Department of
Environmental Science, Policy, and Management

GRADFEST SYMPOSIUM

May 4, 2012
University of California, Berkeley

Graduate Research Symposium
Friday, May 4, 2012

Department of Environmental Science, Policy, and Management
University of California, Berkeley

Program schedule

morning

9:00 am Registration, coffee, baked goods

9:20 am Welcome: Manisha Anantharaman, UC Berkeley

9:30 am Shasta Ferranto
Management without borders? A survey of landowner practices and attitudes towards cross-boundary cooperation

9:50 am Lisa Schile
Tidal wetland vegetation in the San Francisco Bay Estuary: Modeling species distribution with sea-level rise

10:10 am Clare Gupta
Elephants gone wild: People and park relations around Chobe National Park, Botswana

10:30 am Lindsay Chiono
Long-term effects of fire hazard and fuels reduction treatments in the northern Sierra Nevada, California

10:50 am Faculty Mentor Award presentation by the ESPM Graduate Students Association
Update from Claire Kremen, Head Graduate Advisor

11:00 am Keynote Address
Lessons from the Story of Stuff *by Annie Leonard, Founder and Co-Director of the Story of Stuff Project*

12:00 pm Lunch, poster session, and career development mixer

Note: All events take place in the East Pauley Ballroom or the lobby outside of East Pauley.

afternoon

1:00 pm **Seth B. Shonkoff**
The public health dimensions of horizontal hydraulic fracturing

1:20 pm **Sarah Sawyer**
New insights into the ecology and conservation of the critically endangered Cross River Gorilla

1:40 pm **Mathew Plucinski**
Using infectious disease modeling to explain the distribution of disease burden

2:00 pm **Sonja Schwartz**
One fish? Two fish? Red fish? Blue fish? Use of molecular methods to examine the origins of biodiversity in Caribbean corals (Family: Faviidae*) and Indo-Pacific parrotfishes (Genus:* Scarus*)*

2:20 pm **Becca Ryals**
Carbon and greenhouse gas dynamics in annual grasslands: Effects of management and potential for climate change mitigation

2:40 pm **Steve Bellan**
New methods for counting dead animals: Anthrax outbreaks in the zebra of Etosha National Park, Namibia

3:00 pm **Karen Weinbaum**
Sustainability and socioeconomics of wildlife hunting in Central Africa

3:20 pm **Matteo Kausch**
Modeling the impact of soil aggregate size on selenium immobilization

3:40 pm **Avery Cohn**
Examining and supporting efforts to reduce agricultural causes of deforestation in Brazil

4:00 pm **Kevin Krasnow**
Wildfire management and regeneration of quaking aspen in the Sierra Nevada

4:20 pm **Marek Jakubowski**
Lidar pulse density in the Sierra Nevada: How low can you go?

4:40 pm Graduate Diversity Council presentation

5:30 pm Departmental fellowship recipients, graduates, outstanding GSIs, extramural fellowship recipients, and Steel Rod/Golden Tongs winners honored

Keynote speaker

Annie Leonard

Founder and Co-Director The Story of Stuff Project

Annie Leonard captivates and compels millions to action through her creative films that call our attention to the high costs of our consumerism, the global impact of our throw-away technology, the corruption of our economic system, the pervasive use of toxic chemicals in our everyday products, and much more. With more than two decades of experience investigating and organizing around environmental health and justice issues, Annie has made it her life's calling to blow the whistle on important issues plaguing our world today. She is currently the Co-Director of the Story of Stuff Project, which she founded in 2008 after she created the 2007 The Story of Stuff webfilm.

Shasta Ferranto

Management without borders? A survey of landowner practices and attitudes towards cross-boundary cooperation

Since the 1980s "ecosystem management" has been recommended by conservation scientists and land management agencies as a sound approach to managing natural resources. Fragmented ownership patterns and variation in ownership values, however, can create barriers to its implementation. Practicing ecosystem management requires cross-jurisdictional problem-solving and, when private lands are involved, cross-boundary cooperation from many individual landowners. In this paper the results from a statewide survey of forest and rangeland owners in California were analyzed using an audience segmentation approach. Landowners were grouped into four clusters according to their ownership values and characterized as rural lifestyle, working landscape, natural amenity, and financial investment. Groups differed in their willingness to cooperate with others and in the amount and types of management they carried out. All groups, however, were more willing to cooperate with neighbors and local groups than with state and federal agencies. Understanding the values, motivations and management practices of different types of landowners can help guide potential collaborations between neighboring landowners, land management agencies, and other conservation organizations.

