

**CAPE HATTERAS NATIONAL SEASHORE
COLONIAL WATERBIRD MONITORING
2011 ANNUAL REPORT**



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ABSTRACT

In 2011 colonial waterbird (CWB) monitoring at Cape Hatteras National Seashore (CAHA) consisted of identifying and protecting active colonies as well as conducting a single walk-through nest survey. The nesting population of CWB was determined by taking a nest count during a walk-through survey between May 30 and June 10, 2011. This year Bodie/Hatteras District contained six colonies, Hatteras District contained six colonies, and Ocracoke contained three colonies. The total number of nests for least terns (LETE), common terns (COTE), black skimmer (BLSK), and gull-billed terns (GBTE) increased in 2011. In 2011, 1063 LETE nests, 112 COTE nests, 99 BLSK nests and 15 GBTE nests were documented. The largest colony occurred on Bodie Island Spit consisting of 473 LETE nests (and 18 chicks) and four COTE nests. The Green Island colony accounted for 57% of BLSK nests and 70% of COTE nests at CAHA. CAHA accounted for 30% of all LETE nesting in the state of North Carolina contributing 1063 nests for a state total of 3,547 nests. In 2011 North Carolina met the NC Waterbird Committee's population goal for the species of 2,000 nests as well as the habitat goal of 25 sites with nesting occurring in 54 documented sites.

INTRODUCTION

CAHA is located along the northern Outer Banks region of North Carolina. Consisting of more than 30,000 acres distributed along approximately 66.8 miles of shoreline, it is part of a dynamic barrier island system. CAHA provides traditional nesting habitat for several species of special concern and state-listed colonial-nesting waterbirds, including the common tern (*Sterna hirundo*), least tern (*Sterna antillarum*), gull-billed tern (*Gelochelidon nilotica aranea*), and black skimmer (*Rhynchops niger*). The federally threatened piping plover (*Charadrius melodus*), and the American oystercatcher (*Haematopus palliatus*), a North Carolina species of special concern, also nest at CAHA. Over the years there have been different levels of staffing and hence different levels of monitoring and data collection for CWB breeding activity. The varying levels of effort over the years make it difficult to compare results from one year to the next.

CWB refer to those species of birds that nest in large groups or colonies and obtain their food from the water. Terns, gulls, pelicans, skimmers, and cormorants are all examples of CWB. Terns and skimmers nest above the high-tide line in sand, gravel, or shell beds.

The LETE, the smallest of the terns and gulls, is the most prevalent of the four species of CWB monitored at CAHA. They are gray and white with a black cap, a white forehead, yellow legs, and a yellow bill with a black tip. Courtship typically takes place at the nesting site. Like all terns and skimmers, the male will entice a female through a method known as fish flashing, in which he presents her with a fish. Upon acceptance, the pair will copulate and scrape. LETE nest on sandy beaches close to the water. A clutch of 2-3 eggs is laid in a scrape (i.e. a small shallow depression) and are cryptic in coloration, making them difficult to see. Both adults will incubate the nest for approximately 20-22 days. Once a nest has hatched, the adults will feed the semi-precocial chick(s), which have left the nest, for 19-20 days until they fledge. The LETE has the shortest incubation and fledging periods of the shorebird species monitored at CAHA.

The COTE is larger than the LETE. It is gray and white with a black cap, reddish-orange legs, and a reddish-orange bill. COTE will incubate for 21-27 days. The chicks typically fledge between

26-27 days. GBTE are similar in size and coloration to the COTE, with the exception being the black legs and thick, black, blunt bill. Nests are incubated for 22-23 days and chicks will fledge in 28-35 days.

The BLSK is a medium to large black and white waterbird. The bill is orange and black with the lower mandible extending past the upper mandible. The bird gained its name by its feeding habit of skimming over the water looking for prey. They are active more at dusk and dawn than during the day. Incubation of 3-5 eggs lasts 21-23 days. The semi-precocial chicks are ready to fledge within 23-25 days.

Consent Decree

In October 2007, a lawsuit was brought against the NPS by the Defenders of Wildlife and the National Audubon Society for failure to provide adequate protection of threatened and endangered species and species of concern from the impacts of off-road vehicle (ORV) use at CAHA. On April 30, 2008, a settlement agreement that had been reached between all parties to the lawsuit was approved by the U.S. District Court as a consent decree (CD). The purpose of the CD was to provide additional protection measures pending the development of an ORV management plan and special regulation. Examples of changes in management as a result of the CD included earlier dates for the establishment of pre-nesting closures and larger buffer requirements for nesting birds and chicks. This was the fourth year that the CD determined the management of protected species at CAHA.

METHODS

Closures

In addition to the pre-nesting closures for piping plovers (PIPL) that are described in the 2011 PIPL annual report, closures for CWB were installed in areas where breeding behavior, scrapes, nests, or chicks were observed. This included areas of CAHA where pre-nesting closures had not been established. As per the CD, LETE required a 100-meter buffer for breeding behavior, scrapes and nests and a 200-meter buffer for unfledged chicks. Other protected CWB species required a 200-meter buffer for all breeding and nesting activity (Table 1). Closures were modified as the colonies expanded or nests hatched to maintain the required buffer sizes from the outer-most nest or chicks in the colony. When multiple species were present, the greatest applicable buffer distance was used.

Table 1. CWB Nesting and Chick Buffers Required by the 2008 CD.

