ESA HISTORICAL RECORDS COMMITTEE

(ESTABLISHED 1944)

NEWSLETTER

Resources for the history of the Ecological Society of America
and the history of ecology and allied sciences

No. 19 **October 2019**

Notes from Louisville, August 2019: A Celebration of Diversity and Plasticity

Karen Warkentin delivered a thought-provoking plenary address at the opening of the annual meeting of the Ecological Society of America in Louisville last August. She is an integrative and comparative biologist who is interested in phenotypic plasticity, development, and behavior, but she also integrates perspectives from gender and sexuality studies with biology. Since 2011, half of her teaching at Boston University has been in women, gender and sexuality studies, in collaboration with humanists and social scientists. As she explained, she brings biological knowledge about diversity and plasticity into conversation with other fields, and brings gender and sexuality studies back to biologists.

Her plenary lecture, entitled "All the Variations Matter: Bridging Disciplines and Communities to Study Diversity in Life History and Sexual Behavior," segued from a discussion about how frog embryos perceive vibrational cues to make life and death decisions, to the importance of encouraging diversity within science, technology, engineering and mathematical (STEM) fields. Here we present a few highlights from her talk, which may be viewed on YouTube here:
https://www.youtube.com/watch?v=B3I133TVfBs

Warkentin explained through her own research, and the research of her graduate students and collaborators, why diversity is important for creative science. Her talk was a reminder of the conservative nature of much of science, a conservatism illustrated by the way certain kinds of questions remain unasked, and certain topics of research remain unexplored, for long periods of time. This conservatism fosters skeptical reactions to new ideas, and quick dismissal of claims that appear to be impossible or without significance. Diversity within the community of scientists, she argued, was one way to break through this conservatism, for diverse people bring new perspectives to science and their perspectives can lead to new questions and new knowledge. In her work, observations that opened up new questions leading to foundational discoveries began with close attention to the diversity and plasticity of behavior within the animal world. She discovered things that others had dismissed as impossible.

Warkentin works mainly on frog eggs and is known for her discovery of predator-induced hatching, as well as integrative work on how frog embryos respond to environmental cues when hatching. Her research trajectory was shaped by many experiences. As a child in Kenya, she learned to love the tropics, but frogs were not yet in the picture. Later, as an undergraduate in Canada, she experienced an epiphany after hearing a lecture about reproductive diversity in tropical frogs. In Canada, she explained,

frogs just dump their eggs in the water and go away. In the tropics, frogs reproduce in an extraordinary variety of ways, which she had no idea was even possible in one vertebrate order. As she said, this astonishing news "basically blew my queer Canadian mind." She decided to join Mike Ryan's lab at the University of Texas-Austin, to study the integrative biology of reproduction in tropical frogs. The lab's research was on sexual selection in frogs, but she was not interested in making frog heterosexuality the focus of her dissertation. She chose instead to study early life stages, where the sex of her animals was unknown and irrelevant.

In 1991 she headed to Costa Rica in search of a frog with interesting eggs or tadpoles, and found the beautiful red-eyed tree frog, which lays terrestrial eggs on leaves hanging over ponds. On hatching, the tadpoles fall into the water. She started with some basic natural history, monitoring the fate of those eggs, and she noticed that snakes ate about half the eggs. Watching a well-developed clutch closely, she saw that the embryos hatched quickly. This observation led to a hypothesis about adaptive plasticity in hatching time: maybe those embryos were using hatching to escape from snakes. Predators in the water might select against early hatching, if less developed tadpoles were more vulnerable and more likely to be eaten. More experiments would be needed to test the hypothesis that early hatching really was an adaptive response to snake predation.

On presenting her ideas and data between field seasons, Warkentin found some senior colleagues to be skeptical, for they thought it was impossible that a frog embryo could hatch fast enough to escape from a snake, and that it was impossible that a few days of development would make a difference to tadpole survival in the water. Undaunted by this skepticism, she returned to Costa Rica to set up experiments, and succeeded in documenting escape hatching at the pond. On submitting the work for publication, she encountered the same skepticism. One reviewer responded that every herpetologist knew that if one jiggled well-developed frog eggs, they hatched, but the hatching did not mean anything. Her discovery was trivial. Warkentin explained that the common assumption was that snakes were inadvertently breaking already-weakened egg capsules, which released the passive embryos. But were these embryos really so passive?

To demonstrate the falseness of these assumptions, Warkentin showed the audience a video of embryos hatching from a clutch that a snake was advancing upon, eating the embryos as it advanced. We watched as the snake touched and jiggled the eggs while feeding. And we watched as one embryo rapidly wiggled, ruptured the egg, stuck out its snout, and escaped to freedom in a way that was anything but passive. Warkentin explained that further research showed that these embryos stored a hatching enzyme enabling rapid release from the egg capsule, and that the hatching responded to vibrational cues during snake attacks, which the embryos sensed with the otoconial organs of their inner ears and also with their lateral line. Recent work by Warkentin's students is uncovering the mechanisms controlling when and where the hatching enzyme is released.

Warkentin explained that we now know that environmentally cued hatching is widespread in amphibians, whose embryos respond to many different kinds of biotic and abiotic factors. Biologists now study cued hatching directly and use it to ask other kinds of questions. Her story, she felt, illustrates the importance of learning to frame questions that nobody has thought to ask. What others took to be an impossible concept was for her a possibility that motivated her to pose a testable hypothesis leading to new knowledge.

