IGC Graduate Research Symposium
April 5, 2024

The Moss Arts Center

- AGENDA -

8:00 – 8:55	• Welcome Table with name tags (Entrance to Main Lobby) • Coffee & refreshments - 1st Floor Fife Lobby • Poster setup - 2nd & 3rd Floor Fife Lobbies
8:55-9:00	**Welcome,** by Dr. Bill Hopkins - The Cube
9:00-10:10	**IGC Platform Presentations Session 1** - The Cube Moderator: Isaac VanDiest **9:00-9:15** - Sex-specific mating strategies link phenology and infection in bats affected by an emerging fungal disease, **Macy Kailing** **9:15-9:30** - Regulation by disclosure: Toxic Releases Inventory in the News, **Hye-jeong Seo** **9:30-9:45** - Examining Associations Between Inflow and Infiltration and Detection of Viruses and Antibiotic Resistance Genes Across a Rural Sewershed, **Amanda Darling** **9:45-10:00** - The legacy of macroevolutionary history on invasions and modern adaptive responses in lizards, **Bailey Howell** **10:00-10:10** - CAPSTONE PRESENTATION: Utilizing community gardens for enhancing local biodiversity in Blacksburg, VA, **Prashasti Agarwal and Taylor Fossett**
10:10-11:25	• **Poster Viewing: Morning Session** – 3rd Floor Fife Lobby • Coffee & refreshments - 1st Floor Fife Lobby - Identifying Drivers of Demand for Wild Turtles in the United States, **Zoie McMillian** - Estimating Pathogen-Spillover Risk Using Host-Ectoparasite Interactions, **Reilly Brennan** - Species Conservation, Collaborative Governance, and Global Change, **Tori Hymel** - Sustainable transition to the circular economy in Polyurethane foam industry by using backcasting method, **Mona Abadian** - Modeling Environmental Systems of Systems Using Hetero-functional Graph Theory: A Case Study of Lakes and Dams Toward Comprehensive Land-Use, Watershed, and Economic Analysis, **Meg Harris** - Combating the Spread of Antibiotic Resistance Negotiation Simulation: Using Serious Games to Simulate Policy Deliberation, **Becki Riddle**

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	- Ecological memory of spring air temperature drives summer water quality dynamics in temperate lakes, **Abby Lewis** - Predicting Dynamics of Arapaima spp. Populations from Social and Ecological Variables, **Emma Hultin** - Fisher's perception of social norms and illegal harvesting in the Brazilian Amazon, **Caetano Franco** - Greenhouse gas dynamics in vulnerable tropical coastal wetlands: assessing the spatial variability and the potential impacts of saltwater intrusion, **Carla López Lloreda** - Evaluation of ecological niche modeling (ENM) of infectious diseases: A systematic review, **Shariful Islam** - Measuring variation in migratory behavior using eBird data, **Nic Bone** - First satellite track of a juvenile shortfin mako (Isurus oxyrinchus) in the Mediterranean Sea, **Brendan Shea** - Using arboreal camera traps as a tool to monitor plant-seed disperser interactions in the temperate forests of Central Appalachian Mountains, **Abir Jain** - How Root Architecture in Cover Crops Influences Organic Carbon Stocks in Soil, **Stephanie Duston** - Co-Management in Fisheries: Exploring its Relationship with Food Security, **Priscila Cunha** - Reliably different: aggression is flexible but higher in urban male song sparrows compared to rural, **Taylor Fossett** - Assessing the factors that contribute to the nest abandonment of bluehead chubs (Nocomis leptocephalus), **Thomas Bustamante**
11:30-12:30	**Keynote Speaker -** The Cube Keynote Title: *High-Stakes Science Communication* **Dr. Linsey Marr,** University Distinguished Professor and Charles P. Lunsford Professor of Civil and Environmental Engineering at Virginia Tech
12:30-1:45	**Lunch Break** - 1st Floor Fife Lobby ***1:30-1:40*** Students that presented in the AM session should remove their posters from 3rd floor at this time.

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1:45-2:40	**IGC Platform Presentations Session 2** - The Cube Moderator: Abby Lewis **1:45-2:00** - Recognizing and Restoring Virginia's Piedmont Grasslands, **Jordan Coscia** **2:00-2:15** - Relative Activity and Occupancy of Little Brown Bats (Myotis lucifugus) Along the Chesapeake and Ohio Canal, **Megan Moran** **2:15-2:30** - Fish 'n' Floods: The Impact of High-Water and Low-Water Levels on Catch in the Amazon River Floodplain, **Gabriel Borba** **2:30-2:40** - CAPSTONE PRESENTATION: Bridging Science Communication Barriers in Virginia: Per- and polyfluoroalkyl substances (PFAS) in private drinking water wells, **Amanda Darling and Kathleen Hohweiler**
2:40-2:50	**Intermission** - Coffee available outside of The Cube
2:50-3:35	**IGC Platform Presentations Session 3** - The Cube Moderator: Joshua Mouser **2:50-3:05** - Multivariate climate change impacts on seed dispersal by ants: a mesocosm approach, **Melissa Burt** **3:05-3:20** - Shifting Focus toward Holistic Watershed Management: Effects of Spatially Targeted Stream Restoration on Watershed-Scale Flood Dynamics, **Luke Goodman** **3:20-3:35** - Colder temperatures augment bacterial pathogen persistence on bird feeders, **Sara Teemer**
3:35-4:50	• **Poster Viewing: Afternoon Session** – 2nd Floor Fife Lobby - Predicted prophages of bacterial isolates collected from amphibian skin, **Emma Bueren** - Feeding birds but not FeederWatching: barriers to participation, **Christy Pototsky** - Canadian hydroelectricity imports to the U.S.; Modeling of hourly carbon emissions reduction in New England, **Amir Gazar** - Assessment of nest predators for a declining tidal marsh songbird in Virginia, **Bridget Re** - Riparian-stream connections and the role of disturbance governing the frequency and intensity of forest insect pest outbreaks, **Sergio Sabat-Bonilla** - Using phylogenetics to predict bat species' adaptability to White-Nose Syndrome, **Eliza Tarimo**

