The Mass Extinction of Scientists Who Study Species

By Craig McClain

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January 19, 2011

From the Fields *is a periodic Wired Science op-ed series presenting leading scientists' reflections on their work, society and culture.*

We are currently in a biodiversity crisis. A quarter of all mammals face extinction, and 90 percent of the largest ocean fish are gone. Species are going extinct at rates equaled only five times in the history of life. But the biodiversity crisis we are currently encountering isn't just a loss of species, it's also a loss of knowledge regarding them.

Scientists who classify, describe and examine the relationships between organisms are themselves going extinct. The millions of dollars spent globally on technology to catalog species may actually be pushing out the people we rely upon: taxonomists and systematists. We're like young children frantic to add new baseball cards to our collections, while the actual creators of the baseball cards themselves are vanishing.

Take for example the aplacophorans, a rare rare group of invertebrates closely related to octopuses, squids, snails and clams. Most of us will never see even one of the approximately 360 known species of small (less than a couple of inches long) aplacophorans that inhabit ocean depths greater than 50 feet. But, ignorance of this group is not limited to the public.

Fewer than two dozen scientific papers have been published on the group since 2005, even though many new species await discovery and description. And most of these studies were done by one scientist, the venerable Amélie Scheltema of Woods Hole Oceanographic Institute. As she edges closer to retirement, she may sadly become the last to study aplacophorans.

If 50 percent of the species of aplacophoran went extinct tomorrow, we would never know.

Amelie's story is tragically common. Martin Sørensen of the Natural History Museum of Denmark is one of the very few active kinorhynch, or mud-dragon, taxonomists. Martin also represents one of only two living taxonomists who have studied gnathostomulids. The other, Wolfgang Sterrer, is retired.

Both kinorhynchs and gnathostomulids are small, less than one-tenth of an inch in length, and dwell in between grains of sand and mud on the ocean floor. Fewer than 300 species are described from both of these phyla — the broadest classification scientists group animals into — and our knowledge of them is based almost entirely on collections from the well-explored eastern coast of the United States, the Mediterranean and the west coast of Europe.

"Even within these areas new species appear quite often, and when I collect outside [these areas], I always expect to find undescribed taxa exclusively," Sørensen wrote in a recent e-mail to me. His new work in the

East China sea has already uncovered 15 new species. Indeed, the morning he e-mailed me, Sørensen, looking through his microscope, had just discovered another new species.

"The number of taxonomists working on these obscure taxa has always been rather low (which explains our limited knowledge about them), but within the last 20 years taxonomy as a discipline has come under even harder pressure which has resulted in a further decline in the number of experts," Sørensen wrote.

This problem plagues well-known groups, too. For example, nematodes represent more than 28000 described species of freshwater, marine, terrestrial and parasitic roundworms. On the seafloor they account for 85 to 95 percent of all organisms. But a new study found the number of scientific papers describing new nematode species is half of what it was a decade ago, and a third of the decade before that. Anywhere between 10 000 and 100 000 species remain undescribed.

Why the loss of taxonomists? Because we have devalued their contributions, both monetarily and scientifically.

Some attribute the decline of these researchers to the replacement of outdated methods that would not meet the scrutiny of science today. These critics envision taxonomists as lone museum scientists surrounded by dusty wood cabinets and bottles of formaldehyde where species description is more art than science. But this portrayal overlooks the suite of modern genetic methods that those interested in discovery and description of new species use with increasing frequency.

This new breed of taxonomists includes Chris Mah of the Smithsonian National Museum of Natural History and Adrian Glover of the Natural History Museum in London, who are among the world's leading experts on sea stars and marine worms, respectively. Both demonstrate that the most informative science comes from synthesizing genetic techniques with more classical taxonomy based on knowledge of the anatomy and natural history of organism.

Extinction of taxonomists continues despite a growing pool of funds for biodiversity programs and databases. EUNIS, EOL, OBIS … the list goes on. These databases have pooled our collective biodiversity knowledge, helping identify what drives biodiversity and set conservation priorities.

Thankfully (my own research has relied upon them), thousands of hours and millions of dollars have been spent on these initiatives. However, many of these programs did not financially support taxonomists generating the data these databases required.

After a decade and 650 million dollars, the Census of Marine Life represents one of the largest initiatives to document biodiversity on our planet. In some regards, it was a great success, supporting 2700 scientists to produce 2600 new scientific publications and thousands of new species descriptions. But as the Census ends this year, no agency or organization is offering to fill the funding void previously filled by the Alfred P. Sloan Foundation.

Perhaps more importantly, the Census, like many initiatives, did not provide long-term positions and appointments for those doing taxonomic work. Many biology departments within universities no longer employ a taxonomist. The remaining positions are relegated to museums.

Why? As Sørensen explains, "The declining number of taxonomists and systematists is at least to some extent linked to the fact that your scientific production today should be measurable." And the units of measurement are collected grant money or the impact factor of a journal paper. Taxonomy has never been considered hot, and pure taxonomic studies are rarely funded, he wrote. Departments need grant money to operate.

Science as an institution may also be partly responsible for undercutting taxonomic work. Although a crude metric fraught with several issues, we measure the impact of a scientific paper by how many times other scientific papers have cited it. Similarly, we measure the impact of scientists by counting their cumulative citations. Unfortunately, taxonomic work is rarely cited, even when it should be.

On the other hand, the brilliant biodiversity databases we have created lead to a plethora of scientific papers. The Paleobiology Database, a comprehensive online catalog of fossil species, has already generated more than 100 publications. But the requirement for using this database, like most others, is citation of the database itself, not the nearly 35,000 papers generating the original data.

The decline in taxonomists means that at some point in the future we will be unable to train new generations of taxonomists. This problem is recognized by the National Science Foundation, which in 1994 created a program to enhance taxonomic research. But while this initiative provides training, it does not create job opportunities.

Other problems are taking form too. For example, in 2006 I set out to explore how biodiversity and body size were linked among animals. To do so I needed information on the largest - and smallest-sized species for each group of animals — something surprisingly not readily garnered from the published literature.

I relied on my connections with taxonomists for guidance and information, but for many groups I struggled to find a contact. Even for well-known animals, I was amazed by how few scientists still studied them.

My personal experience highlights how progress in biology as whole may be impeded if we lose taxonomy. The problem we face is a loss of knowledge not yet recorded in the scientific literature. In our technological efforts to concentrate our biodiversity knowledge, we may be rendering a field and body of knowledge obsolete.

And in the process, we may be undermining our own efforts to protect biodiversity.