

Bald Head Island Conservancy Sea Turtle Protection Program 2021 Annual Report

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2021 Nesting Season Executive Summary

The 2021 sea turtle nesting season on Bald Head Island (BHI) was the third consecutive season in which above-average numbers of nests and false crawls were recorded. The Bald Head Island Conservancy's Sea Turtle Protection Team (STPT) patrolled for 169 days/nights (102 dawn and 67 night), recording BHI's first nest on 25 May and the last nest on 14 August. There were a total of 93 nests and 128 false crawls, 45 genetically unique individual nesting females were identified (we are awaiting the genetic confirmation of 8 nests) and 51 (54.8%) imperiled nests were relocated. For the first time since 2017, a green sea turtle (*Chelonia mydas*) paid a visit to the shoreline of BHI to lay our 82nd nest of the season. BHI saw the return of 8 legacy turtles - Caroline, Emily, Fluffy, Mary Jane, Sandy, Scarlett, Turquoise, and Yoda. Fluffy and Mary Jane were tagged in 1998 and 1999, respectively, meaning they have been nesting on BHI for at least 20 years. All nesting activities were performed by loggerhead (*Caretta caretta*) or green sea turtles, pending genetic confirmation. The first hatching event was observed on 25 July, while the last two nests were excavated on 20 October, with an average incubation time of 59.5 ± 4.3 days. There were an estimated 9,948 eggs laid on BHI beaches, which produced an estimated 7,433 hatchlings. Mean hatch success was 74.7%, while mean emerge success was 70.5%. For a second consecutive year, two predator exclusion cage (PEC) designs, MasterNet and welded wire, were used for nest protection. This year's PECs were part of a research project funded by North Carolina Sea Grant to determine their efficacy against mammalian depredation. There was little variation in efficacy between designs, as the MasterNet cage had a 97.2% efficacy rate, while the welded wire cage produced a 94.9% efficacy rate. In total, 6 nests were taken by coyotes (*C. latrans*), of which 4 were unprotected, 1 was covered by the MasterNet PEC design, and 1 was covered by the welded wire PEC design. No major hurricanes passed close enough to BHI to cause damage to or the loss of any sea turtle nests, although one nest was lost to Tropical Storm Elsa and a second was lost to a King Tide event. Loss to storms or tides dropped dramatically in 2021 compared to the 2020 nesting season when 49 nests were lost to Hurricane Isaias. All sea turtle monitoring and sample collections were performed pursuant to North Carolina Wildlife Resources Commission Endangered Species Permit #21ST14, Shank.

