Ecology & Management of Annual Grass-Oak Woodland Rangelands 2009

Project: **602 Predicting the effects of environmental change and host diversity on the dynamics of insect-vectored generalist pathogens**

Leader: *Professor Susan Harrison, Division of Environmental Studies, UC Davis*
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Objective: Interactions between human-induced environmental change and pathogen dynamics are one of the most pressing and poorly understood issues facing scientists this century. Environmental change can alter pathogen dynamics in ways that increase human disease risk, intensify pathogen pressure on imperiled species, degrade ecosystem services, and endanger agricultural systems. It is crucial to understand the two major mechanisms by which anthropogenic activity affects pathogens: 1. alteration of host-community structure and 2. alteration of the abiotic environment. Vector-transmitted generalist pathogens are of particular concern as leading causes of emerging diseases. Our ability to predict how this group of pathogens will respond to human activity is limited because most theory focuses on specialists but does not explicitly incorporate the abiotic environment, and it is often logistically impossible or unethical to conduct experiments to directly test causation of processes thought to control pathogen transmission.

To address these limitations, we will develop mathematical theory of generalist vector-transmitted pathogens that explicitly incorporates host competition for abiotic resources. We will test the predictions of this theory using geographic-scale field experiments with an aphid-vectored plant virus, barley yellow dwarf (BYDV). We will test how changes in moisture and nutrient availability interact with changes in host community diversity and composition to control disease dynamics. The BYDV system is unique in that it allows us to create spatially- and phylogenetically-replicated experimental communities that mimic five important types of disease systems, thus allowing us to predict the effects of human activity on a variety of host communities and pathogens using a single general theoretical framework

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Project: **707 Nutrient Network: A Cross-Site Investigation Of Bottom-Up Control Over Herbaceous Plant Community Dynamics And Ecosystem Function.**

Leader: *Katharine Nash-Suding, Assistant Professor, University of California at Irvine*
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Objective: Our proposed experiment at SFREC will be represent of at least 40 replicated experiments in the Nutrient Network (NutNet). One goal of this project is to contribute towards a general mechanistic understanding of the relationship between productivity and diversity and its dependence on environmental factors. This research will also fill a gap in our

Project: **707 Nutrient Network: A Cross-Site Investigation Of Bottom-Up Control Over Herbaceous Plant Community Dynamics And Ecosystem Function. – Continued**

understanding of the generality of multiple resource limitation of plant productivity and its consequences for other trophic levels. At the same time, this experiment will allow us to perform stand-alone research addressing questions of multiple resource limitation in California grasslands.

Project: **808 Can Rangeland Soils be Managed for Soil Carbon Sequestration?**

Leader: *Whendee Silver, Professor, Division Ecosystem Sciences, UC Berkeley*
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Objective: Managed rangelands represent a large land-use footprint in California and have considerable potential to sequester C in soil and offset greenhouse gas emissions through changes in management practices. Climate policies and C markets may provide incentives for rangeland managers to pursue strategies that optimize soil C storage, yet we lack robust understanding of C sequestration in rangelands over time and space. Preliminary research suggests that subsoiling and composting are promising approaches for sequestering C in rangeland soil. Subsoiling and composting are both likely to change soil chemical and physical characteristics, and these will have direct and indirect effects on soil C pools. Using field experiments, laboratory incubations, and modeling, our research will the effects of subsoiling and compost amendments on rangeland soils managed for grazing. We will also compare the differences between rotational and short duration ultra-high intensity grazing regimes.

We will use field experiments to explore the effects of these promising management strategies on soil chemical and physical properties, plant inputs, and soil C and N dynamics. The proposed research employs the use the stable and radioisotopes to track C movement and provide initial estimates of the mean residence time of C in soils. We will scale our results in two ways. First we will provide a field level life cycle analysis for compost and contribute to a regional life cycle estimate that scales from production to soil application. Second, we will use the DayCent and CENTURY soil organic models to estimate the effects of these management approaches on rangeland soil statewide.

Project: **902 Interactions between seed density, seedling thinning dynamics, and nutrient supply in California grasslands**

Leader: *Valerie Eviner, Assistant Professor, Department of Plant Sciences*
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Objective: In most ecosystems, litter senesced at the end of the growing season is assumed to be the main source of carbon and recycled nutrients. However, experiments conducted by Eviner and Vaughn at HREC demonstrate that self-thinning of grass seedlings provide N and C inputs that are similar in magnitude to the C and N derived from senesced litter. In the late spring, 70% of aboveground plant N is retranslocated from senescing litter to seeds. Over 90% of these seeds germinate in the fall and these seeds and seedlings likely take up and store N during the early rains, when a significant amount of litter-derived N is leached from the system. Intense seedling competition through the growing season results in mortality of approximately 75% of the seedling, resulting in a steady release of highly labile C and N. Since seedling density largely drives seedling thinning, shifts in seed density (through management- or environment- induced changes in seed production) likely have large impacts on plant growth and nutrient cycling. Similarly, seed granivory's impact on seed density can have strong impacts on the grassland community and ecosystem. The proposed research will monitor site-to-site and year-to year variations in the relationships between granivory, seed density, seedling thinning, plant biomass, nutrient cycling and leaching throughout the growing season.