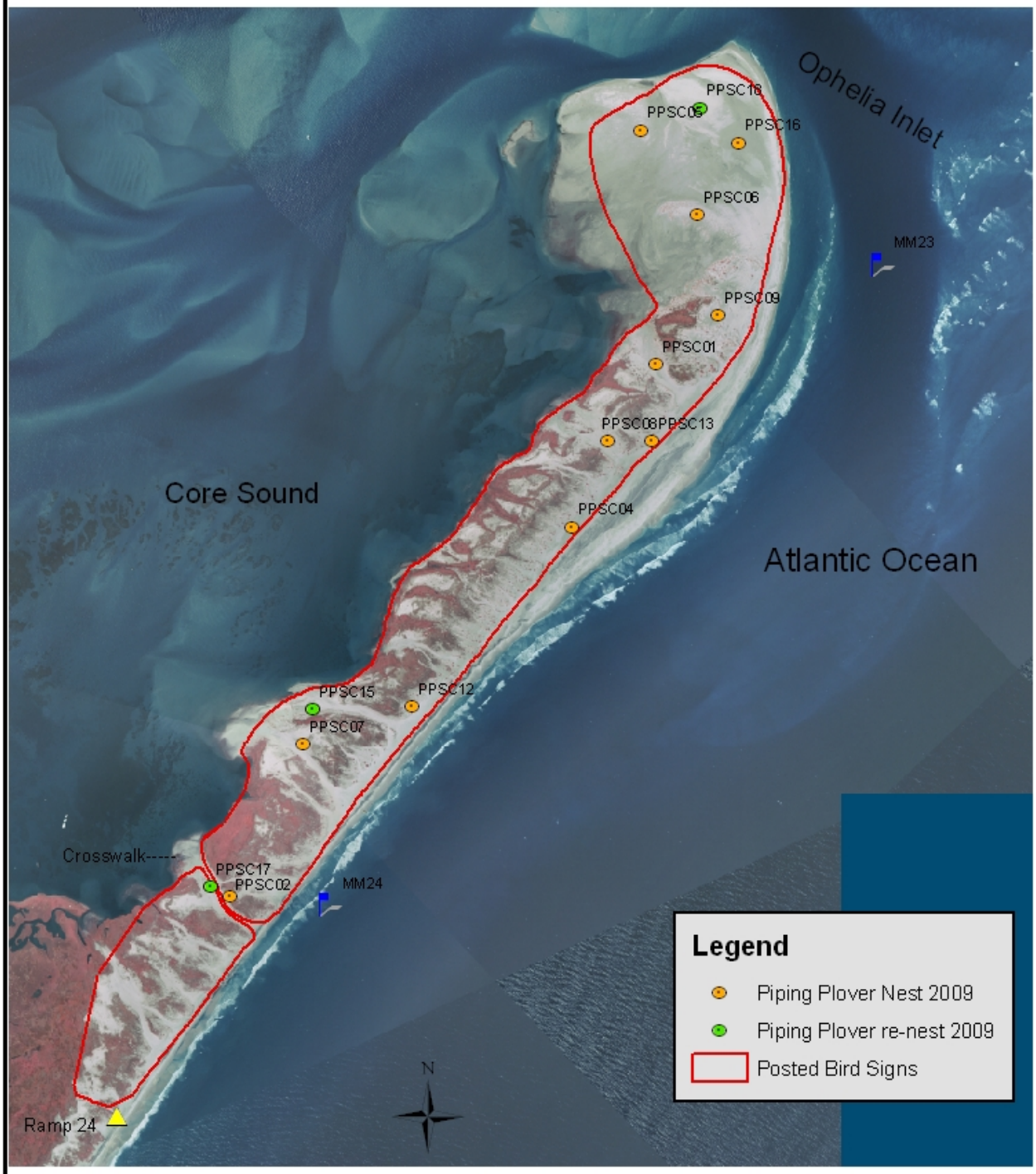

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Figure 8. Cape Point Nesting Site

