The Rubenstein School of Environment and Natural Resources

The University of Vermont

THIRTY-SIXTH ANNUAL GRADUATE RESEARCH SYMPOSIUM

Friday, October 18th, 2019
4:45 PM

George D. Aiken Center

Please recycle this program.
Thirty-Sixth Annual Graduate Research Symposium

Friday, October 18th, 2019
Room: Aiken 103

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Reception to follow in the Aiken Solarium

Thanks to Wilton Burns for moderating this session, to Carrie Finkelstein for providing technical assistance, and to Eva Kinnebrew for videotaping.
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Presenter Abstracts

(in alphabetical order)
Vegetation Type Influences the Response of Moth Communities to Hurricane Disturbance in a Tropical Rainforest

Aura M. Alonso-Rodríguez, PhD Program
Advisor: Taylor Ricketts, PhD

Cyclonic storms dominate the disturbance regime in many tropical forests, yet their potential impacts are still unknown for many taxa. Hurricanes Irma and María (both category 4) struck the island of Puerto Rico on September 2017, causing an estimated mortality and severe damage of 23-31 million trees. This habitat transformation may have severe consequences for insects such as moths, which generally depend on host-plant availability for their survival. In this study, we assessed hurricane impacts on moth assemblages in two of the dominant forest types of the Luquillo Mountains, Tabonuco and Sierra Palm forests. Moths were collected monthly from Apr-Aug 2017 (pre-hurricanes) and Oct 2017-Mar 2018 (post-hurricanes). Processing of macro-moths resulted in ~1300 individuals distributed in ~200 morphospecies. Preliminary results show a complete shift in species composition, regardless of forest type. However, total moth richness and abundance in Tabonuco forests was significantly higher than Sierra Palm forests, but only post-hurricanes. This highlights the potential role of native Tabonuco trees, which generally stand up to hurricanes, in providing shelter for moths and other invertebrates in an otherwise decimated forest. As hurricane frequency and intensity continue to increase due to climate change, these remaining old-growth forests may be vital for conserving biodiversity.

It’s Okay to Decay: Creating a Conservation Burial Ground

Kate Berdan, Master’s Program
Advisor: Clare Ginger, PhD

Today’s green burial movement embraces environmentally friendly burial materials and practices to enhance soil nutrients, natural landscapes, and human connections with nature. Some organizations in the movement have gone a step further to create burial grounds with the management goal of conserving land and biodiversity. These conservation burial grounds are protected in perpetuity through conservation easements, that is, deed restrictions, and managed to protect native biodiversity. Vermont first legalized the creation of natural burial sites in 2015, and even more recently amended burial depth requirements in 2017 to make it possible to implement natural burial practices. Thus, traditional cemeteries are just beginning to allow green burial and no conservation burial grounds currently exist in Vermont. This project seeks to research and understand the green burial movement and the potential for conservation burial grounds to serve as a tool for land trusts in Vermont, specifically Vermont Land Trust. I will work with Vermont Land Trust collaboratively in conducting this work to account for their mission, questions, and needs. I anticipate the project will lead to a report and recommendations appropriate to their organization and the Vermont landscape.
Assessing Moose Habitat Suitability and Selection in Vermont

Joshua A. Blouin, Master’s Program
Advisors: James Murdoch, PhD & Therese Donovan, PhD

Wildlife management often requires measures of the relative suitability of habitats, which can be used to inform decision-making. Estimating habitat suitability is especially important for highly managed species like those that are harvested and declining. The moose is a harvested species in Vermont that has experienced significant declines in recent years due to winter tick infestations. Identifying important habitats provides a means of increasing moose populations and planning future management activities. This study will examine patterns of habitat use by moose and aims to 1) develop a habitat suitability index model, and 2) evaluate how the health condition of moose affects habitat selection. The model will be based on GPS radio-collar locations, contemporary maps of land cover types, and fine-scale landscape conditions from LIDAR imagery, and used to map suitability across the state. This will show areas of high (and low) importance, identify features that affect habitat quality, and provide a tool for exploring the effects of landscape change on moose habitat. I will also use information on tick loads and home range estimates to evaluate whether patterns of habitat use differ by health condition. The results will provide new insights into the effects of ticks on moose behavior.

