The Climate and Deserts Workshop

POSTER ABSTRACTS

Factors Driving *Pinus jeffreyi* Regeneration at a Forest-Shrubland Ecotone in Eastern California

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Global climate change will affect distribution of plant species, community species composition, and ecosystem functioning. This research focuses on large-scale precipitation and small-scale microhabitat drivers of *Pinus jeffreyi* regeneration at a forest-shrubland ecotone in eastern California. Germination and establishment were examined by planting *Pinus jeffreyi* seeds and seedlings into areas of altered snow depth (increased, decreased, and ambient snow depth manipulated by snow fences) and microhabitat (under the potential nurse species *Artemisia tridentata* and *Purshia tridentata* and in open intershrub spaces) in the spring of 2006, and monitoring survival and growth throughout the growing season. Soil water availability, photosynthetically-active radiation, air temperature, and soil temperature were measured in snow depth and microhabitat treatments. Snow melted earlier on decreased-depth compared to increased-depth plots. Soil water content at 15 cm depth was higher for increased snow depth plots during the beginning of the snowmelt period. There were differences in PAR between nurse shrub canopies and open intershrub spaces, but there were no differences in soil or air temperature. Overall seedling mortality was very high (ca. 80%) by the end of October. No differences in seedling growth or mortality due to snow depth were observed. Seedling mortality due to drought was higher in intershrub spaces as compared to under nurse shrubs, but mortality due to herbivory was higher under nurse shrubs. No differences in seedling growth among microhabitats were observed. Results suggest that microhabitat niches may be equally if not more important than changes in precipitation patterns for *Pinus jeffreyi* establishment at this ecotone.

Testing Alternative Climate-mediated Mechanisms of Loss of American Pikas from the Great Basin Ecoregion

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Biotic responses to climate change will vary among taxa and across latitudes, elevational gradients and degrees of insularity. Ecological niche forecasting uses biotic and abiotic variables characterizing the existing geographical range of a species to predict how the species will respond to altered conditions such as those resulting from global climate change. However, due to factors such as phenotypic plasticity, ecotypic variation, and evolved tolerance to thermal stress, it remains poorly understood whether species losses should be greatest in populations experiencing the greatest climatic change or in populations living closest to the edge of the bioclimatic envelope. Surveys of American pikas in montane areas of the Great Basin during the 1990s, and subsequent information-theoretic analyses, suggested that population extirpations during the 20th century were best explained by a combination of climatic, biogeographic, and anthropogenic factors. Surveys during 2003-2007 documented additional extirpations and upslope migration of the minimum elevation of

pikas at remaining sites. For both extirpations and upslope migrations, losses during the last decade have occurred much faster than they did during the 20th century. To address the evidence in support of alternative hypotheses of thermal stress on pikas, we placed 236 temperature sensors within pika habitats for 30 months and performed vegetation surveys in the vicinity of 25 sites with historical records of pikas in the Basin. We correlated our sensor data with data from the nearest weather stations and used this relationship, combined with long-term data from the same weather stations, to back-estimate temperatures within pika habitats at hundreds of locations each year between 1945 and 2006. To try to explain patterns of loss, we posited three alternative mechanisms of direct thermal stress: a) winter-cold stress; b) acute-heat stress (indexed by number of days >28˚C); and c) chronic-heat stress (indexed by average temperature during 1 June through 31 August). Magnitude of change was defined as change in our thermal metrics between 1945-1975 and 1976-2006, to avoid climatic anomalies. We found that patterns of persistence were generally best predicted by: a) drop in number of spring days <0˚C between the two 31-yr periods; and b) recent average-summer temperatures. Projection of our results into the future suggests the likelihood of pika losses at all but the most core populations very soon.

Monitoring Great Basin Climate Change within an Integrated Framework: the GBILM Approach

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The Great Basin Integrated Landscape Monitoring (GBILM) team is testing an interdisciplinary, inter-agency monitoring program for the 450,000 km^2 Great Basin. GBILM's primary goal is to develop and test state-of-the-art landscape monitoring approaches for the region. We identified and prioritized landscape-scale ecosystem drivers and developed conceptual models that hypothesize on the isolated and synergistic effects of these drivers on key landscape elements. Climate variability (natural) and change (anthropogenic) were identified as high-priority drivers and as critical covariates of all other priority drivers. To test our approach we initiated four projects investigating the potential effects of groundwater drawdown, wildfire-invasive plant interactions, land treatments, and climate change. All projects will draw upon our 30-year landcover and landscape change analysis derived from multi-resolution satellite image interpretation.

