ABSTRACTS

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Research Power Talks

Male-male coalitions and aggression in two species of manakins

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Manakins are neotropical birds with a polygynous mating system where males aggregate in a specific area (lek) to court females, and direct aggressive interactions are rarely seen. As such, manakins are often considered non-territorial. Moreover, in some manakins species, males form coalitions with other males to perform coordinated courtship displays. While existing research has explored these social coalitions and cooperative behavior in manakins, the behavioral response to territorial intrusions by novel males is not well understood. To understand territorial behavior in manakins, we challenged territorial males to simulated territorial intrusions. We conducted these challenges in two species on manakins that differ in their social systems. First, we investigated the wire-tailed manakin *(Pipra filicauda),* where males perform cooperatively coordinated displays with other males and queue for future territorial positions. Subsequently, we investigated the red-capped manakin *(Ceratopipra mentalis*), which has no cooperative behavior, but males can approach other males to share perches but display little aggression. We tested aggression in these two species by introducing a taxidermic mount intruder onto a territorial male and quantifying the individual's behavioral response. While males of both species responded aggressively to the territorial intrusion, we found no significant differences in the aggression scores between the species. We concluded that while manakins' social organization includes a high tolerance to neighbor males, and in some species, males even cooperate, aggression and territoriality are still present, at least in these two species.

Integrating ecosystem contributions to stream corridor carbon dioxide and methane fluxes

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The heterogeneity of CO1 and CH4 sources within and across watersheds presents a challenge to understanding the contributions of different ecosystem types to stream corridor carbon cycling. Stream carbon fluxes integrate biogeochemical processes from their contributing valleys and upstream corridors. Changing hydrology and diverse landscape patches (e.g., surface, subsurface, and riparian) can have dynamic influences on stream corridor greenhouse gas emissions. To identify patterns and sources of carbon emissions across stream corridors, we measured gas concentrations and fluxes over 2 summers at Coweeta Hydrologic Laboratory, NC. We sampled CO2 and CH4 along four streams (including flowing and dry channels), adjacent wetlands, and riparian hillslopes. Stream CO2 concentrations varied as much over space as they did time (550-2500 µatm), and all streams were sources of CO2 to the atmosphere (median from all stream reaches = 93.9 mmol m-2d-1). Streams were sources or sinks of CH4 depending on sampling location (-0.0001 to 0.158 mmol m-2d-1). Hillslopes were sources of CO2 (median 259 mmol m-2d-1) and sinks of CH4 (-0.086 mmol m-2d-1); stream dry beds were sources of both gases (median 62 mmol CO2 m-2d-1 and 0.003 mmol CH4 m-2d-1). Wetlands were consistently sources of CO2 (median 211 mmol CO2 m-2d-1); however, wetland CH4 emissions were highly heterogeneous (range 0 – 2713 mmol m-2d-1). Ongoing work seeks to integrate stream discharge with high-frequency dissolved CO2 sensor data with within-reach spatial CO2 data to identify spatiotemporal patterns of variation. Future expected hydrologic and climatic extremes will change carbon cycling through watersheds. A better understanding of carbon fluxes from diverse habitat patches within and between stream corridors will improve our quantifications of freshwater contributions to landscape and regional carbon emissions as ecosystems respond to global change.

Exploring Social Network Maps as Tools to Enhance Collaboration in Climate Adaptation

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Networks can be influential in tackling complex, multi-stakeholder problems by fostering learning and the development of innovative practices. Assessing the structure of social networks can provide insight into how relationships influence outcomes. Social network maps are increasingly employed in environmental management to identify strengths and weaknesses in the existing network and how these areas may influence future collaborations. Social network maps also represent one form of a boundary object, which are materials or abstract artifacts that bridge the gaps between social worlds and can facilitate communication and

learning across groups. In this presentation, we explore how social network maps may be used as tools to identify opportunities for and barriers to collaboration in adaptation planning. We will study the networks of entities working on climate adaptation in eight communities across the US as they incorporate adaptation strategies in their general plan updates. To create the social network maps, survey data will be collected on the pre-existing relationships of workshop participants. The maps will be presented to participants via an interactive, website application and incorporated as the networks consider how to implement proposed adaptation strategies. The network maps and website will be evaluated through periodic surveys and interviews after the tool is first introduced. Feedback from participants and the research team will be incorporated to improve the website and mapping session with each successive community. If this is a helpful tool, it could have implications for the future of adaptation planning, as well as tackling other complex, multi-stakeholder issues.