In recounting this story, Warkentin observed that she could not have been the first biologist to bump into a red-eyed tree frog egg clutch and see a few eggs hatch. Other people at those ponds could have seen what she saw. The observation was not novel; what was novel was to see a possibility where others had not. Something had motivated her to pursue hatching plasticity as a potentially general phenomenon. She explained this difference by pointing out that "both my migratory history and my queer life have shaped my thinking and my interests."

Warkentin developed the idea that within STEM fields, human diversity benefits science by improving creativity, information processing, complex thinking, problem-solving, and decision-making. By diversity she meant diversity among people (such as diversity in gender, race, or ethnicity) but also diversity within individuals (such as having international experience or a bicultural heritage).

Her talk ended with an interesting discourse on how an understanding of developmental plasticity as a ubiquitous property of life can also provide a new way to understand diversity in human gender and sexuality. Humans have inherited from their animal ancestors an ancient ability to use sexual behavior in many different ways and for different reasons. But humans show even more variability in gender and sexuality traits than other species. To understand this higher level of variability, Warkentin noted that one main difference between humans and apes was that humans need help with child-rearing, and therefore engage in cooperative breeding, which is uncommon among mammals. The evolution of cooperative breeding in our ancestors, in turn, shaped the evolution of many of the traits that separate us from other animals. These traits include enhanced social and communication skills, while kin-selection, operating in this context, might have been a factor contributing to diversity in gender and sexuality.

Returning to her title's theme, "all variations matter," Warkentin deftly wove together biological and social themes to underscore the point that diversity and variability are important for understanding how life evolved, but also important for understanding the special qualities that make us human. Coming full circle, she argued that diversity is also important to advancing science, because different people ask and are motivated to ask different questions. Without a doubt, she concluded, "undiscovered diversity remains" and there are still things we don't fully understand concerning the diversity and plasticity of life.

After the First Earth Day: An Ecologist Reflects on His Work in Public Service

Arthur Cooper, a member of the Historical Records Committee, has written an account of his work as a government administrator in North Carolina from 1971 to 1976, *My Years in Public Service: An Ecologist's Venture into Government* (AuthorHouse, 2017). The book focuses on the period from 1971 to 1976, but touches briefly on his work as a member of the North Carolina Coastal Resources Commission from 1976 to 1989. In 1971 he took a leave of absence from his faculty position at North Carolina State University to become deputy director for programs and plans of the Department of Conservation and Development, soon folded into a new Department of Natural and Economic Resources, in the state government. The decision to bring in an ecologist was prompted in part by the rise of the environmental movement (the first Earth Day being in April, 1970). Cooper notes that his expertise in coastal ecology was particularly important for the passage of the Coastal Area Management Act (1974), especially in enumerating the areas specifically included in the Act.

The National Environmental Policy Act (NEPA) went into effect in January 1970. One of the interesting aspects of Cooper's book is the way it describes the gradual process of adapting to NEPA, which required every agency of the federal government to include an Environmental Impact Statement (EIS) in relation to its proposals for legislation. State agencies had to review and comment on EISs and make the information available for public review. At first, these impact statements and reviews were superficial, and state comments had little impact. Cooper points out that it took several years after NEPA for its impact to be felt at the state level. He had an important role in helping the state agencies to evaluate EISs and reject impact statements that failed to offer full and fair assessments of development projects affecting North Carolina.

One that he received from the Army Corps of Engineers, for a dam and lake to provide water for the city of Raleigh, was a scant 15 pages long and concluded that the project would have no negative impacts. Cooper and coworker Robert Finch, who had been hired specifically to deal with EISs, sent a response that spelled out the report's deficiencies. The Corps then provided a detailed report that, at 2000 pages, gave a better assessment of the project's merits and demerits. At other times, excessively detailed statements made evaluation of projects more difficult. Cooper remembered an impact statement for a nuclear power plant that consisted of two volumes, each nearly a foot thick, that were wheeled into his secretary's office on a freight cart.

An interesting story showing the importance of direct observation of potential impact on communities concerned a project to widen a road, which meant demolishing several houses and possibly a church in an African-American community. Cooper took a drive along that stretch of road and saw "an elderly black lady sitting in a rocking chair on the porch of a house that certainly would have been demolished." This sight made him rethink the need to rewiden the road, and he and Finch decided to oppose it. The road was never widened.

Cooper writes that where the EIS played the greatest role in determining the outcome of a controversial project was in the debate over the proposal to create a pumped-storage hydroelectric project on the New River. The New River, formed by the convergence of two rivers (North Fork New River and South Fork New River), is actually a very ancient river that meanders northward through North Carolina into Virginia and West Virginia, where it joins the Kanawha River. The two forks join in North Carolina about five miles south of the Virginia state line. The original project, proposed in the 1960s, was for two hydroelectric dams on the Virginia side, and was not particularly controversial.

Subsequent plans to increase the size of the Blue Ridge Project meant it would affect many more people and communities, and by the 1970s serious opposition arose. In 1973 Cooper wrote a "blistering critique" of the project on behalf of his Department, based on Finch's assessment of the EIS. The rewritten EIS still favored the Project and was approved, but opposition intensified at local, state, and federal levels. The controversy was resolved when President Ford signed the bill saving the New River in 1976. As Cooper remarks, the New River was saved not by disapproval of an EIS, but by Congressional politics. However, he notes that the EIS served as a vehicle to prolong and sharpen debate over the wisdom of the project, long enough for the political process to develop a final decision.

His memoirs provide a valuable insider's account of the early years of environmental politics.