RACHEL E. BOWES: RESEARCH STATEMENT

My educational and professional goal is to add to the scientific knowledge base in fundamental and applied ecology by pursuing my research interests in ecology, food webs, and conservation of biodiversity. I have successfully designed and implemented research projects both as an individual and as part of a group, completed countless days of field work, and have presented my findings both visually and verbally to colleagues within the science community and to the general public. These attributes, in addition to my own determination and ability to self-motivate, provide a strong foundation for continuing active scientific research.

How I conduct research

When conducting a comprehensive research program, I like to attack the problem from many different angles. My usual course of study includes basic observational field work, where I explore the system. After/during this portion of research I will conduct *in situ* experiments where I or nature modifies the environment in some way. I will then have a better idea of the important aspects of the study system. In controlled experiments (if the system allows) I can then have control over the important aspects of the system and further tease apart the mechanisms of what I am studying. The final step includes bringing everything together in either a framework or a model. I can then change aspects of the model to examine how this should change the dynamics of the system. These approaches give me the ability to fully explore the study system and create products that other people and scientists can build upon and use.

Publishing

My philosophy on publishing is to publish in the most appropriate journal that has the widest audience. I strive to write journal articles that are not only scientifically relevant, but useful to a general ecological audience. My publications have been in journals that have the most appropriate audience, while simultaneously being highly rated in their field.

Funding

I have been successful at obtaining funding for my research from regional and national sources. I was awarded an NSF Doctoral Dissertation Improvement Grant and helped to get a funded NSF Early-Concept Grants for Exploratory Research during my tenure as a graduate student, as well as several smaller regional grants, fellowships, and awards. I will continue to apply for and seek funding for my research, a topic of which is in the forefront of ecological research and of interest to many funding sources.

Past research experiences

I have had several diverse opportunities to expand my abilities as a researcher. This has made me a well-rounded researcher, proficient in many necessary skills. I have also led several undergraduates through the process of scientific research, developing different projects with them. These have consisted of: using next generation sequencing to determine possible female mate preferences associated with major histocompatibility complex (MHC) alleles in the sailfin molly*;* looking at deep water algae layers influence on benthic invertebrate distribution in stratified lakes; using compound specific stable isotope analysis to illuminate lake food webs; and investigating the correlation between the amount of microplastics available in an

invertebrate's environment and the amount ingested by the organism by developing an optimized enzymatic digestion protocol utilizing Chitinase and Proteinase-K enzymes. Below I list in chronological order three research projects more in depth in which I have been involved.

Temporal analysis of river food webs

The principal goal of my dissertation was to understand better the factors controlling the complexity of river food webs through time. At a shorter time scale, I first looked at how season and food availability affect fish in rivers. I utilized bulk tissue stable isotope analysis to determine trophic position of fish in the field, over different seasons, and fish in the lab, under different amounts of nutrient stress.

In the remaining chapters of my dissertation, I employed a new technique, applying nitrogen and carbon stable isotope analysis of amino acids to samples to determine trophic position and carbon food sources over time. First, I demonstrated the utility these new methods in a controlled feeding experiment in the laboratory, determining fish trophic positions. I showed that the new methods seem to offer more accuracy and precision in trophic position estimates when compared to more traditional methods of bulk tissue isotope analysis. With these new analytical methods, I proposed multidimensional metrics for use with compound specific analyses of food webs, as well as other multidimensional community measures (e.g., fatty acids, ordinal traits). Then, I evaluated long-term historical changes in habitat structure (in ArcGIS) in relation to shifts in trophic position and food sources of fish museum specimens using amino acid stable isotope analyses of both the Mississippi and Ohio rivers. I found that changes in trophic position of fish in the two rivers correlated with impoundment of the systems, and that the carbon source ultimately fueling the higher level consumers was algae within the river.

Hierarchical functioning of river macrosystems in temperate steppes

In my first postdoctoral experience, I worked on the MACRO (Macroecological riverine synthesis) project, which joins together a diverse group of scientists, graduate students and researchers from Mongolia, the USA, and Europe – focusing on macrosystem ecology as it relates to river basins in major temperate steppe regions of the world. My expertise in compound specific isotope analyses and the metrics and statistical analyses I had developed using the software "R" have been integral in contributing to this project. I assisted with field work, and provided insight into food web analyses and models for a project that consists of looking at 18 rivers in 2 continents.

River connectivity

For my second postdoctoral research position, I am a part of the River Ecology and Management Group at Karlstad University, Sweden. Here, I aim to improve our understanding of how riverine ecosystems respond to dam removal. My focus is on the holistic and comprehensive evaluation and assessment of river continuity. Current projects I developed and oversee include: dam removal influences on river system metabolism and gas exchange; how barriers block migrating fish movement assessed by telemetry and environmental DNA (eDNA); using stable isotopes to assess whole river food webs and changes in access to marine derived nutrients with barrier construction and removal; changes in benthic fauna diversity and functional traits with dam removal; riparian vegetation community responses to dam removal; determining Swedish public perspectives of dams; and a network analysis on the decision making process of dam removal in Sweden.

Future research

Rivers and their tributaries are the arteries of the planet, pumping freshwater to wetlands and lakes and out to sea. They flush nutrients through aquatic ecosystems, keeping thousands of species alive, and sustain fisheries worth billions of dollars. The importance of rivers to societies is easily recognizable, with many modern and ancient population centers being located along large rivers, tributaries, streams, and deltas. However, the sustainability of rivers and the health of their fish and invertebrate communities are increasingly threatened by a combination of instream structural modifications (levees, dams, and loss of side channels and backwaters), water extraction, watershed disturbance, pollution, climate change (including timing of snowmelt), and introduction of non-indigenous species.

Food webs are special descriptions of biological communities focused on trophic interactions between consumers and resources. Well-functioning food webs are fundamental in sustaining rivers as ecosystems and maintaining associated aquatic and terrestrial communities. Understanding energy flow up trophic levels in river food webs, nutrient cycling pathways, and ecosystem processes regulating rivers is essential in planning for wildlife conservation, environmental protection, and floodplain management. There are still many unanswered questions in regards to ecosystem functioning (i.e. food webs, river metabolism, etc…) in rivers and how they are influenced by landscape variables, interact with surrounding terrestrial ecosystems, and impacted by anthropogenic effects. This field provides an abundance of highly pertinent and fundable hypotheses, is innovative, a fruitful topic in the scientific literature, and the methods can easily involve students at all levels.