Vine, Landon

From: Fox, Lori
Sent: Tuesday, November 24, 2009 2:05 PM
To: Sundar, Danielle
Subject: FW: AMOY data

Categories: Projects/ CAHA
Attachments: AMOY data revised (20091124).xls; CAHA CH3 with Buxton Comments-AMOY Tables-rev 11-24-09.doc


AMOY data revised (20091124).x...


CAHA CH3 with Buxton Comments-..

For caha admin...

Lori Fox
Deputy Director, Denver Operations/Senior Planner

Direct 303-985-6602
Main 303-985-6600
Mobile 301-461-8772

Fax 303-984-4942

The Louis Berger Group, Inc. | 12596 West Bayaud Street| Suite 201 | Lakewood, CO 80228-2031 | www.louisberger.com

-----Original Message-----
From: Sandra_Hamilton@nps.gov [mailto:Sandra_Hamilton@nps.gov]
Sent: Tuesday, November 24, 2009 11:22 AM
To: Britta_Muiznieks@nps.gov
Cc: Wetmore, Doug; Fox, Lori; Mike_Murray@nps.gov
Subject: Re: AMOY data

Thanks, Britta.

Doug: Can you double check the numbers with the excel spreadsheet so we're sure we have it all correct in the DEIS, please. Thanks.

Sandy

Sandy Hamilton
Environmental Protection Specialist
National Park Service - Environmental Quality Division Academy Place P.O. Box 25287 Denver CO 80225
PH: (303) 969-2068
FAX: (303) 987-6782

Britta

Muiznieks/CAHA/NPS

11/24/2009 08:29 AM

To: Sandra Hamilton/DENVER/NPS@NPS, Mike Murray/CAHA/NPS@NPS

cc: lfox@louisberger.com, dwetmore@louisberger.com

Subject: AMOY data

I went through the data one more time. I need to figure out how to "lock" the data so someone else doesn't go in and change the corrections that I have made.

I'm attaching the excel sheet I used to fill in the tables. I just used the excerpt for the table that I had created when I was emailing Ted and Shiloh back and forth. These should be the correct numbers in the table now but it wouldn't hurt for someone to double check them with the excel table.

(See attached file: AMOY data revised (20091124).xls)(See attached file: CAHA CH3 with Buxton Comments-AMOY Tables-rev 11-24-09.doc)

Britta Muiznieks
Wildlife Biologist
Cape Hatteras National Seashore

252-995-3740-Office
252-475-8348-Cell
252-995-6998-FAX

Location		1999	2000	2001	2002	2003	2004	2005
Green Island	# prs	unk	unk	unk	unk	?	2	2
	# nests	unk	unk	unk	unk	?	3	3
	nests hatched	unk	unk	unk	unk	unk	2	2
	# fledged	unk	unk	unk	unk	?	2	0
Bodie Island	# prs	2	2	2	2	4	3	2
	# nests	3	3	3	5	5	7	3
	nests hatched	0	0	1	1	1	0	1
	# fledged	0	0	1	2	0	0	0
Bodie-Hatteras	# prs	5	4	3	3	6	4	4
	# nests	6	5	3	3	6	4	5
	nests hatched	0	2	2	0	6	4	4
	# fledged	0	0	2	0	3	6	2
Hatteras Island	# prs	19	19	21	14	10	11	12
	# nests	25	24	25	22	17	14	18
	nests hatched	7	8	8	3	4	10	8
	# fledged	3	2	4	4	3	3	6
Ocracoke Island	# prs	15	12	13	12	8	9	5
	# nests	17	17	15	18	12	11	10
	nests hatched	7	6	11	6	4	7	3
	# fledged	2	7	17	3	1	8	1
Total	# prs	41	37	39	31	28	29	25
	# nests	51	49	46	48	43	39	39
	nests hatched	14	16	22	10	15	23	18
	# fledged	5	9	24	9	7	19	9

2006	2007	2008	2009			
2	2	2	2	12		
2	2	4	2	16		
2	1	1	1	9		
2	2	2	3	11		
2	2	3	4	28		
2	2	5	4	42		
1	1	2	1	9		
0	0	2	1	6		
3	5	4	4	45		
5	9	6	6	58		
2	3	4	5	32		
2	3	4	2	24		
11	10	11	9	147	45	192
14	12	14	13	198	58	256
9	7	5	6	75	32	107
3	6	7	7	48	24	72
5	4	3	4	90		
8	10	3	6	127		
5	3	1	2	55		
2	1	2	0	44		
23	23	23	23	322		
31	35	32	31	444		
19	15	13	15	180		
9	12	17	13	133		

Location	Ocracoke Island				Hatteras Island				Bodie Island				Green Island			
	# prs	# nests	nests hatch	# fledged	# prs	# nests	nests hatched	# fledged	# prs	# nests	nests hatched	# fledged	# prs	# nests	nests hatched	# fledged
1999	15	17	7	2	24	31	7	3	2	3	0	0	unk	unk	unk	unk
2000	12	17	6	7	23	29	10	2	2	3	0	0	unk	unk	unk	unk
2001	13	15	11	17	24	28	10	6	2	3	1	1	unk	unk	unk	unk
2002	12	18	6	3	17	25	3	4	2	5	1	2	unk	unk	unk	unk
2003	8	12	4	1	16	23	10	6	4	5	1	0	?	?	unk	?
2004	9	11	7	8	15	18	14	9	3	7	0	0	2	3	2	2
2005	5	10	3	1	16	23	12	8	2	3	1	0	2	3	2	0
2006	5	8	5	2	14	19	11	5	2	2	1	0	2	2	2	2
2007	4	10	3	1	15	21	10	9	2	2	1	0	2	2	1	2
2008	3	3	1	2	15	20	9	11	3	5	2	2	2	4	1	2
2009	4	6	2	0	13	19	11	9	4	4	1	1	2	2	1	3

	Total			
	# prs	# nests	nests hatch	# fledged
1999	41	51	14	5
2000	37	49	16	9
2001	39	46	22	24
2002	31	48	10	9
2003*	28	43	15	7
2004	29	39	23	19
2005	25	39	18	9
2006	23	31	19	9
2007	23	35	15	12
2008	23	32	13	17
2009	23	31	15	13
	322	444	180	133

*excludes GI, incomplete data

TABLE 13. OYSTERCATCHER NESTING PAIR COUNT COMPARISON, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	Ocracoke Island	Hatteras Island	Bodie Island	Green Island	Total
1999	15	24	2	—	41
2000	12	23	2	—	37
2001	13	24	2	—	39
2002	12	17	2	—	31
2003	8	16	4	—	28
2004	9	15	3	2	29
2005	5	16	2	2	25
2006	5	14	2	2	23
2007	4	15	2	2	23
2008	3	15	3	2	23
2009	4	13	4	2	23
Total	90	192	28	12	322

Source: Simons and Schulte 2007, 48; 2008, 81.

NOTE: Data available only for years listed.

Comment [bdm1]: If we don't include '03 data below, we probably shouldn't include pair numbers here either.

TABLE 14. OYSTERCATCHER BREEDING DATA SUMMARY, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	Nesting Pairs	Nests	Nests Hatched	Nest Survival	Chicks Fledged	Fecundity
Ocracoke Island						
1999	15	17	7	0.412	2	0.13
2000	12	17	6	0.353	7	0.58
2001	13	15	11	0.733	17	1.31
2002	12	18	6	0.333	3	0.25
2003	8	12	4	0.333	1	0.13
2004	9	11	7	0.636	8	0.89
2005	5	10	3	0.300	1	0.20
2006	5	8	5	0.625	2	0.40
2007	4	10	3	0.250	1	0.25
2008	3	3	1	0.333	2	0.67
2009	4	6	2	0.333	0	0.00
Total/*average	90	127	55	0.433	44	0.49
Hatteras Island						
1999	24	31	7	0.226	3	0.13

TABLE 13. OYSTERCATCHER NESTING PAIR COUNT COMPARISON, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	Ocracoke Island	Hatteras Island	Bodie Island		Green Island	Total
2000	23	29	10	0.345	2	0.09
2001	24	28	10	0.357	6	0.25
2002	17	25	3	0.120	4	0.19
2003	16	23	10	0.435	6	0.37
2004	15	18	14	0.778	9	0.60
2005	16	23	12	.0.521	8	0.50
2006	14	19	11	0.579	5	0.36
2007	15	21	10	0.476	9	0.60
2008	15	20	9	0.450	11	0.73
2009	13	19	11	0.579	9	0.69
Total/*average	192	256	107	0.418	72	0.37
Bodie Island						
	Nesting Prs	Nests	Nests Hatched		Fledged	
1999	2	2	0	0.000	0	0.00
2000	2	3	0	0.000	0	0.00
2001	2	3	1	0.333	1	0.50
2002	2	5	1	0.200	2	1.00
2003	4	5	1	0.200	0	0.00
2004	3	7	0	0.000	0	0.00
2005	2	3	1	0.333	0	0.00
2006	2	2	1	0.500	0	0.00
2007	2	2	1	0.500	0	0.00
2008	3	5	2	0.400	2	0.67
2009	4	4	1	0.250	1	0.25
Total/*average	28	42	9	0.214	6	0.214
Green Island						
2004	2	3	2	0.667	2	1.00
2005	2	3	2	0.667	0	0.00
2006	2	2	2	1.000	2	1.00
2007	2	2	1	0.500	2	1.00
2008	2	4	1	0.250	2	1.00
2009	2	2	1	0.500	3	1.50
Total/*average	12	16	9	0.562	8	0.67

1

CHAPTER 3: AFFECTED ENVIRONMENT

The "Affected Environment" describes existing conditions for those elements of the natural and cultural environments that would be affected by the implementation of the actions considered in this *Off-Road Vehicle Management Plan/Environmental Impact Statement* (plan/EIS). The natural environment components addressed include wetlands and floodplains; rare, unique, threatened, or endangered species; state listed and special status species; wildlife and wildlife habitats (with a focus on birds and invertebrate species that could be affected by ORV use or management); soundscapes; visitor use and experience (including night skies); socioeconomic resources; and Seashore management and operations. Impacts for each of these topics are analyzed in "Chapter 4: Environmental Consequences."

WETLANDS AND FLOODPLAINS

WETLANDS

Wetlands include areas inundated or saturated by surface or groundwater for a sufficient length of time during the growing season to develop and support characteristic soils and vegetation. NPS classifies wetlands based on the U.S. Fish and Wildlife Service (USFWS) Classification of Wetlands and Deepwater Habitats of the United States (the Cowardin classification system). Based on this classification system, a wetland must have one or more of the following attributes:

- The habitat at least periodically supports predominantly hydrophytic (wetland) vegetation.
- The substrate is predominantly undrained hydric soil.
- The substrate is nonsoil and saturated with water, or is covered by shallow water at some time during the growing season. (Cowardin et al. 1979).

The majority of the undeveloped acreage within the Seashore can be classified as a wetland. The predominant wetland types at the Seashore are marine and estuarine. Marine wetlands occur along the beaches on the oceanside of the Seashore, and estuarine wetlands generally occur along the soundside, adjacent to the many tidal creeks that are prevalent along the islands.

Marine wetlands at the Seashore are located in the intertidal zone (from extreme high tide to extreme low tide) and in the subtidal zone, which includes areas permanently submerged below shallow coastal waters (Cowardin et al. 1979). Marine wetlands are found along the entire length of the ocean shoreline and are typical of a sandy beach environment, subject to high wind and wave energy. Estuarine wetlands consist of deepwater and adjacent tidal wetland areas that are often partially enclosed by land but are influenced by marine waters and freshwater runoff from adjacent uplands (Cowardin et al. 1979). Estuarine wetlands

at the Seashore typically fall into two classes: emergent or scrub–shrub. Emergent wetlands, also referred to as tidal marshes, are characterized by herbaceous perennial vegetation such as salt marsh cordgrass (*Spartina alterniflora*), black needlerush (*Juncus roemerianus*), bulrush (*Scirpus* spp.), and cattail (*Typha* spp.) (NCDENR 2008). Scrub–shrub wetlands are typically dominated by woody vegetation less than 20 feet tall. Typical vegetation species found in these wetlands include wax myrtle (*Myrica cerifera*) and Eastern red cedar (*Juniperus virginiana*) (Sutter 1999). Although most wetlands at the Seashore are tidal, there are also some areas of nontidal wetlands, located primarily on Hatteras Island near the village of Buxton and Buxton Woods Coastal Reserve. These wetland areas include forested and emergent wetlands and are predominantly freshwater swamps and marshes that are not influenced by the tides.

Wetland areas provide substantial environmental and economic benefits to the Seashore and surrounding areas of coastal North Carolina. For example, wetlands trap sediment and pollutants from stormwater runoff and provide a natural filter before this runoff can enter local waterways. Wetlands also store large volumes of water and function like sponges to reduce the likelihood of flooding during storm events. Wetlands also protect the shoreline from erosion and provide excellent habitat for fish and wildlife species, many of which are threatened or endangered (NCDENR 2008b). As required by Director's Order 77-1, the NPS must avoid adverse impacts on wetlands to the extent practicable, must minimize any impacts that cannot be avoided, and must compensate for any remaining unavoidable adverse impacts on wetlands (NPS 2008b).

FLOODPLAINS

North Carolina's barrier islands have historically been and continue to be affected by coastal forces and flooding events. The barrier islands that comprise the Seashore are flat and narrow and lie adjacent to the shallow and wide Pamlico Sound. The widest part of the Seashore islands is near Cape Point, between Buxton and Frisco (Pendleton et al. 2005). According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, the entire Seashore is within the 100-year floodplain.

Generally, lands along the ocean beaches and adjacent to the sound (at wide points) are in flood zone "VE," which is the flood insurance rate zone that corresponds to 100-year coastal floodplains that have additional hazards associated with storm waves. Zone "VE" is also referred to as the "Coastal High Hazard Area." The remainder of the Seashore not directly adjacent to the ocean or sound lies within the "AE" zone, which is within the 100-year floodplain and subject to waves less than 3 feet high (NCDCCPS 2008).

Because the Seashore is entirely within the 100-year floodplain and is subject to high-water-table conditions, many areas are conducive to drainage and flooding that often result from storm events. Areas

near Buxton Woods and Cape Point Campground have been documented as historically flood-prone and are examples of popular Seashore destinations that experience flooding during times of above-average precipitation events (NPS 2003b). As required by Director's Order 77-2, the NPS must protect and preserve the natural resources and functions of floodplains, must avoid environmental effects associated with the occupancy and modification of floodplains, must avoid actions that could adversely affect wetland functions, and must restore floodplain values previously affected by activities in floodplains (NPS 2003c).

RARE, UNIQUE, THREATENED, OR ENDANGERED SPECIES

This section addresses species present at the Seashore that are listed by USFWS as either endangered or threatened. In some cases, the species may also be listed by the state of North Carolina. These species include the federally and state listed piping plover (*Charadrius melodus*); federally and state-listed loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and leatherback sea turtles (*Dermochelys coriacea*); and federally and state-listed seabeach amaranth (*Amaranthus pumilus*).

Species listed only by the state, and not federally listed as threatened and endangered, are discussed in the State Listed and Special Status Species section.

PIPING PLOVER

The piping plover is a small (6 to 7 inches long, weighing 1.5 to 2.2 ounces), highly camouflaged, sand-colored shorebird endemic to North America. The USFWS recognizes three distinct piping plover population segments: (1) the Atlantic Coast (from the Maritime Provinces of Canada to the Outer Banks of North Carolina), (2) the Great Lakes (along Lake Superior and Lake Michigan), and (3) the Great Plains (from southern, prairie Canada to Iowa). Wintering populations are found on the Atlantic Coast from North Carolina to Florida, on the Gulf Coast from Florida to Mexico, and in the Caribbean, with the greatest number of wintering birds found in Texas. Fewer than 3,000 breeding pairs of piping plovers were detected in the United States and Canada in 2001, although the most recent breeding census estimated breeding pairs in excess of 3,500 (Elliott-Smith et al. 2009). Piping plovers were common along the Atlantic Coast during much of the 19th century, but nearly disappeared due to excessive hunting for decorative feathers. Following passage of the Migratory Bird Treaty Act in 1918, plover numbers recovered to a 20th century peak in the 1940s. Increased development and beach recreation after World War II caused a population decline that led to federal protection for the plover (USFWS 2007b). Habitat loss caused by human development and recreation, and low reproductive rates caused by disturbance and predation, were considered to be the primary causes of the decline (Elliot-Smith and Haig 2004). The Atlantic Coast population was federally listed in 1986 as threatened (Federal Register 1985). At the time

of listing, there were approximately 790 Atlantic Coast pairs, and the species was in decline. Therefore, a recovery target of 2,000 pairs was established in the 1996 Revised Recovery Plan for the Atlantic Coast population (USFWS 1996a). Disturbance and predation were intensively managed after the listing, and the Atlantic Coast population rose to 1,890 pairs by 2007 (USFWS 2007c, 1), but was still short of the recovery goal of 2,000 pairs (USFWS 1996a; USFWS, Hecht, pers. comm. 2008).

Piping plover density is lower south of New Jersey; the Atlantic Coast Southern Region population was estimated at 333 pairs in 2007, which was the highest since 1986, but still short of the regional goal of 400 pairs (table 1). North Carolina experienced more than a 50% decline in breeding pairs from 1989 (55 pairs) to 2003 (24 pairs) (USFWS 2004a) for reasons discussed in the "Risk Factors" section later in this document; however, the number of breeding pairs has since climbed to a 22-year high of an estimated 64 pairs in 2008 (NCWRC 2008a).

Piping Plover in North Carolina

North Carolina is currently the only state on the Atlantic Coast that hosts piping plovers during all phases of their annual cycle, including the establishment and holding of territories, courtship and copulation, nest scraping and nest building, egg laying and incubation, chick rearing and fledging, and migration and wintering (Cohen 2005a). Band sightings indicate that plovers from all three North American breeding populations depend on Cape Hatteras during migration and/or the winter. Plovers from the endangered Great Lakes population have been observed in fall and spring migration and during the wintering period (Cohen 2005a). Early nesting records indicate that plovers were nesting at Pea Island in 1901 and 1902 (Golder 1986). The first published account of breeding piping plovers in North Carolina is from 1960, when a young bird was photographed in early June on Ocracoke Island (Golder 1985).

TABLE 1. SOUTHERN REGION (INCLUDING NORTH CAROLINA) PIPING PLOVER POPULATION TRENDS, NUMBERS OF BREEDING PAIRS

	Delaware	Maryland	Virginia	North Carolina	South Carolina	Southern Region Total
1986	8	17	100	30[a]	3	158
1987	7	23	100	30[b]	—	160
1988	3	25	103	40	—	171
1989	3	20	121	55[a]	—	199
1990	6	14	125	55	1	201
1991	5	17	131	40	1	194
1992	2	24	97	49	—	172
1993	2	19	106	53	1	181
1994	4	32	96	54	—	186
1995	5	44	118	50	—	217
1996	6	61	87	35	0	189
1997	4	60	88	52	—	204
1998	6	56	95	46	—	203
1999	4	58	89	31	—	182
2000	3	60	96	24	—	183
2001	6	60	119	23	0	208
2002	6	60	120	23	—	209
2003	6	59	114	24	—	203
2004[c]	7	66	152	20	—	245
2005[d]	8	63	192	37	—	300
2006[e]	9	64	202	46	—	321
2007[f]	9	64	199	61	—	333
2008[g]	10	49	208	64	—	331

Source of 1986–2001 data is USFWS 2002a.

Source of 2002–2003 data is USFWS 2004a.

[a]The recovery team believes that the apparent 1986–1989 increase in the North Carolina population was because of an intensified survey effort.

[b]No actual surveys were made in 1987; estimate is that from 1986.

[c]USFWS 2004b, Preliminary 2004 Atlantic Coast Piping Plover Abundance and Productivity Estimates (Updated March 2007). Figures are preliminary estimates.

[d]USFWS 2005. Preliminary 2005 Atlantic Coast Piping Plover Abundance and Productivity Estimates.

[e]USFWS 2006b. 2006 Atlantic Coast Piping Plover Abundance and Productivity Estimates.

[f]USFWS 2007c. 2007 Atlantic Coast Piping Plover Abundance and Productivity Estimates.

[g]USFWS 2008. 2008 Preliminary Atlantic Coast Piping Plover Abundance and Productivity Estimates.