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	- Wildfire and prescribed burn effects on soil microbial community structure, function, and diversity, **Meredith Snyder** - Dissemination of antimicrobial resistance (AMR) upstream and downstream of a wastewater treatment plant in rural Southwest Virginia, USA, **Idowu Kayode Okeshola** - Annual survival and steroid hormones in birds, **Camilo Alfonso** - Does climate mediate changes in zooplankton succession in a eutrophic reservoir?, **Heather Wander** - Low-dose lead exposure alters gene expression in the songbird brain during a critical period of development, **Casey McLaughlin** - Tradeoffs in acoustic detection error for invasive and native anurans in the southwestern US, **Grace O'Malley** - The role of parental care and parental investment in sexual dichromatism, **Jay Margolis** - Flood-Pulse Effects on the Growth of Pseudoplatystoma fasciatum in the Amazon Basin, **Luciana Pereira** - Venturing into the Virtual Wild: Innovations in Ecological Modeling with Virtual Species and Rarity Frameworks, **Mariana Castaneda-Guzman** - A Tale of Two Pine-Savannahs: Case Studies on Mixed Flocking Behavior, **Noah McNeill** - An Analytical, Ecological and Molecular Approach to Assess Responses of Freshwater Bivalves to Anti-Inflammatory Pharmaceuticals, **Katie Mayer** - Spatiotemporal changes in dissolved organic matter across a reservoir watershed, **Dexter Howard**
4:50-6:00	**Reception and Platform Award Announcements -** 3rd Floor Fife Lobby ***6:00-6:15*** Students that presented in the PM session should remove their posters from 2nd floor at this time.

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PLATFORM PRESENTATION:

Sex-specific mating strategies link phenology and infection in bats affected by an emerging fungal disease

Kailing, M.J.* [1], *Hoyt, J.R.*[1], *White, J.P.*[2], *Redell, J.A.*[2], *Kaarakka, H.M.*[2], *Langwig, K.E.*[1]

[1] Department of Biological Sciences, Virginia Tech
[2] Wisconsin Department of Natural Resources

Mating dynamics can affect species resilience to global change, including disease emergence, as they shape demographic and evolutionary processes that govern population growth and adaptation as well as individual mortality. Accordingly, understanding how mating systems influence interactions between individuals and novel pathogens can improve our ability to predict population responses to disease. Here, we examined how mating activity varies between sexes of bats impacted by white-nose syndrome to understand how reproductive strategies contribute to disease impacts, particularly because replication of the cold-temperature dependent pathogen is inhibited on active bats and permitted on inactive. We installed passive antenna systems at the entrances of hibernacula to characterize activity of little brown bats. We also measured infections on bats during autumn mating and early hibernation. We found females were active on fewer nights that were warmer, arrived after males, and ended activity earlier. Males remained highly active throughout an extended mating period compared to females. Differences between sexes in infection were not observed during the mating period. Rather, female-biased infection arose after mating activity concluded and hibernation began. Different activity between sexes and an asynchronous transition from swarm to hibernation likely reflects males maximizing their mating opportunities by remaining active, thus reducing infection. Females must conserve their energy to meet the higher cost of spring reproduction, thus, by reducing activity sooner advance fungal growth. We show how the mating system can promote sex-biases in infection. Broadly, we emphasize the value in understanding mating dynamics to support management in the face of global change.

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PLATFORM PRESENTATION:

Regulation by disclosure: Toxic Releases Inventory in the News

Seo, H.* [1], *Schenk, T.*[1]

[1] School of Public and International Affairs, Virginia Tech

This study provides a comprehensive overview of the status of Toxic Release Inventory (TRI) reporting in news media and the role of informational intermediaries in disseminating TRI data. Despite the high number of TRI reporting facilities and significant releases, there is a notable lack of media coverage, attributed to factors such as decreased public awareness of TRI facilities, limited media resources, and the complexity of TRI data. Environmental organizations emerge as the primary intermediaries utilizing TRI data, followed by investigative news articles and researchers/experts. These intermediaries play a crucial role in interpreting and disseminating TRI data to the public, with environmental organizations particularly effective in garnering news coverage. Recommendations for improving information disclosure effectiveness include enhancing the specificity of EPA press releases and expanding training sessions for TRI users. Overall, understanding the dynamics between TRI reporting, media coverage, and informational intermediaries is vital for advancing public awareness and engagement with environmental issues.

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PLATFORM PRESENTATION:

Examining Associations Between Inflow and Infiltration and Detection of Viruses and Antibiotic Resistance Genes Across a Rural Sewershed

Darling, A.* [1], *Deck, M.*[1], *Davis, B.*[2], *Rivera, G.M.*[1], *Price, S.*[3], *Byrne, T.*[4], *Amaral-Torres, A.*[1], *Markham, C.*[1], *Vikesland, P.*[1], *Krometis, L.*[3], *Pruden, A.*[1], *Cohen, A.*[5]

[1] Civil Engineering, Virginia Tech
[2] Environmental Protection Agency, Cincinnati, OH
[3] Biological Systems Engineering, Virginia Tech
[4] Genetics, Bioinformatics, and Computational Biology, Virginia Tech
[5] Population Health Sciences, Virginia Tech

As wastewater-based surveillance earns credibility for understanding early warning disease transmission risk, it is important to understand if significant variability is introduced by system biases, particularly those driven by inflow and infiltration (I&I).

To characterize I&I impacts on pathogen detection, we collected monthly wastewater samples at 12 sewershed nodes and WWTP influent from a system with an estimated 30% I&I contribution to influent flow. ddPCR was performed to enumerate three viruses (Rotavirus, Norovirus GII, and SARS-CoV-2), one clinically relevant antibiotic resistance gene (ARG) (blaCTX-M-1), and one ARG that reflects the anthropogenic influence of AMR (intI1) alongside three human fecal markers. 10% of samples were processed for TaqMan Array Card (TAC) qPCR to enumerate 31 enteric pathogen targets.

Of the monitored pathogens using TAC, SARS-CoV-2, Salmonella spp., Norovirus GI/GII, Adenovirus 40/41, pathogenic Escherichia coli spp., and Clostridium difficile were detected upstream at multiple sites but not detected in WWTP influent on the same sampling event. Despite known I&I impacts at WWTP influent, detection frequency for Norovirus GII and Rotavirus was greater at influent than non-I&I impacted sites. ddPCR concentrations were higher at WWTP influent than 90%, 45%, and 90% of upstream sites for Rotavirus, SARS-CoV-2, and Norovirus GII respectively, including those with minimal I&I.

Collecting upstream samples and sensitive detection methods may be necessary for some pathogenic targets where I&I conditions are more extreme. Most likely due to lateral mixing post conveyance, WWTP influent exhibited improved detection and higher concentrations of targets using ddPCR compared to most upstream sites, even those with limited I&I influence.