Species	Breeding Behavior/Nest Buffer (m)	Unfledged Chick Buffer (m)
LETE	100	200
Other Protected CWB	200	200

Monitoring

CAHA is broken into three resource management operational districts: Bodie/Hatteras, Hatteras, and Ocracoke. Each district had a team of biological technicians responsible for monitoring the species in that area. The Bodie/Hatteras District covered the area from Ramp 1 to Oregon Inlet (which includes Bodie Spit), and Rodanthe to Ramp 30. The Bodie/Hatteras District also included Green Island, a small, semi-vegetated island on the sound-side of Oregon Inlet. Hatteras District

is the largest of the three districts and extends from Ramp 30 south to Hatteras Inlet and includes Cape Point, South Beach, and Hatteras Inlet Spit. The Ocracoke District covers the area from Hatteras Inlet to South Point at Ocracoke Inlet.

Monitoring of CWB at CAHA focuses on identifying nesting habitat, protecting nesting areas and chicks, and performing routine nest and chick counts. Technicians were responsible for locating areas where colonies were forming. This involved observing CWB for courtship, copulation, and scraping behaviors. Colony establishment began when scraping behavior or physical scrapes were observed. After establishment and closure approval, a closure was installed around the area utilizing the required buffer. Once a closure was established, the area was observed at least once daily from either outside the closure or inside the closure at the shoreline by resource management field staff. The distance from the outer most nests/chicks to the closure boundary was checked during observation periods to ensure all nests or chicks were within the required buffer. If a nest or chick was outside of the buffer, the closure was modified to meet the buffer requirements. Once clutches began to hatch, closures were modified to meet the required 200 meter distance.

One walk-through survey was performed for each colony during estimated peak nesting which for CAHA is usually around the first week of June. Surveys were conducted between May 30 and June 10, 2011 except for one colony (HIC06) (*see discussion section*). Efforts were made to minimize entry into established colonies after the survey date to lessen disturbance.

Predator Control

Because mammalian predation is a major issue in CWB colonies, predator control by trapping was conducted for target predators near nests and chicks in 2011. Trapping was conducted in all districts. When technicians walked through areas they documented and reported any signs (e.g. print, scat) of predators they observed. If predator sign was found in a closure, trapping efforts were increased in that area. Traps were installed in the vicinity of the closure with the intent of targeting the specific predator in the area.

In an experimental project to control canid, raccoon, opossum and feral cat predation on nests and chicks at the Bodie Island Spit colony (“BIC01” in 2011), a 5-strand electric fence was installed. The fence was removed after all the chicks in the colony had fledged. (Appendix A.)

RESULTS

Nest Observations

The nesting population of CWB was determined by taking a nest count during a walk-through survey between May 30 and June 10, 2011. One colony in the Hatteras District was established later due to predator activity, making completion of a survey impossible during this time period. For this colony, a walk-through survey was performed on June 23, 2011. Results for each district are presented below.

Bodie/Hatteras District

Six CWB colonies formed in the Bodie/Hatteras District during the 2011 breeding season (Table 2 and Appendix B; Maps 1-2). These colonies accounted for 58% of the LETE nests, 74% of COTE nests, 58% of BLSK nests, and 20% of GBTE nests reported for CAHA. In addition to the nests, 23 LETE chicks from three separate colonies were documented during the walk-through surveys.

The largest colony at CAHA occurred on Bodie Island Spit consisting of 473 LETE nests (and 18 chicks) and four COTE nests. The Green Island colony accounted for 57% of BLSK nests and 70% of COTE nests at CAHA.

Hatteras District

Six CWB colonies (all consisting of only LETEs) formed in the Hatteras District (Table 2 and Appendix B: Maps 3-4). These colonies produced 22% of the LETE nests reported. For the fifth straight year, there were no BLSK nests on Hatteras Island. There were also no COTE nests documented this year. In addition to the documented nests, five LETE chicks were documented during the walk through surveys.

Ocracoke

Three CWB colonies formed on Ocracoke (Table 2 and Appendix B: Map 5) this year. These colonies produced 21% of the LETE nests, 26% of the COTE nests, 42% of the BLSK nests, and 80% of the GBTE nests reported. In addition to the nests, 16 live LETE chicks were documented during the walk through surveys.

Table 2. Peak Nest Counts at CAHA for 2011.

2011 CWB Nests/Chicks						
	Location	Survey Date	LETE	GBTE	BLSK	COTE
Bodie / Hatteras District	GIC01	6/10/2011		3/0	57/0	79/0
	BIC01	6/6/2011	473/18			4/0
	BHC01	6/5/2011	64/2			
	BHC02	6/6/2011	25/0			
	BHC03	6/7/2011	32/3			
	BHC04	6/8/2011	19/0			
Hatteras District	HIC01	6/1/2011	137/2			
	HIC02	6/1/2011	33/0			
	HIC03	6/2/2011	5/0			
	HIC04	6/1/2011	38/0			
	HIC05	6/1/2011	2/0			
	HIC06	6/23/2011*	15/3			
Ocracoke District	OIC01	6/1/2011	142/14	12/0	34/0	28/0
	OIC02	5/31/2011	39/2		8/0	1/0
	OIC03	5/30/2011	39/0			
Total			1063/44	15/0	99/0	112/0

*Survey conducted outside of recommended survey window due to late establishment of colony

Nest Counts

Because of the large number of chicks documented during walkthroughs in 2010, all surveys were conducted by the first week of June with the exception of Green Island and HICO6, the colony that was established late in Hatteras District. To be more consistent with how other parks conduct their surveys and to minimize disturbance to the colonies, only one walk through of each colony

was conducted. In 2011 CAHA accounted for 30% of all LETE nesting in the state of North Carolina contributing 1063 nests for a state total of 3,547 nests. In 2011 North Carolina met the NC Waterbird Committee’s population goal for the species of 2,000 nests as well as the habitat goal of 25 sites with nesting occurring in 54 documented sites.

