New Faculty Member Studies Old Fishes

An on-going VIMS study of 400-year-old sturgeon remains from Jamestown promises to throw light on the role these fishes played in the early history of North America's first permanent English colony.

The newest member of the VIMS faculty, Dr. Eric Hilton, will work to extend the study of sturgeon back a bit further—by about 80 million years.

Hilton, who began as an Assistant Professor in the Department of Fisheries Science in September, is a comparative anatomist with a Ph.D. in Organismic and Evolutionary Biology from the University of Massachusetts.

Most recently, Hilton completed a post-doctoral fellowship at the Field Museum in Chicago, where he pursued a comprehensive study of the anatomy and developmental biology of living and fossil sturgeons from around the world.

The results of his work both shook up the sturgeon family tree and portend changes to management strategies for the world's sturgeon stocks, which are threatened on all fronts—from the James River to the Caspian Sea.

Part of Hilton's post-doctoral study was a detailed description, along with geologist Lance Grande, of the earliest well-preserved fossil sturgeon, a new species from the Late Cretaceous of Montana, with an estimated age of 78 million years.

The fossil, which was collected from within the rib cage of a duckbilled dinosaur, was so well preserved that Hilton and Grande were able to dissect out the gill arches and other fragile head bones.

"It was a finely articulated, 3-D specimen with a series of new aspects," says Hilton. "It was obviously a sturgeon—its mouth, its fins—but it had a whole suite of other characters that were completely unlike any sturgeon that's known today."

Hilton cites his study of this ancient fish as a good example of the continuing value of anatomical studies—even in today's world of DNA analysis and molecular genetics.

"Comparative anatomy allows you to bring in fossils and start to say something about diversity through time," says Hilton. "But all studies of fossils should start with understanding as much as you can about living organisms, their anatomy and relationships, in order to put the fossils into context."

Hilton says that new and fundamental discoveries are being made in anatomical research every year. "New species are being discovered all the time, and with those come new interpretations of who's related to whom."

He notes that new research techniques are also allowing researchers to throw additional light on already known species. "We're still learning basic aspects of sturgeon anatomy, even though these fishes have been studied for more than 300 years," says Hilton. "The basic principles of comparative anatomy may be old, but the application of those principles is cutting-edge."

The tools that Hilton and colleagues use to study skeletal materials incorporate recent advances in both preparation techniques and digital imaging. "The advances in digital photography and reproduction in scientific papers, even in the last 10 years—it's an ongoing revolution," says Hilton. "Our ability to communicate anatomy is growing exponentially." (*Editor's note: for an example, visit* www.digimorph.org/specimens/Pseudoscaphirhynchus_kaufmanni)

To prepare specimens, Hilton uses a technique in which a series of chemical baths stain bones red, cartilage blue, and make soft tissues clear. "We can clear the muscle tissue and basically look at the whole skeleton through a transparent animal. By arranging a series of specimens from many collections, we can assemble an ontogenetic series that allows us to look at the development of individual bones."

For his comprehensive study of sturgeon development, Hilton first focused on the shortnose sturgeon *Acipenser brevirostrum*, the smallest of eastern North America's three sturgeon species. He painstakingly prepared a specimen representing each day of the sturgeon's first month of life, and continued with specimens representing regular intervals to adult size.

"All told," says Hilton, "we prepared hundreds of specimens. This is more or less a complete series for this fish, the best that's ever been put together."

Hilton's detailed study of this developmental sequence, along with comparisons between shortnose sturgeons and other sturgeons from around the world, suggest that the species that taxonomists have traditionally grouped into the genus *Acipenser* are actually not each other's closest relatives.

"Take Aral Sea sturgeons," says Hilton, "little fishes in the genus *Pseudoscaphirhynchus*. Historically, they've been widely regarded as most closely related to our river sturgeons, the genus *Scaphirhynchus*. But in looking at newly discovered anatomical characters I've been able to show that these fishes are actually more closely related to the stellate sturgeon of the Black and Caspian Sea *[Acipenser stellatus]*."

VIMS' newest faculty member Dr. Eric Hilton holds a shovelnose sturgeon (Scaphirhynchus platorynchus) *from the Missouri River.*

Clarification of these relationships is much more than an esoteric exercise in taxonomy. Hilton notes that his revision of the relationship among *Scaphirhynchus*, *Pseudoscaphirhynchus*, and *A. stellatus* suggests that *A. stellatus* may be a better model for conserving sturgeons from the Aral Sea, which are on the verge of extinction.

To help conserve and manage Virginia's own troubled population of Atlantic sturgeon *(Acipenser oxyrhynchus)*, Hilton plans to pursue studies that would help determine whether sturgeon from different Bay tributaries differ in anatomy or body shape. Because sturgeons return to their natal rivers to lay eggs, discerning river-to-river variations in morphology may help in stocking efforts.

Though Hilton says that sturgeons will always be a theme in his research, his plans at VIMS include branching out into studies of other fishes as well. That reflects the breadth of his previous work, such as his dissertation research on bony-tongue fishes and a one-year fellowship at the Smithsonian studying jacks and pompanos.

"I'd like to use the principles and techniques I've learned to start working on more derived and 'advanced' fishes," says Hilton. "I have ongoing projects with carangids—starting to look at their skeletal anatomy and development. I've just put in a proposal to work on eelpouts and their relatives. I'm collaborating with colleagues to understand how population-level processes—migration, dispersal, those sorts of things—can translate into higher-level evolutionary patterns."

Hilton is also excited about his role as the new curator of the VIMS Fish Collection. With 122,00 specimens from 295 families, the collection is significant in terms of its overall size and contains unique and important collections of fishes from Virginia's freshwater streams, Chesapeake Bay, and the deep sea. One of Hilton's goals will be to initiate another phase of growth and fill in some of the collection's holes to get an even more comprehensive record of the diversity of fishes.

"Collections are a documentation of a certain animal at a certain time and place," says Hilton. "That's an important record for people 5, 10, or 100 years from now. They can say 'this population is no longer there, or it's in trouble, or it's doing well.' Collections provide that record."

"At the same time," he adds, "you can go back to these specimens and say 'They got the ID wrong, and here's why.' You can point to particular characters and say, for instance, 'No, they were really talking about a shortnose sturgeon in that river versus an Atlantic sturgeon, or vice versa.' You can resolve those controversies and in that way help inform management decisions."

Fisheries Chair John Olney notes that Hilton's experience with both living and fossil fishes will add a new dimension to the Department. "As an internationally recognized expert in sturgeon biology and fish evolution, Eric will be a valuable asset to the Institute and the Commonwealth in the area of conservation and management of these threatened species. His classical training in fish anatomy and identification will support his role as Curator of the VIMS fish collection, a large and important resource for teaching and ichthyological research in Virginia."