

**CAPE HATTERAS NATIONAL SEASHORE  
AMERICAN OYSTERCATCHER (*HAEMATOPUS PALLIATUS*) MONITORING  
2012 ANNUAL REPORT**



National Park Service  
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## **ABSTRACT**

In 2012, 22 pairs of American oystercatcher (AMOY) nested at Cape Hatteras National Seashore (CAHA). Nests, including re-nests by pairs with failed attempts, totaled 30. Of these nests, 18 hatched and produced chicks, for a total of 40 chicks. Eleven pairs of AMOY were successful in fledging chicks. There were 15 fledged AMOY chicks, which represents a 0.68 fledge rate per pair. The 2012 breeding season was the first breeding season that CAHA was managing under the requirements of the Cape Hatteras National Seashore Off-Road Vehicle Management Plan and Special Regulation (ORV Management Plan).

## **INTRODUCTION**

The AMOY is a ground-nesting shorebird native to North Carolina. As with many shorebirds, oystercatcher numbers have been in sharp decline over the past 20 years. With only an estimated 10,000 individuals (or 3,500 breeding pairs), the AMOY has been designated Significantly Rare by the U.S. Fish and Wildlife Service (USFWS), and is a Species of Special Concern in North Carolina (but is not currently characterized as a threatened & endangered species). Habitat loss and fragmentation due to beach development has resulted in nesting attempts in marginal habitat. Nesting attempts in marginal habitat is thought to lead to an increased number of unsuccessful breeding attempts. Off-road-vehicle (ORV) use on the beach can lead to direct mortality of chicks and eggs and pedestrian disturbance can indirectly cause loss of nests or chicks. The main cause of direct mortality of chicks and eggs is believed to be mammalian predators, but studies suggest that there is also an interaction between human presence and predation events by mammalian mesopredators (McGowan 2004) (McGowan and Simons 2006).

### **ORV Management Plan**

On February 15, 2012 the ORV Management Plan was enacted at CAHA. It was developed from 2007-2012 and was accompanied by a special regulation detailing requirements for ORV use at CAHA. A copy of the ORV Management Plan and other related documents are available electronically at <http://parkplanning.nps.gov/caha>. It includes establishment of an ORV permit system to drive on CAHA beaches. It also establishes pre-nesting closures and buffer requirements for nesting birds and chicks. This was the first year the ORV Management Plan guided the management of protected species at CAHA.

## **METHODS**

CAHA employs a number of methods in the monitoring and protection of breeding AMOY. These include protection of back-shore habitat; installing pre-nesting closures for birds exhibiting territorial behavior; monitoring of breeding pairs, nests and chicks; banding of juvenile AMOY; removing predators; and adaptively moving closure boundaries to comply with the required buffers of the ORV Management Plan for nests and chicks. Chick movements were monitored closely to ensure they were adequately protected by the established buffers.

Breeding behavior is defined as territorial behavior, courtship, mating, scraping or other nest-

building activities by birds setting up in new or previously established territories. AMOY nests and scrapes received 150 meter buffers to reduce possible disturbance to courting or incubating adults. Once the nests hatched, 200 meter buffers were maintained around the chicks. Larger buffers were used if individual birds were observed to be disturbed at these distances.

### **Closures**

In addition to the pre-nesting closures for piping plovers (PIPL) that are described in the 2012 PIPL annual report, pre-nesting closures for AMOY were installed in areas where the habitat was suitable for nesting and where nesting has occurred in more than one of the past five years. As per the ORV Management Plan, AMOY required a 150-meter buffer for breeding behavior, scrapes and nests and a 200-meter buffer for unfledged chicks. When multiple species were present, the greatest applicable buffer distance was used. In 2012, all 22 AMOY breeding pairs held territories within the pre-nesting closures and 29 of 30 AMOY nesting attempts occurred inside the pre-nesting closures (Appendix A; Maps 1-6). Although a pre-nesting closure had been established at Hatteras Inlet for an established breeding pair, the habitat where it had previously nested continued to erode (i.e. old nest sites were in the inlet) and was no longer available for protection. The pre-nesting closure that was established for this pair was based on the best professional judgment of the resource management staff. The pair nested just to the west of the pre-nesting closure in sparsely vegetated habitat and was protected immediately upon discovery.

### **Monitoring**

Breeding pairs of AMOY were located by surveying potential habitat including all ocean-side beaches and sound-side beaches. The presence of birds that are observed near the same location on a regular basis, or birds giving any kind of territorial or breeding display were watched carefully for signs to determine if they were nesting. If nests or scrapes were found, observers marked the location with a handheld GPS unit. Closures were installed (or modified) as necessary to maintain the required buffer distance(s).

