

2018 Northeast Natural History Conference Oral Abstracts

Listed in alphabetical order by first-listed author/presenter. Code at the bottom of each abstract indicates when in the conference schedule the presentation will be given: Day-Session-Room-Presentation # (thus, for example, Sun-AM2-E-4 indicates the presentation will be the 4th presentation in Room E in the Sunday Morning II concurrent session time slot).

Engaging Students in Genuine Research and Conservation at Local and Regional Scales

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Abstract - Conservation planning carried out at a local watershed scale (USGS Hydrological Unit Code 12) is often connected to planning at a larger, regional scale. In this project, we assessed culverts within the Pocantico River Watershed, as well as portions of adjacent watersheds, for the purpose of understanding the role of these structures in amphibian and reptile habitat connectivity within this region. The day-to-day assessment work was carried out by a team of graduate and undergraduate students, who engaged with the public and discussed our conservation goals in the course of their work. All assessment data have been added to the North Atlantic Aquatic Connectivity Collaborative database, placing the team's work in a larger, regional context. During the next steps of this project, students will be presenting our team's findings both at scientific conferences and to local stakeholders, such as watershed alliance organizations and municipal conservation boards and transportation boards. This dissemination is vital to ensure the application of our work and for the students to experience the processes of genuine conservation planning.

Sun-AM2-E-4

Shrubland Bird Conservation and an Early-successional Shrubland Habitat Decision Support Tool

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Abstract - Shrubland birds are widely recognized as a group of conservation concern. We summarize over 2 decades of research intended to provide guidance for incorporating shrubland management into a diverse conservation portfolio, and for designing and executing specific management activities for shrubland birds. Although controversy exists regarding the classification of shrubland birds as conservation targets and the importance of active management to their populations, we highlight evidence of pre-colonial disturbance regimes and that most shrubland birds species are declining throughout their ranges. Furthermore, we estimate that only a few percent of northeastern forests consist of shrubland habitat, and this amount continues to decline. We present findings on habitat associations that illustrate how habitat specialization compounds the vulnerability of shrubland birds. Shrubland birds are area sensitive, with some species scarce or absent from group-selection openings; their habitats are ephemeral, with most species disappearing from managed sites within a decade of treatment; and some species are habitat-specific. The degree to which habitat quality is affected by landscape characteristics is poorly understood, but recent findings show area thresholds for occupancy are higher if a habitat patch is near a large source patch. All of these findings are being integrated into an online decision-support tool for managers and conservation practitioners. The tool will allow an interested party to specify a project locality and a management activity, at this point limited to silvicultural openings. The tool will query digital abundance maps, which are bird conservation region-specific, and will then return a probability of occurrence for each species in the potential species pool for that locality, conditioned on the patch size of the treatment and its proximity to large source patches of shrubland habitat. Lastly, the tool will tally the likely number of species in the proposed opening, and provide an objective conservation value of the opening based on predicted bird occurrences and species-specific Partners in Flight conservation scores. Current efforts are underway to refine this tool to include broader landscape conditions, treatment type, time since treatment, and residual basal area.

Sun-PM2-E-4

Evidence of RNA Virus Spillover from Managed Honeybees to Wild Bumblebees

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Abstract - Pathogen spillover between managed and wild animals causes species declines, threatens global biodiversity, and impacts ecosystem function and services. The decline of many species of *Bombus* (bumblebees) has been linked to an increased prevalence of pathogens likely caused by spillover events from managed bees. Although poorly understood, RNA viruses are suspected of moving from *Apis mellifera* (Honeybee) into wild bumblebee populations through the shared use of flowers. However, more work is needed to elucidate the principle directionality of virus transmission, the role of flowers in transmission, and the extent to which viruses replicate within bumblebee host species. Using a combination of field studies and controlled experiments, we show that managed Honeybees are significant contributors of RNA viruses to both wild bumblebees and the landscape. In a field study in Vermont, we visited 19 sites either with or without neighboring managed Honeybee apiaries and show that viruses detected in wild bumblebees and on flowering plants are directly linked to the presence of neighboring Honeybees. We found that prevalence of deformed wing virus (DWV) and black queen cell virus (BQCV) was significantly higher in bumblebees collected near Honeybee apiaries. In addition, bumblebees were more likely to be infected with DWV when neighboring Honeybees had high infection levels. In sites completely absent of Honeybees, no DWV was detected in bumblebees. We also confirm replication of DWV and BQCV in 2 bumblebee species not previously examined. Furthermore, we detected viruses on a remarkably high proportion of flower samples (18%), and all positive samples were collected within Honeybee apiaries. In a controlled flight cage experiment using infected captive Honeybee colonies and 3 different plant species, we demonstrate that Honeybees leave behind viruses while foraging on flowers. We also found that viruses were not equally deposited across different plant species indicating that bee foraging behavior and/or floral morphology may affect likelihood of virus disposition. Our study adds to our understanding of bee virus epidemiology and highlights the need to improve disease-monitoring efforts for managed bees to reduce spillover events.

Sun-PM2-C-4

Nitrogen-Removal Services of Restored Salt Marshes in Jamaica Bay (New York, NY)

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Abstract - Coastal wetlands are important sites of nitrogen removal, a critical ecosystem service in highly eutrophic environments. They are also subject to increasing threat from eutrophication, sea-level rise, and coastal development. In Jamaica Bay, over 92% of historic wetland area has been lost over the past century. Despite considerable efforts to restore wetlands, few studies have examined the value of ecosystem services that newly constructed wetlands provide, and little is known about the ecological mechanisms that influence nitrogen-cycling processes. Past and ongoing restoration efforts in Jamaica Bay provide a unique opportunity to study nitrogen-removal processes in extant and restored wetlands in an urban, eutrophic environment. We used a chronosequence of marsh restorations (restored 2003–2012) to assess how marsh vegetation, sediment characteristics, and key processes of the nitrogen cycle develop over time following restoration. Results from continuous flow-through core incubations indicated that restored marshes remove nitrogen via denitrification. We found that nitrogen removal generally increased with marsh age. The highest denitrification rates were observed in an unrestored marsh that has remained relatively stable. Denitrification rates in young restored marshes were seasonally limited by the availability of nitrate and organic carbon. Nitrate limitation was not detected in the oldest restored marsh or in unrestored marshes. In surveys conducted across the restoration chronosequence, we detected increases in total organic matter and belowground plant biomass, suggesting that restored marshes are likely to become more stable and that the influence of marsh plants on sediment chemistry and microbial processes is likely to increase as restored marshes age. Marsh plants were also found to play a significant role in enhancing nitrogen-removal services in young restored marshes. In field experiments, marsh plants were found to increase the temporal and spatial variability of sediment oxygen concentrations and to increase denitrification rates by as much as 5-fold in young restored marshes. Our results provide strong support that restored marshes are providing nitrogen-removal services and that these services are likely to increase in value as the marshes age.

Sun-AM1-B-4

The Bowser Road Mastodon: The Case for the Clovis Hamstringing of “John Charles” by Large Stone Biface

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Abstract - Hack/chop marks found on the astragalus and calcaneus (heel bones) of the *Mammot americanum* (Mastodon) “John Charles”, recovered from the Bowser Road site, Orange County, NY, raise the possibility that the Mastodon was immobilized by hamstringing. I will briefly review accounts of humans hamstringing *Elephas maximus* (Asian Elephant), *Loxodonta cyclotis* (African Forest Elephant), and *Laxodonta africanus* (African Bush Elephant) from the time of Alexander the Great through the big game hunters of the 18th to the 20th centuries, as well as pertinent aspects of Elephant anatomy. I will discuss the potential for use as proboscidean hamstringing tools the large stone bifaces, such as found at Green Mountain, VT; the enigmatic Northeastern “Petalas blades” described by Robert E. Funk; and the large Clovis bifaces, often cached, of the central and western US.

Sat-PM2-C-3

Understanding Agricultural and Climatic Correlates of Grassland Bird Population Fluctuations

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Abstract - Grassland bird populations depend on agricultural lands in many parts of the world and are declining due to land-use change and agricultural policies. In eastern North America, *Ammodramus savannarum* (Grasshopper Sparrow) and *Sturnella magna* (Eastern Meadowlark), which often breed in hayfields, have declined 50–75% over the last 2 decades in many states. Identifying drivers of population fluctuations could provide insight into policy levers for reversing declines. While previous studies have looked for agricultural or environmental correlates with population declines across states, few have looked at the effect of annually changing conditions within states over time. We used a time-series regression and mixed-model approach in 6 Mid-Atlantic states (1996–2015) to relate variables encompassing climate, agricultural practices, and conservation spending to annual observed population-growth rate. We also modeled variation in potentially bird-relevant agricultural variables based on a suite of climatic variables. A linear mixed-model containing hay yield (kg/ha) in the previous year as a variable best explained variation in Grasshopper Sparrow populations (negative relationship; $R^2 = 0.12$). Eastern Meadowlark population fluctuations were best explained by models including the previous year's June temperatures, early spring rainfall, and conservation spending ($R^2 = 0.08$). Models including the average timing of the first hay harvest did not rank highly in explaining variation in populations of either species. We found considerable among- and within-state variation in agricultural management practices (e.g., hay yield, harvest timing), much of which was explainable by state and climate variables ($R^2 = 72\text{-}79\%$). Hay yield can also be affected by the number of harvests per season, which would be expected to be negatively correlated with grassland bird reproductive success due to nest losses from machinery. Our findings underscore (1) the importance of understanding the complex inter-relationships among climate, agriculture, and grassland bird reproductive biology in agricultural systems, and (2) the potential of using climate and agricultural data to stretch conservation dollars by targeting them where and when they are most needed.

Sun-PM2-E-5

Detecting the Emerging Infectious Disease Ranavirus in Amphibian Communities of Vermont

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Abstract - Ranaviruses are a group of emerging pathogens negatively impacting amphibian communities around the globe. This disease has the capability of causing mass mortality events; yet, its distribution and natural variation are not entirely understood. Virtually no ranavirus studies have been conducted in the natural amphibian communities of Vermont, and so we do not know whether it is present in the state. The goal of this study was to estimate ranavirus prevalence and host abundance in northwestern Vermont. In the summer of 2016, we collected toe or tail tissue from a total of 1822 amphibians across 18 sites every other week from May to August. In the summer of 2017, we collected an additional 1214 amphibian samples across 29 sites in July and August. Using a random subset of summer 2016 samples ($n = 220$), we tested for ranavirus using quantitative PCR (qPCR) to amplify a conserved region in its major capsid protein and obtained prevalence estimates for the state. No mass-mortality events were witnessed throughout each summer; however, our results indicated ranavirus was present in 11 of the 220 samples (5%) and in 7 of the 18 sites (38.9%) tested thus far, which is lower than prevalence estimates from previous studies in surrounding states. Additionally, ranavirus was found in 7 of the 10 species collected and in all life stages. We hope to expand our results and eventually inform amphibian conservation efforts by identifying disease hotspots in the state. To better understand the complexities of this disease, it is imperative for its distribution and prevalence to be identified in locations it has not been previously found and for its impacts on host populations to be revealed.

Sun-PM2-D-1

The Enigmatic History of Braun's Holly Fern

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Abstract - The fern genus *Polystichum* in New England has only 2 species, the diploid *Polystichum acrostichoides* (Christmas Fern) and the tetraploid *Polystichum braunii* (Braun's Hollyfern). This fortunate lack of local diversity in the world's third largest fern genus makes possible focused study of hybridization and polyploidy in New England with reduction in the number of complicating variables. Many polyploids in the genus *Polystichum* have clearly demonstrated evolutionary histories, but the origin of the circumboreally distributed allotetraploid *P. braunii* has been obscure. Using chloroplast and nuclear DNA sequences, we demonstrated that *P. braunii* is always derived from the same progenitors, but with at least 2 origins. Variants isolated from the nucleus resolved with 2 divergent clades, an eastern Asian and a North American. These variants do not have near allies among similar species in our sample; the North American progenitor appears to be extinct and the Asian progenitor is so far undiscovered. A divergence-time analysis based on the cpDNA markers yielded evidence of an older time of origin for *P. braunii* than for other allotetraploids in the woodfern family Dryopteridaceae. This early divergence time in concert with niche modeling, considered with geological and paleontological evidence, led us to conclude that the 2 origins were in Beringia. Since *P. braunii* is genetically undifferentiated but widely distributed, it appears to have expanded to its circumboreal range from at least 2 refugia in the recent past, though it has a relatively ancient origin.

Sun-AM1-A-1

The Fire at the Pringle Herbarium: A Disaster Averted

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Abstract - The Natural History Museum in Torrey Hall brings together 3 of the most important natural history collections in Vermont: the flora represented by the plants in the Cyrus Pringle Herbarium and the fauna as documented for both the invertebrate and vertebrate animals in the Zadock Thompson Zoological Collections. The size of the combined collection is about 700,000 accessions. Torrey Hall, the University of Vermont Building housing the Pringle Herbarium as well as the Thompson Collections, was opened as the new University library and location for the burgeoning natural history collections for the University of Vermont in the summer of 1863, at the turning point in the Civil War. The Reverend Joseph Torrey, ninth President of the University and a botanist himself, dedicated the building. The roof interior of Torrey Hall, the University of Vermont Building housing the Pringle Herbarium as well as the University's vertebrate and invertebrate collections, caught fire—apparently related to braising work on the new roof—on the morning of August 3, 2017. Prospects for saving anything in the interior at first seemed dismal, but firemen from Station 3 quickly brought the fire under control. To put out the fire in the roof, about 500,000 gallons of water were delivered to the main section of the building. The result was standing water on the floors on all levels. However, all of the collections in metal cabinets were unimpacted by the water. The impact of this water on unsheltered materials was random, even capricious. In some places, plants out in the open, simply held in folders, were dry. In other places, hundreds of specimens were soaked. We had about 36 hours to stabilize the wet collections before fungal attack would compromise them. Two days of herculean effort resulted in the salvaging of much of our wet material. At any one time over those first 2 days, we had 15 or 20 people working together on the wet specimens on tables set up for the purpose under a tent. Following our University Library colleagues' instructions for recovering wet books, we froze the wet specimens and packed them into a rented freezer truck on site. Then, in less than a day, we came up with space for all the collection cabinets. The University's Physical Plant Department was able to reinvent functional herbarium facilities in Jeffords Hall, allowing us to restore our routine collection functions within a few weeks of the fire. In the first weeks, local emergency restoration specialists removed the compromised portions of the building interior, leaving the rich 19th-century architectural features intact but opening up the possibility of an innovative redesign and reconstruction of the building interior to suit our vision for the University of Vermont's Natural History Museum. Planning the restoration of the building's interior is now underway. We look forward to our return to Torrey Hall sometime in 2020.

Sun-PM2-A-1

Effect of Elevation on Proportion and Infection Rate of Two Common Lyme Disease Hosts in Vermont

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Abstract - Lyme disease incidence is currently on the rise in northern New England. As such, understanding the disease within its ecological and geographical context is increasingly important. The changes in biotic and abiotic factors that occur with increasing elevation are similar to changes due to geographical climatic variation. Therefore, patterns observed along an elevational gradient may provide insights into the influence of climate on disease dynamics. Although a majority of past studies of Lyme disease hosts have focused on *Peromyscus leucopus* (White-footed Mouse), its range overlaps widely with *Peromyscus maniculatus* (Deer Mouse), and these *Peromyscus* spp. are considered cryptic species in the northeastern United States. Both rodents are competent hosts for *Borrelia burgdorferi*, the causative bacterial agent of Lyme disease in North America, and occupy similar ecological and behavioral niches. This study investigated the effect of elevation on the proportions of these *Peromyscus* spp. and their rates of infection with *B. burgdorferi*. We conducted trapping at 13 deciduous forest sites in Addison County, VT, varying from 113 m to 569 m in elevation, and identified *Peromyscus* spp. using a multiplex polymerase chain reaction (PCR) assay. Infection rates were determined using PCR amplification of a conserved region of the *Borrelia ospC* gene. A greater proportion of Deer Mice were infected than White-footed Mice. In addition, a significantly higher fraction of trapped mice were White-footed Mice at lower elevations. Ultimately, this study will improve understanding of the ecology of Lyme disease in northern New England and inform future research and prevention efforts.

Sun-PM2-D-3

Climate Change, Plant Migration, and Assisted Colonization: The View from New England

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Abstract - Rapid climate change in coming decades is projected to outstrip many plant species' natural dispersal abilities, leading to increasing mismatches between species' native ranges and the actual locations of suitable habitat. In order to avoid severe declines or extinctions of vulnerable species in the wild, some conservation biologists have proposed "assisted colonization" or "managed relocation" interventions to facilitate colonization of new regions where species might be able to survive in the future but where they are not currently native. This controversial approach presents both opportunities and risks for species conservation in a rapidly changing world, and raises fascinating questions about biogeography and ecology. This talk will review the rationale for "assisted colonization" of climate-threatened plant species and consider the biogeographical and ecological risk factors suggesting that some species, particularly small-ranged endemics, might require intervention to survive in the future. We focus on the flora of temperate deciduous forests in the eastern US as a test case, as this is the dominant biome of the region and includes many endemic species. The vast majority of endemic forest plants are concentrated in the Southeast US, with few endemics extending their distributions north of the last glacial maximum, likely due in part to long-term dispersal limitation and suggesting limited potential to respond rapidly to modern climate change. Patterns of endemic richness within the Southeast US show significant associations with topographic variation, highlighting landscape features that likely favored the formation of refugia in unglaciated regions during the climatic cooling of the Pleistocene. However, the current localization of these hotspots of forest plant diversity in the south may rapidly expose them to threats from modern climate warming, particularly for those endemics associated with isolated high elevation areas or other cool microhabitats. These endemics are examples of the types of species that might be proposed for assisted colonization into New England in the future, as they appear unlikely to migrate long distances naturally. In contrast, most plant species native to New England have broader geographic distributions and appear to be at reduced immediate risk from climate change.

Sun-AM2-B-1

Conservation and Recovery of White-nose Syndrome-Affected Bats in Vermont

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Abstract - White-nose Syndrome is a deadly fungal disease that has caused rapid and significant population declines in four of Vermont's 9 bat species, while also causing some mortality in 2 additional species. Vermont was one of the first states to experience the devastating effects of this disease and has remained a leader in the national effort to research the cause, manage the spread, focus conservation and recovery efforts, and contribute to ongoing treatment investigations. Post-WNS population trends in Vermont suggest that some species are continuing to decline (i.e., *Myotis sodalis* [Indiana Bat]), some may be stabilizing at very low population levels (i.e., *Myotis lucifugus* [Little Brown Bat]), and others are too rare to infer a trend (i.e., *Perimyotis subflavus* [Tricolored Bat]). The talk will focus on conservation efforts targeted at minimizing non-disease threats, the power of professional collaboration and citizen science, and the importance of filling information gaps in the natural history of these now-rare species.

Sun-AM1-C-1

Plant Traits and Community Metrics Along a Snowmelt Gradient at Alpine Snowbank Sites on Mt. Washington, NH

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Abstract - In northeastern North America, alpine snowbank communities are rare plant assemblages that form in sheltered sites above treeline where late-lying snow provides insulation from late-season frosts and a longer-lasting source of water. We studied community composition and plant traits across a gradient of snowmelt timing at snowbank sites on Mt. Washington, NH. We used nMDS ordination and ANOSIM to examine community composition across the snowmelt gradient, and measured plant traits (height, leaf dry matter content, leaf area, and specific leaf area) in several comparisons. We calculated community-weighted mean trait values across the snowmelt gradient and phenotypic plasticity of 4 focal snowbank species—*Carex bigelowii* (Bigelow's Sedge), *Chamaepericlymenum canadense* (Bunchberry Dogwood), *Clintonia borealis* (Bluebead Lily), and *Maianthemum canadense* (Canada Mayflower)—between snowbank core and edge habitats. ANOVAs indicated that vascular plant diversity increased and lichen diversity decreased along with later melt date; no trend was evident in bryophytes. ANOSIM indicated that vascular plant and bryophyte/lichen communities were significantly stratified across the snowmelt gradient. In the community-weighted mean trait analyses, height, leaf area, and specific leaf area increased with later snowmelt, and leaf dry-matter content decreased; the 4 focal species showed matching responses in traits across the snowmelt gradient, except for *M. canadense*, which was shorter in snowbed cores. The transition in trait values across the snowmelt gradient is indicative of changing environmental conditions, as well as changing ecosystem functions occurring there. Genetic analysis may be necessary to evaluate population dynamics among isolated alpine communities. Given their sensitivity to environmental conditions, alpine snowbank communities are considered vulnerable to climate change; changes in community composition or plant traits may reflect climatic trends in the region.

Sat-AM2-D-4

Plant Life on Harsh Soils: Contrasts in Edaphic Endemism and Adaptation to Serpentine, Karst, Gypsum, Dolomite, and Other High-pH Soils, with Examples from Mid-Atlantic Serpentine, *Primulina* Species in China, and Agro-ecosystems

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Abstract - It is widely appreciated that many plant taxa only occur on particular soils, and that chemically harsh soils are often home to unique species not found on more-common or less-challenging soil types. As extreme soils can shape species diversity in many regions, understanding the mechanisms of adaptation of extremophiles can inform our understanding of how crops can be improved to tolerate a broader range of soils. Since the pioneering work of Arthur Kruckeberg in the 1950s, serpentine soils have been recognized as a unique class of extreme soils. In recent years, these soil types have become a model system in which to understand the population genomics of local adaptation and speciation, as well as underlying mechanisms of extreme soil tolerance. Other extreme soil types, such as karst, dolomite, and gypsum can also be inhospitable to most plants and give rise to similar patterns of plant diversity, but are under-studied. These soils share the high pH of serpentine, but otherwise differ in chemical composition. With high levels of calcium (instead of magnesium as in serpentine) and generally shallow and nutrient-poor soils, they occur in broad regions from the tropics to the poles. Although occurring far more frequently than relatively geologically rare substrates like serpentine, patterns of endemism and adaptation to karst, gypsum, gabbro, and other special substrates are now receiving greater attention. For example, work utilizing karst-specialized groups such as *Primulina*, are excellent systems to study mechanisms of tolerances as well as diversification and endemism on karst in biodiverse regions like southwestern China. Key contrasts between these systems include differences among the stress imposed by high pH, heavy metals, water limitation, and nutrient shortages, as well as differences in connectivity among patches and relationships to more-mesic intervening substrate. As nearly 30% of the Earth's surface has high-pH soils, and soils worldwide are increasingly contaminated with heavy metals, understanding adaptations to the range of these extreme soils may guide efforts to breed crops better able to tolerate harsh soils.

Sun-AM1-D-3

Trophic Position of the Invasive Asian Shore Crab (*Hemigrapsus sanguineus*) in Southern New England

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Abstract - *Hemigrapsus sanguineus* (Asian Shore Crab) is a widespread invasive species that putatively has caused dramatic declines in abundance and diversity of native organisms on rocky shores of North America. In laboratory settings, it generally prefers animal prey over algae, although it consumes both in the field. Because animal tissue is more readily digestible and energy-rich, we hypothesized that the trophic position of the Asian Shore Crab would be higher (i.e., the diet would be more carnivorous) at sites with a greater abundance of animal prey, especially *Mytilus edulis* (Blue Mussel). To test this hypothesis, we collected soft tissue samples from Asian Shore Crabs from 9 rocky intertidal sites in Massachusetts and Rhode Island and used stable isotope ratios to compare relative trophic level of crabs among sites. A greater ratio of ^{15}N to ^{14}N in the soft tissues of an organism generally indicates a more carnivorous diet. As expected, Asian Shore Crabs exhibited significantly higher ^{15}N to ^{14}N ratios than did producers (algae) or herbivores (*Littorina littorea* [Common Periwinkle]). Although crabs at 2 sites in Rhode Island displayed unusually high ^{15}N to ^{14}N ratios compared to other sites, the ^{15}N to ^{14}N ratio was not significantly correlated with abundance of Asian Shore Crabs, abundance of putative animal prey species, or most habitat characteristics. Only percent algal cover was significantly associated (positively) with the ^{15}N to ^{14}N ratio. These results suggest considerable geographic variability in diet, but the mechanism remains unclear. Further sampling and long-term data on population dynamics of Asian Shore Crabs, their prey, and their competitors, will be necessary to clarify these patterns.

Sat-PM1-D-2

The New York City EcoFlora Project: Connecting Urban People and Nature

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Abstract - In 2016, The New York Botanical Garden (NYBG) created and began prototyping the New York City (NYC) EcoFlora project. An EcoFlora (“Ecological Flora”) is a database of naturally occurring plant species and their relationships with other organisms and physical conditions that allow the plants to exist. An EcoFlora combines established knowledge from herbarium specimens and the scientific literature with real-time observation of plants, and thus contributes not only to our body of scientific data, but also provides opportunities for education and informs conservation. The project addresses 2 interrelated needs. First, as people increasingly live in urban habitats, there is the need to better understand the effects of urbanization on biodiversity; particularly, what organisms persist through the urbanization process, and how they adapt to the changes urbanization brings: fragmented habitats, changes in soil moisture and microbes, and disappearance of commensal organisms and replacement by others. Second, there is the need to alleviate a societal ailment known as “plant blindness”, which is defined as people’s inability to fully appreciate plants and their multiplicity of beneficial roles in the ecosystem and in society. The NYC EcoFlora, led by NYBG, in partnership with governmental and private stakeholders, is designed to address these problems through its innovative design of integrating original observations of NYC plants and their biotic interactions by citizen scientists with legacy biodiversity data from herbarium specimens and published scientific literature. The NYC EcoFlora will increase environmental literacy, by reducing plant blindness, for the City’s residents, and increased natural history knowledge will provide a stronger scientific basis for sound, sustainable stewardship of NYC’s biodiversity. The NYC EcoFlora is designed to be a model project for replication in other urban areas; excellent progress has been made to date towards achieving this goal. Recruitment and retention of citizen scientists is principally fostered by monthly EcoQuest Challenges, which encourage residents and visitors to document the wild flora and fauna of New York City by taking and sharing photos via iNaturalist, an easy-to-use mobile App. Since the first EcoQuest Challenge in August 2017, more than 300 observers have recorded approximately 3000 observations of more than 80 species.

