Research probes temperature-dependent sex determination in turtles

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Red Eared Slider turtle. Credit: Nightryder84

Thane Wibbels, Ph.D., professor of biology in the University of Alabama at Birmingham College of Arts and Sciences, used to go out in the wild to catch turtles.

He wrestled 900 large sea-turtles "rodeo style" when he was a doctoral

student doing research on Australia's Great Barrier Reef, jumping on their backs to corral them and take blood samples for hormone measurements. At the University of Texas, he scouted turtle nests at Austin's water purification plant and dug up the eggs.

But the red-eared slider turtles that Wibbels and former UAB doctoral student Kayla Bieser study have an easier source.

"I drive down to Kliebert's Turtle and Alligator Farm in Hammond, Louisiana, at least five times a year," Wibbels said. "I'll pick up about 1,000 eggs at a time."

Those turtles are a model to try to answer a key question: How does temperature determine whether a turtle embryo turns into a male or a female? In humans, our chromosomes—specifically the X and Y chromosomes—determine whether a baby will get a pink ribbon or a blue ribbon. But if you take red-eared slider eggs and incubate them at 78.8 degrees F, all the hatchlings will be male. If you had incubated those same eggs at 87.8 degrees F, all the hatchlings would have been female. An intermediate temperature yields a mix of male and female.

Researchers call this "temperature-dependent sex determination." It is a trait of reptiles, and it probably dates back at least 220 million years to the reptile-like creatures that were forebears to all reptiles today, as well as forebears to all the species of birds and mammals in the world today. Yet the temperature control of the sex of a hatchling is still a mystery.

In a paper in the journal *Sexual Development*, published online in November and in print this month, Bieser and Wibbels investigated sex-determining/differentiation genes in red-eared sliders, during the period when the embryonic gonadal tissue develops into either testes (male) or ovaries (female). The genes they investigated are closely conserved genes that are also active during embryonic development of birds,

mammals and other reptiles.

Bieser, now an assistant professor of biology at Northland College in Ashland, Wisconsin, measured the expression levels of five key genes in turtle eggs incubated at either the male- or the female-producing temperature. She checked them from stage 15 to stage 21 of embryonic development, the crucial period when temperature can affect the sex of a red-eared slider. She found that the gene dmrt1 was the earliest gene that showed sex-specific expression in males, and she measured other genes that were activated and when they were activated.

"It gives us a roadmap of the genes that are important in vertebrate sex determination, and which ones are earliest," Wibbels said. "The one that stands out in male sex determination in all vertebrates is dmrt1."

Wibbels now plans to focus on dmrt1 and its potential connection to the still-unknown temperature switch. The recent sequencing and annotation of the Western painted turtle genome will aid in his effort to understand the mechanistic basis of temperature-dependent sex determination.

Provided by University of Alabama at Birmingham