Dr. Kathleen Bell
Dept. of Economics, University of Maine

Spanning boundaries for career and conservation success

A member of the University of Maine faculty since July 2001, Kathleen P. Bell received an A.B. in Economics and Environmental Studies from Bowdoin College, a Ph.D. in Economics from University of Maryland (advised by Nancy E. Bockstael), and conducted postdoctoral research at University of Washington. Prior to becoming an academic, she worked in the private (Abt Associates, Inc.) and public (US EPA) sectors to develop solutions to environmental problems. Her research employs economics to address environmental, public health, and community economic development issues. Kathleen enjoys working with researchers from other disciplines and with colleagues from the private and public sectors.
Traditional Talks

Mammalian species richness and community composition varies in residential backyards across an urban gradient

Aaron M. Grade¹, Susannah B. Lerman², Paige S. Warren³

¹Program in Organismic and Evolutionary Biology, UMass Amherst; ²USDA Forest Service Northern Research Station; ³Department of Environmental Conservation, UMass Amherst

As human populations grow and urbanize, residential land-use represents significant potential wildlife habitat or corridors for wildlife movement. Diverse mammalian communities are found in green spaces across levels of urbanization, but it is unclear how mammalian community diversity and composition vary in residential areas across urban gradients. We conducted a camera trapping study in backyards across an urban gradient to assess how features of residential areas across multiple scales are related to mammalian diversity and composition. We found that the landscape-scale urban gradient better explained species richness and composition than more local habitat measures. Species richness peaked at intermediate levels of urbanization, a pattern seen in other taxa but previously undocumented in mammalian communities. Additionally, presence of domestic cats in yards related to a significant increase in mammalian species richness. These findings indicate that landscape-scale features may be more important filters on mammal species use of residential yards than yard management by residents, although human-caused disturbances, particularly cats, could be altering mammal use of residential yards. A yard’s context on the landscape may be the main determinant of what mammal species will be present, but residential yards could still provide useful resources for wildlife. Managing both resources and disturbances in yards may increase mammal use and may facilitate movement through yards to adjacent patches of intact habitat. Residential areas, especially in rural areas, represent potential habitat or critical connectivity corridors for wildlife management in an urbanizing world.
Exploring mechanisms underlying the range limit of an ecologically important marine crab in an ocean warming hotspot

Jordanna M. Barley¹, Brian S. Cheng²

¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

Anthropogenic climate change is universally driving species distribution range shifts. Understanding and documenting species’ range shifts is important because this phenomenon can allow for novel species to radically disrupt ecosystems. Although range shifts are observed across taxa and ecosystems, the mechanisms underlying them is poorly understood. The Gulf of Maine is experiencing particularly rapid warming compared to the global ocean, making this a great system to study ocean warming effects on species’ range expansion. Within the Gulf of Maine, salt marsh ecosystems have experienced rapid decline and evidence suggests that purple marsh crab (Sesarma reticulatum) populations are a contributing factor. We first identified the current range limit of purple marsh crabs using field surveys throughout coastal Massachusetts. We then experimentally tested the effects of temperature on the dispersal capacity of purple marsh crabs sourced from an edge and interior population because theory suggests that edge populations may be selected for greater development rates, which can facilitate range expansion. Preliminary results suggest that purple marsh crabs are capable of finishing larval development at 18°C, which is within the range of current habitat temperatures. Although this would seem to indicate that purple marsh crabs are poised for an active range expansion, the edge population appears to be less sensitive to temperature than the interior population, potentially constraining dispersal potential. Furthermore, the temperature threshold for larval development of purple marsh crabs is nearly identical to that of the fiddler crab (Uca pugnax), a similar species that is undergoing rapid range expansion. The current inability of purple marsh crabs to expand their range in the rapidly warming Gulf of Maine may be tied to larval behavior (vertical migration) that limits its potential to colonize new habitat. We conclude that a mechanistic understanding of processes driving range expansions will require an integration of organismal physiology, behavior, and physical transport mechanisms.