The total number of nests for LETE, COTE, GBTE, and BLSK increased in 2011 and were the highest totals for all species within the last five years (Table 3).

Table 3. CWB Nest Count Comparisons from 2007 to 2011.

Year	LETE	COTE	BLSK	GBTE
2007	194	109	11	0
2008	232	19	4	0
2009	577	53	61	0
2010	381(118)*	21(1)	12	1
2011	1063 (44)	112	99	15
*Totals in () represent documented chicks				

Productivity

While it is certain some colonies fledged chicks, there are no definite numbers for CWB productivity for 2011. In 12 of the 15 documented colonies, LETE fledglings were observed. BLSK fledglings were observed in three colonies. COTE fledglings were observed in one colony (GIC01).

Nest/Chick Loss

Three factors are thought to have contributed to the loss of nests or chicks: predation, weather, and abandonment. On multiple occasions, more than one factor may have occurred. In six of the 15 colonies, predation of eggs and/or chicks was documented. Predators included ghost crabs, avian species, raccoon, feral cat and coyote. One entire colony in the Hatteras District (HIC03) was predated and then the site was abandoned. Soon after, a new colony (HIC06) was established about 0.4 miles west of the original colony location.

Human Disturbance/Closure Intrusions

In determining the cause of loss of nests or chicks, human disturbance was considered as the primary cause only if direct observation or documentable evidence could support that conclusion. Any unobserved, potential or assumed effects of human disturbance were therefore not included in the recording of violations and potential causes.

A violation was any human act (intentional or unintentional) that could cause disturbance to the birds nesting inside resource protection areas. A violation was considered deliberate when the violation resulted in the destruction or damage of resource property (signs, sign poles or string) delineating a closure, or damage to eggs or chicks was documented. Examples of violations include pedestrians walking through the closure, ORVs running over resource protection signs, dogs off leash inside a resource closure, and kite-boarders/surfers landing inside the closure.

Closure Intrusions

Closure Intrusions were violations of resource closures that did not involve damage to resource property or damage to eggs or chicks. Intrusions were reported by resource field staff when footprints, tracks, or people were observed inside of the resource protection closures. Most intrusions were not witnessed. The total number of recorded intrusions is conservative as colony sites were not continuously monitored by staff and wind can obscure or reduce the likelihood of finding tracks. The number of intrusions documented for CWB colony closures are presented below (Table 4).

Table 4. CWB Closure Intrusions Recorded by Field Staff for 2011.

District	Intrusion Type			
	Pedestrian	Dog	ORV	Other*
Bodie/Hatteras	70	9	5	2
Hatteras	66	4	0	2
Ocracoke	40	1	0	3
Total	176	14	5	7
* - includes boats, horses, etc.				

Deliberate Violations

Those violations that result in the destruction of resource protection signs and/or string and flagging and/or the loss of nests or chicks are considered deliberate violations. The CD defined a confirmed deliberate violation as “an act that disturbs or harasses wildlife or vandalizes fencing, nests, or plants”. Deliberate violations of the established pre-nesting areas and buffers, as determined by NPS staff, were required to be automatically expanded by 50 meters. The second and third deliberate violations required an automatic expansion of 100 and 500 meters, respectively.

In 2011, there were two deliberate ORV violations involving closures in which CWB nested. The first deliberate violation occurred on July 16, 2011 at the closure 0.4 mi south of Ramp 4. ORV tracks entered the main closure for approximately 50 meters, breaking closure string, and then exited in the closure. The second deliberate violation occurred on August 10, 2011 at the closure 0.2 mi north of Ramp 23. String was broken and rope was untied, however there was no resource damage. The closure violation coincided with consideration of closure removal and was therefore not expanded.

Electric Fence

For the second year in a row, an electric fence was installed on Bodie Island Spit to protect the colony (BIC01) that consistently uses this area. This colony contained the most number of nests out of all the colonies and constituted 44% of all LETE nests recorded at CAHA this year. A more detailed report of this project has been attached. (Appendix A). Other colonies are being considered for future electric fence installations in order to better protect colonies from mammalian predators.

DISCUSSION

This year an increase in total number of LETE, COTE, GBTE, and BLSK nests was observed and each species had their highest nest totals in the last five years. A number of factors may have contributed to this. First, based on the last state-wide survey in 2007, the LETE population is increasing in the state and it is a safe assumption that CAHA is the beneficiary of immigrants from other colonies in the state. Second, timely installation of closures and increased buffers may have had an influence on the number of LETE pairs, or other CWB pairs, nesting at CAHA. Third, weather events may influence when and where the birds nest in any given year. This year we again experienced no major storms during the nesting season. Fourth, predation may affect whether or not a colony returns to nest in the same location. This year in the Hatteras District, a colony (HIC03) was heavily predated by raccoon(s), forcing a majority of the colony to vacate the area and re-establish a new colony (HIC06) later in the breeding season than is typically observed. Finally, the level of effort in surveying the CWB nesting populations at CAHA has not remained the same over time. CAHA is moving away from conducting frequent CWB nest counts just for reporting purposes and is attempting to minimize disturbance to the colonies while still maintaining a close eye on the colonies from afar. Although higher nesting numbers may have been attained by more frequent walk-throughs as in years previous to 2010, the potential negative impacts to the colony are too great and CAHA has decided to continue with a single walk-through per season except for in study areas such as the Temporary Electric Fence Project at Bodie Island Spit.