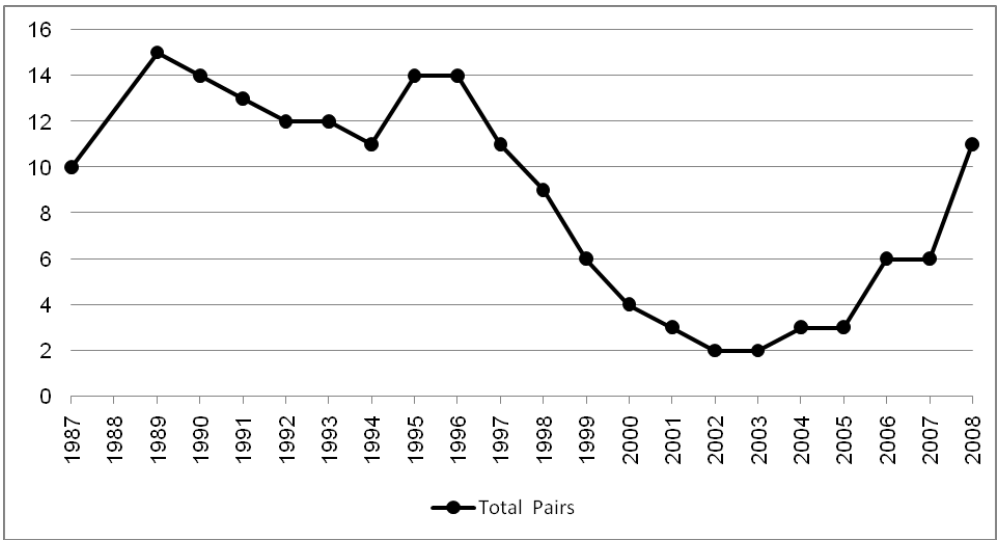
— = No data available.

Comment [bdm1]: Check with Anne Hecht to see if 2009 numbers are available yet.

At the Seashore, four nests and one brood were observed in 1984, and five chicks were confirmed to have fledged that year. All four nests were located adjacent to least tern (*Sterna antillarum*) colonies on wide,

open, sandy flats (Golder 1985). Nine pairs were counted in 1985 (Golder 1986), and 10 pairs in the summer of 1987 (Cooper 1990). The piping plover population reached a high of 15 pairs at the Seashore in 1989, and subsequently varied between 11 and 14 pairs through 1996, after which a sharp decline began (see figure 1). The population at the Seashore reached a low of two breeding pairs in 2002 and 2003, with only three breeding pairs reported in 2004 and two in 2005 (NPS 2009b). The population increased to 6 pairs in 2006 and 2007 and to 11 pairs by 2008 (NPS 2009b, 6). **[Preparer's Note: Park to confirm discrepancies between 2007 and 2008 reports, which have a different number of pairs for 1993 and 1994.]**

Comment [bdm2]: The 2007 report is correct. In the 2008 report the correct numbers were used in Table 5a.

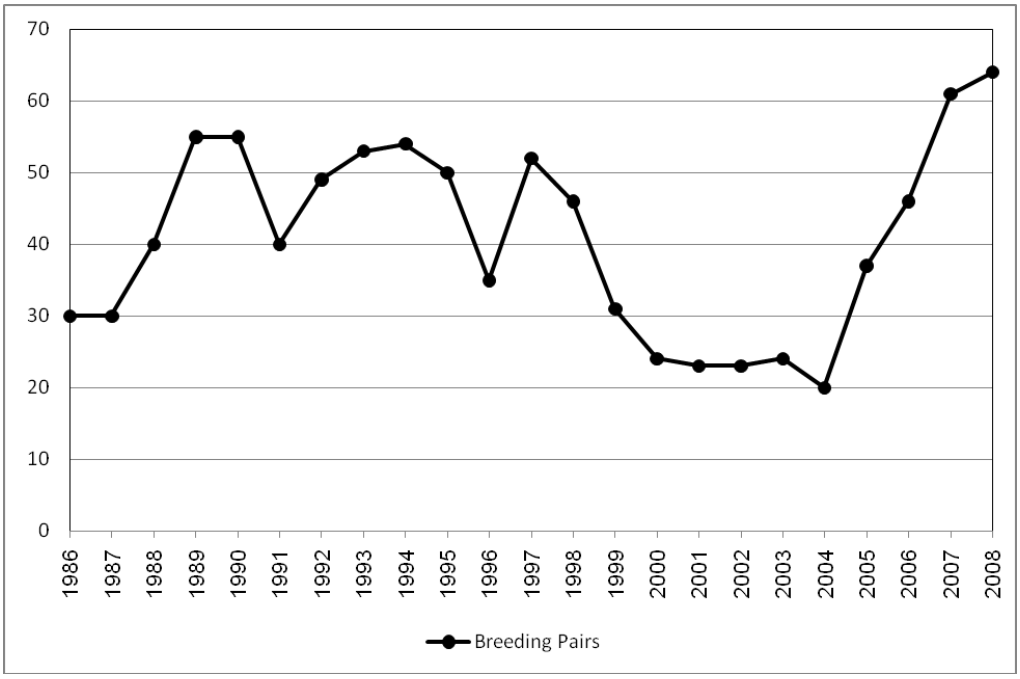


Source: NPS 2009b

FIGURE 1. NUMBERS OF PIPING PLOVER BREEDING PAIRS, CAPE HATTERAS NATIONAL SEASHORE, 1987–2008

North Carolina Wildlife Resources Commission (NCWRC) staff conducted a 2008 piping plover breeding census along the coast of North Carolina. The census included all suitable habitat on ocean and inlet beaches with the exception of Browns Island, which lies within a military live-fire training range. The census estimated a total of 64 pairs and five individuals, which is a 5% increase from the 2007 estimate of 61 pairs and is the highest number recorded in North Carolina in the years that complete surveys have been conducted (1986–2008; see figure 2). Statewide, the distribution of piping plovers was similar to previous years, with the majority of nesting pairs found at Cape Lookout National Seashore (NCWRC 2008a).

Comment [bdm3]: Should give more details as to the totals provided. Are they for the survey window or best estimate? Totals may be different than total breeding pairs in annual reports.



Source: USFWS 2004a, 2004b, 2005, 2006b, 2007c, 2008

FIGURE 2. NUMBERS OF PIPING PLOVER BREEDING PAIRS IN NORTH CAROLINA, 1986–2008

Comment [bdm4]: Are these totals from the census window or the "Best estimate" of pair numbers? The State usually asks us for both. From what I have seen these numbers don't always add up to the numbers in our annual report. State usually reports pair numbers and I think FWS is mistakenly reporting these as nesting pairs.

Habitat Description

On the Atlantic Coast, piping plovers nest in sand, gravel, or cobble substrates in backshore, dune, interdune blowout, overwash fan, and barrier flat zones of open or sparsely vegetated beaches. Nest sites may have little or no slope (Cairns 1982; Burger 1987), although nesting does occur on lower-elevation dunes (Cairns 1982). On wide beaches, piping plovers nest in the open to maintain a wide field of view, but on narrower beaches nests can be established under clumps of vegetation (Cairns 1982; USFWS 1996a).Where beaches are wide, piping plovers tend to nest far from the tide line to reduce risk of nest overwash, but this can place nests closer to vegetated dunes where the risk of predation is higher (Burger 1987). Piping plovers have also been observed nesting within least tern colonies, which could provide an added defense against predators due to the antipredator behavior of least terns (Burger 1987). (sidebar: photo of nest site, plover incubating)

All piping plover breeding sites at the Seashore were designated as critical habitat for wintering birds, as defined by the federal Endangered Species Act (ESA) (Federal Register 2001) until 2004, when a court decision vacated the designation for Oregon Inlet, Cape Point, Hatteras Inlet, and Ocracoke Island (*Cape*

Hatteras National Seashore Access Preservation Alliance versus U.S. Dept. of the Interior, 344 F. Supp. 2d 108 [D.D.C. 2004]). A rule to revise designated critical habitat for the wintering population of the piping plover in North Carolina was proposed in 2006 (71 FR 33703). That proposed rule described four coastal areas (named Units NC-1, NC-2, NC-4, and NC-5), totaling approximately 739 hectares (1,827 acres) entirely within the Seashore, as critical habitat for the wintering population of the piping plover. The USFWS also proposed to add 87 hectares (215 acres) of critical habitat to two previously proposed units. As a result, the proposed revised critical habitat designation for the species now includes four revised critical habitat units totaling approximately 826 hectares (2,042 acres). The final rule for the revised critical habitat designation became effective on November 20, 2008 (Federal Register 2008).

In the winter and on migration, piping plovers tend to be found in areas with wide beaches and inlet habitats, foraging in moist, substrate habitat that includes both low- and high-wave-energy intertidal zones, mudflats, moist sand flats, ephemeral pools, shores, and brackish ponds (Cohen 2005a; Elliot-Smith and Haig 2004; Nicholls and Baldassarre 1990; Wilkinson and Spinks 1994). During winter distribution surveys on the Atlantic Coast from 1986 to 1987, piping plovers were almost always found associated with other species of shorebirds, such as sanderlings (*Calidris alba*), least sandpipers (*C. minutilla*), or western sandpipers (*C. mauri*), in addition to other piping plovers (Nicholls and Baldassarre 1990). (sidebar: photo of foraging habitat)

Diet

Piping plovers feed primarily on freshwater, marine, terrestrial, and benthic invertebrates (Elliot-Smith and Haig 2004) such as marine worms, fly larvae, beetles, crustaceans, or mollusks (USFWS 1996a). Adults forage both day and night (Staine and Burger 1994), but young chicks are brooded during the night and therefore feed by day (Wolcott and Wolcott 1999). During territory establishment, foraging adults exhibit a preference for a moist substrate habitat that particularly includes mudflats, sand flats, ephemeral pools, and shores of brackish ponds and excludes the high-wave-energy intertidal zone (Cohen 2005a). Broods forage primarily on damp sand flats or moist substrate habitat, where the abundance of prey is much higher than in other habitats (Kuklinski et al. 1996). (sidebar: brooding)

Chicks with access to moist substrate habitat survived better than chicks without such access in Virginia (Loegering and Fraser 1995) and Rhode Island (Goldin and Regosin 1998). A study in New York in 1992 and 1993 found that piping plover broods had higher foraging rates in areas with ephemeral pools and tidal flats, which suggested that these habitats were superior. This study also documented higher incidences of arthropods in the moist substrate habitat, which could explain the increased plover numbers and survival rates in these habitat types. Management implications of this study include conserving a

variety of foraging habitat (Elias et al. 2000). Burger (1994) found that when broods had access to a diversity of foraging habitat zones, the impact of human disturbance was reduced because chicks had opportunities to escape disturbances and still forage.

Breeding Biology

On the Atlantic Coast, breeding territory establishment and courtship generally begin in late March, the first nests are initiated in late April, and the brood-rearing period extends from late May to mid-August (Cohen 2005b). On beaches with more birds in the northern end of the Atlantic Coast breeding range, most pairs establish breeding territory within a day or two of the birds' arrival in early spring, whereas pairs on sites with fewer birds can take several days or weeks longer to become established (Elliot-Smith and Haig 2004).

Piping plovers are primarily monogamous during the breeding season but often change mates between seasons. The nest is built by the male and consists of a shallow scrape in sandy substrate that may or may not be lined with pebbles and shell fragments. The normal clutch size is four (USFWS 2007b), and the average duration for egg laying is six days (Elliot-Smith and Haig 2004). Replacement of lost or destroyed eggs has not been reported. If one or more eggs are lost, the pair continues to incubate the remaining eggs. Incubation is shared by males and females and typically commences the day of clutch completion, but sometimes occurs when the next-to-last egg is laid (Elliott-Smith and Haig 2004).

The length of incubation ranges from 25 to 29 days, and a pair will re-nest multiple times if successive clutches are destroyed, but re-nesting after the chicks hatch is rare (Elliott-Smith and Haig 2004). Chicks leave the nest scrape within a few hours of hatching, except when a nest hatches at night, and they never return (Wolcott and Wolcott 1999). Broods may move hundreds of meters away from the nest site during the first week after hatching (USFWS 1996a). Chicks are vulnerable soon after hatching, and survival rates are lower if the brood is forced to move. Members of a breeding pair share brood-rearing duties, though some females desert broods within 5 to 17 days (Elliott-Smith and Haig 2004). Although chicks follow adults to a foraging habitat, chicks forage for themselves. Fledging time ranges from 25 to 35 days (USFWS 1996a), and most adults and young depart the breeding grounds between mid-July and early September (Cohen 2005a).

Breeding Chronology and Performance at Cape Hatteras National Seashore

Locally breeding piping plovers arrive at the Seashore in mid-March, begin courting and pairing in April, and begin to scrape and build nests in the third week of April. Bodie Island Spit, Cape Point, South Beach, Hatteras Inlet Spit, North Ocracoke Spit, and South Point Ocracoke (South Point) all contain

potential nesting habitat. Nesting has occurred in all but one of these areas in the last 10 years. Although there has not been a breeding pair on the north end of Ocracoke Island since 1996, resource management staff members ~~also~~ continue to monitor this area for potential plover activity. Seashore personnel generally begin monitoring for piping plover arrival and pre-nesting behavior in late March and early April. Monitoring and surveys of these sites are conducted a minimum of three times per week. Once nests are located, they are briefly approached once a week to inspect the exclosure, count eggs, and search for predator tracks. Morning and evening observations begin when clutches are expected to hatch. Monitors observe from a distance for evidence of hatching or chicks. All known nests are protected by predator exclosures, which have been in use at the Seashore since 1994. After hatching, the broods are monitored ~~from dawn to dusk~~ a few hours in the morning and a few hours in the afternoon until the chicks have fledged or are lost. Monitoring staff members document brood status, behavior, individual bird and/or brood movements, human disturbance, predator interactions, and other significant environmental events.

Comment [bdm5]: The Consent Decree (Pg. 10) now requires us to start monitoring on March 15. We monitor every 2 days from March 15 to April 15, and daily from April 16 to July 15. Bodie Island Spit is monitored daily from March 15 to July 15.

Table 2 shows the numbers of breeding pairs of piping plovers at the six primary nesting sites from 1987 to 2008. Table 3 provides data on piping plover hatching and fledging success at the Seashore from 1992 through 2008. The 11 nesting pairs identified in 2008 marks an 83% increase from the 6 pairs identified in 2007 (NCWRC 2008a).

Fledge rate (or reproductive rate) is defined as the number of chicks that survive until fledging age per breeding pair. Since 1989, reproductive rates at the Seashore have ranged from 0.00 to 2.00 chicks per breeding pair, with an average rate over the 17 years from 1992 to 2008 of 0.67 chicks per breeding pair (NPS 2009b), the highest in the state (NPS 2008c). During 2008, a total of 11 breeding pairs fledged 7 chicks (a rate of 0.64 chicks per pair) (NCWRC 2008a). However, a rate of 1.20 fledged chicks per breeding pair annually would be needed to sustain the population (USFWS 1996a), and the recovery goal set by the USFWS is 1.50 fledged chicks per breeding pair. Hence, the fledge rate at the Seashore has averaged less than half the recovery goal since 1992.

TABLE 2. NUMBERS OF PIPING PLOVER BREEDING PAIRS BY SITE, CAPE HATTERAS NATIONAL SEASHORE, 1987–~~2008~~2009

Year	Bodie Island Spit	Cape Point	South Beach	Hatteras Inlet Spit	North Ocracoke Spit	South Point	Total Pairs
1987	0	4	0	4	1	1	10
1989	—	—	—	—	—	—	15
1990	0	8	0	4	2	0	14
1991	0	5	0	3	5	0	13
1992	0	4	0	4	4	0	12
1993	0	5	1	3	3	0	12
1994	0	5	1	3	2	0	11
1995	0	6	1	4	2	1	14
1996	1	5	1	5	1	1	14
1997	1	4	1	3	0	2	11
1998	0	4	1	3	0	1	9
1999	0	3	1	1	0	1	6
2000	0	2	0	2	0	0	4
2001	1	1	0	1	0	0	3
2002	1	0	0	1	0	0	2
2003	0	0	0	1	0	1	2
2004	1	0	0	1	0	1	3
2005	0	0	1	1	0	1	3
2006	1	2	1	1	0	1	6
2007	1	4	0	0	0	1	6
2008	1	5	1	0	0	4	11
2009	0	5	0	0	0	4	9
Total (% of total pairs)	8 (4.8*)	67 (40.4*)	10 (6.0*)	45 (27.1*)	20 (12.0*)	16 (9.6*)	181 (100)

Comment [bdm6]: Need to recalculate if including the 2009 data.

Source: NPS 2009b.

*Total number of pairs was 181, but locations were not available in 1989. Therefore, percentages from the specific sites are based on the 166 nests that were recorded at one of the six specific nesting areas.

— = No data available.

TABLE 3. PIPING PLOVER HATCHING AND FLEDGING SUCCESS AT CAPE HATTERAS NATIONAL SEASHORE, 1992–~~2008~~2009

Year	# Total Pairs	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate[b]
				#	%	#	%[a]	#	%	
1992	12	14	49[c]	8	57	17	35	8	47	0.67
1993	12	21	69	9	43	27	39	8	30	0.67
1994	11	18	65[d]	10	56	32[e]	49	9	30	0.82
1995	14	19	63	13	68	30	48	7	23	0.50
1996	14	16	56[f]	10	63	30	53	3	10	0.21
1997	11	16	47[f]	10	63	32	68	3	9	0.27
1998	9	8	31	6	75	20	65	12	60	1.33
1999	6	6	23	3	50	11	48	7	64	1.20
2000	4	6	23	3	50	10	44	3	30	0.75
2001	3	3	10	1	33	3	30	2	67	0.67
2002	2	3	8	1	33	1	13	0	0	0.00
2003	2	2	5[f]	2	100	~~4~~[f]5[f]	100	1	20	0.50
2004	3	2	6	1	50	4	~~66~~67	0	0	0.00
2005	3	2	8	2	100	8	100	6	75	2.00
2006	6	4	15	3	75	9	60	3	33	0.50
2007	6	10[g]	29	6	60	17	59	4	23	0.67
2008	11	13	43	8	62	22	~~54~~51	7	32	0.64
2009	9	9	34	6	60	22	65	6	27	0.67

Source: NPS 2009b.

[a]Percentage of all known eggs.

[b]Fledge rate is defined as the number of fledged chicks per breeding pair (# Total Pairs).

[c]Assumes three eggs from a brood whose nest was not found.

[d]Assumes two eggs from a brood whose nest was not found.

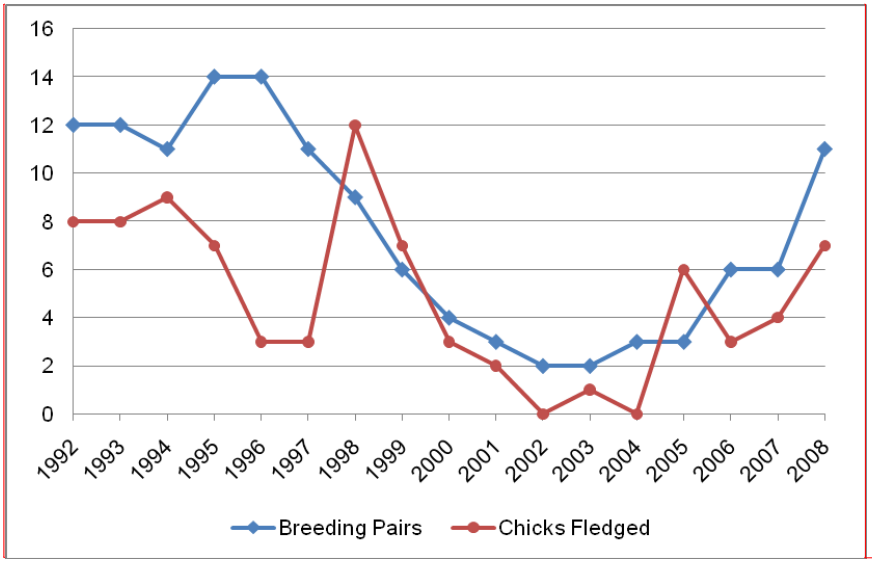
[e]Includes those presumed hatched.

[f]Assumes one egg from a brood whose nest was not found.

[g]Based on consultation with USFWS, it was determined that Nest 1 and Nest 2 were a single nesting attempt.

Comment [bdm7]: In the following tables the percentages have one decimal point

The decline in the local breeding population (figure 3 below) from 1995 to 2003 is likely a reflection of the low reproductive rate (NPS 2005a) and resultant lack of recruitment. However, the increase in the numbers of piping plover breeding pairs since 2003 is encouraging.