Sat-AM1-C-3

Serpentine Vegetation Dynamics and Mesophication in the Mid-Atlantic Area

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Abstract - The biological and evolutionary significance of serpentine habitats has long been recognized due to the unique endemic flora and high biodiversity. I investigated the coevolution of biotic and abiotic variables in association with anthropogenic factors where multifaceted drivers are accompanying afforestation on native serpentinite grasslands of the US Mid-Atlantic region. I used an integrated dataset combining plot spatial data, chronostratigraphic data (including mining-related Cr concentrations), and temporal data from dendroecological tree cores to evaluate vegetation dynamics. Woodland vegetation history was inferred by depth profiling using stable carbon isotopes. Differences in vegetation dynamics were observed with an increase in woody floristic richness with progression from the grasslands. Dendrochronology and plot stem density data suggests poor recruitment of xeric species and concomitant increase in more mesic species. Differences in bulk density, soil depth, heat load, incident radiation, and trace-element data significantly correlate with a unique historic C₄-dominated grassland that has become afforested and where the woody species community is transitioning from xeric to mesic conditions. System changes have modified the traditional serpentine syndrome that arises from abiotic constraints and have been ameliorated by anthropogenic changes that act as drivers of loss in species diversity, widespread mesophication and compositional changes of plant communities over the last several decades. Findings suggest that fire and *Pinus* (pine) clearance alone may not be sufficient to restore conditions favorable to less competitive, herbaceous heliophytes.

Sun-AM1-D-2

The Decline of *Operophtera* (Lepidoptera: Geometridae) in Carlisle, MA, in 2017

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Abstract - As part of a larger study of moth seasonality, male moths of the genus *Operophtera* were counted daily between 2012 and 2017 from photographs taken at the porch lights at a residence in Carlisle, MA. The majority of Carlisle specimens are *O. brumata* (Winter Moth), of which there has been an outbreak in eastern New England. The general pattern of seasonal occurrence was the similar in all years, with animals occurring from the first week of November to mid-January, with the majority from mid-November to mid-December. The total numbers year to year were 975 (2012), 1032 (2013), 1385 (2014), 3306 (2015), and 1290 (2016). In 2017, the number declined to 192, with 97 of those occurring on 1 night. The combined daily data suggest 2 unequal peaks of occurrence, and microscopic examination of the certain moths in 2017 suggests that the earliest occurring are *O. bruceata* (Bruce Spanworm). As in previous years, the daily differences in occurrence were extreme, with greater moth numbers occurring on warmer nights. The development of larvae within *Operophtera* eggs is known to be highly temperature dependent, and larval eclosion needs to occur in synchrony with bud burst of favored host plants. The reason(s) for decline in adult *Operophtera* may be due to unusual weather conditions in winter and spring 2017, or to the presence of an introduced parasitic fly, *Cyzenis albicans*, or both. Since the decline in *Operophtera* in 2017 appears to be a widespread phenomenon in Massachusetts, the former explanation may be more persuasive.

Sat-AM2-B-4

The Maine Vernal Pool Special Area Management Plan

Aram J.K. Calhoun (University of Maine, Orono, Maine; calhoun@maine.edu) and E. Hertz (Blue Sky Planning Solutions, Bowdoin, ME; hertzmaine@gmail.com)

Abstract - Conservation of natural resources on private properties has always been a challenge. Vernal pools, small ephemeral wetlands, are a particularly contentious wetland resource as they are commonly perceived by landowners and developers as hindrances to development due to their location, the difficulty of identifying them, and confusion between state and federal regulatory oversight. In order to develop more effective conservation of pools and to meet the needs of the private sector, we organized a 30-person stakeholder group to develop an innovative, cooperative solution for improving vernal pool conservation outcomes and development potential. At each step of the way, the best available science was incorporated into the decision making. The outcome of this 7-year process was The Maine Vernal Pool Special Area Management Plan (VP SAMP), approved for use by the Army Corps of Engineers and the Maine Department of Environmental Protection in September 2016. This innovative mitigation tool was developed by our stakeholder group composed of regulators, ecologists, developers, planners, municipalities, and land trusts. It represents a unique public/private partnership focused on landscape-scale conservation of vernal pool landscapes while also providing benefits for developers, municipalities, land trusts, and local landowners. The VP SAMP is a voluntary mitigation mechanism for impacts to vernal pools that allows a municipality to collect a fee for impacts to vernal pools in designated growth areas in exchange for conservation of vernal pools and surrounding undeveloped areas embedded in the rural landscape. Currently, 2 Maine towns are in the process of implementing the SAMP and many other towns and New England states have expressed interest in learning more about the process.

Sat-PM2-B-4

Tracking Prairie Warblers during the Non-breeding Season using Light-level Geolocators

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Abstract - Populations of *Setophaga discolor* (Prairie Warbler) have declined across their range in the past few decades and are currently a species of conservation concern. Their decline is due in part to the loss and degradation of shrubland habitats that they use during the breeding season, but little is known about factors during the non-breeding season that also may be contributing to their decline. As a first step towards understanding these factors, we wanted to identify the areas that northern populations of Prairie Warblers use during the non-breeding season (i.e., migratory stopover and over-wintering habitats) as well as the timing of their movements among these areas. To gather this information, in 2016 we attached light-level geolocators to 25 Prairie Warblers from the Albany Pine Bush Preserve (APBP) and 22 from Montague Plains Wildlife Management Area (MPWMA). We colorbanded an additional 31 birds in APBP and 65 birds in MPWMA to serve as a control group in the examination of the effects of geolocators on return rates. Eleven birds with geolocators returned to APBP and 9 returned to MPWMA in 2017. Across both sites, return rates of birds without geolocators were 18% higher than birds with geolocators ($P < 0.05$). Preliminary analyses of geocator data suggested that birds from both sites overwintered primarily in Hispaniola, with some individuals in Haiti and others in the Dominican Republic. Migration routes and timing were difficult to determine precisely due to large variance in estimated locations, but during fall migration most birds appeared to move south along the eastern US to Florida before crossing the ocean to Cuba and then to Hispaniola. Birds followed a similar pathway during spring migration to their northern breeding grounds. These findings contribute to our understanding of the full annual cycles of migratory birds and will assist in the management and conservation of this species.

Sun-PM2-E-1

The Comparative Autecologies of Sugar Maple and Beech

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Abstract - Forty years ago I set out to understand how differences in the architecture of leaf display and branching influenced the responses of shade-tolerant trees to canopy gaps. While previous studies had focused on the importance of canopy gaps for maintaining populations of less shade-tolerant species, even our most shade-tolerant trees clearly responded to and indeed needed canopy openings to reach adult size. That work revealed a tortoise/hare story of differences in the ways that *Acer saccharum* (Sugar Maple) and *Fagus grandifolia* (American Beech) exploited the opportunities created by canopy gaps. Those differences could be phrased in the language of niche theory, but more generally they constitute one facet of the autecology (a formal term for natural history) of the species. In the years since then, without specifically planning to do so, I have studied myriad other differences in the autecologies of these 2 iconic eastern tree species, including strong differentiation in the responses of seedlings and saplings along gradients of soil base saturation and soil moisture, and wildly different reproductive strategies. But as members of the guild of truly shade-tolerant eastern trees, with broad (and roughly similar) climatic distributions, the 2 species share a common response to climate change and prevailing selective logging regimes. The wild card in this story is the ongoing effect of beech bark disease. The impact of that introduced pest/pathogen complex on both forest dynamics and ecosystem function is strongly influenced by the underlying autecology of beech.

Sat-PM1-B-4

Downgrading an Invasive Species: A Case Study with *Lythrum salicaria* (Purple Loosestrife)

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Abstract - According to the Endangered Species Act, a species may be delisted or down-listed once recovery is demonstrated. What if this was the case with an invasive species? Today's technology and research has allowed us to come up with remarkable ideas like biocontrol agents that should let us consider a once alien and destructive species to be known as a naturalized species. I am conducting a study that may provide some insight into an invasive plant species, *Lythrum salicaria* (Purple Loosestrife), that may create positive or neutral effects in an ecosystem. In this study, I will be determining the general reproductive success of *Hibiscus moscheutos* (Hibiscus) with the influence of *Lythrum salicaria* (Purple Loosestrife) through 3 phases of sexual reproduction: pollination, fertilization, and seed maturation. My summer 2018 study will utilize multiple plots in a natural habitat at Montezuma National Wildlife Refuge. Here, Purple Loosestrife has already been controlled by leaf beetles *Galerucella pusilla* and *G. californiensis* (Chrysomelidae). If this invasive is now at controllable levels, my research may show a reduction in some of the undesirable factors Purple Loosestrife once had on the ecosystem there. My research will test the hypothesis that low densities of Purple Loosestrife will not have an effect of pollen competition with native Hibiscus. This presentation is intended to start a dialog about when it is appropriate to delist or down-list an invasive. At what point in time can we say that an invasive species is no longer a threat and what are the factors we should consider when reevaluating invasive species as naturalized?

Sat-AM2-C-5

Major Changes in Soil Fungal Communities Across Soil Horizons and Between Adjacent Forests

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Abstract - The spatial and temporal variability of fungal communities is central to understanding plant diversity and the functioning of ecosystems due to their direct influence on plant nutrition and defense. Globally, distribution of soil fungi is mostly determined by environmental parameters. At a local scale, fungal communities are the result of dispersal and stochastic processes as well as a/biotic factors. Most fungal ecology studies have explored community composition across space and found major changes. However, vertical changes across different horizons can also be important and have strong ecological consequences with distinct functional differences. We have compared adjacent forests dominated by *Acer saccharum* (Sugar Maple) and/or *Fagus grandifolia* (American Beech) to quantify the importance of soil abiotic factors and dominant vegetation on fungal communities. Sugar Maple associates with arbuscular mycorrhiza (AM) fungi, whereas American Beech associates with ectomycorrhiza (EcM) fungi. Their distribution provides an opportunity to compare AM-, EcM-dominated and mixed forests under similar environmental conditions. We used high-throughput sequencing of marker genes to identify fungi within the first 5 soil layers of 15 plots. The study was conducted at the University of Montréal's field station (Station de biologie des Laurentides, Saint-Hippolyte, Québec, Canada). The described fungal communities show major compositional and functional variability, driven by the changes of abiotic factors such as organic matter content and soil depth. Saprotrophic fungi tend to dominate the upper layers of the soil that are richer in organic carbon, nitrogen, and phosphorus, whereas symbiotrophic fungi are more abundant in the deeper layers, much poorer in organic matter. Moreover, fungal communities vary significantly among the mycorrhizal strategies of the dominant trees (AM vs EcM). This variability suggests these associations are an important filter at small spatial scales (6 km² in this study). The results suggest that changes of fungal communities in forest soil are largely driven by the environmental heterogeneity among soil layers, resulting in major differences in composition within even just a few centimeters.

Sat-AM1-E-2

Mycorrhizal Symbioses in Phytotechnologies: Promises and Knowledge Gaps

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Abstract - There is a growing interest in using plants to provide low-cost ecosystem services in a diversity of environments (e.g., polluted, degraded, urban). These utilizations of plants are collectively referred to as phytotechnologies. Many plants used in phytotechnological applications are naturally found to associate with mycorrhizal fungi. These fungal associates can provide numerous ecosystem services, or help plants to do so. There is thus an obvious incentive to better understand how mycorrhizal symbioses can assist phytotechnologies. For some phytotechnological applications, the benefits of using mycorrhizal fungi seem well-established, while for others, these benefits are either uncertain or simply unexplored. In all cases, a trait-based, mechanistic understanding of what allows mycorrhizal fungi to provide any benefit/service is urgently needed. This knowledge will help to develop reliable, mycorrhiza-assisted phytotechnologies in the future, while also improving our fundamental understanding of the evolution of stress tolerance in these important plant-associated symbionts. Here, I present major promises and knowledge gaps in the literature that will help us move forward in the application of mycorrhizal technologies in phytotechnology.

Sun-AM1-B-3

Mortality and Morphology in Egg Masses of Unisexual and Jefferson Salamanders

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Abstract - Unisexual *Ambystoma* salamander egg masses have often been observed to exhibit very high rates of embryo mortality. The ecological consequences and underlying mechanisms are of great concern to researchers and managers studying these and other members of the species complex, all of which are listed as rare species throughout much of their range. Substantial embryo mortality is commonly used by field ecologists as an indicator that unisexual salamanders are present in a pond; egg masses of unisexual salamanders appear otherwise very similar to those of *A. jeffersonianum* (Jefferson Salamander). Early researchers suggested that elevated mortality among unisexual salamanders was due to lack of fertilization caused by sperm limitation. However, recent work has suggested that embryo failure is due to genetic errors particular to the unisexual salamander lineage. Our goals in this study were to (1) identify when during development embryonic mortality occurs in unisexual salamanders, and (2) to develop a morphological metric to distinguish egg masses of unisexual and Jefferson salamanders. Collecting from sites across western Massachusetts, we reared 356 eggs from 11 egg masses of known species identity in the laboratory, examined field photographs of 96 egg masses of known species identity, and examined 757 field photographs of egg masses of unknown species identity. We developed a simple, scale-independent metric to distinguish Jefferson Salamander egg masses from those of co-occurring unisexual salamanders. Among developing embryos beyond the earliest stages, we found no difference in mortality rates between unisexual salamanders and Jefferson Salamanders. However, we observed a large pulse of embryo mortality in the earliest stages of development, followed by a trickle of additional mortality at later stages. Our results suggest that the primary cause of embryo mortality in Massachusetts populations of unisexual salamanders involves failure of embryos to initiate development, which is consistent with the hypothesis that sperm is the limiting factor.

Sat-AM1-D-3

The Field Naturalist Approach as a Book

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Abstract - Every place has a story. The story begins hundreds of millions of years ago, before the oldest rock on the forest floor was formed. Rocks, hills, soils, ferns, maples, salamanders and fox tracks all whisper the tales of volcanoes, glaciers, creatures, rivers and people that have shaped this land. Can you read these stories? In a course inspired by UVM's Field Naturalist Program, I taught students to interpret landscapes, and now I am turning this course into a book to be published by Yale University Press. Each chapter begins with a photograph of one of the class field sites, holding a mystery. Readers are asked to look at the clues in the photographs to uncover the layered stories at the sites. Falling within a single watershed, the sites work together tell a larger landscape narrative. These site-specific stories are used as a platform to explore universal ecological rules, shedding light on readers' own landscapes.

Sat-PM1-E-2

Invasiveness of Intra- Versus Inter-continental Exotic Plants in New England: Implications for Assisted Migration

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Abstract - Nearly half of the New England flora is not native to the region (45%; 1571/3534 species). Of exotic plant species, 74% are from other continents, a.k.a. “inter-continental exotics”, while 26% are from elsewhere in North America, a.k.a. “intra-continental exotics”. We compiled invasive species lists from New England states to assess what proportion of naturalized or adventive non-native species are considered problematic, and tallied herbarium records to obtain a more direct assessment of spread/extent across the region. Inter-continental exotics were classified as invasive at a rate 4 times that of intra-continental exotics (6% vs 1.5% of species). Our estimates using the number of naturalized/adventive species as the potential species pool for both groups makes this the best case-study to date comparing intra- and inter-continental exotic invasiveness for the flora of North America. Intra-continental exotic plants in New England come from elsewhere in the Eastern US (123 species), the Western US (76), or have native ranges spanning the 100th meridian (174). Inter-continental exotics most often hail from Europe and Asia, invasiveness being highest among species from Asia (5.7 vs 8.5% of species, respectively). Inter-continental exotics may be more invasive than intra-continental exotics because, for example, the former may more successfully escape natural enemies in New England, or may have evolved stronger competitive abilities on account of originating in floristically diverse source regions (e.g., East Asia). Additionally, rates of invasiveness among intra-continental exotics may be lower since most plant species prone to rapid spread and increase in North America may have already done so in the distant past and are already part of our native flora. As such, the remaining pool of North American plant species outside New England may be depleted of potential invaders. These results help gauge risks from “assisted colonization”, as one of the major concerns with this controversial conservation approach relates to the risk of invasiveness of species translocated to new regions to keep pace with climate change. Since this approach would typically involve moving species modest distances within, rather than between, continents, it might be less risky than often presumed. However, our results also suggested risks may be elevated for legumes and aquatic plants.

Sun-AM2-B-2

Micromammal Mycophagy and Diversity of Hypogeous Sequestrate Fungi in the Eastern Canadian Boreal Forest

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Abstract - Fungal metabarcoding of feces from mycophagous micromammals confirmed the occurrence of 27 species of hypogeous, sequestrate fungi. Those species came from phyla *Ascomycotina*, *Basidiomycotina*, and *Zygomycotina*, including 11 new species records for the area. Based on 596 fecal samples collected from 131 sites in 5 regions of eastern Canadian boreal forest, mostly consisting of *Abies balsamea* (Balsam Fir) and *Betula papyrifera* (White Birch), 8 micromammal species were identified as mycophagous. Four of these mammals were sampled enough to evaluate their consumption of fungi, which varied from 21% to 81% of samples containing at least 1 hypogeous fungi. Our results are consistent with the current literature and significantly broadens the documented range of fungal species consumed by micromammals of eastern Canada, such as *Barssia* sp., *Leucangium carthusianum*, *Alpova cf. diplophloeus*, *Chamonixia caespitosa* and *Cortinarius pinguis* by *Myodes gapperi* (Southern Red-backed Vole); *Hydnotrya* spp. by *Blarina brevicauda* (Northern Short-tailed Shrew); *Chamonixia caespitosa* and *Cortinarius pinguis* by *Peromyscus maniculatus* (Deer Mouse); and *Endogone* sp. by *Tamiasciurus hudsonicus* (American Red Squirrel).

Sat-AM1-E-3

The Natural History of Red Spruce

Charles V. Cogbill (Harvard Forest, Petersham, MA; cvcogbill@gmail.com)

Abstract - *Picea rubens* (Red Spruce) is a conifer endemic to eastern North America. Spruce was the prince of the eastern trees, being the mainstay of the river drives, construction lumber, Native American use, chewing gum, and instrument makers. It presents many mysteries to the paleoecologist, field observer, vegetation ecologist, plant physiologist, and environmentalist. The common perception is that it is a dominant in the spruce–fir forest of the northern Appalachian Mountains. Yet, south of the glacial boundary spruce stands are scattered as an elevational band of “spruce–fir” forest in “sky islands” of Appalachian mountain ranges south to the Great Smoky Mountains. Spruce–fir forest is conspicuously absent from some southern peaks. One hypothesis is that spruce–fir was driven off the peaks in the post-glacial warm period and later expanded downslope and, importantly, northward along the Appalachian chain. This hypothesis is challenged by occurrence of spruce in lower poorly drained valleys and the genetic isolation of southern populations. Where did the northern Appalachian Red Spruce come from? Paleocological evidence of a sudden expansion of spruce 2000 years ago, a westward range extension in Canada, and a decided preference for foggy temperate environments suggest a glacial refugia off the east coast. While the distinctive high-elevation “spruce–fir” is traditionally associated with the “boreal forest”, the boreal spruce is *Picea mariana* (Black Spruce). Although closely related to and hybridizing with Red Spruce, distinguishing between these 2 is subtle and frustrating. Red Spruce is not found in the boreal forest, is affected by wind rather than fire disturbance, and has limited cold tolerance. This defines Red Spruce as a temperate conifer closer in range with *Pinus strobus* (White Pine) or *Tsuga canadensis* (Eastern Hemlock). The primary habitat of Red Spruce was not on high mountains, but in the region below the deciduous/coniferous ecotone on flats or wet shorelines. Its range has been considerably reduced because spruce was logged out from the mixed spruce–hardwood forest. The Westfeld paradox addressed the lack of spruce regeneration in this “purified” forest. Change in the coniferous/deciduous boundary and the “return” of spruce after spruce decline of the 1960–1970s are still unclear.

Sat-PM1-B-1

Forty-two Years of Change on Franconia Ridge

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Abstract - The Franconia Ridge Trail (a segment of the Appalachian Trail) has been the site of the most intensive and comprehensive study of trail management and hiker impact of any alpine trail in the world. Informal photographs since the 1860s have documented an expansion of the trail from just the summit of Mount Lafayette to a traverse of the entire ridge to the south to Little Haystack. Changes in the erosion along the trail, impact of hikers on the trail, the effect trail management through time, the revegetation of abandoned trail segments, and the condition of the surrounding relatively undisturbed vegetation are documented by a series 62 trail segments photographed in 1975; 10 cross-trail transects established before reconstruction in 1977; 12 sites sampled in 1977–1980 testing the effects of transplanting, seeding, natural revegetation, fertilization, and terracing; mapping of 2 areas of extensive degradation in 1988; the establishment of 11 semi-permanent vegetation transects in 1993; and a comprehensive follow-up in 2016–2017 resampling of all previous vegetation/trail sample sites. The collation and archiving of these data are contained in 2 photograph portfolios, a database, and an analytical reports. Overall, the trail was unmanaged in 1975 and was an undefined and broad trampled swath in many places. Some of the most disturbed sites were barren gravel or exposed bedrock. Trail management through the least disturbed sections has resulted in moderate recovery through 1993, but many sections (such as the old trail around the east side of Mount Truman) have degraded since then. The highly degraded sections in 1975 have not recovered despite efforts of revegetation, active protection, and limiting traffic. It is clear that the some of the Franconia Ridge trail is stable (such as over bare rock or through krummholz walls), but much continues to degrade due to heavy and unrestricted hiker traffic. Reference vegetation in adjacent areas has shown significant changes, but in no consistent direction. Significantly the alpine meadow areas have shown a remarkable reduction in *Carex bigelowii* (Bigelow’s Sedge) cover, but no change in total cover, dominant species, or flora.

Sat-AM2-D-5

Enhancing the Edibility of New England's Landscapes with Native Species

Russ Cohen (Naturalist, Wild Edibles enthusiast, Native seed collector, and Native species propagator and planter, Arlington, MA; eatwild@rcn.com)

Abstract - There's an increasing inclination to utilize more native species in home landscaping and in parks and other conserved landscapes, thanks to books like Doug Tallamy's *Bringing Nature Home*, which extol the virtues of native plants over exotic ornamentals for attracting and sustaining beneficial insects. Yet, for some property owners/managers, this alone may be insufficient motivation to "go native". The "you can eat it too" attribute of many native species offers a powerful incentive for people and organizations to "go native" in their landscaping that were insufficiently swayed to do so by the ecological rationale alone. The berries of *Amelanchier* spp. (aka Juneberries or Shadbush) for example, are equally edible by songbirds and people. The taste of the ripe fruit is like a cross between cherries and almonds. Edible wild plants offer opportunities for people to connect to nature via their taste buds, thereby building their enthusiasm and public support for adding edible native plants to their home landscaping, as well as for conserving other lands that host edible wild plants. Adding native edible plants to a landscape can boost biodiversity as well as "spice it up" (literally as well as figuratively—i.e., we can have our acorn cake and eat it too). This presentation will cover at least a dozen of the tastiest native species the Northeast US region has to offer, along with successful techniques for native seed gathering/storage, propagation of native plants from seed, and adding edible native plants to New England's landscape.

Link to pdf version of presentation: <https://drive.google.com/file/d/1JgLeIltweDALldBThq4pJ0-Jy8R4LNJm/view?ts=5ad50413>

Link to Northeast native edibles database:

<https://drive.google.com/file/d/1WZeyIU1VV5FggzOuNlukIo9B7yFMQbH1/view?ts=5ad503dd>

Sun-AM1-E-4

Hybridization Threat Assessment of Assisted Migration for Vascular Plant Species

Bryan Connolly (Framingham State University, Framingham, MA; bconnolly@framingham.edu)

Abstract - "Assisted migration" or "managed relocation" is one tool that may be employed to reduce climate-change-induced extinction rates of small-range endemics in Eastern North America. Relocation of any species can have unintended negative ecological consequences. This exploratory talk will discuss potential risks of moving a species into the range of a related plant, including genetic swamping or the creation of an aggressive genotype through hybridization. The risk, rate, and consequences of hybridization for both the recipient community and the relocated plant will be considered. Species ranges, taxonomic information, and data from botanical gardens and horticulture will be discussed to help regulators and land managers assess threats and make appropriate decisions on importing plants.

Sun-AM2-B-3

Translocation Success of Captive Bred Spadefoot Toad, *Scaphiopus holbrookii*, Populations in Restored Wetlands on Cape Cod, MA

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Abstract - *Scaphiopus holbrookii* (Eastern Spadefoot Toad; Scaphiopodidae), is a fossorial anuran typically found in sandy soil type habitats interspersed with temporary ponds. In Massachusetts, the northernmost corner of its range, it is listed as Threatened due to habitat loss and degradation. As of 2016, only 32 populations had been verified since 1982. In 2011, Mass Audubon's Long Pasture Wildlife Sanctuary began to locally enhance the status of this threatened species through the translocation of head-started toads obtained from Sandy Neck Barrier Beach in Barnstable, to newly created wetlands at the Ashumet Holly Wildlife Sanctuary in Falmouth. This conservation initiative has grown into a multifaceted project that includes not only conservation, but education, advocacy, and citizen science outreach. Following several years of successful propagation of over 21,000 toads in captivity in Cape Cod school classrooms, we have begun to recover captured translocated individuals at restored wetlands through pitfall trapping and nighttime surveys. Thus far, 32 post-metamorphic translocated toads have been captured in pitfall traps at Ashumet Holly Wildlife Sanctuary. More translocated toads were captured in 2017 than in all prior years combined. In 2018, we will install additional pitfall traps in anticipation of continued increase in capture success and hope to analyze growth rates through skeletochronology to determine age cohort at recapture. Now that translocated toads have begun maturing, we will focus attention toward reproductive success by monitoring breeding pools through nighttime surveys and placement of audio recording devices to document evidence of calling and reproduction. The discoveries of former and additional breeding populations in the state by volunteers with the Massachusetts Natural Heritage Program is encouraging as they represent additional populations outside Cape Cod, which with protection and active management, may prove sustainable.

Sat-AM2-A-3

Analyzing Patterns of Spread for Two Invasive *Viburnums* on a Local and Statewide Scale

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Abstract - Within the last decade, the focus of much invasive species management has shifted from controlling the spread of entrenched invasive species to early detection and eradication of newly invasive species. However, the detection and eradication of recent invaders and the ability to predict their potential distribution and methods of dispersal can be hampered by lack of information regarding the new species' natural history as well as the ability to share information between land management agencies. Point-pattern analysis can be used to assess spatial patterns, at both large and small scales, when species populations are relatively small. This ability is critically important because hypotheses can be formed to explain the underlying processes that affect dispersal and recruitment, leading to a more informed management decision regarding appropriate control measures. *Viburnum dilatatum* (Linden Viburnum) and *Viburnum sieboldii* (Siebold Viburnum) are relatively new invasive species whose ranges are expanding in northeastern United States forest understories. While they are not yet recognized as significant invaders, they have been noted as a local concern in New Jersey for invasiveness, and the potential exists for these species to further expand their range via seed dispersal by birds. The goal of our study is to use point-pattern analysis to understand the patterns of species distribution both within sites, at the local community level, and statewide, to explore potential patterns of spread. We mapped individuals within 50 m x 50 m macroplots per species at Lewis Morris County Park in Morristown, NJ, to explore local dispersal and used point data from the New Jersey Invasive Species Strike Team to explore statewide dispersal patterns. We found that Siebold Viburnum likely relies on clonal spread at distances under 3 m but is likely bird-dispersed at distances from 8 to 12 m. In contrast, Linden Viburnum likely spreads by fruit— by seedfall at close distances (<4 m) and by localized seed dispersal by birds at distances between 6 and 13 m. Statewide, the patterns of distribution are less clear, and a more holistic regional approach would be most effective in providing insight; however, to date, a complete dataset does not exist.