Impacts of Asian Longhorned Beetle and Associated Eradication Efforts on the Current Composition of Forests in Worcester County, MA

Olivia Box, Master’s Program
Advisor: Anthony D’Amato, PhD

Asian longhorned beetle, Anoplophora glabripennis (ALB), is an invasive species that entered southern New England in 2008. Eradication efforts required the removal of all host trees, primarily Acer rubrum and Acer saccharum. Three primary treatments were used to address ALB: i) removal of all host species, ii) removal of all host species and stump removal, and iii) removal of all host species and herbicide treatment. These treatments began the pathway to eradication of ALB in Worcester county, Massachusetts but it is not yet known how this disturbance effected composition of these forests and how they will progress over various management schemes. In 2018, sites treated for ALB were sampled following USFS Forest Health Monitoring protocols and the herbaceous layer, seedlings, saplings, and overstory trees were quantified in each stand. Vegetation is compared among the stands and treatments using standard forestry methods and multivariate statistics. These preliminary findings will inform managers of the present forest composition in Worcester, MA and begin to uncover the effect of treatment type on vegetation development post-disturbance in Worcester County. These findings are particularly relevant as ALB invasions continue to be high-risk in areas across the United States, particularly in areas with host species and ports.
Singing *Viriditas*: Sacred Ecology in the Music of Hildegard von Bingen

*Dan Cottle, Master’s Program
Advisor: Adrian Ivakhiv, PhD*

The medieval nun Hildegard von Bingen was born in precarious times. Long before her birth, human action had poisoned the Earth and perverted the order of nature. Something had to be done, and scheming politicians were only making matters worse. (Sound familiar?) Called by visions, Hildegard deployed a remarkable range of skills toward the goal of healing her world, becoming accomplished in theology, philosophy, poetry, science, medicine, and especially music. My research examines how music may enlighten and enrich ecological understanding and action using Hildegard's most famous musical drama as a model. I will argue that Hildegard intended the *Ordo Virtutum* to be a form of musical-spiritual-ecological practice: an embodied way of knowing the world and of negotiating right relations among all things. Seen in this light, the play becomes a model for modern musical communities to create new futures for our own troubled world.

Quantifying Floodplain Water Storage and Benefits of Floodplain Restoration for the Lake Champlain Basin in Vermont

*Stephanie Drago, Master’s Program
Advisor: Beverley Wemple, PhD*

Floodplains play a major role in maintaining the health and sustainability of riverine systems, but human interventions have reduced the connectivity between stream channels and floodplains. Geomorphic assessments of streams and rivers in Vermont (USA) show they have been significantly altered within the past two centuries due to straightening, berming, and armorng channels to accommodate agriculture, roads, and rail lines. These alterations in river-floodplain connectivity have decreased floodplain functioning, specifically their capacity to store water during flood events. Currently, there is a lack of knowledge concerning the amount of floodwater, sediment, and nutrient retention provided by Vermont’s floodplains. This research seeks to address this gap by mapping floodplains of the Vermont portion of the Lake Champlain Basin and estimating floodwater storage under varying recurrence interval floods using a low-complexity hydrologic model. I also develop a GIS-based method for identifying floodplain reconnection opportunities (i.e. berm removal and floodplain lowering) along historic rail lines. I found that floodplain storage varied considerably among watersheds of the Lake Champlain Basin and future work will determine the key attributes that control these differences. This work seeks to provide new insights into the function of floodplains in our study region and offer opportunities to support future decision making on restoration initiatives.
Downstream Energy Justice and Vermont’s Renewable Energy Transition

Walter Keady, Master’s Program
Advisor: Bindu Panikkar, PhD

Combustion of fossil fuels is a core cause of climate change. Governments have responded with energy transition plans for decreasing the use of fossil energies in favor of renewable ones. While Transitions Studies analyzes these changes largely in terms of technology and policy goals, the study of how, not simply whether renewable transitions occur is critical. The field of Just Transitions is a necessary counterweight that studies how energy transitions may remediate existing harms and those resulting from the transition itself. But studies of just transition policies frequently focus on upstream injustices – those occurring at sites of energy production and extraction. While critical, this focus ignores insights from the field of energy justice, which views the entire energy system, from wellhead to washing machine, as inextricably linked to social and political structures. Energy justice emphasizes that downstream factors, those relating to individual energy use, are also sites of injustice. This research seeks to integrate just transition and energy justice research frameworks through a case study of Vermont’s renewable energy transition and its impact on residential energy use.

Modelling Agricultural Frontiers in the Amazon Basin Using Mixed Methods

Eva Kinnebrew, PhD Program
Advisor: Gillian Galford, PhD

The Amazon basin is the site of rapid agricultural expansion, which often jeopardizes biodiversity and human livelihoods in conservation priority areas. Agriculturally-driven deforestation is influenced by a complex set of socio-ecological factors, like soil type, access, global commodity markets, and regulation. However, most land use change research focuses on a single method and fails to capture such multi-dimensionality. In this project, we integrate qualitative and quantitative methods to more comprehensively understand land use change in the Amazon basin. We first use remote sensing to create a time-series of deforestation and characterize areas of agricultural infringement. Building on this analysis, we produce a land use change model to identify areas at risk of agricultural conversion. Simultaneously, we employ discourse analysis to categorize how conservation actors understand drivers and solutions of agricultural frontiers. We provide points of intersection between methodologies by having preliminary model results guide discourse analysis (i.e. node categorization), and by spatializing (as possible) emergent discourse themes for inclusion in subsequent model runs. The results of this project will not only help explain deforestation dynamics in the Amazon, but also outline a procedure for integrative mixed-method research. This research is the product of a SESYNC graduate student pursuit.
Developing an Adaptive Management Framework for Sustainable Cashmere Production in Mongolia

