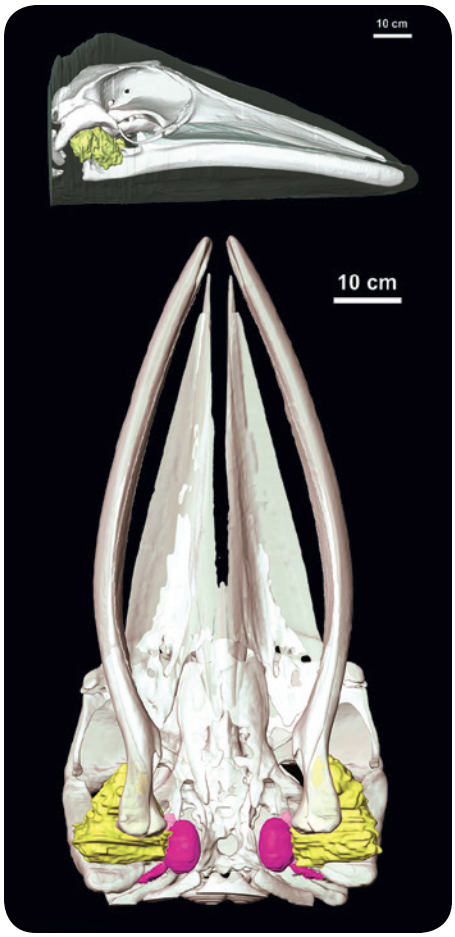
New Insights into How Whales Hear



Scans courtesy of Maya Yamato, WHOI

Fats (yellow) in minke whale heads may transmit sound from the sea to their ears (pink).

For decades, scientists have known that dolphins and other toothed whales have specialized fats in their heads that efficiently convey sound waves from the ocean to their internal ears. But until now, the hearing systems of their toothless cousins, baleen whales, remained a mystery.

While toothed whales use echolocation to find prey, baleen whales graze mostly on zooplankton, and so some scientists have speculated that baleen whales may not need such a sophisticated auditory system. But a study by scientists at Woods Hole Oceanographic Institution (WHOI), published in April 2012 in *The Anatomical Record*, has shown that some baleen whales also have fats leading to their ears. The scientists propose that fats in both types of whales may transmit sound and share a common evolutionary origin.

The auditory anatomy of baleen whales has been largely unknown because specimens to study are hard to obtain. Unlike many toothed whales, they are large and never kept in captivity. They rarely strand on beaches, and they decompose rapidly when they do.

For the new study, lead author Maya Yamato, a graduate student in the MIT/WHOI Joint Program in Oceanography, received seven heads of minke whales that had stranded and died, mostly on beaches on Cape Cod. She collaborated with the International Fund for Animal Welfare's (IFAW) Marine Mammal Rescue and Research unit in Yarmouthport, Mass.

The whale heads were scanned using computerized tomography (CT) at the Computerized Scanning and Imaging (CSI) lab at WHOI and magnetic resonance imaging (MRI) at Massachusetts Eye and Ear Infirmary in Boston. Using these biomedical techniques, the researchers generated 3-D visualizations of the whales' internal anatomy, with both bones and soft tissue intact and in their undisturbed natural positions. That provided "an unprecedented view of the internal anatomy of these animals," they wrote.

Then the whale heads were dissected in the necropsy facility at the Marine Mammal Center at WHOI. Together, the studies showed that all the minke whales had "a large, well-formed fat body" connecting to the ears, providing a potential transmission pathway guiding sound from the environment to their inner ears.

"This is the first successful study of intact baleen whale head anatomy with these advanced imaging techniques," said WHOI Senior Scientist Darlene Ketten, director of the CSI lab at WHOI and co-author on the paper. "It really is an important addition to our understanding of large whale head and auditory systems."

Also collaborating on the study were Julie Arruda and Scott Cramer at the CSI and Kathleen Moore of IFAW.

—Lonny Lippsett

This research was funded by the Joint Industry Program, the Office of Naval Research, the U.S. Navy, and by graduate fellowships from the National Science Foundation and the WHOI Ocean Life Institute.

LUSH LIFE IN THE INHOSPITABLE DEPTHS

West of the Cayman Islands, three miles deep on the Caribbean seafloor, hydrothermal vents provide oases for communities of life that thrive under high-pressure conditions, without light or oxygen. Hot, chemical-rich fluids gush like geysers from vents; microbes extract energy from the chemicals to grow and provide the base of a food chain that includes shrimp, anemones, starfish, crabs, and fish.

In 2012, WHOI scientist Chris German led an expedition returning to explore vents on the Mid-Cayman Rise. Discovered in 2009, these vents are the deepest known, and, with fluids above 400°C (750°F), among the hottest. They also spew from rocks not typically found in seafloor crust, with atypical mineral composition that alters the vent fluids' chemistry. Under similar conditions, life on Earth may have originated and life on other planets and moons may also exist. Thus, the Mid-Cayman vents offer a natural laboratory to learn how life evolved on Earth and where to search for life elsewhere in the solar system.

WHOI researchers used the remotely operated vehicle *Jason* to map the vents with sonar and gather samples of microbes, organisms, and rocks. At left, *Jason* pilots use the robot's manipulator arm to deploy a specially made device to collect vent fluids and maintain them under high pressure.

This research was funded by NASA, the National Science Foundation, the Gordon and Betty Moore Foundation, InterRidge, and the Natural Environment Research Council (United Kingdom).

Read the Blog:
http://oases2012.blogspot.com