

Search for the wings of a crustacean sheds light on origins of insect wings

August 27 2020, by Susan Meikle



A Parhyale hatchling. Credit: Courtney Clark-Hatchel

Genes from a tiny shrimp-like crustacean could help in the search for the origin of insect wings, a new study finds.

To be clear, there is no evidence that any crustaceans ever evolved to fly, according to evolutionary biologist Yoshi Tomoyasu, associate professor of biology at Miami University and senior author of the study recently published in *Nature Ecology and Evolution*.

The origin of [insect wings](#) is a biological mystery that has fascinated scientists for centuries. Insects evolved their wings long before birds and bats, yet, we do not know how their wings evolved, said Courtney Clark-Hatchel (Miami '12, Ph.D. '18), first author of the paper.

"Through searching for the 'wings' of a [crustacean](#) we hope to gain an understanding of where insect wings came from and how this novel structure emerged," she said.

In their study, Clark-Hatchel and Tomoyasu investigated the function of genes in the crustacean *Parhyale* whose insect counterparts are important for making wings. Their earlier research in insects identified two distinct types of tissues that contribute to form a complete wing.

In *Parhyale*, which has a body plan similar to that of insects (but without wings), they found that a [gene network](#) similar to the insect wing gene network acts on two separate tissues—the terga (back of the body) and the proximal leg (or upper part of the leg), similar to those analogous tissues in insects.

"It is striking to compare the potential wing homologs of *Parhyale* with those that have been identified in the wingless segments of insects," Clark-Hatchel said.

Their results appear to support a dual evolutionary origin of insect wings. Previously reported studies by Tomoyasu and David Linz (Miami '10, Ph.D. '17) show that a novel structure (the wing) can evolve through the collaboration of two previously unassociated tissues.

"These outcomes have a crucial impact on the course of the intellectual battle between the two historically competing [wing](#) origin hypotheses," Clark-Hatchel said.

Clark-Hatchel, currently a postdoctoral researcher at the University of North Carolina at Chapel Hill, developed the idea for this study while she was an undergraduate student working with Tomoyasu.

"This project, which was supposed to consist of looking at expression and function of one gene in *Parhyale* and take just a few months, ended up expanding to look at expression and function of three genes and expression alone of a handful more, and ended up taking about four years," she said.

"Ultimately, the effort that went into this project was well worth it."

Question-and-answer evolutionary biology tutorial with Tomoyasu

What is a wing homolog?

Wing homologs are the tissues that have common ancestry with insect wings but not necessarily used for flight.

What is an arthropod?

Insects and *Parhyale* are arthropods. An arthropod is an invertebrate animal having an exoskeleton, a segmented body and paired jointed appendages: insects, arachnids (i.e. spiders, mites), myriapods (i.e. centipedes), and crustaceans (i.e. shrimp, crabs).

With more than 1 million species that live on land, in the sea and air, arthropods make up 75% of Earth's living and fossil organisms.

Did insects evolve from crustaceans?

Yes, it is thought so. Among arthropods, insects are most closely related to crustaceans, and thus may have evolved from a group of crustaceans.

What are the oldest-known insects with wings?

I believe that the oldest-known winged insects were those that belonged to the extinct order Palaeodictyoptera, which are most closely related to insects such as mayflies and dragonflies.

Is there any evidence that any crustaceans ever evolved to fly?

No.

More information: Courtney M. Clark-Hachtel et al. Two sets of candidate crustacean wing homologues and their implication for the origin of insect wings, *Nature Ecology & Evolution* (2020). [DOI: 10.1038/s41559-020-1257-8](https://doi.org/10.1038/s41559-020-1257-8)

Provided by Miami University

Citation: Search for the wings of a crustacean sheds light on origins of insect wings (2020, August 27) retrieved 26 June 2024 from <https://phys.org/news/2020-08-wings-crustacean-insect.html>

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