The effectiveness of enforcing collective property rights

Felipe J. Quezada¹, Nathan Chan²

¹Resource Economics Graduate Program, UMass Amherst; ²Dept. of Resource Economics, UMass Amherst

In this paper we analyze how enforcement affects the success of a collective property right. Specifically, we examine the effect of patrolling effort on density, abundance, biomass and probability of success of areas managed under the TURF program implemented in Chile to regulate access to near-shore fisheries. We construct and analyze a bio-economic model to generate several theoretical predictions: (i) patrolling has a positive effect on stock, (ii) distance to enforcement authorities has a negative effect, and (iii) the effect of distance to local community is ambiguous. To test the empirical validity of these hypotheses, we construct and analyze a novel data set of fishing and patrolling in the Chilean abalone fishery. Consistent with our model, we find that patrolling is effective on increasing density and abundance, while location did not have a significant effect. Conversely, patrolling did not have a significant effect on the probability of TURF success and is determined mainly by location. We conclude that patrolling effort has an important role on determine density and abundance level of an area within a season.
Winter Lake Drawdowns: Investigating Impacts on Downstream Hydrology and Temperature

Alec Baker¹, Allison Roy², Todd Richards³, Michelle Craddock⁴, Kate Bentsen⁴
¹Environmental Conservation Grad Program, UMass Amherst; ²Massachusetts Cooperative Fish and Wildlife Research Unit, UMass Amherst; ³MassWildlife; ⁴Massachusetts DER

Winter drawdowns are a common lake management strategy in Massachusetts that lower lake elevation during the winter to kill nuisance aquatic vegetation, among other purposes. Reservoir water elevations are altered by managing water releases from dams, resulting in increased downstream discharges during the fall and decreased discharges during the spring, relative to unmanaged systems. These changes in water quantity likely translate to altered habitat (e.g., bed mobilization) and water quality (e.g., temperature), with potential consequences on productivity, biotic integrity, and ecosystem health. Current state-issued guidelines for planning and permitting for winter drawdowns focus primarily on in-lake impacts and claim that “properly conducted” drawdowns should not alter flows beyond normal variation or downstream ecosystems, despite a lack of information on downstream impacts. We propose to collect continuous, high-resolution discharge and temperature data below drawdown dams and dams managed without altered discharges. These data will be used to describe variation in hydrologic and thermal regimes downstream of drawdown reservoirs and develop hypotheses on the effects of altered flows on downstream ecosystems. Results will help managers and policy makers consider previously overlooked downstream impacts when updating management guidelines.

Exploring species and community-level response of forest birds to a multi-dimensional paradigm of landscape heterogeneity

Benjamin J. Padilla¹, Chris Sutherland²
¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

Human mediated landscape modification in the form of urbanization or agriculture impacts habitat and resource availability, and is a strong driver of ecological processes such as species occupancy, and community dynamics. Therefore, a thorough understanding of the reciprocal pattern-process relationship between ecosystems and landscapes is vital for informed biodiversity conservation. Ecologically relevant landscape models that efficiently reflect complexity of heterogenous landscapes while remaining ecologically intuitive and applicable are needed in order to develop general theories and consistent emergent patterns in landscape ecology. Previous work by Padilla and Sutherland (2019) has shown that implementing a standardized landscape quantification framework reveals a consistent multi-dimensional landscape paradigm that simultaneously describe variation from hard-to-soft (i.e., urban to exurban), and brown-to-green (i.e., agricultural to natural). We utilized this multi-dimensional landscape paradigm to explore the response of bird populations to human-dominated landscapes in western Massachusetts, using species specific and community level models for occupancy and abundance.

