Yale SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

• 34TH F&ES RESEARCH CONFERENCE •

PROGRAM

FRIDAY, APRIL 20, 2018

KROON HALL, 3RD FLOOR, 195 PROSPECT STREET

#FESresearch

INTRODUCTION

Welcome to the 34th Annual F&ES Research Conference! This year's Research Conference combines the Masters Colloquium and Doctoral Conference and includes our postdocs, Centers, and Programs to showcase some of the most innovative and cutting-edge research happening at the School. Excellence in scholarship is at the core of F&ES's mission. For over 100 years, the School has brought the best science to bear on the most pressing natural resource challenges. Today, the topics we study—many of which are on display at this year's conference—are far reaching both in the breadth of topics covered and geographic areas of focus. We have also partnered with Yale's Pathways to Science Program to engage local high school students in this year's conference, with the hope that they will continue to be part of our broader research community.

We thank you for your participation and look forward to a lively day of discussions and debates.

Sincerely,
F&ES Research Conference Organizing Committee:

COMMITTEE CO-CHAIRS:
Daniel Kane, Doctoral Co-Chair
Julia Monk, Doctoral Co-Chair
Annie Stoeth, Masters Co-Chair

COMMITTEE MEMBERS:
Melanie Quigley, Director of Strategic Initiatives
Dr. Karen Seto, Associate Dean of Research

Elisabeth Barsa
Robert Buchkowski
JoAnne DeBernardo
Gai Doran
Michelle Downey
Matt Garrett
Dani Heller
Sam Jordan
Joan McDonald
Simon Queensborough
Mike Slattery
Sara Smiley Smith
Megan Sullivan
Julie Vance
Jay Wason
Paul Wolfram

SCHEDULE

	THE KNOB		
8:30–9:00	**Breakfast and Registration**		
	BURKE AUDITORIUM		
8:45–8:55	**Welcome Remarks** **Karen Seto** Frederick C. Hixon Professor of Geography and Urbanization Science Senior Associate Dean of Research, Director of Doctoral Studies *Yale School of Forestry and Environmental Studies*		
	KROON GO1	KROON 321	KROON 319
9:00–10:15	**Environmental Knowledge and Implications for Action** Pages 4-5 **CHAIR:** Katherine Hollins **SPEAKERS:** Leehi Yona Paul Burow Samantha Maher	**New Haven to New England: Spotlight on Local Research** Pages 6-7 **CHAIR:** Eric Fine **SPEAKERS:** A Andis Alexandria Moore Jessica Wikle Kevin Dahms	**Ecology, Evolution, and Management in Tropical Forests** Pages 8-9 **CHAIR:** Eva Garen **SPEAKERS:** Andrew Muehleisen Ben Rifkin Juan Penagos Zuluaga Peter Umunay
	THE KNOB		
10:15–10:30	**Break**		
	BURKE AUDITORIUM		
10:30–11:00	**Upgoer 5 Talks** Oral presentations limited to the 1000 most common words Pages 10-11 **CHAIR:** Sarah Smiley Smith **SPEAKERS:** Ana Fanton Borges Robert Buchkowski Peter Berrill Mary Burak		
	KROON GO1	KROON 321	KROON 319
11:15–12:15	**Urban Centers and Equity** Pages 12-13 **CHAIR:** Colleen Murphy-Dunning **SPEAKERS:** Bhartendu Pandey Cara Donovan Katherine Wolf	**Hot and Dry: Impacts of Extreme Weather** Pages 14-15 **CHAIR:** Simon Queenborough **SPEAKERS:** Rachel Renne Cameron Musser Kangning Huang	**Environmental Change in India: From Cities to Forests** Pages 16-17 **CHAIR:** Ned Gordon **SPEAKERS:** Amrutasri Nori-Sarma Meghna Krishnadas Swetha Kolluri
	THE KNOB	FOREST GARDEN	THE KNOB
12:15–1:30	**Lunch**	**Wellness Break with Herb Garden Planting**	**Centers and Programs Expo**

	BURKE AUDITORIUM		
12:15–1:30	**Poster Session** Exhibits and Presenters Pages 18-19 **PRESENTERS:** Lexi Smith, Chen Chen, Adam Eichenwald Linus Blomqvist, Kate Burrows		
	KROON G01	KROON 321	KROON 319
1:30–3:00	**Decolonizing Research** Pages 20-21 **CHAIR:** Julia Monk **SPEAKERS:** Elham Shabahat Deepti Chatti Noah Schlager Coral Bielecki Maxime Lambert	**Energy Supply and Demand in a Changing World** Pages 22-23 **CHAIR:** Reid Lifset **SPEAKERS:** Pei Huang Erica Barth-Naftilan Jo Brooks Paul Wolfram Stefano Carattini	**Underneath it All: The Role of Soils in Terrestrial and Aquatic Ecosystems** Pages 24-25 **CHAIR:** Mark Bradford **SPEAKERS:** Yishen Li Annie Stoeth Eli Ward Sam Jordan Jessica Swindon
	THE KNOB		
3:00–3:15	**Afternoon Break**		
	BURKE AUDITORIUM		
3:15–4:00	**Flash Talks** 6 talks, 5 minutes each Pages 26-28 **CHAIR:** Sarah Smiley Smith **SPEAKERS:** Adam Roddy, Megan Sullivan, TC Chakraborty Kyra Prats, Emily Dolhansky		
	BURKE AUDITORIUM		
4:00–5:00	**Keynote Address** Page 29 **Cynthia Malone** Doctoral Candidate, Department of Geography and Planning, *University of Toronto* Co-chair, Equity, Inclusion, and Diversity Committee, *Society for Conservation Biology*		
	BURKE AUDITORIUM		
5:00–6:30	**Awards Ceremony, Closing Remarks, and Reception** **Karen Seto** Frederick C. Hixon Professor of Geography and Urbanization Science Senior Associate Dean of Research, Director of Doctoral Studies *Yale School of Forestry and Environmental Studies*		

ENVIRONMENTAL KNOWLEDGE AND IMPLICATIONS FOR ACTION

Chair: Katherine Hollins
Program Manager, Sustaining Family Forests Initiative *Global Institute of Sustainable Forestry*
Kroon G01 | 9:00–10:15 AM


Chair


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01. LEEHI YONA, MESc CANDIDATE
Pessoptimist, silo buster, Impressionist painter.

Integrating Climate Science And Policy: The Intergovernmental Panel On Climate Change's Greenhouse Gas Inventories
The Intergovernmental Panel on Climate Change (IPCC) is best known for its Assessment Reports on human-induced climate change. In parallel it leads a second effort to develop and refine internationally-agreed upon methodologies for calculating and reporting national greenhouse gas emissions and removals. The resulting greenhouse gas inventories are critical components of national-level mitigation commitments, the bedrocks of the Paris Agreement. The inventory guidelines are currently undergoing refinement to be completed in 2019. Our research integrates ecological and political analysis to study the ways in which these guidelines were developed, and ways in which they can be improved. We argue that the IPCC guidelines are not equipped to handle the task of developing national greenhouse gas inventories for most Paris Agreement countries; many of which will be required to do so for the first time. Particularly for land use cover and land use change (which includes forests and agriculture), the IPCC guidelines provide a set of default values and methods that lack rigor, resolution and scientific consensus as to their validity. We suggest that now is the time to consider the challenges posed by the current process to develop the guidelines, and to avail of recent major advances in quantitative and expert synthesis to overhaul the process and thereby better equip multi-national efforts to limit climate change. The topic of greenhouse gas inventories is important and timely. By 2019 it will be the basis of all domestic and international climate change policies. In May 2018, the United Nations climate negotiations framework will be hosting its first meeting (the Talanoa Dialogue) to discuss progress made on Paris Agreement commitments. These emissions reductions are rooted in greenhouse gas accounting.

02. PAUL BUROW, DOCTORAL CANDIDATE, F&ES & ANTHROPOLOGY

Ecologies of Belonging: Piñon-Juniper Woodlands and the Cultural Politics of Nature in North America's Great Basin
How can the piñon pine and its iconic pine nuts help us understand the cultural and environmental politics of belonging in North America's Great Basin? This presentation examines how claims to belonging – the quality of being native or having a recognized claim to a place in space – are shaped by settler colonialism and the politics of environmental conservation. What and who belongs in this landscape is a debate that draws upon varied modes of "knowing nature", whether ecological, traditional, vernacular, or local. These forms of knowledge have profound implications for social and environmental justice – especially as it relates to Indigenous sovereignty. Thus, my talk will examine the place of indigeneity as the site of political, discursive, and material contestation in this heavily managed forest and rangeland landscape. Piñon pine (pinus monophylla) is native to the Great Basin, but is often described as a "weedy native species" along with Utah juniper (Juniperus osteosperma). Piñon-juniper woodlands cover 100 million acres (an area equivalent in size to California) of the U.S. Intermountain West. These forests have served an important role in the environmental history of the region, fueling mining and settlement in the 19th century as they provided raw material for smelters, building construction, and fuel wood. They were further cleared in the 20th century for agriculture and ranching. The beginning of the 21st century saw a renewed effort to remove piñon-juniper woodlands as part of ecological restoration projects to protect the threatened sage grouse (Centrocercus urophasianus) by extirpating trees believed to be encroaching on erstwhile sagebrush steppe. These woodlands are notable for their cultural valence to Indigenous and other local communities, and have been central to the production of social scientific knowledge about the relationship between cul-

ture and ecology. These woodlands figure prominently in ecological ideas about indigeneity and invasiveness that are linked to settler colonialism. This paper fills this gap by detailing the cultural and ecological politics shaping debates over who and what belongs on the land during an era of precarious life under the disturbances of neoliberal capitalism and state governance.

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03. SAMANTHA MAHER, MESc CANDIDATE
Likes maps, math, and critters.