Incubating pairs with nests were monitored daily and observed even more closely near expected hatch dates. Expected hatch dates were calculated from an average nest incubation period for AMOY as 27 days from first egg laid or 24 days from last egg laid (Baicich and Harrison 1997). If an incubating bird was not observed on the nest, the nest scrape was checked for the presence of eggs and, if the eggs were missing, the area was inspected for signs of predators. A few of the nests were also monitored by trail cameras which were checked regularly for signs of predators or predation. Once chicks hatched, staff attempted to observe each chick daily barring severe weather.

### **Chick Movement**

After hatching, staff installed a minimum buffer of 200 meters around AMOY chicks. Chicks have been observed to move as much as 100 meters on the first day after hatching and up to 500 meters or more within the first week after hatching. As the chicks commenced their movement away from the nest sites, they were monitored closely. An approximate GPS point was taken for their new location and the closures were expanded when necessary to ensure adequate buffers.

The expanded closures provided a minimum buffer of 200 meters on each side of the AMOY brood but may have been larger based on the brood's documented movement patterns. This type of intensive management ensured that the flightless chick(s) were properly buffered from vehicle and pedestrian traffic.

### **Predator Control**

Because mammalian predation is a major factor in AMOY nest loss and chick mortality (McGowan 2004), predator control by trapping was conducted to target predators near nests and chicks in 2012. Trapping was conducted in all districts. When technicians walked through areas they documented and reported any signs (prints, scat, etc.) 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 that area.

### **Banding**

In addition to carrying out actions required by the ORV Management Plan, resource management staff banded AMOY chicks under NCSU's banding permit. Banding aids in tracking survival of individuals, determining breeding success of individual pairs, documenting movement of young birds to other areas, and aids in determining breeding site fidelity. Being able to identify individual birds has also allowed NCSU and CAHA staff to coordinate data with scientists from other states to examine genetics, migration patterns, and long-term survival rates of the AMOY population. Banding birds made data collection simpler and adds certainty to observations.

## **RESULTS**

In 2012 22 pairs of AMOY nested at CAHA. There were a total of 30 nests of which 18 nests hatched. The first banded breeding bird was observed on March 5, 2012 and the majority of the AMOY arrived between March 12 -25, 2012. All of the banded breeding birds had arrived by April 20. The first nest of the season was found on April 4, 2012 and the last nest was found on June 27, 2012. The average time to hatch for the 17 nests with known incubation was 30.1 days. The average time to fledge for the 11 broods that fledged was 42.9 days. The youngest chick to fledge was 39 days old and the oldest fledgling was 65 days old when flight was first observed. This average does not include separate dates for individuals within a brood but is based on the date of the first chick to fledge from all of the broods. The productivity for 2012 was 15 chicks fledged from 22 pairs for a fledge rate of 0.68 chicks per pair (Table 1).