APPENDICES

APPENDIX A:

Temporary Electric Fence at Bodie Island Spit to Protect Nesting CWB

APPENDIX B: MAPS

Map 1: Bodie Island & Green Island Colonial Waterbird Colonies 2011

Map 2: Bodie Hatteras Colonial Waterbird Colonies 2011

Map 3: North Hatteras Colonial Waterbird Colonies 2011

Map 4: South Hatteras Colonial Waterbird Colonies 2011

Map 5: Ocracoke Hatteras Colonial Waterbird Colonies 2011

APPENDIX A: Temporary Electric Fence at Bodie Island Spit to Protect Nesting CWB



INTRODUCTION

Prior to the onset of the 2011 breeding season, an electric fence was installed on Bodie Island Spit so that the breeding populations of CWB could successfully nest and fledge chicks without disturbance from mammalian predators. Predators targeted for exclusion included coyote, red fox, gray fox, raccoon, opossum and feral cat. The electric fence was used in conjunction with predator trapping and removal. Prior to 2010, the first year an electric fence was installed, nest success was extremely low and predation of this colony was extremely high.

METHODS

Location and Configuration

The CWB habitat on Bodie Island Spit in 2011 was generally in the same location as during the 2010 breeding season. The location of the electric fence was only slightly modified and installed a little farther west to include some new habitat. After colony arrival, the electric fence nearly surrounded the entire colony with the exception of some outliers that nested south of the fence.

The configuration of the fence remained the same as in 2010. The electric fence was comprised of five alternating hot/cold Hot Strand™ wires. The wire spacing begins from the bottom up 6", 6", then 8", 10", 12", making the total fence height 42". Chicken wire was laid on the ground below the wire. This was to allow for a solid ground for mammalian predators to receive the shock and will also deter mammalian predators from digging under the fence. The perimeter of the fence was 0.85 miles and the enclosed area was 0.036 square miles. The fence was in place on May 3 and remained operational through August 11, 2011 for a total of 101 days.

Fence Monitoring and Maintenance

The electric fence was monitored and maintained on a daily basis. The CWB colony was monitored from a distance which would not disturb the birds and a comparison was made between bird activity inside and outside the electric fence. This included observations of incubating birds, chick activity and breeding behavior. Predator activity was also documented.

The perimeter of the fence was walked on a daily basis and a voltmeter was used to test the strands to determine the operational status of the fence; readings were taken from various locations. Overall, maintaining the fence required a moderate effort. The most labor involved removing excess sand deposition on the chicken wire, caused by wind. Occasionally, there was debris entangled within the strands, most commonly balloons and brush of various sizes. There were two instances where a strand was broken thus not completing the circuit. The broken strands were quickly replaced.

Nest counts

Surveys of the colony were conducted on a weekly basis beginning May 12, 2011 and ending June 13, when nest surveys were stopped to avoid disturbance to chicks in the area. Nest surveys were conducted to determine the number of active nests on the ground and to see whether or not predators were having an effect on nest numbers. Surveys were done by foot both inside and outside the fence. With the aid of tongue-depressor sticks, staff was able to document the success or failure of individual nests. A single stick was placed within 12" of the nest and each nest was assigned a particular number. During surveys, the labeled nests were checked and nest

status was determined. Nest loss, egg loss/gain and chick loss/gain are all examples of variables recorded.

RESULTS

Predator/Fence Interactions

There were multiple predator interactions associated with the electric fence and the CWB colony. A total of 10 breaches occurred throughout the time the electric fence was operational (Table 1, Figure 1 and 2). A breach was defined as an instance where a predator penetrated the fence thus gaining access to the CWB colony. Entry and exit breaches were differentiated by tracks of the intruders. Three of the four coyote breaches occurred on three consecutive nights and were believed to be the same individual based on tracks. The coyote developed a strategy of jumping through the fence as opposed to trotting/walking through; decreasing the chances of a shock. This coyote was eventually captured and removed as a result of trapping efforts.

Table 1. Fence Breaches by Species.

Predator	# of Breaches
Coyote	4
Raccoon	4
Opossum	2

Figure 1. Breach Locations by Species and Exact Point of Entry.



Figure 2. Breach Locations by Species and Exact Point of Exit.



A total of ten fence contacts occurred among three different species as documented by predator tracks leading up to the electric fence (Table 2, Figure 3). A contact is defined as the predator physically coming into contact with the fence and receiving a shock, thereby deterring the predator from entering the fence and gaining access to the CWB colony. Fence contacts were also documented from inside the fence, resulting from the predator’s attempt to exit the fence once inside. A total of six contacts occurred outside the fence while four occurred inside. The educated coyote that breached the fence was also stopped five times by coming in contact with the fence and receiving a shock.

Table 2. Fence Contacts by Species and Location.

Predator	# of Contacts	Inside	Outside
Coyote	6	1	5
Raccoon	4	3	1
Opossum	0	N/A	N/A

Figure 3. Contact Locations by Species and Location (Inside/Outside).