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PLATFORM PRESENTATION:

The legacy of macroevolutionary history on invasions and modern adaptive responses in lizards

Howell, B.K.* [1], *Pham, S.T*[1], *Hagey, T.J.*[2], *Uyeda, J.C.*[1]

[1] Department of Biological Sciences, Virginia Tech
[2] Department of Science and Mathematics, Mississippi University for Women

A species' ability to succeed in novel environments is critically influenced by its inherent traits. These traits, varying across species, can either facilitate or hinder responses to novelty, granting an advantage to some (often invasive species) while leaving others vulnerable. To assess the predictive capacity of species traits and phylogeny, I used random forest classifiers to predict whether a given lizard species is introduced within its range. Comparing models containing only species trait data to those incorporating phylogeny, we found an increase in predictive accuracy when phylogenetic information is included. This underscores the importance of understanding species relationships in predicting responses to novel environments, particularly when trait data is limited.

Furthermore, the evolution of these traits through time may offer additional insights into species' adaptability, helping us to understand why some species thrive in new environments. To explore this, I modeled the evolution of two morphological traits associated with urban tolerance in two lizard clades, Anolis and Hemidactylus, both comprising numerous urban-tolerant and invasive species. We found heterogeneity in the evolution of these traits (limb length and toepad area) between the two clades, suggesting that their evolutionary histories may influence their responses to novel habitats in unique ways.

To further investigate this phenomenon, my future research will explore whether trait variability within each clade predicts trait divergence between forest and urban populations within species. By elucidating the link between traits, macroevolutionary history, and species' responses to environmental change, we can better understand how certain species succeed in changing landscapes.

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CAPSTONE PRESENTATION:

Utilizing community gardens for enhancing local biodiversity in Blacksburg, VA

Agarwal, P.*[1], ***Fossett, T.E.****[2], *Walters, J.*[2]

[1]School of Plant and Environmental Science, Virginia Tech
[2]Department of Biological Sciences, Virginia Tech

Urbanization and climate change, two of the world's biggest "wicked problems," are altering habitats on a global scale, posing a major threat to the biodiversity we see across ecosystems. When it comes to taking steps towards combating these wicked problems, the average person can feel at a loss. However, there are steps that can be taken to enhance biodiversity that the average person may be unaware of. One resource that is often overlooked is community gardens. Community gardens provide food security, community engagement, an opportunity for learning, and can act as hotspots for enhancing local biodiversity. For our capstone project, we collaborated with Hale Community Garden in Blacksburg, VA to pursue 4 main goals: 1) survey the needs of community garden members 2) use this information to build a model for sustainable multi-use gardening 3) install bird nest boxes at Hale Community Garden to provide a nesting location for native, cavity-nesting birds and 4) lead a birding trip at Hale Community Garden to help the community feel connected to local wildlife. As per our survey, the residents of Blacksburg have got a 'green thumb!' Gardeners are successfully growing as many as 40 different types of food, fruit, and flowers, with a mix of natives and exotic species. We used our survey data to build a multi-use model for gardening in Blacksburg, VA, a tool that we hope will act as a kickstart for novice and experienced gardeners alike who are willing to protect and restore native vegetation and biodiversity.

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POSTER VIEWING: MORNING SESSION

Identifying Drivers of Demand for Wild Turtles in the United States

McMillian, Z.* [1], *Chaves, W.*[1]

[1] Department of Fish and Wildlife Conservation, Virginia Tech

Illegal turtle trade and unsustainable collection are major threats to turtle populations all over the world. Demand for food, pets, commodity goods, and medicine are likely drivers of illegal wildlife trade worldwide, but details surrounding drivers of turtle trade within the United States (U.S) remain largely unstudied. The objective of this research project was to understand the relationship between turtle acquisition and social norms, the desire for an exotic pet, the desire for companionship, and threat perceptions of turtle trade impacts on wild populations. We used an online panel survey of 1464 adults living in the U.S, consisting of those who own turtles, those who have considered owning turtles, and those who have never owned or considered owning a turtle. Logistic regression models were use for threat perceptions and social norms, while chi-squared tests were used to compare the motivations between turtle considerers and turtle owners. We found that those who identified companionship and exotic pet ownership as a motivator were more likely to be turtle owners (26.5%, 8.68%) than merely consider owning a turtle (17.25%, 6.94%) ($p=0.00018$, $p=1.13e-10$). There was a positive correlation between higher threat perceptions and turtle ownership ($r=0.17$, $p=0.0048$), and a positive correlation between turtle ownership and social norms related to having friends, family, peers, and role models who owned turtles ($r=0.73$, $p < 2e-16$). This information can help us understand drivers of turtle consumption and ultimately inform strategies to reduce illegal turtle trade and increase responsible turtle ownership in the U.S.

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POSTER VIEWING: MORNING SESSION

Estimating Pathogen-Spillover Risk Using Host-Ectoparasite Interactions

Brennan, R.N.* [1], *Paulson, S.L.*[1], *Escobar, L.E.*[2,3,4,5]

[1] Department of Entomology, Virginia Tech
[2] Department of Fish and Wildlife Conservation, Virginia Tech
[3] Center for Emerging, Zoonotic and Arthropod-borne Pathogens, Virginia Tech
[4] Global Change Center, Virginia Tech
[5] The Kellogg Center for Philosophy, Politics, and Economics, Virginia Tech

Pathogen spillover corresponds to the transmission of a pathogen or parasite from an original host species to a novel host species, preluding disease emergence. Understanding the interacting factors that lead to pathogen transmission in a zoonotic cycle could help identify novel hosts of pathogens and the patterns that lead to disease emergence. We hypothesize that ecological and biogeographic factors drive host encounters, infection susceptibility, and cross-species spillover transmission. Using a rodent-ectoparasite system in the Neotropics, with shared ectoparasite associations as a proxy for ecological interaction between rodent species, we assessed relationships between rodents using geographic range, phylogenetic relatedness, and ectoparasite associations to determine the roles of generalist and specialist hosts in the transmission cycle of hantavirus. A total of 50 rodent species were ranked on their centrality in a network model based on ectoparasites sharing. Geographic proximity and phylogenetic relatedness were predictors for rodents to share ectoparasite species and were associated with shorter network path distance between rodents through shared ectoparasites. The rodent-ectoparasite network model successfully predicted independent data of seven known hantavirus hosts. The model predicted five novel rodent species as potential, unrecognized hantavirus hosts in South America. Findings suggest that ectoparasite data, geographic range, and phylogenetic relatedness of wildlife species could help predict novel hosts susceptible to infection and possible transmission of zoonotic pathogens. This study supports the idea that ectoparasite relationships among rodents are a proxy of host interactions and can inform transmission cycles of diverse pathogens circulating in wildlife disease systems.

