Comb jellies possibly first lineage to branch off evolutionary tree

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Beroe abyssicola is a type of comb jelly examined as part of the study. Credit: University of Alabama in Tuscaloosa

A researcher at The University of Alabama was part of a new study that

provides further evidence in support of a controversial hypothesis that a group of marine animals commonly called comb jellies were the first to break away from all other animals, making it the oldest surviving animal lineage.

Dr. Kevin M. Kocot, UA assistant professor in biological sciences and curator of invertebrate zoology in the Alabama Museum of Natural History, is a co-author on a paper published in *Nature Ecology & Evolution* that outlines the findings.

The work was led by Dr. Nathan Whelan as a post-doctoral researcher in the lab of Dr. Ken Halanych, professor of biological sciences at Auburn University and director of Molette Biology Laboratory for Environmental and Climate Change Studies.

Comb jellies, whose scientific name is Ctenophora, are a group of invertebrates who swim with rows of cilia, often referred to as combs. Found worldwide, they are a crucial part of marine food chains.

Ctenophores comprise approximately 200 described species with complicated and unresolved relationships among the various lineages. Additionally, ctenophores are a diverse group with numerous physiological and ecological differences among species.

By sequencing active genes (transcriptomes) from 27 different species of comb jellies spanning the diversity of the group and conducting genome-scale phylogenetic analyses, the research team reconstructed the evolutionary history of the group and inferred the evolution of key ctenophore characters.

Using a molecular clock analysis, the team found that comb jellies split off from other animals 88 to 350 million years ago, much earlier than previously suspected. The analysis supports the conclusion that comb

jellies, not the simpler sponges, are the sister group to all other animals.

"Taken together, these results have important implications for our understanding of early animal evolution and provide insight into a poorly-known but fascinating group of marine invertebrates," Kocot said.

Morphologically simple animals, sponges lack nerves, muscles, and perhaps even true tissues, but, despite evolutionary simplicity, it is possible sponges evolved from a more complex animal, simplifying secondarily.

Dr. Kevin M. Kocot is part of a study examining comb jellies. Credit: University of Alabama in Tuscaloosa

"If sponges are secondarily simplified, it means they are probably kind of weird, and may not tell us as much about ourselves as we previously thought," Kocot said.

It is also possible sponges represent the ancestral morphology of animals and that ctenophores independently derived complex characters such as nerves and muscles. Previous research by this team published in *Nature* in 2014 showed that comb jellies pattern their nervous system using different genes than other animals, a result some have interpreted as evidence for independent evolution of neurons in this group.

"We were surprised to discover just how different the early evolution of animals is compared to what has been traditionally assumed," said Halanych. "We found interesting and major changes in lifestyle, including feeding habits and habitat preferences, with some animals being benthic and others pelagic.

"Understanding relationships within ctenophores, or comb jellies, is paramount to understanding some of the important features found in early animals, such as the evolution of the nervous system and muscles. Interestingly, the earliest branching ctenophore began developing muscles like those found in bilateral animals."

Whelan earned his doctorate in biological sciences from UA in 2013 and is now the director of U.S. Fish and Wildlife Service's Southeast Conservation Genetics Lab.

"Our work for this project reveals important patterns about early animal evolution and begins to unravel mysteries surrounding the diversity of comb jellies," Whelan said. "By adding new data and continuing to challenge conventional wisdom, we have obtained much stronger results

than in the past."

The team also included the lab of Dr. Leonid Moroz, distinguished professor of neuroscience, genetics, biology and chemistry at the University of Florida.

"Comb jellies are extremely fragile marine organisms," said Moroz. "Most of them can only be studied within their natural habitats. Thus, we must find them, perform experiments on a ship, make samples, and even sequence in open oceans, sometimes thousands of miles offshore.

"Every collection is an adventure by itself—from cold Antarctica to hot equatorial seas—to understand how Mother Nature made muscles and neurons in these creatures independently from the rest of animals. A fun job for a neuroscientist, and everyone, indeed!"

The paper, "Ctenophore relationships and their placement as the sister group to all other animals," appears online and will be published in an upcoming issue of *Nature Ecology & Evolution*.

More information: Nathan V. Whelan et al. Ctenophore relationships and their placement as the sister group to all other animals, *Nature Ecology & Evolution* (2017). DOI: 10.1038/s41559-017-0331-3

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