Sat-AM2-C-4

Transatlantic Hitchhiking: A Possible Case of Acanthocephalan Parasites Transported to New York by a Rare Vagrant, the Corncrake (*Crex crex*)

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Abstract – Recently, an individual *Crex crex* (Corncrake) was discovered on Long Island, NY, far from its normal range: This species breeds in Europe and Asia, then winters in Africa. While this is not the first record of the Corncrake in New York, it is extremely rare, with the last record in New York State being in the 1960s. The bird was killed (presumably by a car), resulting in a rare opportunity to study the parasites of this vagrant bird. Within this bird's digestive tract, specimens of a parasite were discovered. These parasites were visualized stereoscopically for identification to phylum and determined to be in the Acanthocephala. For a more refined identification, we amplified and sequenced mitochondrial cytochrome c oxidase subunit I (COI) and ribosomal rRNA genes (18S and 28S), helping to identify the acanthocephalans as members of the genus *Plagiorhynchus*. Additionally, individual parasite specimens were postfixed in osmium tetroxide and then scanned using micro computed tomography (CT), ultimately allowing for 3D reconstructions of external and internal anatomy. To our knowledge, this is the first time any acanthocephalan has been studied with CT, allowing us to discuss the possibilities CT may enable for parasitological work. Finally, given that we found a number of individuals of *Plagiorhynchus*, we discuss the importance that rare long-distance dispersal events may have for parasite evolution.

Sun-PM2-D-2

Conservation Ecology in a Developing Landscape: A Case Study of Three Vermont Projects and Navigating the State and Local Regulations Designed to Conserve Natural Resources

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Abstract - As consulting ecologists and environmental engineers in Vermont, it is our job to help landowners (commercial, residential, renewable, other) navigate the local, state, and federal regulations that may impact their project. We will present 3 recent urban/suburban projects with a step-by-step breakdown of planning, fieldwork, design (ecological and engineered), and permitting. Each project is subject to and provides a discussion of how regulations conserve Vermont's protected natural resources within the confines of a developing landscape.

Sat-AM1-C-1

Wild Heart of Place: Empowering Local Conservation with the Vermont Master Naturalist Program

Alicia Daniel (Vermont Master Naturalist, Burlington, VT; Alicia.daniel@uvm.edu)

Abstract - How can conservation education increase community engagement at the town level? After 30 years of teaching UVM Field Naturalist students, Alicia Daniel has launched the Vermont Master Naturalist (VMN) Program to “advance conservation, build community, and connect Vermonters to the wild heart of place”. After 2 successful years in Burlington, pilot VMN chapters are launching this summer in towns across the state. In each town, a team of 10–15 naturalists attend a series of 4- or 5-day-long field workshops throughout the year and apply their training to conservation projects in their town. Workshops build place-based natural history from the ground up exploring local geology, glacial history, plants, animals, natural communities, Native American land use, and European settlement history to the present. Explore what we have discovered so far and hear the questions we have only begun asking as this new initiative takes shape.

Sat-PM1-E-1

Wildlife Impacts of Free-Roaming Domestic Cats and Management Responses in New York State

John B. Davis (University at Albany – SUNY, Albany, NY; jbdavis@albany.edu)

Abstract - Despite decades of mounting evidence that free-roaming *Felis catus* (Domestic Cat) have significant and unsustainable impacts on wildlife, there is still no consensus about how to mitigate the problem. Free-roaming cats (FRC) include household pets that are allowed regular outdoor access, abandoned and stray animals, so-called “community cats”, and truly feral, unapproachable cats. The losses of native birds and small mammals to FRC are a direct consequence of both the enormous numbers and the high densities of these subsidized, non-native predators in the environment. There are probably 100 million FRC in the United States, with perhaps 6 million or more in New York State (NYS). Numbers continue to grow, through abandonment of unwanted pets, natural reproduction, and well-intentioned but misguided efforts to support neighborhood cat colonies. Yet, fewer than 10% of local governments in NYS have laws that are specifically directed at the management of FRC, and the majority of these laws are reactive and typically do not consider impacts on wildlife. Local governments that do attempt to take a more aggressive management stance toward FRC are often besieged by militant advocates of a method known as trapneuterrelease (TNR), although there is little evidence that TNR is effective in reducing wildlife losses. A more comprehensive approach would begin by recognizing FRC as an introduced species. An adaptive management strategy for FRC founded on the principles of integrated pest management could provide a framework for building community consensus and beginning the difficult process of modifying human behavior.

Sat-AM2-C-1

Short-eared Owl (*Asio flammeus*) Habitat Preferences on the Montezuma Wetlands Complex

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Abstract - The Montezuma Wetlands Complex (MWC) Project Area encompasses ~20,000 ha of public and private land in central New York State, and includes the Montezuma National Wildlife Refuge (US Fish and Wildlife Service) and the Northern Montezuma Wildlife Management Area (NYS Department of Environmental Conservation). The mission of the MWC is to protect, restore, enhance, and manage wildlife habitat; to preserve and restore ecological integrity for the long-term benefit of wildlife populations and society; and to serve as a model for landscape-level restoration and ecosystem management. Since 2010, twenty-four wetland and grassland sites within the MWC have been surveyed from fixed points from November through March (21 weekly and 3 monthly) for the presence of wintering raptors, including *Asio flammeus* (Short-eared Owl [SEOW]), a winter visitor classified as endangered in NYS and a focal species for the Refuge. Surveys have been conducted by volunteers who record the behaviors, locations, and numbers of birds sighted, from one-half hour before to one-half hour after sunset. In order to determine which habitats on the MWC are preferred by wintering SEOW, we used current aerial imagery and expert knowledge to refine and update previous ecological community maps produced by the NY Natural Heritage Program. The updated habitat map and the raptor survey data were combined into a geographic information system (GIS), which allowed us to evaluate SEOW habitat use in detail. We found that although the majority of feeding and foraging activities occur on wetland habitats, when the survey data were adjusted for habitat availability, impoundment dikes were the preferred feeding locations. These results have important implications for habitat management and restoration in the MWC, and at other wetland locations managed for SEOW.

Sat-AM2-A-2

Uncovering Hidden Biodiversity through Insect Tracks and Sign

Charles S. Eiseman (independent researcher, Northfield, MA; ceiseman@gmail.com), Julia A. Blyth (Maria Mitchell Association, Nantucket, MA; jablyth@gmail.com), Noah D. Charney (Harvard University, Petersham, MA; noah@alumni.amherst.edu), and Sydne Record (Bryn Mawr College, Bryn Mawr, PA; srecord@brynmawr.edu)

Abstract - A focus on the evidence left by certain herbivorous insects, such as galls and leaf mines, can reveal otherwise overlooked biodiversity. In many cases, these persistent signs on plants are sufficient to identify the species that caused them. We surveyed the islands of Nantucket and Tuckernuck, MA, for galls and leaf mines, collecting those that we could not identify in order to rear adults from them. We found well over 200 species not previously reported from the islands, not including dozens of reared parasitoid wasps that remain to be identified. In the process, we documented new host associations and previously unknown immature stages, including the first rearing records for *Erynephala maritima* and *Oulema palustris* (Coleoptera: Chrysomelidae), *Eriocraniella platyptera* (Lepidoptera: Eriocraniidae), *Agromyza vockerothi* (Diptera: Agromyzidae), and *Chirosia filicis* (Diptera: Anthomyiidae). Many species represent new state records, including *Phytomyza multifidae* (Agromyzidae), new to the US, and *Staticobium* sp. (Hemiptera: Aphididae), a genus new to North America. We also reared species that were new to science, several of which now have names: *Platygaster tephrosiae* and *P. vitisiellae* (Hymenoptera: Platygasteridae), *Brachys howdeni* (Coleoptera: Buprestidae), *Marmara viburnella* (Lepidoptera: Gracillariidae), *Liriomyza pistilla* (Diptera: Agromyzidae), and *Megaselia nantucketensis* (Diptera: Phoridae). Others remain to be described. We suggest that other biodiversity inventories would benefit from incorporating our approach.

Sat-AM2-B-5

***Pinus resinosa* (Red Pine) in the Northern New England Landscape**

Brett Engstrom (Field Naturalist, Marshfield, VT; engstrombrett@gmail.com)

Abstract - Native *Pinus resinosa* (Red Pine) is an uncommon tree in northern New England where northern hardwood and mixed forests dominate the landscape. It primarily occurs as small stands or scattered trees in dry, fire-prone habitat, especially rocky slopes, cliff brows, and summits, as well as sandy river and lake terraces. Throughout its Northern Forest range, Red Pine depends on fire for natural regeneration because its germination requires a mineral seedbed along with moderate to high light intensities. While it lacks some adaptations to fire, such as cone serotiny, found in at least some populations of *Pinus rigida* (Pitch Pine) and *P. banksiana* (Jack Pine), its thick bark and ability to heal from trunk scorching make it a fire-resistant species. A fire-history and age-structure study of Red Pine stands along a ridge in eastern Chittenden County, VT, show non-lethal, surface-fire return intervals of 3 to 50 years, while more intense fires that killed canopy trees occurred at intervals of 50–100+ years. Taking place from the European settlement period starting in the early 1800s to the 1920s, this fire history likely represents an unusually high fire frequency. Data collected from stands throughout the region over the last 30 years show little Red Pine regeneration in response to a lack of fires. While active fire-suppression by municipal, state, and federal agencies has likely played a role in the decrease of fire frequency over the last 85+ years, the prediction of contracting Red Pine populations as a result of continued fire suppression may be offset by increase of fire frequencies and intensities due to global warming. Recent regional research on Red Pine decline and fire ecology will be discussed.

Sat-PM1-B-2

Exploring and Celebrating *Larix laricina*

Celia Evans (Paul Smith's College, Paul Smiths, NY; cevans@paulsmiths.edu)

Abstract - Harsh environments often lead to resourcefulness in those that can survive them. And sometimes there is a rare beauty in those survivors, perhaps appearing even more beautiful because of the stark surrounding. Tamarack, Eastern Larch, American Larch, and Hackmatack are a few of the common names used through time referring to *Larix laricina*. In the family *Pinaceae*, the genus *Larix* hosts from 10 to 12 species that are important in forested landscapes across the northern part of the northern hemisphere and up into the sub-arctic. Many of these deciduous conifers live at high elevation, but the northeastern species *Larix laricina* finds its community most often in peatlands—wet, often acidic and nutrient-poor environments, exposed to extreme cold and with abundant light. We will celebrate this evolutionary gem of a species and explore its beauty, cultural uses (historical and current), community associations, and complex physiology. Information will be gleaned from a broad literature as well as some recent research (a case study) to understand factors influencing the abundance and distribution of *Larix* in an Adirondack Peatland.

Sat-PM1-B-3

Bioaccumulation of Methylmercury in Wood Frog and Spotted Salamanders in Vermont Vernal Pools

Steve Faccio (Vermont Center for Ecostudies, Norwich, VT; sfaccio@vtcostudies.org), **Kate L. Buckman** (Dartmouth College, Hanover, NH; Kate.L.Buckman@Dartmouth.edu), **Vivien Taylor** (Dartmouth College, Hanover, NH; Vivien.F.Taylor@Dartmouth.edu), and **John D. Lloyd** (Vermont Center for Ecostudies, Norwich, VT; jlloyd@vtcostudies.org)

Abstract - Mercury contamination via atmospheric deposition and leaf fall is widespread in the Northeast, and hotspots with enhanced deposition and biological uptake have been identified throughout the region. Due to a variety of favorable landscape characteristics, including their relatively high organic carbon, fluctuating water levels, and low dissolved oxygen, vernal pools provide ideal conditions for the conversion of mercury to its more toxic and bioavailable form, methylmercury (MeHg). Yet little is known about mercury's presence, cycling, and methylation in vernal pools, its effects on vernal pool fauna, and potential export into terrestrial systems. We investigated the role of landscape characteristics on the production and transfer of MeHg in vernal pool foodwebs in Vermont. We analyzed mercury in samples of water, soil, leaf litter, invertebrates from several trophic levels, and eggs, larvae, and adult amphibians. This presentation will summarize results of MeHg concentrations in all life stages of *Lithobates sylvatica* (Wood Frog) and *Ambystoma maculatum* (Spotted Salamander). Methylmercury levels in amphibian embryos were similar among the 2 species (Wood Frog mean = 5.4 ppb; Spotted Salamander mean = 3.5 ppb), but were ~4 orders of magnitude greater than MeHg in pool water (mean = 0.0008 ppb), suggesting females may depurate mercury during oviposition. Methylmercury bioaccumulated rapidly in Spotted Salamander larvae (mean = 237.6 ppb ± 18.5 SE), and was significantly greater compared to Wood Frog tadpoles (62.5 ppb ± 5.7 SE). Methylmercury levels in adult tissue samples were significantly greater in Spotted Salamander (mean = 79.9 ppb ± 8.9 SE) compared to *L. sylvatica* (mean = 47.7 ppb ± 9.7 SE). These results appear to represent the first to quantify MeHg levels in adult Wood Frog and Spotted Salamander.

Sat-PM2-B-1

Laws Don't Stop Claws: Regulations to Limit the Trade of Pet Crayfish are Ineffective

Zen Faulkes (The University of Texas Rio Grande Valley, Edinburg, TX; zen.faulkes@utrgv.edu)

Abstract - The pet trade moves many individual animals of many species around the world globally and can cause problems both at the beginning of the supply chain (e.g., unsustainable exploitation of native populations) and at the end of the supply chain after final sale to owners (e.g., release of pet animals into non-native habitats). While less popular than tropical fish, pet crayfish that are released into new habitats can have unexpectedly large effects, because crayfish are keystone species that sit in the middle of food webs. Several American states and Canadian provinces have regulations meant to prevent the trade of crayfish. I compared the online sales of pet crayfish in selected Canadian provinces with laws prohibiting the trade of crayfish to provinces without such laws. Contrary to the intended goals of the laws, provinces with laws regulating crayfish do not consistently have the fewest advertisements for crayfish. Every province examined had some individuals selling crayfish within the province. This finding suggests either that more consumer education and enforcement is necessary for the legislation to be effective, or that fundamentally different approaches are needed to meet the goals of preserving natural habitats from introductions of non-native species.

Sat-PM1-D-5

The Impact of White-tailed Deer Herbivory on Two Rare *Asplenium* Species from the Great Lakes to the Northeast

Susan Fawcett (Pringle Herbarium, University of Vermont, Burlington, VT; sfawcett@uvm.edu) and Anton A. Reznicek (University of Michigan Herbarium, Ann Arbor, MI; reznicek@umich.edu)

Abstract - As early as 1947, Aldo Leopold recognized the devastating impacts of *Odocoileus virginianus* (White-tailed Deer) overabundance on the vegetation of northeastern North America, noting the disproportionate pressure on low-growing and palatable species. Although the impacts of White-tailed Deer herbivory have been relatively well-studied for woody plant species, where the long-term consequences may be evident by comparing canopy composition with understory regeneration, the impacts on herbaceous species has been more difficult to document. Thirteen species of *Asplenium* (spleenworts) occur in the northeastern United States, with 8 of the 13 considered endangered in at least 1 state. Two rare species, *Asplenium rhizophyllum* and *A. viride*, are sympatric in Wisconsin, Michigan, Ontario, New York, and Vermont. Because these species are evergreen, they are susceptible to herbivory year-round. In the present study, I analyze the impact of deer herbivory on growth rate of these 2 species at 40 locations across the zone of overlap of their geographic ranges. A key insight is that while *Asplenium viride* regenerates all new leaves each spring, *Asplenium rhizophyllum* maintains each leaf for longer than 2 years on average, making it potentially more vulnerable to herbivory, a finding corroborated by greater population declines on browsed versus un-browsed populations. The influence of other factors, including phenologic differences between the species, colony height, snow cover, and other climatic and ecological variables are also considered. The conservation of these rare species depends on an understanding of the factors influencing their survival, and White-tailed Deer herbivory has been an under-appreciated threat.

Sun-AM2-D-1

Wetland and Ecological Restoration in Action: Vermont Case Studies

Carla A. Fenner (VHB, South Burlington, VT; cfenner@vhb.com)

Abstract - The science and practice of ecological restoration, including wetlands, is complex and dynamic. Environmental factors such as landscape position, vegetative cover, soil characteristics, and biophysical region, as well as land-use history factors, restoration goals, and stakeholder priorities are unique to each place and each project, and must be carefully considered in every step of restoration planning and design. This presentation will focus on the planning, design, implementation, and outcome of select recent wetland and upland habitat restoration projects in Vermont. Aspects of restoration of hydrology, soils, and vegetation will be examined through individual project case studies. Additionally, the presentation will review project-specific challenges in site design, identification and selection of appropriate reference conditions, equipment and material logistics, and adaptive management, and will consider the potential use of similar methods for other restoration efforts in New England.

Sat-PM1-A-3

Interpretation Strategies for the 21st Century

Kelly E. Finan (Kelly Finan Illustration, Hop Bottom, PA; kelly@kellyfinan.com)

Abstract - Love sharing the minutiae of fern gametophytes with the general public through interpretive talks? Do you adore writing lengthy descriptions of dragonfly claspers for interpretive signs? Sorry, naturalists, it's not about you! The most important thing to consider when designing an interpretive program is the interests of your audience, and only after you harness this power can you convey your message in the most effective way. Scientific illustrator Kelly Finan will explain the pros and cons of several remote interpretive methods, and guide you through strategies to identify your audience and their interests, consider modern technology, and brainstorm a method to share your message in a way that your audience will both remember and enjoy.

Sat-PM1-E-3

Species-specific Detection of Prey DNA in Analyses of Western North Atlantic *Halichoerus grypus* (Gray Seal) Diet

Kelly R. Flanders (University of New England, Biddeford, ME; kflanders@une.edu) and Kathryn A. Ono (University of New England, Biddeford, ME; kono@une.edu), Zachary H. Olson (University of New England, Biddeford, ME; zolson@une.edu)

Abstract - The western North Atlantic *Halichoerus grypus* (Gray Seal) population has been markedly increasing in recent years, shifting the interactions of marine food webs they are involved in. Accurate information regarding Gray Seal diet is necessary to resolve unknown ecological impacts and evaluate the extent of seal-fishery interactions. Methodological limitations complicate pinniped diet assessments—*Lophius americanus* (Monkfish), *Leucoraja ocellata* (Winter Skate), *Melanogrammus aeglefinus* (Haddock), and *Morone saxatilis* (Striped Bass) are 4 species which cannot or have not been detected at substantial levels with traditional otolith analysis of Gray Seal scat. Molecular scatology, a relatively nascent approach in comparison to traditional hard-parts scatology, was utilized to detect the presence of the 4 target fish species in wild Gray Seal scats collected from Muskeget Island ($n = 25$) and Monomoy Island ($n = 80$) in Massachusetts. In our study, we successfully developed PCR detection assays for Monkfish (detection threshold: 0.005–0.008 ng/ μ L; $n = 10$), Winter Skate (detection threshold: 0.005–0.008 ng/ μ L; $n = 10$), and Haddock (detection threshold: 0.003–0.006 ng/ μ L; $n = 10$). Our methods were validated with the use of scat samples from captive feeding trials conducted at the Aquarium of Niagara. Of the 105 wild scat samples tested, 3 were positively identified as containing Monkfish DNA, 1 scat positively identified for Winter Skate, and 1 scat positively identified for Haddock. Our results suggest that Gray Seals are not consuming commercially important fish species in sufficient quantities to negatively impact fish populations. Preliminary hard-parts analysis of the scat samples is consistent with molecular results, as very few species other than *Ammodytes americanus* (Sand Lance) have been identified. Our findings demonstrate the validity of our molecular technique on wild scat samples and allow for a greater understanding of Gray Seal ecology and interactions with the fisheries. Our approach can be utilized to track changes in diet over time, to detect differences in diet between locations, and to develop assays for other prey species of interest.

Sat-PM2-D-2

Using Vermont Wetland Bioassessment Methods to Track Restoration Success

Julie Follensbee (VT DEC Wetlands Program, Montpelier, VT; Julie.follensbee@vermont.gov)

Abstract - The State of Vermont Wetlands Program is expanding an ongoing statewide wetland biomonitoring project to include assessment of wetland restoration sites to document the outcomes of restoration projects. We are initiating a small biomonitoring project on NRCS Wetland Reserve Easement restoration sites. The goal is to conduct initial monitoring prior to construction for new sites and before planned enhancement activities on existing sites. Future monitoring is planned to track the habitat development of each site and document changes in wetland condition. The biomonitoring criteria to be used include vegetation, soils, and when appropriate, water chemistry. Vegetation plots will allow for quantitative condition measurements to be generated using Floristic Quality Assessment methodology. Monitoring will also include permanent photo locations, broad-scale natural community mapping, and overall wetland condition assessment using Vermont Rapid Assessment Methodology. We expect that over time we will see a notable improvement in Floristic Quality Assessment Index scores and higher condition assessment scores as sites recover.

Sat-PM1-A-1

The Recovery of a Bat Population During Nine Years of Exposure to *Pseudogymnoascus destructans*: The Etiological Agent of WNS

Craig L. Frank (Fordham University, Armonk, NY; frank@fordham.edu), Carl J. Herzog, (NY State Department of Environmental Conservation, Albany, NY; carl.herzog@dec.ny.gov), and April D. Davis (NY State Department of Health, Albany, NY; davis@health.ny.gov)

Abstract - White-nose Syndrome (WNS) severely affects *Myotis lucifugus* (Little Brown Bat), *M. sodalis* (Indiana Bats), *M. septentrionalis* (Northern Long-Eared Bat), and *Perimyotis subflavus* (Tricolored Bat). It is caused by an extensive cutaneous infection with the fungus *Pseudogymnoascus destructans* during hibernation. Infected bats arouse more frequently from torpor during hibernation, which leads to a premature depletion of body fat reserves, and death. WNS first appeared at 6 hibernations sites in NY State during the winter of 2007–2008, causing the numbers of Little Brown Bat, Northern Long-Eared Bat, and Tricolored Bat to decrease by 75–98%. The Little Brown Bat populations at these 6 sites are now recovering. The number of Little Brown Bats hibernating at the Williams Preserve mine has increased by more than 3-fold since 2009. Field studies were conducted at this mine on the torpor patterns of hibernating Little Brown Bats during the winters of 2008–2009 and 2013–2014. Mean (\pm SE) torpor bout duration in 2008–2009 was 8.2 ± 1.8 d, whereas it was 12.9 ± 1.3 d in 2013–2014. The torpor bout duration of individual bats during 2013–2014 varied from 6.9 to 18.2 d in length. None of the telemetered bats survived the hibernation period in 2008–2009, but 74% survived hibernation during 2013–2014. Bats collected during 2015–2017 also had greater body fat contents than those collected during the same point in the hibernation period during 2008–2009. These findings indicate that this population of Little Brown Bat is developing a resistance to cutaneous infection with *P. destructans*, thereby avoiding WNS.

Sun-AM2-C-3

The Role of Storytelling in Science Communication

Eve Frankel (The Nature Conservancy, Montpelier, VT; eve.frankel@TNC.org)

Abstract - In an increasingly fragmented media landscape, framed by a culture of skepticism and distraction, facts can no longer stand alone to influence audiences. It is more important than ever to embrace the role of communicator as well as scientist, to convey important information to non-science audiences. The Nature Conservancy has been embracing the importance of storytelling in influencing supporters, partners, and lawmakers to advance conservation goals. We will talk about the importance of becoming a narrator of an interesting story versus a presenter of a scientific body of work. Successful narratives create increased engagement, improved re-call, and enhanced perception of legitimacy. Best practices will be highlighted and common pitfalls, such as when using powerpoint presentations, will be discussed. Eve Frankel has been a communications professional in the renewable energy and conservation fields for over 15 years. She applies the principals of storytelling to broaden the value proposition of conservation to reach a broader audience in Vermont and in New England.

Sat-PM1-E-4

Student-Led Scenic Viewshed Protection in the Hudson Valley

George R. Frantz (Cornell University, Ithaca, NY; grf4@cornell.edu)

Abstract - The practice of open-space protection for the purpose of protecting land and ecological resources is well established in the USA. Methodologies to identify and prioritize the protection of agricultural lands, wildlife habitats, and other land and water resources have been developed and implemented for several decades. Scenic resources are “public areas, features, and sites that are recognized, visited, and enjoyed by the general public for their inherent visual qualities” (Maine Scenic Assessment Handbook) often from the public highways, or from publicly accessible places such as parks and preserves or water bodies. While open-space protection programs may often have positive secondary impacts of protecting scenic resources, e.g., agricultural landscapes, programs with the specific objective of protecting scenic resources are relatively uncommon. Over the past 3 years, students in the Land Use and Environmental Field Workshop at Cornell University have been working in communities in the Keuka Lake watershed of western New York and the Hudson River valley to develop and test methodologies for identifying and prioritizing scenic resources for protection. They have tested a number of approaches utilizing factors such as land use and land cover, presence of ecological resources, presence of cultural and historic resources, and number of potential viewers, that can provide an objective lens to determine the comparative importance of multiple scenic resources in a community, and prioritize them for protection. This presentation will discuss the methodologies developed in the course of the field workshops, the variety of approaches to community outreach and engagement used by the student teams during their field work, and lessons for practitioners in engaged learning.