**Table 1.** AMOY 2012 Breeding Season at CAHA.

Pair #	Nest #	Location	Date Found	Date of First Egg <sup>1</sup>	Hatch Date	Days from First Egg to Hatch	Fledge Date	Days to First Fledge	# Fledged
GIAM01	GI01	Green Island	UNK	UNK	UNK	UNK			0
GIAM01	GI02	Green Island	6/27/12	6/27/12					0
BIAM01	BI01	Bodie Island Spit	4/24/12	4/24/12					0
BIAM01	BI02	Bodie Island Spit	5/22/12	~5/20/12 (5/22/12 – 2 eggs)					0
BHAM01	BH01	R27-R30	4/18/12	4/18/12	5/17/12	30 days	6/28/12	43 days	1
BHAM02	BH02	R27-R30	4/19/12	4/19/12	5/18/12	30 days	6/30/12	44 days	1
BHAM03	BH03	R27-R30	4/21/12	~4/15/12 (4/21/12 – 3 eggs)	5/17/12	33 days			0
BHAM04	BH04	R27-R30	4/24/12	4/24/12	5/22/12	29 days	6/30/12	40 days	1
BHAM05	BH05	North of R27	5/7/12	5/7/12	6/6/12	31 days			0
BHAM03	BH06	R27-R30	6/8/12	6/8/12					0
HIAM01	HI01	Sandy Bay	4/4/12	4/4/12					0
HIAM02	HI02	South of R38	4/10/12	4/10/12	5/8/12	29 days	6/15/12	39 days	1
HIAM03	HI03	South of R55	4/11/12	4/11/12					0
HIAM04	HI04	R43-R44	4/13/12	4/13/12	5/11/12	29 days	6/20/12	41 days	2
HIAM05	HI05	Cape Point	4/17/12	4/17/12	5/16/12	30 days	6/27/12	43 days	2
HIAM06	HI06	R45-R49	4/20/12	~4/18/12 (4/20/12 – 2 eggs)	5/16/12	29 days	6/29/12	45 days	2
HIAM07	HI07	R45-R49	4/21/12	4/21/12	5/19/12	29 days			0
HIAM08	HI08	R45-R49	4/23/12	4/23/12	5/22/12	30 days			0
HIAM09	HI09	South of R38	5/2/12	5/2/12	6/2/12	32 days	7/13/12 7/17/12	42 days	2
HIAM01	HI10	Sandy Bay	5/5/12	5/5/12					0
HIAM10	HI11	Cape Point	5/9/12	~5/7/12 (5/9/12 – 2 eggs)	6/5/12	30 days	7/25/12	51 days	1
HIAM03	HI12	Hatteras Inlet	5/20/12	~5/14/12 (5/20/12 – 3 eggs)	6/15/12	33 days	7/25/12	41 days	1
HIAM01	HI13	Sandy Bay	5/24/12	5/24/12	6/21/12	29 days			0
HIAM07	HI14	R45-R49	6/6/12	6/6/12	7/3/12	28 days	9/5/12	65 days	1
OIAM01	OI01	R68-R70	4/21/12	4/21/12	5/20/12	30 days			0
OIAM02	OI02	North Ocracoke	4/28/12	~4/26/12 (4/28/12 – 2 eggs)					0
OIAM03	OI03	R59-R67	4/29/12	4/29/12					0
OIAM04	OI04	South Point	5/13/12	~5/11/12 (5/13/12 – 2 eggs)					0
OIAM05	OI05	South Point	5/22/12	5/22/12					0
OIAM02	OI06	North Ocracoke	6/13/12	~6/11/12 (6/13/12 – 2 eggs)					0
					<b>Avg.</b>	<b>30.1 days</b>	<b>Avg.</b>	<b>42.9 days</b>	

<sup>1</sup>Date of first egg was calculated based on eggs being laid every other day for nests which were discovered with two or more eggs.

### Nesting Summary by Island and Year

In 2012, CAHA documented 22 nesting pairs. Of these pairs, one pair was found on Bodie Island, 15 were found on Hatteras, five were found on Ocracoke, and one was found on Green Island (Table 2). Altogether, these pairs produced a total of 30 nests (Table 3).

**Table 2.** Breeding Pairs by Year and Island.

Year	Bodie	Hatteras	Ocracoke	Green	Total
2007	2	15	4	2	23
2008	3	15	3	2	23
2009	4	13	4	2	23 <sup>1</sup>
2010 <sup>2</sup>	1	15	4	3	23
2011	1	14	5	3	23
2012	1	15	5	1	22

<sup>1</sup>Twenty-three is a conservative interpretation of the pair numbers. One breeding adult lost its mate and re-paired with another bird and nested, but it was only counted as one pair rather than two pair.

<sup>2</sup>The 2010 breeding pairs have been corrected from the 2010 annual report.

**Table 3.** Total Nests by Year and Island.

Year	Bodie	Hatteras	Ocracoke	Green	Total
2007	2	21	10	2	35
2008	5	20	3	4	32
2009	4	19	6	2	31
2010	2	17	6	3	28
2011	1	17	5	3	26
2012	2	20	6	2	30

### Productivity

In 2012, 18 of 30 nests hatched (Table 4). There were 11 successful AMOY pairs (Table 5) which fledged 15 AMOY chicks (Table 6). Although the chicks fledged per breeding pair at CAHA appears to be cyclical, there is generally an increasing trend in productivity when looked at over multiple years (Figure 1).