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POSTER VIEWING: MORNING SESSION

Species Conservation, Collaborative Governance, and Global Change

Hymel, V.* [1], *Schenk, T.*[1], *Armsworth, P.*[2]

[1] School of Public and International Affairs, Virginia Polytechnic and State University
[2] Department of Ecology and Evolutionary Biology, University of Tennessee Knoxville

This portion of a larger NSF-funded project focuses on the anthropogenic drivers of change and the governance system charged to respond. It explores the reactions of stakeholders engaged in species protection to changes in statuses and distributions. Our research questions spotlight interactions between actors involved in species protection. To do so, we focus on those working in the Southeastern United States, a landscape identified as critical to the future of biodiversity and characterized as a fragmented and layered governance system. While we focus on biodiversity, questions about how natural resources management agencies and other stakeholders can adapt and collaborate effectively in light of coming changes are more general.

We conducted semi-structured interviews with key actors in biodiversity protection, including state wildlife agencies, federal conservation programs, and large non-governmental organizations. We focused on how these organizations approach management of species, both individually and in concert; where they perceive opportunities for enhancing collaborative governance; and what obstacles they perceive to effective adaptation and collaboration.

Preliminary results include themes of the importance of trust in building relationships, opportunities for collaborations within and across state boundaries (especially as protected species' habitats shift), areas of weakness in utilizing climate change information (namely, how to interpret the wealth of pre-existing information), and what support agencies need to approach large procedural shifts like incorporating plants into State Wildlife Action Plans. This work has shown the importance of understanding and guiding the social science side of wildlife management to maximize programmatic effectiveness and potentially limited time and resources.

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POSTER VIEWING: MORNING SESSION

Sustainable transition to the circular economy in Polyurethane foam industry by using backcasting method

Abadian, M.* [1], *Russell, J.D.*[1]

[1] Department of Sustainable Biomaterials, Virginia Tech

The circular economy (CE), as a solution to mitigate the environmental impacts, requires technical solutions, and alignment between the value-chain stakeholders. We employed Backcasting to develop strategies for a CE transition within polyurethane (PU) foam value-chain. Backcasting starts by recommending a vision for a desirable future and then working backward to identify the pathways needed to achieve that.

A two-day workshop involving 43 participants from industry, government, and academia was conducted through the ABCD Method. Participants envisioned 100% circularity in PU foam value chain and identified the current barriers and enablers. Then, they worked in groups to identify the CE requirements. Participants ranked these requirements individually and in the groups. After considering the top pathways, groups categorized them according to their time implementation.

During the workshop participants identified 84 barriers impeding the transition to CE. Participants generated 348 CE requirements to overcome barriers, leading to the identification of 78 CE pathways. the consensus-building process revealed strategic importance for all stakeholder groups in the CE transition. It indicated a shared vision, general awareness and acknowledgment of urgency regarding CE transition action.

Through backcasting, the study facilitated discussions among industry stakeholders, enhancing understanding of challenges, opportunities, and priorities for CE transition in the PU foam industry. The collaborative process resulted in a shared vision, diverse strategic pathways, and aligned priorities. The outcomes will be used to develop a comprehensive white paper and a strategic CE transition roadmap for the PU foam industry, contributing valuable insights to voluntary sustainability initiatives.

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POSTER VIEWING: MORNING SESSION

Modeling Environmental Systems of Systems Using Hetero-functional Graph Theory: A Case Study of Lakes and Dams Toward Comprehensive Land-Use, Watershed, and Economic Analysis

Harris, M.* [1], *Farid, A.*[2], *Little, J.*[1]

[1] Department of Civil and Environmental Engineering, Virginia Tech
[2] Stevens Institute of Technology, School of Systems and Enterprises

The United Nations 17 Goals for Sustainable Development prioritize the challenges threatening the long-term health of the planet. These goals necessitate global partnership across nations and disciplines, drawing upon data and knowledge from human and natural systems, including sociocultural, biophysical, and sociotechnical systems. This research presents a multi-discipline-multi-problem thinking framework for modeling complex environmental systems of systems to address societal challenges. The approach uses Hetero-functional Graph Theory, a theory-guided method that reconciles disparate system-specific ontologies, meta-data, and mental models. Commencing with a demonstrative system featuring a single lake and dam, comparative simulations encompassing changing inflow, outflow, and dissolved oxygen levels demonstrate modeling capability. Then, the integration of multiple interconnected lakes and dams along river networks reveal the scalability of the approach. This methodology sets the stage for simulating larger-scale systems, incorporating aspects of land-use, watersheds, and economic factors which are far more difficult to directly couple otherwise. The ultimate objective of this research is the application of these models to the Chesapeake Bay Region, facilitating comprehensive environmental management and policy development. This study aims to offer a robust, extensible tool for comprehending and addressing the intricacies inherent in environmental systems.

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POSTER VIEWING: MORNING SESSION

Combating the Spread of Antibiotic Resistance Negotiation Simulation: Using Serious Games to Simulate Policy Deliberation

Riddle, R.B.* [1], *Goodman, L.*[1], *Schenk, T.*[1]

[1] School of Public and International Affairs, Virginia Tech

Background and Aim
Antimicrobial resistance represents a One-Health issue, indicating that the drivers and potential solutions are found in many sectors. Policy development in the field requires the engagement of stakeholders from government agencies and interest groups in order to create informed, broadly supported, and effective policies. This mixed-methods study examines how serious games can be used to teach both stakeholders and researchers about the importance of antimicrobial resistance, the influence of stakeholder values and the use of science in policy negotiations.

Procedure and Method
We developed a multi-role negotiation-style serious game focused on developing policy recommendations based on given information and assigned stakeholder interests and values. We surveyed the players of the game to understand the effectiveness of the exercise against six different learning objectives using a pre/post survey design. The game was immediately followed by a semi-structured focus group. We generated descriptive statistics and a Wilcoxon matched pairs test comparing pre- and post- exercise surveys, and coding of the focus-group.

Findings/Results
Participants noted that they felt that the interests should play less of a role, and consequently using more scientific information when forming policy recommendations. The players felt that the game was effective in teaching how policy deliberations can be impacted through the use of scientific information and the influence that different stakeholders and their values can have.

Implications/Applications
Findings of this study demonstrate how serious games are effective in cross-disciplinary training, forming more effective collaborations to combat antimicrobial resistance and promote evidence-based decision making.