Lisa Schile

Tidal wetland vegetation in the San Francisco Bay Estuary: Modeling species distribution with sea-level rise

Sea-level is expected to rise between 55 and 140 cm by 2100 and is likely to significantly affect the distribution of tidal wetlands; however, little is known about the effects of increased sea level on tidal marsh vegetation. We conducted a field experiment to examine how increased inundation duration and competition affect above- and below-ground growth of two wetland plant species: *Schoenoplectus acutus* and *S. americanus*. PVC planters, called marsh organs, were installed at fixed elevations that were lower than current plant distributions at two historic marshes in the San Francisco Bay Estuary. Each marsh organ had five rows of three six-inch PVC pipes, each row 15cm lower than the row above. In every row, rhizomes of each species were grown individually and together. On a monthly basis, plant heights were recorded and inundation duration, pore-water sulfide concentration, salinity, and redox potential were measured. In September, all above- and below-ground biomass was harvested. Salinity and sulfide concentrations varied little across elevations within a site but differed between sites. *Schoenoplectus americanus* growth and biomass dramatically decreased with increased inundation at both sites. *Schoenoplectus acutus* growth was affected less by increased inundation, with a slight decrease in biomass. Both species had a negative response to competition and the magnitude varied by species and elevation. Data from this experiment along with eight years of field data were used to calibrate a marsh accretion model, the Marsh Equilibrium Model (MEM). MEM is a zero-dimensional model that incorporates suspended sediment concentration, plant biomass and elevation ranges, and tidal range to model how the marsh surface elevation changes with sea-level rise. MEM currently is being applied to salt, brackish, and freshwater marshes in the Estuary to model predicted effects of sea-level rise on marsh distributions.

Clare Gupta

Elephants Gone Wild: People and park relations around Chobe National Park, Botswana

Today, conservation in Africa is generally thought to be sustainable only if wildlife can "pay its way" and provide direct economic benefits to local people. Moving from fortress conservation to a people-inclusive form of conservation is a step forward; however, I argue that the logic of community based natural resource management (CNBRM)—that direct benefits from wildlife must be created to mitigate its costs—has its limitations. To understand what a protected area and its associated conservation policies mean for a community, in terms of costs, benefits and changed livelihoods, we must examine the other relevant governmental policies and programs in place that come to bear on people's livelihoods. Using the case of Botswana's Chobe Enclave, I show that the detrimental effects of wildlife conservation policy on Chobe residents' livelihoods—namely crop destruction and livestock predation by wildlife—have been mediated by governmental policies reflective of Botswana's status as a welfare developmental state and also by strong rural-urban socio-economic linkages.

In Chobe it is state transfers (i.e. welfare) in conjunction with remittances from family members working outside the village that have allowed people to "get by" in the face of decreasing livelihood options. State subsidies to agriculture allow some people to continue to farm while government work programs and safety nets, as well as remittances from family members working outside the village, provide people who exit farming with alternative sources of income. In this way, Chobe National Park may be more sustainable than other African protected areas less because CBNRM has provided effective solutions to human-wildlife conflict and more because other structural conditions unique to Botswana—a functioning welfare state and a long history of circulation of people and resources between urban and rural areas—quietly play a role in maintaining a certain standard of living for local communities.

Lindsay Chiono

Long-term effects of fire hazard and fuels reduction treatments in the northern Sierra Nevada, California

Mechanical thinning and prescribed burning treatments are commonly applied to abate wildfire hazards in dry western forests historically characterized by frequent, low-to-moderate intensity fire. Although the stand structures and surface fuel reductions resulting from treatments are temporary, few studies have assessed the lifespan of these effects. I sampled surface fuels and vegetation following treatment for fire hazard reduction in a chronosequence of time since treatment in the northern Sierra Nevada. Field data were used to aid fuel model selection and to parameterize Fuels Management Analyst Plus, a fire behavior and effects model. A semi-qualitative, semi-quantitative assessment of ladder fuel hazard was applied to supplement modeled fire behavior metrics. Potential fire behavior and effects were compared among time-since-treatment and untreated control groups. The oldest treatment sites were still significantly different from untreated sites with respect to overstory characteristics including tree density, basal area, and canopy fuel load. Other stand characteristics, particularly timelag fuel loads, seedling density, and shrub cover, exhibited substantial variability, which contributed to a lack of significant difference among treatment age classes and among treatment and control groups. Untreated sites exhibited fire behavior that would challenge wildfire suppression efforts, and projected overstory mortality was considerable. In contrast, fire behavior and severity were low to moderate in even the oldest treatments. This study supports past estimates that fuel treatments for wildfire hazard reduction may be effective for at least 10-15 years in the mixed conifer and east side pine forest types characteristic of the northern Sierra Nevada.