**Table 4.** Nests Hatched by Year and Island.

Year	Bodie	Hatteras	Ocracoke	Green	Total
2007	1	10	3	1	15
2008	2	9	1	1	13
2009	1	11	2	1	15
2010	1	13	5	2	21
2011	1	13	5	3	22
2012	0	16	1	1	18

**Table 5.** Successful Pairs (at Least 1 Chick Fledged) by Year and Island.

Year	Bodie	Hatteras	Ocracoke	Green	Total
2007	0	6	1	1	8
2008	2	6	1	1	10
2009	1	6	0	1	8
2010	0	10	3	2	15
2011	1	9	4	3	17
2012	0	11	0	0	11

**Table 6.** Number of Chicks Fledged by Year and Island.

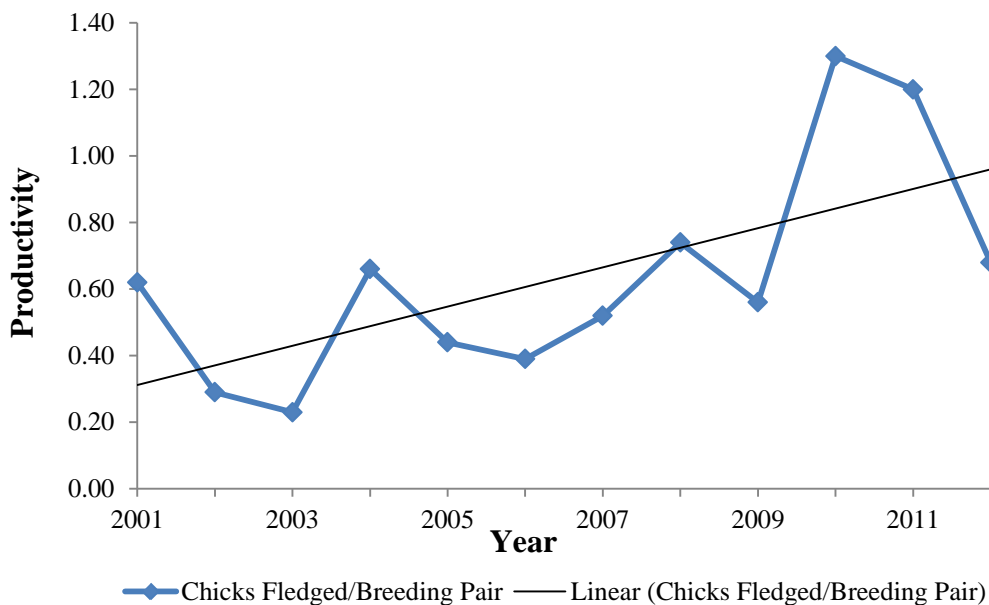
Year	Bodie	Hatteras	Ocracoke	Green	Total
2007	0	9	1 <sup>1</sup>	2	12
2008	2	11 <sup>2</sup>	2	2	17
2009	1	9	0	3	13
2010	0	23	3	4	30
2011	1	16	7	4	28
2012	0	15 <sup>3</sup>	0	0	15

<sup>1</sup> The AMOY chick that was believed fledged on Ocracoke Island in 2007 was later found dead and is no longer counted in the replacement population of AMOY.

<sup>2</sup> Of the chicks which fledged from Hatteras in 2008, one died after a car-strike post-fledge (at Sandy Bay), and another (also thought to be struck by a vehicle N of Buxton) was transferred to long-term care.

<sup>3</sup> Of the 15 chicks which fledged from Hatteras in 2012, one died of unknown causes post fledging.

**Figure 1.** Fledge Rate and Trend for AMOY Breeding at CAHA from 2001-2012.



### Nesting Season

The AMOY nesting season began on April 4, 2012 with the discovery of the first nest and ended on September 5, 2012 with the fledging of the last chick (Table 7). The first chick of the season was found on May 8. The last nest of the season was found on June 27 and the last nest to hatch, hatched on July 3.

**Table 7.** Annual AMOY Breeding Milestones.

<b>Year</b>	<b>Date First Nest Found</b>	<b>Date Last Nest Found</b>	<b>Date of Earliest Hatch</b>	<b>Date of Latest Hatch</b>	<b>Date of Latest Fledge</b>
2007	11-Apr	26-Jun	17-May	16-Jul	13-Aug
2008	22-Apr	20-Jun	21-May	6-Jul	12-Aug
2009	17-Apr	19-Jun	15-May	7-Jul	20-Aug
2010	15-Apr	21-Jun	12-May	16-Jul	23-Aug
2011	15-Apr	11-Jun	14-May	6-Jul	14-Aug
2012	4-Apr	27-Jun	8-May	3-Jul	5-Sept

### Nest Failures and Chick Mortality

Of the twelve nests that were lost in 2012, two nests were lost to storm over wash, eight nests were lost to predation, and two nests were abandoned (Table 8). Fox, ghost crab and avian predators are believed to be responsible for some of the nests lost to predation. It is sometimes difficult to attribute nest loss to the exact species if the predation is not directly observed.

