COUNTING TURTLES BEFORE THEY HATCH

Predicting Loggerhead nesting distribution in Cocoa Beach, FL

Image Source: Wikimedia Commons

INTRODUCTION

Each year, more than 10,000 female loggerhead sea turtles (*Caretta caretta*) come to the Atlantic coast of Florida to nest. From late April to early September, loggerheads come to shore at night and dig nests on some of Florida's most popular beaches.

Loggerheads are currently threatened due to bycatch, rising sea temperatures, and nesting habitat loss. By understanding how and where loggerheads decide to nest, we can preserve their habitat while gaining insight into nesting predictors for other turtles. This project utilized false crawl locations, proximity to infrastructure, night lighting, and beach slope to try to predict nesting density along a 10-mile stretch of beach in Central Florida.

METHODS

The study site was chosen based off the availability of sea turtle nesting and false crawl data obtained from Geomar Environmental Consultants, Inc. Since loggerheads have fewer variations in annual nesting numbers than other species of turtles, I assumed the 2018 data was representative of the annual trend. After gathering nesting, geological, and anthropogenic data, I analyzed and processed them in the following ways:

False Crawl Density: False Crawls are indicated by turtle tracks showing a turtle came onshore to dig a nest, but returned to the water instead. The locations of over 600 false crawls were turned into a density raster using the point density function and reclassified on a scale from 1-5.
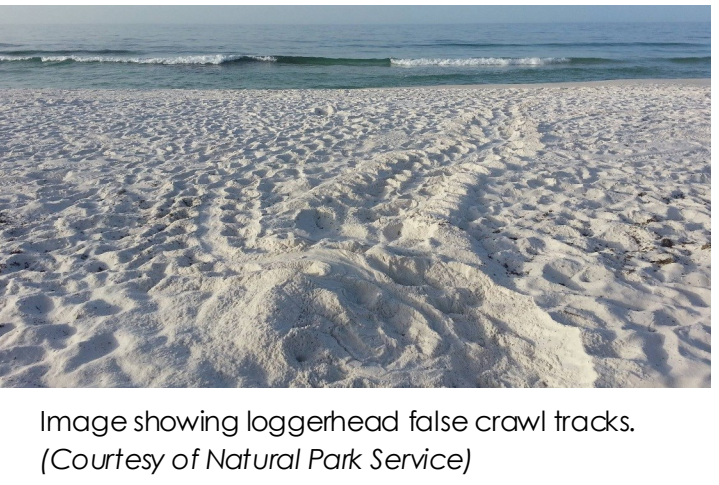
Image showing loggerhead false crawl tracks. (Courtesy of Natural Park Service)

Night Pollution: The NASA Black Marble satellite images were resampled for a higher resolution using cubic convolution and reclassified on a scale from 1-5. While these images do not capture the blue wavelengths of light thought to affect turtles the most[1], these wavelengths of light still affect turtle nesting.
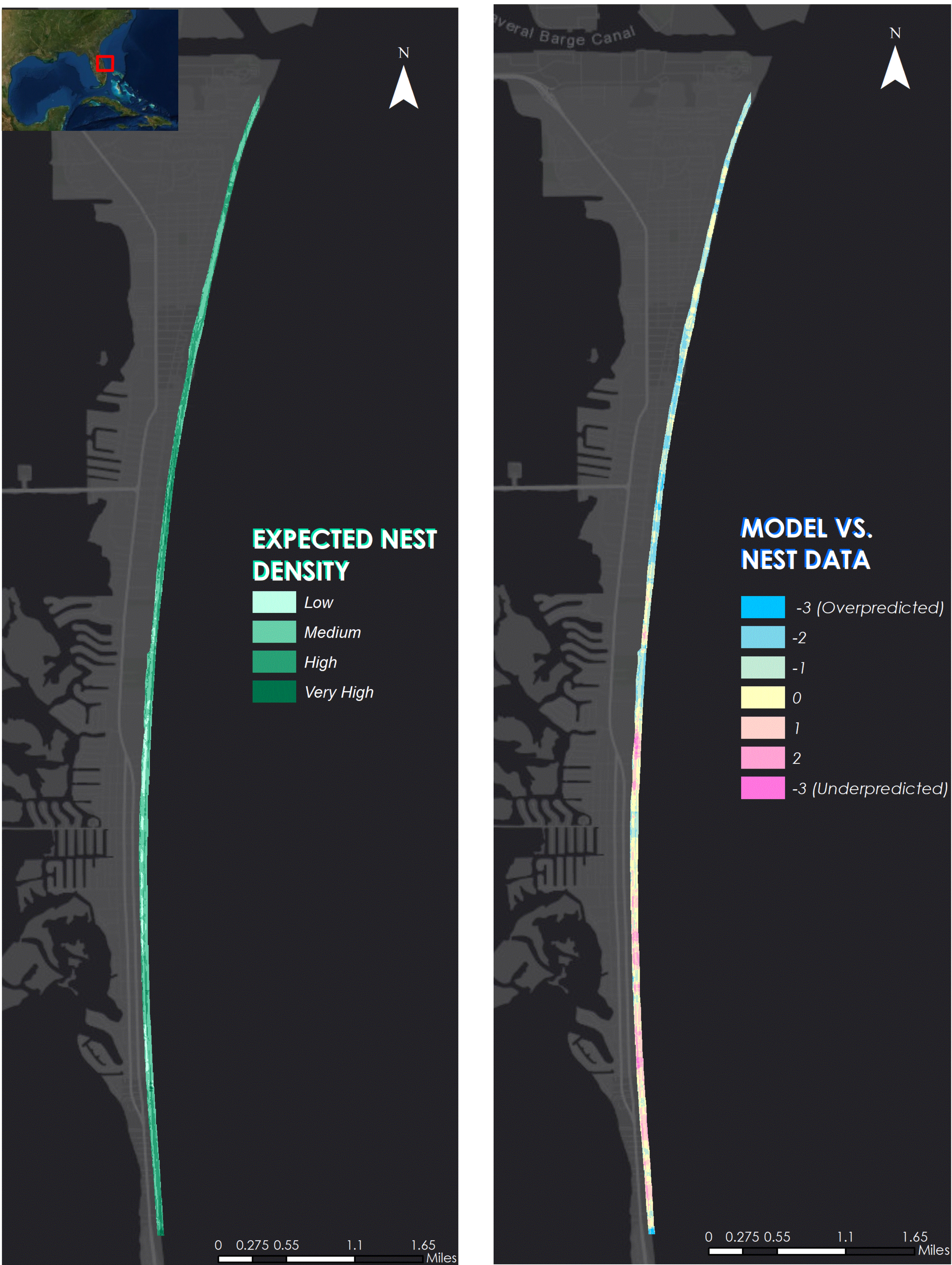
Hotel Distance: After creating a shapefile for beachfront buildings, I created a multiple ring buffer with 60 meter, 80 meter, and 100 meter distances from each structure. Proximity to manmade infrastructure can increase noise pollution, nighttime beach traffic, and sand displacement, all of which can affect nesting.