Edge-dependent effects of corridors on seed dispersal by ants

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The loss and fragmentation of habitats are two of the biggest threats to biodiversity. Populations of organisms remaining in fragmented landscapes persist in smaller and more isolated pieces of habitat surrounded by human land-use. Corridors, strips of habitat reconnecting isolated habitat fragments, are used by land managers to mitigate the effects of isolation caused by fragmentation. Although much work has been done to understand the effects of corridors on seed dispersal by vertebrates, less is known about how corridors affect plants relying on nonvertebrate seed dispersers such as ants. To understand how habitat connectivity and edge effects impact ant seed dispersal, we conducted ant community sampling with pitfall traps and observations of seed removal by ants from depots in a landscape-scale experiment that manipulated connectivity (via corridors) and amount of edge across habitat patches. We asked: (1) How is seed dispersal by ants affected by connectivity and edge effects?, and (2) Are these effects mediated by changes in (a) ant community composition or (b) ant behavior? While we found no effect of connectivity and edges on the number of seeds ants dispersed or the number of ant species dispersing seeds, we did find that ants moved seeds about five times further in fragments connected with corridors. This effect was only present in the interior of fragments and did not appear to depend on the identity of ant species moving

seeds. Overall, this research suggests that habitat connectivity can have important effects on the quality of seed dispersal by ants.

Temperature loggers capture intraregional variation of inundation timing for intermittent ponds

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Hydroperiod, or the amount of time a lentic waterbody contains water, shapes communities of aquatic organisms. Precise measurement of hydroperiod features such as inundation timing and duration can help predict community dynamics and ecosystem stability. In areas defined by high spatial and temporal variability, fine-scale temporal variation in inundation timing and duration may drive community structure, but that variation may not be captured using common approaches including remote sensing technology. Here, we provide methods to accurately capture inundation timing by fitting hidden Markov models to measurements of daily temperature standard deviation collected from temperature loggers. We describe a rugged housing design to protect loggers from physical damage and apply our methods to a group of intermittent ponds in southeastern Arizona, showing that initial pond inundation timing is highly variable across a small geographic scale (~50km2). We also compare a 1-logger (pond only) and 2-logger (pond + control) design and show that, although a single logger may be sufficient to capture inundation timing in most cases, a 2-logger design can increase confidence in results. These methods are cost-effective and show promise in capturing variation in intraregional inundation timing that may have profound effects on aquatic communities, with implications for how these communities may respond to hydroperiod alteration from a changing climate.

It's in the teeth: Terrestrial reptile fauna recovery following the end-Permian mass extinction

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Few events change global ecosystems as rapidly and irreversibly as mass extinctions, which lead to changes in the dominance and diversity of major groups of organisms. The end-Permian mass extinction (EPME) decimated ecosystems globally and enabled the archosauromorph reptiles (crocodylians, birds, and their closest relatives) to dominate terrestrial environments. Previous work has shown that marine ecosystems took 8-9 million years to recover from the EPME and hypothesized terrestrial recovery was also delayed. However, the scarcity of terrestrial Early Triassic fossil assemblages limits reconstruction of ecological recovery, preventing determining if this delayed recovery is an accurate signal, or the result of preservation bias. The Driefontein locality from the Lower Triassic of South Africa preserves a rich vertebrate assemblage. As articulated specimens are rare in the Driefontein assemblage, we used teeth, isolated and within jaws, to interpret diet of these reptiles. To visualize tooth shape, we collected qualitative character scorings from 111 isolated (of thousands) teeth, ordinated using non-metric multi-dimensional scaling (NMDS). The isolated teeth reveal four new carnivorous/insectivorous morphotypes (categories of teeth based on overall shape) and two morphotypes potential herbivorous morphotypes. The presence of multiple tooth morphotypes, including probable herbivores, indicates that the Driefontein locality preserves a diverse (n>5) archosauromorph assemblage. We interpret this to mean archosauromorphs filled multiple trophic levels within 4 million years of the EPME. This indicates terrestrial ecosystems, at least by dietary groups, may have stabilized from the end-Permian mass extinction in the Early Triassic approximately 5 million years sooner than previously hypothesized.

