Snail venoms reflect reduced competition

May 20 2009

A study of venomous snails on remote Pacific islands reveals genetic underpinnings of an ecological phenomenon that has fascinated scientists since Darwin.

The research, by University of Michigan evolutionary biologists Tom Duda and Taehwan Lee, is scheduled to be published online May 20 in the open-access journal PLoS ONE.

In the study, Duda and Lee explored ecological release, a phenomenon thought to be responsible for some of the most dramatic diversifications of living things in Earth's history. Ecological release occurs when a population is freed from the burden of competition, either because its competitors become extinct or because it colonizes a new area where few or no competitors are found. When this happens, the "released" population typically expands its diet or habitat, taking over resources that would be off-limits if competitors were present. This expansion is believed to drive the evolution of adaptations for taking advantage of the new resources, such as venoms tailored to a broader array of prey.

"Although there are plenty of examples of populations expanding into a variety of niches after experiencing ecological release, little is known about the evolution of genes associated with this phenomenon," said Duda, an assistant professor in the U-M Department of Ecology and Evolutionary Biology.

To investigate the process, Duda and Lee took advantage of a natural experiment involving a species of cone snails (Conus miliaris), which is

found in shallow waters of tropical to subtropical environments from the Red Sea and eastern shores of Africa in the western Indian Ocean to Easter Island and Sala y Gómez in the southeastern Pacific. In most areas where the species is found, C. miliaris has lots of competitors and preys on only three species of marine worms. But on Easter Island, where it has virtually no competition, the snail's diet is much broader, incorporating many additional species of worms.

Cone snails paralyze their prey with venom made up of various "conotoxins." Because different species---or in some cases even different populations---of cone snails have both distinct prey preferences and distinctly different venom compositions, Duda has speculated that natural selection has shaped particular species' venoms to most effectively paralyze their favored prey.

To test this hypothesis, Duda and Lee looked at two conotoxin genes and compared patterns of variation found in the Easter Island snails with those of snails from Guam and American Samoa, where the snails have not experienced ecological release.

"On Easter Island, where the snails are eating far more things than they're eating elsewhere, we see that different toxins predominate, suggesting that natural selection has operated at these toxin genes," said Duda, who also is a research associate with the Smithsonian Tropical Research Institute. "These results imply that ecological release is associated with strong selection pressures that are associated with the evolution of new ecologies."

More information: dx.plos.org/10.1371/journal.pone.0005558

Source: University of Michigan (news : web)