GBILM's climate change project proposes (pending funds from USGS's Global Change RFP) to: (1) refine climate reconstructions for the past 30 years, (2) compare ecotonal shifts in riparian, conifer forest, and alpine systems to climate, wildfire and land-use trends over the last three decades, (3) evaluate the impacts of ecotonal shifts on sensitive wildlife populations, and (4) analyze climate-induced effects on wildlife habitat, fire trends, and non-native grass invasions in Great Basin shrublands. We would improve climate reconstructions by mining data from >1,000 "off-line" weather stations and adding inexpensive high-spatial-resolution temperature probe arrays on

transects that span elevation gradients. Objectives 2 and 3 will result from satellite image analysis. Our results would inform land managers on the potential climatic effects on the resources they manage and improve our ability to monitor climate at management-appropriate scales.

Communicating Climate Change Information to Natural Resources Managers through Cooperative Extension

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Natural resource management needs to be designed using region specific climate science. The University of Arizona Cooperative Extension Climate and Natural Resources Working Group develops and provides relevant information, tools and models to assist natural resource managers to address climate change impacts on the resources they manage. The group conducts workshops for multiple stakeholders to discuss climate change impacts on natural resources, and how planning and management practices can be adapted. An innovative workshop approach using “vertical integration” is used to explore the concerns of natural resources managers by fostering dialogue and collaboration between managers (end-users of scientific knowledge), extension agents and specialists (interpreters and disseminators of scientific knowledge), and leading scientists (producers of scientific knowledge). Three workshops attended by 350 people have been conducted: 1) forests and woodlands, 2) rangelands and 3) riparian areas. Climatologists, ecologists, researchers and resource managers provide presentations to share findings and the current state of knowledge. Interactive, thought-provoking breakout discussions engage the audience. Fact sheets and climate scenario exercises have been developed and published. We find natural resource managers demonstrate a strong demand for climate change information. Climatologists and ecologists are eager to share their knowledge and are interested in new research questions that meet the resource managers’ needs. There exists an important window of opportunity for extension educators to lead as “translators” and “information brokers” that put research findings into simpler terms to facilitate better understanding and application. Extension educators can effectively reach a broad audience by integrating climate science into existing programs.

Can Prescribed Fire and Livestock Grazing Restore Southern Arizona's Semi-Arid Grasslands?

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Land managers are under increasing pressure to manage for biodiversity and mitigate the impacts of nonnative species, and this trend is expected to increase as the effects of nonnative species are documented. In southern Arizona many nonnative species have greatly expanded their ranges within the last few decades. These nonnative species now dominate many areas formerly occupied by native species. Lehmann lovegrass (*Eragrostis lehmanniana*) was introduced to southern Arizona in the

1930's to control erosion. It has subsequently spread into several states in the southwestern U.S. and northern Mexico. We are evaluating the efficacy of prescribed fire and livestock grazing in controlling Lehmann lovegrass with a replicated, full-factorial experiment. Prescribed fire is a potentially powerful management tool because it can be applied to large areas, it was historically present in the semi-arid grasslands of southern Arizona, and it can be relatively cost-effective. Preliminary results suggest Lehmann lovegrass decreases after a fire while native grass populations remain relatively stable or increase, which is contrary to previous reports. However, livestock grazing caused relatively little short-term community change even as grazing occurred shortly after each fire. With careful monitoring, prescribed fire can be a useful tool in the restoration and rehabilitation of semi-arid grasslands.

Potential impact of Global Environment Change on a Rare Desert Butterfly

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The rare Indra Swallowtail butterfly subspecies (*Papilio indra pygmaeus*) is known for only one mountain range in North America, near Needles, Southern California. This dwarfed and distinctly patterned subspecies described and named in 1998 is limited to just 2 square miles of the uppermost reaches near Mount Manchester in the Dead Mountains and is dependent upon a single larval host plant species, Panamint Spring Parsley (*Cymopterus panamintensis* var. *acutifolius*), a species also endemic to southern California. During recent episodic periods of drought this perennial does not emerge and the butterfly, which is tightly tied to it for its existence, does not fly. In recent years the butterfly population appears to have started to decline, possibly resulting from inability to remain in pupal diapause over extended years of drought. If the predicted drop in annual precipitation in the Desert Southwest continues in its apparent current trend this unique subspecies may very well become extinct within the next couple of decades. The big question is: can wildlife managers save it?