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2009 Annual Report: Marine Mammal Center

Marine mammals generate intense popular and scientific interest and have a special conservation status in the U.S. Many populations are threatened or endangered because of past whaling and current fishing and shipping industries. Today the threats to marine mammals are less obvious than when whalers decimated whale populations, but the new threats may be just as dangerous. Fisheries compete with marine mammals for food; chemical and noise pollution threatens them [pdf article about the effects of noise pollution on marine mammals]. Our ignorance about the effects of these threats makes it nearly impossible to manage the impacts of human activities on the ocean environment. Protecting marine mammal populations requires the best science and technology for objective assessment of risks and for creative approaches to reduce these risks.

The mission of the WHOI Marine Mammal Center (MMC)—now in its second year—is to develop strength in basic research and technology, concentrating on conservation applications through strategic partnerships and interdisciplinary approaches. The Marine Mammal Center, funded in May 2008 by a generous gift from Pete and Ginny Nicholas and family, builds on WHOI's expertise, capabilities and facilities—including ships, vehicles, and a state-of-the-art laboratory, testing, and imaging facility. To better study marine mammals and improve prospects for their conservation, the MMC promotes the development of interdisciplinary teams and new opportunities, new research initiatives in critical areas, and important outreach activities.

Marine mammals offer unique opportunities for basic research. They can dive for more than an hour, down to 2 km, under pressures exceeding 200 atmospheres. These extreme diving capabilities are fascinating to respiratory physiologists. Marine mammals have some of the most sophisticated auditory systems among animals, are second among mammals only to humans in their abilities to modify the sounds they produce based upon what they hear, and some species have an extraordinary biosonar. Marine mammals have large and complex brains for their body sizes, but little is known about their neurobiology.

The WHOI MMC has a commitment to bring scientists together across disciplines to continue to support WHOI's tradition of innovation in studying marine mammals at sea. All of these areas of basic research are essential for conserving marine mammal populations. During 2009, the MMC issued a request for proposals for marine mammal research. There were a total of eight submissions from four WHOI Departments requesting support more than three times the amount available. The MMC is gratified that the proposals responded so well to the call for interdisciplinary innovation. Three proposals were funded—one to study whether bacteria found on the skin of humpback whales can indicate their health status, another to test whether a new broadband sonar can map whale prey, and a third to model the risk that whales may tangle in lobster traps.

Over the past eight years, an average of 220 marine mammals were stranded dead or alive on Cape Cod each year, a remarkably high number for such a small area. Live, stranded animals pose an animal welfare problem, while all stranded animals provide unique opportunities for research. The WHOI MMC has strategic partnerships with the International Fund for Animal Welfare Marine Mammal Rescue and Research Division (formerly the Cape Cod Stranding Network), which finds and cares for animals on the beach, and the National Marine Life Center in Bourne, Mass., which is building a state-of-the-art rehabilitation facility for marine mammals and sea turtles. The WHOI Marine Mammal Center contributes a state-of-the-art necropsy and imaging facility where researchers can study these animals.

The MMC will be working with our partners and the broader biomedical community to develop research opportunities with stranded marine mammals, consistent with the highest standards of animal welfare and husbandry. Partners will include an animal welfare organization that decides about the disposition of animals on the beach, a rehabilitation facility responsible for top quality care of captive animals, and the research group at WHOI. The

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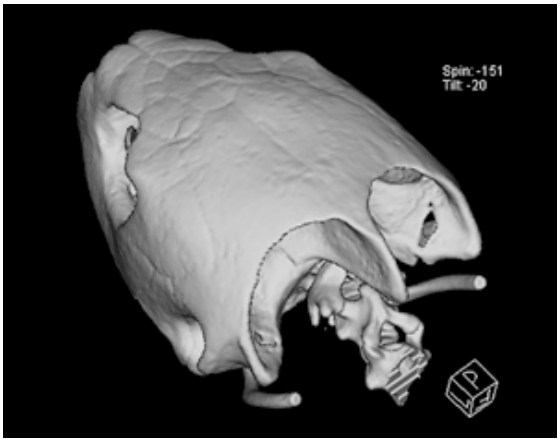
In this Dec. 17 snapshot of activity in the Marine Research Facility Necropsy Lab, researchers investigate the body of a common dolphin that died the day before in Harwich. The animal is being examined for gross pathology and being sampled to determine how it died. The ears and lungs will be used for ongoing research projects. At far left, Misty Niemeyer from the International Fund for Animal Welfare, Marine Mammal Rescue Research Division, records data. Examining the dolphin at left are independent researcher Gregory A. Early, Colby Moore, a WHOI guest student and grad student at Baylor University, and Rui Prieto, a University of Azores graduate student visiting from Horta, Azores. At right, Maya Yamato, a MIT/WHOI grad student, is removing the ears, as Alex Zosuls, from Boston University, observes. Andreas Fahlman, a WHOI research specialist in biology, is preparing the lungs for a study of their compliance at different pressures. (Photo by Michael Moore, Woods Hole Oceanographic Institution)