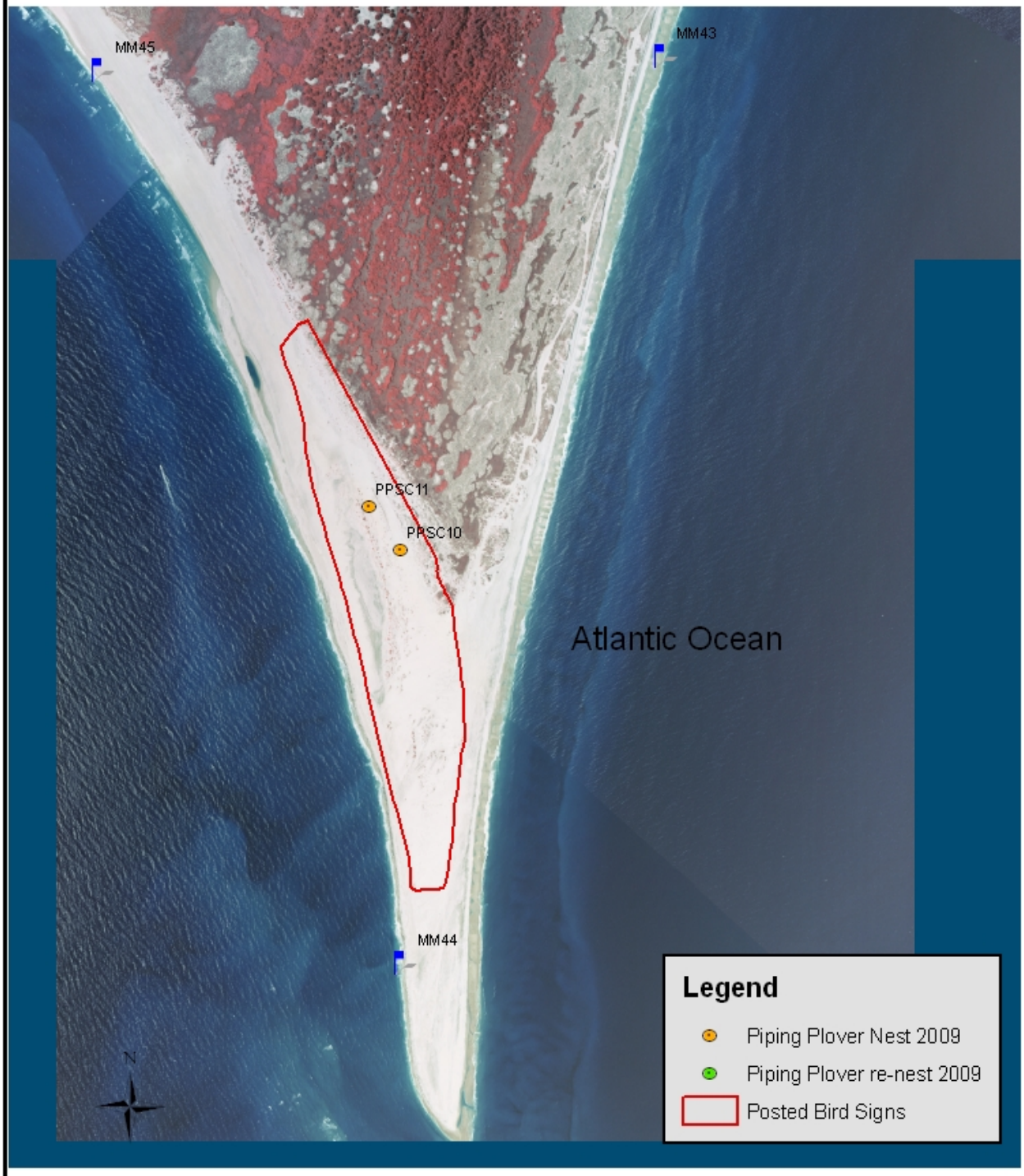

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Figure 9. Power Squadron Spit Nesting Site