Exposing frog embryos to bacterial isolates: Colonization order impacts microbiome structure in Dendropsophus ebraccatus tadpoles

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Priority effects, or impacts of colonization order, can have a lasting influence on the composition of ecological communities. Externally developing embryos, such as amphibian

embryos, experience stochasticity in colonization order by environmental bacteria that ultimately comprise the initial microbiome. To determine if priority effects during embryo colonization impacted bacterial community composition on newly hatched tadpoles, we selectively inoculated the embryos of lab-raised hourglass tree frogs, *Dendropsophus ebraccatus*, over two days with two bacteria (*Acinetobacter* sp. and *Stenotrophomonas* sp.) initially isolated from the skin of wild adult *D. ebraccatus* in Panama. On day one, each egg received an inoculation of one of the isolates or sterile water. On the second day, eggs received either the same isolate, the alternate isolate, or sterile water. Through 16S rRNA gene amplicon sequencing, we observed shifts in ASV relative abundance within tadpole communities due to priority effects. Being the first inoculum led to increased relative abundance for *Acinetobacter*, but not for *Stenotrophomonas*. Our results suggest that the initial microbial source pools that embryos are exposed to shape bacterial communities at later life stages; however, stochasticity in colonization does not impact all bacterial colonists in the same manner.

Sex-biased infections and mortality in a multi-host fungal pathogen of bats

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Emerging infectious diseases are a key threat to wildlife and understanding disease dynamics within populations is fundamental for the conservation of impacted species. Intersex differences in infection are widely observed across disease systems and may have consequences for host population recovery. We explored sex-biased infections of bat species impacted by an emerging fungal disease, white-nose syndrome, and evaluated disease-associated differences in mortality between sexes and potential effects on population structure. We collected fungal swabs, morphometrics, and environmental data from five

species of hibernating bats at 43 sites spanning the eastern and midwestern U.S. to characterize infections and host traits over the course of an annual outbreak. We also used RFID systems at hibernacula and PIT-tagged bats to determine the role of sex-based activity patterns in shaping intersex infection patterns. We found females suffered from more severe infections than male conspecifics when there was a clear sex-bias. In addition, we found females were less likely than males to be recaptured overwinter and accounted for a smaller proportion of populations over time. Notably, female-biased infections were evident by early hibernation, suggesting that sex-based dynamics prior to hibernation may play an important role in shaping WNS outbreaks. Higher fall activity in male bats compared to female bats may enable males to reduce infections relative to female bats. Higher impacts in female bats may have cascading effects on bat populations and extend the consequences of WNS beyond the hibernation season, such as limiting recruitment and increasing the risk of Allee effects.

How much is enough? Determining the minimum infectious threshold for Usutu virus transmission between birds and biting Culex mosquitos