Seth B. Shonkoff

The public health dimensions of horizontal hydraulic fracturing

The United States (US) sits on an estimated 482 trillion to 827 trillion cubic feet of natural gas with 141 trillion cubic feet stored in the Marcellus Shale formation (which underlies parts of Pennsylvania, New York, West Virginia, Virginia, and Maryland) alone (EIA 2012). In the 1990s, powerful new drilling techniques allowed natural gas to be extracted from previously unexploited deep geological formations (shales, tight sands, and coal seams). High-volume slick water horizontal hydraulic fracturing (fracking or horizontal hydraulic fracturing) was developed in the 1990s and has, with significant regulatory exemptions, subsequently facilitated a rapid influx of inexpensive domestic natural gas. Advocates laud natural gas as a "bridge fuel" to wean the US economy off of imported hydrocarbon fuels. However, fracking has received pushback from the environmental and public health arenas and by adjacent communities as reports of air pollution, fouled drinking water wells, explosions, and industrial landscapes proliferate across rural America.

Significant knowledge gaps in the epidemiological and environmental health literatures persist, hindering the work of those that aim to identify and to mitigate the risks of fracking. The aim of this project is to illuminate the public health dimensions of hydraulic fracturing by reporting: (1) the known human health risks posed by the fracking process and (2) the hurdles to identifying public health threats associated with fracking.

Sarah Sawyer

New insights into the ecology and conservation of the critically endangered Cross River Gorilla

The Cross River Gorilla (*Gorilla gorilla diehli*; hereafter: CRG) is one of the world's least studied and most threatened primates. CRG occur only in a discontinuous distribution in the southern portion of the Cameroon-Nigeria border region, an area that represents one of Africa's biodiversity hotspots. Less than 300 individuals remain today, distributed in 14 subpopulations. A lack of understanding of the relationship between CRG ecology and available habitat plagues conservation decision-making, and assessment of CRG habitat use and requirements is desperately needed (Berg et al. 2011). To date, habitat selection by the CRG has been modeled only at coarse spatial scales, using remotely-sensed landscape data and large-scale species distribution maps. These coarse-scale models fail to explain why CRG display a highly fragmented distribution within what appears to be a large, continuous area of suitable habitat. This study aimed to refine our understanding of CRG habitat use to inform conservation planning both for the subspecies and for other fragmented species of conservation concern. For this research, I used resource selection functions to understand habitat use by CRG at multiple scales. Specifically, I employed generalized additive models at the scale of the subpopulation range and conditional logistic regression at the scale of individual movements. Results suggest that CRG habitat selection is highly scale dependent. Localized measures of habitat quality strongly influenced selection at the subpopulation or landscape scale, while human activity and food availability were the best predictors of selection at finer scales. Understanding why CRG do not occur in seemingly suitable habitat is crucial for designating critical habitat both within and between CRG subpopulations. Study results indicate that conservation planning to maintain critical habitat and connectivity among CRG populations will require an integrative, multi-scale planning approach incorporating large-scale landscape characteristics, human use patterns and CRG food availability.

Sonja Schwartz

One fish? Two fish? Red fish? Blue fish? Use of molecular methods to examine the origins of biodiversity in Caribbean corals (Family: *Faviidae*) and Indo-Pacific parrotfishes (Genus: *Scarus*)

