Secrets of the seahorse tail revealed

Computer models expose surprising evolutionary history, inspire engineering applications

Boston (March 31, 2015) – A team of engineers and biologists reports new progress in using computer modeling and 3D shape analysis to understand how the unique grasping tails of seahorses evolved. These prehensile tails combine the seemingly contradictory characteristics of flexibility and rigidity, and knowing how seahorses accomplish this feat could help engineers create devices that are both flexible and strong.

“The project brought together engineers who know computer modeling and biologists who can provide the evolutionary questions,” said leader of the research team, evolutionary biologist Dominique Adriaens, Ph.D., professor at Ghent University. “From a biological point of view, we want to understand how natural selection modified a relatively rigid ancestral tail covered with bony, armored plates into the complex seahorse tail, which is still completely covered in armored plates but is very flexible.”

Adriaens, a member of the American Association of Anatomists (AAA), will present this research at the AAA Annual Meeting during Experimental Biology 2015.

The team used information from the muscles and bones of a real seahorse tail to develop a computer model they can use to decipher how the tail gets its remarkable traits. For example, the model allows researchers to test how specific muscles and skeletal structures contribute to the tail’s grasping movement and affect the angles of bending. The computer model allows researchers to manipulate anatomy in a way that isn’t possible with living seahorses. The output can be visualized as a 3D animation of the tail and be used to estimate the energy needed to bend the tail.

The research team used thousands of 3D points from the computer model to quantify and map the seahorse’s unique armor and the muscular and skeletal system within. They then compared the anatomy of the tail to that of other fish species within the seahorse’s family, some of which do not have tails that bend or grasp.

“We hypothesized that the variation in the grasping species would be much less than non-grasping fish because it would require certain building blocks to construct a tail that is flexible and rigid at the same time,” said Adriaens. “To our surprise, we found differences in the ways a grasping tail was made, based on the same skeletal and muscular elements. Although a grasping tail is highly exceptional for a fish, it evolved multiple times independently within the family that seahorses belong to.”
Adriaens is collaborating with Michael Porter, Ph.D., assistant professor in the Department of Mechanical Engineering at Clemson University, who wants to use the findings to make protective armor that is flexible and strong, or to develop grasping robots that are long and slender.

“Understanding the mechanisms involved in the evolution of the seahorse tail lets us eliminate engineering optimization and instead use biology as our optimization model,” Porter said. “This knowledge allows us to tweak properties to achieve desired flexibility and strength characteristics. Because the seahorse armor allows for a lot of flexibility, it would be interesting to see if we can develop armored devices that have flexibility, and while not necessarily prehensile, would have a large range of motion with multiple degrees of freedom.”

Seahorses use their strong and flexible tails to anchor themselves to plants and other materials on coral reefs or the sea floor, allowing them to hide from predators.

*Dominique Adriaens will present the findings during the Experimental Biology 2015 meeting on Tuesday, March 31 from 8:48 – 9:12 a.m. at the Evolutionary Tapestry of Vertebrate Morphology and Function session in Room 104AB, Boston Convention and Exhibition Center.*

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*Images and videos available.*

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**About the American Association of Anatomists (AAA)**
AAA is the professional home for an international community of biomedical researchers and educators focusing on anatomical form and function. Founded in 1888, the society advances the three-dimensional understanding of structure as it relates to development and function, from molecule to organism. [www.anatomy.org](http://www.anatomy.org)

**About Experimental Biology 2015**
Experimental Biology is an annual meeting comprised of more than 14,000 scientists and exhibitors from six sponsoring societies and multiple guest societies. With a mission to share the newest scientific concepts and research findings shaping clinical advances, the meeting offers an unparalleled opportunity for exchange among scientists from across the United States and the world who represent dozens of scientific areas, from laboratory to translational to clinical research. [www.experimentalbiology.org](http://www.experimentalbiology.org)

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