Sea Surface Temperature Serving as Determining Factors for Sea Turtle Locations in the Atlantic Ocean

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LONG-TERM GOALS

The long-term goal of this project was to determine the correlation between sea surface temperature and sea turtle locations. In addition, the overall goal will determine other possible indicators that may influence the presence of sea turtles.

OBJECTIVES

The Mid-Atlantic serves as a host environment for a number of sea turtle species that encompasses their seasonal migration routes. Global evidence suggests that migration routes are strongly influenced by two factors: sea surface temperature and chlorophyll-a concentrations. Data gathered from the Pacific Ocean presents compelling evidence of this relationship. In contrast, findings from studies conducted in the Atlantic have not yet confirmed the role of these factors.

This study's objective attempted to establish a correlation between sea turtle locations in the Atlantic Ocean in relation to sea surface temperature. Currently all five species of sea turtles in continental United States waters are protected under the Endangered Species Act of 1973 (PL93-205). Monitoring and studying sea turtles is imperative to the overall survival of the species.

APPROACH

The Physical Oceanography Distributed Active Archive Center (PO.DAAC) provided the data source for the project. Multi-Channel Sea Surface Temperature (MCSST) data derived from Advanced Very High Resolution Radiometer (AVHRR) was utilized for this project in addition to sea turtle point source data from WhaleNet. WhaleNet is an interactive educational website which focuses on whales and marine research.

The AVHRR data was acquired in GeoTiff format. This format was selected due to its compatibility with ArcView GIS. Sea surface temperature ASCII files for each dataset were collected to determine water temperature at turtle locations.

After obtaining all satellite images and ASCII files, GeoTiffs were imported into ArcView GIS. Turtle locations were then plotted on the image.

Report Documentation Page

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14. ABSTRACT
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15. SUBJECT TERMS

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WORK COMPLETED

MCSST datasets have been collected in addition to turtle point source data for January 1999 to August 1999. ASCII files have been examined and water temperatures have been assigned to each turtle sighted.

RESULTS

An upper and lower thermal limit was identified for the sea turtles sighted. The upper thermal identified was 30.1 C while the lower thermal was 17.1 C. The period investigated for this study was January 1, 1999 to August 29, 1999. That time period was selected based on the availability of MCSST data and sea turtle point source data. Figure 1.2 represents the most frequent sea surface temperature for each turtle sighted during its given week and month. Figure 1.1 represents data acquired and utilized from PO.DAAC during the first week of January, April, and August. Figures 1.3, 1.4, and 1.5 represent sea surface temperatures for each turtle sighted within the months of January, April and August.

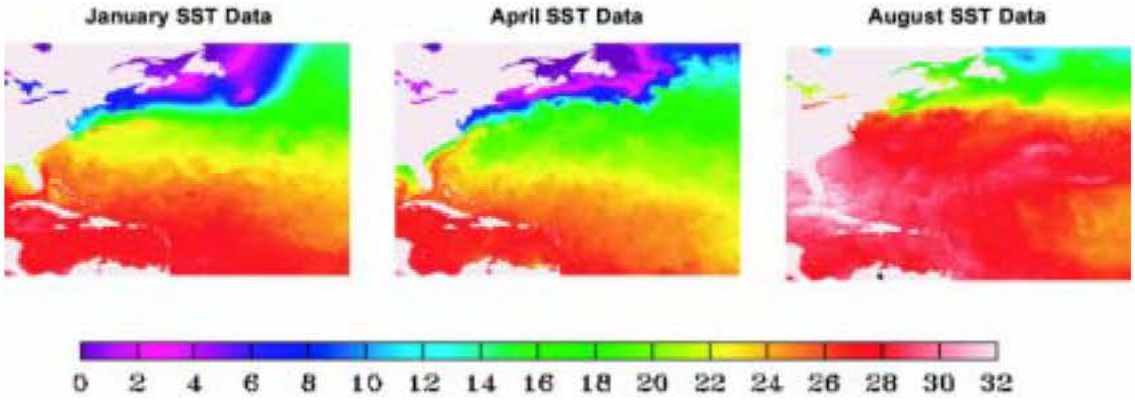

Figure 1.1 – This figure represents MCSST SST data collected from PO.DAAC.

