

**CAPE HATTERAS NATIONAL SEASHORE
COLONIAL WATERBIRD MONITORING
2012 ANNUAL REPORT**



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ABSTRACT

In 2012 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 June 3 and June 16, 2012. A total of 17 active colonies were documented in 2012. Green Island contained one colony, Bodie Island contained one colony, Hatteras Island contained twelve colonies and Ocracoke Island contained three colonies (Appendix B, Maps 1-6). The total number of nests for least terns (LETE) decreased in 2012. The total number of nests for common terns (COTE), black skimmers (BLSK), and gull-billed terns (GBTE) increased in 2012. Of these active colonies, only 11 of these colonies meet the requirements of a colony (i.e. 10 or more nests) as defined in the Cape Hatteras National Seashore Off-Road Vehicle Management Plan (ORV Management Plan). In 2012, 833 LETE nests, 218 COTE nests, 221 BLSK nests and 43 GBTE nests were documented. The largest colony occurred on Ocracoke Island consisting of 70 LETE nests, 153 COTE nests, 150 BLSK nests, and 36 GBTE nests. The largest LETE colony, 262 nests, occurred on Bodie Island Spit.

INTRODUCTION

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. 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 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. 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 period 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.

Cape Hatteras National Seashore Off-Road Vehicle Management Plan and Special Regulation

On February 15, 2012 the Cape Hatteras National Seashore Off-Road Vehicle Management Plan and Special Regulation (ORV Management Plan) was enacted. It was developed from 2007-2012 and was accompanied by a special regulation detailing requirements for off-road vehicle (ORV) use at CAHA. A copy of the ORV Management Plan and other related documents are available electronically at <http://parkplanning.nps.gov/caha>. The ORV Management Plan includes establishment of pre-nesting closures and buffer requirements for nesting birds and chicks as well as the requirement for an ORV permit to drive on CAHA beaches. It states that “Concentrations of more than 10 CWB nests in more than one of the past five years and new habitat that is particularly suitable for shorebird nesting...will be posted as pre-nesting closures...by Apr 15”. This was the first year the ORV Management Plan guided the management of protected species at CAHA.

METHODS

Closure

In addition to the pre-nesting closures established for piping plovers (PIPL) and American oystercatchers (AMOY), pre-nesting closures for CWB were installed by April 15, 2012 in areas where the habitat was suitable for nesting and where nesting had occurred in more than one of the past five years (Appendix B, Maps 1-6). This included areas where pre-nesting closures had not been established for PIPLs and/or AMOYs earlier in the breeding season. As per the Final ORV Management Plan, LETE buffers were 100 meters for breeding behavior, scrapes and nests and 200 meters for unfledged chicks. Other protected CWB species received 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 applied.

Table 1. CWB Nesting and Chick Buffers.

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

Monitoring

Monitoring of CWB at CAHA focused on identifying nesting habitat, protecting nesting areas and chicks, and monitoring colony activity. Technicians were responsible for locating areas where active colonies were forming. This involved observing CWB for courtship, copulation, and scraping behaviors. Colony establishment began when scraping behavior or physical scrapes were observed and a closure (with applicable buffers) was installed around the area. 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. Efforts were made to minimize entry into colonies to minimize colony disturbance.

One walk-through survey was performed for each colony during estimated peak nesting which for CAHA is usually around the first week of June. Some colonies may be surveyed earlier than this

if chicks have been observed in the colony and the colony was established early in the season. The distance from the outer most nests/chicks to the closure boundary were checked during observation periods to ensure all nests or chicks were within the required buffer.

Predator Control

Because mammalian predation can greatly affect colony success, predator control was conducted near established colonies. Traps were installed in the vicinity of the closure(s) with the intent of targeting specific predators. When field staff 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.

In an experimental project to control canid, raccoon, opossum and feral cat predation on nests and chicks at the Bodie Island Spit colony (BIC01) and one of the Hatteras Island colonies (HIC04), electric fences were installed as a deterrent. The electric fences were used (in conjunction with trapping) to deter predators from entering the colonies. The fences were removed after all the chicks in the colony had fledged. (Appendix A)

RESULTS

Scrape/Nest Observations and Counts

To minimize disturbance to the colonies, only one nest count was conducted during the peak nesting period. In 2012 the walk through surveys (with some exceptions) were conducted between June 3 and June 16, 2012. Transportation to the Green Island colony (GIC01) was sporadic in 2012 due to weather and boat availability. The first complete survey on Green Island was conducted on June 27. Even though the surveys were conducted in late June, totals should reflect peak nesting for COTE and BLSK since they are typically late nesters at CAHA. One colony on Hatteras (HIC01) was surveyed twice due to the later nesting patterns of COTE, BLSK, and GBTE, one colony on Ocracoke (OIC01) was surveyed early because of early colony establishment, another colony on Ocracoke (OIC02) was surveyed on June 17 due to inclement weather on June 16 and the third colony on Ocracoke (OIC03) was discovered and surveyed on June 24. Peak nest counts for each colony are presented below (Table 2).