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POSTER VIEWING: MORNING SESSION

Ecological memory of spring air temperature drives summer water quality dynamics in temperate lakes

Lewis, A.S.L.* [1], *Carey, C.C.*[1]

[1] Department of Biological Sciences, Virginia Tech

In many temperate lakes, summer bottom-water temperature and dissolved oxygen regulate both habitat viability and biogeochemical cycling, affecting ecological function year-round. However, trends in summer bottom-water dynamics are poorly explained by trends in summer air temperature, limiting our ability to predict the future effects of climate change on lake ecosystem function. To characterize drivers of variation in summer bottom-water dynamics, we analyzed data from 615 temperate lakes across 18 countries and 5 continents, with a median time series duration of 30 years at each lake. We found that many lakes exhibited seasonal ecological memory, whereby summer bottom-water temperature and dissolved oxygen were more associated with spring air temperature than summer air temperature. Conversely, summer surface-water temperature was more associated with summer air temperature. Across lakes, the extent of seasonal ecological memory in bottom waters was mediated by both the strength of thermal stratification and lake size, and the timing of thermal stratification regulated which window of spring air temperature was most influential. Our results help explain why trends in summer bottom-water temperature diverge from trends in summer air temperature, and suggest that predicting future water quality may require accounting for differential changes in climate among seasons.

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POSTER VIEWING: MORNING SESSION

Predicting Dynamics of Arapaima spp. Populations from Social and Ecological Variables

Hultin, E.A.* [1], *Brooks, G.C.*[1], *Kindsvater, H.K.*[1], *Castello, L.*[1]

[1] Department of Fish and Wildlife, Virginia Tech

Arapaima spp. are integral to both the economy and culture of Brazil, particularly for communities living in the Brazilian Amazon, and provide a valuable case study exemplifying the need to manage fisheries as coupled socio-ecological systems. After being severely overharvested in the late 1900s, arapaima are now under a co-management system whereby fishing communities collaborate with the Brazilian government and non-governmental organizations to set yearly harvest quotas and closed harvest seasons. Arapaima management presents a modeling challenge because of both the variation in human harvest behaviors across their range and their complex life history traits. We are evaluating modeling methods to integrate ecological and human social factors with a Bayesian hierarchical approach to understand their relative influence on arapaima populations. We will include count data from local observations, harvest data, hydrological dynamics, and human social factors that may serve as proxies for illegal/unreported harvest. This project is a novel attempt to integrate social and ecological data into a population model with tangible management implications. We aim to quantify both the ecological and socio-cultural factors most influential in regulating arapaima populations and produce a new framework for conducting integrated socio-ecological fisheries research.

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POSTER VIEWING: MORNING SESSION

Fisher's perception of social norms and illegal harvesting in the Brazilian Amazon

Franco, C.* [1], *Sorice, M.G.*[1]

[1] Department of Forest Resources and Environmental Conservation, Virginia Tech

Individual perceptions, influenced by personal experiences and cultural factors, are important drivers of human behavior. In particular, societal expectations significantly shape the decision-making process, especially in contexts like fishing. In this study, we analyzed the perception of fishers regarding the interaction between social norms and illegal fishing for arapaima (Arapaima gigas ssp.) in communities involved in community-based management initiatives in the Brazilian Amazon. Specifically, we examined the relationship between the strength of social norms, and the perceptions of illegal fishing. We used data from structured face-to-face interviews with fishers. To assess the effect of social norms on compliance with regulations against illegal fishing, we conducted a regression analysis where the perceived severity of noncompliance was modeled as a function of variables representing social norms. When social norms are stronger, the perception that illegal fishing occurs is lower. When social norms are weak, the perception of illegal fishing is higher. In contrast, stronger social norms were associated with lower perceptions of illegal fishing. A narrower confidence interval suggested less variability in perceptions among communities with strong social norms. This supports how informal expectations can be understood as a driver of behavior.

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POSTER VIEWING: MORNING SESSION

Greenhouse gas dynamics in vulnerable tropical coastal wetlands: assessing the spatial variability and the potential impacts of saltwater intrusion

López Lloreda, C.*[1], *Martínez, G.*[2], *Sotomayor, D.*[2], *Hotchkiss, E.R.*[1]

[1] Department. of Biological Sciences, Virginia Tech
[2] Department of Agro-environmental Sciences, University of Puerto Rico-Mayagüez

Tropical wetlands can play a more active role in carbon emissions than their temperate counterparts due to high temperatures and high precipitation. Although regional estimates for carbon emissions in wetlands have improved recently, many uncertainties remain about the contributions from the tropics and how disturbances might influence greenhouse gas dynamics in coastal wetlands. To survey wetland CO2 and CH4 concentrations in tropical coastal freshwater wetlands, we sampled dissolved surface water CO2 and CH4 at 7 non-tidal freshwater coastal wetlands in Puerto Rico in December 2020 and July 2021. We also deployed dissolved oxygen (DO) sensors at a subset of 3 sites for 2-3 days. Across sites, CO2 averaged from 202-490 µM and CH4 averages ranged from 0.2-88 µM. These coastal wetlands have consistently low oxygen conditions, usually <1 mg/L, and no diel patterns. Sites experience only temporary increases in DO (e.g., up to 1.2 mg/L), which could be due to turbulence and increased gas exchange. Across a range of conductivity (227-2477µS/cm), average CH4 concentrations were lower in sites with higher conductivity but did not correlate with CO2. These tropical coastal wetlands generally have lower concentrations of CO2 and CH4 than other inland freshwater wetlands. However, tropical coastal wetlands also frequently experience disturbances such as saltwater intrusion that can either enhance or inhibit biogeochemical processes that influence greenhouse gasses. Future work will experimentally address how increasing salinization influences CO2 and CH4 production in Puerto Rican wetlands.

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POSTER VIEWING: MORNING SESSION

Evaluation of ecological niche modeling (ENM) of infectious diseases: A systematic review

Islam, S.* [1,2], *Castaneda-Guzman, M.*[1], *Soler-Tovar, D.*[3], *Escobar, L.*[1,2,4]

[1] Department of Fish and Wildlife Conservation, Virginia Tech
[2] Global Change Center, Virginia Tech, Blacksburg, VA, USA
[3] School of Agricultural Sciences, Universidad de La Salle, Bogotá, Colombia
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Ecological niche modeling (ENM) is a new analytical approach to studying infectious disease ecology. ENM applications to spatial epidemiology are progressively increasing for the strategic identification of transmission-risk areas. How infectious disease research studies use fundamental niche theories and assumptions is often not reported. We systematically reviewed and evaluated articles on ENM applications to disease mapping published between 2020 and 2022, following the protocol developed by Zurrel et al. (2020). We reviewed 69 articles following a structured search and summarized the information for each component. The spatial extent of study areas varied from village level to global; the temporal duration ranged from 1 to 101 years; and the number of species studied ranged from 1 to 17, including pathogens, reservoirs, vectors, and definite hosts. Among the most common missing components in reporting were temporal autocorrelation (98.55%), algorithmic uncertainty (81.16%), temporal resolution (60.1%), absence data (66.67%), coordinate reference system (57.97%), model performance of validation data (56.52%), and model averaging (34.8%). Our findings suggest that there is a lack of consistency in reporting information about different components in the published spatial epidemiology literature that limits transparency, reproducibility, and data legacy in ENM applications to study diseases. Researchers and reviewers working in the field of ENM applications to infectious diseases should consider all components, following good practices in modeling protocols for biologically sound models that are informative for public health decisions.