Sun-AM2-E-3

Microplastic Pollution and Trophic Transfer in Organisms within the Lake Champlain Basin

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Abstract - Microplastics (MPs) in freshwater are an emerging pollution threat deriving from personal care products, textile laundering, marine debris, as well as degradation of macroplastics. Most current wastewater treatment plant (WWTP) technologies cannot remove MPs (<5 mm particulates), thus MPs are subject to trophic transfer within aquatic organisms. Since 2015, we have processed WWTP post-treatment effluent samples from representative treatment plants in the Lake Champlain Basin: in the cities of Plattsburgh, NY ($n = 59$), St Albans, VT ($n = 46$), Ticonderoga, NY ($n = 29$), and Burlington, VT ($n = 14$). All samples underwent wet peroxide oxidation digesting to isolate particulate, size-separation, characterization based on MP type (e.g., fragment, fiber, pellet, film, foam), and Fourier Transform Infrared Spectroscopy (FTIR) to determine polymer type. Given the abundance of MPs in the lake, we surveyed digest tracts of ($n = 506$) lake organisms, specifically invertebrates ($n = 301$), 15 species of fish ($n = 190$), and *Phalacrocorax auritus* (Double-Crested Cormorants) ($n = 15$). The most common MP type varied by WWTP and was dominated by fragments in Burlington (39%) and Plattsburgh (44%), fibers at Ticonderoga (39%) and foam (42%) in St. Albans. Estimated MP emission/day was: Plattsburgh ($n = 14,105$), St. Albans ($n = 30,268$), Burlington ($n = 14,228$), and Ticonderoga ($n = 7841$), differences reflected population served, infrastructure updates, and tertiary treatment. Fibers were the most common (80%) MPs in all organisms, followed by fragments (10%), films (7%), foams (3%), and pellets (<1%). In fish, *Amia calva* (Bowfin) contained the greatest mean MPs ($n = 29.67$), followed by *Salvelinus hamaycush* (Lake Trout) ($n = 21.42$), and *Esox Lucius* (Northern Pike) ($n = 20.1$). In invertebrates, Hydropsyche, a filter-feeder, contained the greatest mean MPs ($n = 3$). We noted trophic transfer in Lake Champlain organisms, as invertebrates, fish, and double-crested cormorants contained on average 0.36, 6.08, and 22.93 MPs, respectively. FTIR analysis revealed MP fibers were predominantly polyester [PET] (15%), cellulose (11%), alpha-cellulose (11%), and rayon (9%). These MPs have the potential to adsorb and desorb harmful chemicals (e.g., heavy metals, bisphenol, phthalate) and pose risk to aquatic organisms and human health.

Sun-PM2-B-2

Rescue and Rehabilitation of Vermont's Bats

Barry Genzlinger (Vermont Bat Center, Milton, Vermont; vermontbatcenter@gmail.com)

Abstract - Some of the northeast bat species seem to have the uncanny ability to end up in the wrong place at the wrong time. Most notorious in that regard are the common *Eptesicus fuscus* (Big Brown Bat) and the state endangered *Myotis lucifugus* (Little Brown Bat), though for different reasons. The former seems to enjoy hanging out with humans, whereas the latter have been impacted by White Nose Syndrome. Other hibernating species and an occasional migrator may also appear in unusual and unexpected locations, though to a much lesser extent. The talk will focus on how these situations occur and what is being done to rescue these bats and increase their chances of survival with the ultimate goal of creating and maintaining healthy bat populations in Vermont.

Sun-AM1-C-4

A Mathematical Model of Probability for the Potential Presence of Mushroom Fruiting Bodies

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Abstract - Wild mushroom harvesting is a booming activity in Canada, mostly in Québec, Ontario, and British-Columbia. The increasing market demand for wild edible mushrooms requires pickers to find more picking areas. However, finding these areas is difficult to achieve since mushrooms are just the visible, ephemeral fruiting body structures that pop up from underlying mycelia during short periods of the year, and their abundance varies according to environmental conditions. Environmental meta-barcoding using next-generation sequencing on soil samples allows the assessment of fungal presence in an area and combined with ecological data will enable the implementation of a predictive mathematical model for potential mushroom presence. We constructed a reference library of ITS-rDNA barcodes for 54 specimens of edible and non-edible mushroom species that occur in Canada, to be included into the probability presence model. We used an Illumina Miseq platform to meta-code fungal ITS sequences from soil sampled at 259 selected sites among the 33,000 inventoried ecological sites that are characterized with 75 ecological parameters across the province of Quebec. Sequence data are being combined with ecological parameters in order to calibrate and generate a mathematical model that can be projected to the 33,000 inventory sites. Probability maps of mushroom presence will be generated. This is the first effort to use meta-barcoding to characterize the fungal biodiversity in the province of Québec from soil samples, with the aim to draw a mathematical model supported by ecological relations to predict the occurrence of mushrooms. This approach could be an important advance in understanding the relation between environmental variables and the presence or absence of mushroom fruiting bodies. It will also provide tools to mushrooms pickers for optimizing their search for the best picking areas of wild edible mushrooms across our vast territory.

Sat-AM1-E-1

Recovery of an Endangered Butterfly in a Fire-managed Urban Pitch Pine–Scrub Oak Barrens

Neil A. Gifford (Albany Pine Bush Preserve Commission, Albany, NY; ngifford@albanypinebush.org), Steven P. Campbell (Albany Pine Bush Preserve Commission, Albany, NY; scampbell@albanypinebush.org), and Amanda Dillon (Albany Pine Bush Preserve Commission, Albany, NY; adillon@albanypinebush.org)

Abstract - Pitch Pine–scrub oak barrens is a globally rare, fire-dependent ecological community. The destruction, fragmentation, and degradation of this community has contributed to the decline of many wildlife species of greatest conservation need including the endangered *Plebejus melissa samuelis* (Karner Blue). One of the last naturally occurring northeastern populations of this butterfly species occurs at the Albany Pine Bush Preserve in eastern New York. State, private, and federal partners have been actively recovering the preserve's population by restoring >200 ha of Pitch Pine–scrub oak barrens since 1992 and by accelerating the colonization of newly restored areas through the release of locally derived, captive-reared Karner Blue butterflies between 2008 and 2015. To evaluate the effectiveness of these efforts, we have been monitoring abundances of first and second brood adults annually since 2007 at multiple sites throughout the preserve using distance-sampling methodology. We used the resulting data in a 2-step process to estimate brood sizes for each year. First, we analyzed the data in Program Distance to estimate the combined abundance of all sites during each survey, and then we fit an insect population curve to the survey-specific abundances to derive brood sizes. For all sites combined, the first brood increased from 700 adults in 2007 to 14,600 adults in 2015, whereas the second brood increased from 850 to 18,700 adults during this time. First and second brood sizes decreased in 2016 and 2017 to 6200 and 11,800 adults, respectively, but still remained above state and federal recovery thresholds. Although these results suggest that recovery efforts are succeeding, further monitoring is necessary to ensure that recovery is maintained and to document the effects of continuing recovery efforts and the influence of long-term processes such as climate change.

Sat-AM2-B-1

Diversity and Ecology of Lycophytes on Utility Corridors in Northern New England

Arthur V. Gilman (Gilman & Briggs Environmental, Barre, VT; avgilman@together.net)

Abstract - Lycophytes, the earliest-diverging vascular plants, are represented by relatively few species in northern New England, but most of these are quite common. They are often conspicuous on managed utility corridors in northern New England, and this land-use category, characterized by a lack of trees but only light-handed management, provides large-scale opportunities for them in terms of range extensions, hybridity, population growth and habitat for locally rare species, community interactions, and novel morphologies. I look at various factors of ecology, habit, and habitat and explore why these spore-dispersed, long-lived plants are so successful on utility corridors in New England.

Sun-AM2-D-2

Performance of Floristic Quality Assessments in Massachusetts Forested Wetlands

Carolyn M. Gorss (University of Massachusetts Amherst, Amherst MA, cgorss@umass.edu) and **Scott Jackson** (University of Massachusetts Amherst, Amherst MA, sjackson@umass.edu)

Abstract - In order to combat the loss of valuable wetland functions and services, federal and state governments must have the tools to accurately assess and monitor the condition of wetland ecosystems. One particular method of wetland assessment is Floristic Quality Assessment (FQA), which has been growing in popularity throughout the United States since its creation in the 1970s. FQA relies on vegetative indicators of human disturbance to assess the integrity of an ecosystem. FQA calculations are based on coefficients of conservatism, professionally assigned scores ranging from 0 to 10 that denote a local species' tolerance to anthropogenic disturbance. Despite increasing interest in the widespread use of FQA, few studies have thoroughly tested the quantitative validity of FQA, especially in New England. We used the Conservation Assessment and Prioritization System (CAPS), a landscape-based, coarse-scale wetland assessment method, as a basis for evaluating FQA's performance in Massachusetts's forested wetlands. Our objective was to understand the relationship and strength of performance of the CAPS index of ecological integrity scores (a form of generalized stressor gradient) against a variety of FQA indices (biological condition gradients), using conservatism scores from 7 states in the Northeast, and 2 ecoregions in Massachusetts. Based on our calculations of the correlation coefficient r -squared, and Spearman's rank analysis, we determined that FQA and coefficients of conservation have a moderate to weak relationship with our index of ecological integrity. Of the 11 different FQA indices we tested, the metric with the strongest relationship to our CAPS index was a site's mean coefficient of conservation value. The results of this research were used to evaluate and identify opportunities to improve FQA for assessing the condition of New England wetlands.

Sun-PM2-A-4

Non-lethal Effects of Predation: An Experimental Test of Backyard-nesting House Wrens Across an Urban-to-Rural Gradient

Aaron M. Grade (University of Massachusetts, Amherst, MA; agrade@umass.edu), **Paige S. Warren** (University of Massachusetts, Amherst, MA; pswarren@eco.umass.edu), and **Susannah B. Lerman** (U.S. Forest Service, Amherst, MA; slerman@cns.umass.edu)

Abstract - Conservation of many avian species hinges on understanding the effects of urbanization. In urban areas, birds are often exposed to higher densities of predators, although seldom to increased predation. Birds may adjust their behavior to perceived predation risk on short time scales (known as non-lethal effects of predation; NLEs). NLEs may have significant impacts on avian populations. We investigated the interactions among parental behavior, NLEs, and urbanization, with *Troglodytes aedon* (House Wren) nest boxes. Through playbacks, we experimentally increased the perceived abundances of predators that consume adult wrens. Nestlings exhibited increased body mass and wing size in more urban areas and with predator playbacks. This response may represent an evolutionary tradeoff to prioritize current reproduction over self-maintenance with increased risk of adult mortality. Manipulative studies in situ are essential for developing a mechanistic understanding of bird parental behavior in human-dominated landscapes.

Sat-AM1-C-2

Rate of Predation vs. Natural Increase of Mastodons during the 13th Millennium BP in Northeastern North America

Richard M. Gramly (American Society for Amateur Archaeology, North Andover, MA 01485; gramlyasaa@comcast.net)

Abstract - By reference to archaeological sites (1) Bowser Road (eastern NY), (2) iscock (western NY), and (3) Sugarloaf (central MA) and studies of African elephant carrying capacity in environments with generic similarities to periglacial New England, I suggest that during the late 13th millennium BP the rate of human predation upon mastodons exceeded the rate of this species' natural increase. This critical situation culminated in the disappearance of mastodons and (presumably) all New World proboscideans.

Sat-PM2-C-4

Vascular Plant Diversity in Southern New England Forested Wetlands

Laura Green (Yale School of Forestry and Environmental Studies, New Haven, CT; laura.green@yale.edu), Marlyse Duguid (Yale School of Forestry and Environmental Studies, New Haven, CT; marlyse.duguid@yale.edu), and Mark Ashton (Yale School of Forestry and Environmental Studies, New Haven, CT; mark.ashton@yale.edu)

Abstract - The forested wetland, one of the most common wetland types in eastern North America, has been subject to substantial changes in legislation, management, and climate in the past fifty years. Despite the predominance of wetland forests on the region's landscape, however, the contemporary botanical composition of these forests is not well-described. The authors undertook the development of a baseline inventory of the vascular plant taxa present in a second-growth forested wetlands at six sites in Southern New England. We used a variety of univariate and multivariate statistical methods to analysis community composition within and across forested wetlands. Despite similarities in soils, landscape position, and land use history, sites varied significantly from each other in composition of both the canopy and understory. We found that the site-specific nature of wetland plant assemblages overwhelms commonalities between sites.

Sat-PM1-A-5

Stormwater Ponds and Wetland Functions: Five Years Monitoring Results and the Need for Wildlife Sensitive Maintenance

Patricia Greene-Swift (Gilman & Briggs Environmental and Elemental Wetland & Ecological Consulting, Barre, VT; lynxtovt@aol.com)

Abstract - Stormwater ponds in South Burlington, VT, were constructed for a residential development neighboring a large wetland complex, greater than 50 acres, comprised largely of emergent wetland, with forested wetland, farm pond wetland, shrub dominated wetlands, and stream-associated vernal pools. The results of seasonal monitoring and incidental data for wetland associated species over a 5-year period found wetland species associated with the natural wetland complex utilizing stormwater ponds for various life stages. *Botaurus lentiginosus* (American Bittern), *Agelaius phoeniceus* (Red-winged Blackbird), *Hyla versicolor* (Gray Treefrog), *Lithobates sylvaticum* (Wood Frog), *Anaxyrus americanus* (American Toad), and *Lithobates clamitans* (Green Frog), along with *Microtus pennsylvanicus* (Meadow Vole), and various duck species were found to be associated with stormwater ponds. Given the variety of known species associated with stormwater ponds, it is prudent that stormwater management activities have associated acceptable management protocols that preclude wildlife mortality. This presentation and discussion of these findings seeks to collaboratively come up with solutions to a growing issue for wildlife in the New England Region

Sat-AM2-A-4

Rhode Island BioBlitz: Exploring 18 Years of Citizen Science Data

David W. Gregg (Rhode Island Natural History Survey, Kingston, RI; dgregg@rinhs.org)

Abstract - Rhode Island Natural History Survey has organized a bioblitz event at a different site somewhere in the state annually since 2000, all but one being held on roughly the same June weekend. Cumulatively, the event has engaged over 2700 volunteers to make over 17,500 species observations. The Rhode Island event has developed its own methodology and unique character distinct from bioblitz events elsewhere. For those interested in how these types of events are organized, the basic structure, stated goals, and documented outcomes of Rhode Island BioBlitz will be briefly presented. Trends and statistics in participation, with discussion of the potential for and the limitations of citizen science, will be summarized. Though the value of bioblitz species data to conventional scientific inquiry have been questioned by some, data from the Rhode Island BioBlitz may offer unusual opportunities given the long time sequence and somewhat consistent methodology. Potentially productive directions for analysis will be explored using the RI BioBlitz data.

Sun-PM2-A-5

Evaluating Forest Understory Plant Dispersal and Establishment Limitations through Transplant Trials

Geoffrey R. Griffiths (SUNY ESF, Syracuse, NY; gegriffi@syr.edu) and Gregory G. McGee (SUNY ESF, Syracuse, NY; ggmcgee@esf.edu)

Abstract - The recovery of post-agricultural forests offers a good model for understanding the complex life cycles of forest understory plants. Between 2015–2017, we evaluated recruitment and survival of seed and vegetative transplants of several forest herbs in fenced and unfenced plots across 3 pairs of residual and secondary forest stands in central New York. Additionally, we tracked flowering and seed production of transplants across the land-use–history gradient under open-pollinated, pollinator-exclusion, and supplemental-pollination treatments. Finally, we surveyed the floral visitor communities of current and transplant populations. Our study provides information for selecting propagules for future plant-reintroduction projects and offers new natural history information of forest understory plants in central New York. Preliminary results revealed no major differences in performance of transplants across stand conditions, highlighted mechanisms of reproductive assurance during variable pollinator activity, and suggests herbivory levels may differ among plant life stages.

Sun-AM2-A-2

Induced Defenses in Snail Congeners in Response to an Invasive Crab Predator

Renée Halloran (Smith College, Northampton, MA; RHalloran@smith.edu) and L. David Smith (Smith College, Northampton, MA, LDSmith@smith.edu)

Abstract - Introduced predators can cause prey species in invaded communities to produce induced defenses. In marine gastropods, phenotypic plasticity in shell shape and thickness reduces vulnerability to durophagous invaders. The extent to which different snail species express inducible defenses may be influenced by their life-history characteristics and the costs sustained from morphological plasticity. The recent establishment of *Hemigrapsus sanguineus* (Asian Shore Crab) in the Gulf of Maine offers an opportunity to examine the dynamics of snail prey and an introduced predator, to address whether related snail species exhibit similar armament strategies and whether induced morphological plasticity is reversible with the removal of the predation threat. Over a 6-month period, we exposed naïve *Littorina littorea* (Common Periwinkle) and *Littorina obtusata* (Flat Periwinkle) to waterborne cues from *H. sanguineus*. Differences in morphological response to predation between periwinkles suggest that species-specific traits influence the extent and form of inducible defenses. When induced defenses were exhibited, reversibility of phenotypic plasticity was observed with the removal of predatory cues, implying that trade-offs incurred through shell plasticity are temporary. Comparisons of armament strategies among related species in response to a common introduced predator can inform predictions about community dynamics with the increasing frequency of marine bioinvasions.

Sat-PM1-D-3

Fear and Loathing in *Carcinus maenas*: Biogeography of Behaviors Associated with Invasion Success

Nicholas B. Hathaway (Smith College, Northampton, MA; nicholas.b.hathaway@gmail.com) and **L. David Smith** (Smith College, Northampton, MA; ldsmith@smith.edu)

Abstract - With rapid expansion of international trade and global development of coastal ecosystems, marine invasions are a major conservation priority. Exotic species must succeed through a series of introduction processes (i.e., transport, establishment, spread) to invade ecosystems, with each sequential stage presenting novel ecological interactions. Behavioral plasticity has been historically understudied in invasion biology, despite its relative importance to invaders as a direct and immediate response to novel stressors encountered in various stages of invasion. Because success is generally low at each stage, invasions may levy strong pressure to select for ecologically relevant behavioral traits (e.g., aggression, boldness), yielding invasive populations that are behaviorally distinct from native sources. Though empirical studies generally support differences in behavioral syndromes between invasive and native populations, virtually nothing is known of how these behavioral patterns may persist over time as invaders adapt to their environment. *Carcinus maenas* (European Green Crab) was introduced to the mid-Atlantic coast in the early 1800s from southern Europe and has since spread north to the Gulf of Maine. There, it has encountered a more recent, cryptic invasion from northern Europe, moving south from the Canadian Maritimes. These 2 invasions provide a unique opportunity to compare behaviors of genetically distinct source populations of an invader at different time points of establishment. Two-hundred European Green Crabs were collected from nine intertidal locations of western Newfoundland, northern Nova Scotia, and southern Maine, representing a gradient in time-since-establishment varying from 10 to 100 years. Specimens were subjected to a series of laboratory assays to evaluate behavioral traits and tendencies relating to agonism, locomotion, and vigilance. In contrast to similar work with other taxa, we found that more recently established crabs exhibit significantly reduced activity and greater vigilance in novel environments than longer-established counterparts. In general, locomotion and boldness are positively correlated, but the strength and statistical significance of this relationship seems to vary by region. These results indicate a highly dynamic role of behavior throughout the invasion process, and underscore the pertinence of analyzing behavioral plasticity in invaders interacting with novel ecosystems. Biogeographic patterns like these can provide useful mechanistic insights into the factors that influence marine invasions at large.

Sat-PM1-D-1

Plant Species Co-Occurrence in Heathland: Plant Traits and Applications for Green Roof Design

Amy Heim (Saint Mary's University, Halifax NS, Canada; Heim.Amy.E@gmail.com) and **Jeremy Lundholm** (Saint Mary's University, Halifax NS, Canada; Jeremy.Lundholm@smu.ca)

Abstract - Biodiverse green roofs are growing in popularity due to the potential benefits they can provide. For example, planting a green roof with one species that attracts pollinators, a second that excels at reducing storm water runoff, and a third that excels at drought tolerance could maximize the benefits received from that green roof system. However, plant species that excel at specific services may not be suitable for co-existing in the green roof environment. This research aims to determine trait-based co-existence mechanisms for vegetation occurring in Coastal Barrens, a habitat similar to the green roof system, and apply this information to green roof design.

Sun-AM1-B-2

Ten Years of White-nose Syndrome: Significant Questions Remain

Carl Herzog (NY State Dept. of Environmental Conservation, Albany, NY; carl.herzog@dec.ny.gov)

Abstract - Much progress has been made in the past 10 years' investigations into what was originally known as White-nose Syndrome. We think we understand the basics of the disease and its impacts, but major questions remain. This talk will highlight some of the key milestones we have achieved since the disease first became apparent in 2007 and identify significant mysteries that our current understanding of the disease cannot yet explain, many of which have significant implications for the conservation of North American bats.

Sun-AM2-C-1

Maidenhair Ferns: Unexpected Complexity on a Serpentine Substrate

Christopher Hoess (Delaware Technical Community College, Dover, DE; choess@dtcc.edu), Edward Williams (Delaware Technical Community College, Dover, DE; ewilli41@dtcc.edu), and Zachary Theis (Delaware Technical Community College, Dover, DE; ztheis@dtcc.edu)

Abstract - Since the discovery of the reticulate tetraploid *Adiantum viridimontanum* (Green Mountain Maidenhair) by Cathy Paris, its parent taxa, *Adiantum pedatum* (Northern Maidenhair) and *Adiantum aleuticum* (Western Maidenhair) have generally been recognized as separate species. Western Maidenhair behaves as a bodenvag in its principal range in western North America, but both Western Maidenhair and Green Mountain Maidenhair are limited to ultramafic substrates in the east. A logical explanation for this pattern might be that Western Maidenhair brought with it a greater tolerance for these substrates, allowing it access to a niche relatively inaccessible to Northern Maidenhair. However, some *Adiantum* from exposed eastern serpentine habitats have proven to be Northern Maidenhair. Careful examination of microhabitats may help explain the coexistence of these taxa.

Sat-AM1-A-1

Wood Frog Movement and Habitat Selection in Urban Settings

Kristine Hoffmann (UMaine, Orono, ME; Kristine.hoffmann@maine.edu), Thomas Hastings (UMaine, Orono, ME; tphastings1s@semo.edu), Mitchell Jones (UMaine, Orono, ME; jonemi02@gmail.com), Aram J.K. Calhoun (UMaine, Orono, ME; calhoun@maine.edu), and Malcolm L. Hunter Jr (UMaine, Orono, ME; mhunter@maine.edu)

Abstract - The complex life cycle of *Lithobates sylvaticus* (Wood Frog) in undisturbed forests includes migrations to vernal pools to breed, then to summer home ranges in forested wetland, and to upland hibernacula, but their habitat use and movements in developed landscapes are poorly understood. We radio tracked frogs at 3 urban vernal pools to quantify migration and habitat selection on a coarse scale by locating frogs daily, and at 1 site on a fine scale by locating frogs hourly during post-breeding migration. Frogs made shorter migrations than those documented in natural landscapes, presumably due to the limited availability of suitable habitat. At one site, where no other wetlands were available, frogs summered at the breeding site or made short movements into the forest. At the second site, frogs remained near the breeding pool, made short migrations to an intermittent stream on the edge of the forest patch, or entered lawns. At the third site, frogs crossed 120 m from the breeding pool through a suburban neighborhood to reach a forested wetland patch or remained in lawns. Frogs at this site were tracked to late November and did not make fall migrations but hibernated in the forest adjacent to the summer habitat on a slightly elevated bank. At the fine scale, we observed frogs migrating at night across open lawns and settling under cover (shrubs, garden plants, sand boxes, grass, etc) when the rain ended or as dawn approached. Sources of mortality included lawn mowers, swimming pools, and predation. Our results indicate that some Wood Frog populations limit their migratory behavior to persist in areas with limited habitat and that diurnal refuges are important for migration through altered landscapes.

Sat-PM2-B-2

Decline of a Foundation Tree Species due to Invasive Insects will Trigger Net Release of Soil Organic Carbon

Danielle D. Ignace (Smith College, Northampton, MA; dignace@smith.edu), Aliza Fassler (Smith College, Northampton, MA; alizamfassler@gmail.com), and Jesse Bellemare (Smith College, Northampton, MA; jbellema@smith.edu)

Abstract - Eastern US forests are witnessing a devastating decline in one of their foundation tree species, *Tsuga canadensis* (Eastern Hemlock). The spread of the exotic pests *Adelges tsugae* (Hemlock Woolly Adelgid) and *Fiorinia externa* (Elongate Hemlock Scale) have greatly altered ecosystems previously dominated by this important evergreen conifer. The implications of this invasion for ecosystem processes are far-reaching because coniferous hemlock is most often replaced by deciduous tree species, such as *Betula lenta* (Black Birch), which have differing effects on forest-floor microenvironments. We took advantage of an “accidental experiment” initiated by patch-level timber harvesting ~30 years ago at Smith College’s MacLeish Field Station (Whately, MA) to investigate how the removal of Eastern Hemlock, and its replacement by young deciduous trees, has affected soil organic layer mass, C:N content, soil respiration, leaf-litter characteristics, and the microbial community. Three years of data collection from a series of plots in hemlock and young birch stands, and 80–100 year-old mature birch stands, revealed dramatic differences in soil carbon pools and cycling. Between forests dominated by hemlock versus mature birch, we saw a significant decrease in soil organic layer mass and the C:N of the remaining organic material. The associated microbial communities differed, with hemlock forest floors consistently having higher bacterial counts than the birch stands during the growing season. Although hemlock and young birch stands showed no significant differences in soil respiration rates, mature birch stands had significantly higher soil respiration rates throughout the entire growing season, regardless of wet or dry years. Our results suggest that the carbon pool in the forest floor is likely to mobilize through greater decomposition with a 6.8x decline in soil organic layer C storage as hemlocks are replaced by deciduous trees. We conclude that the ramifications of this change for carbon storage could be extensive, but may take decades to manifest.