Sea Turtle Protection Program Overview

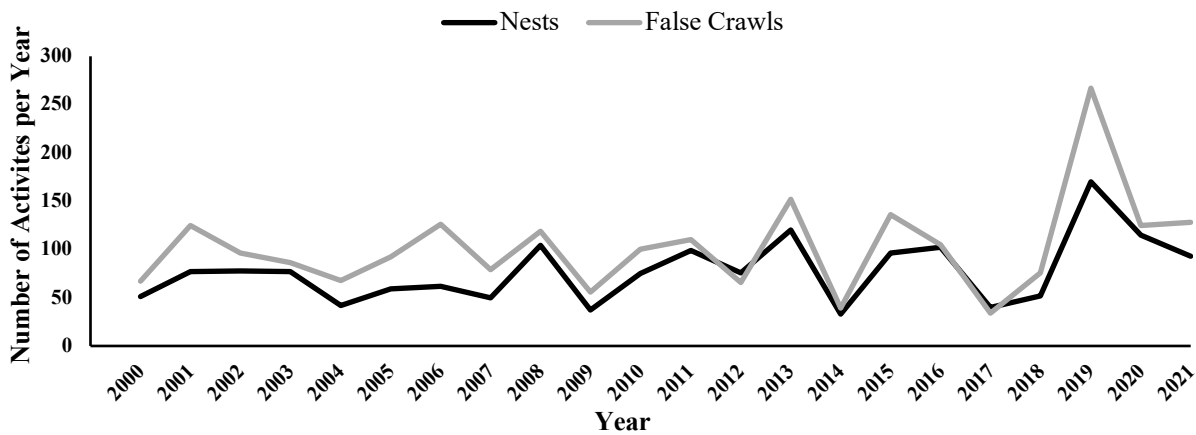
The Bald Head Island Conservancy's (BHIC) Sea Turtle Protection Program (STPP) was established in 1983 in cooperation with the North Carolina Wildlife Resources Commission (NCWRC) and the National Marine Fisheries Service (NMFS). Unofficially, monitoring of nesting sea turtles, their respective nests, and hatchlings began in 1980 with a group of island residents. Considered by NMFS as an "index" and "saturation tagging" beach, BHI and the Conservancy are nationally recognized for their long-term sea turtle monitoring program. As a saturation tagging beach, the Conservancy's Sea Turtle Protection Team (STPT) monitors the beaches of BHI nightly from May to September. During nightly patrols, the STPT's goal is to tag and identify every individual nesting turtle that comes ashore using a standardized data collection protocol. Nesting season begins with dawn patrols (0600 – 0730 EDT) on 1 May until the first nest is observed, after which full night patrols commence and continue through the middle of August. Nightly patrols for nesting mothers are conducted from 2100 - 0600 EDT and include the application of Inconel flipper tags (began in 1991), passive integrated transponder tags (PIT; began in 2002), and the collection of tissue biopsies (began in 2002) for genetic analysis and eggs for stable isotope analysis (SIA; began in 2010). These activities have produced an invaluable 35+ year dataset that allows the Conservancy's biologists and collaborators to track and conduct studies on the reproductive ecology, migration, and population trends of nesting loggerhead, green, leatherback (*Dermochelys coriacea*) and, Kemp's ridley (*Lepidochelys kempii*) sea turtles.

Nesting Activities: Caretta caretta & Chelonia mydas

*All data subject to change as 8 nests await genetic confirmation as of 2/14/2022.

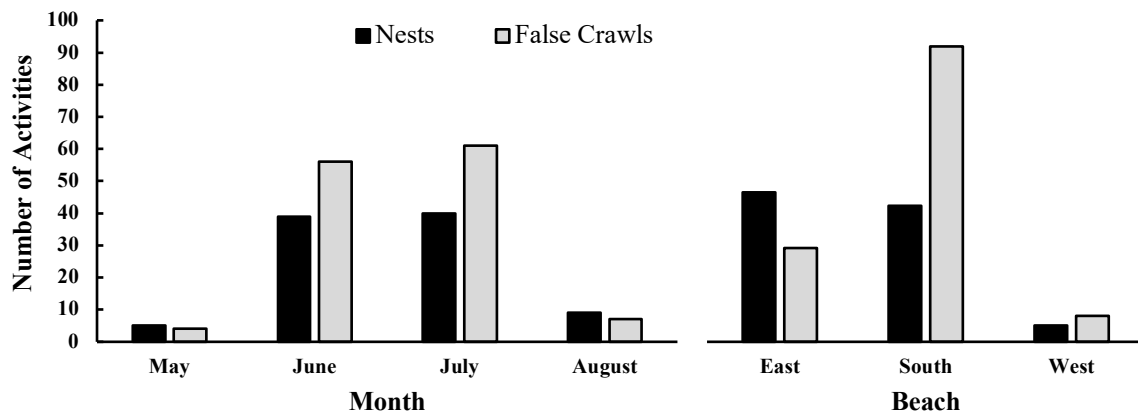
Bald Head Island has averaged 77 ± 33.8 nests and 101 ± 49.4 false crawls since 2000 (Figure 1), with an average of 40 unique nesting females per year since the inception of the Northern Recovery Unit Genetic Capture-Recapture Project in 2010. During the 2021 nesting season, 45 unique nesting females were identified to be responsible for a total of 221 nesting activities observed: 93 nests and 128 false crawls, making it the third consecutive season above average in all three categories. The 93 nests produced 7,433 hatchlings with hatch and emergence successes