Human Disturbance

Only one instance was documented where a direct interaction occurred with pedestrians and the electric fence. The pedestrians were inside a well-signed pre-nesting closure as well as inside the electric fence. On June 3, 2011, five sets of pedestrian tracks were documented at the northeast corner of the fence. The prints travelled a southwest course through the CWB colony and exited the fence near the Bait Pond (Figure 4). No loss of nests, eggs, or chicks was observed. It was determined that this intrusion occurred during daylight hours when the electric fence was “cold” and posed no threat to the intruders.

Figure 4. Pedestrian Violation Showing the Path of Travel.



Overwash Events

Two overwash events occurred while the electric fence was in place, neither of which caused major damage (Figure 5). Minor adjustments to the chicken wire were necessary as the water slightly altered the profile of the location. The first overwash traversed into the fence oceanside on the east side in two locations. This extreme high tide was coupled with a lunar event which caused the tidal surge to reach farther backshore. The second overwash was facilitated by high sustained winds from the southwest which pushed water inland from the Bait Pond and toward the electric fence. This second event spanned a much larger area at the southwest corner of the fence.

Figure 5. Locations of the Two Documented Overwash Events.



Nest Success

The CWB colony on Bodie Island Spit was comprised of two species; least terns (LETE) and common terns (COTE). In terms of overall nest numbers inside the electric fence, a generally increasing pattern was observed on a weekly basis (Table 3). The nest counts were on the rise during the first five surveys, with a peak count of 477 nests on the fifth survey. The nest count slightly tapered down to 436 during the sixth and final survey (6/13). All but four nests were LETE nests and they were the dominant species of this colony.

Table 3. CWB Colony Nest and Chick Progression Inside/Outside of the Electric Fence.

Survey Date	In/Out Fence	Total Nests	1-egg Nest	2-egg Nest	3-egg Nest	Total Eggs	Total Chicks
5/12/2011	Inside	42	25	17	0	59	0
	Outside	3	0	3	0	6	0
5/20/2011	Inside	210	75	130	5	350	0
	Outside	6	3	3	0	9	0
5/27/2011	Inside	243	62	176	5	429	0
	Outside	4	2	1	0	4	2
5/30/2011	Inside	349	73	266	10	635	0
	Outside	4	3	1	0	5	0
6/6/2011	Inside	477	86	379	12	880	18
	Outside	1	0	1	0	2	0
6/13/2011	Inside	436	121	304	11	608	146
	Outside	0	0	0	0	0	3

Even though there were ten predator breaches of the electric fence, documented egg loss was minimal and the colony appeared to be relatively successful (Table 4). A total of 46 LETE eggs were documented as predated, yet the overall nest count continued to rise on a weekly basis. Conversely, the nesting success outside the electric fence was very poor. Only least terns were documented nesting outside, with a maximum nest count of six. The predator activity was much more intense outside the electric fence so these nests had a higher chance of predation. During the final survey on June 13, there were zero nests documented outside the fence.

Table 4. Status of Nests Inside the Electric Fence after Predator Breaches.

Survey Date	Nest Count	# of Predator Breaches	# of Eggs Predated
5/12/2011	42	0	0
5/20/2011	210	1-Coyote (5/20)	25
5/27/2011	243	2-Coyote (5/21-22)	7
5/30/2011	349	1-Raccoon (5/28) 1-Opossum (5/30)	11
6/6/2011	477	0	3
6/13/2011	436	1-Raccoon (6/9)	0

Overall, the electric fence aided in the tremendous success of the CWB colony on Bodie Island Spit. Many nests experienced hatching success with a peak count of 146 chicks observed inside the fence during the sixth and final survey. There were a few chicks observed outside the fence, but it is believed those chicks travelled from inside the fence. During the weeks after the colony surveys ceased, there were numerous fledged LETE chicks observed both inside and outside the electric fence. Additionally, one piping plover nest was documented inside the fence. Two piping plover chicks from that nest fledged.

DISCUSSION

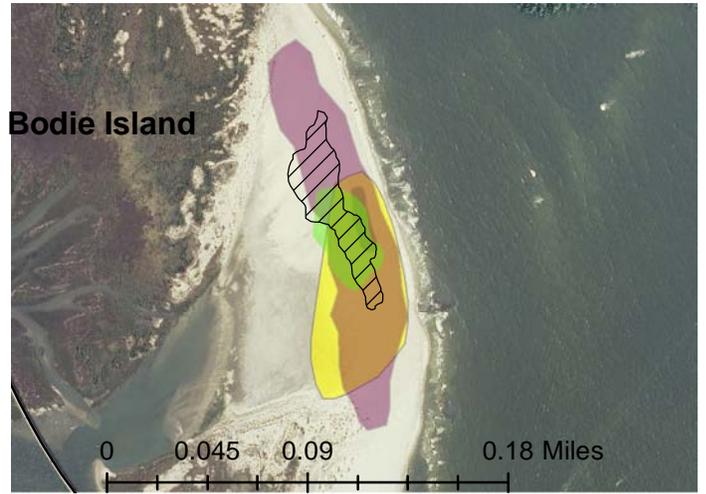
Given the multiple predator breaches, there are some changes that could be made to the fence to further deter predators from entering. Reducing the gap size between the strands by 2” would increase the chance of a shock and produce a denser strand pattern, thus making it more difficult for predators to penetrate the fence. This would decrease the overall height of the fence to 32” and create a new risk of larger predators, such as coyotes, jumping over the fence. Adding two additional strands (one hot/one cold) would restore the original height while still maintaining the dense pattern.