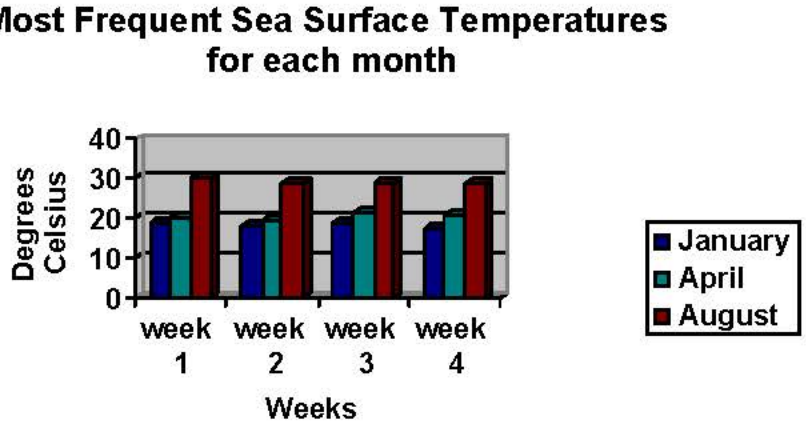

Figure 1.2 – This figure represents the most frequent temperature recorded for each week.

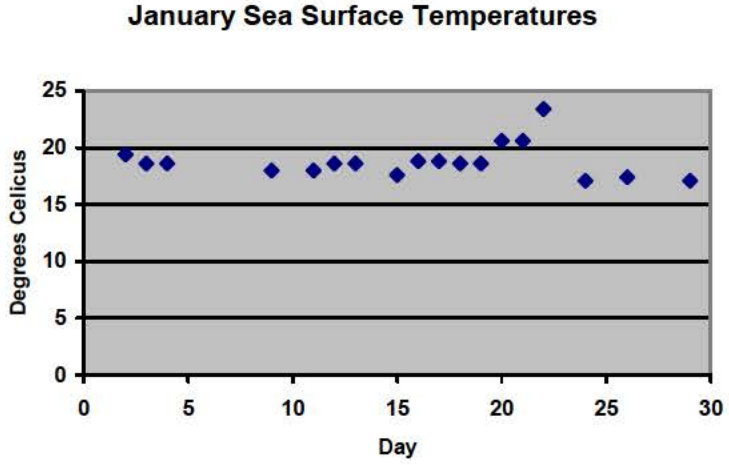

Figure 1.3 – This figure represents the sea surface temperature for turtles sighted in January.

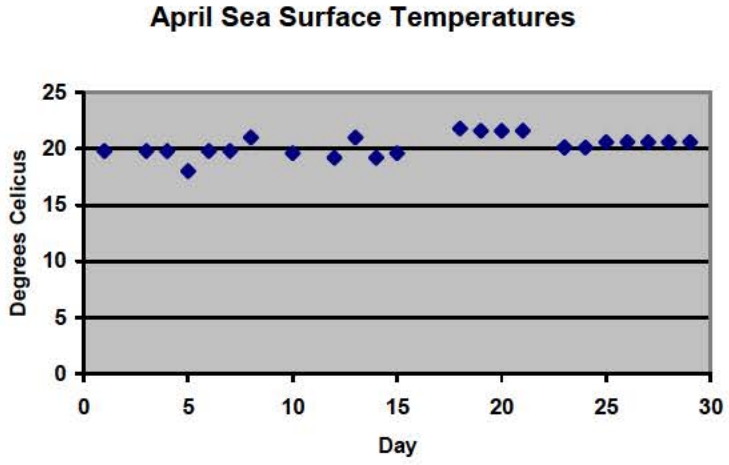

Figure 1.4 – This figure represents the sea surface temperature for turtles sighted in April.