Valuing Ecological Dynamics Using a Natural Capital Approach
Conservation practice focuses on remedying environmental issues that are symptoms of human actions. This entails an understanding of conservation targets as being embedded in complex socioecological systems. We take this concept and apply it quantitatively by expanding on natural capital literature to perform an economic valuation of an endangered species with no market-based economic value. We take into account the dynamics of both the ecological system in which the species exists as well as the human actions affecting the natural system. In doing so, we apply systems thinking to the valuation of a rare species and capture the marginal social value, or shadow price, that is revealed by the human and ecological dynamics of the system. We use this shadow price to examine the inherent tradeoffs between different elements of complex systems, working backward to determine how we are weighting decisions affecting the target species. We apply these methods to the case study of the woodland caribou in the Alberta Oil Sands and calculate a shadow price for caribou within the context of predator-prey dynamics in a highly fragmented landscaped. Our results indicate that current behavior undervalues caribou and drives population declines, indicating a need for changes in management plans. Our framework allows us to hold a mirror to our decisions, examine their consequences, and expand the conversation around ecosystem and conservation management.

NEW HAVEN TO NEW ENGLAND:
SPOTLIGHT ON LOCAL RESEARCH

Chair: Eric Fine
Research Assistant and Partnerships Coordinator, *Yale Project on Climate Change Communication*
Kroon 321 | 9:00–10:15 AM


Chair


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01. A.Z. ANDIS, DOCTORAL CANDIDATE
I study eco-evolutionary dynamics and play with frogs in the woods.

Evolutionary Dynamics of Rapid, Microgeographic Adaptation in an Amphibian Metapopulation
It is clear that human impacts induce new stressors and novel conditions for biota through habitat loss and degradation, climate change, overharvesting, and introduced species, among others. When environmental change outpaces dispersal abilities, species face one of two alternatives: extinction or adaptation, with the former all too common. However, recent research has shown that populations can evolve rapidly, even over small spatial and temporal scales, resulting in microgeographic evolutionary divergence. Within a population, dispersal distances can vary over time and space in response to changing environmental conditions. Since both dispersal patterns and local environmental conditions can structure fine-scale variation, we evaluated whether divergence patterns changed over time in a metapopulation of wood frogs (Rana sylvatica) by comparing populations over nearly 2 decades. We replicated a common garden experiment from 2001 by rearing 1116 wild collected embryos representing 93 full-sib clutches and 12 populations in laboratory conditions. We recorded intrinsic developmental rates and estimated both contemporary microgeographic variation and allochronic evolutionary rates. We further considered if divergence patterns correlated with coincident environmental change. We found evidence for substantial evolution in the populations and persistent microgeographic variation. The recognition that populations can adapt in contemporary timescales within just two decades and over scales of only tens of meters necessarily changes how we envision populations will react to climate change, how we understand biological invasions, how we think about fragmentation, and generally how we will manage ecosystem for the future.

02. ALEXANDRIA MOORE, DOCTORAL CANDIDATE
Field researcher, Ecology nerd, Mud enthusiast, One foot out the door PhD student.

Context-Dependent Consumer Control in New England Tidal Wetlands
Recent studies in coastal wetlands have indicated that consumers may play an important role in regulating large-scale ecosystem processes. Predator removal experiments have shown significant differences in aboveground biomass production in the presence of higher level consumers, or predators. These results indicate that predators play an important role in regulating biomass production, but the extent to which this regulation impacts additional ecosystem functions, such as nutrient cycling and organic matter accumulation, is unclear. This study evaluated the impact that consumers have on large-scale ecosystem properties within southern New England tidal wetlands and contributes to the general understanding of trophic control in these systems. I established enclosure cages within three coastal wetlands and manipulated the presence of green crab predators to assess how trophic interactions affect ecosystem functions. Findings suggest that although these consumers may exert some top-down effects, other environmental factors, such as other consumers not studied here or bottom-up interactions, may variably play a larger role in the maintenance of ecosystem processes within the region. These results indicate that the loss of top-down control as an important mechanism influencing ecosystem functions may not hold for all wetlands along the full extent of the New England coastline.

03. JESSICA WIKLE, MFS CANDIDATE

The Effects of Legacy Trees on Regeneration in Irregular Shelterwood Harvests over 25 Year Chronosequence of Oak-Hickory Forest

Forest managers are faced with meeting a broad variety of societal demands such as wildlife habitat and aesthetic considerations while still providing monetary value to landowners through harvesting timber. Ecological forest management strategies such as irregular shelterwoods can offer alternatives to traditional forest management that help to meet these goals. These techniques often involve leaving more standing structure in the form of legacy trees, which allows less light to the forest floor, and thus often promotes growth of shade tolerant tree species over shade intolerant species. This study examines a 25-year chronosequence of 34 irregular shelterwoods designed to regenerate oak in southern New England. In each shelterwood we measured all legacy trees in a 50 m radius overstory plot, and measured seedling and sapling regeneration in 18 subplots. We focused on analyzing regeneration of the four most common species: red maple (Acer rubrum), black birch (Betula lenta), white pine (Pinus strobus), and red oak (Quercus rubra). We used ANOVA to compare the differences across age classes, both in total and relative growth, as well as to compare differences in regeneration growth based on variation in overstory basal area. Over time, regeneration followed known stand dynamics patterns, with self-thinning occurring in the regeneration of all focus species. Black birch thinned most drastically through time, and the saplings that survived retained a high position in the canopy. Red oak self-thinned most slowly, and by its third decade (19+ years since harvest), began to increase in growth rate above the other 3 species. As overstory basal area increased, growth of red oak slowed, with 5 m2/ha of overstory basal area as a limiting density. Resource managers should consider the tradeoff between increasing legacy trees and decreases in growth of oak regeneration, as well as long term effects of increased structure post-timber harvest.

04. KEVIN DAHMS, MESc CANDIDATE

Storm chasing, sewer-diving, rain gardener.

Quantifying Bioswale Performance through Field Scale Research to Inform Urban Planning Decisions: A Case Study from New Haven, CT

As municipalities across the country opt for green infrastructure (GI) based strategies to meet stormwater management goals, there exists a need to quantify their efficacy. The results from such studies provide valuable insight to engineers and planners as they determine the specifications of GI practices for different applications in cities. Using low cost yet robust field scale research techniques, we quantified the performance of curbside bioswales in managing stormwater runoff and reducing contaminant loading associated with urban runoff. Working with the City of New Haven, our academic research has informed the City's implementation of a large scale green infrastructure (GI) program to reduce flooding in the vulnerable downtown area and reduce pollutant loading to Long Island Sound. This study represents a long term (1 year) pre and post GI implementation study of three (3) small urban sewersheds in New Haven, CT. Using low cost v-notch weirs and water level loggers, we collected continuous sewer discharge data at 5 minute intervals before and after GI implementation. We also incorporated measurements from tipping buckets and event loggers to determine flow into the bioswales during storm events. Comparing this information with local precipitation data and detailed impervious surface delineations, we quantified the reduction in stormwater runoff associated with GI. For most storm events, our results indicate over 90% reduction in runoff volume associated with GI installation. By collecting and analyzing water quality samples and combining the results with the flow data, we accurately measured the flux of total suspended solids (TSS) and nutrients in the storm sewer. The results show that GI interventions reduced contaminant loading by up to 90% for TSS and 60% for nutrients. The results from this work demonstrate that bioswales are effective means for meeting urban stormwater runoff management goals associated with reducing flooding and improving water quality.

ECOLOGY, EVOLUTION, AND MANAGEMENT IN TROPICAL FORESTS

Chair: Eva Garen
Program Director, Environmental Leadership and Training Initiative (ELTI)
Kroon 319 | 9:00–10:15 AM


Chair


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01. ANDREW MUEHLEISEN, DOCTORAL CANDIDATE

Local Adaptation to Herbivory among Tropical Trees Along a Steep Rainfall Gradient

In species-rich tropical forests, pests and pathogens exert significant pressure on plant communities, heavily influencing their ecology. Insect herbivory in particular accounts for up to 70% of annual leaf consumption in tropical forests, and plants will invest in defense at a significant trade-off with their growth. Adaptation to herbivory is also hypothesized as a driver of high tropical diversity, such that plants and their herbivores promote their mutual diversification via an evolutionary feedback. This adaptation may be particularly prevalent across environmental gradients that cause turnover in herbivore composition and abundance. For example, the pest pressure gradient hypothesis suggests that pest pressure will increase in wetter forests, presumably due to relaxed constraints on pest abundance. Thus, it may be that local adaptation in defense commonly occurs along such rainfall gradients, though this question has not been explored. To assess evidence for local adaptation to herbivory, as well as clarify the role of herbivory in limiting species distributions along rainfall gradients, we tracked foliar damage on transplanted seedlings of 13 tree species across three sites spanning a steep rainfall gradient in Panama (from 1500 to 3000 mm/year across 65 km). Seed source was controlled for such that all populations of each species were represented at every site across its range, allowing us to compare native vs foreign performance. Overall, herbivore damage was lowest at our wettest site. When we compared herbivory between populations, those grown in their native range were less likely to be attacked than foreign populations, but only on the wetter end of the rainfall gradient. The strongest native advantage was apparent at our wettest site, where native populations also exhibited less standing herbivory. We interpret these findings as evidence for local adaptation to herbivory, with stronger pressure to adapt to local conditions in wetter forest. Thus, our findings are consistent with the idea that herbivory drives intraspecific diversification in defense in the tropics, namely in wetter forests where pest pressure may be higher.

