

Sex and sea turtles: New study reveals impact of climate change, sea level rise

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Loggerhead turtles are already fighting an uphill battle since roughly one in 2,500 to 7,000 sea turtles make it to adulthood. Credit: Florida Atlantic University

Marine turtles deposit their eggs in underground nests where they

develop unattended and without parental care. Incubation temperature varies with environmental conditions, including rainfall, sun, shade and sand type, and affects developmental rates, hatch and emergence success, and embryonic sex. Although the loggerhead turtle has been around for more than 60 million years, drought, heavy rainfalls and climatic changes are impacting hatchling sex ratios and influencing future reproduction. Because sea turtles don't have an X or Y chromosome, their sex is defined during development by the incubation environment. Warmer conditions produce females and cooler conditions produce males.

Researchers from Florida Atlantic University have just published the results of a four-year study in the journal *Endangered Species Research*, on the effects of turtle nest temperatures and [sand](#) temperatures and on hatchling sex.

"The shift in our climate is shifting turtles as well, because as the temperature of their nests change so do their reproduction patterns," said Jeanette Wyneken, Ph.D., professor of biological sciences in FAU's Charles E. Schmidt College of Science. "The nesting beaches along Florida's coast are important, because they produce the majority of the loggerhead hatchlings entering the northwestern Atlantic Ocean."

Loggerhead turtles are already fighting an uphill battle since roughly one in 2,500 to 7,000 sea turtles make it to adulthood. The typical loggerhead produces about 105 eggs per nesting season and would have to nest for more than 10 nesting seasons over the span of 20 to 30 years just to replace herself and possibly one mate. And, if enough males aren't produced because of climate changes, then this will result in a dire problem for this species.

"If climatic changes continue to force the sex ratio bias of loggerheads to even greater extremes, we are going to lose the diversity of [sea turtles](#) as

well as their overall ability to reproduce effectively. Sex ratios are already strongly female biased," said Wyneken. "That's why it's critical to understand how environmental factors, specifically temperature and [rainfall](#), influence hatchling sex ratios."

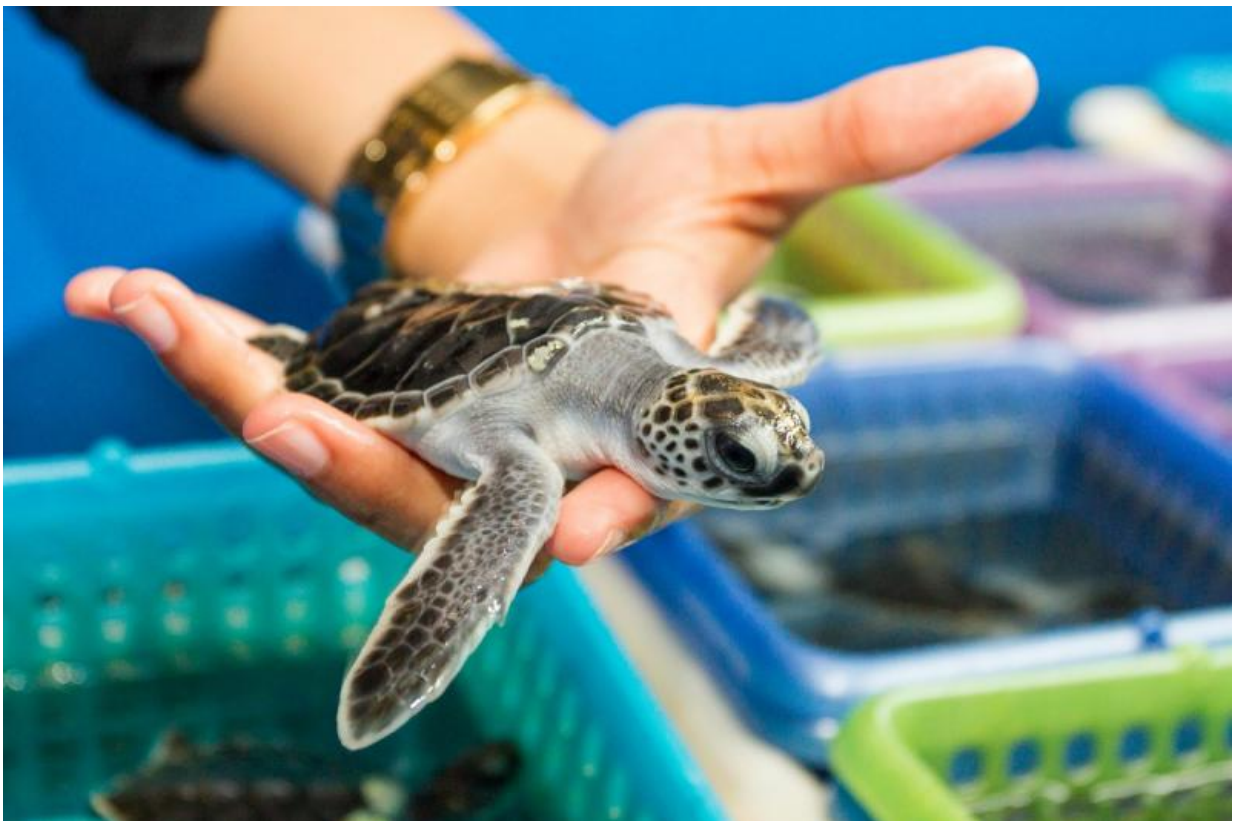


The majority of hatchlings in the sampling were female, suggesting that across the four seasons most nest temperatures were not sufficiently cool to produce males. Credit: Florida Atlantic University

Wyneken and her team documented rainfall and sand temperature relationships as well as rainfall, nest temperatures and hatchling sex ratios at a [loggerhead turtle](#) nesting beach in Boca Raton, located in southeast Florida. Nesting season, which runs from April through

October, were sampled across 2010 and 2013. The researchers used temperature dataloggers in the sand at three locations and buried them at three different depths to create temperature profiles of the sand column above the level that would directly influence eggs. The rainfall data were graphed in temporal synchrony with sand temperature for each depth.

Nest temperatures were recorded throughout incubation. Rainfall data collected concurrently with sand temperatures at different depths showed that light rainfall affected only the surface sand; effects of the heaviest rainfall events tended to lower sand temperatures, however, the temperature fluctuations were very small once the moisture reached upper nest depths.



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Ocean. Credit: Florida Atlantic University

Nest temperature profiles were synchronized with [rainfall data](#) from weather services to identify relationships with hatchling sex ratios. The sex of each turtle was verified laparoscopically to provide empirical measures of [sex ratios](#) for the nest and the nesting beach.

"The majority of hatchlings in the sampling were female, suggesting that across the four seasons most nest temperatures were not sufficiently cool to produce males," said Wyneken. "However, in the early portion of the nesting and in wet years, nest temperatures were cooler, and significantly more males hatched."

Provided by Florida Atlantic University

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