Tracking Sea Turtles in the Atlantic Ocean, looking at Sea Surface Temperature and Surface Currents

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Abstract

Tracking green sea turtles is crucial to their worldwide survival. Globally, the sea turtle population has declined significantly. According to the Marine Turtle Specialist Group, over the past 100-150 years, there has been a worldwide decrease of 48-65% in the number of sea turtles nesting annually. The Atlantic Ocean is no exception to this decline. The purpose of this project was to track two sea turtles as they ventured around the Atlantic Ocean and to compare their movements to other research that has been done to identify areas in which turtles spend time. Green turtles are found in the Atlantic Ocean, specifically off the North American coast. Data was collected from two sea turtles, Catherine, a female, and Chubby, a male, as they traveled from Bermuda to Florida by Bermuda's Department of Conservation Services. Using, the GIS software, ArcMap, the turtles' locations and the temperature of the ocean at the location were mapped. By analyzing this data, the relationship between these particular sea turtles' movements and temperature was established and, by combining the location data with ocean current data, the relationship between the sea turtles' movements and ocean currents was also established. The findings of this study can be used to monitor and focus turtle conservation efforts.

I. Introduction

While tracking sea turtles via satellite has been a popular study, especially over the past years as the population of sea turtles has begun to decline, not many studies have focused on impact of sea surface temperature or sea surface currents on sea turtle movement. However, both of these variables have a large impact on sea turtle movements. Hawkes et al. (2007) concurred at sea turtles that travel around the Atlantic will move to warm waters at the edge of the Gulf Stream during the winter months. Additionally, according to Luschi et al. (2003), major ocean currents have an obvious effect on turtle movements, which sometimes pushes the turtles in a direction that they did not intend to go. The goal of this study was to examine the temperature and currents along the coordinates of the turtles' movements and to see if there is a relationship between the movements and the two variables.

II. Literature Review

According to Kolz et al. (1982), satellite tracking of sea turtles came about as viable alternative to traditional sea turtle tracking methods, such as random extraction and modeling. This method of sea turtle tracking involves few field preparations and studies yield better, more usable data. However, there are some limitations to GPS tracking. For example, the devices that are attached to the turtles are expensive and easily broken during sea turtle movements. Godley et al. (2007), believe that, although the tracking of sea turtles by satellites has been used for many years and there are many advantages to this type of tracking, there are also many advantages to direct observation as there is some inherent bias to satellite tracking, such as interference with data and manipulation by scientists. While these authors' goal is to demonstrate that direct observation is a viable alternative to satellite tracking, they fail to mention the flaws of direct observation, such as the time commitment and expenses that directly observing turtles as they travel across oceans requires. By analyzing the satellite data, like has been done in this project, more knowledge about sea turtle behavior can be acquired in a quicker amount of time. Coyne et al. (2005) also illustrate the flaws in satellite tracking as they discuss that while this technique is easier for many to carry out, the technique generates data that is not in the best form to be used by biologists who would like to analyze the data. Although, this technique has been used many time successfully and generated data that can be useful. For example, in one study, by tracking twelve sea turtles throughout the 2003-2005 nesting seasons across the coast of North Carolina, Hawke et al. (2007) found similar patterns among the seasons and among the sea turtles themselves. One of the patterns discovered by the authors' study was movement to areas of the same temperature at the same the time, a variable examined in this project. Another variable examined in this project was the role of ocean currents on the movements of the turtles and, according to Luschi et al. (2003), ocean currents are likely to affect the behavior and movement of sea turtles. Since sea turtles moving over oceans dive shallow, sea surface currents produce most of the effects.

III. Methodology

For this project, data collection was carried out by Bermuda's Department of Conservation Services as they sponsored the tracking of several green sea turtles as they traveled around the Atlantic Ocean. The GPS coordinates of each turtle were collected several times a day. Additionally, the sea surface temperature in which the turtle spent most of his or her time in within that point was also recorded by the device attached to the turtle. Using the GIS software, ArcMap, the coordinates of the sea turtles were mapped. After the coordinates were mapped, they were converted to a color depending on the temperature, in which the turtle spent most of his or her time in. Catherine spent much of her time around the coast of Florida. Therefore, another map was made to show her movement along the coast. Also, two graphs were made after this to show the temperatures in a different form.

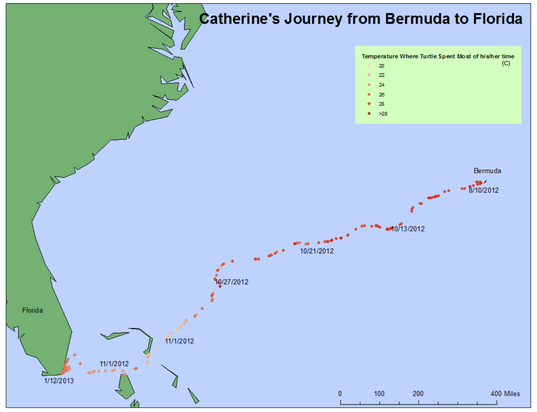

Figure 1 - Scientists began tracking Catherine in early August, 2012 through January 2013. During this time she moved from Bermuda to the coast of Florida

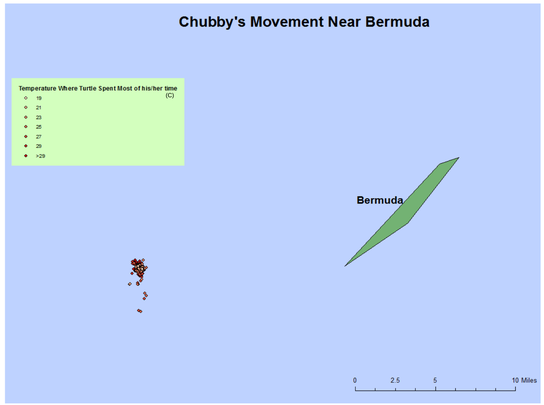

Figure 2 – Scientists began tracking Chubb in early August 2012 through January 2013. During this time he stayed within several miles of the Bermuda coast.