02. BEN RIFKIN, MFS CANDIDATE

Understanding Forest Biodiversity in a Human-Modified Landscape: A Study of Madagascar's Dry Forest

Tropical dry forest throughout the world is threatened by human activities due to economic conditions that lead to deforestation such as agriculture, fuelwood harvest, livestock grazing, among others. However, communities are taking steps to protect these forests. Few studies have reported on the impact of protected areas in tropical dry forests. Evidence indicates that dry forest may be more resilient to human disturbance than rain forest, but to achieve conservation goals it is important to understand how dry forest responds to a reduction in disturbance. Bezà Mahafaly Special Reserve in southern Madagascar, is a community-managed forest that has been protected for over 30 years. This study aims to understand how different levels of human-caused disturbance in Southern Madagascar is influencing structure, diversity, and composition of the dry forest. By comparing the composition and diversity of the forest canopy and regenerating species we determined that niche-partitioning as influenced by soil composition and moisture availability, causes more variation in richness and diversity of canopy species than does disturbance. Disturbance, on the other hand, plays a greater role in richness and diversity variation among regenerating trees in the understory, than does site condition. Fuelwood harvest, and livestock grazing, two of the strongest human pressures on the forest, are likely the main contributors to the varying levels of diversity among regenerating trees, and may be changing the successional dynamics of the forest. The varying levels of disturbance inside and outside of the protected area provides evidence that regeneration of dry forest is vulnerable to the selective pressure of livestock grazing and fuelwood harvest. Forest managers must account for the way in which both human and natural pressures are changing successional dynamics of the forest as it effects future habitat of many threatened endemic wildlife species.

03. JUAN PENAGOS ZULUAGA, DOCTORAL CANDIDATE

Ecology and Evolution of Gynodioecy in Tropical Trees: Females Versus Hermaphrodites

Flowering plants exhibit a wider variety of sexual and breeding systems than any other group of organisms, and this variety has a direct effect on community composition, species abundance, and distribution. In dioecious populations (plants with either male or female flowers), females invest more resources in reproduction (i.e., fruit production) than males. This different cost of reproduction has other effects: females mature later, flower less frequently, and may even grow slower than males. Whether such a cost is apparent in populations with other breeding systems is less well known, such as in gynodioecy species, where individuals can be functionally female or hermaphroditic. In this study, we evaluated if growth rate differed between trees of different genders in a natural population of the gynodioecy tropical tree <i>Ocotea oblonga<i> (Lauraceae) in 50 ha of lowland tropical forest on Barro Colorado Island, Panama. We followed the growth of 29 (7 female, 7 fruiting-hermaphrodite, 15 non-fruiting-hermaphrodites) trees from 1982, and collected phenological data in 2016 and 2017. Variation in fruit production suggests that some hermaphrodite trees functioned as male trees, whereas other hermaphrodites functioned as females. True females produced more and heavier fruits than fruiting-hermaphrodites. However, contrary to our predictions, we did not find significant differences in growth between females and either fruiting- or non-fruiting-hermaphrodites, suggesting that the cost of reproduction over the long-term was equivalent between the different sexes.

04. PETER UMUNAY, DOCTORAL CANDIDATE

Tropical Ecologist, forest policy & manager.

Quantifying Baseline Selective Logging Emissions and Assessing Emissions Reductions Potential from Reduced-Impact Logging (Ril-C) in the Congo Basin Region

Forest degradation emissions from selective logging in Central Africa are large but remain poorly studied. Passive remote sensing tools are not sensitive enough to capture the subtle changes in forest structure that result from selective logging, and until recently there was no standardized field methodology to quantify small-scale logging impacts. Here we use the methodology for improved forest management through climate- effective reduced-impact logging (RIL-C) to quantify baseline carbon emissions from legal timber harvesting by sources, including hauling, skidding and felling. We apply the method in 23 field-sampled concessions in the Democratic Republic of Congo, Gabon and the Republic of Congo. In addition, we model the relationships between total emissions as a function of biophysical conditions (e.g., slopes), logging practices, and relevant forest policies. We estimate potential emissions reductions following RIL-C implementation at two performance levels. Our study provides a robust and cost-effective accounting system that helps design and implement performance-based mechanisms to reduce logging emissions and to monitor progress towards improved forestry practices in Central Africa.

UPGOER 5 TALKS

Oral Presentations Limited to the 1000 Most Common Words

Chair: Sarah Smiley Smith

Assistant Dean of Research and Sustainability, *Yale School of Forestry and Environmental Studies*

Burke Auditorium | 10:30 – 11:00 AM


Chair


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01. ANA FANTON BORGES, DOCTORAL CANDIDATE

What Happens When Climbing-Trees Get Sick?

All trees have two different sets of tiny little pieces that together look like lines, one set of lines moves water and the other, moves food within the tree body. It is important to note that these lines are really long and join all the tree-parts together, so if these lines get sick, the whole tree is sick! When the water-line gets sick it can get blocked, stop moving water, and cause some trees to die slowly, but not all trees die! My work tries to understand how some climbing-trees can keep moving water even when they are sick and why some climbing-trees just cannot work in a normal way anymore. My study ask two questions: 1) What are the pieces or parts inside these lines that makes trees to not get sick? 2) How fast water moves inside these lines? To answer these questions I have a set of different climbing-trees: one that can get sick easily, two man-made that get a little bit sick but do not die, and last but not least one climbing-tree that never gets sick and its daughter (that also was man-made). I am looking inside these climbing-trees looking how their water-line is put together and if they have any special parts that make them hard to break. I'm also counting the time that it takes for water to move inside the climbing-tree when they are normal or when they are sick. So far, I have found that the climbing-tree that never gets sick and its daughter have a special part in their water-line that is really hard to break and this could help them to not die when they get sick.

02. ROBERT BUCHKOWSKI, DOCTORAL CANDIDATE

Ecologist studying animals and nutrients.

Animals Change Where Matter is in Fields But Only When We Consider the Starting Place and the Ground

I study how the animals in fields and in the ground of fields change the shifting of matter between leaves or green parts and brown parts. Animals that eat leaves make the green things have less of some types of matter. We think that the changes in leaves caused by animals also change the way animals eat the dead or brown leaves. We also think that, when dead leaves lose matter slowly because of these animals, it will change the matter in the leaves next year. I studied these two types of animals to see the shifting of matter and the number of green things in a field. I found that when animals eat green leaves they change the matter in them. The animals that eat dead leaves like the leaves with more matter, but the number of leaves that enter into the ground did not match the number of green things in the field. I built a thinking game to understand why. My game says that the reason is the matter in the ground. When matter goes from brown to green in a tight way the change of brown matches the change of green. But when the matter moves through real ground with lots of matter the changes don't match. Also my game shows that places which start with more green things or matter are different than places that start with less. Knowing about the slow shift through real ground and different starting places is important because they better our understanding of how animal change matter. My study shows that animal can change where matter is in the field, but that they might need years to also change the big parts of field matter: the green things and the ground.

03. PETER BERRILL, DOCTORAL CANDIDATE

Energy reduction enthusiast, system analyst.

Making Less Bad Things Happen When We Build Houses and Make Our Homes Feel Warm

When we do things at home like turn on the lights, have a shower, make it feel warm, or clean and dry our clothes, some bad things happen to the world. This is because today there are lots of things that we take out of the ground and burn which help us to build houses and do all of these cool things at home, but when we take these things out of the ground and burn them, bad things happen to the air and the water. That makes the world gets hotter, rain get weird, and people get sick and die. I want to find out how we can keep build our homes better, and do what we do at home without making those bad things happen to the air and the water. I think about changes we can make to our houses, and different ways of making our homes warm or making the lights turn on that need less of the bad things that come out of the ground.

04. MARY BURAK, DOCTORAL CANDIDATE

[Poop!] How Can Humans and Big Animals Live Together?

Sometimes, big animals meet humans when they are both out and about. When this happens, humans can hurt big animals. Humans are often afraid, or know that big animals sometimes hurt them, so they try to avoid this by killing the big animals. Today, big animals are dying a lot from both humans and how humans change the way they use land. I study big animals, with the hope of finding out how humans and big animals can be nice and share the same land. To do this, I pick up big animal poop. In this poop, I get all of the facts I need: where the big animal moves, its family, and how humans change all of this. With these facts, I can draw pictures showing where big animals need to move and live. From this, we can figure out how and where humans can use lands without hurting big animals.

URBAN CENTERS AND EQUITY

Chair: Colleen Murphy-Dunning
Program Director, Hixon Center for Urban Ecology, Urban Resources Initiative (URI)
Kroon G01 | 11:15–12:15 PM


Chair


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01. BHARTENDU PANDEY, DOCTORAL CANDIDATE

Multi-Scalar Urban Inequalities in India
By 2050, a population of size roughly twice the current population of India will be added to urban areas globally and a preponderance of this urban transition will occur in Asia and sub-Saharan Africa. Additionally, this impending urban transition is expected to occur with a weak overall coupling between urbanization and economic development, as a number of scholars have argued. A corollary of this transition is emergent inequalities in urban development outcomes, such as infrastructure access, which might manifest across spatial scales: between regions, urban areas, and neighborhoods. However, our current understanding of multi-scalar nature of these inequalities is limited as most of the previous studies examined inequalities at one particular spatial scale at a time. In fact, a cross-scale assessment of inequalities is rarely undertaken. As a consequence, the underlying principles that shape urban inequalities are also unclear. This study combines data from satellite remote sensing and census surveys to investigate multi-scalar urban inequalities in India. In particular, this study asks the following question: how do urban inequalities, in the form of infrastructure access differentials, vary across spatial contexts and spatial scales? Results from this research test the validity of three key hypotheses: (1) remote sensing-based retrievals of infrastructure inequality levels are positively related to that estimated from census surveys, (2) larger urban areas have less infrastructure inequalities compared to smaller urban areas (in terms of their physical extent), and (3) within urban areas, locational advantage and dis-advantage established due to differential exposures to available infrastructure, reinforces economic differentials. Findings from this research serve as a building block to our scientific understanding of the level and patterns of urban inequalities and highlight the nature of constraints to sustainable development.