With global change currently causing a rapid decline in coral reef populations around the world, understanding the processes that generated diversity in coral ecosystems will be key to predicting future changes and directing conservation efforts. Yet, fundamental questions about species boundaries and histories remain to be answered. This research uses molecular genetic techniques and newly developed computational frameworks to examine divergence in a diverse family of corals and a group of keystone reef fish. By combining a newly compiled fossil stratigraphy with a molecular phylogeny of extant Caribbean *Faviidae*, we reveal that Caribbean faviid corals are not related to their Mediterranean counterparts, and that all living species appear to have originated during a period of rapid environmental change in Mio-Pliocene. A second phylogeny of parrotfishes reveals that *Scarus* ghobban, once thought to have a wide Indo-Pacific distribution, consists of deeply diverged Indian and Pacific ocean clades. Furthermore, these clades form a species complex with a Panamanian endemic species, *Scarus compressus*, and a newly described Western Australian endemic species, *Scarus hutchensi*. A deeper look at the population genetics and life histories of these fishes examines relationships between different parts of the Pacific and suggests the possibility that hybridization and shifts in coloration played an important role in their diversification. By elucidating relationships between species and linking these to contemporary and historic ecological and environmental factors, we are able to take a step forward in understanding the origins of diversity in these two systems.

Becca Ryals

Carbon and greenhouse gas dynamics in annual grasslands: Effects of management and potential for climate change mitigation

Most of the world's grasslands are management for livestock production. A critical component of the long-term sustainability and profitability of these ecosystems is the maintenance of plant production. Amending grassland soils with organic waste has been proposed as a means to increase net primary productivity (NPP) and ecosystem carbon (C) storage, while mitigating greenhouse gas emissions from waste management. While organic matter amendments are commonly used in croplands, few studies have evaluated the effects of these amendments on the C balance and greenhouse gas dynamics of grasslands. We used a combination of laboratory incubations, ecosystem modeling, and field manipulations replicated within and across two grazed grassland ecosystems to determine the effects of composted green waste amendments on NPP, greenhouse gas emissions, and net ecosystem C storage over three years. Amendments elevated total soil respiration by 18 ± 4 % at both sites, but had no effect on nitrous oxide or methane emissions. Carbon losses were significantly offset by greater and sustained plant production. Amendments stimulated both above- and belowground NPP by 2.1 ± 0.8 to 4.7 ± 0.7 Mg C ha-1 over the three year study period. Net ecosystem C storage increased by 25 to 70 % without accounting for the direct addition of compost C. The magnitude of net ecosystem C storage was sensitive to estimates of heterotrophic soil respiration, but was greater than controls in five out of six fields that received amendments. The sixth plot was the only one that exhibited lower soil moisture than the control, suggesting an important role of water limitation in these seasonally dry ecosystems. Treatment effects persisted over the course of the study, which was likely derived from increased water holding capacity in most plots, and slow release fertilization from compost decomposition. We conclude that a single application of composted organic matter can significantly increase grassland C storage and that effects of a single application are likely to carry over in time.

Steve Bellan

New methods for counting dead animals: Anthrax outbreaks in the zebra of Etosha National Park, Namibia

The gold standard of epidemiological data is incidence, defined as number of new cases of disease per unit time and often standardized by the host population size. While successful wildlife disease research and management require good quality data collected from animals and their carcasses, the logistical difficulties associated with studying wild animals frequently limit data collection to easily accessible samples, yielding extremely biased data. When ignored such biases can mislead research and misinform management decisions. In addition, temporal and spatial variation in sampling efforts can create incidence patterns that do not reflect transmission processes, but rather represent artifacts of other ecological processes (e.g. animal movement) or the surveillance process (e.g. non-uniform effort in space-time). Yet, understanding transmission processes is imperative for modeling disease dynamics and, in particular, effective management strategies. I developed methods to address these issues by explicitly modeling the mechanisms of surveillance as well as the underlying ecological and epidemiological processes of interest during outbreaks of anthrax in the zebra of Etosha National Park, Namibia. Opportunistic surveillance data are combined with camera trap data, zebra movement data, scavenger movement data, and human movement data to better understand the causes and consequences of anthrax in this system.

Karen Weinbaum

Sustainability and socioeconomics of wildlife hunting in Central Africa

Wildlife hunting for human consumption and use is a major threat to global biodiversity and, paradoxically, to the very people who depend on it. This phenomenon has come to be known in the scientific literature as well as popular press as the "bushmeat crisis", or the unsustainable hunting of wildlife for human consumption. It is estimated that hundreds of millions of people worldwide rely on terrestrial wildlife as a major source of animal protein, and in many cases, livelihoods, although the actual scale of this reliance remains elusive. My research addresses gaps in our knowledge, focusing on the humid forest zone of Cameroon, Central Africa, considered one of the centers of the bushmeat crisis. As part of a mixed methods approach, I administered a survey of 500 households in a gradient of villages from semi-urban to rural, to examine drivers of wildlife hunting and consumption in relation to household food security status. Results and policy implications will be discussed.

