Project Summary

Intellectual merit and project design: Spooner's dissertation research is examining how community structure and environmental context interact to govern the ecological services provided by communities. Using freshwater unionid mussels as a model system, the proposed research integrates physiological, community and ecosystem ecology to ask how variation in both community structure (mussel species dominance) and environment (temperature regime) affect ecosystem processes in streams. Experiments will manipulate the relative community dominance of five mussel species across three natural temperature regimes in re-circulating stream mesocosms. Individual, species, and community-level response variables will be measured including measures of physiological condition (body mass, tissue glycogen concentration and RNA:DNA, metabolic rate) and ecological performance (clearance rates, nutrient excretion, biodeposition, respiration rates of sediments, water column and whole mesocosms). Data then will be compared to laboratory-derived performance null models to test two, overlapping hypotheses for how dominant species affect stream ecosystem processes:

- H_1: Physiology governs performance and thus ecosystem services. *Prediction: At their optimal temperature, the relative contribution of dominant species to ecological processes in mesocosms will be greater than that of other component species in the community.*
- H_2: Species interactions govern performance and thus ecosystem services. *Prediction: Dominant species will influence the activity and condition of other component mussel species in the community by increasing (facilitation) or decreasing (competition) performance above or below that predicted by the null model.*

Understanding the functional significance of communities is a critical research need as ecosystems become increasingly imperiled due to species loss, habitat alteration, and climate change. Most studies of the relationship between biodiversity and ecosystem function (BEF) have been conducted in terrestrial systems with short-lived plants. This study will broaden our understanding of the BEF paradigm by examining concepts in a freshwater system with a long-lived invertebrate.

Broader Impacts:
Freshwater mussels are highly threatened by habitat alteration, and many populations are declining; the results of this project will contribute to the management and conservation of this imperiled fauna. Diversion of water between watersheds to support growing urban populations is a global threat and has been proposed for the watersheds to be studied in this project. Thus, the results obtained here should help us to understand how water transfers may impact mussel populations depending on known species dominance patterns and thermal regimes. Broader impacts of this research include using this system as a model for teaching trophic ecology and energy transfer concepts to undergraduate ecology students. In a laboratory exercise being tested this semester, students use mussels to estimate metabolism and clearance rates and compare native and invasive species. In addition, graduate and undergraduate students in our laboratory will employ techniques developed from my dissertation towards other research questions.