**Table 8.** Nesting and Nest Loss 2007-2012.

<b>Year</b>	<b>Total Nests</b>	<b>Lost to Overwash</b>	<b>Lost to Predation</b>	<b>Abandoned</b>	<b>Number Nests Hatched</b>
2007	35	5	13	2	15
2008	32	4	11	4	13
2009	31	2	12	2	15
2010	28	1	5	1	21
2011	26	0	2	2	22
2012	30	2	8	2	18

Determining cause of chick loss is even more difficult than determining cause of nest loss. In 2012 there were seven complete brood failures and nine partial brood failures. Environmental conditions surrounding the nest site may obscure evidence of predation. Chicks can move large distances and it is sometimes difficult to locate them. Searches for missing chicks may be intentionally delayed since many different types of disturbances may cause the chicks to hide out of view from the observers.

In 2012 one loss was attributed to unknown causes and 24 chick losses were attributed to predation (Table 9). On Hatteras Island one chick (and an additional fledgling from the same



brood) was found deceased on the shoreline. The death of the chick (and fledgling) was attributed to unknown causes although the death may have been health related as weight gain was minimal and the chick was last observed on day 62 and had still not fledged. An avian predator is suspected to be responsible for four predator related mortalities and a feral cat is suspected to be responsible for an additional two mortalities.

**Table 9** Chicks Lost and Chicks Fledged.

Year	Eggs Hatched	Other <sup>1</sup>	Lost to Predation	Number Chicks Fledged
2007	27	3	12	12
2008	24	2	6	17
2009	31	0	18	13
2010	48	1	17	30
2011	49	0	21	28
2012	40	1	24	15

<sup>1</sup>Siblicide, Exposure, Human Interaction, and Unknown.

### Human Disturbance

Human disturbance, direct or indirect, can lead to the abandonment of nests or loss of chicks. Throughout the season, resource management staff documented 74 pedestrian, three ORV, and 15 dog, boat or horse intrusions in the pre-nesting closures. The numbers are conservative since sites are not monitored continuously, weather erases tracks, and staff did not disturb an incubating pair or young in order to document disturbance. These numbers indicate violations to closures specifically containing nesting AMOYs or habitat protected for AMOYs. It is important to note that most of the closures contained multiple species, including AMOY, colonial waterbirds, 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.

### Banding and Banded AMOY

As the result of a long term cooperative banding project with NCSU, CAHA has begun to document recruitment as banded chicks survive to adulthood and join the breeding population. Of the 29 banded AMOY that nested in 2012, 13 were banded as chicks and therefore their exact age is known. Eight were banded as chicks at CAHA and five were banded as chicks at Cape Lookout National Seashore. Of the 13 breeders banded as chicks, six fledged in 2004, two fledged in 2005, two fledged in 2006, two fledged in 2007 and one fledged in 2008. The remaining 16 birds were banded as adults on their breeding territories so we can assume a minimum age of three at the time of banding. By subtracting two years from the year that they were banded and assuming the minimum breeding age of three years of age, the population of banded AMOY consists of 23 birds that are 7+ years old.

In 2012, CAHA had two pairs of unbanded breeding AMOY, the same as 2011. As shown below in Table 10, pairs consisting of two unbanded birds were uncommon. Banded birds enabled staff to identify breeding pairs and unpaired individuals with confidence.

**Table 10.** Band combinations for AMOY pairs found at CAHA in 2012.

<b>Pair Type:</b>	UNB/UNB	Banded/UNB	Banded/Banded
	(1 pair, BH)	GrC0/UNB	Gr12/GrR0
	(1 pair, OI)	Gr01/UNB	Gr14/GrN7
		Gr07/UNB	Gr27/GrT4
		GrC9/UNB	Gr52/GrL9
		GrAT/UNB <sup>1</sup>	Gr57/GrH2
		GrL4/UNB	Gr76/GrX1
		GrL6/UNB	GrH3/GrAW
		Gr50/UNB	GrL5/RdC9
		Gr54/UNB	GrW3/GrX9
		Gr87/UNB	
		GrU5/UNB	
<b>Total:</b>	<b>2</b>	<b>11</b>	<b>9</b>

<sup>1</sup>GrAT (geo-locator on new band) was formerly banded as GrR6.

Five banded breeders from 2011 did not return this year resulting in some shifting of partners for paired birds. One new banded and two unbanded AMOYs were recruited into the breeding population for a total of 22 pairs in 2012.

In 2012, CAHA RM staff banded a total of 19 chicks with uniquely identifiable bands (Table 11). Due to a shortage in two character band combinations, three character bands were created for the 2012 season. Of the 19 chicks; 18 were banded with three character bands and one was banded with a FWS band but not the darvic green character bands. A total of 193 AMOY have been banded at CAHA since 2002 consisting of 48 adults and 145 chicks (Table 12).

