# Go Fish!

**DePaul researchers take "fishing trips" as far as Ecuador and as nearby as Chicago's Children's Memorial Hospital, unraveling mysteries of evolution and genomics.**

Even though DePaul is nowhere near the ocean, its Department of Biological Sciences has spawned a cadre of fish researchers. They bypass Lake Michigan to study vertebrate fauna in Alaska, Ecuador or the aquaria in their own labs. And, they collaborate with local medical researchers to push the boundaries of knowledge for both fish and humans.

"There are more fish than all other groups of vertebrates combined, so they're good for studying evolution," says Assistant Professor Windsor Aguirre, who studies both the rare (and, in some cases, unidentified) fish in biologically isolated Ecuadorian environments, and the common and well-documented three-spine stickleback, a model species for looking at evolution.

Aguirre and a graduate student, Cory Drevecky, spent part of this summer in Alaska collecting sticklebacks, which normally live in the ocean but go to fresh water to reproduce. Oceanic sticklebacks have established thousands of resident freshwater populations throughout the northern hemisphere, and these have evolved different body types and behaviors. Aguirre studies these differences. His team of one graduate and four undergraduate assistants will help analyze the new specimens: incubating their eggs to breed more sticklebacks, examining body shape variations using digital images and eventually x-raying them at the Field Museum in order to study their vertebral morphology.

Aguirre was born in Queens, N.Y., but his family returned to its native Ecuador when he was 10. His interest in biology started early and was fanned by his undergraduate studies in Ecuador. "It's amazing to study biology in a tropical country," he says. Next summer, he plans to do basic research in the isolated freshwater systems west of the Andes. "There's been virtually nothing published about the fish there, and they've really been devastated by human development," he says. He's discovered one hitherto unidentified species in an Ecuadorian river and expects to find more.

Kenshu Shimada, associate professor of biology and environmental science, trolls one of the more unlikely fishing grounds: the chalk deposits of Kansas, site of a prehistoric ocean. In 2008, he found a fin of what turned out to be a 20-foot-long plankton-eating bony fish, later named *Bonnerichthys gladius*. The fossil dates to the late Cretaceous period, about 85 million years ago. Along with the examination of previously collected museum specimens, the find led to a paper in a prestigious journal, Science, in February because the fossil fish represented the first convincing evidence of gigantic plankton-eating fish in the age of dinosaurs.

by Elizabeth Gardner

Shimada only recently saw the full specimen in person since he had to leave the site shortly after finding the fin, and his colleagues handled the rest of the excavation. "I was astounded at how complete it was," he says.

Shimada has been studying shark fossils since he was a teenager in Japan. Fossilized shark skeletons are even rarer than other vertebrate fossils because their skeletons are mostly cartilage and do not preserve as well as bones. The chalk of western Kansas is one of the few places in the world where paleontologists can find complete shark skeletons. Shimada chose Fort Hays State University in Hays, Kansas, for his B.S. and M.S. because of its strong vertebrate paleontology program. Fish fossils, including sharks, in the museum there, virtually unstudied before he arrived, turned his full attention away from the fossil mammals he initially intended to study.

Shimada frequently uses a CT scanner at Chicago's Children's Memorial Hospital to study both fossil and modern-day sharks in order to compare their anatomies and trace their evolution. He's found skeletal elements that haven't ever been documented by conventional dissection methods. Scanning also allows Shimada to keep the specimens intact—a common requirement of the museums from which he borrows them. Using scanning data, he and his graduate student were able to figure out that fast-swimming sharks have a different tail structure from those that swim slowly. "Now I can tell whether a fossil shark was a fast or sluggish swimmer," he says.

Associate Professor Elizabeth LeClair can find all the fish she wants in her own lab, because what she wants is zebrafish: the small, tough, inexpensive denizens of many a home aquarium. She fell in love with them in 2006 during an intensive six-week training program at the Marine Biological Laboratory in Woods Hole (Mass.) Oceanographic Institute. They're as essential to genetic research, and as ubiquitous, as mice and fruit flies. (The National Institutes of Health has had a Zebrafish Coordinating Committee since 1997 to promote their use as a model organism for studying vertebrate development and disease.) Now LeClair studies them, with the aid of two undergraduate assistants and one master's student who are learning cutting-edge zebrafish research techniques.

(above) ***Bonnerichthys gladius*** **roamed the seas in the age of dinosaurs. (opposite) Aguirre with student researchers Shawn Gideon and Mary Beddaoui analyze stickleback specimens. (below) Shimada and student Achebe Ikechukwu use a CT scanner to study a fossil shark.**

"Zebrafish are healthy and resistant to diseases, and they reproduce like crazy, so you can do genetic studies on them," LeClair says. "The coolest part for us is that they have a transparent embryo, so you can track what goes on in every cell at the level of genes, proteins and tissues. For students, it's a huge recruiting tool to excite them about biology and attract them to the field."

Particularly useful for teaching are zebrafish that have been genetically altered so that they produce fluorescent proteins. "We can watch their cells light up when they perform certain functions," LeClair says.

To LeClair, a developmental biologist, the possibilities for genomic research are unlimited. The zebrafish genome has been sequenced and can be compared with the genomes of other species, including humans, to see which genes have similar actions in all species. "What we observe in zebrafish is likely to be common to all vertebrates," she says.

LeClair has teamed with Jacek Topczewski, an assistant professor of pediatrics at Northwestern University's Feinberg School of Medicine, to explore how mutations cause defects in cartilage development. She recently spent 15 months under DePaul's paid-leave program to study craniofacial development in mutant zebrafish. Because zebrafish and humans share many embryonic processes, studying such mutations may lead to understanding the genetic basis of common human birth defects like cleft lip and cleft palate.

LeClair did the work under Topczewski's NIH grant, and is now waiting to hear whether she'll receive her own NIH support. She says the primary goal of further funding will be to train students in handling, breeding and raising zebrafish and in studying genetics and cell biology. "I want to teach them all the methods they need to be well-rounded biomedical scientists."

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