Matteo Kausch

Modeling the impact of soil aggregate size on selenium immobilization

Soil mineral and organic particles are commonly bound into mm to cm sized microporous structures (aggregates) separated by macropores. While fast advective transport prevails in macropores, the transport inside aggregates is mostly diffusive (slow) which leads to the formation of aggregate-scale concentration gradients impacting biogeochemical reactions. Selenium has emerged as a major environmental contaminant in California. The bioavailable oxyanions selenate, Se(VI), and selenite, Se(IV), can be microbially reduced to solid, elemental Se, Se(0), and anoxic microzones within soil aggregates are thought to promote this process. A mechanistic understanding of Se reduction and retention in aggregates can lead to better predictions of Se transport and attenuation in seleniferous soils which may help improve the management of such ecosystems.

Using a dynamic 3D reactive transport model of a single idealized aggregate, we model the coupling between physical transport and biogeochemical reactions controlling Se reduction at the aggregate-scale. The model was developed based on a series of flow-through-reactor experiments involving artificial soil aggregates. Each experiment/model scenario consisted of a spherical aggregate (experimental diameter: 2.5 cm) surrounded by a constant flow providing Se(VI) and pyruvate under oxic or anoxic conditions. Aggregates contained Enterobacter cloacae SLD1a-1 reducing Se(VI) to Se(IV) and Se(IV) to Se(0). In the model, reactions were implemented as double-Monod rate equations coupled to the transport of pyruvate, O2, and Se-species. In experiments, concentrations of Se(VI) and reduced Se were measured at the outflow (temporally resolved) and in concentric solid-phase sections of aggregates (spatially resolved). This data was used to validate the dynamics of the model and all subsequent simulations where performed within experimentally validated dimensions (=2.5 cm, 8 days).

Simulations predict that larger aggregate size leads to increased Se retention. While the absolute amount of reduction depends on aeration, as well as reactant concentrations, this trend persists across all chemical conditions investigated. Promoting soil aggregation on seleniferous agricultural soils, through addition of organic matter and decreased use of tillage may thus be an effective management practice to decrease impacts of Se contaminated drainage water on downstream ecosystems.

Avery Cohn

Examining and supporting efforts to reduce agricultural causes of deforestation in Brazil

Reducing the pressure of agriculture on forests is at the heart of debates over the future of biofuels and since 2009 it has been an explicit focus of negotiations on Reducing Emissions for Deforestation and Forest Degradation. One proposal, known as land sparing, aims to boost output on agricultural lands and/or steer agricultural expansion onto low carbon content lands to free land for forests and other productive uses. I present a framework to analyze land sparing and I highlight its promises and challenges using a simulation case study of Brazilian cattle ranching intensification. Under land sparing, agricultural yield increases cause a decrease in agricultural land relative to the area that would have existed without the yield increase. Because land sparing is market-mediated, the geography of land use and climate impacts from land sparing depends upon the geography of the markets for the products of the targeted agricultural systems. I illustrate this principle using a simulation depicting global land use and greenhouse gas emissions with and without policies targeting land sparing through the intensification of cattle ranching systems in Brazil. The simulation shows that global trade could offshore the land sparing from Brazilian cattle intensification. In the simulation, increases in low-cost Brazilian cattle reduce the area of profitable cattle around the globe and this delivers land sparing. Were this GHG mitigation offshoring to occur, it could deliver not only GHG benefits, but also political complications stemming from these trade effects. I conclude by exploring these politics, and also by discussing regulatory, political and behavioral assumptions to which these results are sensitive.

Kevin D. Krasnow

Wildfire, management, and regeneration of quaking aspen *(Populus tremuloides)* in the Sierra Nevada

Aspen *(Populus tremuloides)* is considered a foundation species and adds significant biological diversity to conifer-dominated western forests. This species has been shown to be particularly sensitive to climate, and is currently a species of concern due to wide-scale, drought-induced mortality in the Intermountain West. Many California land management agencies have identified aspen restoration as a priority and are conducting conifer removal and prescribed fire treatments in an effort to rejuvenate declining aspen populations. This research evaluates the efficacy of these treatments and compares aspen regeneration after these treatments with observed regeneration after recent wildfires.