Our results highlighted the ecological value of incorporating multiple axes of landscape variation in heterogeneous landscapes. Individual species responded to both axes of variation, with species-specific variation according to natural history of the species in question. Community level response showed a general negative response to human-dominated landscapes in the form of both urban (hard) and agriculture (brown). Our results demonstrate the ecological utility of implementing a multi-dimensional landscape perspective derived from the standardized landscape framework of Padilla and Sutherland as a means to synthesizing research in human dominated landscapes across spatio-temporal extents.
Investigating intraspecific variation of thermal performance across latitude in a marine gastropod
Andrew R. Villeneuve¹, Brian S. Cheng²
¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

Our understanding of the biological consequences of anthropogenic climate change has greatly improved over the last two decades. However, the impacts of climate change on evolutionary processes and the potential for species to adapt to environmental change remains relatively unexplored. By understanding intraspecific physiological performance of populations along environmental gradients, we can make inferences about potential adaptive capacity to climate change (so called “space for time substitution”). I used the broadly distributed and direct dispersing Atlantic Oyster Drill *Urosalpinx cinerea* to test for locally adapted traits using common garden experiments and physiological measurements. I sourced populations of adult *Urosalpinx* across latitudes from the Atlantic and Pacific coasts of North America. I reared F1 snails at two different acclimation temperatures and tested their thermal tolerance in a heat bar experiment. I also grew F1 snails in a common garden experiment and tracked growth rates. Results demonstrated that snails from warmer sites had greater thermal tolerances then cooler sites, but to a lesser extent then hypothesized. Further, tolerance decreased markedly with acclimation. However, growth rates indicate that *Urosalpinx* populations are demonstrating a pattern of countergradient variation, wherein northern populations grow faster at all common garden temperatures when compared to southern populations. These patterns suggest that ongoing climate warming may select for increased thermal tolerance, but decreased growth rate, a finding that is at odds with conventional wisdom. These results confirm that evaluations of climate change impacts should consider evolutionary perspectives, as their inclusion may yield radically different perspectives of species response.

Fine-scale shallow water movements of White Sharks (*Carcharodon carcharias*) on Cape Cod, Massachusetts
Bryan Legare¹, Andy Danylchuck²
¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

The white shark (*Carcharodon carcharias*) is the largest predatory fish in the world. As white shark populations in the Atlantic Northwest are rebuilding, predictable seasonal aggregations of white sharks are forming along Cape Cod, Massachusetts. On Cape Cod, white sharks pose a risk to public safety as human and white shark interactions are on the rise. Information on the fine-scale spatiotemporal use of shallow water by white sharks is necessary in order to inform public safety. In September 2019, we quantified the movements of white sharks using a dense array of receivers arranged to track acoustically tagged white sharks at Head of the Meadow Beach in Cape Cod. Virtual positioning tacked 30 individual white sharks travelling in waters between 1-12 m deep for periods up to 4.5 hours. To link these movements to the local abiotic conditions, we collected high-resolution (2-3 cm) sidescan imagery and bathymetry with an Edgetech 6205 phase-measuring sidescan sonar. In addition, data on oceanographic conditions were collected with an Acoustic Doppler Current Profiler (ADCP), pressure loggers, and light meters. White Sharks were present during 40% of the study period and showed distinct affinity to waters near a gray seal (*Halichoerus grypus*) haul out. Generally, patterns of presence and absence in the shallow water habitats are associated with bathymetry determining individual pathways, changes in oceanographic conditions, and high-energy weather systems. This first of its kind study sheds light on the daily movements of white sharks in shallow waters of Cape Cod.
Fish assessments to inform recovery of dwarf wedgemussel

Jennifer E. Ryan\(^1\), Allison Roy\(^2\)

\(^1\)Environmental Conservation Grad Program, UMass Amherst; \(^2\)Massachusetts Cooperative Fish and Wildlife Research Unit, Department of Environmental Conservation, University of Massachusetts Amherst & U.S. Geological Survey