Sat-AM2-C-3

The Role of Epidermal Lipids in the Resistance of Bats to Cutaneous Infection with *Pseudogymnoascus destructans*

Melissa R. Ingala (Richard Gilder Graduate School, American Museum of Natural History; mingala@amnh.org), Anna J. Hudson (Environmental Science Program, Fordham University; ahudson4@fordham.edu), Johanna J. Monro (Environmental Science Program, Fordham University; jmonro@fordham.edu), and Craig L. Frank (Department of Biological Sciences, Fordham University; frank@fordham.edu)

Abstract - White Nose Syndrome (WNS) is a cutaneous infection caused by the psychrophilic fungus *Pseudogymnoascus destructans* (*Pd*). WNS has caused extensive mortality in hibernating North American bats, particularly *Myotis lucifugus* (Little Brown Bat), *M. septentrionalis* (Northern Myotis), *M. sodalis* (Indiana Bat), and *Perimyotis subflavus* (Eastern Pipistrelle). The epidermis of *M. lucifugus* contains free fatty acids (FFAs) that have been shown to inhibit the growth of *Pd* in laboratory experiments—myristic (14:0), palmitoleic (16:1), oleic (18:1), and linoleic (18:2) acids. However, the effects of other cutaneous lipids which contain these fatty acids on the growth of *Pd* has not been tested. In addition, the relationship between FFA depletion during hibernation and WNS susceptibility is also unclear. We thus hypothesized that (1) the FFA profile of *M. lucifugus* during mid-hibernation cannot inhibit the growth of *Pd* as well as at the onset of hibernation, (2) epidermal monoacyl- and triacylglycerols containing inhibitory FFAs may also reduce *Pd* growth, and (3) epidermal wax esters containing inhibitory FFAs reduce *Pd* growth. We conducted laboratory culture experiments with *Pd* maintained on media varying in lipid composition to test our hypotheses. We found that the early hibernation FFA profiles more effectively inhibited the growth of *Pd* than mid-hibernation profiles. We also discovered that triacylglycerols have no effect on *Pd* growth, but 1-oleoglycerol greatly reduced *Pd* growth. Finally, we found that wax esters containing 18:1, 16:1, and 18:2 can also inhibit the growth of *Pd*. These findings suggest that multiple epidermal lipids contribute to the susceptibility of bats to infection with *Pd* during hibernation.

Sun-AM2-C-4

A Pattern Language For Tree Branching Patterns

Jerry Jenkins (Northern Forest Atlas Project, Eagle Bridge, NY; jerryjenkins@hughes.net)

Abstract - Trees are complicated. They have architectures for early succession and late succession, branches for shade and sun, and twigs for leafing and fruiting. All of this generates characteristic branching patterns. Some are widely shared and likely ancient. Others are species-specific and tied to life history and ecology. All are fascinating and worth knowing about. For those interested, I offer 2 tools: a descriptive language, which I developed over 10 winters of tree study in the 1970s and 1980s, and a pattern language, abstracted from thousands of tree photos, and developed for the Atlas project. The descriptive language names functions (*promotion, suppression, eviction, escape* ...), elements (*leading shoots, nodal sprays, foliar twigs* ...), and complex patterns (zonation, segmentation, nodality, shade branching...). The pattern language illustrates this by pairing photos and diagrams. Much of this information is known to naturalists, though rarely spoken of or named. Almost none of it, so far as I know, has been illustrated or described in books.

Sat-PM1-B-5

Forest Stream Interactions in Old-growth Northeastern Forests: Recovery of Stream Habitats and Implications for Flood Resilience

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Abstract - As northeastern forests continue to recover from historic land-use, the ways in which they interact with stream systems will change accordingly. Important forest stream interactions, such as large woody debris inputs, controls on light availability and related in-stream autotrophic production, structural influences on stream channel geomorphology, and in-stream nutrient processing are likely to change with late-successional forest stand development. Our research in the Adirondack Mountains and across northern New England has: (1) described structural attributes and gap dynamics associated with old-growth riparian forests; (2) assessed linkages between these characteristics and in-stream habitat structure, light availability, and autotrophic production; and (3) investigated in-stream nutrient processing and retention in old-growth streams. We sampled forest structure and in-stream characteristics along 1st- and 2nd-order stream reaches, where the average age of dominant trees varied from 80 to 410 years. Our results indicate that old-growth riparian forest structure is more complex than in mature forests and exhibits significantly greater aboveground tree biomass, both living and dead. In-stream large woody debris volumes were significantly greater at old-growth sites compared to mature sites and were strongly related to the basal area of adjacent forests. In-stream large-log densities correlated strongly with debris-dam densities, although boulder density and stream size were also important variables. Canopy gaps are abundant, positively correlated with concave landforms, and well-distributed along stream reaches. Heterogeneous light environments translate into spatially variable periphyton production, with implications for our understanding of energy dynamics in low-order streams. Collectively, our research has shown that old-growth riparian forests have pronounced effects on stream ecosystems, resulting in exceptionally high large woody debris volumes, higher densities of woody debris dams, greater channel roughness and possibly flood resilience, spatially complex light environments and food webs, and greater rates of in-stream nutrient spiraling and retention. Old-growth riparian forests provide in-stream habitat features that have not been widely recognized in eastern North America. There is now an opportunity to encourage redevelopment of these features in some areas. Careful and judicious management for, and/or conservation of, structurally complex riparian forests will yield high quality stream habitats and stream ecosystem functions that are currently under-represented on eastern forest landscapes.

Sat-PM2-A-4

Can Disruption of an Ant-Plant Mutualism Explain Lack of Recovery of Forest Herbs in Post-agricultural Forests of New York?

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Abstract - Upwards of one-third of New York's forests regenerated following agricultural abandonment in the late 19th and early 20th centuries. Many myrmecochorous plant species (those whose seeds are dispersed by ants) are lacking in post-agricultural second-growth forests decades after land abandonment despite being present in residual analogs. To determine if mutualism disruption can partially explain this trend, we quantified both the rates of seed removal by ants and seed predation by rodents in residual and post-agricultural forests. We experimentally manipulated ant and rodent access to seeds of 4 myrmecochorous understory herbs in paired residual and post-agricultural forests in central New York. We identified *Aphaenogaster rudis* as the primary seed disperser. We found no difference in mean (± 1 SD) seed removal rate by ants between residual stands (3.08 ± 3.11 seeds remaining of original 7) and post-agricultural stands (2.93 ± 3.07 seeds remaining of original 7). Rodents removed little to no seeds (6.65 ± 1.08 seeds remaining of original 7), but gastropods were active in removing elaiosomes of seeds and inhibiting dispersal. It appears that neither ant dispersal or rodent predation are limiting the dispersal of myrmecochorous seeds via mutualism disruption. Rather, the lack of recolonization of post-agricultural forests by several native understory herbs may be explained by establishment abilities or differential growth rates. Given the presence of *A. rudis* in post-agricultural stands, programs to assist migration of the plants will likely suffice to reestablish this mutualism in degraded sites. However, with climate change shifting historical ranges of land plants across temperate regions of North America, efforts must be made to understand how dispersal-limited plants will respond, and what (if any) methods are needed to assist this shift.

Sun-AM2-A-3

Genetic Legacies of Translocations and Isolated Relic Populations of American Marten in the Northeastern United States

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Abstract - *Martes americana* (American Marten) were largely extirpated from the northeastern United States as a result of land development and overharvest before the mid-20th century. Natural recolonization is believed to have occurred from 2 refugia in northern Maine and the High Peaks of the Adirondacks in New York to New Hampshire and the West Canada Lakes region of the Adirondacks, respectively. Furthermore, a 1989–1991 reintroduction attempt in southern Vermont was originally declared unsuccessful but is now believed to be the source of a population that has been detected since 2010. A population in northeastern Vermont detected since 1997 is believed to be colonized by dispersers from New Hampshire. We sequenced a 320-base segment of the control region (D-loop) of mtDNA in 112 individuals and amplified 10 microsatellite loci in 140 individuals from Maine, New Hampshire, northeastern Vermont, southern Vermont and the 2 regions of the Adirondacks to test hypotheses of population origin in Vermont and estimate genetic structure throughout the northeast. Tests of genotypic and allelic differentiation, genetic divergence (F_{ST}), population assignment/exclusion, and genetic clustering indicated that New Hampshire is the primary source of colonization of northeastern Vermont, though the reintroduction may have contributed. The population in southern Vermont is likely a pre-reintroduction remnant with introgression from the reintroduction. Genetic clustering identified 3 areas that were believed to be extirpated and recolonized that may have supported relic populations throughout the 19th and 20th centuries: southern Vermont, New Hampshire, and the West Canada Lakes region of the Adirondacks.

Sat-AM1-B-3

Phylogeography of Songbirds Breeding in the Boreal Forest Archipelagoes of Eastern North America

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Abstract - The boreal forest reaches its southern periphery in North America in the mountains of New York, New England, and the Canadian Maritimes. These isolated patches of boreal forest are breeding grounds for resident and migratory bird species that are broadly co-distributed across the boreal forest biome, and that colonized their current breeding ranges after the retreat of the Laurentide ice sheet some time since 11,000–7000 BP. We examine the extent to which bird species have shared spatial and temporal histories by examining patterns of geographic genetic structure in 5 species we sampled from disjunct montane populations stretching from the Catskills Mountains to Newfoundland, and from populations in central and western North America. We compare mitochondrial ND2 sequences obtained from 3 migratory and 2 non-migratory lineages: *Empidonax flaviventris* (Yellow-bellied Flycatcher), *Poecile hudsonicus* (Boreal Chickadee), *Perisoreus canadensis* (Gray Jay), *Setophaga striata* (Blackpoll Warbler), and the *Catharus bicknelli/C. minimus* (Bicknell's/Gray-cheeked Thrush) species complex. For each species, we present haplotype networks, describe levels of sequence polymorphism and pairwise population divergence, and estimate coalescence times of clades. We also use our ND2 data to test for congruence in phylogeographic patterns among species and to test alternative hypotheses regarding the number of Pleistocene boreal forest refugia in eastern North America.

Sat-AM2-D-2

Phragmites australis Habitat Functions for Other Biota are Diverse and Similar on Three Continents

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Abstract - *Phragmites australis* (Common Reed) is one of the most widely distributed, most abundant, and best-studied vascular plants worldwide but there has been no broad comparative analysis of reed-associated biota on different continents. A survey of observational data on (mostly terrestrial) organisms using *P. australis* reedbeds revealed diverse assemblages with ecological parallels among North America, Europe, and sub-Saharan Africa. I present examples for a selected group of 28 habitat functions (features of the reed plant or reedbed used in particular ways by groups of organisms). Functions include animals eating certain portions of reed, birds roosting in reedbeds, bees nesting inside reed culms, and vines using reeds for support. These similarities in habitat functions in biogeographically distinct world regions suggest a fundamental character of Common Reed ecological relationships related to the large culms and rhizomes, extensive stands, high productivity, deep litter layers, and other traits of reed. The data also underline the biodiversity support functions of Common Reed and their similarity among continents. Managers can consider reed functions and user guilds to design site-specific management approaches and predict outcomes of conservation, management, or other environmental changes affecting reedbeds, whether native or introduced, over-abundant or under-abundant.

Sat-AM2-A-1

Created Vernal Pools Lack Ecological Functions of Natural Pools

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Abstract - Temporary pools, also known as vernal pools, are small, isolated, ephemeral wetlands that undergo cyclical periods of drying and inundation; they are an important ecological resource throughout northern and eastern North America and provide key habitat for several amphibian and invertebrate species. Temporary pools often lack legal protection and are subject to degradation and destruction. Pool creation offers a potential mitigation solution, but long-term monitoring to assess the functioning of created pools is scarce. Furthermore, studies rarely integrate multiple, interacting levels of the pool ecosystem, including physical, chemical, and biological parameters. To address this knowledge gap, we compared the physical habitat, water chemistry, productivity, and community composition of macroinvertebrates and amphibians from 7-year-old created pools ($n = 7$) to reference pools ($n = 6$). Created ponds were smaller in size, received more sunlight, had greater amounts of *Lemna*, *Typha*, and *Phragmites*, and were less likely to dry. Created pools had higher pH and conductivity, but algal biomass did not differ. Macroinvertebrate richness was similar across pools, but composition starkly differed. Amphibian species richness and composition was similar between created and reference pools; however, created pools had fewer focal pool-breeding amphibians, including *Ambystoma maculatum* (Spotted Salamander) and *Lithobates sylvaticus* (Wood Frog). By assessing the entire pool ecosystem, we found that although created vernal pools can provide habitat for a variety of species, the ability to mimic the physical and ecological functions of natural vernal pools is suspect.

Sat-PM2-B-3

The Role of Serpentine Soils in the Evolution of Novel Traits in a Polyploid Fern Complex

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Abstract - Plants adapted to serpentine soils typically have a suite of traits to cope with harsh conditions associated with low water and nutrient availability and increased levels of soil metal concentrations. Few studies have examined the role of these specialized traits in the evolution of new polyploid species. This work aims to determine the relative contribution of parental traits, including a serpentine specialist, in the ecological success of an allotetraploid plant species.

Sat-AM1-A-3

Ecological Dynamics in an Oiled Intertidal Microbial Community, Prudence Island, Narragansett Bay

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Abstract - The release of petroleum byproducts into shallow coastal bays and estuaries alters ecosystem dynamics, including reduced biodiversity and selective loss of species. The damaging effects of the residual toxic organic compounds are especially evident in soft mud sediments. This study of an intertidal microbial community at a contamination site in Narragansett Bay, located at the south end of Prudence Island, characterizes some of the ecosystem changes resulting from chronic release of gasoline and diesel fuel residues from previously installed underground fuel storage tanks at a naval fuel depot, which were later removed as part of cleanup and mitigation efforts on the site. Changes in microbial population dynamics, trophic relationships, species composition, and predation patterns have been observed in field samples collected over an 8-year period, and then compared to a control site and to microcosm studies at the Marine Ecosystems Laboratory (MERL), Graduate School of Oceanography at the University of Rhode Island. I made observations using light and fluorescence microscopy, SEM and video imaging, followed by DNA extraction and analysis, in order to characterize the protistan and micro-invertebrate populations in both communities, and to assess the coping mechanisms utilized by ciliates for survival in the oiled environment. I also evaluated seasonal variation in populations. These comparisons confirm that the response of a marine microbial community to petroleum hydrocarbons shows a shift to an altered, but stable, ecological community during low-level, chronic oil exposure.

Sat-PM2-D-4

Younger Dryas Impact Evidence Associated with the Bowser Road Mastodon

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Abstract - In 2014, excavation of a farm drainage ditch near Middletown, NY, uncovered the skeletal remains of a *Mammot americanum* (Mastodon) ¹⁴C dated to ca.13,000 cal. ka BP. In addition to the skeletal remains, an assemblage of human tools and artifacts were found in close association, suggesting the creature had been subjected to post-kill butchering. The bones' location appears to have been the original kill site near an ancient sandy beach bordering a paleo-lake basin. A subsequent 2015 investigation revealed a mastodon scapula in close proximity to its original skeleton. The scapula was found buried beneath ~30–40 cm of plow-zone peat and lying atop a dense calcareous marl surface, which acts as an aquitard. In addition to the archaeological and paleontological discoveries, analysis of the sediment surrounding and overlying the exhumed skeleton revealed the presence of a large number of extraterrestrial-impact proxies often found to be associated with soil dated to the onset of the Younger Dryas (ca. 12.8 cal. ka BP). These proxies include: once-melted glass fragments and glassy microspherules, iron-enriched magnetic, quench-melt microspherules, and a significant platinum enrichment anomaly. The proxies become markedly diminished above—and in the shadow of—the scapula, and entirely disappear in samples taken from a few cm below the shoulder blade's depth. Anthropogenic contamination was judged to be unlikely due to the high-temperature features observed in association with these proxies using scanning electron microscopy and energy dispersive x-ray spectroscopy. The inferred temperature (at least 1700 °C) required to generate such features exceed those produced by most modern industrial processes. The results appear consistent with other reported evidence supporting a 2007 hypothesis that one or more cosmic impacts precipitated or contributed to the Younger Dryas climate reversal and other environmental effects that postdate the Bowser Road butchering incident by ~200 years. These results suggest a combination of factors may have contributed to megafaunal extinction including—but not limited to—post-impact environmental degradation and heightened human predation on a diminished megafaunal population burdened by abrupt climate change.

Sat-PM2-C-1

Bat Conservation Through Collaboration

Meghan S. Lout (VHB, South Burlington, VT; mlout@vhb.com)

Abstract - VHB is assisting The Vermont Agency of Transportation in the avoidance and minimization of potential impacts to federally and state-listed rare, threatened, and endangered bat species that occur near a bridge-replacement project in Middlebury, VT. Collaboration and dedicated teamwork among The Vermont Agency of Transportation, VHB, The Vermont Fish and Wildlife Department, and The Vermont Bat Center resulted in the successful capture of 6 *Myotis septentrionalis* (Northern Long-Eared Bat) and the location of several roosts through radio telemetry. This project exemplifies the significance of environmental review, a multi-organizational approach, and collaboration among individuals who specialize in various aspects of bat conservation, to protect bats in Vermont. This presentation will focus on the results of surveys completed to date and The Vermont Agency of Transportation's commitment to conservation and mitigation measures that involve dedicated partnerships and cooperative efforts.

Sun-AM1-C-3

Constructed Ecosystems as Components of Urban Environments

Jeremy Lundholm (Saint Mary's University, Halifax, NS, Canada; jlundholm@smu.ca)

Abstract - Constructed ecosystems are human designed and created living systems engineered to produce ecosystem services. I introduce various types of vegetated constructed ecosystems including green roofs and walls, treatments wetlands and bioswales. Green roofs have received a lot of attention due to their multifunctionality and potential to increase habitat for many species in cities. In this presentation, I will introduce habitat-template concepts and evaluate them for selecting plant species for urban landscape applications. Then I will document the relationships between plant traits and green-roof ecosystem services derived from several experiments. These experiments have revealed that plant species and growth form diversity also emerge as important predictors of ecosystem services. Finally, the relationship between natural history and constructed ecosystems is discussed.

Sun-AM1-B-1

Spatial Heterogeneity Predicts Site-level Native and Rare Plant Species Diversity on Coastal Barrens: Implications for Reserve Selection

Jeremy Lundholm [Saint Mary's University, Halifax, NS, Canada; jlundholm@smu.ca] and Caitlin Porter (Saint Mary's University, Halifax, NS, Canada; caitlinjporter@gmail.com)

Abstract - *Bombus affinis*; (Rusty-patched Bumble Bee [RPBB]) was once among the most commonly observed bee species across the eastern US and adjacent Canada. RPBB populations abruptly declined by more than 90% in the late 1990s, resulting in listing as endangered by the US Fish and Wildlife Service in 2017. Evidence suggests the RPBB decline was driven by anthropogenic threats (e.g., bee-pathogen spread, pesticide exposure, and habitat loss), yet ironically, remaining RPBB populations are largely confined to urban and heavily agricultural habitats in Midwestern states. Drawing on historical data and recent inventories, I present the evidence for decline of this bee, discuss the causes and consequences of its rarity, and make predictions about where it may still persist in northeastern North America.

Sun-PM2-C-2

Plants Discovered along Lake Champlain's Sand Beaches during the Extraordinarily Low Water Year of 2016

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Abstract - Department botanists and others conducted surveys for rare plants along Lake Champlain sand beaches in Chittenden County, VT, during the remarkably low water year of 2016. The water levels during late summer and the fall were about 0.3 m (1 ft) lower than recent decades but similar to levels in the 1950s. The low water conditions exposed wet sands ideal for the growth of rare native annual plants adapted to the lake draw-down. The wet sand beaches were dominated by native annuals, appearing as a lawn in places. Other associated habitats adjacent to the wet sand beach that were investigated included dry sand beach, low dune, deep-water emergent marsh, and backwater mudflat. Some of the significant discoveries were: *Cyperus erythrorhizos* (Red-root Flat-Sedge), new to the state; *Cyperus odoratus* (Fragrant Sedge), previously known from southern VT; *Chenopodium berlandieri* (Berlandier's Goosefoot), very rare in the state; and *Sagittaria australis* (Appalachian Arrowhead), new to New England. In summary, ~20 rare (State Conservation Status of S1 or S2) plant species were documented and a similar number of uncommon (S3) plants. For many of the species, multiple occurrences were documented, for example, 17 sites for *Cyperus erythrorhizos* were located.

Sat-AM2-E-2

Stream Macroinvertebrate Responses to Landscape Variables: An Evaluation of Rapid Bioassessment Techniques Using a Statistical Modeling Approach

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Abstract - We calculated 14 benthic macroinvertebrate metrics from kick-net samples taken from 56 Vermont streams as part of the Vermont EPSCoR Streams Project. Geographical information system (GIS) layers were used to measure 26 quantitative landscape response variables from the subwatersheds upstream from each macroinvertebrate sampling site. A generalized additive model used landscape variables to predict macroinvertebrate responses. The following 10 response variables were successfully modeled using this approach: number of Ephemeroptera taxa, number of EPT taxa, taxonomic richness, clinger richness, % EPT, % filterers, % clingers, dominance, % grazers, and % tolerant organisms. We did not successfully fit models for number of intolerant taxa, Plecoptera richness, or Trichoptera richness. Bedrock classification, elevation, catchment area, and site aspect were the most influential landscape variables in our models. Of the land use variables used, % agricultural land and % forested land in the watershed were influential components of the model response. These results are valuable in comparing the relative importance of landscape parameters and on macroinvertebrate responses.

Sun-PM2-B-4

Gammaherpesvirus (GHV) Strain Identification, Prevalence, and Tissue Presence in Vermont Bobcats

Megan T. McCauley (Saint Michael's College, Colchester, VT; mmccauley@mail.smcvt.edu) and Dagan Loisel (Saint Michael's College, Colchester, VT; dloisel@smcvt.edu)

Abstract - Gammaherpesviruses (GHVs) are host-specific DNA viruses that infect a large range of mammalian species. These viruses preferentially target host lymphocyte cell populations and infection may lead to morbidity or mortality in immunocompromised, co-infected, or non-adapted hosts. Recently, novel GHVs were discovered circulating in North American populations of 2 wild felids, *Lynx rufus* (Bobcat) and *Puma concolor* (Puma). Two strains, LruGHV1 and LruGHV2, were identified in wild Bobcats, and the more common strain (LruGHV1) was also detected in Pumas. In addition, variation in GHV genomic sequence was observed among US populations. The objectives of this study were to identify the most common strain of GHV infecting Vermont Bobcats, to gain more knowledge on the prevalence of this virus, and to compare rates of detection of GHV in liver versus spleen samples. To detect GHV presence, we used 2 rounds of nested polymerase chain reaction (PCR) to amplify a 258-basepair region of the viral *glycoprotein B (gB)* gene. We also used quantitative real time PCR (qRT-PCR) to confirm positive status and determine the number of GHV viral copies (viral load). Our research indicates that the LruGHV1 strain is the only strain in Vermont Bobcats with a broad range and high prevalence. Additionally, we have observed a higher prevalence of the *gB* gene (and therefore, GHVs) in spleen DNA samples than in liver DNA samples. This research is significant because it provides a mammalian model for tracking viral infections in the wild, and allows us to better understand GHVs and their transmission in Vermont Bobcats and other wild species.

Sun-PM2-D-4

Earthworm Assemblages in Northeastern Uplands and Consequences for Leaf-litter Fauna

Timothy S. McCay (Department of Biology, Colgate University, Hamilton, NY; tmccay@colgate.edu) and Peter Scull (Department of Geography, Colgate University, Hamilton, NY, pscull@colgate.edu)

Abstract - Colonization of northern North America by exotic earthworms has been implicated in undesirable changes in nutrient cycling, soil structure, and biodiversity. Factors that may be facilitating expansion of earthworms and the consequences of expansion are poorly known in the Northeast, where invasion by putative European taxa has a longer history and is considered less dynamic, than in the Upper Midwest and other regions. We sampled earthworms and environmental attributes at 85 sites in central New York. We additionally sampled the leaf-litter fauna at 25 of these forested sites. We detected no earthworms at 27 of 71 forested sites (38%). Forested sites without detectable earthworm populations were farther from the nearest road and had soils of lower pH than sites at which we collected earthworms. Proximity of the nearest road was associated with earthworm diversity and abundance, and earthworm biomass was highest in low, moist areas. We found a strong, negative relationship between the biomass of earthworms and abundance of invertebrates in the litter layer. This association was likely mediated by the abundance of organic litter, which was much lower at sites with large numbers of earthworms. Interestingly, sites where we detected only the putative native *Bimastos (Dendrodrilus) rubidus* had a high mass of organic leaf litter and large numbers of leaf-litter animals despite high densities of earthworms. We believe that there is potential for further expansion of putative European earthworm taxa in the Northeast and strong evidence for negative consequences of expansion. Additional regulations on activities that promote expansion are advised.

Sun-AM2-A-4

Floristic Change on Mount Desert Island, Maine and Regional Patterns of Plant Species Loss and Decline

Caitlin McDonough MacKenzie (University of Maine, Orono, Maine; caitlin.mcdonough@mained.edu), Glen Mittelhauser (Maine Natural History Observatory, Gouldsboro, Maine; purplesandpiper@gmail.com), and Abe Miller-Rushing (Acadia National Park and Schoodic Education and Research Center, Bar Harbor, Maine; abe_miller-rushing@nps.gov), Richard Primack (Boston University, Boston, Massachusetts; primack@bu.edu)

Abstract - The wealth of historical botanical data in New England and New York allows ecologists to study changes in plant communities over time across many locations. Studies of floristic change in towns, counties, and preserves in the region over the past 150 years reveal regional patterns of species loss and increasing proportions of non-native species. These changes are often linked to land-use change, development pressures, and climate change. Here, we review patterns of change documented by others at locations throughout the region as well as our own analyses of patterns of floristic change at a northern site: Mount Desert Island, ME, which holds the largest section of Acadia National Park. We find floras across the region have lost on average one-quarter of their native species—ranging from a loss of 3.5% of species from the Finger Lakes Region in New York to a loss of 53.1% of species on Staten Island, NY. No variable that we examined (e.g., size of area, size of flora, protected status, and data sources) explains differences in losses across sites. We also explored a data set of 412 conspecifics found both on Mount Desert Island and 324 km away in Concord, MA, and compared species-by-species changes in abundance over the past century to test whether changes in one location might be predictive of changes in the other. We have found that at a community level, changes in abundance in Concord were predictive of changes on Mount Desert Island—local floras throughout the region have lost roughly 25% of their original species over the last 50 to 150 years—but changes in abundance for particular species in Concord were not predictive of how the same species changed in abundance on Mount Desert Island. Thus, it appears that in New England, analyses of changes in nearby floras may help land managers and scientists understand community-level changes likely taking place, but changes in particular species requires local study. Finally, we highlight the importance of context: understanding the survey effort, expertise, and goals of earlier botanists allows contemporary ecologists to make the most of the available historical ecological data.

