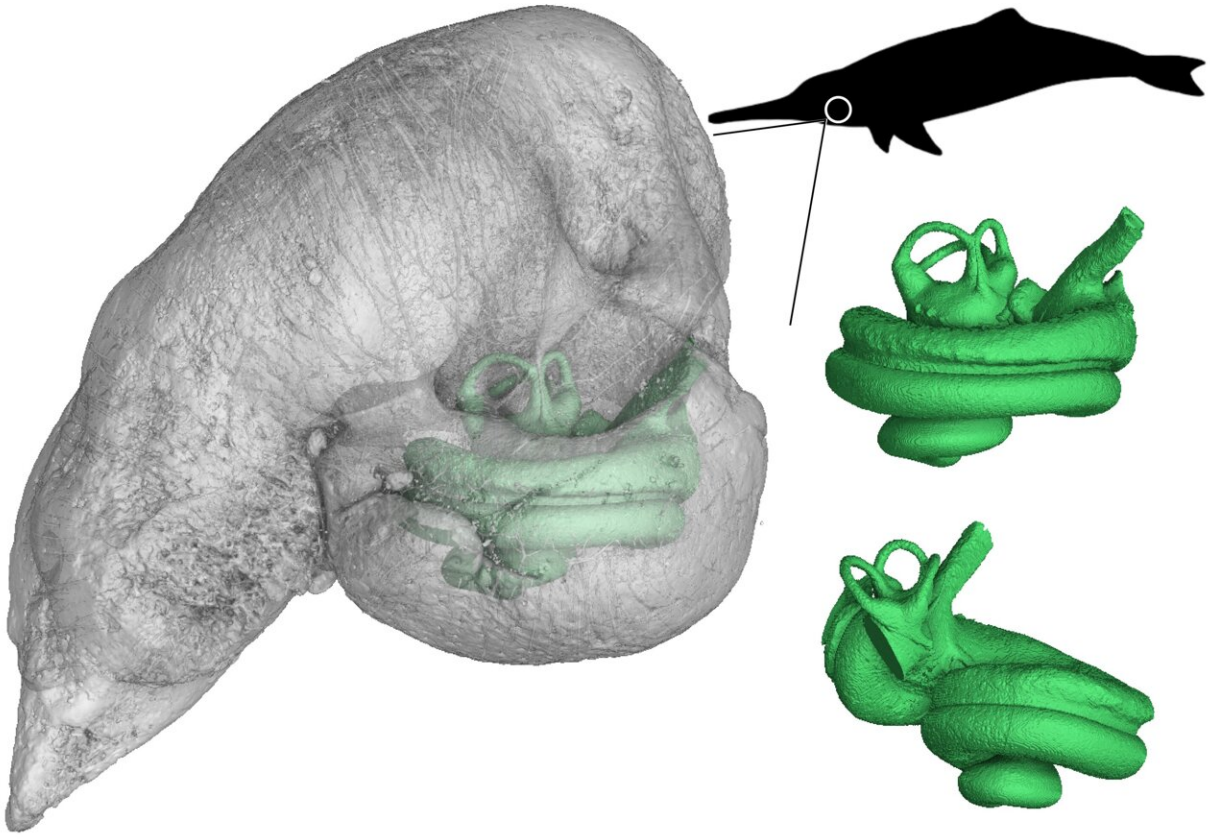
3D models show dolphins already used narrow-band sound waves for orientation 5 million years ago

July 26 2024



Examination of the inner ear of the extinct dolphin species offers insights into the animals' evolution. Photo: Senckenberg Research Institute

Senckenberg researcher Dr. Rachel Racicot and her former student Joyce Sanks from Vanderbilt University have examined the inner ear of the extinct dolphin genus Parapontoporia. In their study, published in the journal *The Anatomical Record*, they show that the toothed whales had already developed specialized high-frequency hearing in the Miocene.

The mammals also colonized rivers, which links them to today's rare and endangered river dolphins. Investigating the sensory systems of toothed whales can help to understand the influence of habitat on their hearing and the evolutionary dynamics of marine mammals.

The return of cetaceans from land to the water about 50 million years ago in the early Eocene marks one of the most pivotal periods in the evolution of mammals. As a result of this change of habitat, whales, dolphins, and porpoises acquired a number of adaptations, including the relocation of their nostrils to the top of their heads and the development of a streamlined body.

"The echolocation used by the animals also developed quite early in their evolutionary history. The animals emit a sound wave that bounces off an object and returns an echo, which provides information about the distance and size of the object. Today, all toothed whales use this natural sonar system," explains Dr. Racicot from the Senckenberg Research Institute and Natural History Museum in Frankfurt.

"Echolocation is a logical hunting and communication strategy, especially in the sea, where sound travels five times faster than in the air, while at the same time visibility is often impaired."

Racicot and Sanks examined the inner ear of three specimens of the now extinct dolphin genus Parapontoporia from the collections of the San Diego Museum of Natural History, using high-resolution X-ray CT scans. With the help of 3D models, they were able to prove that the

mammals already possessed narrow-band high-frequency hearing during the Miocene, around 5.3 million years ago.

"What is particularly exciting is that these dolphins changed their habitat once again and left the marine environment to colonize rivers," says Racicot. Even today, there are still a few dolphins living in rivers. All six species are currently very rare and threatened with extinction.

As a relative of the Chinese river dolphin (Lipotes vexillifer), which was last seen alive in 2002, Parapontoporia offers insights into the transition from a marine habitat to a freshwater environment.

"We assume that selective pressure and/or ecological advantages caused this early and widespread evolution of echolocation in the dolphins we studied. River systems are spatially complex habitats in which this form of orientation and communication was probably advantageous for the long-snouted dolphins," explains Racicot.

"Further research into the sensory systems of toothed whales can be an important tool to study the influence of habitat on cetacean hearing and to understand the evolutionary dynamics of marine mammals."

More information: Joyce Sanks et al, Predicting ecology and hearing sensitivities in Parapontoporia—An extinct long-snouted dolphin, *The Anatomical Record* (2024). DOI: 10.1002/ar.25538

Provided by Senckenberg Research Institute and Natural History Museum

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