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Gators Dive With Flexible Air Tanks

By Devin Powell
ScienceNOW Daily News
14 March 2008

A swimming alligator is an eerily quiet creature. The predator barely seems to twitch a muscle as it twists, turns, and glides toward its prey. This graceful movement may be guided by a rudder buried deep inside the reptile: flexible lungs that allow the gator to navigate by tipping its weight like a seesaw.

Only part of the alligator lung is designated for breathing: a few honeycomblike structures that transfer oxygen to the blood. The rest is divided into large, stretchy sacs that simply store air and look nothing like the lungs of mammals or even of other reptiles such as snakes and turtles. The gator inhales the way humans do, expanding muscles sandwiched between its ribs. But it also sucks in air using a fan-shaped muscle called the diaphragmaticus, which runs lengthwise along the body, connecting the pelvis to the lungs and liver. As the alligator walks, its rotating pelvis works the diaphragmaticus like a piston, pulling the lung sacs far back into the body to help draw air in.

This piston reminded T. J. Uriona, a graduate student at the University of Utah in Salt Lake City, of a muscle used by swimming frogs to change the distribution of air in their lungs. By manipulating their buoyancy, these amphibians tilt underwater like a car whose passengers are all sitting on the same side.

Wondering whether gators could do this, Uriona implanted electrodes in the muscles of five juveniles swimming in tanks. As each animal began to dive, the diaphragmaticus--and three other breathing muscles--switched on, even though the animal was holding its breath. Uriona believes that the muscles were stretching the lungs to transfer more air to the rear of the gator, thereby making the front heavier. When Uriona strapped weights to the animals' tails--the equivalent of pushing down on the wrong side of seesaw--the muscles worked even harder to counter the weight imbalance. But when the same weights were attached at the nose, the muscles eased

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Secret steering.
Alligators use their lungs to maneuver in water.

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up. And when the creature rolled to one side while swimming, the muscles on that side switched on, presumably shifting the buoyant air to the other side. "No one had seen this firing on one side or other in any context before," Uriona says of alligators. He suspects that the process works the same way in crocodiles.

The findings--reported online today in the *Journal of Experimental Biology*--suggest that the diaphragmaticus evolved in two steps, says Colleen Farmer, an evolutionary biologist and Uriona's adviser at the University of Utah. About 245 million years ago, the ancestors of modern crocodilians--a group that includes both crocodiles and alligators--would have used the diaphragmaticus only to walk. A single change--attachment to the lungs--could have switched its function to water navigation. A later change, a rewiring of nerves, might have added the air-pumping piston function, she says.

James Hicks, a physiologist who studies gators at the University of California, Irvine, wonders if birds, which evolved from the same ancestors as crocodilians, might also adjust their lungs to control buoyancy. "Are penguins, for example, doing this when they dive?"

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