Appalachian tiger swallowtail butterfly is a hybrid of two other swallowtails, scientists find

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A yellow form of the female eastern tiger swallowtail butterfly, here at Spruce Knob, W.Va. Credit: K. Kunte, Harvard University

(PhysOrg.com) -- Flitting among the cool slopes of the Appalachian Mountains is a tiger swallowtail butterfly species that evolved when two other species of swallowtails hybridized long ago, a rarity in the animal world, biologists from The University of Texas at Austin and Harvard University have found.

They discovered that the Appalachian tiger swallowtail, Papilio appalachiensis, evolved from mixing between the Eastern tiger swallowtail, P. glaucus, and the Canadian tiger swallowtail, P. canadensis. The Appalachian tiger swallowtail rarely reproduces with its

parental species and is a unique mixture of the two in both its outward traits and inward genetic makeup.

Their research is published in PLoS Genetics.

"How new species form is one of the central questions in evolutionary biology," says Krushnamegh Kunte, a post-doctoral research fellow at Harvard who began his research as a graduate student at The University of Texas at Austin. "Hybrid speciation is more common in plants, but there are very few cases in animals. This study may create the fullest picture we have to date of hybrid speciation occurring in an animal."

Kunte and colleagues studied three of the eight species of North American tiger swallowtail butterflies. These large insects are generally recognized by yellow wings with black stripes and small "tails" on their hind wings.

Of the three species, Eastern tiger swallowtails prefer warmer climes and lower elevations, and the females come in two different forms. They are either striped (yellow and black) or almost entirely black, the latter mimicking a poisonous butterfly called the Pipevine swallowtail, Battus philenor. Canadian tigers are only striped yellow and black, and found in cooler habitats at higher latitudes and elevations.

Close-up image of the wing scales of a male eastern tiger swallowtail butterfly. Credit: K. Kunte, Harvard University

The Appalachian tiger exhibits a mix of those traits. It shares an affinity for cooler habitats with the Canadian tiger, while sharing the ability to mimic the black Pipevine swallowtail with the Eastern tiger.

Digging into the butterflies' genomes, the scientists found that the Appalachian tiger inherited genes associated with cold habitats from males of the Canadian tiger, and inherited a gene for mimicry from Eastern tiger females.

They also found that the Appalachian tiger's genome has become significantly distinct from the genomes of its two parental species, even though the butterflies come into contact with each other in the wild (the Appalachian tiger's range nudges against the Canadian tiger in the northern Appalachian Mountains and against the Eastern tiger in the lower elevations surrounding the mountains).

The conventional view of speciation is that one species splits into two over time. With time, the new "sister" species become more and more reproductively isolated from each other.

Pipevine swallowtail butterfly in the Great Smoky Mountains National Park, Tennessee. Credit: K. Kunte, Harvard University

In the case of hybrid speciation, new species are formed when two species interbreed to create viable hybrids that then evolve on their own. This can occur when two young species haven't yet evolved over a long enough period to be completely reproductively isolated.

Kunte says this is probably the case with these tiger swallowtails. The Eastern and Canadian tigers diverged from each other a mere 600,000 years ago. The Appalachian tiger seems to have diverged from both the parental species only about 100,000 years ago.

"That's not a very long time," says Kunte, "but still we found that the Appalachian tiger has been isolated long enough to have a different appearance and genetic makeup than its parent species."

As for identifying the species in the wild, Appalachian tigers are twice the size of Canadian tigers. Kunte says it's a bit more difficult to distinguish the Eastern and Appalachian tigers. The Eastern tiger has more blue on the hind wing and a spotted yellow band on its forewing underside compared with a solid broad band on the Appalachian tiger.

"Once you train your eyes to tell them apart," says Kunte with a confidence that comes from years of collecting butterflies, "they are relatively easy to distinguish."

Provided by University of Texas at Austin