Sun-PM2-A-2

Conservation Paleobiology above Treeline in the Northeastern United States: Opportunities to Inform Management with Ancient Pollen

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Abstract - Anthropogenic climate change presents new challenges to protected landscapes, especially for conservation areas that protect isolated natural communities comprising small populations at the southern edge of their ranges. The long temporal perspective from paleoecology can help managers identify vulnerable species and predict community-level responses to changes in climate. Across New England, pollen records from ponds, lakes, hollows, and bogs provide a wealth of data about the paleoecology of low elevations and uplands since the last glacial retreat. From this data, paleoecologists have reconstructed patterns in vegetation change as the climate changed with high spatial and temporal resolution. However, the paleoecology of New England's higher elevations remain understudied. Here, we review the last five decades of palynology research above treeline in the northeastern United States. We also aim to collect in one place the management positions, policies, and challenges for alpine and subalpine vegetation scattered across federal, state, and other conservation land in Maine. Our study identifies opportunities to bring together resource managers from across New England and to expand conservation paleobiology research in Maine across a coastal-to-inland gradient at two iconic conservation lands: Acadia National Park and Baxter State Park. Understanding the history of alpine and subalpine vegetation above treeline is deeply relevant as conservation practitioners work to protect these vulnerable communities in the face of anthropogenic climate change.

Sat-PM2-E-4

Intrinsic Markers Reveal the Annual Cycle of a Migratory Insect, *Anax junius* (Common Green Darner)

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Abstract - Dragonfly migration has been observed on every continent except Antarctica, with some species performing spectacular long-distance mass movements. Like birds, in eastern North America millions of Common Green Darners migrate to the north in the spring and south in the fall. Where are they coming from and where do they go? In this study, we combine citizen science data and stable-hydrogen isotope analysis to understand the origin and destination of migratory *Anax junius* (Common Green Darner) and to determine how its annual cycle is organized. We sampled 852 adult wings and 132 exuviae and teneral adult wings from across North America and analyzed their stable-hydrogen isotope values to track their origins. We focused on assessing migration between sites at the northern and southern range extremes. Assignments to breeding origin that incorporated the temperature dependency of first-flight date revealed new insights about how sites at northern and southern range extremes are linked by migration. Migrant Common Green Darner annual life cycle is organized into 2 non-overlapping generations: a northbound migrant generation that moves north and dies, and a southbound migrant generation made up of individuals that emerge from northern ponds in summer.

Sun-PM2-B-5

Reproductive Ecology of Nickel Hyperaccumulation in Serpentine *Streptanthus* spp. (Brassicaceae)

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Abstract - For plant species that occur in heavy-metal-rich soils, floral metal accumulation may greatly alter several aspects of plant reproduction. Here we evaluate the effects of soil nickel (Ni), a metal common in serpentine soils, on pollinator visitation, pollen germination, and fruit and seed production for 2 closely related species: *Streptanthus polygaloides*, a serpentine endemic and Ni hyperaccumulator, and *S. tortuosus*, a non-endemic, non-Ni-accumulating, serpentine-tolerant species. First, we characterized plant-pollinator interactions in natural populations of our study species. Next, to test whether Ni accumulation altered pollinator visitation, we presented arrays of *S. polygaloides* that were grown in either Ni-treated or control soils to insects within both *S. polygaloides* and *S. tortuosus* natural populations and recorded visitation. Finally, in a factorial experiment, we grew each species in soils that were amended to have high or low concentrations of Ni. We then performed hand pollinations and measured pollen germination, fruit production, and seeds per fruit. Floral visitation rates in natural populations were higher to *S. tortuosus* than *S. polygaloides*. In addition, while floral visitor richness was similar, few pollinator taxa were shared between the 2 plant species. Nickel-treatment of *S. polygaloides* reduced visits by bees, but only for arrays presented at *S. tortuosus* sites. In our greenhouse study, high Ni soil treatment resulted in reduced pollen germination and fruit/seed production for *S. tortuosus*. For *S. polygaloides*, soil Ni effects were detected, but in the opposite direction of *S. tortuosus*: high Ni treatment had a neutral (or slightly positive) effect on *S. polygaloides* pollen germination and fruit/seed production. We show that the Ni hyperaccumulator *S. polygaloides* hosts a distinct floral visitor community, indicating that metal hyperaccumulation creates a filter for pollinators, similar to that documented for herbivores. Our study highlights a novel mechanism by which the abiotic environment can alter plant-pollinator interactions, and consequently plant reproduction and speciation. Furthermore, soil chemistry can greatly influence plant reproduction by altering pollen-pistil interactions, and may determine patterns of plant species abundance and distribution on novel soils by directly affecting pollen germination and subsequent reproductive success.

Sun-AM1-D-4

Surveying Moth Diversity in the Northern Adirondack Mountains of New York: Preliminary Findings

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Abstract - Forests harbor an amazing diversity of moths whose caterpillars are an important food source for vertebrates. This project aims to document macromoth diversity on Paul Smith's College campus and the adjacent visitor interpretive center in the northern Adirondacks. The site has coniferous and deciduous forest and several types of wetland habitat. We used traps to sample moth populations at regular intervals from April to September in 2016 and 2017. We also regularly visited established light sources on campus. Traps were equipped with novel light technology, UV LED strip lighting, increasing their portability. Trap design included traditional bucket traps and inexpensive hanging traps made from recycled materials. The majority of species found were also present on regional checklists used for comparison. Uncommon species included several whose caterpillars specialize on wetland plants and 1 native species not documented in New York since the 1800s. The regional checklist comparison yielded low percent similarity, indicating there are likely more species to be found at the study site. A complete species list would represent baseline data and would be useful if plant community changes occur in the future.

Sat-AM2-B-3

Can Butterflies Stand the Heat? The Consequences of Winter Warming on *Pieris rapae* Butterflies

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Abstract - In the context of climate change, shifts in seasonality and increased frequency of temperature anomalies will expose organisms to unpredictable thermal environments to which they are not adapted. These anomalies are likely to have adverse effects on the physiology of overwintering individuals like diapausing insects from temperate regions. This research investigates the extent that increased winter temperatures lead to ecological and physiological consequences in diapausing *Pieris rapae* butterflies (Cabbage White Butterfly) from Vermont and North Carolina. To test the effect of winter warming on physiological and ecological processes, diapausing pupae were exposed to 1 of 4 ecologically relevant winter warming conditions: control, short-term (acute), short-term (extreme), and long-term warming. My results show that diapausing butterflies exposed to hotter winter temperatures have compromised cold-tolerance levels and can emerge earlier than individuals exposed to control conditions. The results from this research will inform how butterflies respond to climate change as global temperatures continue to rise.

Sat-AM2-B-2

A Case Study of the Relationship of Fish and Invertebrate Communities to Organic Matter along Shorelines

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Abstract - Lakeshore development tends to reduce both physical complexity of near-shore woody structure and accumulations of fine and coarse organic matter, which serve as resources for fishes and invertebrates. A comparison of macroinvertebrate communities in near-shore areas at impacted (developed) and minimally-impacted sites in Lower St. Regis Lake, and in reference conditions in nearby Black Pond in the northern Adirondacks revealed substantial differences in macroinvertebrate communities. In Lower St. Regis Lake, the number of macroinvertebrate families residing on woody structure in minimally impacted sites was twice that found in impacted sites (18 vs 9), and 5 families classified as scrapers were found on woody structure at minimally impacted sites compared to none in impacted sites. In Black Pond (reference), although the number of families found on woody structure was comparable to the impacted sites in Lower St. Regis Lake (7 vs 9), the densities found on woody structure in Black Pond was more than twice that found in Lower St. Regis Lake. In Black Pond, the number of macroinvertebrate families found in organic substrates was 5 times that compared to that found in organic substrates in Lower St. Regis Lake (15 vs 3). A comparison of fish densities in near-shore areas at impacted (developed) and minimally impacted sites in Lower St. Regis Lake, and a comparison of fish diets between near-shore and off-shore areas indicate fish communities use near-shore, woody structure for cover and for food. In Lower St. Regis Lake, mean fish densities (catch rates) were significantly higher in minimally impacted sites compared to impacted sites. Preliminary comparisons of stomach content revealed that small fishes (<100 mm) in near-shore areas had a higher frequency of occurrence of macroinvertebrates and a much lower frequency of occurrence of zooplankton compared to small fishes in adjacent, shallow off-shore areas. These findings demonstrate the impact of shoreline development on freshwater community ecology, but also suggest that community indicators can be used as part of a suite of variables to evaluate shoreline restoration efforts in freshwater lakes of the Northeast.

Sun-PM2-B-1

Northern Long-eared Bat in Working Forest Habitats and Implications for Voluntary Conservation

Jesse Mohr (Native Geographic LLC, Fairlee, VT; nativegeographic@gmail.com)

Abstract - Acoustic bat surveys show *Myotis septentrionalis* (Northern Long-eared Bat [NLEB]) continue to be present in at least some of NH's working forests and may be active across a variety of habitats common to working forests, including wetlands, small surface waters, small canopy openings, and forest trails in addition to hardwood, mixed-wood, and partially harvested forest types. In 2016 and 2017, I conducted acoustic surveys in parts of Grafton and Coos Counties, NH as part of a larger NRCS Conservation Innovation Grant partnering with private working forest landowners near known bat resources. The survey results and the presence/absence of NLEB and other declining bat species are the basis for conservation and management recommendations being developed for each landowner; a portion of these recommendations include voluntary cutting restrictions. Generally, across the study area, bat species activity and diversity were frequently highest around wetlands and surface waters, as a result wetland and stream buffers and other already in-place best management practices to protect water quality are being universally recommended to the partnering landowners. Due to the potential presence of NLEB and/or *Perimyotis subflavus* (Tri-color Bat), seasonal cutting restrictions are likely to be recommended for 50% of the landowners or 65% of the area surveyed. All 8 of NH's bat species were detected in one or more habitats common to working forests. While this study lacks adequate sample size or design for statistical analysis, all 8 species appear to utilize forests for some aspect of their life cycle and appear to benefit from the insect rich foraging and/or drinking water of the many ponds, wetlands, streams, areas of regeneration, and openings common to NH's working forest landscapes. Anecdotally, this study found the most NLEB activity on a property with diverse vertical and horizontal forest structure due to a recent partial harvest. Because timber harvesting helps to offset the cost of forest ownership—helping to limit forest loss and fragmentation—and can help create forest and landscape heterogeneity, continuing forestry operations with appropriate measures to conserve bats and bat habitat is also being universally recommended to the partnering landowners.

Sun-AM1-C-2

Post White-Nose Syndrome Bat Activity During Fall Swarm Around Three New Hampshire Mine Hibernacula

Jesse Mohr (Native Geographic LLC, Fairlee, VT; nativegeographic@gmail.com)

Abstract - Winter bat populations at New Hampshire's known mine hibernacula have significantly declined since white-nose syndrome (WNS) spread to the region. Recent fall acoustic bat surveys near 3 of New Hampshire's known mine hibernacula, show *Myotis septentrionalis* (Northern Long-eared Bat), *Myotis lucifugus* (Little Brown Bat), *Myotis leibii* (Eastern Small-footed Bat), *Eptesicus fuscus* (Big Brown Bat), and *Perimyotis subflavus* (Tri-color Bat) continue to remain active near some mine entrances and in nearby foraging and drinking habitats and travel ways. I also observed during the 2016 and 2017 fall surveys that bats were already visiting mine entrances in late August, Big Brown Bats remained active into mid-November whereas most *Myotis* activity tapered earlier in October, migratory bats also occasionally visited some mine entrances during the swarm, and nearby wetlands, ponds, openings, and forests continued to be used throughout the fall swarm. Sampling near the most active Eastern Small-footed Bat entrance was cut short due to severe weather; this bat is known to be one of the last species to enter winter hibernacula, so *Myotis* activity could easily extend later than observed in this survey. Activity was not evenly distributed across the mines, with 1 mine site supporting substantially more bat activity and greater species diversity. Winter hibernacula surveys have previously demonstrated this uneven distribution; the fall acoustic surveys generally correspond with the winter survey findings. However, fall acoustic surveys may show more activity during the fall swarm period in the near hibernacula environs than may be sometimes suggested by hibernacula surveys alone. For instance, until mid-September, the most *Myotis* activity was recorded at a pond near the mine with the least amount of swarming or hibernating *Myotis*; the pond adjacent to the mine with most amount of swarming and hibernating *Myotis* supported less activity. Acoustic surveys also sometimes identified species at the mine entrance or near hibernacula environment not detected during the winter hibernacula surveys.

Sun-AM2-C-2

Comics and Conservation

Rosemary Mosco (birdandmoon.com; rmosco@gmail.com)

Abstract - Humor gives science wings. No matter your art skill level, you can learn to create cartoons that effectively communicate conservation messages to wide audiences. Come learn the process of developing a cartoon from Rosemary Mosco, creator of BirdAndMoon.com and author of science comic books. You'll follow the process from concept through research to final design, and enjoy some laughs along the way.

Sat-PM1-E-5

Impacts of Environmental Factors on the Presence and Severity of Beech Bark Disease in *Fagus grandifolia*

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Abstract - We monitored ~200 *Fagus grandifolia* (American Beech) over 5 years for the presence and severity of beech bark disease. Trees were examined once a year, during which time we ranked them according to the progression of the disease (1 being absent and 5 being dead from infection). We assessed environmental data as potential predictors and included time and DBH to control for the increased likelihood of disease over time. Factors calculated included aspect, slope, curvature, and location. We used GPS coordinates to calculate the distance to the nearest sick tree from location. We hypothesized that distance would have a positive impact on infection likelihood. A Bayesian model using an ordinal logistic likelihood function was used to determine the relationship between the independent variables and the probability of a tree being diseased. Aspect, curvature, and elevation were all significant factors in determining disease presence and severity. The DBH and year were also strongly positive. The distance to nearest sick tree was not significant, nor was the slope of the land the tree was on. Based on these findings, it can be concluded that certain environmental factors have a significant impact on the presence and severity of beech bark disease in *Fagus grandifolia*.

Sat-PM2-A-2

Seasonal Distribution and Abundance of Fishes and Macroinvertebrates in Pleasant Bay, MA

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Abstract - Pleasant Bay, MA, is a coastal lagoon system featuring diverse habitats that support a variety of commercially, recreationally, and ecologically important marine species. The 2013 Pleasant Bay Resource Management Plan (PBRMP) noted the changes in shellfish and finfish abundance, species composition, and fishing activity within the Bay since a 1965–1966 study conducted by the Massachusetts Division of Marine Fisheries. Based on the recommendations of the PBRMP, we conducted an inventory of shellfish and finfish in the Bay, with a focus on commercially and recreationally important species. We conducted intertidal and subtidal fish and invertebrate sampling in Pleasant Bay from June 2015 through June 2016, a survey for postlarval lobsters in 2014, and opportunistic sampling from July 2015 through October 2017. Where practical, sampling efforts were conducted using similar methods and gears to previous studies in the same area or more recent studies in the wider region. Intertidal and subtidal survey effort (trawl, $n = 90$ tows; dredge, $n = 102$ tows; seine, $n = 15$ hauls) was distributed relatively evenly over the year, although there were gaps due to fall and winter weather conditions. The overall species community and seasonal abundance of most species was broadly similar to that observed in the 1965–1966 MADMF study. This study included more sampling methods and greater spatial coverage than the previous study, and documented greater species diversity. Fish community composition and seasonal patterns of abundance during this study were broadly similar to those observed during other recent studies along the eastern shore of Cape Cod. This comprehensive inventory indicated that Pleasant Bay is home to a diverse assemblage of marine animals, many of which utilize the Bay as spawning or nursery habitat. Differences in species diversity and relative abundance were observed between this study and the 1965–1966 MADMF study, as well as between years during this study. Long-term monitoring is necessary to place our observations in a broader context.

Sat-PM2-D-1

Native Pollinators in Vermont's Working Landscape, Including Highlights from Recent Research

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Abstract - Farms can harbor substantial biodiversity, which in turn sustains the supply of ecosystem services. The effectiveness of farm management to enhance biodiversity, however, may be modified by land cover in the surrounding landscape beyond a farmer's direct control. We examined how landscape pattern and farm management affect the abundance and diversity of native bees visiting highbush blueberry in Vermont, USA. We quantified landscape pattern at multiple scales and created an agricultural intensity index that represents farm management practices such as pesticide use and mowed and grain crop area. We observed native bee visitation to assess the supply of pollination service provided to blueberry growers. Across 15 farms, 84 wild bee species were observed visiting highbush blueberry, almost a third of bee species recorded in Vermont. Visitation rate, abundance and species richness increased with the amount of natural area surrounding farms. Less-intensively managed farms had higher levels of bee visitation, greater abundance, and a more diverse bee community. Bee communities and the pollination services they provide are influenced by interactions between local management and landscape pattern. In particular, intensive farm management appears to compound the negative effects of landscape simplification. To support native pollinators on their farms, growers should consider farming approaches in the context of the broader landscape.

Sun-PM2-C-5

Determination of Age and Growth Patterns in Wood turtles (*Glyptemys insculpta*): A Collection-based Study

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Abstract - Collections allow us to use historic specimens to help understand natural phenomenon and to use more invasive techniques that would be considered unsuitable to use on live organisms. A collection of 306 preserved *Glyptemys insculpta* (Wood Turtle) housed at SUNY Oneonta, offers specimens of a relatively equal distribution of males and females, with different ages and localities represented. We attempted aging by skeletochronology, a standard method for estimating growth for other herptile species, but found the method was not reliable for aging Wood Turtles. Aging by growth rings was more reliable. We tested the hypothesis that Wood Turtle growth rings correlate directly to carapace (top part of the shell) and plastron (bottom part of shell) dimensions. A nonlinear regression showed support for these age estimates; rings correlated positively with increased size of the plastron (max length = 165.32 mm), with trivial variance between curves of the scutes counted (avg. slope = 0.188, variance = 0.00001). A Wilcoxon test comparing equality of growth within an individual's carapace from independent counts of rings, was also supported (P -values for 20 turtles N.S., average = 0.532; W [avg.] = 5.52). Preliminary tests revealed that ring width may be used to track climate or habitat factors that determine periods of increased growth. Factors such as temperature and precipitation can be limiting for growth in other ectotherms, and further tests will uncover how well the pattern of Wood Turtle growth rings can track environmental conditions.

Sun-PM2-A-3

Invasive Plants and Biodiversity in the Anthropocene: Complex Management Challenges from Maine

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Abstract - Patterns of terrestrial invasive plant distribution and abundance may be correlated with patterns of biodiversity. Infestations can impact rare species habitat, creating challenging, but high-priority, management situations. In addition, invasive plants may create novel habitats which are used by rare species in the absence of suitable native plant habitat, creating a potential conflict between managing for the benefit of rare biota and managing with the aim of suppressing invasive plants for the benefit of native biota at the site and landscape scale. Examples from Maine will be discussed to illustrate areas of concern and potential management approaches and challenges. Climate change also threatens to fundamentally alter some rare habitats such as salt marshes, which add to biodiversity but are vulnerable to invasive plant infestation. Is it reasonable to use resources to manage invasive plants in situations where the underlying habitat is likely to be significantly altered by climate impacts within the next human lifetime? How should land managers evaluate the benefits of invasive plant management in such cases?

Sat-PM1-C-3

Impact and Recovery of the 2008 Ice Storm on Mount Monadnock Forests, Jaffrey, NH

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Abstract - Ice storms have and will continue to have a significant role in the disturbance history of New England's forests particularly as climate warming effects frequency and intensity of these storms. The severe ice storm of 1998 left a mosaic of patchy damage across the forests of northern New England and New York. A similar pattern of disturbance was left by the 2008 ice storm on Mount Monadnock in SW New Hampshire. The greatest impact was located on the eastern and northern aspects and slightly greater impact between 610 m (2000 ft) and 701 m (2300 ft) in elevation. Although not a stand-replacing disturbance, damage occurred to 35% of the stems on Mt. Monadnock, generally with less than 25% crown damage occurring to individuals. Pulses of severe damage were noted at 580 m (1900 ft) and 732 m (2400 ft), with 16% of the trees suffering greater than 50% crown loss. To assess the forest's recovery from the 2008 ice storm, in 2017, we resampled 100 research plots inventoried after the storm. Plots are located at 31-m (100-ft) intervals from 549 m (1800 ft) to 823 m (2700 ft) on all aspects of the mountain. We assessed tree diameters and crown damage as well as sapling and seedling densities by species and coarse woody debris. Crown recovery, changes in canopy and understory species composition, and changes in coarse woody debris on the ground will be presented.

Sat-PM2-A-3

Distribution and Abundance Patterns of Common Garter Snakes and Northern Water Snakes in Urban and Rural Landscape Settings in Southeastern Massachusetts

David Parisi (Bridgewater Stapes University, Bridgewater, MA; dparisi@student.bridgew.edu), **Calvin Middleton** (Bridgewater Stapes University, Bridgewater, MA; cmiddleton@student.bridgew.edu), Thilina Surasinghe (Bridgewater State University, Bridgewater, MA; tsurasinghe@bridgew.edu), and Adam Enos (Bridgewater Stapes University, Bridgewater, MA; d1enos@student.bridgew.edu)

Abstract - *Nerodia sipedon* (Northern Water Snake [NWS]) and *Thamnophis sirtalis* (Common Garter Snake [CGS]) are two sympatric semi-aquatic snakes distributed across North America. Their habitat use in urban versus rural landscapes has not been investigated in detail. To explore this comparison, we surveyed 12 habitats in rural (5) and urban (7) landscapes for both NWS and CGS, conducted from April to November (3 visits per each location) in 2 successive years (2016–2017). For captured snakes, we recorded species identity, age class (adults or juveniles), and also measured several environmental variables at all sites, both where we observed snakes and those where snakes were absent. We found no significant effect of either the landscape type or habitat on species composition. The abundance of NWS did not differ significantly between rural and urban landscape contexts but differed significantly among different habitat types; in contrast, CGS abundance differed significantly across landscapes, but showed no such differences between different habitat types. Although the relative abundance of neither species differed significantly in different years or months, overall snake abundance varied significantly across different months, suggesting a clear seasonal variation in their behavior. Microhabitat selection of the 2 focal species appeared to be independent from each other, which remained consistently true across variable landscape and habitat types as well as across time (years and months), suggesting microhabitat segregation between the 2 snakes despite their co-existence in the same habitat. The distribution of the 2 focal species also varied significantly along the land–water gradient, where NWS occurred much closer to water than CGS; this observation implied at least partial niche segregation of these snakes with respect to proximity to water. None of the environmental variables we measured were useful predictors of CGS abundance, although NWS abundance was successfully predicted by distance to water, percent canopy cover, air temperature, and substrate temperature, which suggested that CGS is a habitat generalist while NWS is relatively more selective of certain habitat features. The comparable snake abundance we found in rural and urban landscapes is noteworthy as persisting populations of NWS and CGS may account for functional insurance of species-depauperate urban habitats.

Sat-AM1-D-1

Biogeography and Apomictic Evolution in *Phegopteris* (Thelypteridaceae)

Nikisha Patel (University of Tennessee, Knoxville, TN; Nikisha.r.patel@gmail.com), **Arthur V. Gilman** (University of Vermont, Burlington, VT; avgilman@together.net), and **David Barrington** (University of Vermont, Burlington, VT; dbarrington@uvm.edu)

Abstract - *Phegopteris* is distributed across North America and East Asia. The evolutionary and biogeographic history of the genus is further complicated by the presence of apomictic polyploid lineages, suggesting a reticulate history, which has yet to be investigated using a molecular phylogenetic approach. Here, we utilize phylogenetic analysis of plastid markers as well as single molecule reads generated using vector cloning and next-generation sequencing, in order to parse the evolutionary origin of an undescribed apomictic lineage native to Vermont. We integrate inference from time calibration of a plastid phylogeny in order to elucidate the potential role of the separation of North America and Asia in the origins of the undescribed tetraploid. Multiple nuclear and 1 plastid dataset reveal the same pattern and suggest that the undescribed tetraploid apomict resulted from hybridization between a diploid sexual Japanese lineage and a potentially extinct North American triploid apomict.

Sun-AM1-A-2

The Case for Including Disease-Tolerant American Elms in Floodplain Forest Restoration Throughout the Northeast

Rose Paul (The Nature Conservancy, Montpelier, VT; rpaul@tnc.org) and **Christian Marks** (The Nature Conservancy, Northampton, MA; cmarks@tnc.org)

Abstract - Many forested wetland restoration projects avoid using *Ulmus americana* (American Elm) because it will succumb to pathogens that cause Dutch elm disease. However disease-tolerant cultivars are available commercially and more are being developed. American Elm can be considered a foundation species in floodplain forests due to its importance in energy and nutrient cycling, hydrology, food webs, and biodiversity. Northern floodplain forests are dominated by just 2 tree species, *Acer saccharinum* (Silver Maple) and *Fraxinus pennsylvanica* (Green Ash), or sometimes only Silver Maple in the coldest areas. Restoring long-lived American Elms to northern floodplains is particularly important as *Agrilus planipennis* (Emerald Ash Borer) threatens to spread throughout the Northeast. The Nature Conservancy has planted disease-tolerant American Elm at 17 floodplain forest restoration sites in Vermont and almost 20 other sites in the 4-state Connecticut River watershed. Survivorship of transplanted seedlings has generally been >75% at the Vermont sites. On post-agricultural fields, the greatest stressor is competition with forbs for soil moisture, followed by deer herbivory, mechanical damage during spring ice-out, and competition from ruderal vines.

Sat-PM1-A-4

Water Quality Blueprint for Floodplains and Wetlands in the Lake Champlain Basin of Vermont

Rose Paul (The Nature Conservancy, Montpelier, VT; rpaul@tnc.org) and **Dan Farrell** (The Nature Conservancy, Montpelier, VT; dfarrell@tnc.org)

Abstract - The Water Quality Blueprint is a web-based tool developed by The Nature Conservancy for the Champlain Basin of Vermont. The Blueprint allows conservation practitioners to focus on areas that provide the most benefit to water quality and conservation goals. The geographic analysis area is focused on the most inclusive spatial representation of river corridors as well as wetlands throughout the basin. The Blueprint highlights areas for protection and restoration of wetlands and floodplain forests. The primary audiences for the Blueprint are local watershed organizations, town conservation commissions, government agencies, and land trusts.

Sat-PM2-E-3

Uapishka – Les Monts Groulx, Quebec: A Botanist's Travelogue with Notes on Plant Discoveries in the Northeastern Alpine

Matt Peters (Independent Botanist and Ecologist, Woodbury, VT; peters.matt@yahoo.com)

Abstract - Uapishka or Les Monts Groulx, in north central Quebec, is the largest area of low-latitude alpine terrain in eastern North America, spanning an area nearly the size of Rhode Island. Despite relatively recent enhancements in accessibility (construction of Route 389 and trails to treeline), the area remains poorly known from a botanical perspective, with a previously known vascular flora of about 215 species. An exploratory visit I made in 2017 resulted in documentation of several new rare and disjunct species for the region including *Ranunculus allenii* (Allen's Buttercup), *R. pygmaeus* (Pygmy Buttercup), *Cerastium beeringianum* (Bering Mouse-ear Chickweed), *Packera pauciflora* (Alpine Groundsel), *Carex atratiformis* (Black Sedge), and others. In this presentation, I summarize previous botanical reports to put these discoveries in context, and discuss patterns of alpine and subalpine vegetation with comparison to familiar New England alpine areas. Increasing awareness of the area has resulted in improved conservation status, with designation as a provincial biodiversity reserve permanently off limits to industrial uses and as a UNESCO World Biosphere Reserve, but also has the potential to increase recreational use and impacts in this largely trail-less alpine plateau. Consequently, further inventories should be a high priority for informing research and conservation of the region.