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POSTER VIEWING: MORNING SESSION

Measuring variation in migratory behavior using eBird data

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[2] Cornell Lab of Ornithology

Despite the long-term recognition of bird migration as a behavioral spectrum, macroevolutionary studies often are reduced to defining the behavior based on limited categorical classifications. Here, we introduce a novel method utilizing citizen science data from eBird. This method captures the continuous variation in movement regularity across species, providing a continuous measure for a key migratory axis – site fidelity. This approach facilitates more nuanced analyses of migration's evolutionary history in birds, and potentially serves as a more valuable tool for understanding the relationships between migratory patterns and other traits. Ultimately, a deeper understanding of these relationships may help in identifying species vulnerable to a changing world.

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POSTER VIEWING: MORNING SESSION

First satellite track of a juvenile shortfin mako (Isurus oxyrinchus) in the Mediterranean Sea

Shea, B.D.*[1,2], *Castleton, M.* [3], *Chapple, T.K.* [4], *Echwikhi, K.* [5,6], *Gambardella, C.* [1,7], *Jenrette, J.F.* [1], *Moro, S.* [8], *Schallert, R.* [3], *Block, B.A.* [3], *and Ferretti, F.* [1]

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[8] Statzione Zoologica Anton Dohrn, Rome, Italy

The shortfin mako shark (Isurus oxyrinchus) is broadly distributed in tropical and temperate seas globally, but historical and ongoing overfishing have caused dramatic declines in its abundance. The species is listed as Endangered by the IUCN, and Critically Endangered in the Mediterranean Sea, where despite their poor conservation status, they are relatively common shark bycatch, with young-of-the-year and juveniles comprising the bulk of bycaught individuals. Regionally, most fishers typically retain bycaught sharks, with estimates of discard rates as low as ~1%, even for protected species, and shortfin mako sharks are the second-most frequently encountered shark for fishers regionally. Given the low reproductive capacity and late age at maturity of shortfin mako sharks, the ongoing harvest of juveniles represents a particularly grave threat to the species regionally.

Advances in satellite telemetry have improved our understanding of the movements of large marine predators globally; however, virtually no study has focused on Mediterranean populations, especially sharks. Here, we report the satellite track from a pop-off archival tag deployed on a juvenile shortfin mako shark in the Mediterranean Sea in May 2023. To our knowledge, this track represents the first satellite tag deployed on a shortfin mako shark in the Mediterranean. We describe the horizontal and vertical movements of the shark and discuss potential drivers for its movements over 54 days at liberty. We use the high-resolution dataset from the recovered tag to describe a potential fishery interaction that then occurred and discuss the potential implications of this event for the shark's subsequent mortality.

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POSTER VIEWING: MORNING SESSION

Using arboreal camera traps as a tool to monitor plant-seed disperser interactions in the temperate forests of Central Appalachian Mountains.

Jain, A.* [1], *Beamer, B.*[1], *Rogers, H.*[1]

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Animal-mediated seed dispersal is a key ecosystem function that maintains plant species diversity and distributions, yet our knowledge of species interactions is largely restricted to tropical forests. Many animals track fruit resources over long distances, but climate change is likely to restructure seed dispersal networks as it has been demonstrated to alter patterns of bird migration and plant phenology. There have been no full-season studies on plant-seed disperser interactions in the temperate forests of Central Appalachia and the methodological efficacy of observing these interactions is also untested in this region. We utilized arboreal camera trapping to assess the role of Appalachian animals in the seed dispersal of a relatively common fruiting shrub winterberry (Ilex montana) at a high-elevation site in Virginia. We installed cameras on 12 trees over 60 days and ~5000 hours of recording. As the fruiting window of winterberry aligns with the southbound migration of songbirds, we estimated avian visitation rates on fruiting Winterberries and compared that with nightly migration volume across fall 2023 recorded by Cornell Lab of Ornithology's BirdCast migration forecasting. We found that neotropical migrants are important seed dispersers for fruiting plants in fall, and camera trapping is a useful sampling method for observing behavioral interactions between plants and avian seed dispersers in temperate forests. Further, a community-wide understanding of seed dispersal networks along elevational gradients in Appalachian Mountains will have conservation implications as climate change threatens ecosystem function and will inform best future management practices that incorporate species interactions rather than a species-centric approach for conservation prioritization.

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POSTER VIEWING: MORNING SESSION

How Root Architecture in Cover Crops Influences Organic Carbon Stocks in Soil

Duston, S.* [1], *Strahm, B.*[1], *Badgley, B.*[2], *Barney, J.*[2], *Seiler, J.*[1], *Reid, R.*[3]

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Soil carbon pools undergo dynamic cycling influenced by complex interactions which involve plants and microbiota. The allocation of carbon from plants, particularly through belowground roots, plays a significant role in the contribution of soil organic matter (SOM) to soil systems. Our study explores the relationship between belowground plant traits, specifically root architecture and morphology, and the stabilization of mineral-associated organic carbon (MAOM-C).

Thirty cover crop species commonly used in agricultural and reclamation practices were grown to track changes in bulk SOM and MAOM-C over the course of 10 weeks in a controlled greenhouse environment. Findings from our research demonstrates that root morphology in legumes, grasses, and broadleaf plants elicits different responses in SOM stabilization. Notably, in the context of MAOM-C, increasing root diameter and belowground biomass lead to significant losses of MAOM-C in grasses and broadleaf cover crop species, whereas legume roots do not exhibit similar trends.

The significance of this research lies in the understanding that root morphological traits can impact carbon stabilization in MAOM-C which we hypothesize occurs via different mechanisms to include root C:N ratios and overall C:N:P stoichiometry of the soil. Current follow-up research employs isotopic methods to explore how atmospheric carbon cycles from plant to soil in non-legume cover crop species treated with varied nitrogen additions. My aim is to provide insights into the intricate relationships between root traits, nutrient availability, and carbon stabilization in soils, thus contributing to our understanding of soil carbon dynamics and management strategies for carbon sequestration.