Comprehensive recovery programs are needed for the more than 70 federally endangered freshwater mussel species in the United States. One of these species, the dwarf wedgemussel (\textit{Alasmidonta heterodon}), has been federally endangered since 1990. The mussel once ranged from the Neuse River in North Carolina to the Petitcodiac River in New Brunswick, Canada, now only exists in a few isolated populations throughout a diminished range. These declines have led to concerns about the long-term viability of the species. One management strategy for restoring endangered freshwater mussels is lab propagation and reintroduction into the wild. Before release of propagated mussels, it is important to ensure that abiotic and biotic environments are sufficient for reproduction and long-term survival. One critical aspect of the biotic environment is availability of host fish for transforming larvae into juvenile mussels. An understanding of fish populations near healthy dwarf wedgemussel populations and at potential recovery sites is needed before designing a recovery plan. We compiled fish species presence and abundance data within 500 m of dwarf wedgemussel populations in the Connecticut and Delaware basins from existing state fish databases and conducted new fish collections where there were no recent fish surveys. We related fish presence and densities to dwarf wedgemussel data, with a focus on fish species that were successful fish hosts for dwarf wedgemussel in a previous laboratory study. These results will be used in conjunction with habitat and genetic information to inform recovery plans.
Lightning Talks

Impact of a foundational course on students’ attitudes, knowledge, relevance, and future use of Geospatial Information Science and Technology

Amanda E. Suzzi
Program in Geography, Geographic Information Science and Technology, UMass Amherst

While students worldwide are using GPS, Google Earth, and other location-based services (Pokemon Go, Tinder, AirBnB, etc), the adoption of Geospatial Information Science and Technology (GIST) in schools remains low due to a variety of factors. This study examines the impact of the course "Maps+: Fundamentals of Geospatial Technology" on the learning of and attitudes toward GIST. This freshman-level seminar was taught in 12 one-hour classes with supplemental texts, videos, discussions, and additional optional hands on activities in an online instructional classroom. The content included the fundamentals of mapping, GPS, GIST theory, spatial analysis, modelling, cartography, image analysis, and remote sensing. Two in-class hands-on tutorials, "Undercover Mapper," used ESRI's ArcGIS Online to learn basic GIST skills, including exploring attribute tables, using the statistics tool, and creating features. Another in-class hands-on tutorial used Landsat imagery to investigate change detection. A scavenger hunt displayed how the technology can be used to create a resource guide/map. Primarily white, younger than 20, gender-balanced students (n=36) in three sections of a first year experience course comprised the study sample. Students were surveyed with a combined questionnaire of open response and likert scales on the first and last days of class. Metrics measured include attitudes about science and GIST, current GIST skills, relevance of GIST per major, and demographics. The results are forthcoming, but should show a positive increase in attitudes and knowledge. The students should be able to describe the relevance and use of GIST in their future education/careers.

Mycoremediation: A Solution for the World’s Toxic Waste

Megan Brockelbank
Sustainability Science, UMass Amherst

With industry came many forms of toxic wastes and we now see these various chemicals in cord blood of unborn children, drinking water, and in the soil our food is grown in. This is a huge problem that I believe can be solved by mushrooms. Mycoremediation is a form of bioremediation that uses mushrooms natural ability to decompose and disassemble recalcitrant long-chained toxic molecules into simpler and less toxic forms. Mycelium, the white root-like vegetative form of the mushroom, is adept in breaking down toxins and bio-waste by using the enzymes that it secretes in its mycelial mats. The mycelium from different mushrooms can be inoculated into soil of contaminated sites and with mycofiltration bags can be used to filter contaminated water from industrial waste sites and on farms to mitigate runoff of fertilizers, pesticides, and fecal matter helping to reduce the spread into the environment at large. Mushrooms also are able to uptake heavy metals into their fruiting bodies making them essential in site contamination cleanup. Mycoremediation has been effective in removing 98% of the toxins in just one application of mycelium and is also effective in carbon sequestration, something we desperately need in the face of climate change.
Assessing the Efficacy of Conservation Assistance Programs for Family Forest Landowners in Vermont

Meg Harrington¹, Brett Butler²

¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst and Northern Research Station, USDA Forest Service

The future of Vermont’s 1.8 million hectares of forest is determined largely by the decisions of private landowners. To increase forest conservation practices, both government and non-governmental groups provide assistance to landowners in the form of educational and cost-share programs, which we collectively call “conservation assistance” programs. With a focus on programs that enhance wildlife habitat, the purposes of this study are to 1) assess the relevance and productivity of state-administered assistance programs, and 2) compare the efficacy of programs run by the state versus non-governmental groups. We chose to address these questions by analyzing assistance programs within the state of Vermont, USA, because of Vermont’s high percentage of privately-owned forest and its balance of both government and non-governmental programs. To conduct this study, we used a mixed-methods approach integrating qualitative interviews and a quantitative mail survey. In this lightning talk, I will discuss the use of the transtheoretical model of behavior change in the analysis of interview transcripts, as well as our application of the model to the design of the mail survey.

