FISH FOLLOW FUNCTION

BY TOMMY NEWTON

STEVE HUSKEY IS A NOT YOUR AVERAGE FISHERMAN. HE'S A FUNCTIONAL MORPHOLOGIST. HE'S STILL A FISHERMAN, BUT WITH THE FISH HE'S CATCHING AND STUDYING AT WESTERN KENTUCKY UNIVERSITY, HE'S FISHING FOR ANSWERS TO QUESTIONS ABOUT EVOLUTION.

"My dad taught me to fish at a very young age," said Huskey, an assistant professor of biology. "He got me out on the water all the time, as much as he could. I think getting out and fishing was what got me into this field. From there it turned into a love for fish in general. I'd think 'What's this?' 'Why does it do that?' 'What's this shape for?' Now it's just like watching The Discovery Channel."

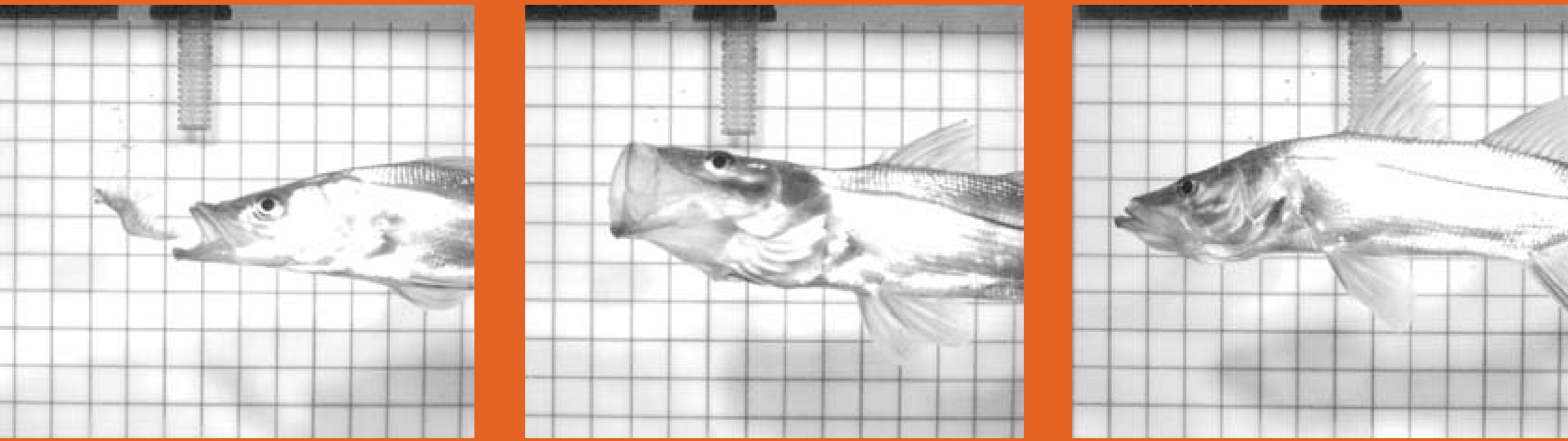
And that's the message he delivers when someone asks what he does or when students take one of his classes at WKU. "When people ask what I do, I say I'm a Ph.D. in functional morphology. Maybe five percent of people know what this is, so most people say 'What is that?' Then I get to tell them I look at an organism and how it relates to its environment. For me, that can be any organism. I can look at fish feeding. I can look at birds flying. I can look at turtles swimming. It's so wide open for me that there's absolutely no possible way I'll ever answer the questions that are out there," said Huskey, who earned his undergraduate degree at Western Michigan, his doctorate at Florida Tech, and completed a post-doc at University of California, Davis.

Huskey looks at an animal's morphological characteristics — its overall body shape and feeding mechanism, its wings or limbs, its physiology and muscle structure, its behavior — and how it uses those characteristics for survival or success in its native environment. He asks, "How does this help us better understand the organism's evolution and shed insight on human evolution?"

The process of evolution drives his research. "Understanding how evolution works is critical to the sciences, especially the life sciences. The more insight we can shed on the process of evolution, the easier it is going to be for people to understand it," he explained.

His work focuses on the evolution of vertebrates, which are organisms with backbones. Fish are his favorite because they are conducive to different experimental designs. "Throw them in the tank, get them acclimated to being

Photos courtesy of Steve Huskey. Photo collage by Stephen Ayers.


Time-lapsed images of a fish's feeding mechanism

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in captivity, let them realize you're the one that provides the food and they'll do whatever you want," he said.

Huskey's laboratory in the Complex for Engineering and Biological Sciences has tanks filled with fish and high-speed video equipment to record their activity. His office in Thompson Complex North Wing has posters, photographs, and skeletons of various fish and other vertebrates.

"All vertebrates first evolved in water," Huskey said. "People often misinterpret that to mean fish turned into amphibians that turned into reptiles and birds that turned into apes that turned into humans. It's not like that. But organisms with backbones first appeared in the aquatic environment and all vertebrates are related by some common ancestor."