02. CARA DONOVAN, MESc CANDIDATE
Food systems thinker, eater too.

'Why Aren't You Giving Us Quinoa Soup?': Changes in Quinoa Consumption in Peri-Urban Cochabamba, Bolivia
The soaring price of quinoa from 2006 to 2013 sparked a bitter controversy about the affect of wealthy American and European appetites on South America's quinoa-producing countries. As the cost of quinoa tripled, were these prices good, on balance, for rural Bolivians? Did the rising price of quinoa boost incomes or make it increasingly impossible for Bolivian farmers to afford this nutritionally dense and culturally important food? Both media and scholarly reports have centered on rural Bolivian farmers and families, but less is reported about the effect of rising price on quinoa consumption among Bolivian's urban populations and child feeding programs. This paper is the result of a qualitative study examining quinoa consumption in peri-urban households and child centers serving children under 6 in Cochabamba, Bolivia. Qualitative data collection was undertaken May-July 2015 via semi-structured interviews with mothers of children under 5 (N = 25), as well as food preparers at child centers which target this age group (N = 12). The study found that both child center food preparers and mothers reported to consume less quinoa, replacing it with more affordable but less nutritious options such as rice, wheat noodles, or quinoa flakes. Even at the time of the interviews in 2015 when the price had lowered substantially, quinoa had not been reinstated on the menu in child centers. The study also revealed that some mothers and child center food preparers employed strategies to continue serving this valued food on a tight budget. The results suggest that peri-urban consumers are sensitive to the price of quinoa, and the impact of rising prices extends to urban consumers and their children within child centers and the home.

03. KATHERINE ROSE WOLF, MESc/MPH CANDIDATE
Queer environmental health justice researcher.

Racial Residential Segregation and Airborne Fine Particulate Matter Component Concentrations in the United States

Both exposure to particulate matter ≤2.5 microns in diameter (PM2.5) and African American racial residential segregation (RRS) in the United States (US) are associated with negative health outcomes including cardiovascular and respiratory diseases, negative birth outcomes, and death. PM2.5 toxicity varies by chemical composition and PM2.5 chemical composition varies by source. In this study we evaluate potential associations between African American RRS and PM2.5 total and component concentrations in US urban areas. We calculated 2005-2015 average census tract concentrations of total PM2.5 (n=886) and 20 PM2.5 components including aluminum (n=276), ammonium ion (n=213), arsenic (n=276), bromine (n=274), calcium (n=276), chlorine (n=276), copper (n=275), elemental carbon (n=201), iron (n=276), lead (n=276), mercury (n=162), nickel (n=276), nitrate ion (n=267), silicon (n=276), sodium (n=264), sodium ion (n=213), sulfate ion (n=277), titanium (n=276), vanadium (n=276), and zinc (n=276) using daily averages from the US Environmental Protection Agency. We used 2010 US Census data to calculate a spatial isolation (SI) index of RRS by census tract and 2008-2012 American Community Survey data to evaluate socioeconomic confounding. We used a one-way analysis of variance to evaluate differences in PM2.5 total and component concentrations by SI quintile and linear models to evaluate associations between PM2.5 concentrations and SI quintiles. Concentrations of total PM2.5 and arsenic, bromine, copper, elemental carbon, iron, nickel, nitrate ion, lead, sulfate ion, vanadium, and zinc were higher for tracts in the highest quintile of SI than for those in the lowest. Linear models showed a 0.41-microgram-per-cubic-meter increase (95% confidence interval (CI): 0.27, 0.54, $p<0.000001$) in total PM2.5 per one-quintile increase in SI after controlling for poverty, region, educational attainment, and percent Hispanic/Latinx. Results suggest that total PM2.5 concentrations are higher in more segregated areas and that associations between PM2.5 concentrations and segregation appear to vary by PM2.5 chemical composition in the US.

HOT AND DRY:
IMPACTS OF EXTREME WEATHER

Chair: Simon Queenborough
Director, *Tropical Resources Institute*
Kroon 321 | 11:15–12:15 PM


Chair


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01. RACHEL R. RENNE, MESc CANDIDATE
Pedestrian with predeliction for sagebrush.

Understanding a Large-Scale Big Sagebrush Die-Off in Southwest Wyoming

The probability of extreme weather events is increasing, with the potential for large-scale impacts to plants. Extreme weather conditions can result in widespread plant mortality when they exceed a species' physiological limitations, and drought-induced plant mortality has become more frequent globally over the past two decades. In 2014, a large-scale die-off of the widespread shrub, big sagebrush (Artemisia tridentata Nutt.), was reported in southwest Wyoming, following extreme drought conditions in 2012 and subsequent extreme precipitation in September of 2013. Across 11 U.S. states, big sagebrush ecosystems provide critical wildlife habitat and support local livelihoods. The big sagebrush die-off exhibited distinct patterns across the landscape, with widespread mortality in some areas and mortality restricted to lowland positions in others, suggesting soil and landscape position contributed to the die-off. I established 51 pairs of upland and lowland plots to capture these patterns, including live upland/live lowland, dead upland/dead lowland, and live upland/dead lowland pairs. I measured the cover and number of live and dead big sagebrush plants and collected soil samples. I used soil and site information with gridded historical weather data as inputs for simulating soil water conditions from 1980 to 2016 using SOILWAT2, an ecosystem water balance model. Sagebrush mortality was greatest on sites with fine-textured soils and sites with low mean annual precipitation. Output from SOILWAT2 indicated that big sagebrush mortality was lowest at sites where 2012 drought and 2013 wet conditions were the most extreme over the simulation period. This suggests that the die-off occurred in locations that were driest on average and that big sagebrush at sites that have experienced frequent drought conditions over the past 37 years were most vulnerable to the extreme events of 2012 and 2013.

02. CAMERON MUSSER, MFS CANDIDATE
Opitimistic drought biologist, tree enthusiast.

Variation in Vulnerability to Drought Stress in the Needles California Ponderosa Pine

Ponderosa pine is an ecologically and economically important species in the West. Recently, drought-induced mortality in Ponderosa pine has contributed the over 100 million dead trees in California. While we have some insight into how the stems and roots perform during drought, we know much less about the foliage, primarily due to methodological limitations. At four national forests representing a drought-intensity gradient within California, we used two independent methods to determine the pine needles' vulnerability to desiccation. We also measured anatomical traits with the hypothesis that trees from dry areas would have traits that maintain leaf functioning during drought. Data from the two methods for estimating water flow through needles suggest that the xylem conduits (i.e. the tracheids) were highly resistant and does not significantly different between sites. However, the pathways for water movement outside the xylem (i.e. the transfusion tissue and mesophyll) were highly vulnerable drought and varied significantly between sites. Contrary to our hypothesis, our data show that populations with wetter growing seasons have larger proportions of outside-xylem tissues as well as lower P12 values. This new information provides insight into the plastic responses of Ponderosa pine needle anatomy and physiology during times of drought.

03. KEN HUANG, DOCTORAL CANDIDATE

Modeling the Water Usage for Urban Heat Island Mitigation in Arid Climates

In the near future, the confluence of rapid urbanization and climate change is likely to increase health risk and energy consumption, by aggravating urban heat island (UHI) effects in more urban areas with large populations. Mitigation of UHI requires understanding its determinants, namely anthropogenic heat, efficacy of heat advection and convection, surface albedo, and evapotranspiration (the sum of evaporation and plant transpiration). While most of these factors are difficult to change, evapotranspiration can be enhanced by providing urban vegetation, which has been found to reduce temperature by 1.3°~1.6°C in previous studies. However, this approach usually needs to be sustained by irrigation, which accounts for a major portion of urban water use, amounting to more than 50% in arid/semi-arid climates. Despite the potential of irrigation in UHI mitigation, it may not be a reasonable use of water in all cities. By 2050, more than 1 billion urban populations will live under water stress due to urbanization and climate change. Since these global changes will also aggravate UHI, many cities are likely to face the difficult choice between UHI mitigation and water conservation. Supporting this decision-making requires advancing our scientific understanding of the relationship between water usage and UHI mitigation effectiveness in various urban environments. We modeled this relationship with multi-sensor and multi-temporal remote sensing data. Images from Landsat/TM, Sentinel-1/SAR, and QuickBird were used to generate urban surface parameters required in the model. Time series SMAP soil moisture, MODIS normalized difference vegetation index (NDVI) and municipal water statistics were used to estimate irrigation water usage. After validating the model with MODIS land surface temperature (LST), we will repeat the simulation while applying various amounts of irrigation to quantify the water-UHI relationship. We found that water-UHI relationships for urban areas depend on the density and extent of the city. The resulting relationships will advance the scientific knowledge on water-energy balance in urban environments, and help manage urban water budget and alter local climate.

ENVIRONMENTAL CHANGE IN INDIA:
FROM CITIES TO FORESTS

Chair: Ned Gordon
Assistant Editor, *Journal of Industrial Ecology*
Kroon 319 | 11:15–12:15 PM


Chair


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01. AMRUTASRI NORI-SARMA, DOCTORAL CANDIDATE

The Influence of Heat Wave Characteristics on Variability in Mortality in Northwestern India: A Propensity Score Matching Approach

Introduction While the relationship between heat waves and health is known, questions remain regarding health effects of heat waves that occur in climates with high baseline temperatures, especially under a changing climate. Additionally, questions remain regarding causal inference, and whether prior results for high effects early in season apply universally. Few studies have attempted to assess the relationship between heat waves and health outcomes in India using quantitative data and systematic methods for analysis, partially because of the lack of existing standardized data collection methods for public health purposes. Methods Data from city registrars and local meteorological departments were collected for 4 communities in Northwestern India. Propensity Score Matching (PSM) was used to assess the correlation between elevated temperature periods (heat waves) and attributable mortality and relative risk of mortality, across a variety of heat wave definitions incorporating duration as well as intensity. Timing in season was also assessed for health impacts. Results Relative risk of heat waves ranged from 1.28 [95% CI: 1.11, 1.46] in Churu to 1.03 [95% CI: 0.87, 1.23] in Idar and Himmatnagar. High attributable deaths for each community did not match with the heat wave definition that resulted in the highest relative risk. Heat waves that occurred later in season were much more deleterious to health, contributing to more attributable deaths than early season heat waves. Conclusion Some heat wave definitions result in a high risk of deleterious health effects, however so few days match those criteria that the absolute health burden is diminished. This is critical from a policy perspective, as a tool for policy makers to determine the most important criteria for declaring a heat wave.