Distribution of Massachusetts' Solar Program Incentives

Alexia Perides¹, Dwayne Breger²

¹Sustainability Science, UMass Amherst; ²UMass Clean Energy Extension, UMass Amherst

Massachusetts is one of the leading states in solar energy, and its success is mainly due to programs that the state has put forth to incentivize and accelerate solar projects. One of which is the RPS Solar Carve-Out II program (familiarly known as the SREC II program). The SREC II program supported more than 1700 MW of solar capacity in Massachusetts, distributed across 75,000 projects. While the solar program has brought benefits to Massachusetts in jobs and greenhouse gas reductions, the distribution of the financial benefits of the economic rents associated with the solar development has not been analyzed. These rents, in the form of rates of return to investors, energy cost discounts, and payments to municipalities or site owners, provide significant opportunities for wealth generation and greater equitable distribution across energy consumer and producers.

Under a seed grant from the UMass Institute for Social Science Research, the Clean Energy Extension is estimating the magnitude of economic rent generated by the SREC II solar market as differentiated by the type of project and ownership arrangement, and the distribution of this rent to classes of beneficiaries. Our work is based on a publicly available database from the Massachusetts Department of Energy Resources of the projects qualified by the SREC II program, and pro-forma cash flow models to establish the net present value of economic rents that accrue to applicable parties. The project findings will be used to evaluate the lost opportunity for the solar market to bring greater equity and wealth distribution to the energy sector, and policies that can encourage these opportunities.
Assessing the population connectivity of a Neotropical freshwater fish, the Golden Dorado

Nadia B. Fernandez¹, Andrew Danylchuk², Lisa Komoroske²

¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

Neotropical freshwater fishes represent the most diverse freshwater fish assemblages in the world. Growing anthropogenic pressures such as overharvesting, habitat degradation, and impacts to movement pathways are of high concern for Neotropical fishes, such as Golden Dorado (*Salminus brasiliensis*). Golden Dorado are the focus of an emerging catch-and-release recreational fishery in South America because of their dramatic fight, powerful bite, and striking physical appearance. Their increasing popularity is attracting anglers from around the world and spurring economic growth in local communities as the fishery expands. However, there is still relatively little known about their basic biology and ecology which impedes development of best practices to ensure long-term economic and ecological sustainability. For one of my dissertation chapters, I will leverage the combined strengths of citizen science and genomic approaches to quantify population connectivity and identify key conservation units of Golden Dorado by working alongside local entities. This procedure will facilitate an avenue for two-way knowledge exchange when it comes to conservation actions needed shape a sustainable future for Golden Dorado and the communities that rely on them.

Towards optimal sampling design for spatial capture-recapture

Gates Dupont

Environmental Conservation Grad Program, UMass Amherst

Reliable estimates of population density throughout a species’ range are central to ensuring the success of conservation practices. Currently, spatial capture-recapture (SCR) has emerged as the industry standard for analyzing observational data to estimate population size by leveraging information from the spatial locations of repeat encounters of individuals. The precision of density estimates from SCR methods is dependent fundamentally on the number and spatial configuration of detectors in the landscape. Despite this knowledge, preexisting recommendations for sampling designs are heuristic and their performance, in most practical applications – i.e., in heterogeneous environments that pose logistical challenges – remains untested. To address these issues, we propose, and evaluate, a genetic algorithm that minimizes any sensible SCR-intuitive objective function to produce near-optimal sampling designs. To motivate the idea of optimality, we compare the performance of designs optimized using two model-based criteria. We use simulation to show that these designs out-perform those based on existing recommendations in terms of bias, precision, and accuracy in the estimation of population size. We have added this very flexible optimal design algorithm to the R package oSCR, allowing conservation practitioners and researchers to generate customized sampling designs that can improve monitoring of wildlife populations.
Condition and Structure of Utility Forests in Massachusetts