Figure 1. Annual nests and false crawls recorded on BHI, 2000 – 2021.



of 74.7% and 70.5%, respectively. There were 51 (54.8%) imperiled nests relocated due to their proximity to the high tide line and as a precaution to the forecasted King Tide events. All but one nesting activity were determined to be from loggerhead (*C. caretta*) sea turtles, resulting in 92 confirmed egg depositions and 128 false crawls, while the remaining activity was the first egg deposition by a green sea turtle (*C. mydas*) on Bald Head Island since 2017. All nesting activities

Figure 2. Temporal & Spatial distribution of Bald Head Island's 2021 sea turtle nesting activities

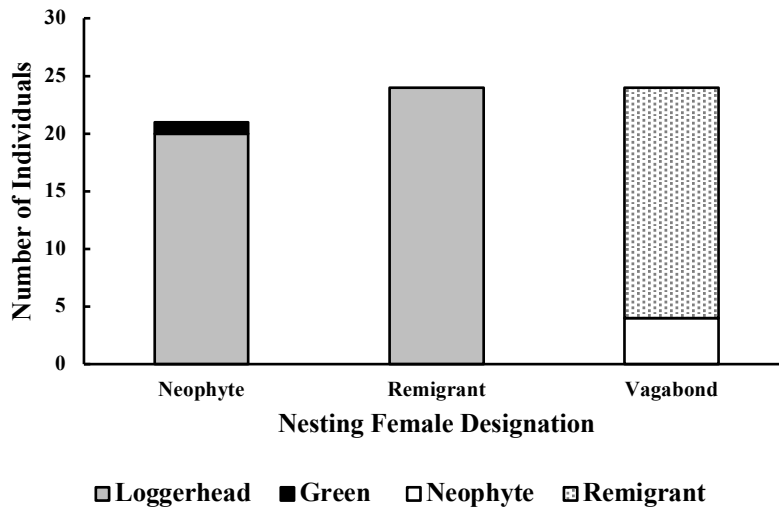


were observed between 25 May and 14 August, with a temporal distribution similar to 2020, with the most activities occurring in July (45.7%, Figure 2). South Beach had the most false crawls (91), while East Beach had the most nests (46; Figure 2). Of the 93 nests, 46 were laid on East Beach, 42 on South Beach, and 5 on West Beach. Three of the five nests on West Beach were laid north of the marina mouth, doubling the total nests ever recorded in this area. This was also the first time in five years that a nest was laid north of the marina and only the fourth season on record in which this occurred (2012, 2015, 2016, and 2021).

Nesting Females

Forty-five individual nesters were identified during night patrols; 42 were identified nesting, while 3 were identified returning to the water after a false crawl. Of the 45 individuals identified, 20 (46.7 %; Figure 3) were neophyte loggerheads (i.e., no tags or genetics on record), 24 (53.3%) were known loggerhead remigrants to BHI, and 1 (0.2%) was a neophyte green. Examination of physical tags and genetic identification indicated that 24 of the 45 nesting individuals were “vagabond nesters” (Figure 3), meaning that they had been identified or observed nesting on other beaches along the southeastern seaboard. In 2021, these 24 vagabond nesters not only laid 48 nests on BHI producing 3,970 hatchlings, but they laid another 45 nests on neighboring beaches within the Cape Fear region and South Carolina, producing an estimated 4,320 more hatchlings. Remigrants laid an average of 2.4 ± 1.4 nests each (56 total) on BHI, while neophytes laid an

Figure 3. The number of remigrant, neophyte & vagabonds identified during the 2021 nesting season.



average of 1.4 ± 0.8 nests each (26 total) on BHI. Nine Legacy turtles (long-term remigrants to BHI) returned to BHI for the 2021 season: Caroline (2 nests), Emily (1 nest), Fluffy (2 nests), Granny (3 nests), Mary Jane (2 nests), Sandy (5 nests), Scarlett (2 nests), Turquoise (4 nests), and

Yoda (one false crawl and no nests on BHI). Turquoise was the most prolific nester in 2021, with 4 nests, resulting in 509 eggs that produced 471 (92.5%) hatchlings. This data demonstrates that BHIC is not only protecting nesting turtles exclusive to BHI but also individuals associated with the larger Northern Recovery Unit (NRU) subpopulation of loggerhead sea turtles on the US East Coast.