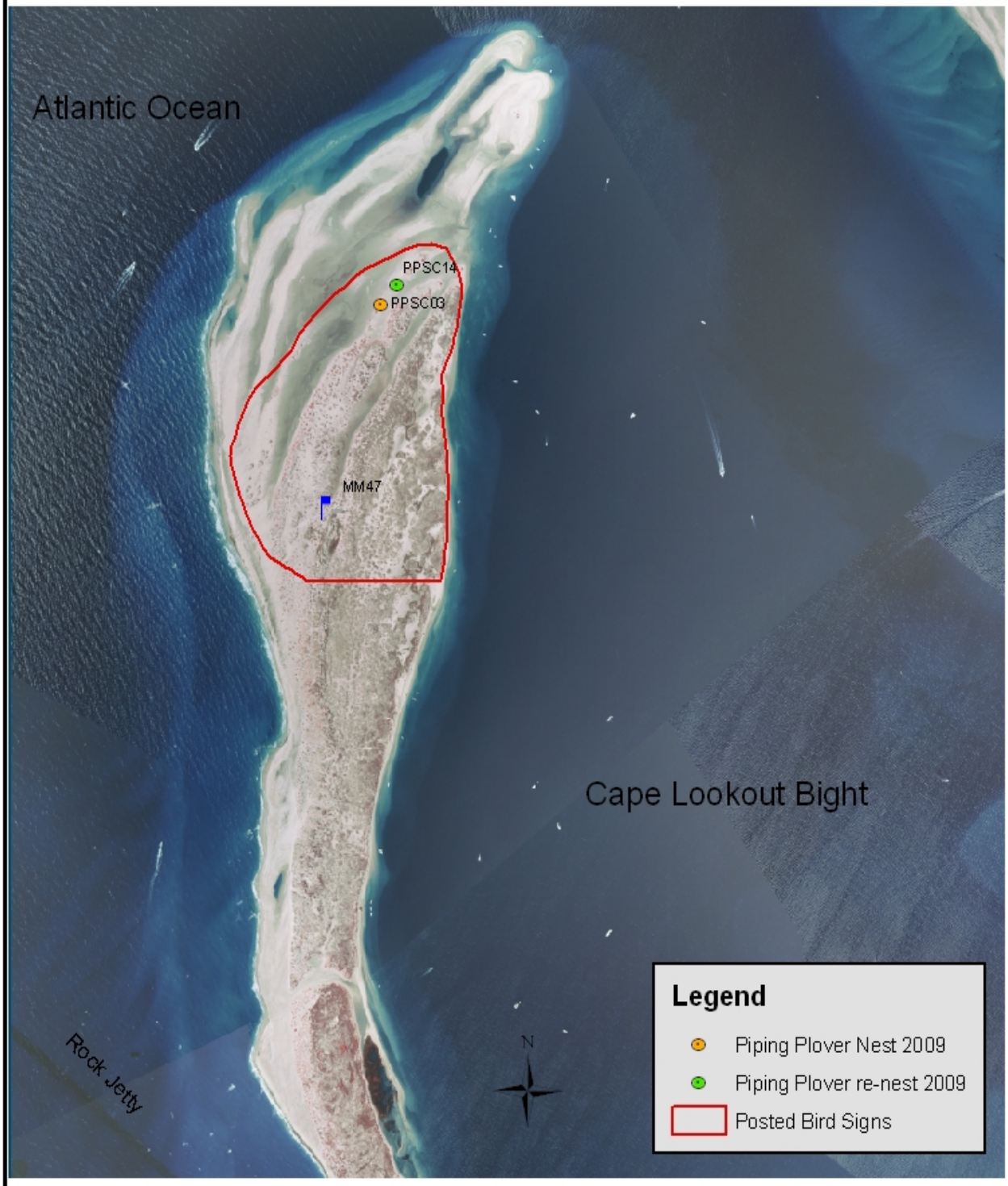

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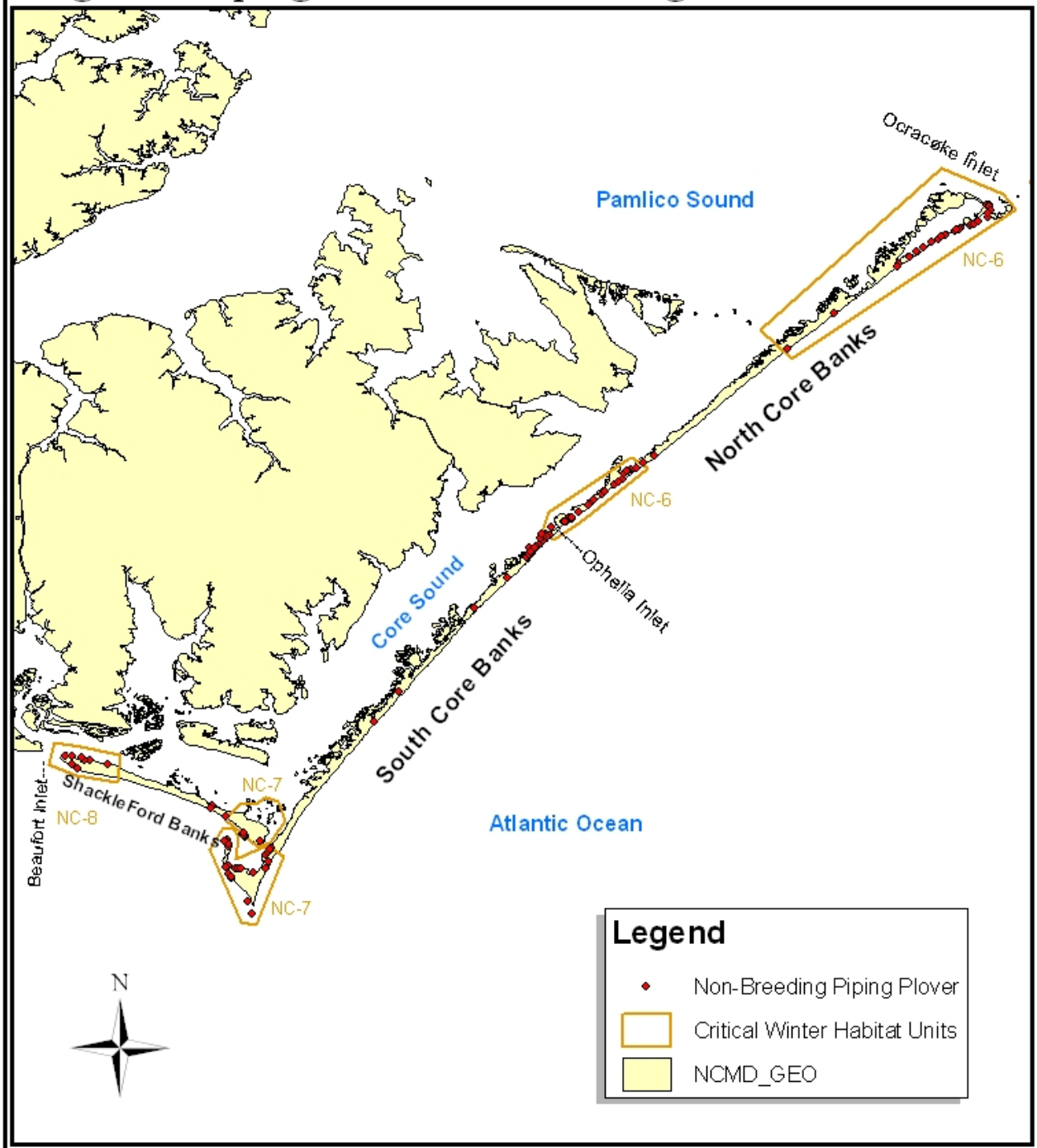
Figure 9. Piping Plover Non-Breeding Observations 2009



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