**Table 11.** AMOY Chicks Banded at CAHA in 2012.

GrCC7	Gr52/GrL9	FWS: 1166-04167	6/19/2012
GrCC8	Gr27/GrT4	FWS: 1166-04168	6/19/2012
GrCC9	Gr01/UNB	FWS: 1166-04169	6/22/2012
GrCC0	GrL5/RdC9	FWS: 1166-04160	6/7/2012
GrCC1	GrH3/GrAW	FWS: 1166-04161	6/11/2012
GrCC2		FWS: 1166-04162	
GrCC3	Gr07/UNB	FWS: 1166-04163	6/18/2012
GrCC4		FWS: 1166-04164	
GrCC5	Gr12/GrR0	FWS: 1166-04165	6/18/2012
GrCC6		FWS: 1166-04166	
GrCAE	GrW3/GrX9	FWS: 1166-04171	7/2/2012
GrCAJ		FWS: 1166-04173	
GrCAM	GrL6/UNB	FWS: 1166-04174	7/5/2012
GrCA4	GrL4/UNB	FWS: 1166-04184	7/16/2012
GrCA5 <sup>2</sup>	GrAT/UNB	FWS: 1166-04185	7/24/2012
GrCFP <sup>1</sup>	Gr57/GrH2	FWS: 1166-04126	8/2/2012
GrCFC <sup>1</sup>		FWS: 1166-04127	8/10/2012
no character bands <sup>2</sup>		FWS: 1166-04186	8/31/2012
GrCAC <sup>2</sup>	Gr14/GrN7	FWS: 1166-04172	6/18/2012

<sup>1</sup>Two banded chicks were later found dead on the seashore.

<sup>2</sup>Three banded chicks were lost to unknown predation after banding.

**Table 12.** Banding effort at CAHA since 2002.

Year	Banded Adults	Banded Chicks	Total
2002	5	6	11
2003	1	1	2
2004	17	16	33
2005	11	10	21
2006	0	5	5
2007	5	8	13
2008	6	12	18
2009	1	10	11
2010	2	31	33
2011	0	27	27
2012	0	19	19

## DISCUSSION

Some uncommon AMOY activity was documented during the CAHA 2012 breeding season. One fledged chick was observed on Bodie Island with an AMOY breeding pair that has historically nested on Green Island. A successful nest and chick were not documented on Green Island by CAHA field staff. It is assumed that the AMOY pair successfully nested on an off-shore island or Pea Island not within CAHA boundaries so this fledged chick was not counted in CAHA fledged chick totals.

On July 27 an abandoned egg was found while conducting a seabeach amaranth survey on Hatteras Island. The single abandoned egg could not definitively be attributed to a specific pair and virtually nothing was known about it. It was not included in the nest or pair totals.

The breeding population of AMOY has been at 23 pairs for the past six breeding seasons and declined slightly to 22 pairs in the 2012 breeding season. The lack of increased pair numbers in recent years can be partly attributed to the deaths of breeding birds with recruits to the population replacing lost birds rather than increasing the number of breeding pairs.

In 2012, an adult AMOY (Gr54) from a known nesting pair on Ocracoke was critically injured. Gr54 had nested on Ocracoke since 2009 and it is suspected that it was defending its nest site when the injury occurred. Although the pair was not observed immediately after the loss of their nest, Gr54 was observed dragging one wing and unable to fly two days after the nest loss. The bird was captured and transported to a veterinary clinic. Examination and x-rays revealed that the wing was broken in two places. Due to the extent of the injuries rehabilitation was not possible and the bird was euthanized. Although the bird was injured by an unknown cause, it is suspected to be the result of mammalian predation.

Another factor influencing the lack of immediate increase of breeding pairs, even though productivity is trending upward, is the fact that juvenile AMOY may not establish territories or reproduce for three to five years, thus any productivity increases the population sees now, will not be realized as recruitment into the breeding population for at least another three to five years. During the 2012 breeding season (March to June) lone birds and pairs of birds, both unbanded and banded, unassociated with nests were observed at CAHA. The age of many of the banded birds is known and some were of age to nest in 2012, but did not, either due to their inability to find, establish and hold a territory, or inability to find a mate of breeding age. Other observed birds will first come into breeding age in 2013.