Source: NPS 2009b.

FIGURE 3. NUMBERS OF PIPING PLOVER BREEDING PAIRS AND FLEDGED CHICKS AT CAPE HATTERAS NATIONAL SEASHORE, 1992–~~2008~~2009

Hatching and Fledging Success at Primary Nesting Sites

The following tables (table 4 through table 9) provide a summary of hatching and fledging success at each of the individual primary breeding sites from the early to mid-1990s through 2008. Average fledge rates across the six breeding sites ranged from 0.13 at Bodie Island Spit to 0.90 at South Beach, and each site has a fledge rate below the 1.50 goal set by the 1996 revised recovery plan. However, there were eight instances of years when one or more sites did meet or exceed this goal, indicating that despite poor Seashore-wide recruitment, some primary nesting sites performed at or above this expectation in some years.

Comment [bdm8]: Y axis should be labeled.

Comment [bdm9]: In 2009 we had 9 breeding pairs and 6 chicks fledged.

TABLE 4. PIPING PLOVER HATCHING AND FLEDGING SUCCESS AT BODIE ISLAND SPIT, 1996–~~2008~~2009

Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1996	1	4	1	100.0	3	75.0	0	0.0	0.00
1997	2	6	0	0.0	0	0.0	0	0.0	0.00
1998	0	0	0	0.0	0	0.0	0	0.0	N/A
1999	0	0	0	0.0	0	0.0	0	0.0	N/A
2000	0	0	0	0.0	0	0.0	0	0.0	N/A
2001	1	3	0	0.0	0	0.0	0	0.0	0.00
2002	1	3	1	100.0	1	33.3	0	0.0	0.00
2003	0	0	0	0.0	0	0.0	0	0.0	N/A
2004	1	2	0	0.0	0	0.0	0	0.0	0.00
2005	0	0	0	0.0	0	0.0	0	0.0	N/A
2006	0	0	0	0.0	0	0.0	0	0.0	~~0.00~~N/A
2007	1	3	1	100.0	3	100.0	1	33.3	1.00
2008	1	3	0	0.0	0	0.0	0	0.0	0.00
2009	0	0	0	0.0	0	0.0	0	0.0	N/A
Average Fledge Rate at Bodie Island Spit = 0.13									

TABLE 5. PIPING PLOVER HATCHING AND FLEDGING SUCCESS AT CAPE POINT, 1992–~~2008~~2009

Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1992	5	19	4	80.0	11	57.9	4	36.4	1.00
1993	6	23	5	83.3	15	65.2	3	20.0	0.60
1994	6	24	5	83.3	16	66.7	5	31.3	1.00
1995	9	33	5	55.6	15	45.5	2	13.3	0.33
1996	5	16	3	60.0	7	43.8	3	42.9	0.60
1997	6	18	5	83.3	15	83.3	3	20.0	0.75
1998	5	19	3	60.0	10	52.6	6	60.0	1.50
1999	3	12	2	66.7	7	58.3	5	71.4	1.67
2000	3	11	2	66.7	6	54.5	2	33.3	1.00
2001	1	3	0	0.0	0	0.0	0	0.0	0.00
2002	0	0	0	0.0	0	0.0	0	0.0	N/A
2003	0	0	0	0.0	0	0.0	0	0.0	N/A
2004	0	0	0	0.0	0	0.0	0	0.0	N/A
2005	0	0	0	0.0	0	0.0	0	0.0	N/A
2006	2	7	2	100.0	6	85.7	3	50.0	1.50
2007	8	22	4	50.0	10	45.5	3	30.0	0.75
2008	6	22	4	66.7	12	54.5	4	33.3	0.80

2009	5	20	5	100.0	19	95.0	5	26.3	1.00
Average Fledge Rate at Cape Point = 0.86									

Comment [bdm10]: Needs to be recalculated if including 2009 data.

TABLE 6. PIPING PLOVER HATCHING AND FLEDGING SUCCESS AT SOUTH BEACH, 1992–~~2008~~2009

Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1992	0	0	0	0.0	0	0.0	0	0.0	N/A
1993	2	7	1	50.0	4	57.1	0	0.0	0.00
1994	1	2	1	100.0	2	100.0	1	50.0	1.00
1995	1	3	1	100.0	1	33.3	1	100.0	1.00
1996	1	3	1	100.0	2	66.7	0	0.0	0.00
1997	2	8	2	100.0	7	87.5	0	0.0	0.00
1998	1	4	1	100.0	4	100.0	2	50.0	2.00
1999	1	4	1	100.0	4	100.0	2	50.0	2.00
2000	0	0	0	0.0	0	0.0	0	0.0	N/A
2001	0	0	0	0.0	0	0.0	0	0.0	N/A
2002	0	0	0	0.0	0	0.0	0	0.0	N/A
2003	0	0	0	0.0	0	0.0	0	0.0	N/A
2004	0	0	0	0.0	0	0.0	0	0.0	N/A
2005	1	4	1	100.0	4	100.0	3	75.0	3.00
2006	1	4	0	0.0	0	0.0	0	0.0	0.00
2007	0	0	0	0.0	0	0.0	0	0.0	N/A
2008	1	4	1	100.0	2	50.0	0	0.0	0.00
2009	0	0	0	0.0	0	0.0	0	0.0	N/A
Average Fledge Rate at South Beach = 0.90									

TABLE 7. HATCHING AND FLEDGING SUCCESS AT HATTERAS INLET SPIT, 1992–2008

Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1992	5	16	2	40.0	5	31.3	2	40.0	0.50
1993	4	16	2	50.0	7	43.8	4	57.1	1.33
1994	6	24	3	50.0	10	41.7	3	30.0	1.00
1995	6	17	5	83.3	11	64.7	3	27.3	0.75
1996	7	26	4	57.1	14	53.8	0	0.0	0.00
1997	4	8	1	25.0	4	50.0	0	0.0	0.00
1998	1	4	1	100.0	2	50.0	0	0.0	0.00
1999	1	4	0	0.0	0	0.0	0	0.0	0.00
2000	3	12	1	33.3	4	33.3	1	25.0	0.50
2001	1	4	1	100.0	3	75.0	2	66.7	2.00
2002	2	5	0	0.0	0	0.0	0	0.0	0.00
2003	1	4	1	100.0	4	100.0	0	0.0	0.00
2004	1	4	1	100.0	4	100.0	0	0.0	0.00
2005	1	4	1	100.0	4	100.0	3	75.0	3.00
2006	0	0	0	0.0	0	0.0	0	0.0	~~0.00~~N/A
2007	0	0	0	0.0	0	0.0	0	0.0	~~0.00~~N/A
2008	0	0	0	0.0	0	0.0	0	0.0	N/A
2009	0	0	0	0.0	0	0.0	0	0.0	N/A
Average Fledge Rate at Hatteras Inlet Spit = 0.51									

Comment [bdm11]: Needs to be recalculated if including 2009 data.

TABLE 8. HATCHING AND FLEDGING SUCCESS AT NORTH OCRACOKE SPIT, 1992–2008

Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1992	4	14	2	50.0	5	35.7	2	40.0	0.50
1993	9	23	1	11.1	1	4.3	1	100.0	0.33
1994	5	15	1	20.0	4	26.7	0	0.0	0.00
1995	2	6	2	100.0	3	50.0	1	33.3	0.50
1996	1	3	0	0.0	0	0.0	0	0.0	0.00
1997	0	0	0	0.0	0	0.0	0	0.0	N/A
1998	0	0	0	0.0	0	0.0	0	0.0	N/A
1999	0	0	0	0.0	0	0.0	0	0.0	N/A
2000	0	0	0	0.0	0	0.0	0	0.0	N/A
2001	0	0	0	0.0	0	0.0	0	0.0	N/A
2002	0	0	0	0.0	0	0.0	0	0.0	N/A
2003	0	0	0	0.0	0	0.0	0	0.0	N/A
2004	0	0	0	0.0	0	0.0	0	0.0	N/A
2005	0	0	0	0.0	0	0.0	0	0.0	N/A
2006	0	0	0	0.0	0	0.0	0	0.0	N/A
2007	0	0	0	0.0	0	0.0	0	0.0	N/A
2008	0	0	0	0.0	0	0.0	0	0.0	N/A
2009	0	0	0	0.0	0	0.0	0	0.0	N/A
Average Fledge Rate at North Ocracoke Spit = 0.33									

Comment [bdm12]: Needs to be recalculated if including 2009 data.

1

TABLE 9. HATCHING AND FLEDGING SUCCESS AT SOUTH POINT, 1995–2008

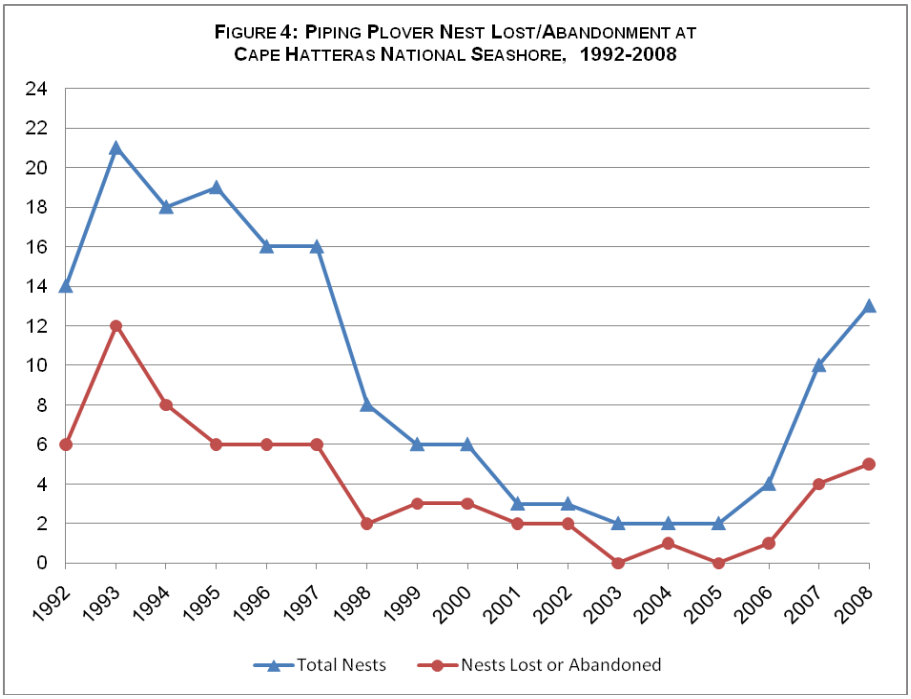
Year	# Nests	# Eggs	Nests Hatched		Eggs Hatched		Chicks Fledged		Fledge Rate
			#	%	#	%	#	%	
1995	1	4	0	0.0	0	0.0	0	0.0	0.00
1996	1	4	1	100.0	4	100.0	0	0.0	0.00
1997	2	7	2	100.0	6	85.7	0	0.0	0.00
1998	1	4	1	100.0	4	100.0	4	100.0	4.00
1999	1	3	0	0.0	0	0.0	0	0.0	0.00
2000	0	0	0	0.0	0	0.0	0	0.0	N/A
2001	0	0	0	0.0	0	0.0	0	0.0	N/A
2002	0	0	0	0.0	0	0.0	0	0.0	N/A
2003	1	1	1	100.0	1	100.0	1	100.0	1.00
2004	0	0	0	0.0	0	0.0	0	0.0	~~0.00~~N/A
2005	0	0	0	0.0	0	0.0	0	0.0	~~0.00~~N/A
2006	1	4	1	100.0	3	75.0	0	0.0	0.00
2007	1	4	1	100.0	4	100.0	0	0.0	0.00
2008	5	14	3	60.0	8	57.1	3	37.5	0.75
2009	4	14	1	25%	3	21.0	2	66.7	0.50
Average Fledge Rate at South Point = 0.53									

Comment [bdm13]: Needs to be recalculated if including 2009 data.

2 **[Preparer's Note: 2004 PIPL report appendix B indicated 100 eggs in 1998, but this was assumed to**
3 **be incorrect]**

4 **Nest Loss/Abandonment**

5 Nest loss and abandonment have had significant impacts on piping plover reproduction at the Seashore. In
6 the 17 seasons from 1992 through 2008, 41% of nests (of 163 discovered) were lost or abandoned (figure
7 4). Factors contributing to nest loss and abandonment include weather, predation, and human disturbance,
8 which are discussed in detail under the "Risk Factors" section later in this document.



Source: NPS 2009b.

FIGURE 4. PIPING PLOVER NEST LOSS/ABANDONMENT AT CAPE HATTERAS NATIONAL SEASHORE, 1992–2008

Comment [bdm14]: In 2009 we had a total of 9 nests and 3 were lost/abandoned.

Nonbreeding Population

In addition to supporting a local breeding population, the Seashore also hosts migrating and wintering piping plovers from all three of the North American breeding populations (the threatened Atlantic Coast and Great Plains populations and the endangered Great Lakes population). The Outer Banks is an important stopover area for migrating shorebirds along the Atlantic coast. Fall migrants arrive at the Outer Banks in July, peak in August and September, and depart by November (Dinsmore et al. 1998). The distribution and abundance of nonbreeding populations at the Seashore are less well documented than the local breeding population. Documenting and protecting nonbreeding piping plovers and their habitats are priorities articulated in the recovery plans for all three North American breeding populations (USFWS 1988; USFWS 1996a, iii; USFWS 2003, iii). Recognizing the importance of the Outer Banks to wintering piping plovers, the USFWS designated 2,043 acres of critical habitat in Dare and Hyde counties in November 2008 (Federal Register 2008).

Wintering piping plovers on the Atlantic Coast select wide beaches in the vicinity of inlets that are associated with a high percentage of moist substrate habitat (Nicholls and Baldassarre 1990, 587;

Wilkinson and Spinks 1994, 36). Because tidal regimes and fall and winter storm patterns often cause piping plovers to move among habitat patches, a diversity of habitat patches may be important to wintering populations (Burger 1994, 698; Nicholls and Baldassarre 1990, 583).

Cohen (2005a) studied nonbreeding piping plovers at the Seashore from 2000 to 2005. The results of this study indicated that the greatest number of nonbreeding piping plovers at the Seashore occurs during the fall migration, which begins in July and peaks between July and September (see table 10). The fall migration counts were highest at South Point, followed by Oregon Inlet (Bodie Island Spit, Pea Island National Wildlife Refuge, and, formerly, Green Island, which is now largely unusable for plovers because of vegetation growth), then Hatteras Inlet Spit, and finally Cape Point (Cohen 2005a, 7).

TABLE 10. MONTHLY MEDIAN AND MAXIMUM NONBREEDING BIRDS SEEN DURING FALL, WINTER, AND SPRING DAILY SURVEYS, SELECTED SITES AT CAPE HATTERAS NATIONAL SEASHORE, 2000–2005

	Month	Bodie Island Spit	Cape Point/ South Beach	Hatteras Inlet Spit	South Point	All Sites
Median	Jul	0.49	0.18	0.45	2.21	5.7
	Aug	0.68	0.31	0.13	3.76	6.4
	Sept	0.66	0.07	0.38	4.22	5.7
	Oct	0.36	0.00	0.86	1.81	3.3
	Nov	0.82	0.00	0.07	1.00	4.2
	Dec	0.77	0.00	0.00	2.07	2.9
	Jan	0.25	0.00	0.00	1.00	1.2
	Feb	3.33	0.00	0.00	1.00	4.3
	Mar	1.25	0.00	0.00	0.75	2.8
	Apr	1.89	0.00	0.62	1.31	3.6
Maximum	Jul	32	5	21	56	56
	Aug	34	6	14	72	72
	Sept	16	5	4	37	37
	Oct	12	1	28	31	31
	Nov	15	0	8	12	15
	Dec	17	0	7	15	17
	Jan	18	0	1	11	18
	Feb	14	0	0	18	18
	Mar	12	3	4	8	12
	Apr	25	3	7	11	25

Source: Cohen 2005a, 56

NOTE: Not all sites were surveyed each day (typically, only one or two were surveyed), so the numbers in the table provide only a rough idea of the total size of the nonbreeding population (Cohen 2005a, 56).

During this time, the first banded winter residents appeared in August; however, other wintering birds could have arrived in July. Cohen suggested that the nonbreeding population from December to January probably consisted entirely of winter residents and estimated that, although the size of the resident wintering population at the Seashore was not precisely known, it may be on the order of 20 to 35 birds (Cohen 2005a). In the winter of 2004–2005, the maximum numbers seen were about 50% of the recent norm; however, whether this observed difference was because of a difference in survey methodology is unknown. The highest counts of wintering residents were at Bodie Island Spit and South Point. Based on a sample of banded birds, winter residents can be present until April (Cohen 2005a). Spring piping plover migrants first appear in February or early March, and their numbers peak in late March or April (table 10). Sites at Bodie Island Spit have had the highest abundance of spring migrants, followed by South Point, with fewer at Hatteras Inlet Spit and Cape Point/South Beach (Cohen 2005a, 7).

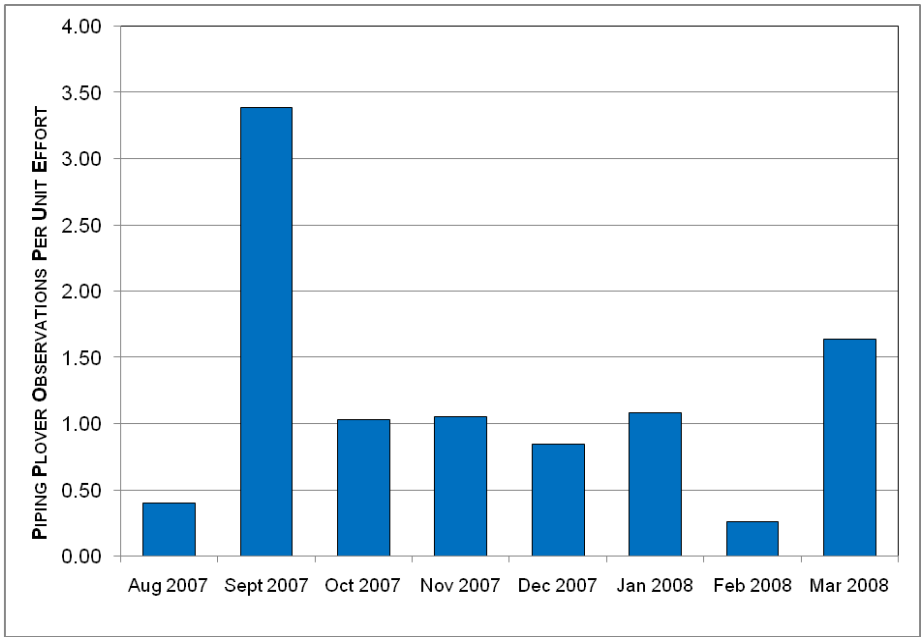
Park staff documented piping plover use of the Seashore throughout 2006. Migratory birds appeared to peak in August and September, with a high count of 93 birds at South Point on August 10 (table 11). South Point revealed the highest counts during fall migration. Three surveys at South Point were coordinated with Seashore surveys on North Core Banks to investigate bird abundance around Ocracoke Inlet (table 11).

TABLE 11. COUNTS OF PIPING PLOVER ON BOTH SIDES OF OCRACOKE INLET DURING FALL MIGRATION, 2006

Date	South Point	North Core Banks	Total	Tide
Aug 10, 2006	93	7	100	Mid
Aug 14, 2006	69	16	85	Low
Oct 2, 2006	15	16	31	Low

Source: NPS 2007d

Park staff also documented nonbreeding plovers' use of the Seashore beginning at the end of the breeding season in August 2007 through March 2008 (see figure 5). Migratory birds peaked in September, with a high of 33 counted on September 7, 2007, on South Point. After the migrants passed through the area in September, plover numbers appeared to stabilize over the winter months except in February 2008, when there was an unexplained drop in numbers.



Source: NPS 2009b

FIGURE 5. MONTHLY OBSERVATIONS OF PIPING PLOVERS PER SAMPLING EVENT FROM AUGUST 2007 TO MARCH 2008

Comment [bdm15]: This same info is avail for Aug 2008 to March 2009. Fig s 5a and 5B?