Lisi Lohre, Master’s Program
Advisor: James Murdoch, PhD

Cashmere, the winter underfur of goats, is a multi-billion dollar global commodity that is sourced almost entirely from northern China and Mongolia. Increasing demand for cashmere has led to environmental degradation in many regions, which has been exacerbated by the rapid rate of environmental change across central Asia. Stakeholders in the cashmere industry recognize the need for better goat herding practices and support the development of a sustainable cashmere certification program. Currently, many groups working towards development of sustainable cashmere operate independently from one another and have little consensus on what constitutes sustainable management. The goal of this study is to develop a framework for making livestock management decisions for cashmere production that maximize sustainable outcomes. The framework will use monitoring data to allow decisions to adapt to changing landscape conditions, and incorporate multiple ecological, economic, and social objectives. The study occurs in Ikh Nart Nature Reserve, Mongolia and will: 1) define sustainability of cashmere production with stakeholder input, 2) develop models that quantify the dimensions of sustainability, and 3) construct an adaptive management framework. The framework will provide a tool for informing livestock management decisions that can be scaled-up to support broader sustainable cashmere certification standards.

Recruitment Dynamics of Red Spruce-Northern Hardwoods Mixedwood Forests of the Northeast U.S.

Jordan Luff, Master’s Program
Advisor: Anthony D’Amato, PhD

Interest in the benefits provided by mixed forests (broadleaf and coniferous species) has greatly increased in recent years given their potential to supply greater timber volume, diverse wildlife habitat, biodiversity values, and resistance and resilience to mounting forest health issues. In the northeastern US, overlapping stands of spruce-fir and northern hardwood forests give rise to a transition zone where red spruce co-dominates with yellow birch, American beech, sugar maple, and varying proportions of other species. However, the historical legacy of selectively cutting red spruce in the 19th century, as well as a range of more recent biotic and abiotic stressors, has effectively “unmixed” much of these forests, shifting their dominance to hardwoods. The goals of this research are to identify critical recruitment limitations of red spruce by: 1) characterizing regional trends in recent recruitment across a range of management regimes using several long-term, permanent forest inventory datasets, and 2) reconstructing natural spatiotemporal recruitment dynamics of mixedwood forests using two old-growth red spruce-northern hardwoods forests in NY and NH. Through this work, I will inform silvicultural recommendations for restoring and maintaining this critical component of north temperate mixedwood systems.
Engaging the public in scientific research through water monitoring (a form of citizen science) has potential to expand knowledge of conditions and to improve collaborative decision-making. Place attachment has also been demonstrated to lead people to adopt more environmentally responsible behaviors. However, few studies have considered if motivations to participate in citizen science programs differ across cultures, the role that place attachment may play as a potential driver of initial or sustained participation, and what actions or behaviors to protect the environment may result from participation. This study applied a mixed-method approach to assess and compare motivations and outcomes of participation of new and experienced volunteers in stream-based water monitoring programs in three countries: the United States, Canada, and New Zealand via: 1) surveys of 24 stream-based volunteer monitoring groups, and 2) follow-up semi-structured interviews with a subset of survey participants. This research aims to determine the extent to which place attachment influences participants’ decision to volunteer over time, as advocacy for protection of local natural areas is a potential benefit of volunteer monitoring related to place-based connections. These findings may also help program directors understand why people participate, providing insight to increase recruitment and retention of volunteers.

Plant Species Removal Decreases Magnitude and Variation in Nitrogen Mineralization in Mountains

Kenna Rewcastle, PhD Program
Advisor: Aimée Classen, PhD

Climate change will result in the loss of plant species from many ecosystems around the world, essentially reshaping both the structure and function of plant communities. The consequences of these species losses will likely depend on the identity of the species lost, the climatic context of each ecosystem, and the nature of plant species interactions within each community. To understand the biotic and abiotic variables that shape the impact of plant species loss on belowground ecosystem processes, we used a series of four unique plant removal experiments distributed across an elevational gradient and conducted a lab incubation of soil samples from each experiment to measure the mineralization of carbon (C) and nitrogen (N). We found that regardless of the identity of the removed species or the environmental conditions at each site, plant removal decreased both the magnitude and variation in N-mineralization rates and marginally decreased C-mineralization rates. Our results present a surprisingly simple pattern of belowground response to biodiversity loss and a foundation for more mechanistic experiments in the future.
The Genetic Diversity of Vermont’s Moose (Alces alces) Population: Preliminary Findings