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Scientists and engineers from WHOI and the U.S. Navy have discovered that sea turtles' skulls and shells not only protect them from predators but also from extraordinarily powerful underwater shockwaves. This three-dimensional reconstruction from CT scans performed at the WHOI Computerized Scanning and Imaging Facility shows a posterior view of a loggerhead sea turtle skull — both the skull's plate-like structure and the deep archways, which shield the ear, brain, and spinal cord from pressure waves. The research, originally intended to help the Navy avoid harming turtles, could also point the way to designing improved

relationship offers a unique opportunity for research on animals that simultaneously meets needs for animal welfare, conservation and research. We believe that this collaboration can create unique opportunities for basic research on diving, physiology, cognition and neurobiology of marine mammals. At the same time, the research can help to identify factors contributing to mortality from strandings, entanglement in fishing gear and other conservation issues.

The WHOI MMC has partnered with the Nicholas School of the Environment at Duke University to enhance opportunities for graduate education with a competitive fellowship for graduate students at either Duke or WHOI to perform conservation-related research projects with scientists at the other institution. The 2009 call for applications resulted in the funding of six Duke graduate students to work with WHOI advisors from several departments. The MMC also helped to organize a course on Marine Mammal Science for the WHOI/MIT Joint Program.

In addition to activities at WHOI, MMC is developing other outreach efforts, including workshops, web sites and databases for open access to critical data and projects, and funds to scientists for interacting with media or providing testimony and expert advice on marine mammal research and conservation issues. The first workshop—"Gulf of Maine Seals—populations, problems and priorities" was held at the end of May and hosted 67 scientists.

Three speakers gave special MMC talks at WHOI during 2009. As an example of published outreach, we include a link to a recent article in *Physics Today* describing the effects of sound on marine mammals. Another project, recently presented at an international marine mammal science meeting in Quebec, Canada, concerns the development of a hyperbaric chamber suitable for use within the WHOI CT scanner. This has enabled the first ever, detailed visualization of the respiratory system of diving mammals at different water pressures. The study is ongoing, but has shown great promise for major improvements to models of diving physiology and our understanding of how marine mammals manage decompression sickness.

—*Peter Tyack, Center Director*

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body armor and helmets for soldiers on land. (Darlene Ketten, Woods Hole Oceanographic Institution Computerized Scanning and Imaging Facility)

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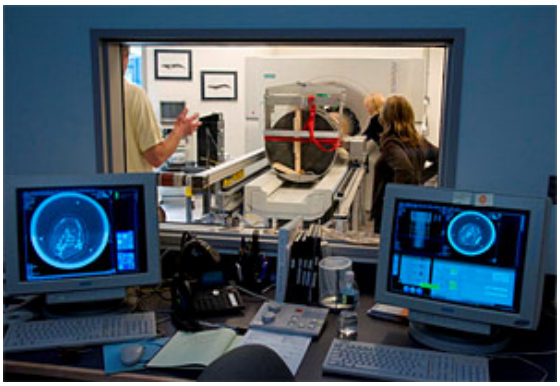
In 2009 a hyperbaric chamber was developed to use within the WHOI CT scanner. (Photo by Tom Kleindinst, Woods Hole Oceanographic Institution)



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The hyperbaric chamber has enabled the first ever, detailed visualization of the respiratory system of diving mammals at different water pressures. The study is ongoing, but has shown great promise for major improvements to models of diving physiology and our understanding of how marine mammals manage decompression sickness. (Photo by Tom Kleindinst, Woods Hole Oceanographic Institution)

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