Experimental questions include: Resistance Strategies: Are prescribed fire and conifer removal restoration treatments effective in stimulating asexual aspen regeneration? How do these treatments compare to wildfires? Resilience strategies: How do pre-fire stand composition and fire severity impact post-fire aspen regeneration? Response strategies: Is it likely that aspen will be able to successfully migrate via sexual reproduction (seeds) in an era of changing climate?

Generalized linear mixed effects models show that both conifer removal and prescribed fire can be effective restoration treatments but that unplanned wildfire produces significantly higher ramet density than either treatment. A significant negative relationship was found between pre-wildfire conifer basal area and post-fire aspen ramet density, indicating that conifer encroachment negatively impacts aspen resilience to fire. Additionally, a significant positive relationship was found between fire severity and post-fire aspen ramet density and growth rates, indicating that increased disturbance severity favors aspen regeneration and persistence. The likelihood of aspen migration via sexual reproduction will also be discussed.

Marek Jakubowski

Lidar pulse density in the Sierra Nevada: How low can you go?

Discrete lidar is increasingly used to analyze forest structure. Technological improvements in lidar sensors have led to the acquisition of increasingly high pulse densities, reflecting the assumption that higher densities will yield better results. In this study, we systematically investigated the relationship between pulse density and the ability to predict several commonly used forest measures and metrics at the plot scale. We found that the accuracy of predicted metrics was largely invariant to changes in pulse density at moderate to high densities. In particular, accuracy predictions of metrics such as tree height, diameter at breast height, shrub height and total basal area were relatively unaffected until pulse densities dropped below 1 pulse/m2. Metrics pertaining to coverage, such as canopy cover, tree density and shrub cover were slightly more sensitive to changes in pulse density, although in some cases high prediction accuracy was still possible at lower densities. Our findings did not depend on the type of predictive algorithm used, although we found that support vector machine (SVM) and Gaussian processes (GP) consistently outperformed multivariate linear regression across a range of pulse densities. Further, we found that SVM yielded higher accuracies at low densities (<0.3 pulse/m^2), while GP was better at high densities (>1 pulse/m^2). Our results suggest that low-density lidar data might be capable of estimating typical forest metrics reliably in some situations. These results might be useful to forest ecologists and land managers who are faced with tradeoff in price, quality and coverage, when planning lidar data acquisition.

Poster session

Iryna Dronova

with Peng Gong and Lin Wang

Object-based "dynamic cover types": A new framework for monitoring landscape-level ecosystem change

Traditional approaches of monitoring ecosystem change with remote sensing data usually focus on 'static' landscape cover types and assess their change per spatial units of interest. However, in dynamic landscapes with frequent disturbance long-term trends in surface composition may be obscured by intermediate shorter-term variation. Availability of cloud-free remote sensing data is often inconsistent among change periods, which contributes to uncertainty in change detection among 'static' classes. Alternatively, we propose Dynamic Cover Types (DCTs) to characterize highly variable areas based on their nested change regimes shaped by climate, phenology and disturbance. We define DCTs as sequences of surface transformations that have distinct temporal trajectories observable across landscapes within a given change period. We combined multispectral and microwave satellite imagery to classify DCTs for a large seasonally inundated freshwater wetland in China in 2007-2008. We further examined DCT response to a hypothetical scenario of a warmer wetter early spring by substituting spring 2008 images with 2007 ones. Instead of using pixels, we mapped DCTs using object-based image analysis and used principal components transformation to enhance their spectral contrast. Object-based DCT boundaries may suggest useful spatial units highlighting characteristic types of landscape change for environmental research, ecosystem monitoring and management considerations.

Melissa Eitzel

with John Battles, Robert York, Jonas Knape and Perry de Valpine

Modeling tree growth from forest inventory data: Sophisticated models for complex monitoring data

Understanding tree growth as a function of tree size is important for a multitude of applications. What variables limit growth is of central interest, and forest inventory permanent plots are an abundant source of long-term information but are highly complex. Observation error and multiple sources of shared variation (spatial plot effects, temporal repeated measures, and uneven sampling intervals) make these data challenging to use for growth estimation. We account for these complexities and incorporate potential limiting factors (tree size, competition, and resource supply variables) into a hierarchical state-space model. We estimate the diameter growth of *Abies concolor* (white fir) in the Sierra Nevada of California from forest inventory data, showing that estimating such a model is feasible in a Bayesian framework using popular Markov chain Monte Carlo tools. In this forest, white fir growth depends strongly on tree size, population density, and individual quality. Resource supply variables (elevation, topographic slope, soil type, annual water deficit, and insolation) do not have a strong impact. This modeling approach can be applied to permanent plots around the world, leading to greater insights regarding patterns of tree growth over larger ecological scales, greater environmental gradients, and different ecosystem types.