There were 62 Inconel flipper and 20 PIT tags applied during the 2021 nesting season. Of the 62 flipper tags, 33 were applied to the left front flipper (LFF) and 29 were applied to the right front flipper (RFF). The difference in tag numbers applied to each flipper is because some BHI remigrants were only in need of the reapplication of one tag. Turquoise received a PIT tag that she did not need and can now be identified by two PIT tag numbers (see data). In addition to recording and applying tags, standard carapace measurements were recorded for each individual at every nest deposition where applicable. The mean curved notch-to-tip length of nesting loggerheads during the 2021 nesting season was 100.2 ± 5.6 cm (range = 90.7 - 111.3 cm; n = 30, Table 1). Remigrants were significantly larger than neophytes in all measurements except curved and straight carapace width (Table 1).

Table 1. Season averages for standard carapace measurements (cm). CNT = curved notch-to-tip, CNN = curved notch-to-notch, CW = curved width, SNT = straight notch-to-tip, SNN = straight notch-to-notch, SW = straight width. * denotes significant difference ** not included in statistics

	<i>CNT*</i>	<i>CNN*</i>	<i>CW</i>	<i>SNT*</i>	<i>SNN*</i>	<i>SW</i>
<i>All</i>	100.2	98.7	93.5	89.7	88.1	70.7
<i>Neophytes</i>	96.4	95.4	90.9	86.9	85.2	69.7
<i>Remigrants</i>	101.8	100.1	94.7	91.1	89.5	71.1
<i>Green**</i>		101.7	92.8		96.2	72.8
<i>p-value</i>	0.012	0.024	0.064	0.040	0.038	0.404
<i>t-stat</i>	2.67	2.38	1.93	2.16	2.19	0.85
<i>df</i>	28	28	28	25	26	26

Nest Relocations & Success

Complete nest relocations were conducted on 51 nests (54.8%), with an estimated 5,459 eggs relocated. Relocations were primarily conducted within 30 minutes after the female exited the beach. Of the 51 relocations, 4 were emergency relocations conducted at 1 – 49 days of incubation, well outside of the recommended relocation timeframe (within 6 hours of oviposition) as described in the Handbook for Sea Turtle Volunteers in North Carolina. All emergency relocations were

discussed with Dr. Matthew Godfrey, Sea Turtle Biologist at North Carolina Wildlife Resources Commission, prior to completion. BHI’s first nest hatched on July 25 with hatchings continuing throughout the fall and the last nest hatching around October 15. Incubation periods ranged from 49 to 80 days, with an average incubation period of 59.6 ± 4.3 days. The month of August had the most emergences (48), while the remaining nests emerged during the months of July (2), September (29) and October (5), or were lost to coyote depredation (6), tides (2), or were duds (1; unknown cause of nest failure). Multiple parameters of nest success were recorded during excavations (Table 2). Average hatch success was 74.7%, with an average emergence success of 70.5% (excluding nests lost to predation or tides). In total, at least 7,341 loggerhead and 92 green hatchlings are estimated to have reached the water. Relocated nests had similar hatch and emergence success rates to *in situ* nests (hatch success: $t_{77} = -1.5$, $p = 0.1$; emerge success: $t_{77} = -1.8$, $p = 0.06$).

Table 2. Nest inventory data. HE = hatched eggs, UE = unhatched eggs, PE = dead pipped eggs (partially emerged from eggshell), LH = live hatchlings, DH = dead hatchlings, TC = total clutch. The 2021 nest success statistics were above average in hatched eggs and total clutch count, but below average in unhatched eggs, pipped eggs, live hatchlings, and dead hatchlings.

