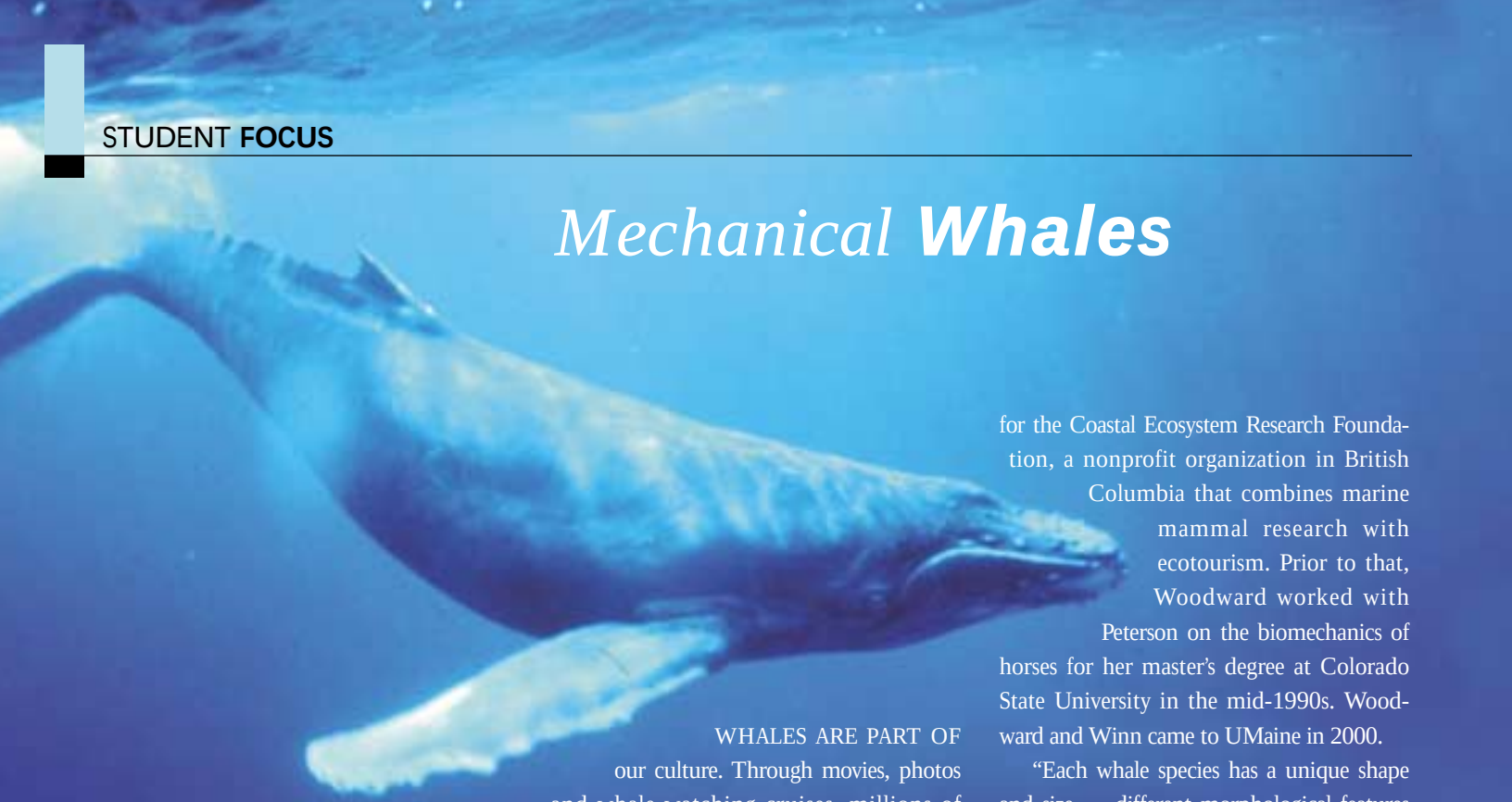
Mechanical **Whales**



Research by two UMaine students hopes to unlock the underwater secrets of the world's largest mammals

Photo by Louis Herman, courtesy of the National Oceanic and Atmospheric Administration (NOAA) Photo Library

WHALES ARE PART OF our culture. Through movies, photos and whale-watching cruises, millions of people have seen the world's largest mammals gliding at the ocean surface or showing off their signature tails or flukes. We've even recorded their eerily beautiful songs.

But considering that whales only spend about 2 percent of their time at the surface, how much do we really know about them?

Two University of Maine students are among a small number of researchers worldwide who are using new technologies to reveal the secrets of whale behavior.

Becky Woodward, a Ph.D. student in mechanical engineering, and her husband and colleague Jeremy Winn, an undergraduate in the School of Marine Sciences, have collaborated on whale research for three years. They are working with Mick Peterson, UMaine associate professor of mechanical engineering, to study how whales maneuver and how their physiology allows them to search for food at the surface and in bone-crushing depths.

Their research is funded by the Maine Science and Technology Foundation and UMaine through the Canadian-American Center, Sea Grant and the GK-12: Sensors program in the College of Engineering.