The feeding mechanism of the earliest vertebrates used suction, similar to how humans drink from a straw. The organism would get close to its prey, blast open its mouth and create negative pressure to draw in the food. Over time, some fish developed two other feeding morphologies. Fish such as barracudas, bass, and snook, use ram feeding to overtake their prey while others, such as parrotfish, triggerfish, and pufferfish, use biting to scratch for food on the surface of a reef.

In his research on suction feeding, Huskey is looking at thirty species in a family of freshwater game fish, such as bass, bluegill, and sunfish, to determine "the evolutionary selective pressures for their amazing diversity in overall design."


photo by LaDonna Harmon

Dr. Steve Huskey

"You've got bluegill, which are fat and round with tiny little mouths; and bass, which are long and slender with giant mouths," he said. The species are closely related but they've used a diverse morphology for success and survival.

By looking at a photograph or skeleton of a bass, Huskey could infer that its long slender body and big mouth would make it very fast and a ram feeder. With a bluegill, Huskey could infer that it might not move as quickly and would creep up on its prey floating in the water employing suction to capture it. "We can look at the morphology and make a guess about what we think it does, but we cannot actually see what is going on until we observe it with a high speed video system," he said.

In the laboratory, Huskey looks at the fish's feeding mechanism by implanting a pressure transducer through the skull into its mouth cavity. High speed video cameras that record up to 8,000 frames per second can capture a feeding event that occurs in as little as fourteen milliseconds. How fast is that? "If you blink you miss it. It's actually faster than a human can blink," Huskey said.

Continuing, Huskey explained, "Once we have recorded the behavior then we can go back and analyze it to see what sort of differences we're seeing and look at the relationship of the morphology of an organism to its environment. That puts it in the context of evolution. The earliest feeding organisms with backbones were very simple suction feeders. And it's changed a great deal since then. It helps us understand how feeding in general evolved."

One of Huskey's students is working on a project on tooth development in wild bass as compared to hatchery bass which has implications for fisheries management. Bass use thousands of tiny teeth to grip what they've captured. In the wild, bass have developed survival skills but hatchery-raised bass are fed food pellets and don't have to worry about predators. An electron microscope that super-magnifies the teeth reveals that the teeth of hatchery-raised bass aren't as well-developed as the wild bass. That means when bass raised in captivity are released into lakes, their chances for survival aren't as great.

Huskey is also seeking funding from the National Geographic Society's Committee for Research and Exploration to study the feeding behavior of the goliath grouper, the largest bony fish species on the coral reefs of North America. The goliath grouper, which looks like an enormous largemouth bass, can grow to 700 pounds and eight feet long, and eats whatever it wants.

The species is threatened but numbers are on the rise thanks to the addition of artificial reefs along the coast of Florida. "And at the same time we're causing the goliath grouper to recover, they sometimes eat sea turtles, which are an endangered species. That means the populations of the goliath grouper and the sea turtle need to be managed correctly to maintain a sustainable resource. Also, we have no idea about the feeding behavior of this giant predator," Huskey warned. "They theoretically could eat a small human."

The study reinforces Huskey's research theme. "The more we

Imagery of Hatchery Bass Teeth Development

Imagery of Wild Bass Teeth Development

understand these animals, the better we can understand evolution and how to best manage these organisms, maintain biodiversity, and improve environmental health."

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In the case of the goliath grouper, humans shouldn't destroy their tropical reefs by overdeveloping beachfront properties and polluting their natural habitat. "We consider ourselves the overseers and owners of the globe rather than being a part of it," he said. "It can't be like that. We're driving these organisms to extinction all the time. Until we thoroughly understand the organisms, how are we going to be able to figure out how to replace what we've almost destroyed?"

Other students are working on projects to study the forelimb biomechanics of the eastern mole and the bite force biomechanics of the coyote. In Huskey's Animal Form and Function class, students watch high-speed ballistic projection of chameleon tongues, feeding behavior of cave fish, prey strikes of snakes, and fights of male beta fish.

"We always ask what's the evolutionary advantage of this, how did it evolve, why did it evolve, why is it successful? For most of them, capturing prey involves staying alive. If you put two male beta fish together, that's not survival as far as feeding; that's survival as far as competing and defeating a rival male for a female. It's always put in a context of some sort of evolutionary advantage."

In his Animal Form and Function Class, Huskey asks students "What is your favorite organism and why? Because you think it's warm and fuzzy and cute? Think about what it does out there in the wild. Why is it such a cool organism?"

Huskey, who came to WKU in 2003, said he has the perfect job. "I think for those of us who really enjoy our positions it's because we study something that has intrigued us since we can remember. We've developed a passion for whatever it is we do. Every time we answer something, it creates more questions that need to be answered," he said.

Huskey hopes to pass that passion along to his students as WKU aims to become a leading American university with international reach. Huskey explains, "I strive for student engagement by trying to get my students to do exactly what they see on The Discovery Channel in class or in the lab." ■