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Usutu virus (**USUV**; *Flavivirus*), is an emerging zoonotic virus typically maintained in an enzootic cycle between mosquitos (*Culex* spp.) and wild birds. USUV is closely related to West Nile virus (**WNV**) and St. Louis Encephalitis virus (**SLEV**), both of which are endemic in the United States. Over the last two decades, increased USUV outbreaks have resulted in a rise in human neuroinvasive disease, concurrent with mass mortality events in several avian species across Europe. Yet, the avian species essential for USUV maintenance and the level of viremia (virus in blood) that is required for transmission between host and vector remain elusive. Due to the similarities of USUV, WNV and SLEV, we hypothesize that the minimum infectious threshold for USUV is comparable to these viruses. To investigate the enzootic transmission dynamics of USUV, we sought to establish avian and mosquito infection models. Juvenile chickens from a line selected for low (**LAS**) antibody production against sheep red blood cells showed susceptibility to USUV, with high viremia levels. Next, we observed a 76% infection rate of American *C. quinquefasciatus* mosquitos fed an infectious blood meal, indicating that *C. quinquefasciatus* mosquitos are susceptible to USUV. Thus, to determine the minimum infectious threshold required for transmission, *C. quinquefasciatus* mosquitos will feed upon our LAS chicken model and USUV infection and transmission rates will be assessed. Discerning the minimum amount of virus necessary for enzootic transmission is critical for identifying

maintenance host species, which in turn, can aid in predicting possible spread and emergence of USUV.

Whole-ecosystem experiments reveal that thermocline deepening shifts the peak biomass depth and community structure of phytoplankton in a eutrophic reservoir

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Phytoplankton are essential to lake and reservoir ecosystem function but can also pose water quality concerns by forming harmful blooms. Phytoplankton communities are increasingly affected by a variety of global change stressors, such as warming waters, extreme storms, and nutrient pollution. Disentangling the impacts of these stressors requires an experimental approach. We conducted whole-ecosystem experiments over four summers to assess the response of phytoplankton depth distribution and community structure to thermocline deepening, a disturbance associated with extreme storms. We experimentally deepened the thermocline of a eutrophic reservoir by over a meter for two summers, and then allowed the thermocline to form naturally for two summers. To assess phytoplankton response, we collected weekly depth profiles of phytoplankton biomass, samples for microscope identification of phytoplankton at the maximum biomass depth, and profiles of environmental drivers, including temperature, light, and nutrients. We found that peak phytoplankton biomass was 1.4 m deeper on average in years with deepened thermoclines and that phytoplankton community structure differed in years with deep vs. shallow thermoclines. Shallow biomass peaks were associated with cyanobacteria, desmid, and dinoflagellate taxa, while deep peaks were associated with chlorophyte, cryptophyte, and diatom taxa. Seasonal patterns were similar across years, suggesting that thermocline deepening does not alter expected seasonal succession. Our results inform ecological theory relating phytoplankton distribution to community structure and quantify the strength of phytoplankton response to a global change disturbance.

Cascading consequences of climate and ontogeny on plant growth, defense, and herbivory in a neotropical shrub

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Plants allocate their resources based on a myriad of interactions with abiotic and biotic factors. As we are experiencing many climatic changes, including increased temperatures and greenhouse gases (e.g., CO2), we are still uncovering the cascading consequences of climate change on these interactions, particularly in the diversity-rich tropical systems. Here, we address how climate and leaf ontogeny affect plant growth, defense, and herbivory in a neotropical shrub. We used open-top, actively-warmed chambers to experimentally manipulate temperature and CO2 surrounding a neotropical shrub, *Piper generalense*, in the forest understory at La Selva Biological Station, Costa Rica. We then measured plant growth, foliar chemical defense (total phenolic concentration), and foliar herbivory to detect changes in resource allocation and its effectivity. We found that simultaneous drivers of climate change increased herbivory, as plants in chambers that paired increased CO2 and temperature experienced approximately 3 times more herbivory compared to plants in control chambers. Across all treatments, plants that experienced greater herbivory exhibited less growth in height (an average of 0.9 cm less growth with every 1% increase in average leaf herbivory). Foliar chemical defense was clearly moderated by leaf age, as younger leaves averaged 1.4 times higher phenolic concentrations than mature leaves. Young and more chemically-defended leaves experienced less herbivory (mature leaves had 5.1 times more herbivore damage, and herbivory decreased 1.4% with every 1% increase in total phenolic concentration). However, we found no evidence that the climatic treatments had an effect on plant growth or chemical defense. Plants allocate resources for defense, particularly to younger leaf tissues that aren't yet physically defended, which helps decrease losses to herbivory. And greater herbivory will ultimately tax the plant, as we observed as less growth in height. The observed increase of herbivory in environments with elevated temperature and CO2 levels may pose an obstacle to plants as climate change exacerbates both, possibly necessitating a shift in plant resource budgeting and allocation. Plants balance a broad spectrum of interactions, and our results emphasize how the roles of climate and ontogeny are inextricably intertwined in species interactions. Understanding the effects of these major players will be a difficult but important task, particularly in the tropics, where chemical- and biodiversity are highest yet sensitivity to a changing climate may be greatest.