Table 2. Peak Nest Counts at CAHA for 2012.

| 2012 CWB Nests/Chicks | | | | | | |
|-----------------------|--------------------|-------------|---------------|--------------|--------------|-------------|
| Location | Colony Name | Survey Date | LETE | COTE | BLSK | GBTE |
| Green Island | GIC01 ¹ | 6/27/2012 | | 34/0 | 32/0 | |
| Bodie Island | BIC01 | 6/13/2012 | 262/8 | 23/0 | 6/0 | 1/0 |
| Hatteras Island | BHC01 | 6/8/2012 | 107/4 | | | |
| | BHC02/BHC03 | 6/5/2012 | 25/0 | | | |
| | BHC04 | 6/5/2012 | 23/0 | | | |
| | BHC05 | 6/5/2012 | 39/0 | | | |
| | BHC06 | 6/7/2012 | 1/0 | | | |
| | HIC01 ¹ | 5/31/2012 | 219/1 | | | |
| | HIC01 ¹ | 6/28/2012 | N/A | 2/0 | 6/0 | 6/0 |
| | HIC02a | 6/6/2012 | 13/0 | | | |
| | HIC02b | 6/7/2012 | 3/0 | | | |
| | HIC03 | 6/8/2012 | 0/0 | | | |
| | HIC04 | 6/5/2012 | 54/1 | | | |
| | HIC05 | 6/7/2012 | 0/0 | | | |
| HIC06 | 6/5/2012 | 0/0 | | | | |
| Ocracoke Island | OIC01 | 5/28/2012 | 70/0 | 153/0 | 150/0 | 36/0 |
| | OIC02 ¹ | 6/17/2012 | 16/2 | 6/0 | 27/0 | |
| | OIC03 ¹ | 6/24/2012 | 1/0 | | | |
| Total | | | 833/16 | 218/0 | 221/0 | 43/0 |

¹Survey conducted outside of recommended survey window.

Four LETE colonies were established and abandoned before the walk-through survey dates.

- Colony BHC03 on Hatteras Island was active (scrapes only) from May 11 – June 2. The colony was abandoned on June 4 and no breeding activity was observed during the survey on June 5, 2012. LETEs were not observed in this area for the remainder of the breeding season. Although this colony was considered an active colony because of observed breeding behavior it is not considered a nesting colony.
- Colony HIC03 on Hatteras Island was active with scraping, one nest and birds in incubating posture from May 7 – May 27. The colony was abandoned on May 28 and no LETE were observed in this area for the remainder of the breeding season. Several raccoon tracks were observed in the area during the survey on June 8, 2012.
- Colony HIC05 on Hatteras Island was active (scrapes only) from April 29 – May 7. The colony was abandoned on May 8 and no LETE were observed in this area for the remainder of the breeding season. No breeding activity was observed during the survey on June 7. Although this colony was considered an active colony because of observed breeding behavior it is not considered a nesting colony.

- Colony HIC06 on Hatteras Island was active with scrapes and one one-egg nest from May 14 – May 18. The colony was abandoned on May 19 and no LETE were observed in this area for the remainder of the breeding season. No breeding activity was observed during the survey on June 5. Although this colony was considered an active colony because of the scrapes and one-egg nest it is not considered a nesting colony.

The total number of nests for COTE, GBTE, and BLSK increased in 2012 and were the highest totals for all species within the last five years (Table 3). The total number of nests for LETE declined slightly in 2012 primarily the result of a smaller colony being documented on Bodie Island Spit. The area where the large colony had been documented in previous years was heavily scoured during Hurricane Irene. Although the new ocean to sound channel that had formed eventually filled in, the elevation was lowered in the area making it more prone to overwash.

Table 3. CWB Nest Count Comparisons from 2007 to 2012.

| Year | LETE | COTE | BLSK | GBTE |
|--|-----------------------|-------------|-------------|-------------|
| 2007 | 194 | 109 | 11 | 0 |
| 2008 | 232 | 19 | 4 | 0 |
| 2009 | 577 | 53 | 61 | 0 |
| 2010 | 381(118) ¹ | 21(1) | 12 | 1 |
| 2011 | 1063 (44) | 112 | 99 | 15 |
| 2012 | 832 (16) | 218 | 221 | 43 |
| ¹ Totals in () represent documented chicks | | | | |

Productivity

Productivity in unmarked CWB colonies is very difficult to determine. While it is certain many colonies fledged chicks, there are no definitive numbers for CWB productivity at CAHA. Of the 17 documented colonies, LETE fledglings were observed in nine colonies, COTE fledglings were observed in four colonies, BLSK fledglings were observed in three colonies and GBTE fledglings were observed in two colonies.