The CWB breeding habitat on Bodie Island Spit changed dramatically after Hurricane Irene passed through the area. Unfortunately, the flats have been replaced by a new inlet connecting the sound with the ocean creating a new island out of the southern end of the spit. Whether or not this colony returns in 2012 to the vastly changed environment remains to be seen.

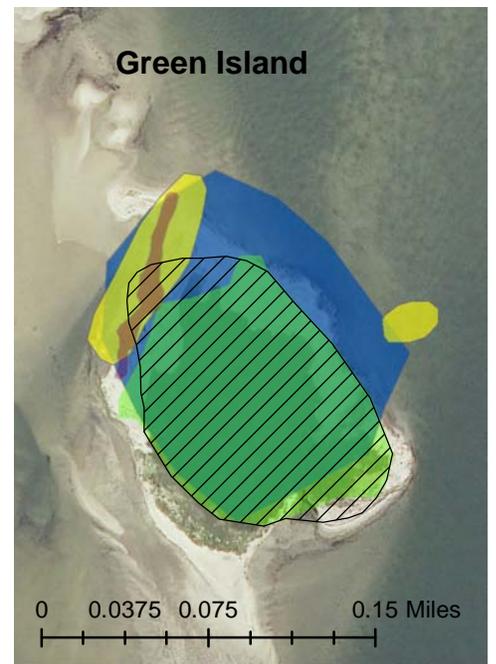
The electric fence has proven to be successful in aiding breeding success of CWB on Bodie Island Spit especially when conducted in conjunction with predator trapping. For this reason, installing electric fences on Hatteras and Ocracoke Islands where mammalian predation is an issue is recommended. Many of the CWB locations have also been impacted by Hurricane Irene, so an assessment of habitat must be performed before fence installation occurs.