02. MEGHNA KRISHNADAS, DOCTORAL CANDIDATE

Dampened Regulation by Natural Enemies Decreases Plant Diversity with Edge-Effects in Fragmented Forests

Fragmentation is a pervasive threat to biodiversity in forests worldwide, and understanding the mechanisms of biodiversity loss in fragments is an urgent challenge. In fragmented forests, proximity to edges reduces plant diversity, but the ecological processes underlying edge-mediated loss of diversity are poorly understood. In particular, while theory predicts that top-down regulation by insect herbivores and fungal pathogens maintain high plant diversity in forests, it is unknown whether these diversity-enhancing interactions between plants and their natural enemies are disrupted at forest edges. Here, we experimentally demonstrate that weakened activity of fungal pathogens and insect herbivores reduced diversity of recruiting seedlings near forest edges in a human-modified tropical forest landscape. At 90-100 m from forest edges, applying fungicide and insecticide lowered seedling diversity—relative to control plots—by weakening density-dependent seed and seedling mortality caused by natural enemies. In contrast, pesticide application affected neither seedling diversity nor density-dependent mortality within 60 m of forest edges, where diversity declined during the seed-to-seedling transition. Our study provides novel, mechanistic evidence that human modification of forests can erode plant biodiversity through the cryptic loss of top-down regulation by specialized natural enemies.

03. SWETHA KOLLURI, MEM CANDIDATE
Rural Development Professional; Data Scientist;
Artificial Intelligence enthusiast; Global South

Prediction Model For Crop Productivity in India

Climate change is aggravating the challenges faced by the agriculture sector. Increasing temperatures, variability in rainfall, and frequency and intensity of extreme weather events are adding to pressure on agriculture systems all over the world. The vulnerability of agriculture to climate change is high in India, where the livelihoods of 600 million people (about 50% of population) depend on agriculture. Climate change is predicted to result in a 4%-26% loss in net farm income towards the end of the century. Such research provided impetus to formulate national climate adaptation policies in India. However, there is no guidance to the policy makers on how these estimates translate into predictions in the immediate future at the disaggregated level. Operating in a highly resource constrained environment, the Indian policy makers often ask which geographies, agriculture seasons, crops and communities are more vulnerable to climate change than others? Which crop insurance policy protects the farmer from the vagaries of climate? My research engages with some of the above questions by modelling crop productivity of the top-10 crops of India at the district (sub-state) level in India. I have combined government administrative data on crop production at the district level with irrigation data, climate data, soil data, and economic data during the years 1997-2014. I used machine learning methods such as random forests, gradient boosting machine, and neural networks to build a prediction model of crop productivity at the district level in India. Finally, the climate forecasts using Global Climate Models, most suitable for the Indian context are used to predict the crop productivity in the near future at the district level for each crop. The prediction model is expected to assist policy makers and crop insurance companies to provide optimum solutions to farmers through well-targeted or customized programs and products.

POSTER SESSION
Exhibits and Presenters

Burke Auditorium | 12:15–1:00 PM


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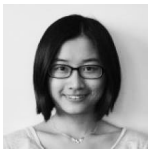
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01. LEXI SMITH, MESc CANDIDATE
Aspiring land manager and conservation ecologist.

Modelling Aboveground Biomass of Bunchgrasses in Wyoming Big Sagebrush Steppe Plant Communities
Studying biomass in dryland ecosystems is fundamental to understanding their structure and function, as well as effectively managing the natural resources they provide. However, direct biomass measurements can be time consuming and require destructive harvesting of plants. Alternatively, biomass can be estimated using nondestructive field measurements for each species of interest. Wyoming big sagebrush steppe in the western United States is a widespread dryland ecosystem that lacks reliable biomass estimation methods based on individual plant measurements. To fill this knowledge gap, I am developing regression equations that predict aboveground biomass of eight bunchgrass species within sagebrush plant communities using nondestructive field measurements. These measurements include average height, basal diameter, and tiller count for each bunchgrass individual. During the summer of 2017, I destructively sampled plants from 20 sites across the big sagebrush steppe in southwestern Wyoming. This resulted in measurement and harvest of 520 bunchgrass individuals representing eight of the most common bunchgrass species in this ecosystem. I am using regression modelling to determine which plant measurements are most effective at predicting aboveground biomass for each species. The resulting equations will allow biomass estimation from simple field measurements throughout the Wyoming big sagebrush steppe, with the potential of improving large-scale land management and conservation in this region.

02. LINUS BLOMQVIST, MESc CANDIDATE
Conservationist and aspiring environmental economist.

Whales' Saving Grace: The Role of Scarcity and Substitution in the Demise of Industrial Whaling
Over the 20th century, almost three million whales were killed – most of them in the Antarctic – and many species narrowly escaped extinction. Whaling reached its maximum around 1960 and then declined. By the late 1960s, most countries had ceased whaling, although the USSR and Japan continued for another decade. But why did whaling decline? My research explores this question using an econometric model of supply and demand, covering Antarctic whaling in the period 1945-1977. Unsurprisingly, the depletion of whale stocks had a significant effect on harvests. But other factors were at play, too, even though the effects varied by country. Neither the USSR nor Japan was responsive to changes in the wholesale price of a whale. This is likely due to heavy state involvement in both countries' whaling industries. The USSR did not even respond to stock changes in this period, perhaps as a result of fixed catch targets. The two other major whaling nations – Norway and the UK – did, however, respond to prices. Declining prices in the 1950s and 1960s was therefore a significant factor in these two countries' abandoning whaling. The decline in prices, in turn, was largely driven by cheaper substitutes for whale oil, such as palm oil. In other words, palm oil and other vegetable oils helped save the whales in the 20th century in the same way that kerosene helped save them in the 19th.

03. CHEN CHEN, DOCTORAL CANDIDATE

Long-Term Temporal Trend of the Short-Term Association Between Fine Particulate Matter Concentration and Hospital Admissions Among Elderly Americans
Background/Aim Previous studies show that fine particulate matter (PM2.5) concentrations are associated with increase in short-term risk of adverse health outcomes. However, since the U.S. established many policies to control PM2.5 in the past several decades, leading to changes in PM2.5 total mass concentration and composition, the short-term association of PM2.5 and adverse health outcomes may have changed as well. This study aims to investigate whether a temporal trend exists for this association. Methods We utilized hospital admission data of U.S. Medicare beneficiaries (>65y) and EPA PM2.5 monitoring data between 1999 and 2013, and analysed cardiovascular

outcomes and respiratory outcome separately. We employed two-stage Bayesian hierarchical models to estimate the county-level and nation-wide temporal trend of association between hospital admission rates and PM2.5 concentration. To ensure internal validity of statistical model, we conducted extensive sensitivity analyses with the hypotheses tested stated a priori. We also summarized policies targeting PM2.5 between 1999 and 2013. Results We observed a 1.77% (95% CI: 0.92 to 2.63%) decrease in the percentage change in respiratory hospital admission rate with a 10 μg/m3 increase in same day PM2.5 over the study period when assuming a linear temporal trend, while no statistical significant trend was observed for cardiovascular hospital admission rates. Based on previous literatures and biological plausibility, we evaluated four possible explanations for the observed temporal trend. Conclusions Results indicate that the health impact of PM2.5 on respiratory admissions has declined over time. Based on qualitative evidence, changes in population susceptibility towards acute exposure to PM2.5 on respiratory adverse health outcomes, and combination of changes in multiple chemical components are the likely explanations for the observed temporal trend.

04. KATE BURROWS, DOCTORAL CANDIDATE

Environmental migration scientist, aspiring baker.

Patterns of Environmental Displacement in Indonesia

Climate change has the potential to impact migration patterns worldwide. Recent research has been conducted linking large-scale population movement to changes in temperature and precipitation. However, few studies have looked specifically at individual-level differences between those who move for environmental reasons, those who move for non-environmental reasons, and those who do not move at all. It is critical that we better understand individual and household-level heterogeneity across migrants and non-migrants in order to more fully understand migratory responses to environmental drivers. This project uses Indonesian household-level survey data from movers and non-movers for environmental and other causes to address two primary objectives: first, to explore differences in demographics and socioeconomic status, and second, to understand characteristics of the moves themselves. We found that environmental migrants tended to be significantly older, less educated, more likely to be married, and more likely to be female than their non-environmental counterparts. This suggests that migration for environmental purposes is generally undertaken as a family, which contrasts with findings from other regions that show increased rates of young, male household members migrating as a means to diversify income after droughts and other environmental stressors. We also found that environmental moves were generally made over shorter distances and were less likely to cross provincial boarders than non-environmental moves, supporting previous research that environmental migration tends to be localized. To mitigate the negative effects of climate change, we must better understand how environmental factors are already influencing migratory patterns. This research provides some insight into this issue in Indonesia. Further work is needed to better explore how environmental stressors affect the migration decision making process, and to understand how this displacement affects public health.

05. ADAM EICHENWALD, MESc CANDIDATE

Food webs and wildlife researcher.