If CAHA hopes to see an increasing population of AMOY, especially close attention will need to be paid to birds with no known breeding history. Field staff needs to be adequately trained to identify breeding behaviors associated with territory establishment to allow for the immediate protection of these areas. Adequate protection from disturbance and a continuation of the predator control program should result in an increasing population of AMOY at CAHA over time.

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## **APPENDICES**

### **APPENDIX A: MAPS**

Map 1: Bodie Island and Green Island AMOY Nesting Activity 2007-2012

Map 2: Bodie/Hatteras AMOY Nesting Activity 2007-2012

Map 3: North Hatteras AMOY Nesting Activity 2007-2012

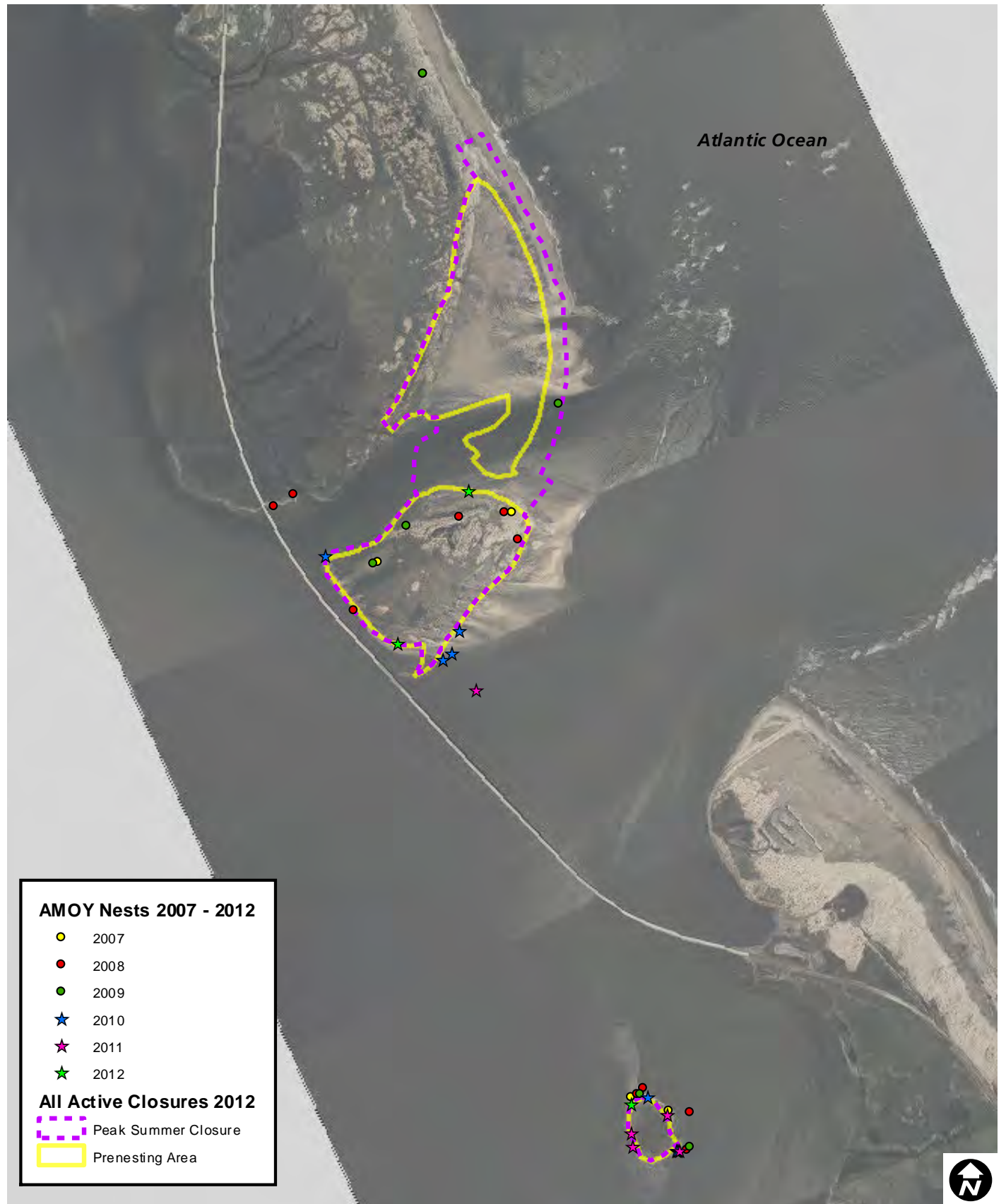
Map 4: Southeast Hatteras AMOY Nesting Activity 2007-2012