	<i>HE</i>	<i>UE</i>	<i>PE</i>	<i>LH</i>	<i>DH</i>	<i>TC</i>
2021 Average	81.7	19.6	1.1	3.2	1.4	109.3
2021 Total	7433	1786	96	292	131	9948
Decadal Average (2010 - 2020)	6575.5	2003.0	136.2	543.2	167.3	9028.1

Research, Publications, & Presentations

Designing a Nest Cage for Coexistence: Living with a Non-Native Predator, Canis latrans

The Conservancy (Lead PI Hillbrand) completed this research project funded by North Carolina Sea Grant’s Mini-Grant program on November 7, 2021. The purpose of this study was to consider the needs of different types of NC sea turtle protection programs and provide recommendations for predator exclusion cages that could withstand different coyote behaviors and periods of depredation pressure. A material used for nest screens in Georgia (“MasterNet”) showed promise in a preliminary trial on BHI where a coyote was unable to infiltrate a baited cage made from MasterNet and PVC during a 30-min depredation attempt. An analysis of MasterNet’s performance in Georgia (Butler et al. 2020) showed that it is successful at keeping out predators such as raccoons (*Procyon lotor*) and coyotes. However, coyotes are versatile, adapt quickly, and have learned to tunnel under the 4’ x 4’ MasterNet screens since its debut (Butler et al. 2020). Using the field-tested MasterNet as the fencing material placed around a PVC cube frame to create a cage, we hypothesized that the strength of the MasterNet and durability of the PVC would hold

up against continuous depredation attempts by coyotes. We found little variation between designs as the MasterNet cage had a 97.2% efficacy rate, while the welded wire cage produced a 94.9% efficacy rate during the 2021 sea turtle nesting season. Our findings suggest the MasterNet cage is a suitable option for a replacement for the welded wire cage consistently used in sea turtle nest protection. The final report can be found [here](#).

2021 Intern Projects

Abigail Steele – [Out of the Surf: Water quality parameters as a cue for loggerhead sea turtles](#)

Clara Dawson – [Where & When: Coyote observations and predation assessment](#)

Eric Plessett – [The Living Shell: Epibiont diversity of loggerhead sea turtle carapaces](#)

Emma Jones – [No Nests Here: Effects of beach nourishment on loggerhead nesting activity](#)

Karlee Szympruch – [Between the Calipers: An assessment of neophyte and remigrant offspring](#)

2021 Publications & Presentations

Conservancy staff were lead or co-authors on one grant final report, one scientific manuscript, and two poster presentations in 2021.

Hillbrand, P.A., Urbanek, R.E., **Darrow, E.S.,** 2021. Designing a Nest Cage for Coexistence: Living with a Non-Native Predator, *Canis latrans*. Project #2020-R/MG-2008. North Carolina Sea Grant's Mini-Grant Final Report. November 7.

Shamblin, B.M., Dodd, M.G., Pate, S.M., Godfrey, M.H., Pfaller, J.B., Williams, K.L., Ondich, B.L., Steen, D.A., **Darrow, E.S., Hillbrand, P.,** Boettcher, R., Coyne, M.S. & Nairn, C.J., 2021. In search of the “missing majority” of nesting loggerhead turtles: improved inter-seasonal recapture rates through subpopulation-scale genetic tagging. *Mar. Biol.* 168, 1–14.

Hillbrand, P.A., Darrow, E.S., Jobe, S., Urbanek, R.E., & Abernathy, E., 2021. Efficacy of four predator exclusion cage models for sea turtle nest protection. The Wildlife Society Meeting. November 1-5. Virtual Poster Presentation.

Jobe, S., Urbanek, R.E., **Hillbrand, P.A., Darrow, E.S.,** & Abernathy, E., 2021. Predator Exclusion Cages as Visual Attractants to Mammalian Predators. The Wildlife Society Meeting. November 1-5. Virtual Poster Presentation.