Virginia Emery

with Camila Torres, Larissa Walder and Neil Tsutsui

A cuticular hydrocarbon cue inhibits the rearing of new queens in the Argentine ant (*Linepithema humile*)

Queens exert considerable reproductive control in social insect colonies. Even the rearing of new gynes (reproductive queens) is under strict control, but the identity and function of these inhibitory cues are not well understood. In the Argentine ant (*Linepithema humile*), mature queens die in the winter, and new gynes are produced in the spring. However, these springtime colonies can be experimentally inhibited from producing new gynes when live mature queens are reintroduced to the nest. We hypothesized that queen-specific cuticular hydrocarbons are the chemical cue responsible for inhibiting gyne production. We tested this hypothesis with three treatment groups; colonies with queens, colonies without queens, and colonies without queens, but supplemented by queen cuticular hydrocarbon extract. Only the queenless colonies made new gynes, and there was no difference in the number of gynes produced in colonies with live queens or with only queen extract. We suspect the specific hydrocarbons are a group of 5-methyl alkanes which only appear on egg-laying queen cuticles, and are now experimentally testing the bioactivity of these 5-methyl compounds. This work is one of the first to isolate the specific reproductive chemical cues involved in the production of new gynes in an ant species.

Traci L. Gryzmala

The phylogenetic signal of metafemoral hairs in the Aderidae (Coleoptera)

The Aderidae (Coleoptera: Tenebrionoidea) are a group of beetles that are found worldwide and consists of forty-five genera. They are intriguing from a natural history perspective as many species are found in caves, some are social parasites of termites, and others exhibit sexual dimorphism. Unfortunately, there has never been a phylogeny published for the Aderidae and this has inhibited work on the group. This project uses molecular data (COI, 16S, ArgK) to construct a preliminary phylogenetic hypothesis for generic relationships of the Aderidae. The morphological character of metafemoral hairs is evaluated within this phylogenetic context. Nine equally parsimonious trees are recovered from analyses. The presence of metafemoral hairs is observed in eight out of thirteen genera that are scattered throughout the tree. Therefore, this morphological character does not appear to convey phylogenetic signal. Future analyses will include additional taxa, more genes, and the inclusion of morphological character data for an integrative taxonomic approach.

Margot Higgins

From copper to conservation: Mining for nature and culture in Wrangell St. Elias Park and Preserve

Places are constructed through the stories people tell and these stories have consequences for cultural and natural resource management. Alaska has a long history of narrative encounters between local residents and visitors that have material consequences; this trend continues in Alaska national parks (Cruikshank 2005). At road's end in Wrangell St. Elias Park and Preserve (WRST), there is the National Park Service story of the railway, developed by the Kennecott Corporation to take some of the richest copper ore in the world from its origins in the Wrangell Mountains to the coast in Cordova. Last summer progress and declension narratives surrounding the mining era were told during a centennial celebration that included a historical slide show, a reenactment of the railroad opening, a period dress party, and tea and cake on the lawn of a local lodge. Included on the agenda just a few days before the festivities, was a dance recital by local Ahtna children, most of whom now live outside of NPS boundaries. At the conclusion of the performance, the Interpretive Supervisor for the Park bestowed a copper railroad spike upon the Ahtna people as a "thank you" gift. But such a gesture might also be interpreted as another nail in the coffin that has displaced people from national parks over the last 150 years. I argue that the NPS history eclipses and arrests the local Ahtna history and the present living history of the community, and my work aims to contribute to a more dynamic and complicated history for NPS interpretation.

Sarah M. Lewis

with Larry Dale, Gary Fitts, Kevin Koy and Maggi Kelly

Where will drought-tolerant, cellulosic biofuels fit into the landscape?

