# Line of defense: Scientists report surprising evolutionary shift in snakes

February 24 2020, by Mary-Ann Muffoletto

A juvenile Rhabdophis tigrinus “keelback” snake from the Japanese island of Ishima, takes a defense posture. Utah State University herpetologist Alan Savitzky and colleagues document an evolutionary example of adaptation in the reptiles to compensate for the absence of defensive compounds following a shift

to a new class of prey. Credit: Alan Savitzky

In the animal kingdom, survival essentially boils down to eat or be eaten. How organisms accomplish the former and avoid the latter reveals a clever array of defense mechanisms. Maybe you can outrun your prey. Perhaps you sport an undetectable disguise. Or maybe you develop a death-defying resistance to your prey's heart-stopping defensive chemicals that you can store in your own body to protect you from predators.

Such is the case with most snake species of the *Rhabdophis* genus. Commonly called "keelbacks" and found primarily in southeast Asia, the snakes sport glands in their skin, sometimes just around the neck, where they store bufadienolides, a class of lethal steroids they get from toads, their toxic prey of choice.

"These snakes bend their necks in a defensive posture that surprises unlucky predators with a mouthful of toxins," says Utah State University herpetologist Alan Savitzky, who has long studied the slithery reptiles. "Scientists once thought these snakes produced their own toxins, but learned, instead, they obtain it from their food—namely, toads."

In a surprising twist, Savitzky and colleagues discovered not all members of the genus derive their defensive toxin from the same source. The multi-national team, consisting of researchers from USU; Kyoto University, University of the Ryukyus and Nihon University in Japan; the Chinese Academy of Sciences and Leshan Normal University in China; the National Pingtung University of Science and Technology in Taiwan; the University of Sri Jayewardenepura in Sri Lanka; and the Vietnam Academy of Science and Technology, reports a species group of the snakes, found in western China and Japan, shifted its primary diet

from frogs (including toads) to earthworms.

Utah State University herpetologist Alan Savitzky examines a keelback snake at the Ashiu Forest Research Station near Kyoto, Japan. He and colleagues published findings about an adaptation following a shift in the species' dietary habits in the Feb. 24, 2020, online edition of PNAS. Credit: Kyoto University

The earthworms don't produce the toxins; instead, the snakes also snack on firefly larvae, which produce the same class of toxins as the toads. Their findings appear in the Feb. 24, 2020, early online issue of the *Proceedings of the National Academy of Sciences*.

"This is the first documented case of a vertebrate predator switching

from a vertebrate prey to an invertebrate prey for the selective advantage of getting the same chemical class of defensive toxin," says Savitzky, professor in USU's Department of Biology and the USU Ecology Center.

Given the distant relationship between toads and fireflies, he says, the dramatic dietary shift most likely involved a chemical cue shared by the toads and fireflies; perhaps the toxins themselves.

"This represents a remarkable evolutionary example of adaptation to compensate for the absence of defensive compounds following a shift to a new class of prey," Savitzky says.

**More information:** Tatsuya Yoshida el al., "Dramatic dietary shift maintains sequestered toxins in chemically defended snakes," *PNAS* (2020). www.pnas.org/cgi/doi/10.1073/pnas.1919065117

Provided by Utah State University

Citation: Line of defense: Scientists report surprising evolutionary shift in snakes (2020, February 24) retrieved 5 May 2024 from https://phys.org/news/2020-02-line-defense-scientists-evolutionary-shift.html