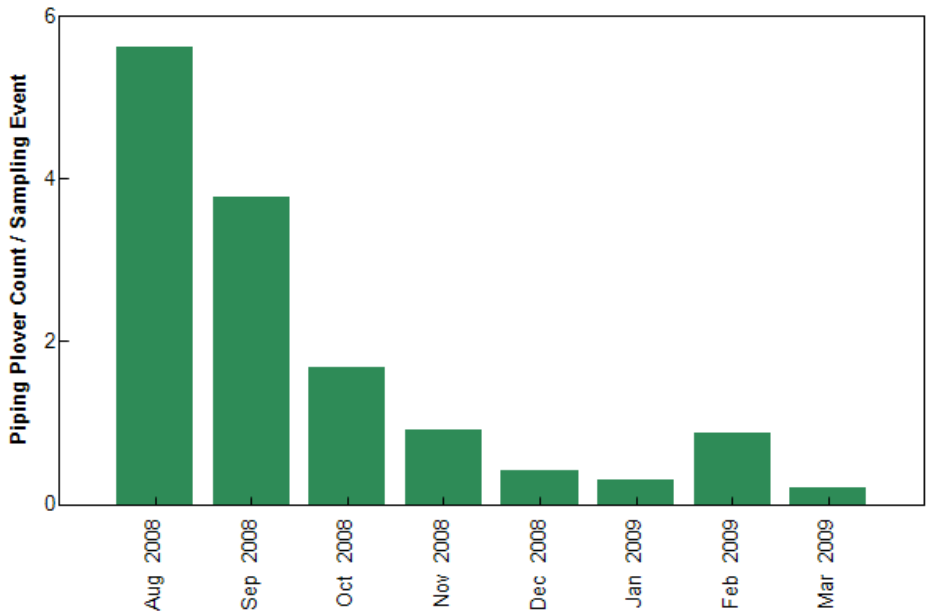
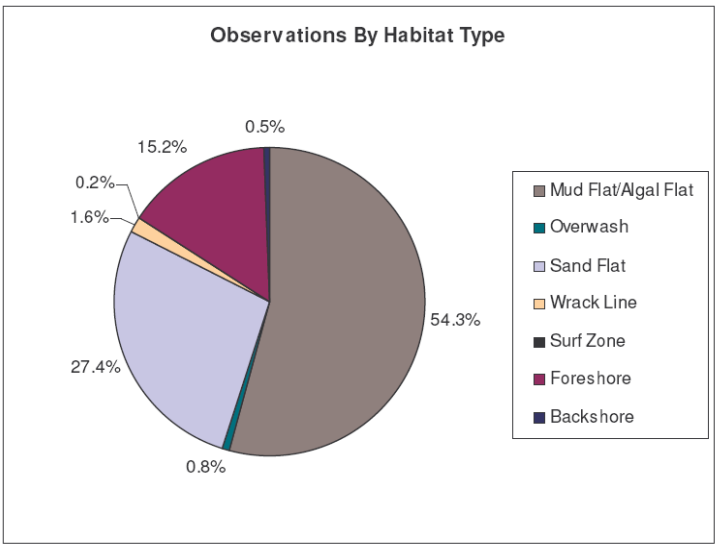


Fig. 5 b?

Park staff documented the habitat type in which migratory and wintering piping plovers were observed from August 2007 to March 2008 (figure 6A) and from August 2008 to March 2009 (figure 6B). Of the 387 observations, 210 were in mudflat/algal flat, 106 were in sand flat, 59 were in foreshore, 6 were in wrack line, 3 were in overwash, 2 were in backshore, and 1 was flying over the surf zone (NPS 2009b, 16).

Comment [bdm16]: Same could be generated for August 2008 to March 2009.



Source: NPS 2009b

FIGURE 6A. WINTERING OBSERVATIONS OF PIPING PLOVER BY HABITAT TYPE

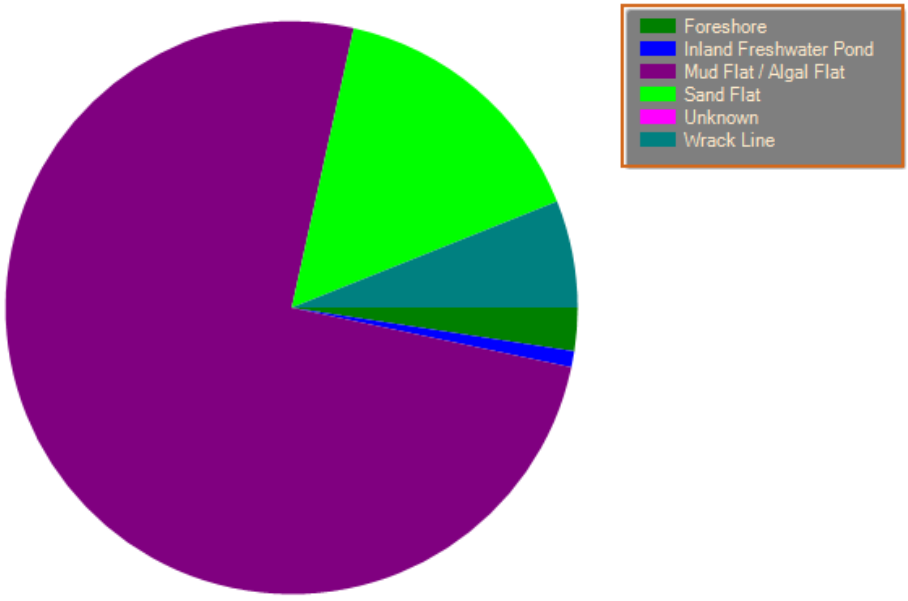
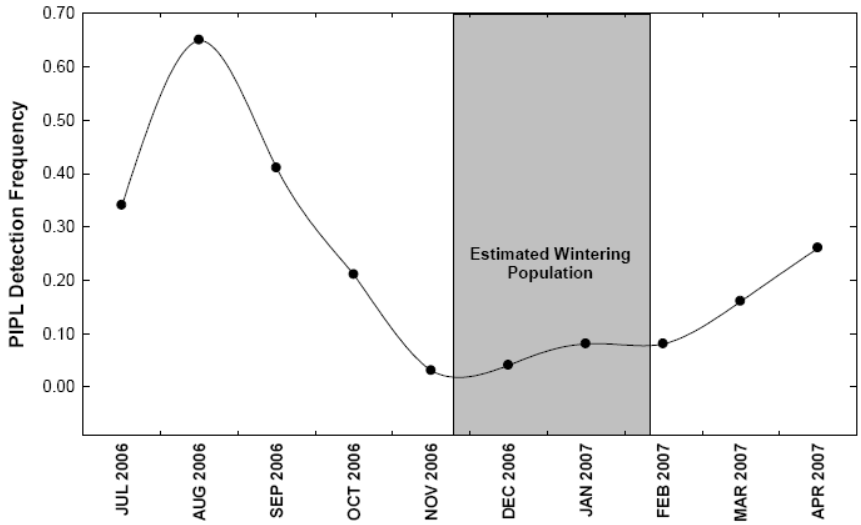


FIGURE 6B. WINTERING OBSERVATIONS OF PIPING PLOVER BY HABITAT TYPE (AUGUST 2008-MARCH 2009)

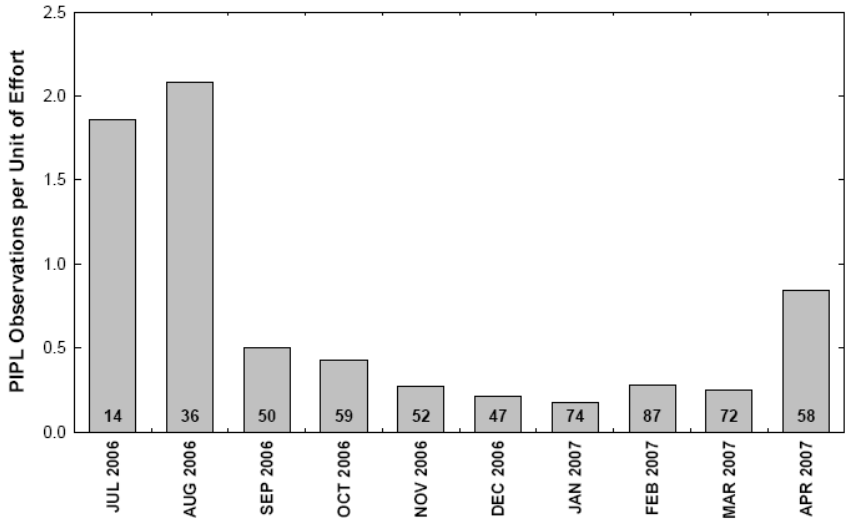
Comment [bdm17]: Table used for pie chart **Habitats**

In addition to the monitoring being conducted by Cohen (2005a) and park staff, the Southeast Coast Network (SECN) Inventory and Monitoring Program conducted a comprehensive study on wintering shorebirds at the Seashore. Pilot implementation of this long-term shorebird monitoring protocol began in mid-July 2006 and the first report was published in March 2009. The study found that the fall migration appeared to peak in August (figure 7) and the spring migration likely peaked in May, but nest initiation by piping plover and logistical issues precluded sampling later than April 2007. The three highest single-day counts (for sampled areas only) were 24 in July 2006, 50 in August 2006, and 14 in April 2007. Monthly normalized counts (number of birds observed per 30-minute sampling event) are shown on figure 8.



Source: Byrne et al. 2009.

FIGURE 7. DETECTION FREQUENCY FOR PIPING PLOVER (PIPL) AT BODIE ISLAND SPIT, CAPE POINT, HATTERAS INLET SPIT, NORTH OCRACOKE SPIT, AND SOUTH POINT—CAPE HATTERAS NATIONAL SEASHORE, 2006–2007



Source: Byrne et al. 2009.

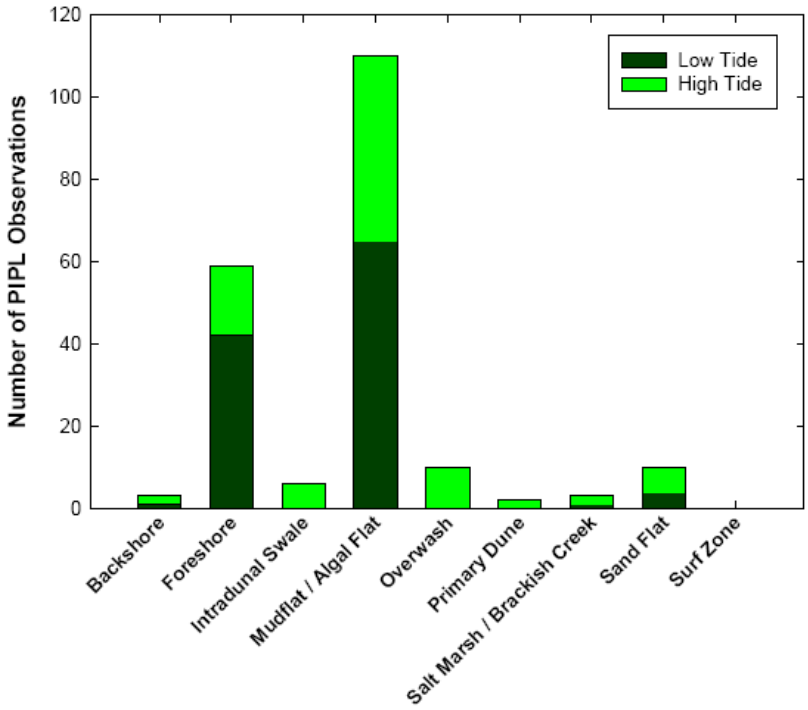
FIGURE 8. MONTHLY NORMALIZED COUNTS OF PIPING PLOVER AND NUMBER OF SAMPLING EVENTS AT CAPE HATTERAS NATIONAL SEASHORE, 2006–2007

[Preparer's Note: Waiting for raw wintering data from 2006-2009]

The SECN study found that the majority of piping plover observations occurred in mudflat/algal flat and foreshore habitat types (figure 9).

Comment [LBP18]: As with Fig. 6, please provide a legend explaining the numbers (number of surveys?) within the bars.

Comment [LBP19]: Months in x-axis labels should be title case. Also, this chart is quite fuzzy—better resolution available?



Source: Byrne et al. 2009.

FIGURE 9. NUMBERS OF PIPING PLOVER OBSERVATIONS BY HABITAT TYPE AND TIDE STAGE AT CAPE HATTERAS NATIONAL SEASHORE, 2006–2007

The results of the SECN study were consistent with previous studies that found that the moist substrate habitat type plays a vital role in the survival of nonbreeding piping plovers. It was also noted that migratory and wintering piping plovers occurred more frequently in accreted areas (i.e., the points and spits), which are popular spots for recreational ORV use at the Seashore (Byrne et al. 2009). The importance of protecting nonbreeding piping plovers was demonstrated in a research program by the Canadian Wildlife Service between 1998 and 2003, which primarily tracked migration patterns and survival rates of the Eastern Canada population of piping plovers. Individuals from this population were identified migrating and wintering at points along the east coast of the United States, including North Carolina (Amirault et al. 2006). The analysis of this research identified adult survival as the single most important factor influencing the population trends of this piping plover population and showed that expanding protection of nonbreeding habitat was an important factor in the recovery of the species (Amirault et al. 2006).

Risk Factors

Small populations such as the Atlantic Coast piping plover populations face a heightened risk of extinction compared to large populations because they are more vulnerable to the following: (1) random environmental variations, such as storms; (2) reduction in genetic variations that limit a species' ability to adapt to local conditions; (3) sudden, random drops in birth and death rates; and (4) an impaired ability to find suitable mates (Lande 1988).

Given the vulnerability of the small piping plover populations in North America to random events, the persistence of the populations will depend increasingly on controlling sources of mortality to adults, eggs, and chicks throughout their range. Predators, human disturbance, and limited or blocked access to foraging habitat have been identified in past research as contributing to impaired reproductive success for plovers using the Seashore (Kuklinski et al. 1996). There may be evidence that piping plovers are finding it increasingly difficult to attract mates (known as the "Allee effect"), because surveying reports from 2001 to 2003 and 2005 indicate that unpaired birds displaying territorial behavior were observed in the pre-laying period at several sites **[Preparer's Note: Waiting for full reports & appendices from 2001, 2002, 2003 and 2005 to confirm this].** Thus, providing a disturbance-free environment early in the season may help piping plovers to establish territories and attract mates (Cohen 2005b).

Rates and sources of mortality and disturbance, and the responses of piping plovers to disturbance in the nonbreeding season, have not been specifically assessed at the Seashore. However, it is known that piping plover foraging and roosting habitats are used by pedestrians and ORVs outside of the breeding season (Cohen 2005a). Therefore, the potential exists for piping plovers to be killed by being run over by ORVs (Melvin et al. 1994) or taken by domestic pets. Studies have shown that the density of wintering plovers is higher in areas with limited human presence (Cohen et al. 2008; Nicholls and Baldassarre 1990b). Furthermore, disturbance to roosting and foraging birds by ORVs, unleashed pets, and pedestrians may reduce foraging efficiency or alter habitat use, thereby increasing the risk of nutritional or thermal stress (Zonick 2000).

Weather and Tides. Nine named hurricanes affected the Outer Banks between 1993 and 2008 (NOAA 2009). Hurricane Isabel, which hit the coast in September 2003, renewed piping plover habitat on portions of the Seashore and may have resulted in a reduction in predator populations (NCWRC 2008a). In the years immediately following the storm, piping plover numbers and productivity increased. However, there have been no significant storms since that time, and much of the created habitat is now deteriorating due to revegetation (NCWRC 2008a). No significant weather events, such as hurricanes or tropical storms, occurred during the 2006 breeding season. However, smaller, localized events may have affected nesting. Nest 4 on South Point was partially buried by high wind and blowing sand. One egg was buried

by sand, and the nest was a deep cup rather than a scrape (June 29). One adult remained hunkered down on the nest during the strong winds, and the buried egg was visible again during the nest check. A strong thunderstorm was noted on the night before Nest 2 on South Beach was discovered lost; however, the loss is characterized as "unknown" because it cannot be shown conclusively that weather was the cause. Five nests were lost to weather, predation, or abandonment during the 2007 breeding season. Nest 1, a two-egg nest on Cape Point, was lost during a Nor'easter storm. It is unknown if the eggs were blown out of the nest scrape in the 50- to 60-mile-per-hour winds, buried under the sand, or taken by a predator. In 2008, a series of sandstorms with wind gusts over 35 miles per hour may have caused the pair from Nest 1 (Cape Point) to abandon the nest. A nest on Ocracoke was buried during a Nor'easter prior to the nest being located by resource management staff. One egg was found when compacted sand was removed from a scrape that had been maintained prior to the arrival of the storm (NPS 2009b). In 2009 there were high winds and rain prior to a single egg (first egg of a clutch) disappearing at Cape Point (B. Muiznieks, pers. comm).

Hurricanes and other ocean storms can lead to unusually high tides, and subsequent flooding can overwash piping plover nests (Cohen 2005a). In May 2000, a 3-day storm produced high winds, heavy rain, and ocean overwash. One clutch at Cape Point was buried under windblown sand and abandoned, while a second was lost to flooding at Hatteras Inlet Spit (NPS 2001b).Wave action and erosion caused the abandonment of a nest in 2002 when waves undermined a protective dune, resulting in the nest being flooded by ocean overwash. The eggs were scattered from the nest and the adults did not return to them (NPS 2003d). In 2009 a four egg nest discovered on June 8th on South Point, Ocracoke, was overwashed by spring tides on June 23rd (B. Muiznieks, pers. comm).

Indeed, some piping plovers that nest too close to mean high tide may lose their nests on normal high tides (Cohen 2005a). Storms can also result in widespread mortality of chicks (Houghton 2005). Besides these direct effects of storms on piping plover nests, flooding from extreme high tides or storm surges may alter habitat enough to render it unsuitable for nesting. This may lead to the abandonment of habitat within or between breeding seasons (Haig and Oring 1988).

Predation. Predation, especially by mammalian predators, continues to be a major factor affecting the reproductive success of the piping plover (Elliot-Smith and Haig 2004). Predators of eggs, chicks, and/or adults include mink (*Mustela vison*), nutria (*Myocastor coypus*), muskrat (*Ondatra zibethicus*), otter (*Lutrinae* spp.), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), domestic dogs (*Canis lupus familiaris*), feral and domestic cats (*Felis catus*), crows (Corvus brachyrhynchos), gulls (*Larus* spp.) (NPS 2008c), and birds of prey (Murphy et al. 2003). The impact of predation has been postulated to be greater

on beaches with high human use because the presence of pets and trash (which may attract wild predators) is correlated with the presence of humans (USFWS 1996a).

Fox activity was recorded at all active plover nesting areas in 2001 and one late nest initiation and two nest abandonments were linked to this activity (NPS 2002b). No direct evidence of predation of chicks or eggs was recorded from 2001 through 2006, although the presence or tracks of crows, grackles (*Quiscalus* spp.), gulls, ghost crabs (*Ocypode quadrata*), Virginia opossum, mink, raccoon, red fox, grey fox, and domestic cats and dogs were documented within many plover breeding territories. A fox den was discovered within the Bodie Island Spit bird closure in June 2006 (NPS 2007d). During the 2007 season, one egg in an exclosed nest was lost to a ghost crab and other eggs were missing from a nest at Cape Point. Staff observed both raccoon and opossum tracks in the area of the nest scrape (NPS 2008c). Predators or high winds generated by a Nor'easter storm are thought to be responsible for missing eggs and eggs observed eight feet from scrapes (NPS 2008c). In 2008, park staff documented the loss of two plover chicks at Cape Point due to avian predation. One chick was taken by a gull and another by a crow. Staff also documented the presence or tracks of crows, ghost crabs, grackles, gulls, opossum, mink, raccoon, red fox, grey fox, and feral cats within many of the piping plover breeding territories (NPS 2009b). In addition to causing direct mortality, predators in piping plover habitat can also lead to piping plovers' abandoning territories within and between breeding seasons (Cohen 2005b). In 2009, two chicks at Cape Point were lost to suspected opossum predation on day three (B. Muiznieks, pers. comm..)

