Developing quantitative approaches to examine the influence of animals on community dynamics and ecosystem processes

Animals influence cycling and fluxes of nutrients and organic matter (OM) within and across ecosystem boundaries. During Developmental Leave, I learned and applied several new quantitative modeling approaches to explore resource use and nutrient cycling effects of organisms. I examined the fluxes of OM and contaminants from aquatic systems via emergent aquatic insects and how terrestrial spiders obtain a substantial portion of their diet from emergent aquatic insects. Using stable isotopes (δ13C and δ15N), we estimated the contribution of emergent aquatic insects to spider diets using a Bayesian inference approach and found that the proportion of aquatic prey in spider diets predicted mercury (Hg) concentration in spiders. We also determined that Hg can be used in Bayesian dietary mixing models to accurately predict diets of spiders. We then used δ13C, δ15N, and Hg in a Bayesian niche modeling approach to estimate percent niche overlap among different spiders groups. In the second part of my talk, I present ongoing work in which examines the relationship between biodiversity of subterranean aquatic organisms (stygobionts) and rates of stygobiont nutrient recycling in the Edwards Aquifer, Texas, USA. Taxon-specific nutrient excretion rates were measured and then linked to abundances at each site in order to calculate the contribution of each species to the overall community-wide nutrient excretion rate. Data were used in probabilistic numerical simulations to examine how community nutrient recycling (ecosystem functioning) was affected by loss of species from the community (loss of diversity). In general, declines in species richness led to declining rates of nutrient recycling. However, the shape of the response was dependent upon species identity and the order of species loss from the community. Large-bodied stygobiont species or species that comprised a substantial proportion of the community biomass had the largest effects on community recycling rates.