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 17 colonies, predation of eggs and/or chicks was documented. Predators included ghost crabs, avian predators, raccoon, mink, feral cat and coyote. Nests laid closer to the water were more subject to overwash than nests laid higher on the beach. Some nesting areas, especially those on the spits, were more prone to overwash in 2012 as Hurricane Irene scoured many of these areas in 2011.

Human Disturbance

Human disturbance, direct or indirect, can lead to the abandonment of nests or loss of chicks. Throughout the season, field staff documented 84 pedestrian, three ORV, and 15 dog, boat or horse intrusions in closures with CWBs. The numbers are conservative since sites are not

monitored continuously, weather erases tracks, and field staff did not disturb an incubating pair or young in order to document disturbance. These numbers indicate violations to closures specifically containing nesting CWBs or habitat protected for CWBs. It is important to note that most of the closures contained multiple species, including CWB, American oystercatchers, and piping plovers. Most illegal entries were not witnessed, but documented based on vehicle, pedestrian, or dog tracks left in the sand. Pedestrian entry most often required visitors to lift or stoop under the string that connected all posted signs, while vehicular entry required visitors to drive through or around a sign boundary. Visitors' unleashed dogs are also a threat to protected species and continue to be a problem.

Electric Fence

For the third year in a row, an electric fence was installed on Bodie Island Spit to protect the mixed colony (BIC01) that occupies this area. This colony gets frequently depredated and the electric fence, used in conjunction with trapping, has helped deter predation and is resulting in some productivity from this colony. This was the first year an electric fence was installed on Hatteras Island at Ramp 34 to protect a LETE colony (HIC04). A more detailed report of this project has been attached (Appendix A).

DISCUSSION

This year an increase in total numbers of 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, installation of pre-nest closures and maintenance of appropriate buffers may have had an influence on the number of CWB pairs nesting at CAHA. Second, weather events may influence when and where the birds nest in any given year. This year no major storms occurred during the nesting season. Predation may also affect whether or not a colony returns to nest in the same location from one year to the next. Finally, experienced field staff has resulted in the early detection and protection of newly forming colonies and has aided in the minimization of disturbance to the colonies.

The majority of the colonies, other than those found at the spits and Green Island, are single species colonies. The spits and Green Island are where recovery of black skimmers, common terns and gull-billed terns can be attained. Unfortunately, the colony that had nested at Hatteras Inlet has disappeared. The old colony location has eroded and is no longer available for nesting. However, this was the first year since 2006, black skimmers and common terns were documented nesting at Cape Point. One gull-billed tern pair had attempted to nest in 2010 and prior to that they had only been documented at Cape Point in 2004.

In previous years, in an attempt to get more accurate nest counts, more frequent walk-throughs were conducted through the colonies with nesting birds. Colony boundaries were delineated in the annual report maps utilizing the outermost nests of the nesting colonies. In 2012 the method for delineating colony boundaries had to be modified as only one official walk-through was conducted for each colony and some colonies were not active at the time of the official walk through. In order to provide a more accurate representation of active colony locations, scrapes, nests and heads-up digitizing was used to delineate active colony boundaries for the annual report in 2012.

For the purpose of this and future annual reports, the different colony types will be defined as follows:

Active colony – a colony where birds are exhibiting breeding behavior and requiring protection under the ORV Management Plan. If a pre-nesting closure is not already present, a closure with appropriate buffers will be established.

Nesting colony - a colony where nesting has been documented or inferred through birds in incubating posture. Two or more nests (or birds in incubating posture) less than 200 meters apart are required to be considered a nesting colony.

ORV Management Plan colony – a colony consisting of ten or more nests (or birds in incubating posture) less than 200 meters apart. These colonies will be utilized for determining pre-nesting closures in future years.

Under these definitions, CAHA documented 17 active colonies, 12 nesting colonies and 11 ORV Management Colonies in 2012 (Table 4).

