Tracking turtles with telemetry

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A new model has been created that can forecast the location of Eastern Pacific leatherback turtles along the coast of Central and South America in an effort to decrease bycatch mortality of this critically endangered and ecologically important species.

Scientists from University of Maryland Center for Environmental Science have developed a unique model in collaboration with Dr. George Shillinger at the nonprofit Upwell Turtles that can predict on a monthly basis where Eastern Pacific leatherbacks are most likely to be residing.

"Upwell was created to address an unmet need in sea turtle conservation: protecting turtles in the ocean, where they spend most of their lives. By engaging new consistencies and improving access to predictive tools, like the South Pacific Turtle Watch, we can reduce the threats turtles face at sea from fisheries interactions," said Upwell Executive Director Dr. George Shillinger.

A website called South Pacific Turtle Watch will be launched in coordination with this study as an online resource to educate the public on the importance of protecting leatherback turtles and to allow public access to the models predicting Eastern Pacific leatherbacks' location.

By providing countries connected to this species with this information, scientists hope for a decrease in the accidental capture of Eastern Pacific leatherback turtles by fisheries, a threat that is partially responsible for the species' 98 percent decline since the 1980s.

"A lot of managers and government agencies in Central and South America have been asking for something. They know leatherback populations are declining, they know fisheries have a role in it, so they have been thirsty for some information about what they can do so leatherbacks don't disappear," said study author Aimee Hoover of the University of Maryland Center for Environmental Science.

The decline in this leatherback turtle population is not all to blame on fisheries, but the purpose of this study was to produce data to inform potential management strategies to help both turtles and fishermen.

"Fishers aren't targeting leatherbacks and other marine turtle species," said Shillinger. "Incidental capture of turtles consumes time, damages equipment, and attracts unwanted negative attention. The South Pacific Turtle Watch tool will enable fishers to take proactive measures to reduce their bycatch, potentially reducing the risk of fisheries-turtle interactions within high-use turtle habitats."

Leatherback turtles, which can live over 45 years, grow up to 2000 pounds, and reach lengths over 9 feet, prey exclusively upon gelatinous zooplankton. As such, leatherbacks play an important role as a keystone species in controlling jellyfish populations, which may be increasing as a result of changing climatic conditions and food web alterations from fisheries pressures. Jellyfish are not only important for the diet of these turtles but can damage fishermen's nets and boats if they are caught in high numbers. It is estimated that less than 1,000 adult females of the species remain.

This study is the first segment of a two-part project hoping to improve leatherback turtle management strategies. This portion focused on modeling turtle residence time—how long the individual stays in one location—through satellite telemetry. Researchers are currently working on a complementary paper that will predict leatherbacks' location

through observer data collected from trained observers and volunteers on fishing vessels that encounter this critically endangered species.

Satellite telemetry technology allows for measurements and data to be collected remotely, which allows these free-moving creatures to be tracked from a distance for years once they are tagged with satellite transmitters. Turtles tagged in Costa Rica, Mexico and Peru were tracked for up to two years during a period spanning over two decades. In total, tracks from 45 different leatherbacks were used in the final analyses of this study.

The model predicts the seasonal route of leatherbacks, who migrate south from their nesting beaches into the South Pacific Gyre and then travel north to warmer temperatures near the equator during the winter, forming a circular pattern. Leatherback turtles are predicted to either travel down along the coast of Central America or travel out to the Pacific Ocean and south.

This statistically advanced model confirms previous tracks that have been developed and allows monthly models to be predicted based on current environmental conditions of leatherbacks' habitat, such as temperature, upwelling and sea surface height. Upwelling is of particular interest to turtles as it refers to the process of nutrient rich waters being brought to the surface that leads to increased abundance of prey, like gelatinous zooplankton.

"To our knowledge we're paving the way by incorporating dynamic environmental variables," commented Hoover. "Every month we're looking at a different temperature and environment over time to help model our predictions based on the changing environment this animal is experiencing."

The paper, "Predicting residence time using a continuous-time discrete-

space model of leatherback turtle satellite telemetry data" by Aimee Hoover, Dong Liang, and Helen Bailey of the University of Maryland Center for Environmental Science, George Shillinger of Upwell Turtles, and scientists from ProDelphinus, Facultad de Biologia Marina, Plymouth Marine Laboratory, Cornell University and MigraMar, was published in the journal *Ecosphere*.

More information: Aimee L. Hoover et al, Predicting residence time using a continuous-time discrete-space model of leatherback turtle satellite telemetry data, *Ecosphere* (2019). DOI: 10.1002/ecs2.2644

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