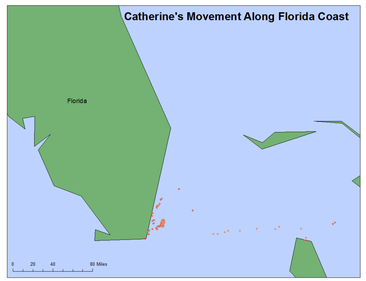

Figure 3 – In December 2012 and January 2013 (up until the end of data collection), Catherine stayed along the Florida Coast

Figure 4 – Currents in the Atlantic ocean affect sea turtle movements as they travel across the open ocean (*conserveturtles.org* 2012).

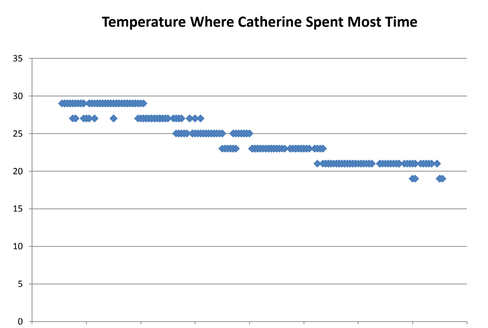

Figure 5 – Catherine's temperature gradually went down as she traveled from Bermuda to Florida

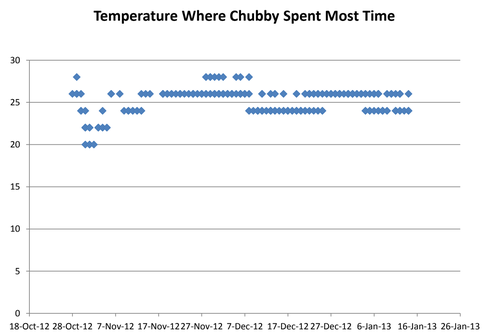

Figure 6 – Chubby's temperature changed by only a few degrees as he stayed near the Bermuda coast

IV. Results and Discussion

After examining the figures, many patterns and trends were found among the two turtles' movements. On the map that shows Catherine's movement from Bermuda to Florida, it is evident that Catherine moved south as time progressed to the winter months. Additionally, looking at her journey with respect to temperature, the temperature decreases as Catherine moves toward Florida. This change in temperature could be because, as time goes on and the year progresses to winter, the temperature naturally decreases. There were several points in Catherine's movements south that she went back north, which could be due to ocean currents that caused her to move in a direction that she did not intend to go in (Luschi et al. 2003). Once Catherine reached the Florida coast, she stayed in an almost constant area. While this lack of movement could be attributed to nesting, female turtles usually nest in the early summer months, so this could more likely be attributed to, as the winter comes, many turtles find wintering areas that are near land (Hawkes et al. 2007). This movement is shown in the map that shows Catherine's movement along the Florida Coast. Contrasting all of Catherine's movement is that of Chubby's. Chubby did not travel beyond only a few miles off the coast of Bermuda, as seen in the map that explains Chubby's movements off the coast of Bermuda. Chubby found warmer water than Catherine . This could be one of the reasons that Chubby did not move from the coast of Bermuda as time went on.

V. Conclusion

As sea turtles move across the ocean, traveling from one place to another, their movements are influenced by many variables, such as sea surface temperature and ocean currents. As an endangered species, it is important for scientists to track the movements of green sea turtles in order to increase and focus conservation efforts. Satellite tracking of sea turtles can reveal trends in the previous discussed variables. For example, Catherine's movements went along with previous research. She moved south during the winter months. The temperature hovered around the same few degrees throughout Catherine's journey, showing that she moved south and toward Florida because of this. Additionally, she moved on the edge of the Gulf Stream current, as suggested by previous research as well. On the other hand, Chubby did not follow these patterns. He stayed around the Bermuda coast even with the ocean current movement and the as the temperature decreased. This is important because, as this does not go with the trends that have been previously established, there may be other turtles that do not follow the trends as well. This means that scientists will have to expand research into different areas. There could be many turtle populations that are being depleted due to human activity that are being missed by conservation efforts, as these are only geared toward areas where previous research has found turtle movement or residency. As global warming increases climate change and sea surface temperatures and ocean currents change, the factors that influence sea turtle movements may also change (Coyne et al. 2005). This is why it is essential for research like this to continue to explore how sea turtle movements change with time.

V.I. Future Research

Research can be extended to continue to examine the track of the turtles. It would especially be interesting to look at the track of Catherine to see if she remains in Florida throughout the winter and to see if she ventures back, the track suggested by previous research. Additionally, research can be extended to track turtles in other parts of the world to see if turtles are not following the track laid out by sea surface temperature and ocean current data. Research should also be done to study the specific effects that climate change is having on these variables and how this is affecting sea turtle movement.

VII. References

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