Biotic and Abiotic Factors Creating a Landscape of Fear: Spatial Patterns of Ptarmigan Due to Predation Risk from Gyrfalcons

Predation risk and prey fear responses to predators are well-established concepts in animal behavioral ecology. What remains uncertain is how spatial variation in risk effects and abiotic factors translates into spatial variation in prey occurrence. To address this lack in understanding, we report on an analysis of ptarmigan (Lagopus sp.) spatial responses to predation risk from their primary predator the gyrfalcon (Falco rusticolus) in an Alaskan tundra landscape, including both biotic and abiotic factors. We examined the spatial responses of rock ptarmigan (L. muta) and willow ptarmigan (L. lagopus) at different distances from gyrfalcon nests across the study region. We also examined environmental variables in our analysis, as gyrfalcons use the physical conditions of the landscape to aid in hunting success. As predicted, ptarmigan were spatially distributed at increasing distances from gyrfalcon nests. Ptarmigan also responded to spatial risk with changes in behavior and were more likely to be seen hiding under shrubs when closer to gyrfalcon nests. However, ptarmigan were not located uniformly at large distances from gyrfalcon nests. Our data demonstrated that when selecting areas of low predation risk, ptarmigan prefer sites that are protected from wind but show high wind speeds in the sky above. This selection allows for better thermoregulation in the face of wind chill, but it also increases the difficulty of a successful attack for a falcon. We conclude that ptarmigan balance a number of factors to achieve the lowest possible risk of death from their most prolific predator, exhibiting differences in spatial distribution, behavioral plasticity, and responsiveness to abiotic variables to defend against the expression of multiple functional traits of predation.

DECOLONIZING RESEARCH

Chair: Julia Monk
Doctoral Candidate, *Yale School of Forestry and Environmental Studies*
Kroon G01 | 1:30–3:00 PM


Chair


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01. ELHAM SHABAHAT, MESc CANDIDATE
Story-listener and teller, writer, photographer.

Shifting Forests, Invisible Histories: Contestations and Conceptions of Gishwati Forest in Rwanda
Gishwati-Mukura is a new national park in Rwanda, established in 2015 by conjoining two forest reserves: Gishwati and Mukura. In Gishwati, various actors determine the landscape and its history: nature, culture, international organizations, and local conservation non-governmental organizations. Sometimes this history is linear and visible, transforming the landscape in visible ways; often the history is invisible with acts of erasure of local land use, meanings and practices. The Rwandan state permeates through everyday life, transforming relations, commodifying land, and establishing hierarchies of knowledge and control over space. I argue in this research project that the visibilities and invisibilities of the history of Gishwati renegotiate and continually transform the landscape, ultimately redefining what Gishwati is. My research begins by situating the dramatis personae of my time in Gishwati, focusing on a number of individuals who tell the history of Gishwati through their memories and stories. Finally, the stories of Gishwati include the Batwa, the historically marginalized, pygmy forest-dwellers of Rwanda. This research works to elucidate how discourses of degradation construct Gishwati and pave the way for its legibility. I examine contestations of power that mark Gishwati as a landscape, and conclude with an examination of how a politics of place would contribute to an understanding of the history of Gishwati.

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02. DEEPTI CHATTI, DOCTORAL CANDIDATE
Feminist political ecologist, cat lover.

Studying the Other: Epistemic and Ethical Challenges in Development Research in the Global South
Much development research in the Global South is carried out by researchers based in the Global North. How is this research carried out on the ground, and how do the subjective positions of the researcher and researched affect the knowledge production exercise? How do historic systems of power inform and influence development research, and what are the epistemic and ethical challenges of such scholarship? In what ways does contemporary research in the Global South respond to critiques of development generated by critical social scientists over the last few decades? By following one cookstove research project in rural India carried out by a consortia of researchers based in the United States and Canada, I analyze how these questions play out on the ground, and ultimately affect the research outcomes. I rely on ethnographic data that I have collected since 2013, as a participant observer in this research project. Cookstove research is carried out under a broader umbrella of expanding energy access to low-income families in the Global South.

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03. NOAH SCHLAGER, MESc CANDIDATE

Indivisible Bond of People and Land: Territorial and Dialectic Boundaries of Indigeneity at Bears Ears
The Bears Ears National Monument has become the focus of a major debate on public lands in the United States. Bears Ears was the first National Monument to be proposed by Tribes, designed with the intent to create a collaborative-management system where the United States engages Tribes in a government to government relationship when deciding how to manage and care for the land encompassed within the National Monument. In my time at F&ES, I saw the monument created and then largely taken away. The outcome is far from settled, as of December 7th environmental groups and tribes are taking the Trump administration to court—Utah Diné Bikeyah, one of the most significant non-profits supporting the monument, put out a statement saying that to the tribes the original designation is still thought of as in place (Utah Diné Bikeyah 2017). In contrast to the interests and investments of tribes, national reporting and public debate has been focused on a louder public land versus anti-federalist narrative, making Tribal concerns a subheading to that conflict. Much of the language used in the public debate around Bears Ears fails to mention Native people or characterizes Native people in ways rooted in outdated understandings of Indigeneity and Tribes relationships and rights to the land. Careful examination of the situation requires an understanding of Bears Ears

in the context of both the very specific struggle over land rights and boundaries of Indigenous sovereignty in Southeastern Utah, as well as the National and International push for meaningful empowerment of Indigenous peoples in co-managing publicly owned lands. We have to understand Co-management as an extension of settler-colonialism and consider the colonial roots of environmental management and the ways in which Indigenous peoples embed deep meaning in landscapes which get erased by both Pro and Anti monument narratives.

04. CORAL R. BIELECKI, MESc CANDIDATE

Hawaiian Understandings on the Agency of Nonhumans

The Kahoʻolawe Island Reserve encompasses a 45-square mile island in Hawaiʻi that has been devastated by ungulates, napalm, mock atomic warheads, bombs, rockets, and the mismanagement of biological resources. Fifty years of use (1941-1994) by the U.S. military as a weapons testing range resulted in Kanaloa-Kahoʻolawe becoming the most heavily bombed place in the Pacific. Yet, despite the degraded landscape, the island is a sacred place for learning and healing. Thousands have risked bodily harm to engage with the restorative project which regards the island as very much alive. While much research describes socio-ecological systems as complex, subjective, and lively sites of knowledge production, little attention has been paid to the agency and contributions of nonhuman biota. Far less attention has been given to understanding the agency of landscapes. This work is a more than human history of Kanaloa-Kahoʻolawe island in the Hawaiian archipelago. I seek to describe how non-humans are entangled with the social world of knowledge production and consider how recognizing such an iterative engagement might contribute to contemporary scientific study. It particularly uses decolonizing methodologies and discussions of time-space relations to reframe nature–culture relations. It analyzes the biocultural terrains of the borders between matter and meaning, the self and the universe, human and nature on Kahoʻolawe island. Underpinned by powerful dynamics, Kanaloa-Kahoʻolawe continues to present possible new political, legal, ecological, and ideological challenges, as well as opportunities.

05. MAXIME LAMBERT, DOCTORAL CANDIDATE

Sex biology, herpetology, and cities.

The Evolution of Sexuality and Same Sex Sexual Behavior in Animals

Sex, sexuality, and sexual behavior have historically been studied from an evolutionary perspective within a heteronormative and western framework. This has limited our ability to adequately perceive, describe, understand, and value the sexual diversity that has evolved across myriad animal species. Researchers and society are becoming increasingly aware and appreciative of the LGBTQIA+ community and the diversity of sexual behaviors in the animal kingdom. This prompts a reconsideration of how evolutionary biology has traditionally addressed the study of sex. Same-sex sexual behavior (SSSB) occurs in over 1,500 animal species and evolutionary biologists have sought to understand how and why "homosexual behavior" has repeatedly evolved and persisted. This question implicitly assumes that heterosexuality is the baseline condition for animals. Furthermore, SSSB is considered inherently maladaptive and an evolutionary conundrum. We argue that these assumptions have not been rigorously examined, and instead hypothesize that multi-sexuality, an expression of both heterosexuality and SSSB within a species, is the original condition for sexually reproducing animals. From a multi-sexual state, we can more adequately understand the sexual diversity that has evolved and which ecological and social conditions may have led to different sexual states. Furthermore, we challenge the idea that SSSB is inherently maladaptive, and discuss the contexts under which it may be adaptive. By challenging the lens through which we study sex evolution, we can more fruitfully examine the evolutionary history of diverse sexual strategies.

ENERGY SUPPLY AND DEMAND IN A CHANGING WORLD

Chair: Reid Lifset
Associate Director, Industrial Environmental Management Program
Editor-in-Chief, *Journal of Industrial Ecology*
Kroon 321 | 1:30–3:00 PM


Chair


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01. PEI HUANG, POST-DOCTORAL FELLOW

Is Abundant Natural Gas a Bridge to a Low-Carbon Future or a Dead-end?
A fierce debate rages on whether abundant natural gas is a bridge to a low-carbon future or a hinderance to long-term decarbonization. This paper uses a detailed energy-economic market equilibrium model to study the effects of an upper bound case of natural gas availability. We show that a market-driven abundant natural gas supply can provide substantial reductions in air pollution but does not considerably reduce CO2 emissions in the longer-term, especially relative to a moderate carbon price. However, we quantify large welfare benefits from abundant natural gas. The spatial disaggregation of our results allows for a clear picture of the distributional impacts of abundant natural gas, illustrating that there are clear winners and losers from a path that relies on abundant natural gas.

02. ERICA BARTH-NAFTILAN, DOCTORAL CANDIDATE

Fracking and Methane in Groundwater—Is there a Connection?
Controversy persists over the potential of unconventional oil and gas development to contaminate drinking water with methane or other chemicals. Over the past several years we have collected over 500 groundwater samples from groundwater monitoring wells in a region of shale gas development before, during, and after drilling, hydraulic fracturing, and the start of production of seven shale gas wells. We observed significant variability in methane concentration and composition, some of which was attributable to shale gas development, and some of which was likely not caused by these operations. I will discuss our findings, interpretation of results, and my field work in gasland.