Ryan Suttle
Environmental Conservation Grad Program, UMass Amherst

Trees benefit communities in numerous ways, including reducing ambient temperature, removing pollutants and particulates from the air, sequestering atmospheric carbon, and improving stormwater retention and filtration. However, trees also pose risks, especially in proximity to overhead utility lines, where they cause a large proportion of electrical power outages. As such, trees must be frequently and often severely pruned away from lines to minimize this risk. Trees located elsewhere in areas which do not have utility lines, such as in private yards or along streets, are not pruned as frequently or severely. In this study, I will compare trees pruned around Eversource Utility Company power lines (utility-trees) to non-utility trees in similar growing conditions. I will collect data metrics including individual tree crown condition, percent deadwood in tree crowns, and likelihood of failure for trees in utility plots vs non-utility plots. Additionally, I will evaluate the contribution of ecosystem services delivered by utility trees vs non-utility trees using the USFS software i-Tree. Comparing these quantified ecosystem service benefits and tree condition across the two sample populations, I aim to evaluate how severely, if at all, utility pruning affects trees.
Individual Posters

Assessment of the Economic and Ecosystem Service Contributions of the USDA Forest Service Landowner Assistance Programs

Jacqueline Dias¹, Brett Butler²

¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst and Northern Research Station, USDA Forest Service

The USDA Forest Service, State and Private Forestry Deputy administers multiple Landowner Assistance programs to assist private woodland owners. The programs aim to establish forest stewardship programs for management of non-Federal forest lands, encourage working forests, prevent insects and diseases, and more. The forests participating in these programs provide numerous economic goods and ecosystem services like carbon sequestration and climate change mitigation. Because a great amount of forest land is in private ownership, Landowner Assistance programs are integral to keep forests intact and to avoid parcellation and other associated factors facing landowners. I will specifically be assessing the Forest Legacy Program, Forest Stewardship Program, Landscape Scale Restoration, and Urban & Community Forestry grant programs. Using IMPLAN, InVEST and i-Tree, three modeling systems, I plan to estimate the economic contributions and ecosystem services the forests in these programs provide. I will use data of local economies, jobs, forest management and recreation activities to quantify economic contributions participating forests make to surrounding economies through IMPLAN’s input-out modeling system. Data originating from USDA Forest Service Forest Inventory and Analysis and the National Land Cover Database will be used to estimate ecosystem services through i-Tree and InVEST, respectfully. Quantifying and estimating economic contributions and ecosystem services provides a framework for understanding how these programs could benefit and assist the private woodland owner and their surrounding communities. Nonprofits, conservation organizations, and policy makers can use the results of this study to encourage and educate landowners on the benefits associated with these Landowner Assistance programs.
Biogeochemical Profiling of Transient Microenvironments at the Root-Soil Interface

Mariela Garcia Arredondo¹, Zoe G. Cardon², Morris E. Jones³, Yilin Fang⁴, Steve Yabusaki⁴, Marco Keiluweit³

¹Environmental Conservation Grad Program, UMass Amherst; ²Marine Biology Laboratory, Woods Hole, MA; ³School of Earth & Sustainability and Stockbridge School of Agriculture, UMass Amherst; ⁴Pacific Northwest National Laboratory, Richland, WA

