

# Sticking around: Scientists explore parallel evolution in stick insects

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*Timema cristianae*, a rather short and stout, plant-eating stick insect found exclusively in southwestern California's Santa Ynez Mountains, has repeatedly evolved two ecotypes adapted to two different host plant species; making it an ideal model to study parallel speciation. Credit: Photo by M. Muschick.

Is evolution predictable and repeatable? That's a question Utah State University scientist Zachariah Gompert set out to explore with colleagues using *Timema cristianae*, a rather short and stout, plant-eating stick insect found exclusively in southwestern California's Santa Ynez Mountains.

Timema, also known as "walking sticks," are cryptic, meaning they visually blend into their surroundings to avoid detection by predators. The multi-university research team studied two specific ecotypes of the insect; that is, distinct varieties within species that are adapted to specific environmental or ecological conditions.

"The insects we studied have repeatedly evolved two ecotypes adapted to two different host plant species," says Gompert, assistant professor in USU's Department of Biology and the USU Ecology Center. "The ecotypes feature different back stripes and shades of green. They also have mating differences."

The divergent ecotypes provided an ideal model for Gompert and colleagues to explore natural selection's role in parallel speciation – a type of parallel evolution in which certain traits that cause reproductive isolation evolve repeatedly in independent, closely related populations, as they adapt to different environments. The researchers published their findings in the May 15, 2014, issue of *Science*.

"To conduct our study, we analyzed whole-genome divergence between 160 stick insects from four pairs of natural populations on different host-plant species," says Gompert, an evolutionary geneticist, who joined USU in August 2013. "We then re-sequenced 449 additional partial genomes from ecotype pairs experimentally transplanted to different host plants."

Stick insects make cooperative test subjects, he says, because "they

generally stay put (on a specific plant) for their entire lives."

The researchers documented a genetic basis of adaptive changes in genes, along with changes in functions of genes.

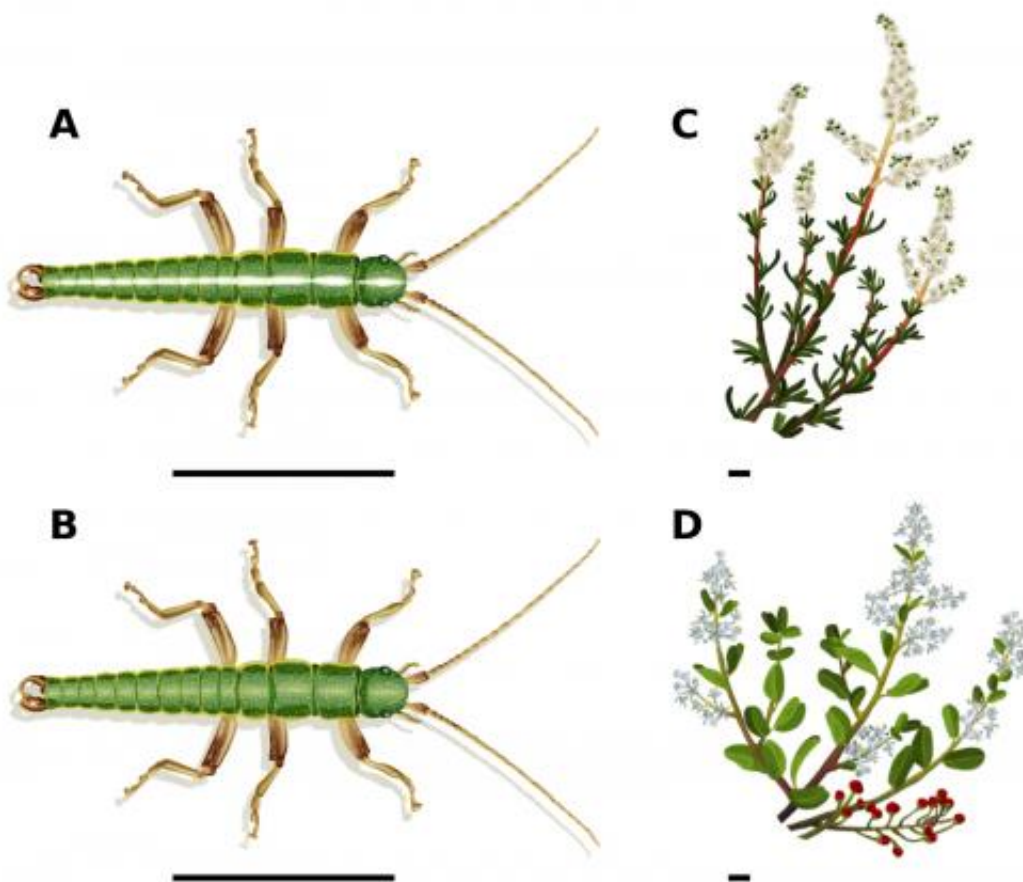


Researchers used a combination of ecological fieldwork and genomic assays to see how natural selection is playing out across the genome of *Timema cristinae*, a California stick insect that is evolving into two unique species. Credit: M. Muschick/University of Sheffield

"We noted a whopping, whopping enrichment in binding metal ions within these organisms," Gompert says. "Whether the insects store

specific metals for future needs or employ a mechanism to protect themselves from too much of these metals, we don't know. This will be an interesting area for future study."

The team's study touches on the long-held argument of determinism versus randomness and historical contingency in evolutionary biology, he says.



The species *Timema cristinae* has two distinct varieties, or ecotypes. One features a distinct white stripe on its back and feeds on the thin, needle-like leaves of a shrub called *Adenastoma*. The other phenotype has no stripe and feeds on *Ceanothus*. Credit: T. Farkas/University of Sheffield

"We asked ourselves: 'If you rewound life as if it was a videotape and played it back, would you get the same results?'" Gompert says. "Our results suggest, at least partially, yes. Despite some idiosyncratic outcomes, there may be a repeatable component driven by selection – even at the genome-wide level and during the complex process of speciation."

The study was supported by the European Research Council and faculty start-up funds from Utah State University. In addition to USU, institutions with researchers participating in the study included England's University of Sheffield, University of Nevada-Reno, Texas A&M University, University of Wyoming, Notre Dame University, Germany's F. Blumenbach Institute of Zoology and Anthropology, Switzerland's University of Lausanne, Rice University and Canada's Simon Frazer University.

**More information:** Stick Insect Genomes Reveal Natural Selection's Role in Parallel Speciation, [www.sciencemag.org/content/344/6185/738](http://www.sciencemag.org/content/344/6185/738)

Provided by Utah State University

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