Can emotional prompts spotlight local opinions to improve flagship species selection?

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Surrogate species are common tools for mitigating biodiversity loss, whereby the preservation of one species enables the preservation of entire communities or ecosystems. While most surrogates are selected based on distribution or ecosystem function, the flagship species is unique, selected solely for its ability to act as a marketing symbol for conservation. Effective flagship species garner awareness and financial support, while encouraging the adoption of behavior change to advance conservation objectives. Despite their multipurpose use, flagships have been widely pigeonholed as a tool for generating funding. Consequently, research on flagship selection has fixated on the opinions of the wealthiest stakeholders, who are generally international wildlife viewers from the Global North. Meanwhile, the opinions and experiences of local stakeholders are often omitted from consideration. To better assess the preferences and experiences of local stakeholders, we developed a novel approach to flagship species selection. We conducted semi-structured focus group interviews with conservancy committees throughout Namibia, using emotional prompts to investigate what species traits are associated with positive and negative emotions, and compared our findings to the traits, definitions, and identities of traditional flagship species. Dozens of traits were associated with positive emotions, including many not previously ascribed to flagship species. Meanwhile, traits associated with negative emotions, which are notably lacking from flagship literature, were some of the most prevalent. Our findings indicate that current flagship species selection is myopic, failing to give credence to the experiences of local stakeholders who are ultimately tasked with the conservation of their wildlife.

Redundant or complementary? Identifying patterns of multifaceted frog and toad biodiversity in the eastern United States

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Biodiversity at its core describes variation among organisms. It is often quantified as species richness, with a high number of co-occurring species designating important ‘hotspots’. However, variation among organisms is not limited to species diversity. Other facets of biodiversity, including life history and phylogenetic diversity, may occur parallel to richness or may be independently distributed spatially. Considering multiple facets may be vital to understand the distribution of biodiversity’s functional and adaptive components, particularly if those facets do not co-occur with richness. We characterized spatial patterns and environmental drivers of species, phylogenetic, and life history diversity of anurans (frogs and

toads) in the eastern United States. We measured richness by building species distribution models (SDMs) to estimate the range of 27 anurans of the eastern US using publicly available occurrence and environmental data. We used phylogenetic data and a recently published anuran trait dataset to characterize phylogenetic and life history diversity. Finally, we compared patterns and drivers among facets to quantify areas of redundancy and complementarity. Measuring biodiversity as a multifaceted concept improves our understanding of why anurans occur where they do and can help inform more comprehensive and multidimensional conservation.

Assessing efficacy of agricultural best management practices for restoring stream health

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Agricultural best management practices (BMPs) are implemented to protect stream health while continuing agriculture. Stream health goals are often not achieved because the factors controlling BMP efficacy (e.g., landscape conditions, ecological responses, and social factors) are often not considered when installing BMPs. We are using an interdisciplinary approach to assess factors that may influence BMP efficacy. We used the Soil and Water Assessment Tool to model pollutant delivery to streams in southwest VA from 2000–2019. We are also collecting water quality data (*E. coli*, fecal coliforms, phosphorus, nitrogen, and suspended solids), benthic habitat condition (median pebble size and embeddedness), and benthic macroinvertebrate composition at 31 sites during spring and autumn from 2019–2022. Lastly, we will use surveys to understand landowner persistence in BMP implementation and maintenance after cost-share funding ends. Here, we present preliminary correlations among BMP counts, water quality, benthic habitat, and stream health (Virginia Stream Condition Index; VSCI). BMPs were positively correlated with nitrogen, but uncorrelated with other water quality metrics or VSCI. Benthic habitat was uncorrelated with suspended solids or VSCI. VSCI was negatively correlated with all water quality metrics except fecal coliforms. The relationships between VSCI and water quality parameters were expected; however, we were surprised by the lack of other relationships with BMPs and the positive correlation with nitrogen. Our small sample size may inhibit our ability to detect effects of BMPs given the spatiotemporal variation among sites. Also, BMPs may be too sparse or not in appropriate locations to achieve desired effects.

