Living in Coexistence: A Novel Predator Exclusion Cage Design

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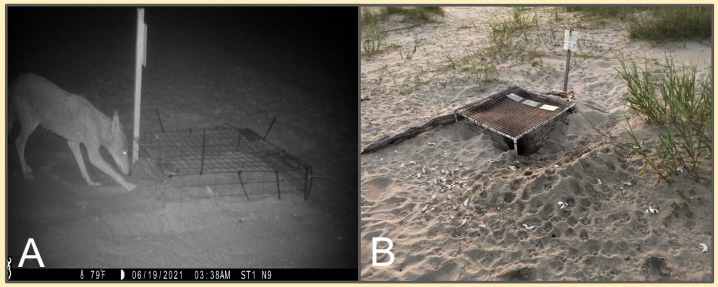
Introduction

- Coyotes (*Canis latrans*) are the main source of sea turtle nest depredation on Bald Head Island, NC despite the use of predator exclusion cages (PEC).
- PECs are common in sea turtle conservation and historically, the Bald Head Island Conservancy (BHIC) used **welded wire (A)** but adopted a **PVC geogrid (B)** model after research on the effects ferrous material has on hatchling navigation was published. [2,3,4]



- In 2019, coyotes mastered infiltrating the geogrid PEC, resulting in the largest loss of sea turtle eggs in BHIC history **(Table 1)**, motivating BHIC to design and test the efficacy of a new PEC against PECs commonly used in the sea turtle nest monitoring community.

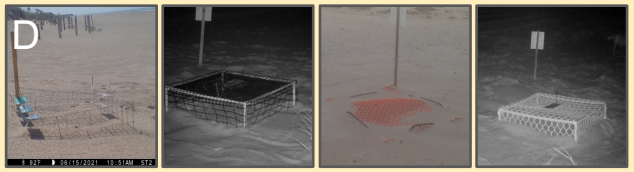
Table 1. 2019 Coyote Depredation

Depredation Attempts		
Failed	**Successful**	**Total**
132	58	190
Sea Turtle Loss		
Eggs	**Hatchlings**	**Full Nests**
2056	104	9

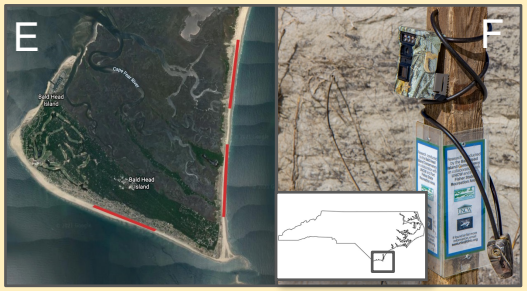
- BHIC designed a PEC using a PVC frame & **MasterNet© fencing (C)**, commonly used to protect nests in Georgia.[1] We predicted that the MasterNet© cage would be more effective than previous PECs.

Methods – Baited Nests

- Four PEC models **(D)** were selected to protect baited nests along 3 transects on BHI & Fort Fisher **(E).** Four of each model and 4 controls were placed along each transect for two 14-day trials in 2020.
- 1 camera **(F)** was paired with each of the 4 PEC models and 1 control along each transect to catalog species.



Efficacy: Effectiveness of reducing depredation.
Success: Successful depredation. **Failure:** Failed depredation.



Results – Baited Nests

Table 2. Baited Nests Depredation Activities

	Welded Wire	Geogrid	MasterNet© Screen	MasterNet© Cage	Control
Failure	21	26	23	23	0
Success	0	2	7	0	26
Efficacy	100%	93%	77%	100%	0%

- **Species Observed:** Coyote & Red Fox (*Vulpes vulpes).*
- MasterNet © & welded wire cages were the most effective **(Table 2)** and were used to protect live nests in 2021.

Methods – 2021 Live Nests

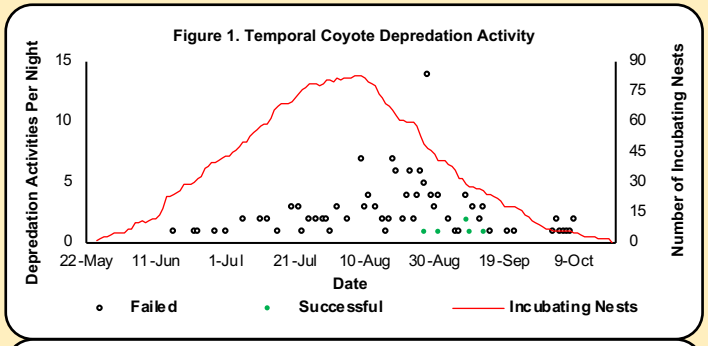
- MasterNet© & welded wire PECs used over live nests
- Night patrols for nesting mothers were conducted
- Randomized cage installation

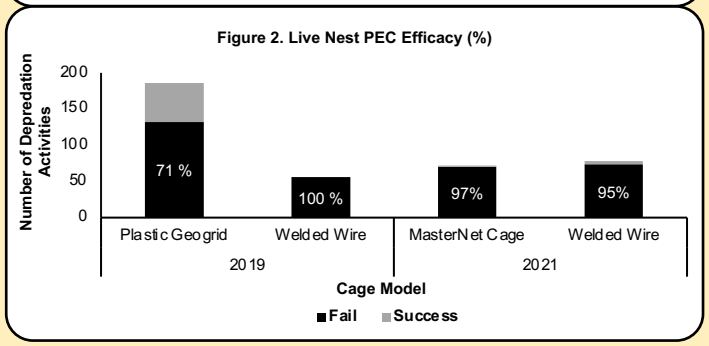
18 cameras paired with 9 of each PEC

- Identify predator species & PEC efficacy

Results – Live Nests

- **Species Observed:** Coyote, 150 depredation activities **(Figure 1)**.





- **Efficacy:** MasterNet© Cage – 97%; Welded Wire – 95% **(Figure 2)**.
- No significant difference in efficacy between the two models $X^2(1, N=150) = 1.4$, $p = 0.2373$.

Management Recommendations

- The MasterNet© cage showed similar, strong efficacy against consistent coyote depredation pressure to the welded wire cage.
- The MasterNet© cage is a suitable replacement for welded wire until its effects on hatchling navigation can be confirmed.
- PEC models need to continuously adapt, as predators do. For now, these two models will keep the loss minimal.
- Our findings and continued research will aid managers in their depredation mitigation strategies protecting endangered sea turtles.

- **Acknowledgments:** 2020 & 2021 Bald Head Island Conservancy interns, Emma Phillips & North Carolina Sea Grant

References: 1. Butler, Zachary P., et al. "Predation of loggerhead sea turtle eggs across Georgia's barrier islands." Global Ecology and Conservation 23 (2020): e01139. **2.** Irwin, William P., Amy J. Horner, and Kenneth J. Lohmann. "Magnetic field distortions produced by protective cages around sea turtle nests: unintended consequences for orientation and navigation?." Biological Conservation 118.1 (2004): 117-120. **3.** Fuxjager, Matthew J., et al. "The geomagnetic environment in which sea turtle eggs incubate affects subsequent magnetic navigation behaviour of hatchlings." Proceedings of the Royal Society B: Biological Sciences 281.1791 (2014): 20141218. **4.** Salmon, Michael. "A brief exposure to magnetic distortions during embryonic development may compromise the migration of loggerhead hatchlings." Chelonian Conservation and Biology 18.1 (2019): 102-104.