03. JOLISA BROOKS, MESc CANDIDATE
Indigenous-Detroiter, Diplomat, Womanist, Political Ecologist.

For The Love of Coal? Geopolitical Analysis of Energy Development and the Resource Curse in Kosovo
Economic history has illustrated a paradoxical pattern of resource-rich nations suffering –rather than profiting from abundant oil and mineral deposits amassed under their land. Coined by Richard Auty in the late 20th century, the resource curse denotes the contradiction that countries with a wealth of non-renewable natural resources tend to have less economic growth, more political instability and worse development outcomes than countries with scarcer natural resources. Although this "paradox of plenty" is pervasive throughout middle and low-income nations, the curse is not universal or inescapable. Despite possessing its own "black gold" and boasting the 5th largest lignite coal reserves in the world, Kosovo's citizens are amongst the poorest in Europe and its federal government epitomizes corruption. Under the guise of promoting political and energy sovereignty, the US Department of State, in conjunction with USAID, The World Bank and the EU is supporting the development of Kosovo C, a 600MW multi-million dollar coal fire plant. In a post-Paris era, coal expansion seems as enigmatic as the curse itself. The more insidious paradox is the US propagation of fossil fuel expansion and reinforcement of coal dependency in Kosovo while simultaneously reducing fossil fuel consumption domestically. This study seeks to examine the recourse curse as it operates in Kosovo and the role international organizations have in reinforcing the curse.

04. PAUL WOLFRAM, DOCTORAL CANDIDATE

On the Over and Underestimation of Impacts From Individual Passenger Transport at Different Assessment Scales

Transport is understood to be a major cause but also one of the main mitigation options for climate change. Both, conventional as well as low-carbon transport equipment has been subject to numerous environmental assessments. However, several shortcomings of such technology assessments have been identified by scholars, which can lead to considerable divergence between the estimated and the real environmental impact of transport equipment. These discrepancies can lead to false optimism about technology choices. Eliminating errors in technology assessments therefore is indispensable in order to steer the transport sector into a future that is compatible with climate change mitigation targets, such as the 2C target. This work is therefore concerned with consolidating and integrating these factors into an overall assessment framework in order to overcome several shortcomings of previous environmental assessments of individual passenger transport equipment.

05. STEFANO CARATTINI, POST-DOCTORAL FELLOW

Social Interactions and the Adoption of Solar PV: Evidence from Cultural Borders

Social spillovers are considered a key feature of technological diffusion. In presence of cultural barriers, social spillovers may, however, be hampered. In this paper, we exploit exogenous cultural borders and a quasi-natural experiment to investigate the role of social spillovers in the adoption of solar photovoltaic (PV) technology. With data on about 19,000 solar PV systems, we assess whether proximity to a language border implies a lower rate of PV adoption. The results confirm that the cultural border hinders social spillovers. Following the implementation of a nationwide feed-in tariff fundamentally changing the financial profitability of solar PV, we find a divergence in the rate of adoption between municipalities located very close to the border, and others located further away. This effect is, however, moderated by the proportion of inhabitants speaking the language of the other side of the border. The effects measured in this paper are persistent over time, and consistent with the role of localized social spillovers in the adoption of clean technologies. The number of "missing" PV adoptions resulting from the language border is non-negligible, as the border leads to 20% less PV adoptions.

UNDERNEATH IT ALL: THE ROLE OF SOILS IN TERRESTRIAL AND AQUATIC ECOSYSTEMS

Chair: Mark Bradford

Professor, Soils and Ecosystem Ecology, *Yale School of Forestry and Environmental Studies*

Kroon 319 | 1:30 – 3:00 PM


Chair


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01. YISHEN LI, MESc CANDIDATE

Water warrior: fresh and salty.

Age Matters: Water Residence Time Controls Organic Matter Processing in Major North American Rivers

In aquatic and coastal ecosystems, dissolved organic matter (DOM) serves diverse, fundamental roles. Riverine DOM exported to coastal waters comes from two major sources – either produced in situ (autochthonous) through primary production, or delivered from terrestrial runoff (allochthonous) by streamflow – each behaving distinctively. In large river networks, which DOM source dominates is often determined by water residence time, reflecting how much time is available for biogeochemical processing to occur before DOM reaches the ocean. Emerging optical methods, such as UV-vis spectroscopy and fluorescence excitation-emission matrices (EEMs), offer powerful tools to reveal DOM composition, sources, and properties. However, a knowledge gap exists between DOM hydrology and biogeochemistry, partly due to the lack of accurate metrics to characterize water residence time in large, heterogeneous watersheds. Through a 7-year water quality monitoring effort under the USGS National Stream Quality Accounting Network, we identified the sources of DOM from 22 major river basins across North America by UV-vis spectroscopy absorbance and EEMs florescence index of colored DOM. Meanwhile, we constructed proxies for water residence time in watersheds from stable isotopic tracers δ18O and δ2H in streamflow. Both absorbance and fluorescence analyses indicated that DOM from watersheds of shorter water residence time is more likely to preserve terrestrial signatures due to less biogeochemical processing. As climate change leads to more intense precipitation events that effectively shorten water residence time in river basins, more terrestrial DOM could end up in our rivers and eventually oceans. This study is the very first to synoptically characterize DOM sources by water residence time on the whole-watershed scale across diverse biomes and landscapes. Since water residence time profoundly controls ecosystem dynamics, our work could also be translated to study other important processes, from nutrient cycling to pollutant transport, thus greatly advancing aquatic science and management.

02. ANNIE STOETH, MESc CANDIDATE

Educator, bug/trash/volcano enthusiast.

Dirty Soils in the City: Examining the Relationship Between Plastic Waste and Underlying Edaphic Invertebrate Communities

Trash is an increasingly universal issue given the global dearth of adequate waste management systems and the fact that even effective recollection/recycling/disposal structures do not remove all waste from the environment. Though ubiquitous, litter is understudied and often believed to be relatively innocuous. This study examines the interaction between non-hazardous municipal solid waste and the urban ecosystem, looking specifically at the effect of plastic surface litter on soil invertebrates, as measured through abundance, community structure, and diversity. The study focuses on soil ecosystems of NYC public parks. During the summer of 2017, 50 paired samples (from underneath plastic litter and from underneath natural surface coverings) were collected across 5 parks in the Bronx. A 5-week manipulative experiment was also conducted, using uniform soil substrate and invertebrate communities to establish microcosms that were then covered with dried leaves (n=3), plastic (n=3), and clear broken glass (n=3) to examine causative relationships. During the fall of 2017, invertebrates from all 109 samples were extracted, counted, and recorded, and background soil characteristics (including SOC, pH, water holding capacity, gravimetric moisture, and bulk density) were measured. Data was analyzed using t-tests, generalized and mixed effects linear models (including poisson) and ANOVA. Results failed to show any statistically significant differences in invertebrate communities between polluted and unpolluted soils.

03. ELI WARD, MFS CANDIDATE

Vine enthusiast (& occassional wine enthusiast).

Impacts of Invasive Woody Vines on Soil Processes in Forested Urban Natural Areas: Implications for Ecology and Management

Many cities are implementing efforts to restore natural areas through invasive species removal, and woody vines are a leading concern in urban forest management. Vines are distur-

bance-adapted plants that thrive in urban systems, and they aggressively compete with trees for light, water, and nutrients. By increasing tree mortality and reducing regeneration, invasive vines may alter the future structure, composition, and function of forest communities. Invasive vines may also impact belowground processes, including the carbon (C) and nitrogen (N) cycles, and if these changes persist in the soil following restoration, additional site treatments may be required to restore the system. This study examined the relationship between native and non-native woody vine abundance and C and N availability in 54 invaded and un-invaded oak-hickory forest plots in New York City. We identified and measured all trees, surveyed understory vegetation, and collected soil and leaf litter samples to analyze gravimetric moisture, water holding capacity, pH, soil organic matter, microbial biomass, labile carbon, net potential nitrogen mineralization, and net potential nitrification. We used linear mixed models and principal component analysis to analyze the relationship between woody vine cover and soil processes. We found a positive relationship between invasive woody vine cover and net potential nitrification and soil pH but no relationships between native vines and soil processes. Invasive vines were associated with high N availability and pH and low soil moisture, microbial biomass, and C availability. Different invasive vine species were also associated with different soil properties. Celastrus orbiculatus occurred on dry sites with lower C and higher N availability, Lonicera japonica abundance was associated with high microbial biomass and C availability, and Ampelopsis brevipedunculata occurred on moist, low C sites. Our findings highlight the need for additional management experiments and suggest that different invasive vine species may require different site treatments for restoration.

04. SAM JORDAN, MESc CANDIDATE

Enthusiastic plant counter changing ecology.

Soil Water Availability Shapes Species Richness In Dryland Plant Communities

Plant communities are controlled by multiple, interacting ecological drivers that influence the frequency, abundance, and diversity of species. For many terrestrial ecosystems in dryland climates, soil water availability is the primary limiting resource that influences structure, function, and composition. Here we use intensive field sampling coupled with soil water balance modeling to explore the relative importance of biotic and abiotic variables on plant species richness at the landscape scale in dryland plant communities. We asked 1) what are the patterns of total and functional type richness? and 2) what are the relationships between total and functional type richness and macroclimatic, ecohydrological, and biotic conditions? We estimated species richness at multiple spatial scales in 48 dryland plant communities dominated by big sagebrush (Artemisia tridentata) across an elevational gradient, and quantified richness and variability for total and functional type richness at each spatial scale. We used multiple regression and model selection using AIC to determine whether climatic means, multiple metrics of soil moisture from a soil water balance model (SOILWAT2), or site-specific soil and vegetation variables were more related to total and functional type richness. We found that at the largest sampling scale (1000 m2), richness was more strongly related to ecohydrological variables than climate or biotic variables. Variance partitioning revealed that a large portion of variability in total community (~54%), grass (~40%) and forb (~47%) richness was explained by soil water variables. Including ecohydrological, macroclimatic, and biotic predictors in the same model did not substantially increase explanatory power beyond ecohydrological variables alone. Our findings reinforce the potentially greater explanatory power of soil water variables over climatic conditions in dryland plant communities, and offer insight as to which aspects of soil moisture may be most influential to species richness in big sagebrush communities.

05. JESSICA SWINDON, MESc CANDIDATE

Friend of all fauna & flora.