Understanding the dynamics and vulnerability of mineral-organic interactions is critical for projecting climate change impacts on soil fertility and carbon storage. Plant roots and associated microbes release an array of reactive rhizodeposits, potentially both forming and disrupting protective mineral-organic associations in the surrounding soil environment. But our ability to measure and predict the impact of rhizodeposits on the dynamics of mineral-organic associations in the rhizosphere remains limited. Here, we aim to define the biogeochemical conditions within transient microenvironments along single plant roots and assess their potential impact on mineral-organic associations. To this end, we integrated microsensor measurements in well-controlled rhizoboxes with a process-level root-soil model. Using in-situ electrochemical microsensors, micro-dialysis probes, and microbiosensors, we show how root-induced variations in the geochemical regime and microbial activity influenced Fe-OM interactions. Continuous, high-resolution profiling of growing and maturing Avena sativa roots over 14 days revealed clear diel cycles, but even more dramatic changes along transects from root tip, to uptake zone, and mature suberized zones. Root tips showed a sharp decline in pH and Eh as well as a concurrent increase in microbial activity, Fe and OM concentrations, possibly linked to the greater abundance of root-derived organic compounds. As roots matured, concentrations of root-derived organic compounds and microbial activity decreased, accompanied by a recovery of pH and Eh and a decline in Fe and OM concentrations.

Our results indicate that the fate of mineral-organic associations in the rhizosphere depends, in part, on the nature of transient microenvironments along plant roots. Our combined microsensor and modeling approach provides the unique ability to systematically assess the dynamic interplay between roots, microbes and minerals within these microenvironments, and their sensitivity to shifts in climate and vegetation which are fundamental to predictions of soil fertility and carbon storage.
The role of songbirds in agricultural insect pest control on small, integrated New England farms

Samuel J. Mayne¹, Dave King², Joe Elkington², Jeremy Andersen²
¹Environmental Conservation Grad Program, UMass Amherst; ²Department of Environmental Conservation, UMass Amherst

Songbird control of agricultural pest populations through predation has the potential to aid small-scale farming operations, representing a rare win-win situation where wildlife conservation directly benefits human productivity. Agricultural lands account for nearly half of global land use, and chemically intensive, industrialized farming poses a serious threat to many wildlife populations. Songbird populations on small, integrated farms in New England may play an important role in mitigating pest damage and outbreaks, but the key songbird species, level of pest suppression, and spatial variation in pest removal is not currently known. Using gene metabarcoding of songbird feces, I will analyze the diets of common songbird species to determine their role in insect pest reduction. I will also evaluate the magnitude and spatial change in pest reduction services rendered by songbirds through controlled elimination of songbird predation and simulated pest outbreaks. I expect that songbird predation will significantly decrease pest populations and crop damage, with pest suppression greater closer (<40m) to non-crop songbird habitat (hedgerows, woodlands, grasslands, shrublands, and wetlands). I also anticipate that crop pests will constitute a larger portion of the diets of generalist and insectivore species than other local songbird species. With these results, farmers and wildlife managers can adjust their land management practices to enhance songbird pest removal services on local and landscape scales. By quantifying songbird ecosystem services, policy makers and farmers can more accurately compare the costs of intensive, homogenized farming and diversified, wildlife-supporting agriculture.

Evaluating Close-Kin Mark-Recapture as a Tool for Parameter Estimation in Elasmobranchs

John Swenson¹, Dovi Kacev², Michael Kinney³, Charlotte Boyd⁴, Kevin Feldheim⁵, Lisa Komoroske⁶
¹Program in Organismic and Evolutionary Biology, UMass Amherst; ²Scripps Institution of Oceanography; ³NOAA Southwest Fisheries Science Center; ⁴NOAA Alaska Fisheries Science Center; ⁵Field Museum; ⁶Department of Environmental Conservation, UMass Amherst

Successful marine resource management relies on population assessments that evaluate the status of marine fisheries stocks and species of concern. These assessments require data that can be challenging to obtain, hindering reliable population assessments for many species. Close-kin mark-recapture (CKMR) is an emerging approach that uses genetic data in a mark-recapture framework to estimate key demographic parameters - such as abundance and survival - in populations for which such estimates were previously unreliable or infeasible. However, like any new method, before the CKMR framework can be broadly applied, it first needs to be validated in different biological systems to examine its ability to reliably produce robust parameter estimates that can be incorporated into population assessments and stock projections. This project uses simulation and genetic data drawn from a tractable population of Lemon Sharks that has been exhaustively sampled and intensively studied for over 20 years to test central assumptions of the CKMR framework. By combining simulation with a robust empirical dataset, this research will help establish best practices for designing and implementing a CKMR experiment and is expected to demonstrate the utility of CKMR for informing management of vulnerable elasmobranch species.
Differential gene expression associated with tumor-forming disease in marine reptiles
Jamie Adkins Stoll, Shreya Banerjee2, Lisa Komoroske2
1Environmental Conservation Grad Program, UMass Amherst; 2Department of Environmental Conservation, UMass Amherst