Table 4. Total Colonies by Colony Type.

| Location | Name | Colony Type | | |
|-----------------|-------------|---------------|----------------|----------------------------|
| | | Active Colony | Nesting colony | ORV Management Plan Colony |
| Green Island | GIC01 | Yes | Yes | Yes |
| Bodie Island | BIC01 | Yes | Yes | Yes |
| Hatteras Island | BHC01 | Yes | Yes | Yes |
| | BHC02/BHC03 | Yes | Yes | Yes |
| | BHC04 | Yes | Yes | Yes |
| | BHC05 | Yes | Yes | Yes |
| | BHC06 | Yes | No | No |
| | HIC01 | Yes | Yes | Yes |
| | HIC02a | Yes | Yes | Yes |
| | HIC02b | Yes | Yes | No |
| | HIC03 | Yes | No | No |
| | HIC04 | Yes | Yes | Yes |
| | HIC05 | Yes | No | No |
| Ocracoke Island | HIC06 | Yes | No | No |
| | OIC01 | Yes | Yes | Yes |
| | OIC02 | Yes | Yes | Yes |
| | OIC03 | Yes | No | No |
| Total Colonies | | 17 | 12 | 11 |

In an effort to continue to refine our CWB nest counts, in the future CAHA may attempt to conduct a minimum of two nest abundance surveys during the first two weeks of June. The highest count would be reported as the nesting peak. Resource management staff will make more of a concerted effort to quantify birds documented in incubating posture as an alternative to conducting more frequent walk-through counts. Although we are losing some accuracy by not conducting more frequent walk-throughs, the nesting birds will benefit from less overall disturbance to the colony.

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 2007 - 2012

Map 2: Bodie Hatteras Colonial Waterbird Colonies 2007 - 2012

Map 3: North Hatteras Colonial Waterbird Colonies 2007 - 2012

Map 4: Southeast Hatteras Colonial Waterbird Colonies 2007 - 2012

Map 5: North Ocracoke Colonial Waterbird Colonies 2007 - 2012

Map 6: South Ocracoke Colonial Waterbird Colonies 2007 - 2012

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

INTRODUCTION

Prior to the onset of the 2012 breeding season, an electric fence was installed on Bodie Island Spit and in one location on Hatteras Island 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 on Bodie Island Spit, nest success was extremely low and predation of this colony was extremely high.

METHODS

Configuration

The electric fence runs off of a solar panel and battery that charges an energizer. The energizer charges the electric wire (three hot, two cold) to deter predators from entering the enclosed area. The electric fence is comprised of five alternating hot/cold Hot Strand™ wires. The initial wire spacing from the bottom up was 4", 6", 6", 8", 10", making the total fence height 34". Chicken wire is buried just under the surface of the sand below the wire to provide a ground. The chicken wire is held in place with anchoring pins, sand and the fiberglass posts used to support the electric wire. On Bodie Island the configuration was changed to 6", 6", 6", 8", 10", due to large amounts of sand and eel grass deposition around the bottom strand; giving a new total height of 36". The electric fence is only turned on at night (by an automatic timer) when the possibility for predation is highest.

On Bodie Island the perimeter of the fence was 0.5 miles and the area encompassed was 0.015 square miles. The fence was in place and operational on April 3 and remained operational through August 15, 2012. On Hatteras Island the perimeter of the fence was ~0.3 miles and the area encompassed was 0.005 square miles. The fence was in place and operational on May 15 and remained operational through August 8, 2012.

Location

In the aftermath of Hurricane Irene in August 2011, the appearance of Bodie Spit changed drastically. A new inlet was formed, and crucial bird nesting habitat was lost. In time, however, the undisturbed areas of backshore sand eventually transitioned into ideal nesting habitat comprised of small dunelets and shellbeds. Unlike in previous years, the location of the electric fence mostly encompassed the northern end of the "flats" and surrounded all potential higher elevation, breeding habitat.

The second electric fence location on Hatteras Island at Ramp 34 has sporadically been a least tern colony site, with a colony forming in some years and not in others. The area appeared suitable for nesting during the 2012 breeding season. The fence encompassed shellbeds and the backshore area of the beach.

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, bird breeding behavior and predator activity.

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 significant time and effort. There were several times that the energizers malfunctioned and the fences were not operational. At Bodie Island there were several instances of overwash on the ocean side of the fence causing the chicken wire to roll into knots and eventually dragged down the fiberglass rods. Two months after initial installation, the chicken wire at Bodie Spit was removed completely when maintenance of it was determined to no longer be practical. Most of the mammalian predators were entering through the wires and not attempting to dig under them. At both locations occasional debris would entangle within the strands, most commonly balloons and brush of varying size.

Nest counts

One walk-through survey was performed for each colony during estimated peak nesting which for CAHA is usually around the first week of June. Nest counts were conducted from June 3 through June 16 in 2012. Surveys were conducted both inside and outside the electric fences for each colony. The Bodie Island colony (BIC01) was surveyed on June 13 and the Hatteras Island colony (HIC04) was surveyed on June 5.

RESULTS

Predator/Fence Interactions

There were multiple predator interactions associated with the electric fence and the CWB colony. A total of 15 breaches and nine contacts were documented throughout the time the electric fences were operational (Table 1). 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. 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.