Beach Slope: Multiple studies have cited higher turtle nesting densities on beaches with higher slopes[2]. After importing an integrated topographic and bathymetric model from NOAA, I calculated slope along the shoreline and reclassified the intensity values into five categories.

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RESULTS

EXPECTED NEST DENSITY
- Low
- Medium
- High
- Very High

0 0.275 0.55 1.1 1.65 Miles

MODEL VS. NEST DATA
- -3 (Overpredicted)
- -2
- -1
- 0
- 1
- 2
- -3 (Underpredicted)

0 0.275 0.55 1.1 1.65 Miles

FALSE CRAWL DENSITY
- Very Low
- Low
- Medium
- High
- Very High

LIGHT POLLUTION
- Very Low
- Low
- Medium
- High
- Very High

HOTEL DISTANCE
- 60 Meters
- 80 Meters
- 100 Meters

BEACH SLOPE
- 0.01-2.59%
- 2.59-5.18%
- 5.18-8.22%
- 8.22-10.18%
- 10.18-13.23%
- 13.23-23.0%

NESTING DENSITY
- Very Low
- Low
- Medium
- High
- Very High

DISCUSSION

As seen from the two maps on the left, the model did an okay job predicting loggerhead nest density(75% of data within ±1 std. deviation). While no other predictive model exists for Cocoa Beach, clearly at least a few variables used in this suitability analysis do have an effect on nest density. However, there are multiple limitations of this suitability analysis.

Multiple other studies have cited factors such as sand surface temperature, sand grain size, and effective fetch as factors in nesting density[4], none of which were factored into this analysis. This project also relies off data from one year in a very small study location, and might only be applicable to one species of turtle. Furthermore, Florida's beaches are constantly changing due to hurricanes and storms, so the LIDAR and other geophysical data used here could be inaccurate.

SOURCES

1. Weishampel, Z. A., Cheng, W. and Weishampel, J. F. (2016), Sea turtle nesting patterns in Florida vis-à-vis satellite-derived measures of artificial lighting. *Remote Sens Ecol Conserv*, 2: 59-72. Doi:10.1002/rse2.12

2. Herren, R., and Ehrhart, L. (1998), The Effect of beach nourishment on Loggerhead Nesting and Reproductive Success at Sebastian Inlet, Florida. *19th Annual Sea Turtle Symposium*.

3. Geomar Environmental Consultants (2019). 2018 Sea Turtle Monitoring Report Federal Shore Protection Project, Flood Control and Coastal Emergencies (FCCE) Brevard County – North Reach.

4. Lockwood, B., and Moulding, A. (1999) Obstacles associated with sea turtle nesting in Biscayne national park. *19th Annual Sea Turtle Symposium*.

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