Global changing? Climate warming? Framing effects in climate change communication

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Political polarization is growing in the United States, and environmental issues have been swept up in the rising tide of partisanship. Concomitant with the growth of polarization, there has been increasing use of—and research about—strategic framing in communications. In this context, frames are "interpretive storylines" that highlight aspects of the issues being communicated. They are generally divided into two broad categories: equivalence and emphasis frames. Equivalence frames present logically identical information in different ways, while emphasis frames select different attributes of an issue to spotlight. Frames can impact attitudes, intentions and behaviors across a broad range of contexts, including in the environmental realm. Increasingly, scholars have sought to determine whether the political polarization of attitudes about environmental issues can be overcome through strategic framing. This research seeks to derive lessons from the literature about communicative framing effects on individuals exposed to messages about anthropogenic climate change. Through a systematic literature review, I am exploring relationships among message framing approaches, recipients' political views, and framing effects. A secondary goal of this research is to examine the prevalence of moral framing in climate change framing literature and the potential role of moral messaging in framing effects, by drawing on Jonathan Haidt's Moral Foundations Theory. After delving briefly into the background information outlined above, this research power talk will share results from ongoing literature searches and preliminary coding of included articles.

The spatial arrangement of nutrient fluxes through shallow, acidic forest soils

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In small headwater catchments, mass balance approaches for examining elemental fluxes have long been used to interpret watershed nutrient cycling and forest productivity. However, catchment structure (e.g., vegetation, minerology, topography) can vary greatly, and at relatively short distances, therefore flux estimations are often aggregated to a scale that misrepresents what is known about hillslope processes. Our project aims to characterize annual nutrient fluxes within the shallow soil zone along hillslopes at Hubbard Brook Experimental

Forest, N.H. using ion exchange resins coupled with hydrological measurements. We hypothesize that annual nutrient fluxes across a watershed are nonuniform due to spatial differences in biogeochemical processes and rates (e.g., mineral weathering, decomposition, leaching). Our hypothesis is supported by distinct spatial patterns in soil and groundwater chemistry that covaries with landscape position. A better understanding of the spatial variability in nutrient fluxes, especially those that are limiting to productivity, is important to quantifying the recovery of base-poor soils and stream water following acid deposition in Northeast forests.

Unraveling migration patterns of catfishes in the Amazon

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Most fish movements in Neotropical river-floodplains coincide with the flood pulse, which is the predictable annual flooding of large rivers. We are studying the migration of two species of catfishes in the Amazon basin, *Pseudoplatystoma fasciatum,* and *P. tigrinum*, which are threatened by poorly regulated fishing activities and the construction of hydropower dams that block their migratory movements. Despite these threats, the migrations performed by these catfish have not yet been studied. We, therefore, are addressing the following questions: What is the migration ecology of *P. tigrinum* and *P. fasciatum* in the Amazon Basin? Do *P. tigrinum* and *P. fasciatum* present homing behavior? To answer these questions, we will characterize the movement ecology of these catfishes by analyzing the trace-chemical composition of Strontium isotopes on their otoliths, i.e., their ear-bones. Otoliths record the chemical signature of the water in which the fish live as they grow and move between waters of different trace chemical compositions. Our analysis of the trace chemical composition of the otoliths will provide the profiles of Strontium isotopes, which will reveal migration patterns along with the life of individuals. These results will be used to inform stakeholders on the migration patterns and critical habitats used by the species to avoid overfishing and to guide the construction of the dams. Thus, this research will produce the knowledge necessary to develop new science-based fisheries policies to sustainably manage and conserve these catfish.