Sat-AM2-E-4

Dragonflies and Damselflies: An Introduction and Field Survey Priorities for the Northeast

Bryan Pfeiffer (University of Vermont, Burlington, VT; bryan.pfeiffer@uvm.edu)

Abstract – Dragonflies and damselflies are among the most successful animals on Earth, with prototypes flying as early as the Devonian and the extant order, Odonata, surviving mass extinctions. Basically, these insects got it right early and haven't changed much since. This presentation, designed for new or advancing entomologists and citizen naturalists, features a practical introduction to dragonflies and damselflies and advice for finding and documenting species of greatest conservation need in the Northeast. This will be in part a celebration of the drama and audacity of this order, with a goal of attracting new observers and investigators to these insects. For established odonatologists, the presentation will help direct our field work to more vulnerable or imperiled species and natural communities.

Sun-PM2-B- 6

Assisted Migration as a Response to Climate Change: Should We be Doing this with Plants and if so How and Under What Constraints?

Robert Popp (Vermont Department of Fish & Wildlife, Natural Heritage Inventory, Barre, VT; bob.popp@vermont.gov), **Bob Zaino** (Department of Fish & Wildlife, VT Agency of Natural Resources) Assisted Migration Committee; robert.zaino@vermont.gov), **Sandy Wilmot** (Department of Forest, Parks, & Recreation, VT Agency of Natural Resources Assisted Migration Committee; sandy.wilmot@vermont.gov), **Lisa Thornton** (Department of Forest, Parks, & Recreation, VT Agency of Natural Resources Assisted Migration Committee; lisa.thornton@vermont.gov), and **Nancy Patch** (Department of Forest, Parks, & Recreation, VT Agency of Natural Resources (Assisted Migration Committee; Nancy.patch@vermont.gov)

Abstract - The possibility of assisted migration to promote the movement of plant species as a response to climate change is highly controversial. Most scientists would agree that the concept needs further study before being implemented. However, there is evidence that assisted migration is already happening; for example, the Torreya Guardians introducing *Torreya taxifolia* (Florida Torreya) to sites throughout the southern Appalachians beyond the species historic range. Although well intentioned, it is questionable whether this effort received rigorous scrutiny before proceeding. Some states and Canadian provinces have developed policies to promote the planting of commercially important species northward or at higher elevation than they naturally occur. In an attempt to avoid reacting to future proposals, the Vermont Agency of Natural Resources (ANR) Assisted Migration Committee was formed to draft guidelines for considering assisted migration for rare species and implementing it for commercially important species. The committee searched numerous sources and found surprisingly little in the way of existing policies. We feel strongly that regardless of the final verdict, the concept of assisted migration needs to be openly discussed and the benefits and liabilities objectively assessed.

Sun-AM2-B-4

Recent Discoveries in the Vermont Alpine: Natural or Introduced?

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Abstract - Vermont's alpine area comprises only a little more than 41 ha (100 acres). Of that ~2.4 ha (6 acres) exist on the summit of Camel's Hump. Unsurprisingly the mountain has been extremely well botanized with numerous records dating back to the 1870s. With the creation of the VT Natural Heritage Program, there was a more recent surge of plant inventory work beginning in the late 1970s. Despite this abundant inventory work, however, populations of previously undocumented, exceedingly rare plants are still being discovered. In 2014 Bob Zaino, State Lands Ecologist, reported 4 patches of *Diapensia lapponica* (Diapensia) on the North Summit of Camel's Hump. Investigating further, we found that it had been observed in 2007 by another biologist who was unaware of its significance as a new population disjunct by ~32 km (20 miles) from its only known station in Vermont on Mt. Mansfield. On that summit, it is scattered in a few localized, small patches on the Chin and West Chin. Nowhere in Vermont does it exist as the locally abundant groundcover as it does in New Hampshire and Maine. This discovery was even further confounded by the subsequent discovery of a number of stems of *Rhododendron lapponicum* (Lapland Rosebay) growing within 2 of the Diapensia mats. Lapland Rosebay had previously been unknown from the Vermont flora. We initially speculated that the plants were certainly introduced because of the unlikely coincidence of 2 previously unknown, very rare plants growing in close proximity to one another in a well-botanized location. However, subsequent evidence has been mixed, and we remain less certain of the provenance of these plants.

Sat-AM2-E-3

Classification and Environmental Drivers of Barrens (Heathland) Plant Communities in Nova Scotia, Canada

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Abstract - Barrens (heathland) ecosystems in Nova Scotia have been historically understudied, and limited work has been undertaken to characterize and describe their ecology. Consequentially, substantial knowledge gaps have hindered local conservation planning, and Nova Scotia is frequently absent from regional maps of comparable habitat in Eastern North America. Nova Scotia's barrens are culturally iconic and ecologically important because of their distinct vegetation and environmental drivers. Over the past 10 years, we have undertaken a standardized classification project to define and describe these ecosystems and provide a baseline for future research. We sampled 338 releve plots from 173 barren sites across their geographical range in Nova Scotia. Data collected from each plot included: vascular plant, bryophyte and lichen species abundances, plant community structure, humus form and depth, mineral soil structure and chemistry, and 19 environmental variables mainly describing topographic factors. We used multivariate ordination and clustering statistics to determine key environmental drivers and to produce a classification of barrens plant communities in Nova Scotia. Our study inventoried 595 species of vascular plants, bryophytes and lichens. Nova Scotia's heathland plant communities are dominated by *Empetrum nigrum* (Black Crowberry), *Empetrum eamesii* (Pink Crowberry), *Corema conradii* (Broom Crowberry), *Arctostaphylos uva-ursi* (Bearberry), *Juniperus communis* (Common Juniper), *Gaylussacia baccata* (Black Huckleberry), *Gaylussacia bigeloviana* (Dwarf Huckleberry), *Rhododendron canadense* (Rhodora), *Ilex mucronata* (Mountain Holly), *Kalmia angustifolia* (Sheep Laurel), *Vaccinium angustifolium* (Late Lowbush Blueberry), *Vaccinium uliginosum* (Alpine Bilberry), lichens of the genus *Cladonia*, and stunted *Picea mariana* (Black Spruce). Species associated with the Atlantic Coastal Plain were limited to the interior of southwestern Nova Scotia, and more generally in sheltered areas along the coast, while species with arctic and alpine affinities were mostly restricted to exposed coastal areas and the Cape Breton Highlands. Although Nova Scotia's barrens plant communities differ geographically, the most important environmental gradients include wind exposure, moisture regime, elevation, distance from the coast, and edaphic factors. Of broad regional interest, relatively low-elevation summits in the Cape Breton highlands were found to support alpine species and communities. Elsewhere in the province, we describe a dwarf heath plant community dominated by the northeastern endemic species *Corema conradii*.

Sun-PM2-C-1

Serpentine Geocology of Eastern North America: Current Knowledge and Information Gaps

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Abstract - Serpentine outcrops are model habitats for geocological studies. While much attention has been paid to serpentine outcrops worldwide, the literature on eastern North American serpentine and associated biota is scant. Most serpentine outcrops in the region have been mapped, but there have been few intensive mineralogical and pedological investigations. Botanical and lichenological surveys are also incomplete, with much of the work focused on a few outcrops in Maryland, Delaware, Maine, Massachusetts, Québec, Newfoundland, Pennsylvania, Vermont, and North Carolina. Detailed ecophysiological and evolutionary studies on species found on eastern North American serpentine outcrops are limited, although several species provide opportunities for the study of the adaptive significance of metal accumulation as well as investigating ecotypic differentiation and species divergence under the serpentine influence. Plant-microbe and plant-other biota interactions also deserve more attention. The role of land managements practices, especially the suppression of fire and grazing, have played a role in the invasion of non-native species to serpentine outcrops in the mid-Atlantic, leading to the conversion of serpentine grasslands into more mesic forests. Additional work needs to be conducted to examine the role of climate change, particularly atmospheric nitrogen deposition and acidification, on serpentine-associated plant and microbial communities in the region. The presentation will summarize current knowledge on serpentine geocology of the region and highlight areas for future research, including the importance of extending geocological investigations to other “harsh” edaphic settings, such as carbonates, guano-enriched bird-nesting sites, and mine tailings found across the region.

Sun-AM1-D-1

Histological Comparison of Parasite Infections among *Elliptio complanata* (Unionidae) Possessing Normal and Deformed Shells from the Nashua River, MA

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Abstract - Approximately 298 species of freshwater mussels (Margaritiferidae: 5, Unionidae: 293) can be found throughout the United States and Canada. Freshwater mussels are unique because they are parasites of fish during their larval period but later transform into benthic suspension feeders. Although North America is a biodiversity focus for mussels, many populations are declining due to habitat loss, contaminants, and potentially infectious diseases. Because mussels provide many ecosystem services, their health is of special interest. However, there is scant information about diseases of mussels. Strayer reported a shell deformity occurring among 5 unionid species in rivers of the Southern Tier and Hudson River Valley regions of New York. Affected mussels displayed a truncated posterior margin of the shell. However, it remains unclear whether shell deformities result from either agricultural or household chemicals, and or an etiological agent. Presently, we are investigating a similar deformity affecting *Elliptio complanata* (Eastern Elliptio; Unionidae), *Lampsilis radiata* (Eastern Lampmussel; Unionidae), *Strophitus undulatus* (Squawfoot; Unionidae), and *Margaritifera margaritifera* (Eastern Pearlshell; Margaritiferidae) in the Nashua River, MA. Mussels were collected during the summer of 2017, fixed in 10% neutral buffered formalin, and mailed to SUNY Oswego. The degree of this deformity ranges from mild to severe. Prevalence of deformed shells (data sourced from whole mussels and empty shells) are as follows: *E. complanata*, 49%, $n = 71$; *L. radiata*, 33%, $n = 3$; *S. undulatus*, 100%, $n = 1$; *M. margaritifera*, 57%, $n = 7$. We are histologically comparing mantle and visceral mass tissues of normal and deformed *E. complanata* to determine whether there are differences in parasitic infections or whether certain lesions are present in normal and deformed individuals. Given the conchological differences, we anticipate certain parasites may be more common in deformed versus normal individuals and there may also be certain histological differences between deformed versus normal individuals. Although the cause of this deformity is presently indeterminate, the purpose of this study is to shed light on the cause and to further our knowledge of what is contributing to the decline of freshwater mussel populations.

Sat-PM1-D-4

Decline and Conservation of the Rusty-Patched Bumble Bee (*Bombus affinis*)

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Abstract - The Rusty-patched Bumble Bee (*Bombus affinis*; 'RPBB') was once among the most commonly observed bee species across the eastern US and adjacent Canada. RPBB populations abruptly declined by more than 90% in the late 1990s, resulting in listing as endangered by the US Fish and Wildlife Service in 2017. Evidence suggests the RPBB decline was driven by anthropogenic threats (e.g., bee pathogen spread, pesticide exposure, and habitat loss), yet ironically, remaining RPBB populations are largely confined to urban and heavily agricultural habitats in Midwestern states. Drawing on historical data and recent inventories, I present the evidence for decline of this bee, discuss the causes and consequences of its rarity, and make predictions about where it may still persist in northeastern North America.

Sun-PM2-C- 6

Mercury in the Mountains: Bioaccumulation and Temporal Trends in Songbirds

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Abstract - Methylmercury, the bioavailable form of mercury, is a neurotoxin with well-documented, adverse impacts on natural systems and wildlife populations. Most investigations of methylmercury bioavailability have focused on freshwater aquatic ecosystems; however, recent research has revealed widespread uptake and bioaccumulation in terrestrial biota, including breeding birds of montane forests in the northeastern US. *Catharus bicknelli* (Bicknell's Thrush), a rare habitat specialist of these conifer-dominated forests, has been a focal species for mercury investigations in breeding songbirds. We report on temporal patterns and demographic correlates of Hg blood concentrations in this long-distance migrant on Mt. Mansfield, VT, over a 17-year period. We also compare findings from 2014–2017 between this and a closely related species, *Catharus ustulatus* (Swainson's Thrush), which data indicate to be steadily moving upslope, possibly in response to changing climatic conditions.

Sat-AM2-D-1

Rocky Summit Grassland Natural Communities in New York State Parks

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Abstract - Grasslands have been noted on rocky summits in the Hudson Highlands of New York since early European explorations of the area. These natural communities are characterized by native graminoids including *Schizachryium scoparium* (Little Bluestem), *Avenella flexuosa* (Common Hair Grass), *Sorghastrum nutans* (Indian Grass), and *Carex pensylvanica* (Penn's Sedge), and may have diverse graminoid and forb floras. Some also are habitat for rare plant taxa including *Pycnanthemum clinopodioides* (Basil Mountain-Mint), *P. torreyi* (Torrey's Mountain-Mint), *Carex bicknellii* (Bicknell's Sedge), and others. We evaluated the status of all previously mapped rocky summit grasslands in NY State Parks, and conducted field surveys of new sites seeking additional examples. We found that the quality and extent of these grasslands has been decreasing in New York, with exotic invasive plants and fire suppression presenting two of the most pressing threats. *Aralia elata* (Japanese Angelica Tree) and *Cynanchum louiseae* (Black Swallow-Wort) were found to be particularly aggressive invasive threats to the grasslands. Nevertheless, diverse and relatively healthy examples of these prairie-like ecosystems persist, even amid a highly developed landscape. We consider whether Rocky Summit Grasslands might best be divided into 2 new community types: a depauperate, acidic variant, and a more diverse, circumneutral or basic variant. We discuss conservation and management challenges to the persistence of these ecosystems.

Sat-AM2-D-3

Allocation of Nonstructural Carbon in Spruce (*Picea*) in Response to Lengthening Growing Seasons

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Abstract - Longer growing seasons should in principle correlate with increased forest carbon sequestration, when soil moisture is sufficient to allow growth. However, recent evidence from northern hemisphere conifers indicates that wood volume (radial growth) is not keeping pace, even when soils are not drying. We hypothesize that seasonal shifts in nonstructural carbon (NSC) allocation shunt photosynthate away from wood formation, to feed other demands during periods of lower insolation. We are testing this in 2 stands of *Picea* (spruce) in east-central New York. We utilized 2-point high-resolution dendrometers on 7 trees to monitor radial growth over 3 years. We also measured soil moisture, PAR, temperature, root growth (min-rhizotrons), sap flow rates, and reflectance indices. NDVI and related spectral imagery were derived from satellite data (LANDSAT), deployment of a UAV, and application of a ground-based IR camera (PHENOCAM network). Over 3 seasons, radial growth has been temporally coordinated between trees and stands, beginning by mid-April, and ending in mid- to late September. Early radial growth followed bud break, separated by a few days, but preceding fine root elongation. Bud break coincided with the maximum spring change (inflection point) in green reflectance, which may serve as a useful phenological marker for shifts in NSC allocation. Stem height extension concluded in June, but cessation of root growth was not evident until early December, when both air and soil temperature minima had fallen below freezing. Although these observations are generally consistent with our hypothesis, more direct measurements of carbon sequestration and flux are desirable. A new instrument is being designed to estimate phloem sugar concentrations at key seasonal intervals. It consists of enzyme-coated probes and open-source potentiometers calibrated to report concentrations of glucose and sucrose. Although the instrument has advanced to a field-ready stage, at this time it requires sap extraction by the user. Following field tests and refinements, an advanced instrument is planned for direct insertion into tree phloem, modeled in part after phloem-feeding aphids.

Sat-PM2-A-1

Bowser Road: New Signs of Early Human Arrival in Southern New York

Guy Robinson (Fordham University, New York, NY; grobinson@fordham.edu) and **Abdel R. Mohamed** (Fordham University, New York, NY; amohamed4@fordham.edu)

Abstract - Fossil pollen is well stratified in the sediments of the Bowser Road Mastodon site. A shrub-tundra landscape of the late glacial gives way to rapid warming then a cooling interval corresponding to the Younger Dryas. Finally, the *Picea* (spruce) woodland transitions to a *Quercus* (oak)-dominated plant community associated with the warmer conditions of today. Spores of the dung fungus *Sporormiella* occur in low numbers throughout the late glacial interval, indicating that notwithstanding the mastodon bones at Bowser Road, large animals appear to have visited the site infrequently. High background levels of microscopic charcoal particles indicate that wildfire was frequent here and at the Otisville Mastodon site 6 km due west. Most notable however is the intermittent appearance of charcoal derived from grass fires during the shrub-tundra interval of the late glacial. These events occur at different times during this interval at Otisville, Binnewater Pond, and now Bowser Road, but are absent from other sites entirely. Rather than tracking climate patterns in any clear way, we cautiously propose that these intermittent bursts of grass-derived charcoal are forming a mosaic pattern over the Wallkill-Hudson Valley landscape and suggest human activity at least 12,700 radiocarbon years before present.

Sat-PM2-C-2

Mapping an Invasion: Student Engagement in an Urban Natural Resources Inventory

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Abstract - A Natural Resources Inventory (NRI) is an important conservation tool used by municipalities to guide planning and development. NRI's are made up of a series of maps that depict the locations of naturally occurring assets such as: water resources, habitats, soils, land use and cultural resources. In 2016, the Environmental Cooperative at the Vassar Barns received funding from the New York State Environmental Protection Fund, NYSDEC Hudson River Estuary Program to complete a NRI for the City of Poughkeepsie, NY. As an initiative of Vassar College, the Environmental Cooperative's mission is to engage students in community conservation. Using the College's GIS resources, the expertise of faculty, and class projects, students have completed drafts of specific chapters of the NRI. The NRI has facilitated student learning about GIS analysis, cartography, and urban planning and conservation. Poughkeepsie has benefited from the completion of this important work that will guide the community as it moves forward in its' planning and revitalization. For example, as part of the NRI, students were employed during the summer of 2017 to map the invasion of *Agrilus planipennis* (Emerald Ash Borer, [EAB]) on city street trees. Working with data from a 2006 street tree inventory, *Fraxinus* sp. (ash) were plotted in ArcGIS using address geocoding. Tree locations were then field verified and corrected if necessary using the ArcGIS Collector app. Individual trees were assessed for signs and symptoms of EAB. Trees were categorized and mapped based on the level of infestation. Of 387 street ash trees, 35 (9%) demonstrated definitive signs of EAB infestation, while 240 (62%) appeared symptomatic for infestation. A published version of the final interactive map has been made available to Poughkeepsie officials. In collaboration with the city's Shade Tree Commission, management recommendations and education materials have been compiled for use by municipal officials. These results and materials will be used to prioritize replanting efforts and educate citizens about EAB.

Sun-AM2-E-2

Advancing Conservation at the Local-level: Engaging Higher Education

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Abstract - Given the prevalence of home-rule in the Northeast, environmental conservation at the local level is an important means of protecting natural resources. However, conservation efforts by municipalities are typically limited by factors such as a lack of funding, staff, and/or technical expertise. This resource gap can be addressed by engaging higher education. The Northeast has a large and diverse assemblage of colleges and universities, with the majority requiring students to conduct independent projects as part of their curriculum. It is common for the majority of these students to choose traditional academic research projects to fulfill their requirements. If students were encouraged to support conservation efforts in local municipalities, they would fulfill a critical need in conservation. Surveys of local municipalities indicated that the following types of projects are of highest importance: natural resource inventories, wetland mapping, habitat assessments, and rare species surveys. The skills needed by students to conduct this work include plant, animal, and habitat identification, GIS, GPS, and ecological surveys. Developing curricula to provide students with these skills will not only advance local conservation but also provide students with the experience they need to advance their careers.

Sun-AM2-E-1

Phenological Changes after 150 years around Buzzards Bay, MA

Jan Salick (Missouri Botanical Garden, St. Louis, MO; jan.salick@mobot.org)

Abstract - Several studies have recorded phenological changes in New England. However, there is one study from 1860–1911 by Eliphalet Williams Hervey that is outstanding in its primogeniture, duration, and thoroughness. In “Procession of the Flowers”, Hervey monitored 1281 species around Buzzards Bay, whereas, over the last 4 years with 2609 observations, we have been able to monitor only 691 species; I can make no assumptions of species disappearance, only of the comparatively short duration of our study and of drastic habitat reduction. Among our results to date, we find that species are flowering both earlier and later in the year, with additional bizarre out-of-season flowering such as New Year's Day 2017. Earlier flowering takes place in species that flower before summer solstice, while later flowering takes place in species flowering after the solstice. Although years differ somewhat, the trends remain significant. Duration of flowering is increasing significantly, with undetermined effects on pollination ecology or plant physiology. Both data sets show ephemerals throughout the year (i.e., not just in spring), as well as continually flowering species. Phenological differences between native and introduced species are not found in Hervey's data; however, the contemporary data show earlier flowering of introduced species. This finding is consistent with the theory that climate change is providing an empty flowering niche early in the year into which introduced species fit. Ethnobotanically, my Narragansett colleagues say that these results are notable in that yields of gathered species are decreasing (e.g., blueberries), in that indicator species are disassociated from natural resources (e.g., shadbush and shad), and in that traditional knowledge and culture become irrelevant.

Sun-AM1-E-2

Landscapes Used by New England Cottontails (*Sylvilagus transitionalis*) at the Edge of their Range

Matthew D. Schlesinger (NY Natural Heritage Program of SUNY ESF, Albany, NY; mdschles@esf.edu) and Paul G. Novak (New York State Department of Environmental Conservation, Schenectady, NY; paul.novak@dec.ny.gov)

Abstract - *Sylvilagus transitionalis* (New England Cottontail [NEC]) has become the poster child for young forest management in the Northeast; its decline is thought to be tied to the Northeast's aging forests and potentially to competition with *S. floridanus* (Eastern Cottontail [EC]). Recent research has shown that occupied sites can have substantial canopy cover, but little other landscape analysis is available in the literature. We investigated landscapes occupied by NEC and EC in eastern New York, which lies at both the western and southern edges of the species' range, and where the EC now dominates. We used locations of 3742 rabbit pellets collected from 2009 to 2017 and identified the samples to species using DNA analysis (NEC: 1060, EC: 2682). We divided our analysis among 5 "focus areas" among which habitat conditions varied widely. Because our dataset came from both systematic surveys and opportunistic pellet collection, we grouped and subsetted the data in several ways to test the robustness of our findings. We discovered that, as reported elsewhere, NEC was found in landscapes with less agricultural and more forest than EC, but the degree of difference depended on the focus area. Where the 2 species co-occurred, partitioning of the habitat was apparent in some areas but was not consistent across the range. The 2 species were found at similar distances from woody, scrub/shrub, and emergent wetlands. Our results have management implications for this declining species in New York and other states where NEC and EC co-occur.

Sat-AM1-B-2

Can Invasive Fruits be Nutritional Traps?

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Abstract - The fruits of native shrubs can be an important food resource for wildlife in forest and shrubland habitats. Migratory songbirds, in particular, rely heavily on fall fruits for nutrition during stopover periods in their energetically demanding annual migrations. The recent invasion of many fruit-bearing, non-native plants may pose a threat to birds and other wildlife if the quality of the food and resources they provide is suboptimal compared to the native plants they displace. We examined the nutritional and biochemical composition of some invasive fruits in NY State and compared them to native fruits that are available to migrating and breeding birds. We found important differences in macronutrients and energy density among fruits, with native fruits generally being the highest in fat and calories. Analysis of other biochemical compounds of nutritional relevance, including total phenol content and antioxidant capacity, provides further insight into the overall quality of these fruits during migration and other times of oxidative stress for birds.

Sat-AM2-C-2

Vermont Conservation Design: A Vision and Plan for an Ecologically Functional Landscape

Eric Sorenson (Vermont Fish and Wildlife Department, Barre, Vermont; eric.sorenson@vermont.gov)

Abstract - Vermont's 2015 Wildlife Action Plan identifies landscape-scale conservation as critical for maintaining populations of Species of Greatest Conservation Need (SGCN). The Vermont Conservation Design is a practical and efficient approach to conserving many SGCN, keeping common species common, and maintaining a landscape that is resilient to climate change. This presentation will describe all the elements of this conservation design and show the resulting maps. We will also discuss approaches for implementing landscape-scale conservation and how we view Vermont Conservation Design as a vision that could provide for our ecological future.

Sat-PM2-E-1

Influence of Edaphic Factors on the Distribution and Interaction of Maidenhair Ferns in the Green Mountains of Vermont

Morgan Southgate (Plant Biology Department, University of Vermont, Burlington, VT; msouthga@uvm.edu) and David Barrington (Plant Biology Department, University of Vermont, Burlington, VT; dbarring@uvm.edu)

Abstract - How does substrate preference influence the distribution and interaction of closely related plant species? This question is relevant to the *Adiantum pedatum* complex, a clade of maidenhair ferns that exhibit a complex distribution pattern in northeastern North America that is directly tied to the geological chemistry of the region. Whereas *Adiantum pedatum* (Northern Maidenhair Fern) is widely distributed in calcium-rich woodlands, *A. aleuticum* (Aleutian Maidenhair Fern) and *A. viridimontanum* (Green Mountain Maidenhair Fern) are both restricted to serpentine-influenced substrates in northern Vermont and southern Quebec. Green Mountain Maidenhair Fern, though a serpentine endemic, is an allotetraploid hybrid lineage derived from a sterile hybrid between Aleutian Maidenhair Fern and Northern Maidenhair Fern, both of which are diploid. To characterize ecological niche differentiation within the clade, we established 52 survey plots of the 3 species in 13 sites across Vermont. For each survey plot, we marked the location by GPS, and collected ecological data including the natural community type, topography, and substrate characteristics. Soil samples from all survey plots were submitted to the UVM Agricultural and Experimental Testing Laboratory for analysis of chemical composition. Multivariate analysis of the ecological survey plot data indicates that edaphic factors, especially the levels of calcium and magnesium in the soil, explain much of the ecological niche differentiation between the 3 species. Additionally, we observed locally enriched northern hardwood forests contiguous with serpentine habitats in northern Vermont, providing documentation of range overlap between the rich-woods and serpentine species on a fine-scale. These results provide evidence that the substrate preferences of the *Adiantum pedatum* complex have a primary influence on their distribution, and have enabled the formation of the allotetraploid hybrid lineage by facilitating secondary contact between the 2 diploid progenitors.