Ghost crabs have occasionally been implicated in the loss of nests (Watts and Bradshaw 1995) and chicks (Loegering et al. 1995). Research on ghost crabs conducted in the lab and at a breeding site at Assateague Island in Virginia suggests that crab predation is generally uncommon. However, this study indicated that the presence of ghost crabs could have a more indirect effect on plover survival. For example, adult plovers may shepherd their broods away from the foreshore, where the best forage normally exists, due to the abundance of ghost crabs at that location (Wolcott and Wolcott 1999). Poor forage was found to be a more likely contributor to chick mortality than predation by ghost crabs (Wolcott and Wolcott 1999). However, anecdotal records indicate that ghost crabs may be more of a problem in North Carolina than at sites farther north (Cohen 2005a). In 2008, ghost crab predation was suspected in the loss of three piping plover nest because ghost crab holes were found inside and around the nests and predator exclosures (NPS 2009b). In 2009, a two–egg nest discovered on May 22nd on South Point, Ocracoke, was incubated well past its expected hatch date and was eventually predated by ghost crabs (B. Muiznieks, pers. comm.).

Human Activity. Human disturbance, both direct and indirect, can adversely affect piping plovers at the Seashore. Studies on piping plovers have demonstrated that reproductive success is lower in areas with high human disturbance (Burger 1991, 1994). Research has shown that plover behavior is altered by the

presence of humans, which ultimately results in chicks exhibiting less time feeding, brooding, and conserving energy. Plovers that are subject to human disturbance spend less than 50% of their foraging time searching for prey and feeding, where undisturbed plovers can spend up to 90% of that time feeding (Burger 1994). These human-caused behavioral changes result in depleted energy reserves, which could leave chicks more susceptible to predation or other stresses (Flemming et al. 1988; Loegering and Fraser 1995). At other sites, it was documented that fledging success did not differ between areas with and without recreational ORV use (Patterson et al. 1991), although pedestrians caused a decrease in brood-foraging behavior in New Jersey (Burger 1994).

Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. Potential pedestrians on the beach include those individuals driving and subsequently parking on the beach, those originating from off-beach parking areas (hotels, motels, commercial facilities, beachside parks, etc.), and those from beachfront and nearby residences. Vehicle impacts can extend to remote stretches of beach where human disturbance would be very slight if access were limited to pedestrians only (USFWS 1996a).

Even with resource closures in places, protected species are still at risk. Approximately 50 to 60 occurrences of ORVs entering protected areas at the Seashore were recorded each year from 2000 to 2002. In 2003, 13 bird closure posts/signs were driven over by an ORV, and several instances of ORVs within the protected area were observed (NPS 2003d, 2004e, 2005a). A total of 105 occurrences of ORVs entering posted bird closures were recorded in 2003. This number represents a substantial increase as compared to 52 recorded in 2001 and 63 in 2002 (NPS 2004e). In 2004, 227 pedestrians and 65 vehicle tracks were reported within posted bird resource closures, including those for piping plovers. However, no plover nests were known to be disturbed, and no plover chicks were known to be lost, although four other bird species were killed by ORVs in 2004 (NPS 2005a). In 2005, 135 pedestrian, 57 ORV, and 13 illegal dog entries into posted bird closures were recorded (NPS 2006d). In 2006 resource staff recorded 255 pedestrian, 47 ORV, 22 dog, and 5 horse violations of bird closures (NPS 2007d). In 2007, resource staff recorded 249 pedestrian, 25 ORV, 17 dog, and 1 horse violation of bird closures (NPS 2008c). During the 2008 breeding season, resource staff recorded 80 pedestrian, 11 ORV, 5 dog, and 1 boat violation of nesting plover closures (NPS 2009b). During the 2009 breeding season, resource staff documented 192 pedestrian, eight ORV, 19 dog, three horse and three boat violations in the pre-nesting closures (B. Muiznieks, pers. comm.). Most illegal entries were not witnessed but documented based on vehicle, pedestrian, or dog tracks left behind. (sidebar: symbolic fence definition)

In New York, the response of incubating adults to the presence of humans near the nest was found to be highly variable, and average nest success was unrelated to the number of disturbance sources observed

within 100 meters (328 feet) of nests (Houghton 2005). However, piping plovers may be more sensitive to disturbance in the Atlantic Coast southern recovery unit, as evidenced by longer flush distances in response to disturbance sources at Assateague Island National Seashore (Loegering 1992). Flushing can affect plover behavior and viability in a number of ways. Flushing of incubating plovers from nests can expose eggs to avian predators or excessive temperatures. Repeated exposure of eggs to direct sunlight on hot days can cause overheating, which can kill avian embryos (Bergstrom 1989). In Texas, piping plovers avoided foraging on sand flats close to areas of high human use (Drake et al. 2001). Zonick (2000) found that the number of piping plovers was lower on disturbed bayside flats than on undisturbed flats, and piping plovers experienced lower foraging efficiency when disturbed. Other unpublished data support the assertion that winter habitat selection is negatively correlated with human activities and development (Houghton 2005). (sidebar: flush distance)

Unleashed pets have the potential to flush piping plovers, and these flushing events may be more prolonged than those associated with pedestrians or pedestrians with dogs on leash. For example, a study conducted on Cape Cod, Massachusetts, found that the average distance at which piping plovers were disturbed by pets was 46 meters (151) feet, compared with 23 meters (75 feet) for pedestrians. Birds flushed by pets moved farther (an average of 57 meters [187 feet]) than plovers reacting to pedestrians (an average of 25 meters [82 feet]). Duration of observed disturbance behaviors stimulated by pets was significantly greater than that caused by pedestrians (USFWS 1996a). In 2002, there was evidence that a dog may have been responsible for the loss of a piping plover chick at Bodie Island. When a plover brood could not be found, large canid tracks were documented in the area where the brood was often seen foraging and resting. A professional trapper with the U.S. Department of Agriculture examined the prints and verified them as domestic dog tracks. The tracks were found running in a sharp turning pattern, seeming to indicate that the dog had been engaged in a chase. Scrape marks where the dog had clawed in the sand were also evident. The chick was not observed at the site thereafter (NPS 2004e). (sidebar: canid)

Vehicles have been documented running over nests (Patterson et al. 1991) and birds. In Massachusetts and New York, biologists found that 18 chicks and 2 adults were killed by vehicles between 1989 and 1993, even on beaches with only five to ten vehicles passes per day (Melvin et al. 1994). Piping plover chicks often move from the foredune area to forage along the wrack line and intertidal zone, which places them in the paths of vehicles. Chicks can end up in or near tire ruts, and sometimes have difficulty crossing or climbing out of them. The normal response of plover chicks to disturbance could increase their vulnerability to vehicles. Chicks sometimes stand motionless or crouch as vehicles approach, and their lack of rapid movement could lead to mortality (USFWS 1996a).

ORV use may also affect the beach through sand displacement and compaction (Anders and Leatherman 1987), which may lead to steeper dune profiles. This, in turn, may prove less suitable for piping plover nesting. Degradation of the wrack line is possible from as little as one vehicle pass (Leatherman and Godfrey 1979), and may negatively impact reproductive success due to the loss of important habitat used by foraging plovers. Also, the wrack line provides habitat for many beach invertebrates, which are a staple of the plover diet.

Beach and dune renourishment projects can alter the profile of beaches, causing increased erosion and habitat loss (Leatherman 1985). Important dune-creation projects have been carried out along most of the Seashore, beginning in the 1930s. These may be affecting the ability of the Seashore to support piping plovers (Steve Harrison and Bob Trick, NPS, pers. comm. with Richard Podolsky, LBG, September 4, 2005). A recent study theorized that beach nourishment projects may negatively impact plover habitat because the resulting dredge spoil is often fine-grained, reducing the availability of pebbles and cobbles, which are a preferred substrate for nesting plovers (Cohen, Wunker, and Fraser 2008). Furthermore, beach stabilization prevents normal storm processes, such as overwash fan formation, thereby leading to long-term loss of moist substrate habitat and to accelerated vegetative succession in potential nesting habitat (Dolan et al. 1973). Construction of artificial structures on beaches eliminates breeding territories and may result in an increased level of predation on and human disturbance of remaining pairs (Houghton 2005).

Research, surveying, and even protective management activities can sometimes expose piping plovers to a risk of disturbance at breeding sites. For example, adult birds may be more vulnerable to predation within exclosures (Murphy et al. 2003), depending on the local predator pool and the type of exclosure used. Adults may also abandon exclosed nests more frequently (Haig and Elliot-Smith 2004).

SEA TURTLES

Sea turtles are large marine reptiles found in subtropical, tropical, and temperate oceans, as well as subarctic areas. They spend the majority of their time in ocean waters, with females coming ashore only to nest on sandy beaches. Five of the seven sea turtle species existing in the world today occur in the coastal waters of North Carolina and the Seashore, and all are listed as either federally threatened or endangered. These five species are the loggerhead sea turtle, the green sea turtle, the Kemp's ridley sea turtle, the leatherback sea turtle, and the hawksbill sea turtle. Of the five species, only three are known to nest at the Seashore: the loggerhead, green, and leatherback sea turtles. The other two species, Kemp's ridley and hawksbill, are known to occur on the beaches of the Seashore only through occasional

stranding, usually either due to death or incapacitation due to hypothermia, and are therefore not discussed further.

In 1978, the loggerhead turtle was federally listed as threatened (NMFS and USFWS 2008). The National Marine Fisheries Service (NMFS) and the USFWS are currently considering petitions to reclassify the loggerheads in the Northwest Atlantic as endangered. Also in 1978, the green turtle was federally listed as threatened, except for the breeding populations in Florida and on the Pacific Coast of Mexico, which were listed as endangered (NMFS and USFWS 1991b). The leatherback turtle was listed as federally endangered in 1970 (NMFS and USFWS 1992). All three species carry the same state listings as their federal listings (NCWRC n.d.).

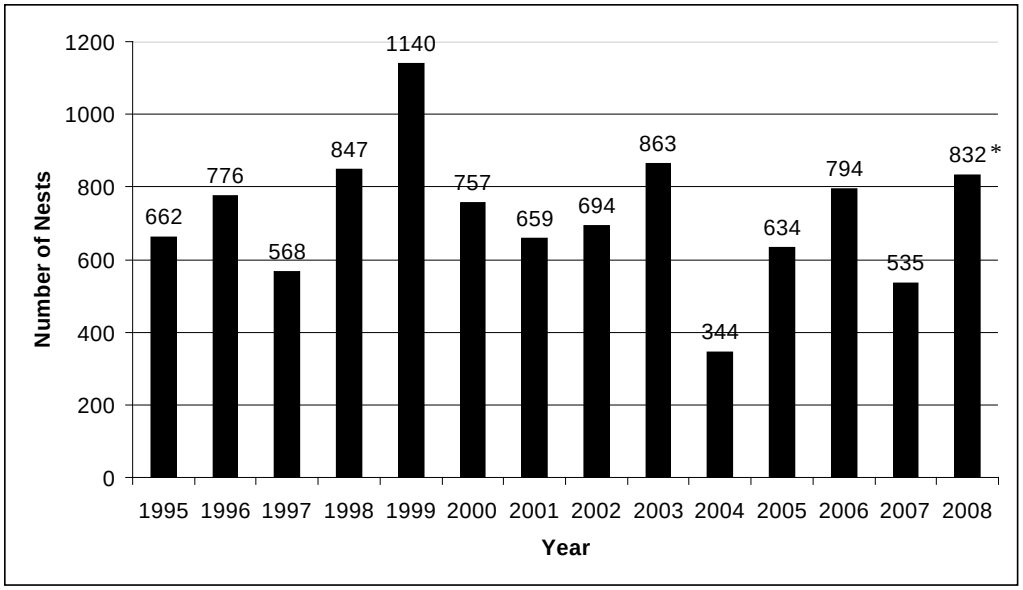
The Seashore staff has been consistently monitoring for sea turtle nests since 1987. However, over the years both monitoring and managing techniques have changed, making data comparison difficult; therefore, only nesting data from 2000 to 2008 is presented, for this data is known to be accurate. The number of nests recorded at the Seashore from 2000 to 2008 has fluctuated greatly, with only 43 nests recorded in 2004 and 112 nests recorded in 2008 (NPS 2008 turtle report). Of the three species that nest at the Seashore, the loggerhead turtle is by far the most numerous, comprising approximately 94% of the known nests between 2000 and 2008 (NPS turtle reports 2005, 2007, 2008; M. Baker, NPS, pers. comm., 2009). Green turtles and leatherbacks breed primarily in the tropics, with only small numbers nesting at higher latitudes. Green turtles have nested regularly at Cape Hatteras, but in fewer numbers, comprising only about 5% of the nests between 2000 and 2008, while leatherback turtles have nested infrequently at the Seashore, comprising only about 1% of the nests (NPS turtle reports 2005, 2007, 2008; M. Baker, NPS, pers. comm., 2009). Of the three districts that make up the Seashore, Hatteras District with approximately 30 miles of shoreline) receives the most nests annually (on average approximately 59%), followed by Ocracoke with approximately 19 miles of shoreline (approximately 27%) and Bodie with approximately 18 miles of shoreline (approximately 14%) (NPS 2009 – 2008 turtle report).

Loggerhead Turtle

The loggerhead sea turtle occurs throughout the temperate and tropical regions of the Atlantic,

Pacific, and Indian oceans. However, the two largest nesting rookeries occur along the western rims of the Atlantic and Indian oceans. Within the United States, the loggerhead turtle nests from Texas to Virginia, with the primary nesting concentrations found on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida (NMFS and USFWS 2008). Over the last decade, the total estimated nesting in the United States has fluctuated between 47,000 and 90,000 nests per year, with about 80% of the loggerhead nesting activity occurring in six counties in the state of Florida (NMFS and USFWS 2008). Within the northern recovery unit as defined in the loggerhead recovery plan (Florida/Georgia border to southern Virginia), studies of annual nest totals in South Carolina and Georgia have documented a decline in the number of nests (Ehrhart et al. 2003). However, since standardized surveying began in North Carolina in the mid-1990s, the number of loggerhead nests per season has remained fairly stable, averaging 722 nests from 1995 to 2008 (figure 10) (M. Godfrey, NCWRC, pers. comm., 2005 and 2008). (photo of loggerhead)

Comment [MDB20]: Inserted above. Photo credit to Cape Hatteras National Seashore 2009.



Source: M. Godfrey, NCWRC, pers. comm., 2005 and 2008.

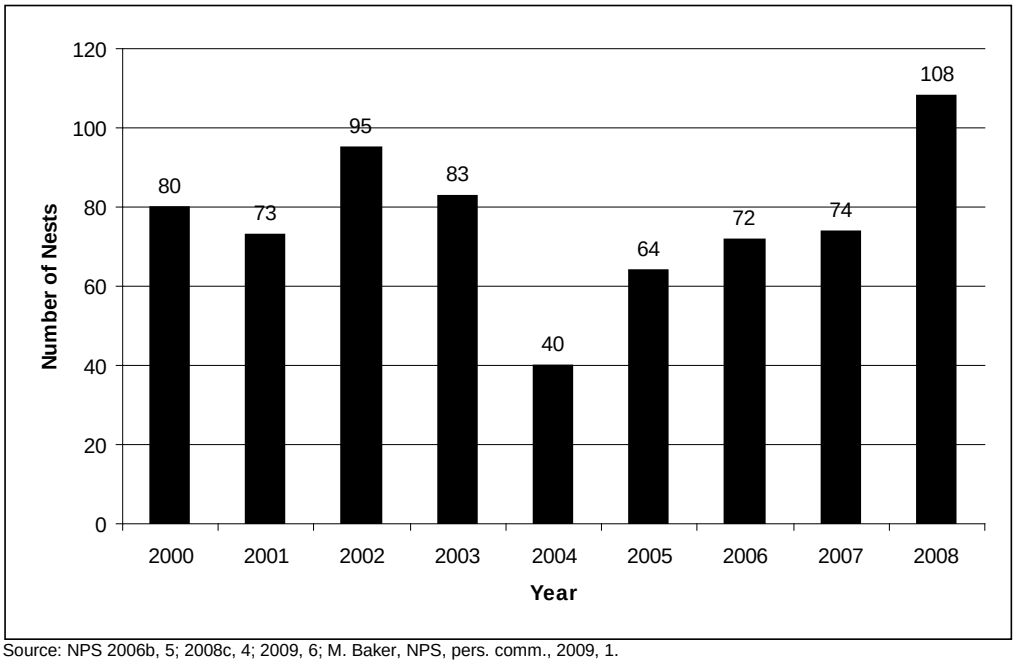
*Preliminary results.

FIGURE 10. NUMBERS OF LOGGERHEAD TURTLE NESTS IN NORTH CAROLINA, 1995–2008

Between 2000 and 2008 the average number of loggerhead nests at the Seashore was 77, with the lowest number of nests occurring in 2004 and the highest number of nests occurring in 2008 (figure 11) (NPS

2006b; NPS 2008c; NPS 2009; M. Baker, NPS, pers. comm., 2009). While only 43 loggerhead nests were laid at Cape Hatteras in 2004, it was a poor nesting year for the entire southeast Atlantic Coast (Lyons 2005).

Loggerhead turtles spend the majority of their life at sea, with only mature females coming ashore to nest every two to three years, on average (Schroeder et al. 2003). The first turtle nests (all turtle species included) typically begin to appear at Cape Hatteras in mid-May, and the last nests are usually deposited in late August (Lyons and Altman 2000; Sayles 2002; Gosh and Lyons 2002; Altman and Lyons 2003; Lyons 2005; K. Sayles, NPS, pers. comm., 2005; NPS 2006b, 2008c, 2009). Typical nesting areas for loggerheads tend to be sandy, wide, open beaches, backed by low dunes (Miller et al. 2003). Some factors that have been found to determine nest selection include beach slope, temperature, distance to the ocean, sand type, and moisture, though results were occasionally contradictory (Miller et al. 2003).



Source: NPS 2006b, 5; 2008c, 4; 2009, 6; M. Baker, NPS, pers. comm., 2009, 1.

FIGURE 11. NUMBERS OF LOGGERHEAD TURTLE NESTS AT CAPE HATTERAS NATIONAL SEASHORE, 2000–2008

Comment [bdm21]: In 2009 we had 103 nests.

Although the process of nest site selection is not well understood, a successful nest must be laid in a low salinity, high humidity, well-ventilated substrate that is not prone to flooding or burying because of tides

and storms and where temperatures are optimal for development (Miller et al. 2003). At the Seashore, between 2000 and 2008, on average, 28% of the nests found (all turtle species included) were relocated from their original location by Seashore staff. Of those nests, 79% were relocated for natural causes (e.g., in areas prone to flooding [below the high tide line], in an area prone to erosion, etc.), while the rest were relocated because of potential human disturbance, primarily because they were within one mile of a lighted fishing pier (Lyons and Altman 2000; Sayles 2002; Gosh and Lyons 2002; Altman and Lyons 2003; Lyons 2005; K. Sayles, NPS, pers. comm., 2005; NPS 2006b; NPS 2008c; NPS 2009). The practice of relocating nests for recreation or lighting issues is not encouraged by the USFWS; therefore, beginning in 2006 nests were no longer relocated for these purposes. As a result, the average number of nests relocated each year from 2006 to 2008 decreased to 18% of the nests found (NPS 2006b; NPS 2008c; NPS 2009).

Comment [bdm22]: In 2009 32 turtle nests were relocated at the time of nest discovery. A few additional nests (i.e. the leatherback nest) were relocated prior to a storm event

Loggerheads are nocturnal nesters. Females emerge from the ocean and crawl toward the dune line until they encounter a suitable nest site. The female clears away surface debris with her front flippers, creating a "body pit," and then excavates a flask-shaped nest cavity with her hind flippers. Loggerheads throughout the southeastern United States lay an average of 100 to 126 eggs per nest (NMFS and USFWS 2008). After laying her eggs, the female covers the nest with sand, and she crawls back to the sea.

Individual females may nest one to six times per nesting season, at an average interval of 12 to 15 days (NMFS and USFWS 2008). Loggerheads do not produce clutches in successive years very often. Typically nesting years are separated by one to three years of foraging in between. (NMFS and USFWS 2008). The nest incubation period (from laying to hatching) depends on temperature and ranges on average from 63 to 68 days in North Carolina (NMFS and USFWS 1991a). The sex ratio of hatchlings also depends on temperature during incubation. Below 84.6 °F, more males are produced than females, and above that temperature, more females are produced (Mrosovsky 1988). For this reason, the northern part of the U.S. Atlantic population, which includes North Carolina, apparently provides a disproportionate number of males to the larger population ~~(Mrosovsky et al. 1984; Hanson et al. 1998)~~which is important for the stability of the population as a whole. (Mrosovsky et al. 1984; Hanson et al. 1998),~~.~~

Comment [MDB23]: Change to new 2009 Recovery Plan

Hatchling emergence occurs almost exclusively at night (Mrosovsky 1968; Witherington et al. 1990) and may occur over several nights. Upon emerging from the nest, hatchlings primarily use light cues to find and move towards the sea (Witherington and Martin 1996). Once in the water, they swim incessantly out to sea to offshore habitats where they will spend the next phase of their life history.