Integrating perspectives on carbon removal and whole-stream metabolism in running waters

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Quantifying whole-stream dissolved organic carbon (DOC) metabolism is needed to better integrate inland waters into whole ecosystem carbon budgets. To understand how in-stream DOC metabolism affects DOC removal, export, and terrestrial loading fluxes, we compared DOC removal in two streams estimated using two common methods: (1) bioassays to measure water column DOC uptake velocity; and (2) daily rates of stream metabolism and OC spiraling (i.e., complete OC removal) calculated from fluorescent dissolved organic matter, oxygen, and water level sensor data. We compared how in-stream OC removal estimated from these two methods affected terrestrial OC loading and DOC export using a mass balance model. Mean OC mineralization velocity (0.07 ± 0.04 m/d (±SD)) was greater than mean bioassay DOC uptake velocity (0.01 ± 0.01 m/d). We also observed this discrepancy in DOC removal rates between these two methods in a literature review of nearly 200 estimates. In model simulations, more DOC was removed when using OC mineralization velocity (0.5 to 17.0%) estimates compared to bioassay DOC uptake velocity (0.02 to 4.2%). We highlight how measurement uncertainty of in-stream DOC processing can have confounding effects when estimating terrestrial-aquatic DOC fluxes and removal. By integrating whole-stream metabolism with DOC transport, we can better quantify the role of running waters in the global carbon cycle.

Enabling the Simulation of Forest Management Under Climate Change

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Forests strongly influence the earth's climate and the climate mitigation plans set out in the Paris Climate accord rely heavily on both preserving existing forest and expanding forest through reforestation. Despite this we know relatively little about how the management of forests may need to change under climate change or how planners should use management to achieve climate goals. In our work we have developed novel tools to simulate many of the major aspects of forest management in one of the leading Earth System Models. By comparing our computer simulations to forest observations from across the Southeastern United States we have been able to verify that our simulations can reproduce the major events in a managed forest's lifecycle while simultaneously allowing us to investigate the ability of a demographic vegetation model to simulate ecological competition processes. These promising results set the stage for future work that will allow us to compare possible forest management alternatives to address global change.

Impact of Root Type on Stream Velocity and Boundary Shear Stress

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The impact of root type (e.g. flexible herbaceous roots vs. rigid woody roots) on fluvial streambank erosion is an ongoing debate. Riparian vegetation can change due to a changing climate, human disturbances, and the proliferation of invasive plant species. Understanding how root systems impact the force of flowing water against a streambank is key to informing how vegetation changes may impact geomorphologic processes like streambank erosion. Therefore, the goal of this experiment was to compare the effects of root type on near-bank velocity and boundary shear stress in a laboratory channel. To simulate a vertical streambank with bare soil (no roots), herbaceous roots, and woody roots, three walls were constructed using PVC sheets. Glued sand was used to represent bare soil (SW), while sand + polyester fibers and sand + synthetic plant material represented the flexible rooted wall (FRW) and rigid rooted wall (RRW), respectively. An acoustic doppler profiler was used to measure three-dimensional velocity profiles at multiple flow rates. Though preliminary, results indicate that roots dampen streamwise velocities; the SW had the highest measured velocities, followed by the FRW and then the RRW. Adjacent to the bank surface, shear stress was highest along the FRW and lowest along the RRW, indicating turbulence from the flexible fibers likely increased the hydraulic force on the banks compared to rigid fibers. The higher shear stress produced by the flexible fibers suggests that exposed herbaceous roots along a streambank may increase soil loss due to fluvial erosion compared to exposed woody roots.