Table 1. Fence Breaches and Contacts by Species.

| Location | Predator | # of Breaches | # Contacts |
|---------------------------|----------|---------------|------------|
| Bodie Island Spit (BIC01) | Coyote | 0 | 1 |
| | Opossum | 0 | 2 |
| | Red Fox | 8 | 5 |
| | Mink | 1 | 0 |
| Hatteras Island (HIC04) | Coyote | 0 | 0 |
| | Opossum | 4 | 0 |
| | Red Fox | 0 | 0 |
| | Mink | 0 | 0 |
| | Cat | 1 | 0 |
| | Dog | 1 | 0 |
| | Deer | 0 | 1 |

Nest Counts

The CWB colony on Bodie Island Spit was comprised of four species; least terns (LETE), common terns (COTE), black skimmers (BLSK) and gull-billed terns (GBTE). The Hatteras Island colony was comprised solely of LETE. (Table 2)

Table 2. Nest counts by species inside and outside of the electric fence

| | Species | Nests (inside) | Nests (outside) |
|---------------------------|---------|----------------|-----------------|
| Bodie Island Spit (BIC01) | LETE | 65 | 197 |
| | COTE | 0 | 23 |
| | BLSK | 0 | 6 |
| | GBTE | 0 | 1 |
| Hatteras Island (HIC04) | LETE | 24 | 30 |

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.

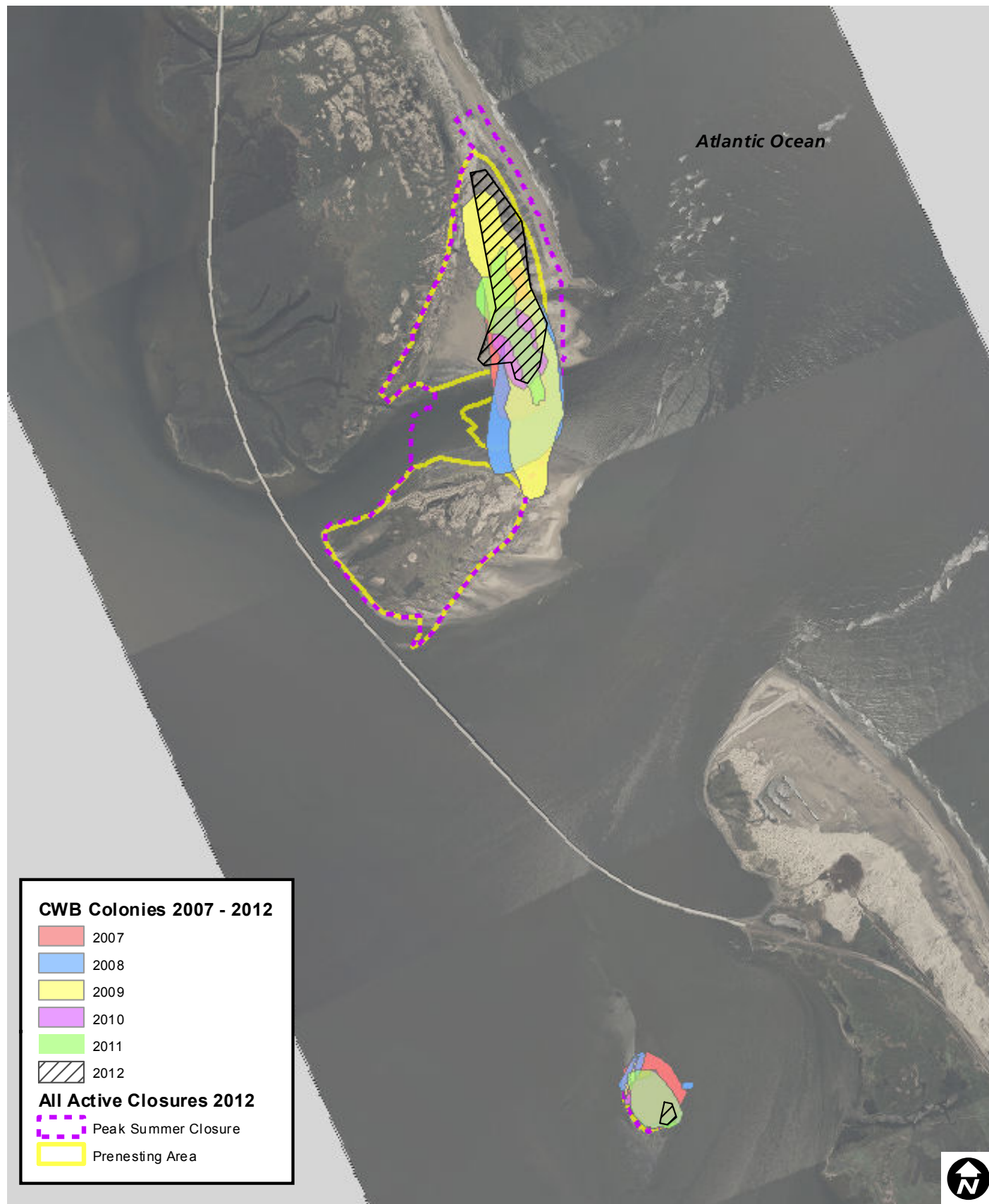
Whether or not we will continue the use an electric fence at Ramp 34 remains to be determined. There have been colonies to the north as well as to the south of the ramp in previous years and determining the best placement of the electric fence prior to the arrival of the colony was difficult.