Green Turtle

The green turtle is a circumglobal species in tropical and subtropical waters. The major green turtle nesting colonies in the Atlantic Ocean occur on Ascension Island, Aves Island, Costa Rica, and Surinam (NMFS and USFWS 1991b). Nesting in the United States occurs in small numbers in the U.S. Virgin Islands and on Puerto Rico and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward counties. North Carolina is near the northern limits of its nesting area. (sidebar: photo of green turtle)

Comment [MDB24]: Inserted below. Photo credit to Back Bay National Wildlife Refuge, 2005.

Nesting habits for the green turtle are very similar to those of the loggerhead turtle, with only slight differences. Average clutch sizes range from 110 to 115 eggs, although this varies by population, and females produce clutches in successive years only occasionally. Usually two to four years or more occur between breeding seasons (NMFS and USFWS 1991b).

From 2000 to 2008, there was an annual average of four green turtle nests at the Seashore, with a peak of nine nests in 2005 (NPS 2006b, NPS 2008c, NPS 2009; M. Baker, NPS, pers. comm., 2009).

Comment [bdm25]: In 2009 the Seashore had 3 green turtle nests.

Leatherback Turtle

Leatherback nesting grounds are distributed circumglobally, with the largest known nesting area occurring on the Pacific Coast of southern Mexico. Nesting in the United States occurs primarily in Puerto Rico, the U.S. Virgin Islands, and southeastern Florida (NMFS and USFWS 1992). (sidebar: photo of leatherback turtle)

Comment [MDB26]: Inserted below. Photo credit unknown….from a cell phone of a tourist on the beach 2009.

Leatherback nesting at the Seashore was first documented in 1998 and has subsequently been documented in 2000, 2002,, ~~and~~ 2007, and 2009 totaling six~~five~~ nests since 2000 (Lyons and Altman 2000; Lyons NPS 2006b; NPS 2008c, 2009; M. Baker, NPS, pers. comm., 2009). Since the species has a minimum of two years between nesting cycles, it is not known if more than one female of the species uses the Seashore as a nesting ground. The Seashore remains the northernmost nesting location on record for this species (Rabon et al. 2003), however in 2009 a leatherback nested in Kill Devil Hills, which currently represents the northernmost nest ever found from this species. ~~.~~

Leatherback nesting habits are very similar to those of the loggerhead turtle, although they tend to begin and end nesting earlier in the year than the loggerhead (NMFS and USFWS 1992). Since 1999, the only two nests laid in April at the Seashore have been leatherbacks (NPS 1999, 2008c). Leatherbacks are thought to migrate to their nesting beach about every two to three years (NMFS and USFWS 1992; Miller 1997). Clutch size averages 116 eggs, and the incubation period averages 55 to 75 days. It is also reported that leatherback turtles nest an average of five to seven times per year, with an average interval of nine to ten days between nesting (NMFS and USFWS 1992).

Potential Threats—Nesting Environment

Threats to the loggerhead turtle on nesting grounds, as outlined in their recovery plan (NMFS and USFWS 1991), are representative of those also faced by green and leatherback turtles.

Storm events, including hurricanes, may destroy nests because of flooding or piling of eroded sand on the nest site. Beach erosion due to wave action may decrease the availability of suitable nesting habitats (NMFS and USFWS 1991a), which can lead to a decline in the nesting rate.

A number of predators such as foxes, raccoons, and ghost crabs dig into nests and prey upon incubating eggs, while some predators, including birds, may take considerable numbers of hatchlings just prior to and/or during their emergence from nests.

Crowding of nesting beaches by pedestrians can disturb nesting females and prevent laying of eggs (NMFS and USFWS 1991a). Furthermore, the use of flashlights and beach fires may deter females from

Comment [MDB27]: Switch to new 2009 recovery plan

coming up on a beach, or may interfere with the sea-finding behavior of hatchlings (Witherington and Martin 1996).

Beach driving can disturb adult females and cause them to abort nesting attempts and can interfere with the sea-finding behavior of hatchlings when headlights are used at night (NMFS and USFWS 1991a). ORV beach driving may harm sea turtles when nests are run over, killing pre-emergent hatchlings or increasing sand compaction and thereby decreasing hatching success (NMFS and USFWS 1991a). Beach driving also poses a risk of injury to hatchlings by leaving ruts that trap or disorient hatchlings attempting to reach the ocean (Hosier et al. 1981). When artificial lighting impairs the behavior of nesting females and emerging hatchlings, the affected animals potentially face increased exposure to the elements, exhaustion, and predation.

Comment [MDB28]: Switch to new 2009 Recovery Plan

Comment [MDB29]: Switch to new 2009 Recovery Plan

Artificial lighting on human structures may deter females from coming up on a beach or may disorient hatchlings as they emerge from nests and try to find the sea (Witherington and Martin 1996). Beach cleaning can directly destroy nests. Poaching is a problem in some countries, but it occurs at a low level in the United States.

An increased human presence may lead to an increase in the presence of domestic pets (which can depredate nests) and may lead to an increase in litter (which may attract wild predators). Trampling can increase sand compaction, which may damage nests or hatchlings.

Recreational beach equipment and furniture can also cause turtles to forego egg-laying by hampering or trapping animals attempting to locate a nesting site. They can also trap emerging hatchlings.

The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through renourishment or through placement of hard structures, such as sea walls or pilings. ORV traffic also contributes to habitat loss through erosion, especially during high tides or on narrow beaches where driving is often concentrated on the high beach and foredune (NMFS and USFWS 1991a). Improperly placed erosion-control structures, such as drift-fencing, can act as a barrier to nesting females. Humans may also introduce exotic vegetation in conjunction with beach development that can overrun nesting habitat or make the substrate unsuitable for digging nest cavities.

Comment [MDB30]: Switch to new 2009 Recovery Plan

Threat Occurrences at Cape Hatteras National Seashore

The following data and discussions are from the Seashore annual sea turtle surveying reports, 1999 to 2008, and include all turtle species (Lyons and Altman 2000; Sayles 2002; Gosh and Lyons 2002; Altman and Lyons 2003; Lyons 2005; K. Sayles, NPS, pers. comm., 2005; NPS 1999, 2006b, 2008c, 2009).

The majority of nest losses at the Seashore from 1999 to 2007 were weather-related, particularly due to hurricanes and other storms. During this time, six hurricanes caused impacts to nests. In 2003, Hurricane Isabel destroyed 52 of the 87 nests (34 had hatched before the storm); there was so much water and sand movement along the beaches that no evidence of any nests could be found afterwards. The Seashore also felt the effects of numerous tropical storms and hurricanes as they passed by offshore.

Foxes were first seen at the Seashore in 1999 and on Hatteras Island in the winter of 2001–2002. Foxes disturbed or destroyed nests in 5 of the 10 years between 1999 and 2008, with the number of nests disturbed or destroyed ranging from one to nine nests per year. Ghost crab predation has been reported sporadically from 1999 to 2008, with 0 to 26 nests per year recorded as having either ghost crab holes burrowed deep into the nest cavity and/or eggshell fragments found on top of the sand in association with crab tracks.

Pedestrian tracks have been recorded inside closures, with counts ranging from 8 to 92 intrusions per year. Pedestrians disturbed or destroyed two to six nests per year from 1999 to 2008 by digging at the nest site; however, no pedestrian disturbances occurred in 2003, and no data ~~were~~ was available for 2005.

Violation of closed areas by ORVs has become increasingly common, with 13 to 109 sets of tracks inside closures, and 4 to 146 incidents of fencing vandalism, recorded per year. ORVs drove over four to five nests per year from 2000 to 2002; however, the nests survived. In 2007, two nests were known to have been run over by ORVs before they were found during the morning turtle patrol and fenced off. One nest appeared undamaged, while four eggs were crushed in the second nest. In 2004, a total of ten hatchlings were inadvertently killed by vehicles in two separate incidents.

Dogs disturbed or destroyed two nests in 2000, and 5 to 60 sets of dog tracks per year have been recorded inside closures. ~~Cats have not been observed to predate eggs or hatchlings, but 10 to 50 sets of cat tracks per year were counted inside closures from 2000 to 2002.~~ In 2008, cats were documented predating on emerging hatchlings at several nests, all within the villages. This was~~is~~ the first year in which this was~~is~~ documented, however, 10 to 50 sets of cat tracks per year were counted inside turtle closures from 2000 to 2002.

The total number of pedestrian, vehicle, and pet violations are conservative estimates, for often the actual numbers could not be determined. Footprints and tracks are often recorded as a single violation, when an undeterminable number of tracks through an area may actually represent multiple violations. Also, tracks below the expanded nest closures are often washed out by the tide before being discovered by the turtle patrol.

TABLE 13. OYSTERCATCHER ~~BREEDING~~ NESTING PAIR COUNT COMPARISON, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	Ocracoke Island	Hatteras Island	Bodie Island	Green Island	Total
1996	12	22	2	—	36
1999	15	24	2	—	41
2000	12	23	2	—	37
2001	13	24	2	—	39
2002	12	~~21~~ 17	~~3~~2	—	36
2003	8	16~~4~~	~~5~~ 4	3~~—~~	27
2004	9	15	3	2	29
2005	5	17	2	1~~2~~	26
2006	5	14	2	2	23
2007	~~5~~4	15	2	2	24
2008	3	15	3	2	23
2009	4	13	4	2	
Total	~~99~~	~~204~~	~~28~~	~~10~~	~~341~~

Source: Simons and Schulte 2007, 48; 2008, 81.

NOTE: Data available only for years listed.

TABLE 14. OYSTERCATCHER BREEDING DATA SUMMARY, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	~~Breeding Pairs~~Nesting Pairs	~~Clutches~~Nests	Nests Hatched	Nest Survival	Chicks Fledged	Fecundity
Ocracoke Island						
1996	12	12	8	0.667	8	0.67
1999	15	17	7	0.412	2	0.13
2000	12	17	6	0.353	7	0.58
2001	13	15	11	0.733	17	1.31
2002	12	18	6	0.333	3	0.25
2003	8	12	4	0.333	1	0.13
2004	9	11	7	0.636	8	0.89
2005	5	10	3	0.300	1	0.20
2006	5	8	5	0.625	2	0.40
2007	~~5~~4	12	3	0.250	1	0.20
2008	3	3	1	0.333	2	0.66
2009	4	6	2	0.333	0	0.00
Total/*average	~~99~~	~~135~~	~~61~~	~~*0.452~~	~~52~~	~~*0.49~~
Hatteras Island						

Comment [bdm31]: Should we be calling these nesting pairs to avoid confusion?

Comment [bdm32]: Depending on whose numbers you use, new totals would need to be recalculated.

Comment [bdm33]: We have found errors in the Simons report. We can provide you with raw data to support our numbers.

Comment [bdm34]: Need to recalculate if using 2009 data.

TABLE 13. OYSTERCATCHER ~~BREEDING~~ NESTING PAIR COUNT COMPARISON, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Comment [bdm31]: Should we be calling these nesting pairs to avoid confusion?

Comment [bdm35]: This is the wrong heading for this table

Year	Ocracoke Island	Hatteras Island	Bodie Island	Green Island	Total
1997	22	26	13	0.500	8	0.36
1999	24	31	7	0.226	3	0.13
2000	23	29	10	0.345	2	0.09
2001	24	28	10	0.357	6	0.25
2002	~~21~~ 17	25	3	0.120	4	0.19
2003	~~14~~ 16	~~21~~23	8	0.381	64	0.29
2004	15	18	14	0.778	9	0.60
2005	17	~~25~~ 24	13	0.520	~~10~~ 8	0.59
2006	14	19	11	0.579	5	0.36
2007	15	23	10	0.435	9	0.60
2008	15	20	9	0.450	11	0.73
2009	13	19	11	0.579	9	0.69
Total/*average	~~204~~	~~265~~	~~108~~	~~*0.426~~	~~71~~	~~*0.38~~
Bodie Island						
1996	2	2	1	0.500	2	1.00
1999	2	2	0	0.000	0	0.00
2000	2	3	0	0.000	0	0.00
2001	2	3	1	0.333	1	0.50
2002	~~3~~ 2	5	1	0.200	2	0.67
2003	~~5~~4	5	1	0.200	0	0.00
2004	3	7	0	0.000	0	0.00
2005	2	3	1	0.333	0	0.00
2006	2	2	1	0.500	0	0.00
2007	2	2	1	0.500	0	0.00
2008	3	5	2	0.400	2	0.6~~6~~7
2009	4	4	1	0.250	1	0.25
~~**Total/*average**~~	~~28~~	~~39~~	~~9~~	~~*0.269~~	~~7~~	~~*0.257~~
Green Island						
2004	2	3	2	0.667	2	1.00
2005	~~2~~1	~~3~~ 2	2	0.667	0	0.00
2006	2	2	2	1.000	2	1.00
2007	2	2	1	0.5	2	1.00
2008	2	4	1	0.~~150~~250	2	1.00
2009	2	2	2	1.000	3	1.50
Total/*average	~~10~~	~~14~~	~~8~~	~~*0.596~~	~~8~~	~~*0.80~~

TABLE 13. OYSTERCATCHER ~~BREEDING~~ NESTING PAIR COUNT COMPARISON, CAPE HATTERAS NATIONAL SEASHORE, 1996–2008

Year	Ocracoke Island	Hatteras Island	Bodie Island	Green Island	Total

Source: Simons and Schulte 2007, 48; 2008, 81.

NOTE: Data available only for years listed.

* = Average.

Comment [bdm31]: Should we be calling these nesting pairs to avoid confusion?

Comment [bdm36]: This header needs to be deleted from this page.

Since 1999, the number of breeding pairs at the Seashore has generally declined, with the exception of very small increases in 2001, 2004, and 2007 (see figure 12). The annual number of fledged chicks has ranged from a low of 5 in 1999 to a high of 20 in 2001. The rapid decrease in chick survival in 2002 is thought to correspond to the arrival of the fox as a predator on Hatteras Island. The advent of predator control efforts at the Seashore in 2003 is thought to be a contributing factor to the noticeable increase in chick survival between the 2003 and 2004 seasons (Simons and Schulte 2008). However, in the absence of hurricane events (which sometimes provide improved habitat) a recent demographic model projected a rapid decline for oystercatchers in North Carolina in the next 50 years (Simons and Schulte 2008, 60).

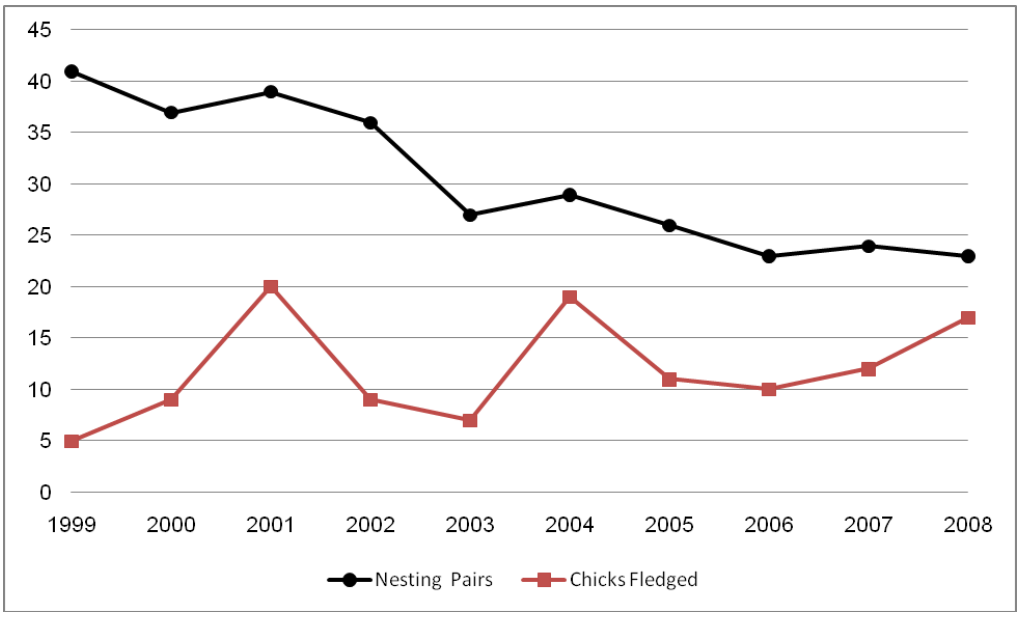


FIGURE 12. AMERICAN OYSTERCATCHER NESTING PAIRS AND CHICKS FLEDGED, CAPE HATTERAS NATIONAL SEASHORE, 1999–2008

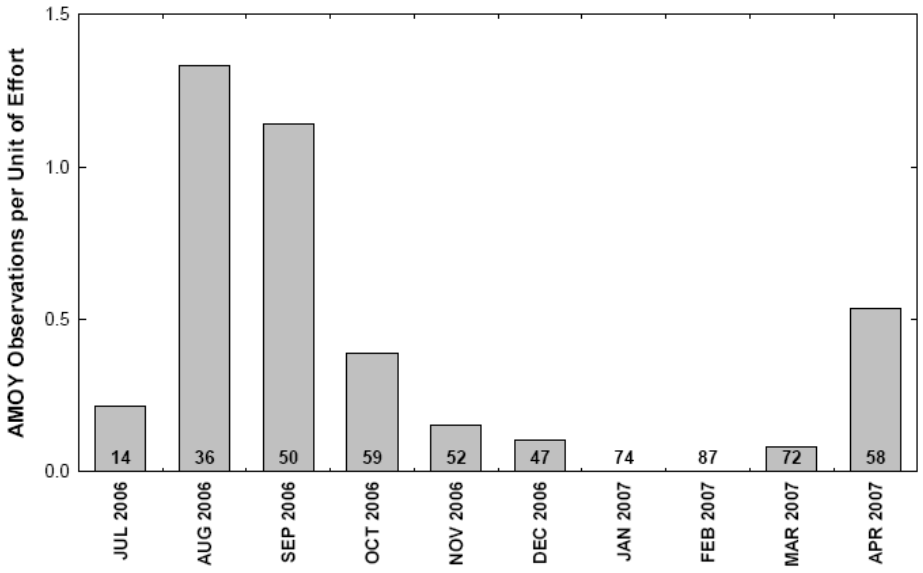
Comment [bdm37]: In 2009 we had 23 nesting pairs and fledged 13 chicks.

Nonbreeding Oystercatchers

American oystercatcher migration generally begins at the end of August and occurs gradually through November. American oystercatchers are short-distance, partial migrants and generally winter along the southeast coast of the United States (Schulte et al. 2007).

Winter and migratory habitat appear to be similar to breeding habitat, although additional research is needed to determine preferred habitat in the winter, especially for birds on migration. Limited observations indicate that winter birds roost on open ground without vegetation in areas near foraging habitat (Nol and Humphrey 1994). A study conducted during the winter of 2002–2003 found that oystercatchers commonly use shell rakes as winter roost sites (Brown et al. 2005). Other habitat types used by wintering oystercatchers include sand islands, inlet beaches, sand spits, edges and interior mudflats on marsh islands, and occasionally docks and jetties (Brown et al. 2005; Schulte et al. 2007)

The NPS Southeast Coast Network (SECN) Winter Monitoring Program is conducting a more comprehensive study on wintering shorebirds. Pilot implementation of this SECN shorebird monitoring protocol at the Seashore began in mid-July 2006. Results for the oystercatcher, which are depicted on figure 13, are discussed below.



Source: NPS Byrne et al. 2009.

Figure 13. Monthly Normalized Counts of American Oystercatchers (AMOY) and Number of Sampling Events at Cape Hatteras National Seashore, 2006–2007 (normalized counts are calculated as number of birds observed per 30-minute sampling event)

[Preparer's Note: Waiting for raw wintering data from 2006-2009]

Comment [bdm38]: This data would not be comparable because when SECN was conducting the surveys they were surveying the entire seashore. When we took over the migratory and wintering monitoring we are only surveying the points and spits.

From July 2006 through April 2007, the majority of American oystercatchers were observed in foreshore and mudflat/algal flat habitat types (figure 14). American oystercatchers appeared to use the foreshore during both tidal extremes and used the mudflat/algal flat habitat only during high tide. The highest numbers of birds appeared to occur in August, and the data indicated that the Seashore does not appear to have a wintering population of oystercatcher. The two highest single-day oystercatcher counts were 13 in October 2006 and 12 in August 2006.