Sat-AM1-A-2

Ecological Intermediacy of the Allotetraploid Hybrid *Adiantum viridimontanum* Relative to its Progenitors in the Green Mountains of Vermont

Morgan Southgate (Plant Biology Department, University of Vermont, Burlington, VT; msouthga@uvm.edu), David Barrington (Plant Biology Department, University of Vermont, Burlington, VT; dbarring@uvm.edu), and Nikisha R. Patel (University of Tennessee, Knoxville, TN; Nikisha.Patel@uvm.edu)

Abstract - What are the ecological opportunities of allopolyploidy in the ferns? In northeastern North America, this question is relevant to the *Adiantum pedatum* complex, a clade of Maidenhair Ferns. *Adiantum viridimontanum* (Green Mountain Maidenhair Fern) is an allotetraploid hybrid derived from a sterile cross between the 2 diploid species *Adiantum aleuticum* (Aleutian Maidenhair Fern) and *Adiantum pedatum* (Northern Maidenhair Fern). There is a remarkable ecological disparity observed within the clade; whereas Northern Maidenhair Fern is widely distributed in calcium-rich woodlands, Aleutian Maidenhair Fern and Green Mountain Maidenhair Fern are both restricted to serpentine-influenced substrates in northern Vermont and southern Quebec. The purpose of the present research was to test the hypothesis that the ecological niches of the serpentine Maidenhair Ferns *Adiantum aleuticum* and *A. viridimontanum* are differentiated from one another due to the inclusion of 2 genomes adapted to both serpentine and rich-woods habitats in the genetic complement of the allotetraploid hybrid. Across 13 sites in VT, we established 52 survey plots of the 3 Maidenhair Fern species, and in each plot collected data regarding the natural community type, associated species, light availability, topography, and substrate characteristics. Soil samples collected from each survey plot were submitted to the UVM Agricultural and Experimental Testing Laboratory for analysis of chemical composition. Multivariate statistical analysis of the compiled ecological data indicates that the ecological niche of the allotetraploid hybrid is intermediate between those of its progenitors, but overlaps more closely with that of Aleutian Maidenhair Fern. These results therefore provide evidence that the ecological niches of the 2 serpentine Maidenhair Ferns are differentiated from one another through the mechanism of hybrid intermediacy.

Sun-AM2-D-4

“Call me Another Thrower”: Protecting Native Biodiversity and the Reality of Managing for Non-native Invasive Plants

Elizabeth E. Spinney (Vermont Department of Forests, Parks & Recreation, Essex Junction, VT; elizabeth.spinney@Vermont.gov)

Abstract - In Vermont, non-native invasive plants are directly impacting the survival of rare, threatened, and endangered native plants. Maintaining the native biodiversity of these affected sites requires consistent monitoring and management. This presentation will discuss several case studies and the consequences of the never-ending nature of managing established non-native invasive plant populations.

Sat-PM1-C-1

Monitoring Cadmium and Copper in *Mytilus edulis* During Dredging Operations in Gloucester Harbor

Matthew Staffier (Endicott College, Beverly, MA; mstaffie@endicott.edu) and **Mari Butler** (Endicott College, Beverly, MA; mbutler@endicott.edu)

Abstract - Gloucester Harbor, a highly industrialized harbor, is known to contain sediment contaminated with a number of toxins including PCB's, copper, cadmium, and others. National Grid recently oversaw a remediation project where contaminated sediment was removed from waters adjacent to the former *Gloucester* Manufactured Gas Plant site. The purpose of this study was to determine how dredging affected the levels of bioavailable copper and cadmium at the dredging site using the indicator organism *Mytilus edulis* (Blue Mussel). Farm-raised Blue Mussels were transplanted in cages to the site before, during, and after the dredging operation. We processed mussel soft tissue using trace metal clean techniques and analyzed the samples for copper and cadmium concentrations using inductively coupled plasma optical emission spectroscopy. Results of a BACI (before after control impact) showed significant increases in levels of cadmium (ANOVA: $df = 76$, $P = 1.3 \times 10^{-9}$) and copper (ANOVA: $df = 76$, $P = 0.0001$). This result agrees with predictions that the dredging would mobilize the contaminants and increase their bioaccumulation in the harbors flora and fauna. Now that the dredging project is completed, we will continue to analyze mussel transplants until levels return to pre-dredging or lower conditions.

Sat-PM2-D-3

Rodent–Mycorrhizal Dispersal Networks and the Underappreciated Role of Generalists

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Abstract - In many forest systems, animals are the primary dispersers of plant seeds and symbiotic fungal spores. Specialist species that consume fruits or fungal fruiting bodies as their primary food source are thought to play a disproportionate role in dispersal networks compared to generalist species. However, dispersal networks are often considered static entities, overlooking the influence of abundance fluctuations and habitat affinities. To determine the relative importance of generalist and specialist rodent species in the dispersal of mycorrhizal fungi, we monitored the interactions of 5 rodent species and 33 mycorrhizal taxa over a 3 year period across 3 forest types at Bartlett Experimental Forest, NH. *Myodes gapperi* (Southern Red-backed Vole), a well-known fungal specialist, consumed more fungi, interacted more often with fungal taxa, and carried higher spore loads compared to generalist rodent species. Network analyses revealed that per individual, Southern Red-backed Vole was the most important disperser of mycorrhizal fungi. Nevertheless, during years when generalist species such as *Tamias striatus* (Eastern Chipmunk) and *Peromyscus maniculatus* (Deer Mouse) reached high abundance, their relative importance in networks was equal to or greater than that of Southern Red-backed Vole, particularly in forest types where Southern Red-backed Vole was less common. Population increases of generalists were coincident with the germination of tree seeds following masting, a time when inoculation by mycorrhizal fungi is critical. Overall, our findings suggest that although specialists play key roles in rodent-mycorrhizal dispersal networks, generalists play a heretofore underappreciated role.

Sat-AM1-B-1

Natal Dispersal: A Tool for Grassland Bird Conservation

Allan Strong (University of Vermont, Burlington, VT; astrong@uvm.edu) and Noah Perlut (University of New England-Biddeford, Biddeford, ME; nperlut@une.edu)

Abstract - In the Northeast, nearly 100% of grassland habitat is privately owned, and the vast majority is devoted to agriculture. In much of the region, increased intensity of grassland management has been negatively associated with grassland bird reproductive success and adult annual apparent survival, contributing to population declines. The success of future conservation depends on development of new strategies, including connecting the interests of landowners and managers directly with birds. In Vermont's Champlain Valley, *Dolichonyx oryzivorus* (Bobolink) and *Passerculus sandwichensis* (Savannah Sparrow) regularly return to breed on or near their natal field, regardless of management intensity. This philopatry enables us to follow individuals for multiple generations, providing rich life-history accounts. We searched for natal dispersers in a 10-km radius around 5 study fields (88 fields, 1110 ha). We used a community-based approach in collecting the data—integrating volunteers from Green Mountain Audubon and undergraduate students. Nearly all (98%) birds observed settled <3000 m from their natal site (Bobolink: mean = 1341 m, minmax = 0-8424, $n = 173$; Savannah Sparrow: mean = 1263 m, minmax = 0-33,883 m, $n = 118$). We shared accounts of Bobolinks and Savannah Sparrow lineages spanning up to 6 generations with local landowners and managers. The lineage data provide engaging stories to begin discussions about farming practices that balance production and grassland bird needs. Dispersal-distance data helped frame the extent of management impacts; in this case, the decisions of a given landowner can affect the bird community within 3 km of their property.

Sun-PM2-E-3

Evolution and Natural History of Green Spores in Ferns

Michael Sundue (Pringle Herbarium, Dept. of Plant Biology, University of Vermont, sundue@gmail.com)

Abstract - Green spores are a distinctive and attractive aspect of fern biology. Their color is imparted by chloroplasts that develop before water is imbibed and germination occurs. Green spores are known to impart or at least be associated with certain intrinsic biological traits. Compared with non-green spores, the viability of green spores is shorter and germination is more rapid. By comparison, non-green spores lack chloroplasts and the lipid compositions associated with photosynthesis before germination. Besides these intrinsic traits, green-spored taxa may be associated with phenological, biogeographic, macroevolutionary and ecological differences. In the northeastern United States, green spores are usually released early in the spring, often before 1 June, whereas most nongreen spores are released after 1 June. Compared with species with non-green spores, species with green spores are overrepresented on oceanic islands, which suggests their greater success in colonizing new habitats. Similarly, among those species or species pairs showing a floristic relationship between the Neotropics and Africa–Madagascar, green-spored species were overrepresented (21%) compared with in Mesoamerica (7%). In term of macroevolutionary rates, green spores were found to have a higher net diversification rate when compared to non-green spores in the family Polypodiaceae. Ecologically, green-spored species are more likely to grow in certain habitats. In the temperate eastern United States, swamps, seeps, and floodplain forests typically have more green-spored species (such as *Matteuccia struthiopteris*, *Onoclea sensibilis*, *Osmunda regalis*, and *Equisetum* spp.) compared with upland forests. In the tropics, green-spored species are found in these same habitats but are most prevalent as epiphytes of humid forests. Some of the above traits may have fostered the evolution of green spores, which have arisen repeatedly in ferns. Detecting green spores, however, cannot always be done by color alone, since pigments in the spore may obscure the chloroplasts inside. I show that by using epifluorescence microscopy, chlorophyll can be detected in spores of species previously not known to have this trait. Detection of additional green-spored species will aid efforts to understand the evolution and natural history of these plants.

Sun-AM1-A-3

Movements and Relatedness of Shrubland-Dependent Songbirds Using Anthropogenic Shrublands in Southern ME and NH

Matthew D. Tarr (University of New Hampshire Cooperative Extension, Durham, NH; matt.tarr@unh.edu), Randy Shoe (University of New Hampshire, Durham, NH; shoebo@comcast.net), Adrienne Kovach (University of New Hampshire, Durham, NH; adrienne.kovach@unh.edu), Stephanie Copeland (University of New Hampshire, Durham, NH; sjc2003@wildcats.unh.edu), and Erica Holm (University of New Hampshire, Durham, NH; erica.holm@outlook.com)

Abstract - In the northeastern United States, populations of many species of shrubland-dependent songbirds have been declining for over 60 years due to habitat loss. In most landscapes today, these birds rely on anthropogenic shrublands including transmission line rights-of-way, regenerating clearcuts, gravel pits, and shrubby old-fields as their primary habitat. Efforts to conserve shrubland birds typically are focused on maintaining existing shrubland habitats and on creating new shrublands, requiring that managers make multiple decisions regarding where on the landscape new shrublands are created and how vegetation within shrublands is managed to provide the greatest benefit to birds. This presentation will provide a summary of recent and current shrubland bird research conducted in anthropogenic shrublands in southern Maine and New Hampshire; since 2014, we have attempted to determine how birds respond to vegetation conditions within shrublands and the extent to which birds use and disperse among multiple shrublands within a 80-km landscape. We used occupancy modeling to predict how shrubland area, shrubland vegetation composition, and the dominant landcover within 50 m–10 km surrounding 101 shrublands affected occupancy of 8 focal shrubland bird species. For most species, landscape composition within 500 m of a shrubland was as good or better a predictor of shrubland bird occupancy than shrubland size or vegetation conditions within shrublands. For most species, occupancy was correlated negatively to increasing proportions of urban development and field/pasture within 500 m and positively with increasing proportions of shrubland within 500 m and shrub density within shrublands. Movement data collected from >750 color-banded adult male *Setophaga discolor* (Prairie Warbler) indicate that many individuals establish territories in more than one shrubland among breeding seasons and that within-season movements ≤ 500 m among nearby shrublands are common, but that some individuals use shrublands >30 km apart within the same breeding season. We have recently genotyped 390 male Prairie Warblers from 42 shrublands across our study area and are analyzing population structure, population level gene flow, and fine-scale relatedness of individuals within this landscape; these efforts will inform a possible collaboration of researchers throughout the Northeast to identify the relevant geographic scale for conserving multiple shrubland bird species.

Sun-PM2-E-2

Potential Causes of Summer and Winter Mortality in *Erythronium americanum*

Jack T. Tessier (SUNY Delhi, Delhi, NY; tessiejt@delhi.edu)

Abstract - *Erythronium americanum* (Trout Lily) is an abundant spring geophyte in the forests of the northeastern United States. In both summer and winters with reduced snow, shallow corms have a higher mortality rate than deep corms. I conducted a series of experiments and descriptive studies to assess the impact of drought, root competition, and herbivory during the summer, and of snow removal, frost, and drought in the winter on corm survival. Summer corms did not die more often in drought conditions, but shallow corms faced more root competition and experienced greater herbivory than deep corms. In the winter, snow removal resulted in colder soils than a control with snow, but soil moisture was not affected by snow removal. Results of the freezing experiment are pending. Collectively, shallow corms are at risk of mortality from herbivory in the summer and lowered soil temperature with reduced snowpack in the winter.

Sun-AM2-A-1

Impacts of Invasive Plants on Rare Species and Natural Communities in Pennsylvania

Jeffrey Wagner (Pennsylvania Natural Heritage Program; jwagner@paconserve.org)

Abstract - The Pennsylvania Natural Heritage Program (PNHP) collects and manages information about the state's rare species and natural communities and makes that information available for numerous uses. When we describe a site and document a rare species, we note threats and issues that the species might be facing at a given site. Invasive species are almost always a concern. However, there are some sites and some populations of rare species that are particularly vulnerable to the impacts of invasive species. In this talk, I will give examples of a handful of these sites and describe what we are trying to do from a stewardship point of view to ameliorate the threats from invasive species. We are hoping to come up with an approach that would allow more of our more than 3000 biodiversity sites to receive attention, and I will briefly discuss some ideas.

Sat-PM1-C-4

Wild Bee Communities of Nova Scotia Heathland Habitat

Emily Walker (Saint Mary's University, Halifax, NS; emily.walker@smu.ca) and **Jeremy Lundholm** (Saint Mary's University, Halifax, NS, jeremy.lundholm@smu.ca)

Abstract - While bee communities servicing agricultural lands in Nova Scotia have been well characterized, those living in natural heathland are understudied. This project involved a survey of the bee communities found in heathland habitat throughout the province of Nova Scotia, Canada, to generate baseline data on bee community composition (species, abundance, guild structure) and to determine the flight periods of constituent bee species. It is part of a larger project quantifying the impact of adverse weather conditions on plant reproduction and bee foraging activity and reproduction in heathland habitat in Nova Scotia. We conducted bee surveys May–September 2017 at 10 locations throughout the province, comprising coastal, inland, and highland (Cape Breton) heathland sites. Bees were continuously collected in colored pan traps, with trap contents retrieved every 2 weeks. We conducted vegetation surveys in September to characterize plant community composition at all bee collection locations. We collected over 5000 specimens during the 5-month field season. We have identified 21 genera of bees, several of which were previously undetected in earlier, less comprehensive bee survey work conducted in heathland habitat. A species of special concern, *Bombus terricola* (Yellow-Banded Bumblebee), was found at several of our sites. A subset of sites contained non-native species, including *Apis mellifera* (European Honeybee) and *Anthidium manicatum* (European Wool Carder Bee), as well as *Bombus impatiens* (Common Eastern Bumblebee), a commercially reared species that is becoming increasingly popular in Nova Scotia.

Sun-PM2-C-3

The Ecophysiology of Fertile–Sterile Dimorphy in Ferns

James E. Watkins Jr. (Colgate University, Hamilton, NY; jwatkins@colgate.edu)

Abstract - Organisms must balance between reproduction, growth, and survival. When these processes are in competition, selection may act to drive functional dimorphism. Unlike seed plants, ferns use their foliar surfaces for reproduction and carbon fixation. Across species, ferns exhibit a remarkable gradient of fertile–sterile dimorphy: from the production of highly reduced fertile fronds (holodimorphic) to no reduction (monomorphic) in laminar area between fronds. Here I discuss the physiological impacts of fertile–sterile dimorphy through a series of observational and experimental field manipulations. I combine ecophysiological measurements of photosynthetic rate, water potential, hydraulic conductivity, and shifts in nitrogen content, with experimental d13C labeling and frond removal to evaluate costs of fertile–sterile dimorphy in 8 ferns spanning a dimorphism gradient (tropical taxa: *Adiantum latifolium*, *Lomariopsis vestita*, and *Thelypteris curtii*; temperate taxa: *Osmundastrum cinnamomeum*, *Osmunda regalis*, *Dryopteris marginalis*, *Onoclea sensibilis*, and *Polystichum acrostichoides*). Fertile sterile dimorphy in ferns appears to come at considerable physiological cost in hemi- and holo-dimorphic species. For this reason, these taxa should combine a series of strategies to help maximize growth and reproduction. Such strategies include establishment in high-resource environments, production of long-lived or evergreen leaves, investment in underground or stored resources, and/or shifts in fertile–sterile frond phenology. It is possible that the relative costs of this reproductive system are offset by increased spore dispersal; however, more work needs to be done to quantify potential tradeoffs.

Sun-AM2-D-3

Life in Murky Water: Patterns of Fish Eye Size from Habitats of Different Turbidity Levels

Daniel P. Welsh (Fitchburg State University, Fitchburg, MA; dwelsh3@fitchburgstate.edu)

Abstract- Many freshwater systems across the northeast and the country have seen increasing amounts of cloudiness due to substances suspended in the water. This increasing turbidity is likely to have evolutionary effects on fish populations through changes in key fitness-related capabilities, such as the ability to find prey and mates and detect predators. Natural selection might be expected to act in a way that improves fish vision, either through the rods and cones (to detect light better) or the overall size of the eye (to increase the amount of light reaching the retina). Surprisingly little is known about how fish eye size might respond to changes in turbidity and whether any such patterns are evolutionary conserved across fish taxa. This work compared the eye size of about a dozen fish species across lakes and streams in central Massachusetts. Results show that, surprisingly, all of these sites were relatively low in turbidity. Despite this, however, species-specific differences in eye size were found, driven by a negative relationship between turbidity and eye size in one species. These results suggest that even low levels of turbidity have the potential to cause changes in eye size, although such effects depend on the species.

Sat-AM1-D-2

Rare Vascular Plants in Massachusetts: Natural Heritage Maps the Mystery

Robert Wernerehl (State Botanist of Massachusetts, Natural Heritage and Endangered Species Program, Division of Fisheries and Wildlife, Westborough, MA; robert.wernerehl@state.ma.us)

Abstract - This talk will cover rare plant species in Massachusetts as an example of how our Natural Heritage system works in New England. We all talk about rare species, be they threatened, endangered, or otherwise at risk, but how do we know how many rare plants occur in Massachusetts? How do we prevent errors from creeping into the database? What is an “element occurrence” and what does that mean for plant populations? I will explain our current Natural Heritage and Endangered Species program methodology for rare plant records and reports, as well as provide numbers of records submitted and mapped over time.

Sat-AM2-E-1

Rare Vascular Plants in Massachusetts: Recent Spatial and Temporal Trends and Threats

Robert Wernerehl (State Botanist of Massachusetts, Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife, Westborough, MA; robert.wernerehl@state.ma.us)

Abstract - As the state botanist, I have the opportunity to survey many rare plant species in Massachusetts. I also have access to considerable data reported from other surveyors. This combination of information provides a good sense of spatial and temporal trends in rare plant populations in the Bay State. My talk will consider these trends, including some very rare species that appear to be stable over time. I will review the many other negative factors that have been likely influencing rare plant populations including *Odocoileus virginianus* (White-tailed Deer) herbivory, fire suppression, climate change, sea-level rise, *Branta canadensis* (Canada Goose) herbivory, legacy effects from atmospheric nitrogen and acid deposition, beach driving, canopy closure, roadside salt spray, and change in disturbance regimes potentially from loss of Pleistocene mammals including mammoths, mastodons, and giant beavers. For each trend or influence factor, I will show specific examples, including maps that I generate using Natural Heritage data, as well as an exciting and useful new source produced by a collaborator that maps trends over time at the town level using herbarium records. Many of these trends could be occurring in all New England states. I will briefly touch on recent restoration efforts in Massachusetts of the federally threatened *Amaranthus pumilus* (Seabeach Amaranth).

Sun-AM1-E-1

Ecology and Botany of Star Island in the Isle of Shoals

Christine Wilson (University of Maryland University College, Rollinsford, NH; christine.wilson@faculty.umuc.edu or christinewilson_2004@hotmail.com)

Abstract - Despite harsh winter winds, corrosive salt spray and thin postglacial soils, the 15.4 ha (38-acre) Star island, off the coast of New Hampshire, hosts over 250 species of native and non-native plants. The plants vary from rare and endangered to some highly invasive introduced species. Many species are limited to highly selective biomes within the 4 primary ecological zones: (1) Subtidal and Intertidal, (2) Maritime Rocky Shore and Barrens, (3) Lower Maritime Meadow and (4) Upper Maritime Meadow. Star Island flora has been disturbed by seasonal human activities since the 1600s, but the plant life is robust and varied enough to support annual Atlantic bird migrations and a strong resident population of *Larus marinus* (Black Backed Gull). Efforts have been made to promote specific native species, such as *Asclepias syriaca* (Common Milkweed), which is critical to North Atlantic migration of *Danaus plexippus* (Monarch Butterfly), and to eradicate some invasive or noxious plants such as *Toxicodendron radicans* (Eastern Poison Ivy).

Sun-AM1-E-3

The Effects of Acid-mine Drainage on the Diversity of Sensitive Species of Macroinvertebrates in Two Branches of a Vermont Stream

Mariah J. Witas (Saint Michael's College, Colchester, VT; mwitas@mail.smcvt.edu) and Declan J. McCabe (Saint Michael's College, Colchester, VT; dmccabe@smcvt.edu)

Abstract - Ely Mine and Elizabeth Mine are copper mines in southern Vermont that have been placed on the EPA's National Priority List, as they pose a risk to human health and the environment. Both mines have been abandoned for years, but runoff from the old mining sites still flows to the Ompompanoosuc River, a tributary of the Connecticut River, and affects the surrounding habitat. We collected benthic macroinvertebrates at these 2 sites above, below, and within a tributary leading from each mine into the Ompompanoosuc to compare water quality and evaluate mine-drainage effects on benthic communities. While the 2 streams had comparable EPT richness measures, we did find that there was higher overall species richness in Elizabeth Mine than in Ely Mine. The Elizabeth Mine's tributary did not contain a single macroinvertebrate, indicating dramatic mine-drainage effects. However, the effluent did not produce detectable differences between the Ompompanoosuc sites upstream and downstream from the mine tributary. Lack of differences between the upstream and downstream sites may in large part be explained by the small discharge volume from the mine and the large dilution factor in the Ompompanoosuc. From this study we can conclude that although the influx of metals and other pollutants from the defunct mining operations is affecting living things within the immediate tributary, the impact is limited in downstream spatial extent.

Sun-PM2-B-3

Assessment of Current Health and Functional Conditions for Several Freshwater Wetlands in the Mianus River Watershed

Isabela M. Yepes (Mianus River Gorge, Bedford, NY; ifabela@gmail.com)

Abstract - There is extensive evidence that natural wetlands contribute to ecosystem biodiversity and natural improvement of water quality, which can impact the drinking water of a watershed. Specifically, the health conditions of the wetlands in the Mianus River Watershed are of interest for the watershed's contribution to nearby coastal rivers and the drinking water for ~130,000 people. Using criteria of size and location relative to the river, I identified a total of 41 wetlands in New York and Connecticut that contribute to the Mianus River Watershed. From 2016 to 2017, I assessed 39 wetlands using a hydrogeomorphic (HGM) assessment protocol which measured hydrology, vegetation, geology, and other related variables. The results of this assessment provided 8 indices of ecological function for each wetland, as well as a specific threats and important ecological features which allow for specific management and restoration recommendations for each site. In sum, 44% of wetlands surveyed scored above 0.75 on the modification of water quality index and thus were identified as a priority to maintain in healthy conditions. Overall, ideal vegetation health (above 0.75) was present for 82% of wetlands, while only 31% had ideal fauna health (above 0.75). Preliminary comparison showed that the wetland that scored lowest in faunal diversity (0.53) had twice as many invasive species (10) as the 2 wetlands that scored highest in faunal diversity (0.89 for both). A potential cause of this finding is that invasive species over time can dominate leading to lower biodiversity and less animal food, thus decreasing overall faunal biodiversity. Since invasive species can come from human/urban proximity, future research can investigate if the wetlands identified to have fewer invasive species and better fauna diversity scores have a greater isolation from urban setting.

Sat-PM1-A-2

Protecting Rare Plants from Invasive Species. A Growing Challenge

Steve Young (New York Natural Heritage Program, Albany, NY; smyoun26@esf.edu)

Abstract - The New York Natural Heritage Program has been inventorying the state's rare plants since 1982. When rare plant sites are visited, plant species lists are written and the presence of invasives species are noted because they are one of the most important threats to population viability. By examining the early field forms of rare plant surveys and comparing them to recent visits it becomes clear that invasives species are becoming more numerous in the number of species present and in their abundance. This trend presents a growing challenge to land managers and the state PRISMs to protect our rare plant diversity.

Sat-PM1-C-2

Discovering Rare Plants Indoors and Out

Steve Young (New York Natural Heritage Program, Albany, NY; smyoun26@esf.edu)

Abstract - A recent updating of the flora of New York by David Werier and field work by botanists throughout the state have turned up some interesting finds both in the herbarium and in the field. Steve will discuss ten different species and the decisions made about how to treat them in the flora and in the state's rare plant lists.

Sat-AM2-E-5

Ridges, Valleys, Bedrock, and Soil: Using the Physical Landscape to Conserve Species in a Changing Climate

Bob Zaino (Vermont Fish and Wildlife Department; robert.zaino@vermont.gov) and **Elizabeth Thompson** (Vermont Land Trust; liz@vlt.org)

Abstract - The physical landscape—the underlying “stage” of the natural landscape—plays a critical role in the expression of biological diversity. With climate change expected to scramble familiar species–habitat associations and rearrange natural communities, conserving diversity in the physical landscape will be increasingly important. Vermont Conservation Design, a comprehensive plan for an ecologically functional landscape, applied a new approach to incorporating physical features in conservation planning. By representing the full diversity of topography, aspect, elevation, and geology as part of a connected natural landscape, the design helps maximize opportunities for species to shift ranges and find suitable new settings in a changing climate. This approach can serve as a practical and efficient way to plan for long-term conservation of biological diversity.

Sat-PM2-E-2