Switchgrass has been targeted by the USDA as a model mass bioenergy crop, however it requires a significant amount of water. In addition, locations that have reliable water availability are also ideal for profitable food crops and food competition is a significant concern. Lands which receive adequate rainfall but which are marginal for food crops due to highly variable timing of the rain are potentially ideal locations to grow drought-tolerant biofuel crops. In order to maximize environmental and economic sustainability of biofuels, it is important to identify the potential geographical niche for this new variety. This project uses a geospatial approach rooted in fuzzy logic that utilizes both physical and economic variables to identify ideal geographic locations for this innovative crop. Spatial modeling using fuzzy logic allows for more flexible weighting of evidence and combinations of evidence than traditional Boolean or weighted suitability models. With this methodology, this study identifies marginal areas centralized in the Great Plains States where efforts to plant drought-tolerant switchgrass can be focused.

Lu Liang

Spectral-climate clustering for global ecoregion delineation

The most biodiverse and productive ecosystems of the Earth are under threat from human development, pollution, and climate change. A new strategy is needed to bring the ecoregion concept into the present-day so that it can continue to be an essential tool for climate modeling, conservation planning, and valuation of ecosystem services. Remote sensing observations from satellite sensors can provide up-to-date and consistent information to improve the delineation of homogeneous ecoregions.

Here we describe an approach that uses clustering to tie together gridded climate features with spectral variables derived from six years of observations from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Aqua and Terra satellites. We use pixels that are representative of all land cover types globally to synthesize clusters from climate and spectral space and define a new set of global ecoregions. Our map preserves relevant patterns in plant productivity based on climate variation while also characterizing regions that have been converted from their natural state by human activities.

Mary Matella

with Adina Merenlender

Restoring floodplain habitat connectivity for aquatic species recovery: An integrated modeling framework

California's Central Valley was once a large dynamic river-floodplain ecosystem that flooded seasonally, but hydrological alterations designed to provide a stable water supply and to prevent flooding have severed hydraulic connections and led to habitat loss and significant declines in aquatic biodiversity. Recovering floodplain connectivity for ecosystem health requires an understanding of structural components related to the physical landscape, functionality of flow dynamics, and knowledge of species habitat requirements for movement, reproduction, and survival. To advance our understanding of floodplain habitat connectivity and benefits of habitat restoration alternatives, we provide a modeling framework to quantify the effects of restoration on hydrological habitat connectivity. We illustrate this approach through a case study of restoration scenarios using historical and climate change flows to restore fish floodplain habitat along the lower San Joaquin River. Case study results show that in addition to channel alterations, higher flows are required to recover significant flooded habitat area, especially given reductions in flows expected under climate change. Our approach provides a template for developing multiple scenarios of restored floodplain connectivity that will help managers evaluate floodplain restoration projects in the context of flood management planning.

Hillary Sardiñas

with Claire Kremen

Quantifying native bee ground-nesting using emergence traps

Native bees are integral to ecosystem functioning and provide critical pollination services to agriculture. However, native bees are predominantly solitary ground-nesters, and the edaphic factors that enhance or limit bee nesting have been understudied because many nests are cryptic. Using a novel technique, emergence traps, we assessed ground nest occurrence and examined correlation to soil characteristics. We also compared the difference between the flying and nesting communities within the site. The emergence trap technique had high success rate (85%) over the entire season, but we did not detect any spatial clustering of nests. Additionally, the nesting community was distinct from the flying community. We did not discern any differences in soil type or structure among nesting sites, however percent bare ground and percent slope were predictive of species diversity within traps. This is a promising technique that could enhance assessments of native bee occurrence and resource use, which would benefit both restoration and conservation efforts.

Katherine Scranton

Individual Heterogeneity in Development: A Mixed-Effects Model for Interval-Censored Cohort Data

Time-to-event data are common in ecology but are rarely analyzed with sophisticated tools common in other fields. Obstacles in applying survival time models to ecological data include the variation of natural systems and interval-censored data. We develop a mixed-effects Weibull model for interval-censored data on time-to-maturation of individuals in a cohort. We incorporate a fixed difference between types of cohorts, and two levels of random effects. There is no available software for mixed-effects survival analysis for interval-censored data, so likelihood calculations with numerical integration of random effects were programmed in R. A simulation study was conducted under different magnitudes of variation to evaluate the power of the likelihood ratio tests and the precision of parameter estimates. Differences in the mean scale as small as 5% can be detected with high power under low variation. Under higher variation, larger differences of 18% can be detected with 80% power. Omitting random-effects produces biased estimates of the Weibull parameters and highly inflated type I error rates in likelihood ratio tests. The methods developed in this paper for fitting hierarchical frailty models to interval censored data would be applicable to a wide range of ecological processes such as survival, oviposition, or onset of disease.

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