Biologist studies glowing squids

She hopes to shed light on relationships between bacteria, animals

NMSU

Bobtail squids, sea creatures that inhabit shallow tropical waters around the world, have a unique way of eluding their predators on moonlit nights. Their undersides glow — just enough to match the moonlight and make them virtually invisible to eels and big fish below.

"If you're a Star Trek fan, you might think of it as a Klingon cloaking device," said New Mexico State University biologist Michele Nishiguchi, who studies the squids and their unusual relationship with the luminous bacteria they use for their protective light.

It is a case study in symbiosis — a mutually beneficial association between two different organisms — that has taken Nishiguchi to exotic locations in Hawaii, the Indo-West Pacific and the Mediterranean to collect specimens and their bacterial buddies. And because both organisms can live independently in a laboratory, unlike those in most marine symbiotic relationships, Nishiguchi can pursue her research at her new home base in southern New Mexico.

"My interest is in how bacteria interact with larger animals, including humans," said the evolutionary biologist who joined NMSU's faculty in January. "Humans and bacteria interact all the time, so it's important to understand how bacteria react and adapt, and what kinds of ecological or environmental factors are involved."

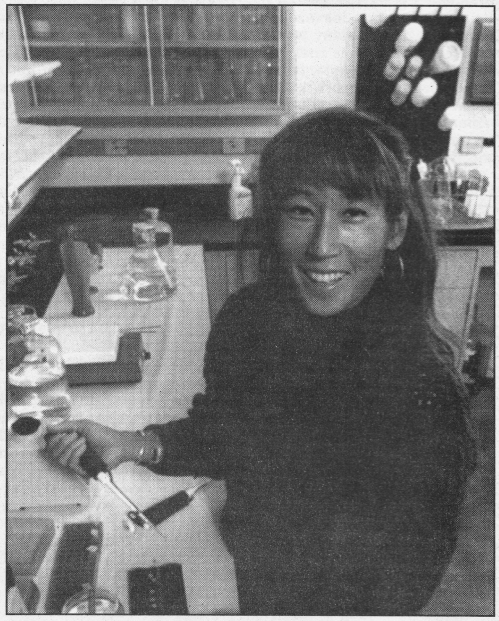
She explores these factors by getting up close and personal with bobtail squids, which include a number of closely related species of small squids in the family Sepiolidae.

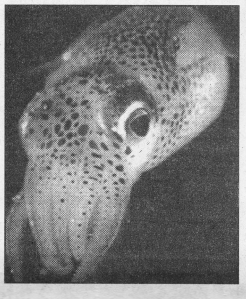
"These little guys are nocturnal; they bury themselves in the sand during the day and come out to hunt at night," said Nishiguchi. The squids are excellent predators, feeding on shrimp and other small marine life, but they also are vulnerable to larger predators in the clear, shallow waters they inhabit, she said.

From below, the bobtail squid would be easily spotted against the moonlight, if not for its "cloaking device" — a light organ that houses glow-in-the-dark bacteria known by the scientific name of Vibrio fischeri.

"The squids have a number of ways of controlling the luminescence," Nishiguchi said. Surrounding the light organ is a bilobed ink sac that acts like the diaphragm of a camera, regulating the amount of light that comes out. On the ventral (bottom) side of the light organ is a lens that casts the light downward. On the dorsal (top) side is a reflector.

Using these mechanisms, the squid can let out just the right amount of light to counter the moonlight on any given night. If there is no moonlight, the squid keeps the ink sac contracted so little light gets out.





NMSU courtesy photos

Michele Nishiguchi, an evolutionary biologist at New Mexico State University, is studying nocturnal Bobtail squids, whose 'light organ' develops only after it has been infected by a bacteria.

"At dawn the squid vents out about 90 percent of its bacteria," and the remaining 10 percent repopulate the light organ during the day, she said. The bacteria benefit from the association by obtaining nutrients from the squid. "These organisms live in nutrient-poor water; that's one of the reasons the water is so clear," she said.

In a juvenile squid, the light organ develops only after it has been infected by the bacteria, and only certain strains of bacteria can get into the organ, Nishiguchi said. Her current research focuses on the selective mechanisms involved, and how different species of bobtail squids favor one strain of Vibrio bacteria over another.

"I'm looking at what type of biochemical clues are needed for recognition," she said. In a controlled laboratory environment, she can set up a competition between two strains of bacteria, introducing equal numbers into a tank with a particular species of squid.

"If you have juvenile squids from Hawaii and you compete bacteria strains from Hawaii with Japanese bacteria, the Hawaiian bacteria will always win," she said, even though the squids from different geographic locations are closely related and the bacteria are of the same species.

"Rarely have evolutionary biologists been able to demonstrate this interorganismal fidelity so clearly," the magazine Science noted in an article reporting on Nishiguchi's research.

How and why the squids can be so finicky are questions Nishiguchi is trying to answer now, through further laboratory studies and analysis of the genetic makeup of related species of bobtail squid.

The answers could have important implications because humans, too, interact with bacteria. For example, specific enteric bacteria that live in the human intestinal tract are beneficial to humans by producing vitamins and other nutritional supplements." We need to learn a lot about bacteria and how they interact with higher organisms on both a cellular and molecular level," Nishiguchi said.

Nishiguchi got her master's degree in marine biology at the Scripps Institution of Oceanography, University of California at San Diego, and her Ph.D. in biology at UC-Santa Cruz. She did post-doctoral research at the University of Southern California, the University of Hawaii and UCLA before coming to NMSU.

"My other love besides the ocean is the desert," she said of her move to Las Cruces. "In a lot of ways the ecosystems are similar — they are filled with a potpourri of organisms trying to adapt to extreme environments."

Karl Hill is the editor at NMSU' University Communications Department. If you have questions or comments about this article, call 646-1885. Upcoming columns will highlight other NMSU research projects.