Global ocean health is increasingly impacted by anthropogenic pressures, compounding stressors associated with natural fluctuations in abiotic and biotic marine features. Such pressures include sea level rise, increasing water and sand temperatures, pollution and overfishing; these are disturbing population dynamics and health of marine organisms across taxa (Schuldt et al. 2016). Globally, marine turtles have been severely impacted by fibropapillomatosis, a disease characterized by the formation of numerous tumors (Herbst 1995). Prevalence of this disease varies by species and population, and pathogenic and environmental factors (e.g. eutrophication, heavy metals) do not fully explain differences in observed patterns of disease prevalence; the role of individual genetics in disease susceptibility have not yet been fully investigated (Jones et al. 2016). Using the Hawaiian population of green sea turtles as a study system, we investigated differences in gene expression in clinically healthy and diseased individuals, as well as analyzing differences in expression on a subpopulation scale. We sequenced RNA from 34 individual green turtles, built and annotated a de novo transcriptome assembly for the Hawaiian green turtle population, and conducted differential gene expression analysis using the edgeR package in R. Using this approach, we detected the presence of functional immune-related genes—including tumor necrosis factor genes—within our samples. Ultimately, we will use differences in gene expression to construct gene expression profiles associated with this disease which can be used to monitor disease prevalence and susceptibility within marine turtle populations globally.

Trait variation and long-term population dynamics for the invasive Alliaria petiolata
Laura M. S. Hancock1, Kristina A. Stinson2
1Program in Organismic and Evolutionary Biology, UMass Amherst; 2Department of Environmental Conservation, UMass Amherst

Long-term population dynamics across heterogeneous environments could be a major factor in determining species’ ability to expand their ranges and persist in novel environments. Though largely restricted to disturbed edge microhabitats in its home range, the invasive herb garlic mustard (Alliaria petiolata) invades intact forest understories – a novel microhabitat type – in its introduced range where it is known to impact above and below ground forest understory community composition. In this study, we conducted field surveys in 2003-2006 (sampling period 1) and 2015-2016 (sampling period 2) to evaluate trait variation, biomass allocation, and long-term population dynamics of A. petiolata growing in three microhabitats (forest edge, forest understory, and a transition zone between the two). Our results show that adult plants in the edge were significantly taller and branchier, produced more fruits, and had higher total and reproductive biomass than plants in the intermediate and forest microhabitats. In sampling period 1, population growth rates (λ) showed that all three population sizes were increasing (λ>1). In sampling period 2, the edge populations showed a steep decline in growth rates (λ<1). Overall, our results do not indicate that A. petiolata populations will decline in the edge or intermediate microhabitats in the coming years. Since edge - and intermediate - patches had higher densities of adult plants which had the largest reproductive biomass, we speculate that the edge – and intermediate - populations may be helping to sustain the forest populations through an influx of propagules.
Lab Group Posters

Freshwater Ecology and Conservation
Roy Group

Shifting Phenology in the Gulf of Maine Ecosystem
Staudinger Group

Plant Ecology in a Changing World
Stinson Group

Applied Spatial Population Ecology Group
Sutherland Group

Soil Microbial Biogeochemistry Group
Keiluweit Group

Focusing on Families to Conserve Forests
The Family Forest Research Center

Thank you to our ECoGSS 2020 sponsors!

Dept. of Environmental Conservation, Student Parent Programs, UMass Dining, UMass Grad Student Senate, The Black Sheep, Trader Joe’s, Cushman Market, Shelburne Falls, Central Rock Gym, The Works, Henion Bakery, Amherst Cinema