Elias Rosenblatt, PhD Program
Advisors: Therese Donovan, PhD & James Murdoch, PhD

The North American Moose (Alces alces) is an important, charismatic mammal facing challenging times, with many populations in eastern North America experiencing recent declines. Though the drivers of these declines have been identified, we have limited understanding of the status and implications of population genetic health in eastern North America. Using samples collected from 152 moose across Vermont, we utilized a newly developed 136-loci SNPs parentage panel to describe genetic diversity, inbreeding, and relatedness within the Vermont moose population. We estimated genetic diversity across our sample using heterozygosity ratios and pair-wise identity-by-state measures. We calculated individual inbreeding as the excess of homozygotes and identified related individuals using a pair-wise exclusion analysis. Resulting data indicate low heterozygosity ratios, high identity by state measures, and evidence of inbreeding for the Vermont moose population. We also identified related individuals across management units in northern and central Vermont. Lack of heterozygosity may have implications for fitness, which could impact individual responses to parasites and habitat fragmentation. Ultimately, these low levels of genetic diversity may compromise the population’s ability to adapt to changing environmental conditions and reinforce the need for management strategies to incorporate goals for maintaining or increasing genetic variation.

Preparedness for Oil and Hazardous Material Spills in Lake Champlain

Jason Scott, Master’s Program
Advisor: Kristine Stepenuck, PhD

Oil and hazardous material spills are not the foremost threat to Lake Champlain however, there is significant transportation infrastructure in the region that could cause extensive environmental damage to wildlife and habitats connected to the lake. My project will strengthen the ability of the emergency response community in the Lake Champlain Basin to prepare for and respond to oil and hazardous material spills by facilitating spill response training and providing important educational resources. It will increase awareness of available scientific information and expertise through the development of a database of academic and scientific resources in the region. Finally, it will bolster Federal and State spill planning efforts with an update to the Multi-Agency Contingency Plan for Emergency Environmental Incidents in the Lake Champlain Region. The products generated as a part of my project will be useful for contingency planners, response personnel and resource managers. I will be working with Lake Champlain Sea Grant and the Environmental Protection Agency to increase knowledge of how a spill may affect sensitive areas of the lake and support agency operations to minimize negative ecological effects while responding to environmental disasters.
Optimization of Over Summer Snow Storage at Low Elevation and Mid Latitude

Hannah Weiss, Master’s Program
Advisor: Paul Bierman, PhD

Climate change impacts winter which threatens nordic skiing globally. In response, over-summer snow storage with wood chips as a covering material has been successfully employed by high-elevation and/or high-latitude ski centers in Europe and Canada. Such storage has never been attempted at a low elevation or latitude site. Here, we assess the melt rates of two 200 m$^3$ wood-chip covered snow piles emplaced during spring 2018 in Craftsbury, Vermont to develop an optimized snow storage strategy. In 2019, we tested that strategy on a 9300 m$^3$ pile. In 2018, we also tested different covering efficiencies. During both years, we monitored volume change over the melt season using terrestrial laser scanning. In 2018, highest rates of snow volume loss were in mid-summer and lowest rates in the fall; mean melt rates were 0.6 to 0.7 % of initial pile volume per day. Wet wood chips covered with a reflective sheet was an effective cover combination for minimizing melt and employed in 2019. The larger 2019 pile lost only <0.16% of its initial volume per day between April and September and retaining 65% of the initial snow volume over summer. Together, these data optimize over-summer snow storage at mid-latitudes and low elevations.

Maple: A Sap to Syrup Guide for Career and Technical Centers of Vermont

Lynn Wolfe, PhD Program
Advisor: Walter Poleman, PhD

Maple syrup production is a very important aspect of Vermont life and history. Every year in the early spring people of all ages find their way to the woods to tap trees, collect sap, and participate in the great tradition of producing maple syrup. In Vermont, maple syrup production is an essential industry from a historical, cultural, agricultural, and economic perspective. As the industry continues to grow, it creates potential employment opportunities for people of all ages, including recent high school graduates. Through a collaboration between Vermont high school agriculture/natural resources instructors, the UVM Extension Maple Specialist, and a UVM graduate student, a maple manual and FFA Maple Career Development Event (CDE) was developed primarily for use by Vermont Career and Technical Center educators and students. The maple manual offers a curriculum to be used across Vermont’s Career and Technical Centers and includes up-to-date, science-based information on maple syrup production. A CDE is a competition designed to both test skill development and to prepare high school students for careers in the particular area of focus. This presentation discusses the goals of the manual and examines the first-ever maple CDE.