Scientists Make, Mate Robot Tadpoles to Prove Propulsion Theory

Underwatertimes.com News Service

Poughkeepsie, New York (Nov 21, 2006 19:34 EST) A team of scientists thinks our ancient predecessors developed vertebrae and a backbone to stiffen their bodies so they could swim more powerfully and has developed robot tadpoles to help prove the theory.

The far-distant forebearers of humans and other vertebrates were much softer than their descendants. Instead of backbones they had flexible rods know as notochords. By evolving vertebrae the attached muscles could generate more force.

"The fossil record shows vertebrae evolved independently at least four separate times. That shows they must really be functionally important," said vertebrate physiologist John Long at Vassar College in Poughkeepsie, N.Y.

To test this idea, Long and his colleagues built robot fish with backbones of varying strength to simulate extinct animals. They then "mated" the best swimmers to see how generations of "offspring" evolved to swim better.

The robots -- "Tadros" -- were modeled after the larvae of marine animals known as sea squirts, swimming creatures that still have notochords.

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Each Tadro had a single electronic eye, a motor, a computerized brain that controlled its motions, and tails made of gelatin of different lengths and stiffness. The robots had bodies between six and seven inches long, with tails two to four inches long, and swam along the surface.

The scientists raced three robots in eight-foot-diameter fish tanks, each swimming to and around a light hanging above the tank.

After seeing which fish swam best, the research team "mated" them using computer simulations that modeled the genetic mixing that occurs during sex to produce the next generation of Tadro tails. The best swimmer was given the greatest mating success and opportunity to pass along its traits, while poorer swimmers were less fortunate.

After 10 generations, Long and his colleagues found that as swimming performances improved, stiffer tails evolved.

"One thing vertebrates really brought to scene were large, fast, active animals, and this part of the anatomy has a direct connection with that," Long said.

But Long said that only 40 percent of the increased swimming efficiency could be related to stiffer tails, which meant other factors were involved, including how easily the tail turns.

"We plan to investigate what that next 60 percent is," Long said.

The research team intends to add a "predator" into the tank during the next swimming competition to see how Tadro tails evolve then. This hunter will try to collide with the robots, while the Tadros will try to avoid it.

This next generation of Tadros will detect the predator using infrared sensors that mimic the pressure-sensitive organs of fish, known as lateral lines.

"We also plan not just on making the backbone stiffer, but on putting in vertebrae, to make them bend, to have joints, and see how that changes things," Long said.

Long and his colleagues reported their findings online Nov. 17 in the Journal of Experimental Biology.

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