LOGGERHEAD NEST INCUBATION TEMPERATURES IN HATCHERY NESTS VS. IN SITU NESTS ON CAPE ISLAND, SOUTH CAROLINA

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Introduction

The current recovery strategy for the U.S. Atlantic population of the Loggerhead sea turtle (*Caretta caretta*) places emphasis on less manipulation of nests and hatchlings due to the risks of embryo mortality, reduced hatchling fitness, and potential sex ratio manipulation. However, management efforts involving nest relocation at locations with high tidal amplitudes and erosion rates can have benefits that outweigh these risks.

Cape Island is the northernmost barrier island of the 64,000-acre Cape Romain National Wildlife Refuge located in South Carolina, USA (Figure 1). Management activities are carried out by the U.S. Fish and Wildlife Service. Historically, Cape Island has received the highest density of Loggerhead nesting in the northern sub-population geographic nesting area which extends from Amelia Island, Florida through Virginia.

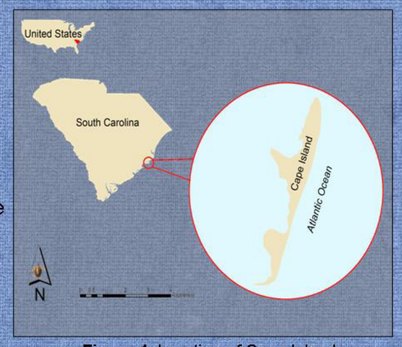

Figure 1. Location of Cape Island

Since the beginning of the nest protection project, hatcheries have been used for relocated nests to prevent loss from erosion or severe tidal inundation as well as predation by raccoons. The program currently uses only self-releasing hatcheries which hold 50 to 100 nests. Due to the large number of nests laid on Cape Island and the significant annual loss of suitable nesting areas, hatcheries are still being used as a necessity.

Hatchery on Cape Island

Purpose: To determine if the use of hatcheries adversely affects incubation temperatures, incubation duration, and/or hatch success on Cape Island.

Methods

The temperatures in the approximate centers of the in situ nests were compared to the temperatures in the centers of hatchery nests. MicroDAQ™ LogTag temperature data loggers (Figure 2) with a ±0.1°C resolution set to record data every ½ hour were used to measure nest temperatures from June 8, 2007, through September 10, 2007. Data loggers were placed into every other in situ nest (n=80) during the same time period as nests being relocated into hatcheries (n=56).

Figure 2. MicroDAQ™ LogTag temperature data logger

In Situ Nests

Sixty eggs, 50% of the average clutch size (South Carolina Department of Natural Resources' state average), were removed from the nests and a data logger was placed upright in the center of the nest with the sensor facing North (Figure 3). Eggs were placed back in the nest, the nest was re-covered, marked, and caged.

Hatchery Nests

New nests were dug out with post hole diggers to a depth of 55 cm and then bowled out to create an egg chamber. Half of the clutch was placed in the nest, a data logger was placed upright in the center of the nest with the sensor facing North (Figure 3), and the remaining eggs were placed around the data logger and covered.

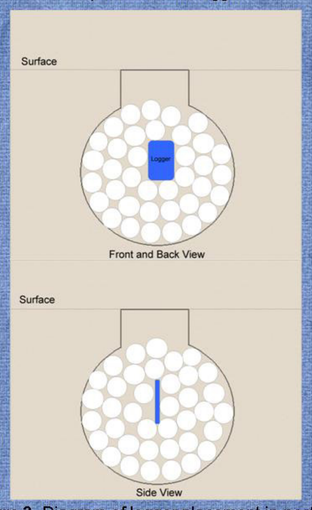

Figure 3. Diagram of logger placement in nest

Results

Mean Middle Third Incubation Temperatures

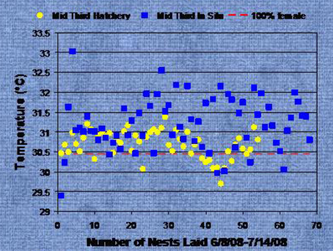

Figure 4. Mean Incubation Temperatures During the Middle Third of Incubation

- Mean incubation temperatures were significantly lower in hatchery nests (30.69°C) than in situ nests (31.19°C) (Two-Sample T-Test, n=122, p=0.00).
- Mean incubation temperatures during the entire incubation duration for hatchery nests (31.02°C) and in situ nests (31.18°C) were not significantly different (Two-Sample T-Test, n=122, p=0.142).
- Incubation temperatures exceeded the pivotal temperature (29°C) (Wibbels, 2005) in the center of the egg chamber for all hatchery and in situ nests.
- Incubation temperatures exceeded the 100% female temperature (≥30.45°C) (Wibbels, 2005) in 81.5% (44 out of 54) of hatchery nests and 89.7% (61 out of 68) of in situ nests. The proportions were not significantly different (Two-Proportion Test, n=122, p=0.202).

2007 Mean Incubation Duration

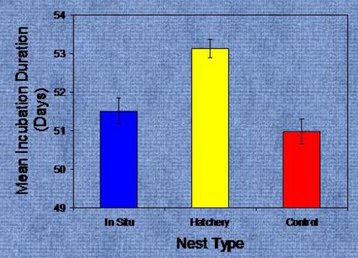

Figure 5. Mean Incubation Duration of In Situ Nests with Loggers, Hatchery Nests with Loggers, and Control Nests (In Situ Nests without Loggers) with standard error bars

- Mean incubation durations were significantly longer in hatchery nests (53.13 days) than in situ nests (51.5 days) and control nests (50.97 days) (ANOVA, n=183, p=0.00)

2007 Mean Hatch Success

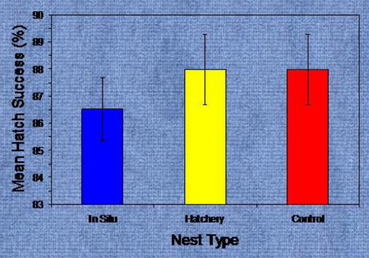

Figure 6. Mean Hatch Success of In Situ Nests with Loggers, Hatchery Nests with Loggers, and Control Nests (In Situ Nests without Loggers) with standard error bars

- Mean hatch success was not significantly different between in situ, hatchery, or control nests (ANOVA, n=183, p=0.607)

Nesting Loggerhead on Cape Island

Conclusion

- **Hatcheries should continue to be used on Cape Island as a management tool.** Due to the high erosion rate of the island and lack of suitable nesting areas, nest relocation is necessary to prevent total loss of nests from erosion. Concerns regarding nest relocation include moving nests into a warmer, drier environment resulting in an increase in nest incubation temperature and a decrease in incubation duration possibly resulting in smaller, less robust hatchlings. However, our results suggest that these concerns are not valid for Cape Island.
- According to a preliminary statistical analysis, incubation durations for hatchery nests were longer than in situ nests on Cape Island for the 2000-2007 nesting seasons (South Carolina Department of Natural Resources and U.S. Fish & Wildlife Service unpublished data, 2000-2007). This finding is the opposite of incubation durations on all other beaches in South Carolina except for Lighthouse Island which was part of Cape Island before it breached in 1996.

Future Research

- We will attempt to determine which characteristics on Cape Island are influencing incubation duration during the 2008 nesting season and how these characteristics differ from other South Carolina beaches.
- The majority of the nests laid in June and July exceeded the 100% female temperature. Further research needs to be conducted to determine the incubation temperatures of nests laid during the entire nesting season on Cape Island (May 1 through August 15).

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References

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