Uprooting Dryland Ecosystems: The Effects of Water and Nitrogen Additions on Root Production

Roots are a significant source of carbon input into the soil, yet little is known about root growth response to altered nutrient availability. Unknown changes in water and nitrogen availability are expected in the next century as a result of shifting climate regimes and the effects are particularly relevant in dryland ecosystems where water and nitrogen are the most frequent limiting factors of net primary productivity. Previous studies have found that elevated resource availability increases aboveground NPP, but what about belowground NPP? My objective was to evaluate belowground NPP by measuring root growth response to water and nitrogen additions within three semi-arid ecosystems. The experimental treatments consisted of three replicates of manipulations: a control, water, nitrogen, and water plus nitrogen. Root growth was measured with ingrowth cores and monitored at six-week intervals for eighteen weeks. We tested the hypothesis that an increase in both water and nitrogen would have the greatest influence on belowground NPP because water and nitrogen are the two most frequently limiting resources.

FLASH TALKS
5 Minute Oral Presentations

Chair: Sarah Smiley Smith
Assistant Dean of Research and Sustainability, *Yale School of Forestry and Environmental Studies*
Burke Auditorium | 3:15–4:00 PM


Chair


01


02


03


04


05

01. ADAM RODDY, POST-DOCTORAL FELLOW
Integrative biologist, subtle rebel.

Explaining Patterns of Biological Diversity by Scaling from Genomes To Ecosystems

Living organisms must fulfill various requirements. Functionally, an organism must be able to perform metabolic processes to transform energy and matter. Informationally, an organism's genome must contain the instructions to enact these functions and to pass them on to future generations. Structurally, an organism's form, constructed from cells with subcellular anatomy, must provide a scaffold for these structural and informational processes. Organisms show remarkable diversity along all three axes: functionally, organisms use disparate metabolic processes to exploit a myriad of energy sources; informationally, organisms' genomes differ greatly in content and architecture, spanning seven orders of magnitude in total size; structurally, organisms range from single cells less than a micron across to expansive organisms built of billions to trillions of much larger cells. Because organismal growth and fitness depends on the rates of resource production and consumption, metabolic rates are thought to directly impact ecological and evolutionary performance. Across all life metabolic rates vary by orders of magnitude, and metabolic rates are determined by the sizes and arrangement of cells. Thus, because of biophysical packing constraints and because of the relationship between cell surface area and volume, more, smaller cells can support higher metabolic rates than few, larger cells. Across all life, cell size is fundamentally constrained by genome size. Thus, the scaling of genome size and metabolism may be a fundamental rule of life governing the structure and function of organisms, with implications for the relative successes of different species, the distribution of organisms in space, and the flow of energy and matter through ecosystems. Furthermore, the scaling of genome size and metabolism unifies the structural, functional, and informational qualities of living organisms and provides a foundation for explaining patterns of evolutionary innovation and ecological success.

02. KYRA PRATS, DOCTORAL CANDIDATE
Ecophysiologist, explores pipes inside plants.

Seasonal Photosynthetic Dynamics in Christmas Fern

Ferns are often underappreciated members of forested ecosystems, and little attention has been given to fern physiology and ecology, despite their being the second-most diverse group of land plants! Many temperate ferns have been relegated to the low-light habitats of the shaded understory. One strategy some temperate ferns, including the Christmas fern, use for coping with shaded understory environments is to extend the life of the leaf through the winter. Temperature permitting, these wintergreen Christmas fern leaves can photosynthesize well into the next spring before new leaves develop. By being wintergreen, the Christmas fern not only extends the total season of photosynthetic activity but also allows photosynthesis to continue under higher light intensity conditions in late fall and early spring, when canopy leaves are not present. However, performing optimum photosynthesis depends on the availability of water, carbon dioxide, and light, as well as the photosynthetic capability of the individual leaf, as determined by the light conditions the leaf experienced during development. Leaves that develop under full sun conditions differ anatomically and biochemically from those that develop in the shade. Yet in the case of the wintergreen Christmas fern, the light conditions under which the leaves develop do not match the light conditions they experience throughout the whole year. Are Christmas ferns able to cope with seasonal changes in the light environment by altering their photosynthetic machinery? How does surviving the cold and snowy winter impact the ability of these leaves to photosynthesize again in the spring? I will aim to answer these questions in my flash talk, showcasing my work at Yale Myers Forest.

03. MEGAN SULLIVAN, DOCTORAL CANDIDATE
Ecologist, watches tropical trees sprout.

Impacts of Logging on Seedling Regeneration in Congo Basin Forests

Selective logging is often hailed as the best compromise between full protection and land-use in regions with high forest cover. Little evidence has been found to show that selective logging impacts the species richness of forests. However, seedling communities in logged forests have shown an increased diversity of functional traits, and trait shifts indicative of more plants with fast-growing, acquisitive life-history strategies. These changes are likely due to plants responding to increased heterogeneity of the forests - particularly changes in light caused by logging gaps, skid trails, and roads in logging concessions. Whether these shifts persist years after cutting to impact lasting change remains unclear. I plan to investigate whether shifts in forest regeneration patterns persist for years after logging, or if they represent a short, unique change in community dynamics that only occurs for a period immediately after logging. To do this, I will set up a network of seedling plots across intact forest in a national park and across sites that vary in their time since logging by 1, 3, 6, and 10 years. Canopy recovery can occur 5 years after logging, causing light levels to return to the shady conditions found in intact forests. I predict that older sites will have a seedling community that is less functionally diverse, with more shade-tolerant species; i.e. a community that is more similar to the one found in an intact forest. Additionally, I predict that the seedling community at recently logged sites will be more functionally diverse with more fast-growing, heliophilic species; i.e. a community that is more dissimilar from the intact forest seedling community.

04. EMILY DOLHANSKY, MFS CANDIDATE
Fire ecologist. Coffee/beer lover.

Pine Barrens Restoration: Is Current Management Enough to Save Them?

Pine barrens forests of the Northeastern U.S. are characterized by open canopies, nutrient poor soils, and fire-adapted plant communities. During the 20th century, fire was purposefully excluded from these forests, altering species composition and resulting in a decrease of Pinus rigida (pitch pine) regeneration. To prevent further loss of pine barrens, the use of prescribed fire and tree thinning (removal) as management tools have increased over the last several decades. However, the ecological effects of management in pine barrens remain unclear, especially in northern New England where few of these forests remain. The objective of this study was to determine the effectiveness of management practices on pitch pine regeneration at the Waterboro Barrens Preserve in southern Maine following twelve years of active management. The preserve has been managed through prescribed fire, thinning, and a combination of the two. We investigated factors that influence tree regeneration including canopy and understory cover, litter depth, and disturbance/management history. Fifty regeneration plots were established in pitch pine-scrub oak (Pinus rigida–Quercus ilicifolia) communities and were stratified between four different management areas. The data show that thinning or burning alone results in negative pitch pine regeneration, but that a combination of the two results in positive pitch pine regeneration. These results have implications for how we can better restore pine barrens that have experienced a history of fire exclusion.

FLASH TALKS CONT.

Burke Auditorium | 3:15–4:00 PM

05. TC CHAKRABORTY, DOCTORAL CANDIDATE
PhD student in Atmospheric Science.

Investigating Impact of Aerosol-Induced Shortwave and Longwave Radiative Forcing on Regional Surface Climate

Aerosols, tiny suspended solid or liquid particles, affect the climate by modulating the Earth's energy budget through radiative forcing. Aerosol radiative forcing is a measure of the change in incident radiative flux for the surface, atmosphere, or top of the atmosphere compared to the aerosol-free case; and can change the temperature of the system. In particular, the surface radiative forcing is important to understand local climatic effects of aerosols. Estimates of the impact of aerosols on the surface radiative forcing show large uncertainties in both magnitude and sign depending on the time of the day and the type of aerosol. Moreover, though radiative forcing is used as a metric in climate change studies, the magnitude of radiative forcing does not linearly change the surface temperature. In this study, we investigate the heterogeneous impact of aerosol-induced radiative forcing on the surface temperature from the global to the regional scale. The study combines a method to attribute the surface temperature perturbation to the radiative forcing and a global reanalysis dataset with aerosol assimilation to isolate the temperature responses to shortwave and longwave radiative forcing. Our results show that the shortwave and longwave radiative forcing have opposite effects, with shortwave radiative forcing reducing surface temperature and longwave radiative forcing increasing it. Globally, the average daytime reduction in land surface temperature due to aerosol-induced shortwave radiative forcing is 0.19 K. Aerosol-induced longwave radiative forcing increases land surface temperature by 0.04 K during the day and by 0.11 K at night. The compensating shortwave and longwave radiative effects reduce the diurnal temperature range, with up to 3 K reductions seen in the highly polluted arid regions of Northern Africa and North-Western China. This work represents an initial step to elucidate the complex interactions between aerosols and the environment at the regional scale.

KEYNOTE ADDRESS

Speaker: Cynthia Malone
Doctoral Candidate, Department of Geography and Planning, *University of Toronto*
Co-chair, Equity, Inclusion, and Diversity Committee, *Society for Conservation Biology*
Burke Auditorium | 4:00–5:00 PM

Black Environmentalisms: Race, Nature, and Radical Thought
Anthropogenic climate change is transforming already degraded ecosystems worldwide, with Black and indigenous people of color facing disproportionately negative impacts to their livelihoods. To contend with these socio-environmental crises, we must go beyond the logics that created this colonial present. Relationships to land and nonhuman life are shaped by scientific racism, which categorizes Black peoples as less than human and as beasts of burden meant to work the land. This talk will highlight how these constructions of human-nature relations reproduce racism and how they have been challenged by Black radical scholarship and movements. I consider diverse sites of contestation throughout the African diaspora, from the land-based resistance of fugitive enslaved peoples to contemporary organizers in the movement for Black lives. In conclusion, I reflect on how these Black radical traditions reveal an alternative environmental science and stewardship based in more ethical relations.

NOTES