Woodward and Winn, who grew up in Virginia and Montana, respectively, worked for the Coastal Ecosystem Research Foundation, a nonprofit organization in British Columbia that combines marine mammal research with ecotourism. Prior to that, Woodward worked with Peterson on the biomechanics of horses for her master's degree at Colorado State University in the mid-1990s. Woodward and Winn came to UMaine in 2000.

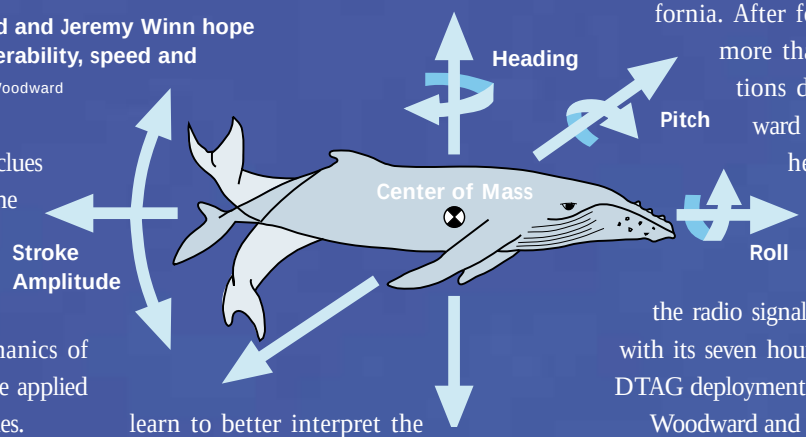
"Each whale species has a unique shape and size — different morphological features that allow them to effectively fill their particular ecological niche within the world's oceans," Woodward says. Her goal is to perform a comparative study between whale species to look at how body shapes may affect maneuverability, speed and efficiency. She also may look at why some species may be able to avoid ship strikes or fishing gear entanglements better than others.

The key to their research is a $10,000 electronic monitoring device invented at the Woods Hole Oceanographic Institution in Massachusetts. Known as the DTAG, the foot-long device includes a variety of motion and acoustic sensors. It is attached by suction cups to a whale's back and is set to release automatically. An onboard transmitter allows researchers to track the animal. After the instrument releases and floats back to the surface, researchers can follow the signal to retrieve the device and its valuable data.

In their research, Woodward and Winn successfully deployed the DTAG on blue whales in the Pacific and humpbacks in the Atlantic during the 2002 field season. Thus far, their study has taken them to the waters off British Columbia, California and Newfoundland. The project has the potential to contribute to our understanding of funda-

Photo by Tonya Peterson

In their research, Becky Woodward and Jeremy Winn hope to better understand the maneuverability, speed and efficiency of whales. Graphic by Becky Woodward



mental whale biology and provide clues about reducing human impact on the marine animals.

From an engineering perspective, the study also will provide a better understanding of the mechanics of underwater maneuvering that can be applied to new designs for underwater vehicles.

With more than 160 dives now recorded, Woodward and Winn have learned to interpret motion sensor data from the tag. The pitch record of fluke stroke patterns helps to estimate the whale's energetic efforts. In addition, characteristic dive profiles are starting to emerge for different behaviors. Dives can be sorted into foraging, feeding or traveling categories based on the shape of the dive, and stroke and glide swim patterns.

"The truth is we don't really know what the whales are doing underwater," says Winn. "But even with its limitations, this data is more than anyone has ever seen before. As we learn to better interpret the data, we will expand our insight into whale behaviors."

On the water in an inflatable zodiac, Woodward and Winn work as a team. Approaching a whale is risky. While one of them guides the boat, the other uses a 20-foot pole mounted on the bow to place the DTAG on the animal's back. From then on, they are committed. They must follow the whale and record details, such as when and where it surfaces, its behavior, and whether other animals are in the vicinity.

They are well equipped for this work. They wear insulated survival suits and carry video cameras, including one for underwater use. They also pack a digital compass, radios, a GPS, range finder, and even spare parts for the DTAG and the boat motor.

"Every time we go out, every time we put a tag on, we have to hope that the whale doesn't head out to sea or that a big fog bank doesn't roll in and make it impossible to follow the whale. Once you put a tag on, you have to follow it until it comes off," says Woodward. "It's a bit nerve-racking to have a $10,000 piece of equipment riding around on the back of a whale."

Once a DTAG failed to release on a blue whale in the Santa Barbara Channel off California. After following the animal for more than six hours, sea conditions deteriorated, and Woodward and Winn were forced to head back to shore for a long night. But luck was with them in the morning; they detected the radio signal and retrieved the device with its seven hours of data — the longest DTAG deployment on a blue whale.

Woodward and Winn now continue their investigations at UMaine. With Mick Peterson, they have formed a cetacean research group that includes John Riley, a bio-resource engineer and faculty member in the School of Marine Sciences; Anna Demeo, a marine sciences student from Southwest Harbor; and Sean Todd, a faculty member at the College of the Atlantic in Bar Harbor.

Woodward and Winn say they want to provide students and the public with opportunities to share their excitement. "We hope to use the research as a teaching tool — a way to tell people about the whales," says Winn.

Nick Houtman