Map 1: Bodie Island & Green Island Colonial Waterbirds 2011

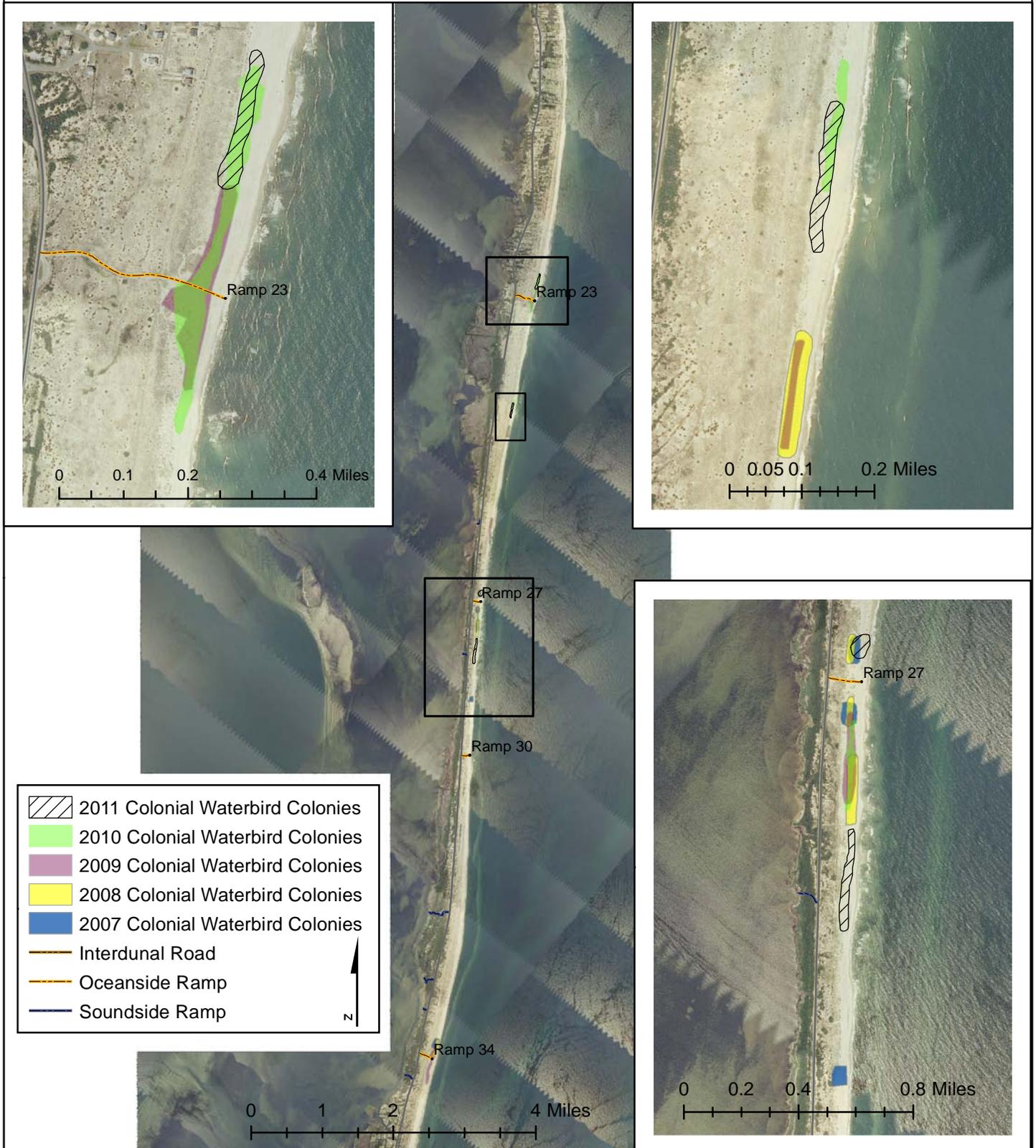


- 2011 Colonial Waterbird Colonies
- 2010 Colonial Waterbird Colonies
- 2009 Colonial Waterbird Colonies
- 2008 Colonial Waterbird Colonies
- 2007 Colonial Waterbird Colonies
- Interdunal Road
- Oceanside Ramp
- Soundside Ramp



