Snake venom research has broad implications for bite treatment

January 26 2024, by Katherine Egan Bennett

Prairie rattlesnakes typically live in the middle of the United States, from Canada south to Texas and from Idaho east to Iowa. They grow about 35 to 45

inches in length and have a signature rattle that is used to warn potential aggressors away. Rattlesnakes are venomous, and their bites can be fatal. Credit: Todd Castoe / University of Texas at Arlington

Studying how rattlesnakes regulate their venom gives us important insight into how their genes are controlled. It also highlights the challenges in treating snakebites, according to new research in the journal Genome Biology and Evolution.

"The research has broad ramifications for improving global treatment of snakebites, with potential to impact millions globally," said Todd Castoe, lead author of the study and a professor of biology at The University of Texas at Arlington.

"How new traits arise, how genomic mechanisms control turning genes on and off, and how genomic changes modify gene regulation are fundamental questions for understanding the mechanisms that control the expression of genes."

For the study, Castoe and his research team—which included scientists from the University of Arkansas at Fayetteville, the University of Colorado at Denver, and the University of Northern Colorado at Greeley—studied prairie rattlesnakes from Weld County, Colorado.

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The team analyzed the animal's venom glands to study gene expression

across individual single cells, with the goal of understanding how those genes are turned on and off by complex genomic mechanisms that regulate gene expression.

"Our findings provide new evidence for how new gene regulatory mechanisms arise to control the timing and magnitude of gene expression, and how existing regulatory mechanisms might be co-opted for new purposes to do so," Castoe said.

To expand their research beyond snakes, he and his colleagues will apply new statistical approaches to generate, test and refine hypotheses for how gene regulatory networks function—innovations that would be broadly applicable to any organism, including humans. The knowledge gained will advance fundamental understanding of how natural selection acts to evolve, maintain and finely tune complex traits.

More information: Aundrea K Westfall et al, Single-Cell Heterogeneity in Snake Venom Expression Is Hardwired by Co-Option of Regulators from Progressively Activated Pathways, *Genome Biology and Evolution* (2023). DOI: 10.1093/gbe/evad109

Provided by University of Texas at Arlington