Effect of temperature on behavior and contact rates in house finches

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Contact rates relevant for pathogen spread are shaped by behavior, and in turn, behaviors of susceptible and infected hosts are influenced by temperature. House finches (*Haemorhous mexicanus*), a songbird species, can become infected with the bacterial pathogen *Mycoplasma gallisepticum* (MG) through direct contact with infected conspecifics or indirect contact via shared use of bird feeders. MG causes the disease mycoplasmal conjunctivitis and outbreaks primarily occur in fall and winter. At cold temperatures, house finches rely on feeders to meet increased energy demands, which may increase contact rates between infected and uninfected

birds. However, the role of ambient temperature in driving behaviors relevant to transmission has not been studied. To determine how temperature influences behaviors and contact rates important for MG spread, we manipulated ambient temperatures (thermoneutral or subthermoneutral) for pair-housed birds and quantified feeding behaviors. We measured contact rates using a fluorescent transferrable powder applied around the conjunctiva of one "index" bird per pair and quantified the amount of powder directly or indirectly transferred to cagemates. To account for effects of sickness behaviors on contact rates, half of the index birds in each temperature group were given lipopolysaccharide injections to induce sickness behaviors similar to those in birds infected with MG. Because behavior and contact rates are integral in determining likelihood of pathogen spread, it is important to understand factors that affect both components. Thus, this experiment can provide insight into the role of the abiotic environment on transmission in this system and other infectious diseases more broadly.

Effects of Urbanization on the Nestling Nutrition of Song Sparrows

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Urbanization presents new challenges to organisms that persist in modified habitats. Urban environments can havereduced biodiversity, altered nutrient availability, and thus, species that persist in urban habitats may have access to less nutritious food or less food overall. Previous work has found that arthropod communities upon which many songbirds rely during breeding are of lower trophic levels in urban environments. A study in crows found that urban nestlings had lower plasma protein and calcium relative to rural nestlings. To determine how urbanization might impact food availability and nutritional quality for song sparrows we completed arthropod surveys 5 times during the breeding season and measured circulating whole protein and calcium levels from 64 urban and 25 rural nestlings across 3 rural and 3 urban sites. We found that our urban study sites had lower arthropod biomass, lower ratios of nutritionally rich orders (e.g. Aranae) and fewer arthropods overall compared to rural sites.

Despite differences in arthropod communities we did not find differences in nestling plasma protein across habitats. Rather, protein increased with age (p=0.0176). Calcium was higher in urban areas (p=0.0082), but there was an inverse relationship between age and circulating calcium in urban habitats (p=0.0123) such that older nestlings had less calcium. These data suggest that urban habitats, though harboring fewer arthropods, may not be nutritionally limiting and that nestlings receive equal and presumably adequate nutrition in both habitats. Future studies will compare diet by measuring what parents are feeding young, and will consider other measures of nestling nutrition.

Including distorted specimens in allometric analyses: using generalized linear mixed models to account for sample deformation

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Allometry, patterns of relative change in body parts, has been a standard to reconstructing patterns of growth within and across animals. Recording allometry through measurements is one of the few methods available to reconstruct growth in fossils. However, many fossil specimens are deformed during fossilization. Deformation can influence recovered allometric patterns by outlier effects, shifting results away from the original biology. Previous studies have removed distorted measurements from analyses; however, this removes variation and limits the number of samples. The issue lies in the method, not the specimens. Linear regression is sensitive to outliers, as opposed to a generalized linear mixed model (GLMM) which can code specimens as distorted. To test the efficacy of a GLMM, we performed a simulation based on measurements of the cynodont, *Exaeretodon argentinus*. To estimate the effects of distortion, we added variation to half of our simulated sample using a binomial distribution. We tested three models, with 1,000 repetitions each: linear regression without added variation, linear regression with added variation, and GLMM with added variation. We found that a linear regression of 10 non-deformed samples performed nearly equivalent to a GLMM of 15 samples including added variation. To validate these findings, we performed a nonparametric bootstrap analysis on two datasets. Results of the bootstrap analysis support our simulations such that the GLMM is better able to reconstruct patterns of allometry in samples with deformation. Our study suggests that a GLMM can better reconstruct patterns of allometry over a linear regression, given fossil datasets.