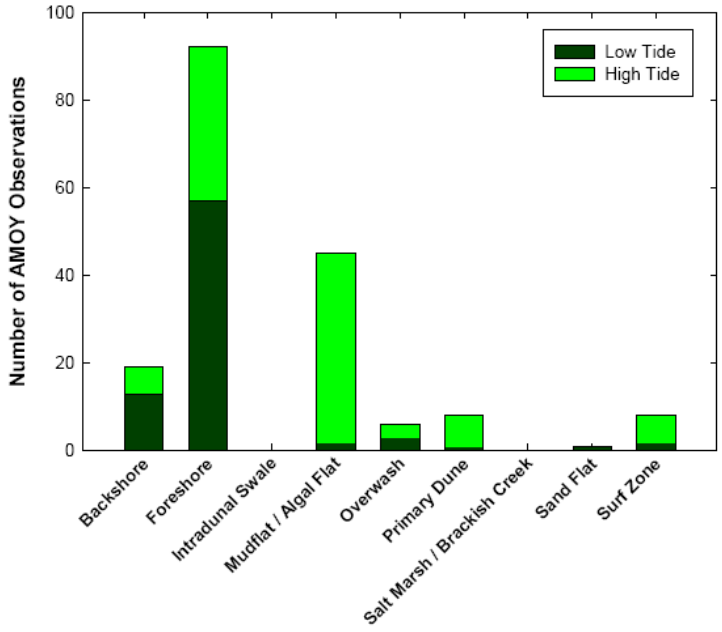


FIGURE 14: NUMBERS OF AMERICAN OYSTERCATCHER (AMOY) OBSERVATIONS BY HABITAT TYPE AND TIDAL STAGE AT CAPE HATTERAS NATIONAL SEASHORE, 2006–2007

RISK FACTORS TO AMERICAN OYSTERCATCHERS

In addition to direct habitat loss, the American oystercatcher faces pressure from recreational disturbance, increases in predators, potential contamination of food resources, and alteration of habitat through beach stabilization (Schulte et al. 2007). Causes of American oystercatcher nest failure on the Outer Banks from 1998 through 2008 could not be determined for 49% of nest failures. However, the causes of failure that could be determined were predation by mammals (54%), predation by ghost crabs (3%), avian predation

(4%), direct human disturbance (4%), abandonment (6%), and overwash (29%) (Simons and Schulte 2008).

Human Activity. Oystercatchers need large, undisturbed beach areas for successful nesting. Research has shown that disturbance by pedestrians, kayakers, vehicles, and unleashed pets can cause the abandonment of nest habitat as well as direct loss of eggs and chicks (Meyers 2005; Sabine et al. 2006, 2008; Toland 1999; Hodgson et al. 2008). Studies of the effects of humans and vehicles on American oystercatchers have indicated lower nest survival and higher chick mortality in places with higher levels of disturbance (McGowan 2004; Sabine 2005; Simons and Schulte 2008). A study at Cape Lookout National Seashore documented lower nesting success for oystercatchers in areas where human disturbance was higher, and also noted that oystercatchers avoided nesting in areas with high levels of human activity (Davis 1999). Another study in North Carolina found evidence that oystercatcher nests that were frequently disturbed by beach vehicles suffered higher rates of nest predation (McGowan and Simons 2006). In addition to direct impacts or mortality, reasons for lower reproductive success in areas of high disturbance may include reduced time spent foraging (Sabine et al. 2008), thermal stress to eggs caused by a lack of incubation when reacting to disturbance (Sabine 2006), and expenditure of energy reserves during flushing or defensive displays (Toland 1999). Studies at Cumberland Island National Seashore (CINS) in Georgia found that chick foraging behavior was lower in the presence of vehicular activity, which could alter chick provisioning and ultimately affect chick survival. Researchers recommended prohibiting beach driving in oystercatcher territories when chicks are present (Sabine 2005). Research on flush responses of oystercatchers to human disturbance indicates that protection of this species requires a buffer distance of up to 600 feet from nesting areas (Meyers 2005; see table 15).

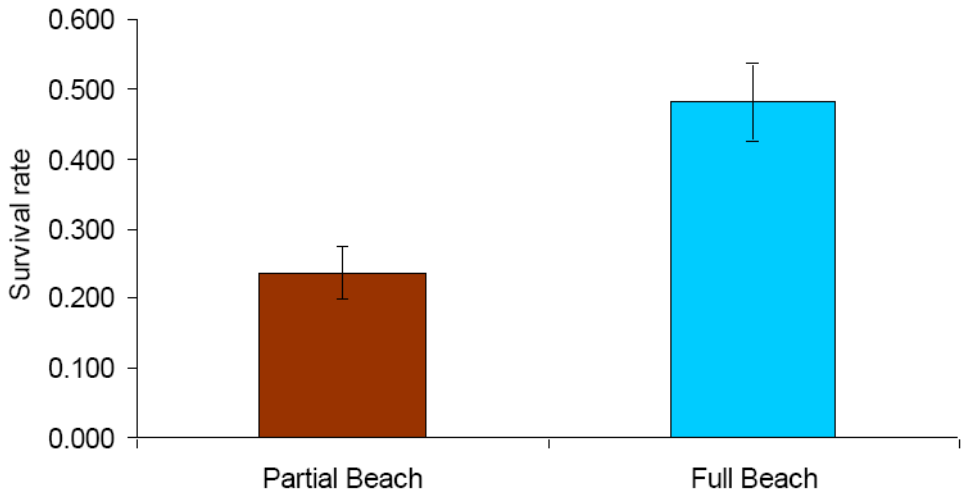
TABLE 15. BUFFER DISTANCES RECOMMENDED FOR FORAGING AND NESTING AMERICAN OYSTERCATCHERS IN FLORIDA, GEORGIA, AND MAINE

Buffer	Disturbance Types	Behavior	Region
450 ft (137 m) (Sabine 2005)	Pedestrians, ORVs/other vehicles, boats, pets	Nesting	Cumberland Island National Seashore, Georgia
492 ft (150 m) (Sabine 2005)	Pedestrians, ORVs/other vehicles, boats, pets	Brood rearing	Cumberland Island National Seashore, Georgia
100 ft (30 m) (Dept. Env. Protection 2008)	Development, vegetation removal	Foraging	Maine

TABLE 15. BUFFER DISTANCES RECOMMENDED FOR FORAGING AND NESTING AMERICAN OYSTERCATCHERS IN FLORIDA, GEORGIA, AND MAINE

Buffer	Disturbance Types	Behavior	Region
250 ft (76 m) (Dept. Env. Protection 2008)	Development, vegetation removal	Roosting	Maine
338 ft (103 m) (Rodgers and Schwikert 2002)	Personal watercraft	Foraging and loafing	West and east coasts of Florida

The reproductive success of oystercatchers at Cape Hatteras has been impacted by vehicle and pedestrian disturbance. From 1999 to 2008, 48% of chicks in full beach closures on Cape Hatteras survived to fledging, while only 24% survived when the beach had an open lane for vehicles and pedestrians (Simons and Schulte 2008; see figure 15). Seashore staff also documented that the highest hatching rate (87%) was found at sites that did not have ORV use or concentrated pedestrian use (NPS 2005b).



Source: Simons and Schulte 2008.

FIGURE 15. AMERICAN OYSTERCATCHER CHICK SURVIVAL BY CLOSURE TYPE AT CAPE HATTERAS NATIONAL SEASHORE, 1999–2008

Direct mortality of oystercatcher chicks from vehicles has been documented since 1995, when three chicks were found crushed in a set of vehicle tracks at the Seashore (Simons and Schulte 2008). Similar events have been documented at neighboring Cape Lookout National Seashore, where studies documented five chick deaths related to vehicles in 1995 (Davis 1999) and one chick and two clutches lost in 1997 when they were run over by vehicles (Davis et al. 2001). Three oystercatcher chicks were killed during the 2003 and 2004 breeding seasons at the Seashore by being run over by vehicles (NPS 2004f, 2005b), as documented by Seashore resource protection staff. A recent radio telemetry study conducted at Cape Hatteras and Cape Lookout national seashores identified human activity as the source of 16% of known chick mortality from 2005 through 2007 (Simons and Schulte 2008), with 8% of that related to vehicle collisions and 8% to other human disturbance.

Weather and Tides. Nine named hurricanes have affected the Outer Banks between 1993 and 2008 (NOAA 2009). Storms and associated high tides during breeding season can reduce nesting success. Overwash and other weather-related events accounted for 29% of documented nest failures at Cape Hatteras from 1999 through 2008. However, periodic hurricanes (outside the breeding season) can benefit oystercatcher nesting success in the long term through the creation of new habitat and the reduction of predators. For example, on Cape Lookout National Seashore, nests lost to predators dropped significantly after Hurricane Isabel flooded the island in September 2003. This drop was attributed to the reduction of the predator population due to hurricane-related flooding (Simons and Schulte 2008).

Predation. Numerous studies and reports have identified nest predation as a major source of oystercatcher nest failure (Davis et al. 2001; Sabine et al. 2006; McGowan et al. 2005; McGowan 2004; Hodgson et al. 2008; Traut et al. 2006; Wilke et al. 2007). Mammalian predation was the major identifiable cause of nest failure for study sites in North Carolina from 1998 through 2008 (Simons and Shulte 2008). Predators include grey fox, red fox, raccoon, mink, striped skunks, dogs, cats, American crows, and gulls (Nol and Humphrey 1994). More recently, video nest recordings have documented raccoon, bobcat (*Lynx rufus*), and ghost crab predation of oystercatcher eggs and nestlings at Cumberland Island National Seashore, Georgia (Sabine et al. 2006). Oystercatchers may lay another clutch if their eggs are lost or destroyed (Nol and Humphrey 1994).

Comment [bdm39]: Remove since striped skunks don't occur on the Seashore?

As previously discussed, predation of oystercatchers is thought to be associated with human activities such as ORV use and pedestrian recreation (McGowan and Simons 2006; Simons and Schulte 2007; Sabine et al. 2008). McGowan and Simons (2006) hypothesized that human recreation might increase the activity of incubating oystercatchers, thereby leading to increased predation rates. Their research found a clear association between recreation and incubation behavior at Cape Hatteras and Cape Lookout during the 2002 and 2003 breeding seasons (McGowan and Simons 2006). ORV traffic was associated with

subcolonies of black skimmers had lower nest density, later nesting dates, and lower hatching and fledging success (Safina and Burger 1983).

Breeding Performance at Cape Hatteras National Seashore

Colonial waterbird breeding at Cape Hatteras generally occurs between the beginning of May and the middle of August. In many cases, colonial waterbirds use areas that were colonized in previous seasons, which include areas protected as pre-nesting closures for piping plovers. Colonies are commonly composed of small groups of least terns, but more diverse colonies sometimes occur.

Although different survey protocols have been used at the Seashore between 1977 and 2008, recent estimates of colonial waterbird nests at the Seashore are clearly much lower than they were 30 years ago (see table 17). Common terns, gull-billed terns, and black skimmers have shown the greatest declines over the last 30 years, both statewide and at the Seashore.

TABLE 17. NUMBERS OF COLONIAL WATERBIRD NESTS AT CAPE HATTERAS NATIONAL SEASHORE, 1977–2008

Species	1977[a]	1983[a]	1988[a]	1992[a]	1993[a]	1995	1997	1998	1999	2000	2001	2004[b]	2007[b]	2008	Avg.
Gull-billed tern	27	7	26	0	12	58	84	21	103	3	108	31	~~60~~	0	~~34.3~~
Common tern	802	763	678	278	422	503	718	715	440	129	573[c]	376	~~18~~109	~~33~~19	~~460.6~~
Least tern	121	508	450	454	761	342	278	173	355	184	202	212	194	~~333~~232	~~331.5~~
Black skimmer	286	296	144	30	226	139	454	366	306	149	193	342	~~0~~11	~~5~~4	~~209.7~~
Total	1,236	1,574	1,298	762	1,421	1,042	1,534	1,275	1,204	465	1,076[c]	1,035	~~212~~320	255~~371~~	N/A

[a]Surveys conducted by J. Parnell, University of North Carolina, Wilmington.

[b]Surveys conducted by NCWRC using non-NPS protocol.

[c]Updated from 2001 report to include nests found on Green Island at Oregon Inlet, which is now included in the Seashore boundary.

N/A = Not applicable.

[Preparer's Note: Waiting for confirmation of 2008 CWB counts]

Within the Seashore, ~~no~~ 6 gull-billed tern nests were recorded in 2007 ~~or 2008~~on Green Island and none were found in 2008 or 2009, representing a decline from the Seashore's average of approximately 40 nests during surveys between 1977 and 2004. A total of ~~33~~ 53 common tern nests were found in ~~2008~~2009, compared to an average of 487 nests from 1997 to 2004. Black skimmer nest numbers have sharply declined at the Seashore, with only ~~5~~ 4 nests counted in 2008 and 61 nests counted in 2009, compared to an average of about 245 nests recorded at sampling events between 1977 and 2004 (table 17). The number of nests recorded in 2007 for ~~all~~ three of the four species was the lowest in the history of waterbird surveys in North Carolina (Cameron and Allen 2008). These species are early nesters that require habitats of bare sand or shell with little or no vegetation for nesting. Historically, these

Comment [bdm40]: 2009 preliminary data has 0 GBTE, 53 COTE, 578 LETE,and 61 BLSK.

Comment [bdm41]: These numbers should not change anymore! The 2007, 2008, 2009 totals represent highest counts for colonies between May 25-June 7. It is not the highest count for individual colonies.

species have nested primarily on barrier island beaches and have suffered declines most likely due to habitat loss and degradation (Cameron and Allen 2008). Other reasons for the decline in North Carolina's colonial waterbirds include mammal and bird predation, human development, beach stabilization, recreational disturbances on the outer and village beaches, and perhaps, impacts on the wintering grounds (Parnell et al. 1995; Erwin 2005). Recommended methods for colonial waterbird conservation include continued monitoring and management, habitat protection and restoration, predator management, and protection from human disturbance (Cameron and Allen 2008).

Nonbreeding

Gull-Billed Tern

Fledged young and adults usually leave North Carolina's colonies by August, moving north for a short period before turning south for the fall and winter. Little is known of concentration areas during migration or winter, although wintering birds are known in Florida and the Gulf coastal region, from western Florida all the way south to Honduras and to Panama on the west coast. The gull-billed tern occasionally winters along the Atlantic Coast of North America as far north as North Carolina (Parnell et al. 1995; Erwin 2005).

Common Tern

Fledged young and adults usually leave North Carolina's colonies in late July to August. They often move north before staging at sandbars near inlets in September and then heading south. Little information is known about winter range, but they are known from Florida south through the Caribbean to Peru and southern Brazil, where tens of thousands have been recorded in late winter (Nisbet 2002).

Least Tern

Fledged young and adults usually leave North Carolina's colonies in late July to August after breeding and also move northward into the New York to New England region before turning south to South America and the Caribbean. However, data are very limited on winter ranges (Thompson et al. 1997). Like other terns, least terns tend to congregate at staging areas along the Gulf Coast in August before departing for the winter (Thompson et al. 1997; Erwin 2005).

Black Skimmer

Fledged young and adults usually leave North Carolina's colonies by early August and disperse northward before heading south. Large flocks congregate at staging areas, often with terns. Adults may remain with their young during fall migration. Most birds from the mid-Atlantic region winter from

southern North Carolina to Florida, the Caribbean, and into Central and South America (Gochfeld and Burger 1994; Erwin 2005).

Risk Factors

Human Activity. Ground-nesting colonial waterbirds are particularly vulnerable to impacts from human activities undertaken by ORV riders, pedestrians, photographers, wildlife managers and scientists, and poachers, because of the birds' usually high colony density and co-occurrence with human recreation (Erwin 1980, 2005; Rodgers and Smith 1995; Rodgers and Schwikert 2002). Disturbances affect the animals' ability to feed, rest, and breed by evoking a flush response (Rodgers and Smith 1995; Rodgers and Schwikert 2002). Human activities that have indirect effects include sonic booms from military operations, aircraft disturbances, the presence of both domestic and feral animals, and the leaving of garbage that subsequently attracts both bird and mammal predators. Early in the spring, when the birds are first arriving and prospecting for breeding sites, even modest disturbances can be highly disruptive to colonial species (Buckley and Buckley 1976). Studies indicate that buffer distances between nesting areas and sources of human disturbances should be approximately 600 feet (Rodgers and Smith 1995; Erwin 1989, 2005).

Human disturbance to waterbirds is frequently documented at the Seashore. At Cape Hatteras, four least tern chicks between Ramps 23 and 30 and seven black skimmer chicks at Ocracoke Inlet were found dead or dying in ORV tracks during the 2003 breeding season. In all cases, the chicks were found adjacent to, but outside of, posted closures (NPS 2004g). Chicks become mobile after hatching, increasing their vulnerability. Colonial waterbird chick mortality from beach vehicles was documented every season from 2001 through 2004. Several chicks were killed by vehicles in 2001, 6 were killed in 2002, 11 were killed in 2003, and 6 were killed in 2004 (2001–2004 CWB reports). Although no colonial waterbird deaths were directly attributed to impacts of human activity, instances of human disturbance to birds were reported in each colonial waterbird annual report from 2005 through 2008 (2005–2008 CWB reports). Although informational signs are posted around all resource closures (including those for colonial waterbirds), violations by pedestrians, ORVs, and dogs are common at the Seashore. In 2008, there were several violations involving vehicles in colonial waterbird closures, including one that resulted in the crushing of a least tern egg by an ATV (July 31 CAHA Press Release).

Weather and Tides. Nine named hurricanes affected the Outer Banks between 1993 and 2007 (NOAA 2009). Flooding and high winds from storms can result in nest loss or failure, which was demonstrated in 1999 when Hurricane Dennis hit the North Carolina coast. Impacts from the hurricane flooded the entire Ocracoke Inlet colony, resulting in the loss of all chicks and eggs (1999 CWB report). Winter storms can

also impact shorebirds. High mortality of many coastal bird species was noted after a snowstorm swept the entire North Carolina coast in 1989 (USFWS 1996a). Storms can also result in beneficial impacts to shorebirds, as seen in 2003 when Hurricane Isabel's passing resulted in the creation of a great deal of suitable beach nesting habitat (2003 CWB report).

Predation. Resource Management staff at the Seashore assumes that the leading cause of colonial waterbird nest and brood failure is predation (2008 CWB Report). Predators of colonial waterbirds at Cape Hatteras include red fox, grey fox, mink, opossum, skunk, dogs, cats, rats, American crows, gulls, and raccoon. Foxes, raccoons,opossum, rats, and feral cats have increased in recent years as human populations have grown in coastal regions (Buckley and Buckley 1976; Erwin et al. 2001; Erwin 2005). The result of this predation has been poor reproduction or major redistributions of species such as gull-billed terns, common terns, least terns, and black skimmers (Erwin et al. 2001, 2003; Erwin 2005). In addition, gulls are often predators of terns as well as competitors for nesting space (Nisbet 2002). These include great black-backed gulls (*Larus marinus*), herring gulls (*Larus argentatus*), and the smaller laughing gulls (*Leucophaeus atricilla*). In addition, in certain areas other bird species may prey on terns and skimmers (or their eggs), such as peregrine falcons (*Falco peregrinus*), great-horned owls (*Bubo virginianus*), fish crows (*Corvus ossifragus*), and others (Erwin 2005). In 2008 the Seashore implemented a well-developed predator trapping program, which was unavailable in previous seasons. The trapping program deflated populations of raccoons, opossums, feral cats, red and grey foxes, and minks, which are all known predators of colonial waterbirds. However, raccoons at the Cape Point colony and mink at the South Ocracoke colonies severely hampered waterbird breeding success in those areas during the 2008 season (NPS 2009).

Comment [bdm42]: Skunks are known predators but not at Cape Hatteras.

Comment [bdm43]: Not documented as predators at Cape Hatteras.

Comment [bdm44]: Rats are known predators but not at Cape Hatteras.

Comment [bdm45]: Gulls are predators but they do not compete for nesting space here at Cape Hatteras.