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POSTER VIEWING: MORNING SESSION

Co-Management in Fisheries: Exploring its Relationship with Food Security

Cunha, P.R.* [1], *Castello, L.*[1], *Brondízio, E.S.*[2], *Fiorella, K.J.*[3]

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Fisheries governance influences environmental health and livelihoods by regulating access to natural resources, including food, thereby impacting local food security. While co-management governance is widely adopted in fisheries, its impact on food security remains insufficiently explored. Limited evidence suggests that co-management may improve food availability and access by enhancing natural resource status and increasing income. However, ensuring food security also involves maintaining food quality, which may be compromised by co-management due to increased income and reduced time for subsistence activities, potentially leading to increased consumption of highly-processed foods. Our study examined the impact of co-management on food security, focusing on access and quality, in 40 riverine communities engaged in Arapaima spp. co-management in the Brazilian Amazon. Data were collected using an institutional analysis protocol based on Ostrom's design principles and perception surveys with households' heads. Analyses were conducted using a Structural Causal Model framework and Linear Mixed-Effects Models. Preliminary data suggests that co-management income doesn't have a significant effect on food access, but income per capita and catch per unit are positively associated with increased food access. Given that only co-management income has been examined thus far, a comprehensive understanding of management's effect on food access is still pending. Findings also indicate that co-management income increase consumption of highly processed foods, a trend further influenced by market distance. These findings underscore the need for additional measures to ensure access to nutritious food in communities facing food insecurity, as neglecting this issue threatens the well-being of communities and the environmental health.

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POSTER VIEWING: MORNING SESSION

Reliably different: aggression is flexible but higher in urban male song sparrows compared to rural

Fossett, T.E.* [1], *Lane, S.J*[1], *VanDiest, I.J.*[1], *Sewall, K.B.*[1]

[1] Department of Biological Sciences, Virginia Tech

Urbanization poses novel challenges for wild animals. Animals can respond to these challenges by changing their behavior. Increased aggression can be associated with urbanization, for example. It is often assumed that the human built environment has the greatest impact on wild animals, but human presence alone can alter animal behavior. Understanding the relationship between urbanization, human presence, and aggression in urban animals requires comparing behaviors as conditions change over time. The quarantine in response to the COVID-19 pandemic offered an opportunity to study the effects of human presence on animal behavior in urban areas. We investigated how urban (n=190) song sparrows (Melospiza melodia) responded to simulated territorial challenges over 8 years (2016–2023) including the years before and after the COVID-19 quarantine and compared their behavior to that of rural birds (n=153). We found that urban birds were more aggressive than rural birds across all 8 years. Both urban and rural birds were less aggressive during the quarantine than in prior years. However, this was part of a pattern of both urban and rural birds decreasing aggression over the 8 years. This study is consistent with prior work showing that changes in human presence influence the behavior of wild animals. Thorough understanding of the effects of urbanization on wild songbirds requires long term studies across variable conditions.

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POSTER VIEWING: MORNING SESSION

Assessing the factors that contribute to the nest abandonment of bluehead chubs (Nocomis leptocephalus)

***Bustamante, T.B.**[1], Frimpong, E.A.[1]*

[1] Department of Fish and Wildlife Conservation, Virginia Tech

Organisms that construct and guard nests are regularly faced with tradeoffs between offspring survival and their own survival. If environmental conditions become too dangerous or unpredictable, then organisms may choose to abandon their nests to ensure their survival. As humans continue altering the environment, we must understand what factors contribute to nest abandonment to predict how abandonment rates of several species may change in the future. In this study we investigated the factors that contribute to nest abandonment in the bluehead chub (Nocomis leptocephalus), a nesting minnow in the Southeastern United States. We observed bluehead chub nesting activity in 2022 and 2023, visually assessed which nests were abandoned or successful, and measured environmental variables around each nest to determine which contribute to abandonment. Preliminary results show that the rate of change in water velocity, sedimentation rate, and the availability of nest associates all impact the probability of nest abandonment. These factors have the potential to become exacerbated in anthropogenically altered environments; therefore, we may observe increased chub nest abandonment rates in disturbed environments. Future work in disturbed streams is needed to determine the extent to which bluehead chub nests are at risk to anthropogenic factors.

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KEYNOTE SPEAKER:

Dr. Linsey Marr

University Distinguished Professor &
Charles P. Lunsford Professor,
Civil & Environmental Engineering,
Virginia Tech University

Keynote: *High-Stakes Science Communication*

Dr. Marr's talk titled, 'High-Stakes Science Communication' will focus on navigating high-stakes science communication during the COVID-19 pandemic, offering valuable insights and lessons learned. Drawing from her experiences, Dr. Marr will talk about the challenges faced in conveying complex scientific information to the public amidst differing perspectives, and evolving circumstances.

About Dr. Marr:

Dr. Linsey Marr holds a B.S. in Engineering Science from Harvard College and a Ph.D. in Civil and Environmental Engineering from the University of California at Berkeley. She leads the Applied Interdisciplinary Research in Air (AIR2) laboratory and teaches courses on air pollution and environmental engineering. Dr. Marr's research group studies the emissions, transformation, transport, and fate of pollutants in indoor and outdoor air.

She is especially interested in emerging or non-traditional aerosols such as engineered nano materials and viral aerosols such as viral pathogens and how they can be physically and chemically transformed in the environment. Her research on the airborne transmission of infectious disease has focused on COVID-19, influenza, Ebola virus disease, and Legionnaire's disease. She collaborates broadly with others to understand how changes at the microscopic to global scale affect public and environmental health.

Marr helped lead the charge to correct misinformation about COVID-19 transmission and is now considered one of the world's leading experts on airborne transmission of viruses.

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PLATFORM PRESENTATION:

Recognizing and Restoring Virginia's Piedmont Grasslands

Coscia, J.T.* [1,2], *Johnson, A.E.M.*[2], *Berton, J.*[3], *Harris, C.*[3], *Floyd, D.*[4], *Beall, M.C.*[1], *Bellangue, D.*[4], *Gorrell, J.*[3], *Chaney, D.*[4], *Sackett, E.*[4], *Staengl, E.*[1,4], *Reid, J.L.*[1]

[1] School of Plant and Environmental Sciences, Virginia Tech
[2] Smithsonian's Virginia Working Landscapes
[3] The Clifton Institute
[4] The Center for Urban Habitats

The grasslands of the Piedmont host diverse communities of sun-loving plants, but more than 90% of these grasslands have been lost. To conserve the grasslands that remain, we need to characterize their floristic communities, assess the impacts of human land use on biodiversity, and develop methods to restore degraded grasslands. To describe the floristic composition of natural grassland communities and assess the impacts of common land use practices on plant biodiversity, we surveyed plant community composition in 132 native grassland fragments and 113 working and restored grasslands across the northern and central Virginia Piedmont. We recorded 737 taxa (86% of which are native) across our native grassland sites, which represent over 23% of the plant species recorded in the state of Virginia. Cluster analysis and ordination of these native grasslands indicated four community groups, which we refer to as the Northern Prairies, Central Prairies, Savanna/Woodlands, and Wet Grasslands (supported by PERMANOVA $P < 1 \times 10\text{-}4$, $R2 = 0.19$). These native grasslands groups diverge from working and restored grasslands based on their dominant land use and management strategies ($P<0.0001$, $R2=0.177$). This divergence is largely due to the high native species richness found in native remnant and semi-natural grasslands ($P<0.01$, $R2=0.69$) and the high introduced and invasive species cover in working and restored grasslands, respectively ($P<0.01$, $R2=0.64$; $P<0.01$, $R2=0.38$). These results suggest that many current grassland management and restoration strategies used by private landowners in Northern Virginia may be insufficient to support and restore native biodiversity in degraded grasslands.