The fence was placed on the upper beach seaward of the duneettes and vegetation to the south of the ramp. Although some birds were protected by the electric fence many chose to nest outside the fence and in the duneettes where fence placement is not practical. There was successful nesting both inside and outside of the fence. There were a number of times throughout the season when the fence was not operational. Given that chicks hatched both within and outside the electric fence, predation in this area may not be as much of an issue as anticipated. It may be more cost effective to trap out mammalian predators on an as needed basis than to install and maintain an electric fence on a daily basis during the busy summer months.

If we hope to maintain an active colony on Bodie Spit, an electric fence (in conjunction with actively trapping the area) seems to be our only option. By eliminating the chicken wire, time involved maintaining the fence will be reduced. The contour of the area changed significantly after the area was scoured by Hurricane Irene in 2011. Although the fence was placed in the areas of higher elevation, the fence was still overwashed a number of times. Many nests were washed out during these events as well. In time, the area should build up again and a large productive colony will hopefully return to the area.

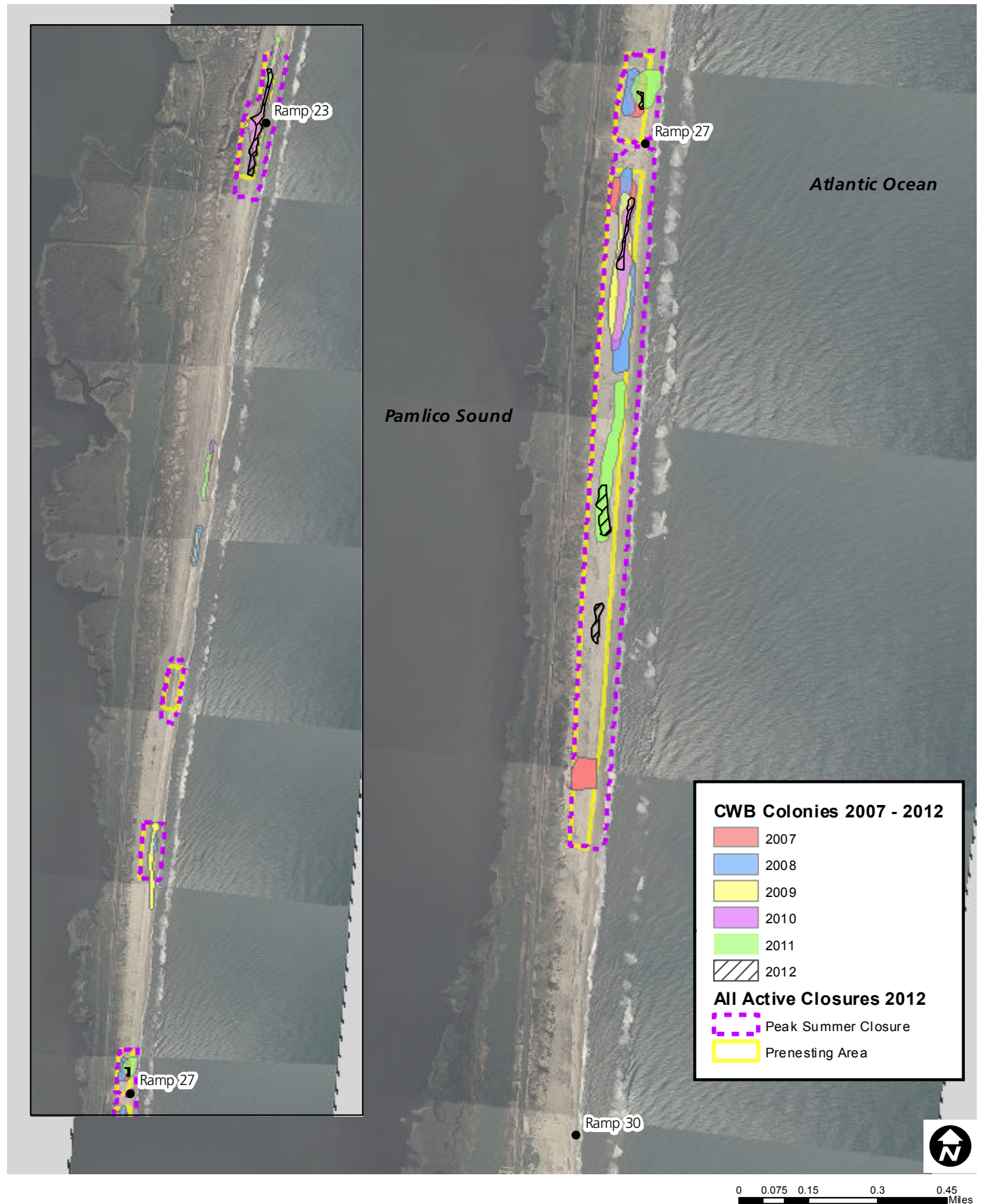


Map 1: Bodie Island & Green Island CWB Colonies, 2007 - 2012





Map 2: Bodie Hatteras CWB Colonies, 2007 - 2012



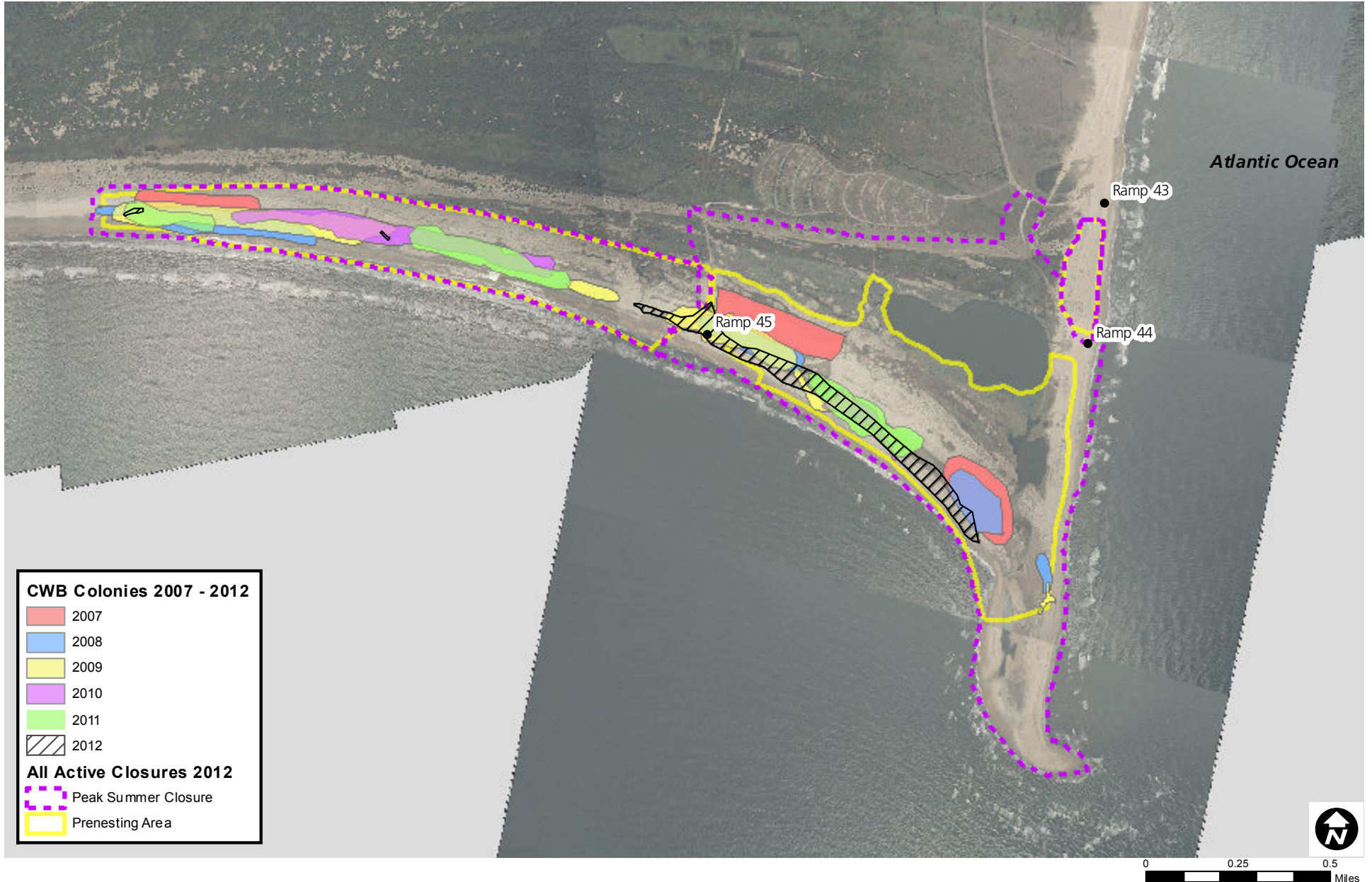


Map 3: North Hatteras CWB Colonies, 2007 - 2012



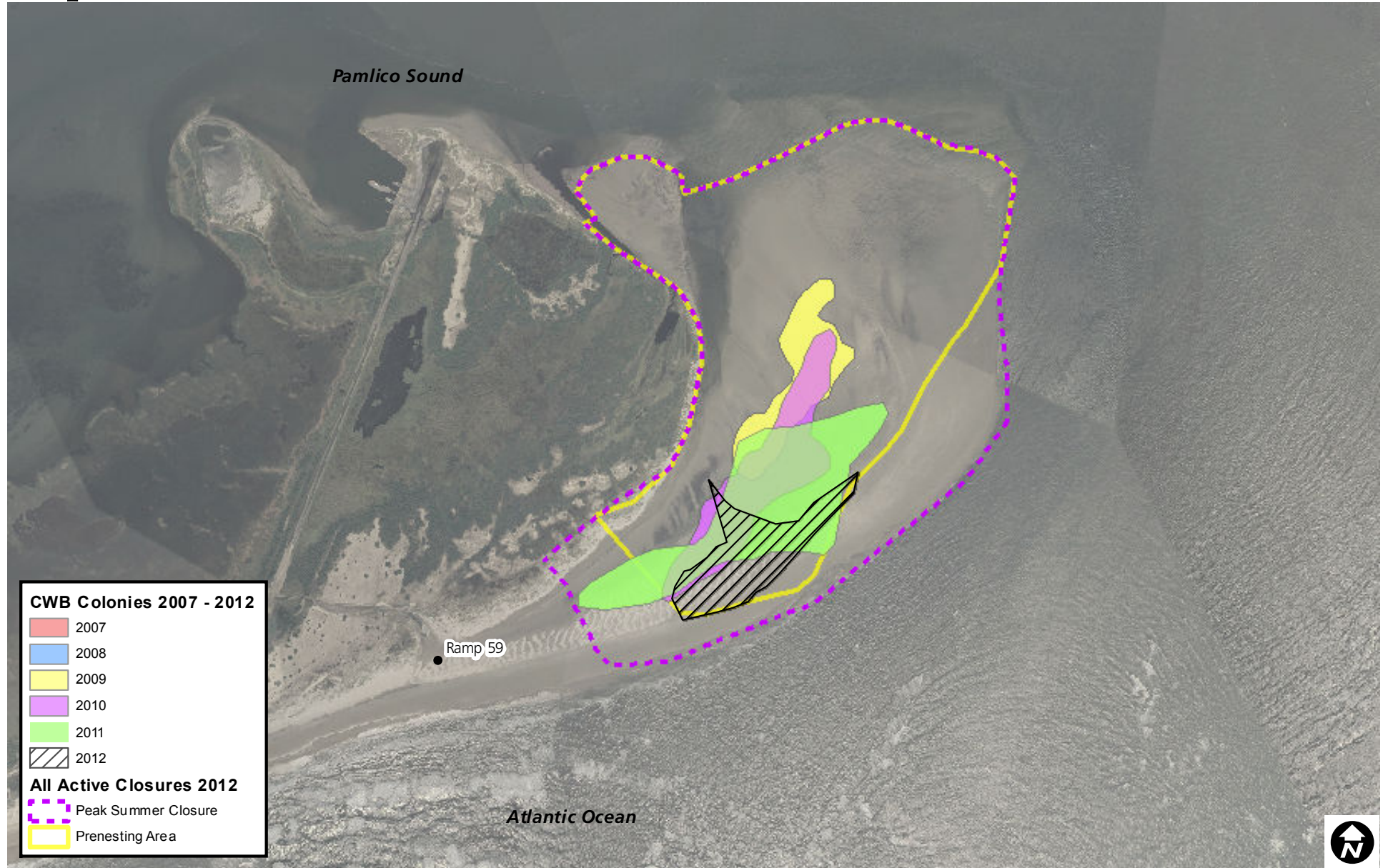


Map 4: Southeast Hatteras CWB Colonies, 2007 - 2012





Map 5: North Ocracoke CWB Colonies, 2007 - 2012





Map 6: South Ocracoke CWB Colonies, 2007 - 2012

