Specialization for underwater hearing by the tympanic middle ear of the turtle

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A group of biologists from Denmark and the US led by Jakob Christensen-Dalsgaard, University of Southern Denmark, and Catherine Carr, University of Maryland, have shown that the turtle ear is specialized for underwater hearing.

The new discovery is published in Proceedings of the Royal Society B March 21, Special features of the turtle ear – a large, air-filled middle ear and a movable tympanic disk increase its sensitivity for underwater sound. Laser measurements of disk vibrations in response to underwater sound show up to 100-fold larger vibrations of the disk than the surrounding water, most likely because the air volume resonates in an underwater sound field and drives the tympanic disk.

The tympanic middle ear is often seen as an adaptation to hearing in air, but the turtle tympanic ear is an anomaly here, because turtles are generally 100-fold less sensitive than other animals with eardrums, like mammals, birds and reptiles.

However, turtles are amphibious animals, and anatomical and biophysical studies by a group of biologists from Denmark and the US have shown that the ear of the red-eared slider is specialized for underwater rather than airborne sound.

CT scans, laser measurements from the ear under water and auditory evoked responses showed that the turtle ear was more sensitive for underwater than for airborne sound. The sensitivity is caused by the air

filled middle ear. Resonance in the air cavity lined by the tympanic disc drives the disc and amplifies its vibrations up to 100 fold under water.

What the turtle is using its sensitive underwater hearing for is unknown. However, the sensitive hearing can be used for prey capture, predator avoidance and navigation under water. An alternative possibility is that turtles communicate by underwater sound. Underwater sound communication is unknown in the red-eared slider, but has recently been described in two other turtle species.

Provided by University of Southern Denmark