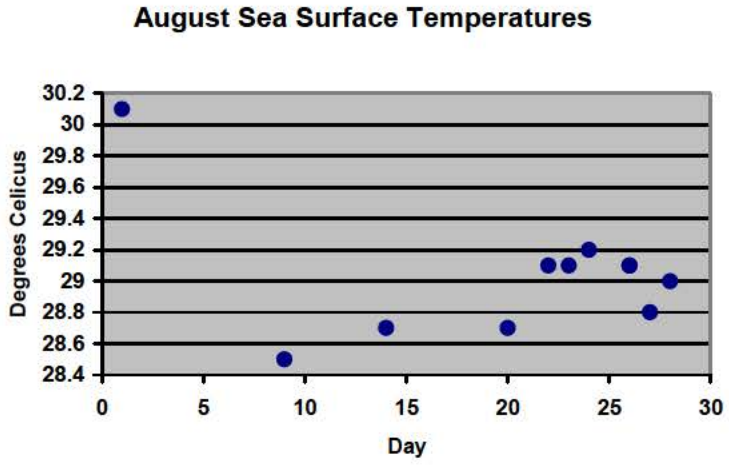

Figure 1.5 – This figure represents the sea surface temperature for turtles sighted in August.

Aerial survey of turtle distribution over North Carolina waters indicates that sea turtles may not be randomly distributed. Their positions may be restricted by water temperature (Coles, 2000; Lutcavage and Musick, 1985; Epperely et al., 1995), with turtles occurring in water greater than 11 C (Epperely et al., 1995). However, the correlation between the location of sea turtles and sea surface temperatures or fronts is poorly understood.

Sea turtles were not geographically randomly distributed but stayed within preferred temperature ranges. For example, during the first week of April out of the six sighting, five of them were located in waters with a temperature of 19.8 C. During the first week of January out of the 3 sightings, two were located in waters with temperatures of 18.6. A wide range of water temperatures was available during each sampling day as shown in figure 1.1, but the turtles were only found in small portions of the range.

William C. Coles has conducted a similar study entitled Satellite Sea Surface Temperature Analysis and Correlation with Sea Turtle Distribution off North Carolina. The objective of Coles study was to determine a correlation between temperatures and turtle locations, using archived satellite derived images of sea surface temperatures and aerial survey data, which determined positions of sea turtles. Upper thermal limits as well as lower limit to preferred turtle temperatures were identified. The available temperature range for the turtles to occupy during Coles study (May 1991 to Sept 1992) was 4.9 to 32.2 C, but turtles were only observed in water from 13.3 C to 28 C. The results from the study conducted confirm findings from Coles research.

There are known problems that should be considered when analyzing results. The first row of weekly MCSST data contains erroneous data in the flag set for the entire time series. Erroneous data also exist in the valid and interpolated data sets for the period between week 322 of 1986 and present at this latitude.

Furthermore, the weekly data provided to the PO.DAAC from the University of Miami were originally stored as 16-bit integers in DSP Format. The PO.DAAC converted these data from 16-bit integers to 8-bit raster images in Hierarchical Data Format (HDF). The digital numbers ranged from –20 to 350. To convert data from integers to bytes, the data had to scaled to values ranging from 0 to 255. As a result, the HDF values of sea surface temperature could vary from the DSP values of sea surface temperature by as much as 0.15 degrees Celsius.

IMPACT/APPLICATION

This project can be extended for future research at the Center of Excellence in Remote Sensing Education and Research (CERSER) located at Elizabeth City State University. The findings will also aid in contributing to the knowledge currently available on this endangered species.

Further research should be conducted to determine the role of wind speed to the migration patterns and water temperatures. The project could also be extended to examine the effects of El Niño and La Niña on the location of sea turtles.

RELATED PROJECTS

While Coles's study had similar objectives different approaches were used to analyze data. Coles's approach for determining turtle location was based off aerial photography collected from North

Carolina. This study however used turtle data gathered from WhaleNet to determine the exact longitude and latitude of the turtle position. Though the methods for analyzing the data were quite different, similar results were yielded for both projects.

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