WILSON'S PLOVER

Wilson's plover is a medium-sized, ringed plover of coastal habitats. Its overall length is 6.5 to 7.5 inches, and its weight ranges between 2 and 2.5 ounces. At all times of the year and in all plumages, its bill is entirely black, large, and heavy; its upperparts are generally grayish to grayish brown, and its underparts are white, with a black-to-brownish breast-band. Its legs and feet are flesh-colored to pinkish. It is readily distinguished from other, similar, ringed plovers by its larger size; by its large, heavy, all-black bill; and by its flesh-colored legs. The piping plover is smaller than Wilson's plover, having obviously paler upperparts, orange legs, and a much smaller, stubbier, two-toned bill that has an orange-yellow base and a black tip (Corbat and Bergstrom 2000; Hayman et al. 1986; Howell and Webb 1995). Wilson's plover has no federal protection status in the United States; however, it was classified as a species of conservation concern by the USFWS in 2002. Birds that appear on this list are those that, without additional conservation actions, are likely to become candidates for listing under the ESA

(USFWS 2002a; 16 U.S.C. 1531–1544). Brown et al. (2001) list Wilson's plover as a species of high concern in their prioritization of shorebird species according to relative conservation status and risk. Wilson's plover is listed as endangered in Virginia and Maryland, threatened in South Carolina, rare in Georgia, state protected in Alabama (Audubon 2005), and as a species of special concern in North Carolina (NCAC 10I.0105, Subchapter 101 15A). (photo of Wilson's and piping plover to show difference)

Distribution

Breeding. Wilson's plover is distributed locally along the Atlantic Coast, from Virginia south to southern Florida, including the Florida Keys, and from southern Florida west along the Gulf Coast to Veracruz, Mexico, the Yucatán, and Belize (Stevenson and Anderson 1994). Breeding locations are uncertain farther south along the Caribbean coast of Central America.

In South America, Wilson's plover breeds locally along the Atlantic Coast, from Colombia south to Brazil, and includes the islands of Trinidad, Aruba, Bonaire, Margarita, and Curaçao, located off the coast of Venezuela (Meyer de Schauensee and Phelps 1978). In the West Indies, it breeds throughout the Bahamas, the Greater Antilles, the Virgin Islands, the Lesser Antilles, and in the Grenadines (Raffaele et al. 1998).

Along the Pacific Coast, Wilson's plover breeds locally along the west coast of Baja California, and from the Gulf of California south to Nayarit, Mexico (Howell and Webb 1995). Farther south along the Pacific Coast, it breeds from Mexico to Ecuador and Peru (Hilty and Brown 1986).

Nonbreeding. Wintering occurs mainly in northeast and central Florida (Corbat and Bergstrom 2000) as well as in west Louisiana and south Texas throughout the remainder of the breeding range (see above), to northern South America (Hayman et al. 1986).

Wilson's Plover in North Carolina and at Cape Hatteras National Seashore

A 2004 survey of the entire coast of North Carolina yielded 232 pairs of Wilson's plover. Of those, the Seashore supported just two pairs of Wilson's plover on Ocracoke Island. In contrast, in 2004, Cape Lookout National Seashore supported 61 pairs and two individuals, which represented 26% of North Carolina's population of Wilson's plover (S. Cameron, pers. comm., November 20, 2005). Wilson's plovers are often seen by Seashore staff during their piping plover observations, but no indications of nesting had been documented until 2009 when a three-egg nest was found in June. The nest hatched in July and produced one chick. ~~No adults or chicks~~The chick was not observed during subsequent

observations and is not believed to have fledged ~~were seen in the area a few days later and it is not known if the chick fledged~~ (B. Muiznieks pers. comm. 2009).

More comprehensive surveying of wintering shorebirds is being conducted per the NPS's SECN Winter Monitoring Program. Implementation of the SECN Migratory, Wintering, and Beached Shorebird Monitoring Protocol at Cape Hatteras began in mid-July 2006. Only a few Wilson's plovers were observed at the Seashore from July to early December, and all birds were seen in foreshore habitat at low tide. SECN staff attributed the low numbers to insufficient training of field staff on the proper identification of Wilson's plover (Byrne et al. 2009).

[Preparer's Note: Waiting for raw wintering data from 2006-2009]

Comment [bdm46]: Again, I don't think our data is comparable to the surveys conducted in '06 and '07.

Habitat Description

Wilson's plovers are typically associated with coastal areas of high salinity and sparse vegetation, including salt flats, coastal lagoons, sand dunes, foredunes, and overwash areas above the high-tide line (Tomkins 1944; Hayman et al. 1986; Corbat and Bergstrom 2000). At the Seashore, Wilson's plover breeding sites have only been known to occur within piping plover closures. Hence, all closures, and much of the management of piping plovers, also apply indirectly to Wilson's plover.

Diet

Wilson's plover is a visual feeder on crustaceans, particularly fiddler crabs, and some insects (Strauch and Abele 1979; Morrier and McNeil 1991; Thibault and McNeil 1994), which they prey upon at intertidal mudflats, sand flats, ephemeral pools, and shores of brackish ponds. They usually forage at low tide on intertidal mudflats (Strauch and Abele 1979; Thibault and McNeil 1994; Corbat and Bergstrom 2000).

Breeding Biology

Before territories are established in mid-March to early April (Tomkins 1944; Corbat and Bergstrom 2000), Wilson's plovers form pairs, and most breeding territories are established by mid-April. As with the piping plover, the nest is a scrape in sand that requires little construction (Bergstrom 1988). Egg-laying peaks from late April through late May (Bergstrom 1988). Re-nesting after failure of a first nest can continue through the end of June. The estimated time required to complete a clutch of three eggs is four to six days (Bergstrom 1988; Corbat and Bergstrom 2000).

Reproductive Success at Cape Hatteras National Seashore

There are no data pertaining to Wilson's plover reproductive success at the Seashore.

Risk Factors

Because Wilson's plovers commonly nest on beaches with wide berms, which are also favored by birds like piping plover, Wilson's plovers are subject to disturbances at their nests and roosts by the same factors as those that affect the piping plover, including beachgoers, pets, and ORV traffic on beaches. Wilson's plovers leave their nests when disturbed and are extremely reluctant to return when intruders are anywhere near, a practice that exposes eggs to predation and overheating (Corbat and Bergstrom 2000).

RED KNOT

The red knot is a shorebird that breeds in the Canadian Arctic and is known to visit only North Carolina, the Outer Banks, and the Seashore, as well as the entire eastern seaboard of the United States, as a migrant and an occasional winter resident (Harrington 2001). There are five subspecies currently recognized (*Calidris canutus canutus*, *C.c. rufa*, *C.c. islandica*, *C.c. rogersi*, *C.c. roselaari*) (Harrington 2001). Two of these (*C.c. rufa* and *C.c. roselaari*) are found in the United States but only during migration and in the winter. Southward migration of *C.c. rufa* and *C.c. roselaari* begins in mid-July, with staging occurring along the United States Atlantic Coast (Harrington 2001). Only those aspects of the red knot's life pertinent to its management and conservation in North Carolina, the Outer Banks, and the Seashore are covered in this section. The red knot is not listed as threatened or endangered by the USFWS, but it is a federal candidate species. The red knot does not carry state status in North Carolina. (photo: red knot)

Emergency Endangered Listing and Taxonomy

On August 1, 2005, in response to the 80% decline in red knot population over the past 10 years, leading conservation groups filed an emergency petition asking the USFWS to list the red knot as an endangered species under the ESA. The listing request came from an alliance of wildlife groups, including Defenders of Wildlife, New Jersey Audubon Society, American Bird Conservancy, the National Audubon Society, Delaware Audubon Society, Citizens Campaign for the Environment, Audubon New York, Audubon Maryland–DC, and the Virginia Audubon Council. On September 12, 2006, the USFWS announced that it had designated the red knot as a candidate for ESA protection. On February 27, 2008, conservation groups again petitioned the Department of the Interior to list as endangered the *rufa* subspecies of the red knot, and a broader taxon comprising both the *rufa* subspecies and the *roselaari* subspecies.

Another indication of conservation concern for the red knot is the fact that in August of 2004, the U.S. Shorebird Conservation Plan (2004) published its list of U.S. and Canadian shorebird populations that are considered highly imperiled or of high conservation concern. The Canadian Arctic–Atlantic Coast

population of the red knot was one of eight taxa classified as Highly Imperiled. In 2008, the USFWS, which proposes candidates for listing under the ESA, determined that the ranking for the red knot should be raised from 6 to 3. The species' listing priority dictates the relative order in which proposed listing rules are prepared, with the species at greatest risk (listing priority 1 through 3) being proposed first (McDowell 2008).

Description

The red knot is characteristically found along the East Coast of the United States, with its greatest population staging on Delaware Bay (Tsipoura and Burger 1999) on its migration from its breeding ground in the Canadian Arctic to the Tierra del Fuego region of Chile and Argentina in South America. It is this subspecies that is the subject of the emergency petition.

Males in breeding plumage have a dark red or salmon breast, throat, and flanks, with a white belly. Their crowns and backs are flecked with gray and salmon (Harrington 1996, 2001; Paulson 1993). Female coloration is similar to that of males, but is typically less intense. Nonbreeding plumage is a plain gray on the head and back, with light fringes of gray and white along the wings, giving an appearance of a white line running the length of the wing when in flight. The breast is white, mottled with gray, and the belly is dull white. For both male and female, the bill is black (year-round), and the legs are dark gray to black (Harrington 1996, 2001). The average weight of the red knot is 5 ounces (which varies considerably through the year), with a body length between 9 and 10 inches.

Range and Migration

Red knots are found in the Arctic regions of Canada during the breeding season, which is mid-June through mid-August. They winter from November to mid-February primarily in two separate areas in South America—Tierra del Fuego in Chile and Argentina, and in Maranhão, northern Brazil (American Bird Conservancy 2005). Additional, smaller numbers of red knots also winter farther northwest in French Guiana and in the coastal, southeastern United States, including North Carolina, the Outer Banks, and the Seashore.

Red knots have one of the longest migrations of any shorebirds. Those individuals that winter in southern South America embark on their northern migration in February, with peak numbers leaving Argentina and southern Chile in mid-March to mid-April (Harrington 1996, 2001). The first stopover is along the coast of southern Brazil (Vooren and Chiaradia 1990) and the final stopover is the Delaware Bay. Their southward migration from the Canadian Arctic begins in mid-July. They arrive in South America along the coast of the Guianas in mid- to late August (Spaans 1978). From the Guianas, red knots continue to

move southward along the Atlantic coastline of South America, and the greater part of the population will continue on to Tierra del Fuego to winter (Morrison et al. 2004).

These long-distance migrations can only occur when the birds have access to productive refueling stops, particularly on their northern migrations, which involve fewer stops than the southern ones. For red knots on the eastern seaboard of the United States, Delaware Bay is the most crucial spring stopover because it is the primary final stop at which the birds can refuel in preparation for their nonstop leg to the Arctic. When they arrive at their final destination, weather conditions can be harsh, and food is scarce. Their fat reserves from the Delaware Bay must sustain them not only during their 2,400-kilometer (1,488-mile) final flight, but also upon arrival in the Arctic until food resources become more plentiful (Baker et al. 2004).

According to representatives from the National Audubon Society, red knots within the Seashore use oceanside beaches for resting and foraging, especially those that are low-angle beaches near larger intertidal zones, including such areas as South Beach (just above the Frisco Ramp), and on the east and west sides of Ocracoke on the oceanside, as well as the soundside areas (inside of the no-ORV closures) on Ocracoke and Bodie Island. Red knots only use the Seashore in the winter and during spring and fall migration.

Nonbreeding Habitat

Harrington (1996, 2001) describes how, during the winter, the red knot frequents intertidal habitats, notably along ocean coasts and large bays. Both areas usually display high waves or strong currents while supplying a sandy habitat. These areas are selectively chosen in South America, with the most abundant population on the island of Tierra del Fuego in Argentina and Chile (Morrison and Ross 1989).

On migration, the red knot principally uses marine habitats in both North and South America. Coastal habitats along the mouths of bays and estuaries are preferred, providing sandy beaches on which to forage (Harrington 1996, 2001). High wave energy is associated with these areas (Harrington 2001; Vooren and Chiaradia 1990; Blanco et al. 1992). Red knots are also known to use tidal flats in more sheltered bays or lagoons in search of benthic invertebrates or horseshoe crab eggs (Harrington 1996, 2001; Tsipoura and Burger 1999). In some cases, beach habitats are preferred because of high densities of benthic bivalves (Harrington 1996). Red knots also use tidal flats in more sheltered bays or lagoons, where they hunt for benthic invertebrates (Harrington 2001) or for special foods, such as horseshoe crab eggs (Harrington 1996; Tsipoura and Burger 1999). Delaware Bay hosts the largest number of spawning horseshoe crabs (a primary food source for the red knot) in the United States. At Delaware Bay, the red knots feed and put on weight needed for winter migration. The increasing human harvest of the horseshoe crab has reduced this

food source for red knots, and this dearth is believed to be contributing to the red knot's failure to reach its needed threshold departure weight of 6.3 to 7.0 ounces. Hence, there has been a systematic reduction in the body weight of red knots leaving Delaware Bay for the Arctic, which negatively impacts their ability to survive and breed (Baker et al. 2004).

Nonbreeding Observations at Cape Hatteras National Seashore

During their wintering shorebird study, SECN staff observed red knots at the Seashore from August 2006 through February 2007. Monthly counts were highly variable (figure 16), with the two highest single-day counts 230 in February 2007 and 170 in November 2006. Almost all red knots documented during this time were located in the foreshore habitat type (figure 17).

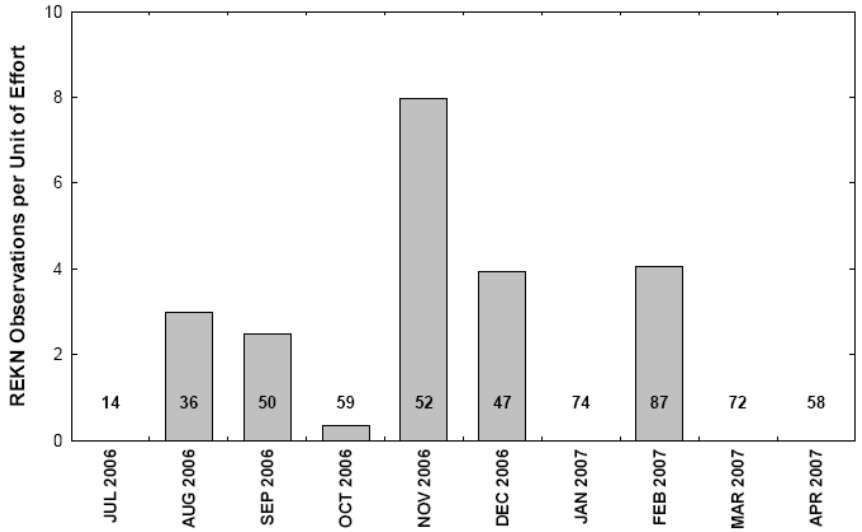


FIGURE 16. MONTHLY NORMALIZED COUNTS OF RED KNOT (REKN) AND NUMBER OF SAMPLING EVENTS AT CAPE HATTERAS NATIONAL SEASHORE, 2006–2007 (NORMALIZED COUNTS ARE CALCULATED AS NUMBER OF BIRDS OBSERVED PER 30-MINUTE SAMPLING EVENT)

[Preparer's Note: Waiting for raw wintering data from 2006-2009]

Comment [bdm47]: Recent year's data would not be comparable since we only survey the points and spits which is not primary REKN habitat.

allow ORV access to Seashore beaches. White posts were placed 150 feet landward from the average, normal high-tide line, or, if existing, at the vegetation or remnant dune line. Beach areas landward of the post line, although not open to ORV use, are open to pedestrian use (NPS 2004b).

Temporary wildlife closures take place throughout the Seashore, including within areas of ORV and pedestrian use, to comply with protection measures afforded nesting sea turtles and protected shorebirds, particularly the piping plover. These closures are implemented at crucial periods during the life of these species. During these closures, the NPS routes ORV beach traffic around the temporary wildlife closure when possible. When full beach closures occur, ORV traffic may be temporarily rerouted around the landward side of the closure area to provide ORV access to open sections of beach. Temporary wildlife closures apply to both ORV and pedestrian use although occasionally pedestrian access will be allowed in pedestrian corridors.

Bird Closures. The open sand flats near the three inlets in the Seashore (Oregon, Hatteras, and Ocracoke) are used by protected bird species and are also favorite fishing areas that visitors access in ORVs. Piping plover, American oystercatcher, and colonial waterbird breeding activity has been documented on and near the ocean beach in all of these locations.

In 2005, a 0.1-mile "pass-through only" section of the ORV corridor was enforced at Bodie Island Spit, to reduce disturbance to plovers foraging at ephemeral pools close to the original corridor boundary. Pedestrians were not allowed in the pass-through zone. At Cape Point, a resource closure was created around a complex of ephemeral pools to protect an oystercatcher brood (the closure extended to approximately 50 feet from the edge of the pools). This closure was later used by a plover brood that hatched to the west. Cape Point was closed to ORVs after the plover brood moved to the ephemeral pool area. At South Ocracoke, the ORV corridor was narrowed in one place to protect a section of ocean intertidal zone where a pair of adult plovers was observed foraging on several occasions. ORVs were permitted to drive past the protected area in the backshore but were restricted from the shore of the sound (Cohen 2005a).

In 2005, at Hatteras Inlet Spit, ORV traffic was temporarily permitted only in the ORV corridor once per hour in convoys escorted by bird observers to reduce the risk of mortality to an oystercatcher brood and to reduce disturbance to an incubating plover nest. ORVs were permitted to park at the tip of the spit, west of the escort corridor. "Gatekeepers" were posted at each end of the escort route to assure that no unescorted ORVs entered the restricted area (NPS 2005b). The spit was closed to recreation at night. Once the plover eggs hatched, Hatteras Spit was closed to ORV traffic until the chicks fledged. The ORV escort program operated in the Hatteras Spit area south of the Pole Road from 7 a.m. until 8 p.m. daily

beginning on May 21, 2005, and ending on June 16, 2005 (27 days) (NPS 2006e). Pedestrian access through the escort area was also prohibited.

In 2005, temporary closures also occurred at multiple other beach locations to protect piping plovers, American oystercatchers, terns, and colonial waterbirds from ORV and pedestrian use. These closures occurred on all three islands but were most concentrated on Hatteras Island, followed by Ocracoke. The Interim Protected Species Management Strategy (Interim Strategy) was published in January 2006 and finalized by a FONSI in July 2007 (NPS 2007). The Interim Strategy presented a multifaceted approach that included including the establishment of pre-nesting closures, species protection buffers, wintering habitat protection, and temporary resource closures. The Interim Strategy did not include an escort system, but instead relied on alternate routes and bypasses to access points and spits while avoiding resource closures. Although the Interim Strategy established specific distances for species buffers, it allowed for the reduction or expansion of these areas based on professional judgment of the resource management staff. Species and recreational vehicle management under the Interim Strategy resulted in beach closures similar to those that occurred in previous years. However, management and closures would be altered by a lawsuit and subsequent consent decree in 2008.

In February 2008, Defenders of Wildlife and the National Audubon Society filed a lawsuit against the NPS alleging inadequacies in management of protected species at the Seashore under the Interim Strategy and failure of the Seashore to comply with the requirements of the ORV executive order and NPS regulations regarding ORV use. However, a consent decree was filed on April 16, 2008, in U.S. District Court (signed on April 30, 2008), whereby the parties involved in the lawsuit agreed to a settlement of the case. The most immediate effect of the consent decree was that it established a prohibition on night driving on beaches between the hours of 10 p.m. and 6 a.m. from May 1 through November 15. The consent decree also resulted in larger buffers than those prescribed in the Interim Strategy being established during portions of the spring and summer around bird breeding and nesting areas; this included creating a 1,000-meter (3,280-foot) vehicle perimeter and a 300-meter (984-foot) pedestrian perimeter around piping plover chicks until they have fledged. From May 15 through August 21, 2008, an average of 10 miles of oceanfront beach at the Seashore was closed to both pedestrians and ORVs. The largest amount of beach closures was reported on May 29, 2008, when 12.8 miles of beach were closed to all users to protect birds exhibiting breeding, nesting, and/or foraging behavior. (Insert photo of typical closures for birds and turtles)

Comment [bdm48]: Should we be consistent with the terminology in the consent decree and call it a buffer?

Sea Turtle Closures. Temporary closures to ORVs and pedestrians are implemented during nesting and hatching activities for all three sea turtle species that are known to nest at the Seashore. In May 2008, approximately 10.6 miles of the 66.4 miles at the Seashore were under resource closures, mostly for bird