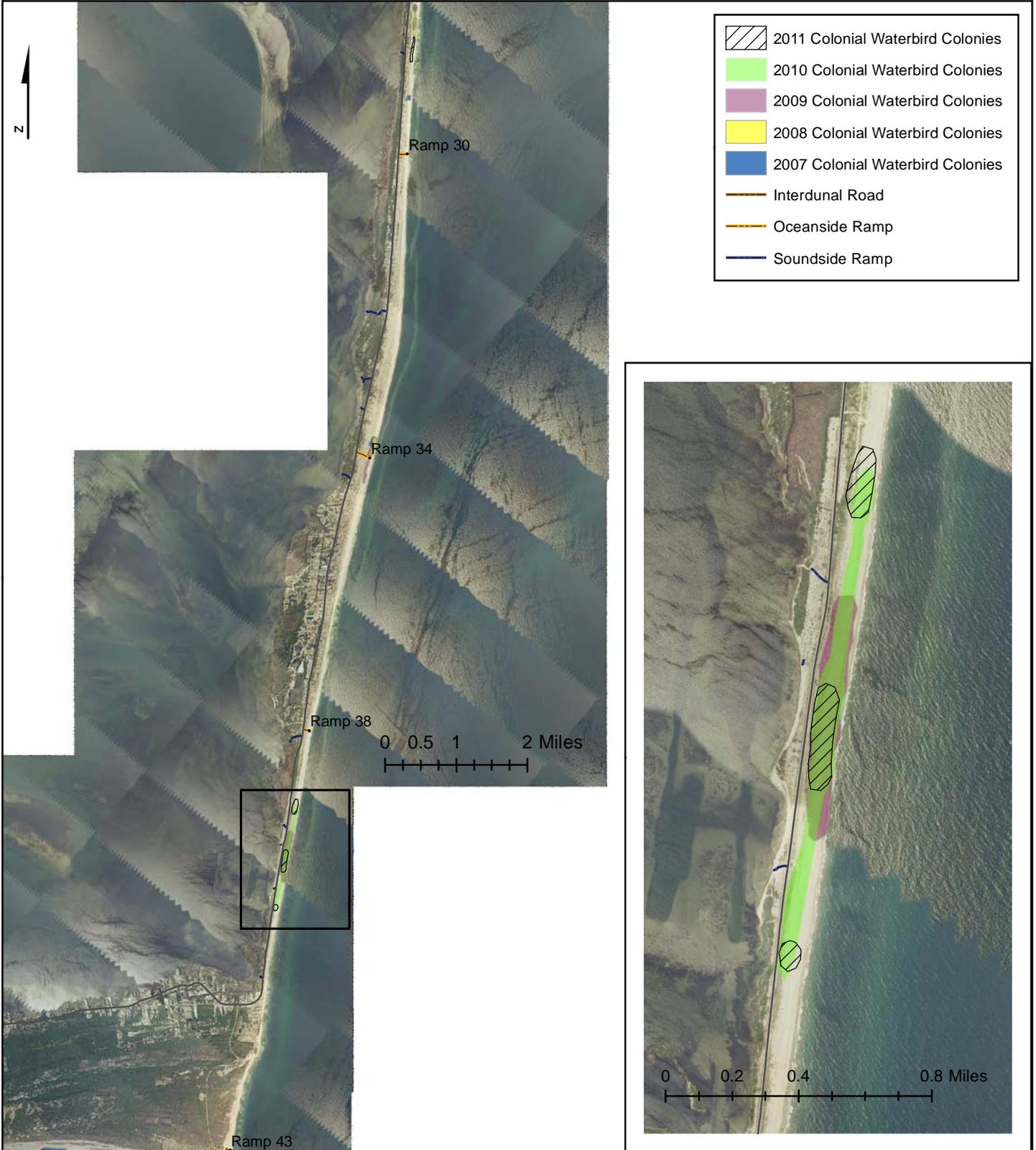


Map 2: Bodie Hatteras Colonial Waterbirds 2011



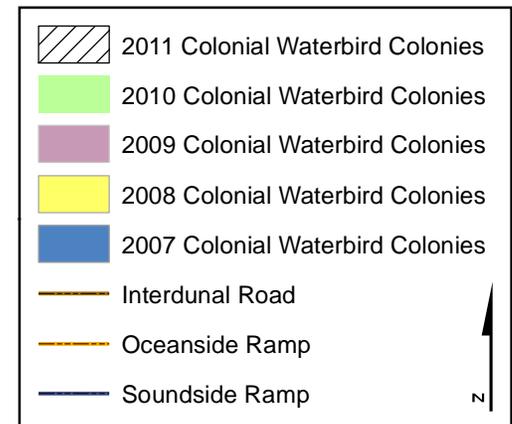
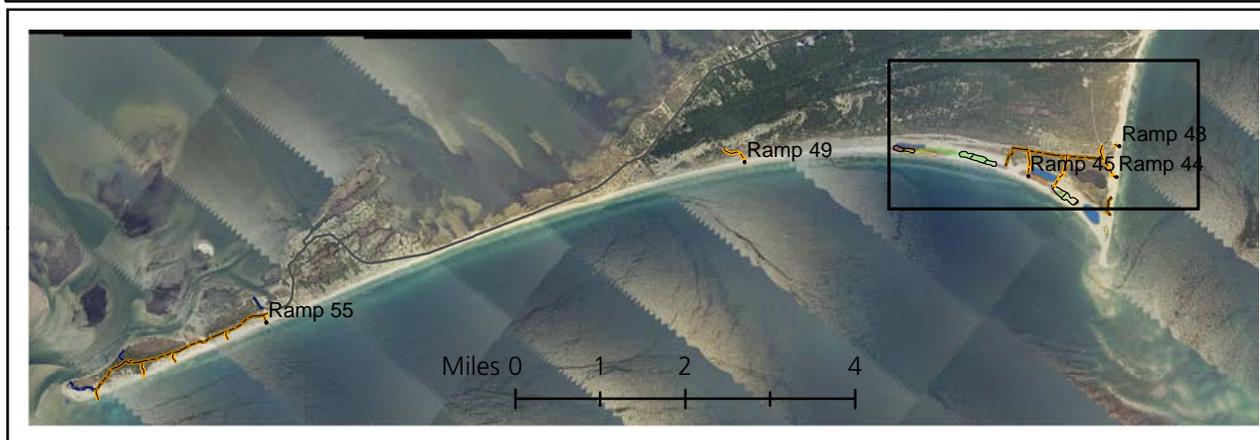
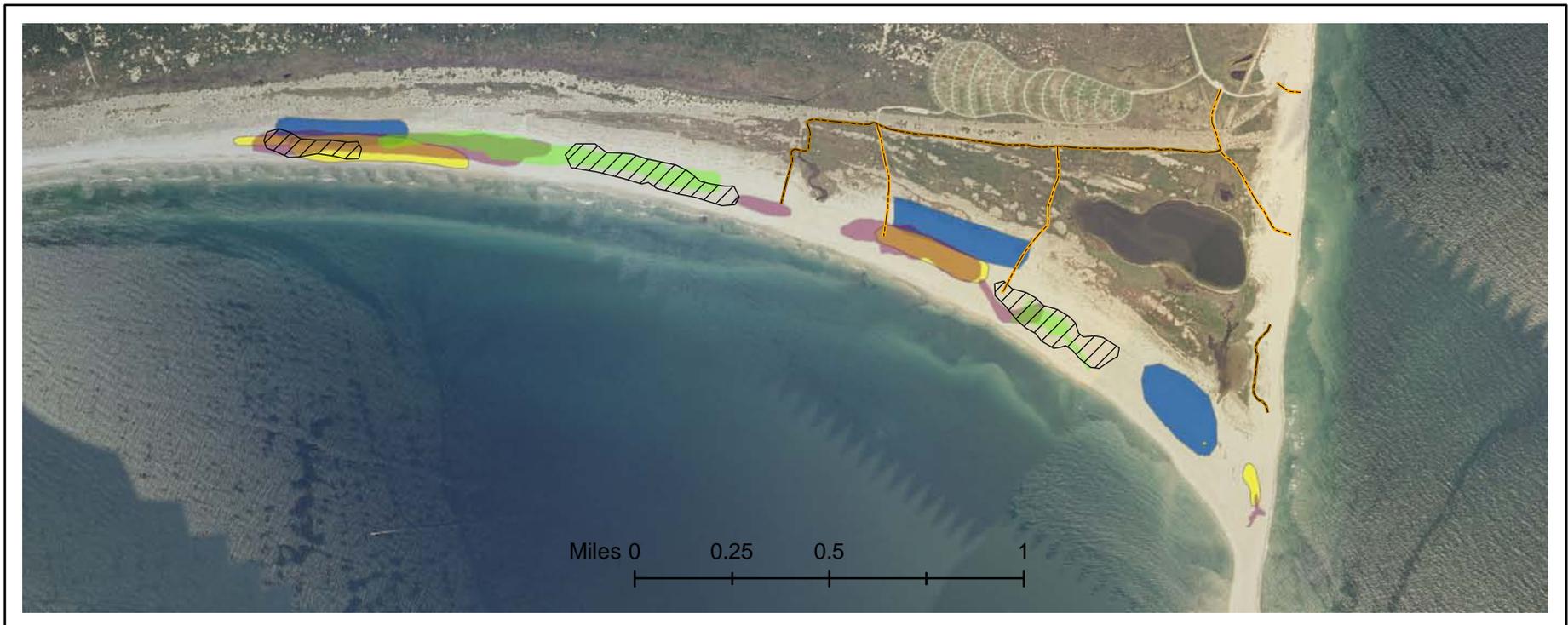


Map 3: North Hatteras Colonial Waterbirds 2011





Map 4: South Hatteras Colonial Waterbird Colonies 2011





Map 5: Ocracoke Colonial Waterbird Colonies 2011