Map 5: Southwest Hatteras AMOY Nesting Activity 2007-2012

Map 6: Ocracoke Island AMOY Nesting Activity 2007-2012

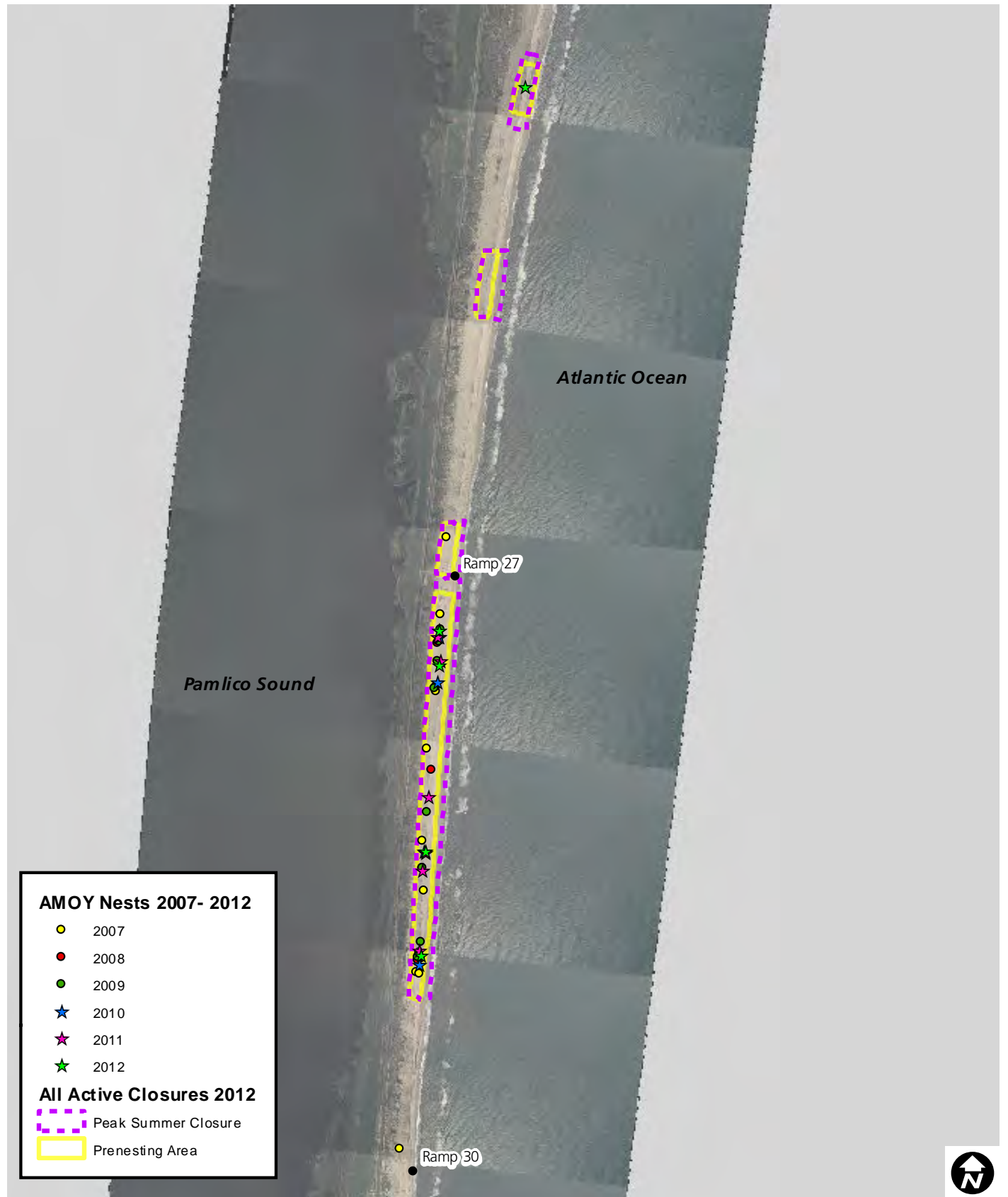


Map 1: Bodie Island & Green Island AMOY Nesting Activity, 2007 - 2012





## Map 2: Bodie Hatteras AMOY Nesting Activity, 2007 - 2012







# Map 3: North Hatteras AMOY Nesting Activity, 2007 - 2012





# Map 4: Southeast Hatteras AMOY Nesting Activity, 2007 - 2012





# Map 5: Southwest Hatteras AMOY Nesting Activity, 2007 - 2012





# Map 6: Ocracoke Island AMOY Nesting Activity, 2007 - 2012