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PLATFORM PRESENTATION:

Relative Activity and Occupancy of Little Brown Bats (Myotis lucifugus) Along the Chesapeake and Ohio Canal

Moran, M.L.* [1], *Litterer, A.S.*[1], *De La Cruz, J.L..*[1], *Ford, W.M.*[2]

[1] Virginia Polytechnic Institute and State University, Blacksburg, VA, USA
[2] U.S. Geological Survey Virginia Cooperative Fish and Wildlife Research Unit, Blacksburg, VA

The little brown bat (Myotis lucifugus [MYLU]) is a species of concern due to dramatic declines following the introduction and spread of white-nose syndrome (WNS), a disease caused by the fungus Pseudogymnoascus destructans (Pd). However, modest population increases have been recorded in the Northeast, and anecdotal evidence suggests the same for the mid-Atlantic region. If populations are truly increasing, it is possible that activity patterns and occupancy on the landscape would reflect a positive change. We created occupancy and relative activity models from bat acoustic data collected on the National Park Service's Chesapeake and Ohio Canal National Historical Park (C&O) along the Potomac River in southern Maryland from 2016-2022. Additionally, because the park runs from Washington D.C to Cumberland, Maryland, spanning 3 physiographic provinces and a diverse urban to rural gradient, it represented a good opportunity to assess a wide suite of habitat variables, and other predictors of detection, such as weather and seasonality, which could be used to inform conservation and management across this landscape. Over this 7-year period, none of our habitat variables had an influence on MYLU occupancy in this region, although seasonality was a strong predictor of detection. Detection probability also increased with year. This is supported by our relative activity models, which showed an upward trend of bat activity over years, suggesting that similar to the Northeast, MYLU populations might be increasing in this region.

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PLATFORM PRESENTATION:

Fish 'n' Floods: The Impact of High-Water and Low-Water Levels on Catch in the Amazon River Floodplain

Borba, G.* [1], *Castello, L.*[1], *Rupprecht, M.*[2], *Martins, E.*[2], *Fleischamn, A.*[3]

[1] Department of Fish and Wildlife Conservation, Virginia Tech
[2] University of Northern British Columbia
[3] Mamiraua Institute of Sustainable Development

Fish catch in floodplain ecosystems is crucial to the livelihoods of millions of people worldwide. The catch is regulated by seasonal fluctuations in water levels, known as "flood pulses," which determine the ecosystem's structure and function. However, the key aspects of the flood pulse that control fish catch are not well understood, even though changes in fish biomass due to interannual variability in flood pulses have a significant impact on fish catch. To identify these aspects, we conducted a study on the Amazon Basin, analyzing 27 years of fish catch and river hydrology data using a generalized additive mixed model (GAMM). We looked at daily fishing trips and river water levels over the Amazon River mainstem to calculate hydrological metrics and fishing efforts. We then modeled the catch of each fish taxa response to hydrological indices based on fish effort and gear type over each fishing trip for each fishery boat. Preliminary results showed that catch is associated with two previous flooded years, where the duration of rising and receding waters are the key hydrological aspects of the flood pulse. A long rising and receding waters in the previous year led to increased catch in subsequent years. Fish depend on the flood to feed and grow. These research results will provide vital information on the effects of the flood pulse on fish catch, allowing for the development of management strategies to help fishers better adapt to hydrological alterations induced by climate change.

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CAPSTONE PRESENTATION:

Bridging Science Communication Barriers in Virginia: Per- and polyfluoroalkyl substances (PFAS) in private drinking water wells

Hohweiler, K.* [1], *Darling, A.*[2], *Krometis, L.*[1], *Ling, E.*[1]

[1] Biological Systems Engineering, Virginia Tech

[2] Civil and Environmental Engineering, Virginia Tech

Per and-polyfluoroalkyl substances (PFAS), a family of an estimated 9,000 compounds, have been detected in a variety of environmental and biological matrices across the United States and the globe. US EPA guidelines on PFAS in municipal drinking water include preliminary Maximum Contaminant Levels (MCLs) and MCL Goals for PFOA and PFOS and a Hazard Index to regulate four additional PFAS (PFHxS, PFNA, PFBS, and GenX) in mixture at present (March 2024). While any official enforceable PFAS limits will be enforced in municipal water systems, private wells are not regulated by the Safe Drinking Water Act, leaving household wells potentially vulnerable to PFAS in drinking water. As of 2024, nearly 23 million Americans and 6 million Virginians are estimated to be reliant on private wells, springs, or cisterns which do not fall under the jurisdiction of US EPA or federally set drinking water contaminant limits. State funded monitoring programs including the Virginia Household Water Quality Program (VAHWQP) are expanding communication efforts to include per- and polyfluoroalkyl substances in response to growing public interest and concern. The purpose of this project is to contribute a practical, comprehensive extension infographic on the current state of PFAS research, health effects, potential risks and treatment considerations for homeowners on private drinking water systems. This infographic will be made available for the public, scientists, and extension agents to better communicate health risks from PFAS to private well owners.

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PLATFORM PRESENTATION:

Multivariate climate change impacts on seed dispersal by ants: a mesocosm approach

Burt, M.A.* [1], *Nelson, A.S.*[2], *Whitehead, S.R.*[1]

[1] Department of Biological Sciences, Virginia Tech, Blacksburg, VA
[2] Department of Ecology and Evolutionary Biology, University of California, Irvine, CA

Ongoing anthropogenic climate change is drastically restructuring ecosystems, yet understanding these impacts is challenging because climate shifts are highly multidimensional. Although future climates are expected to be warmer with altered precipitation magnitude and frequency, most climate change experiments have focused only on temperature. Mutualisms may be especially impacted by climate change owing to their highly context dependent nature. Here, we present results from a greenhouse-based mesocosm experiment where we manipulated both temperature and precipitation magnitude and frequency to determine the effects of multidimensional climate changes on the outcomes of ant seed dispersal mutualisms. We specifically asked how warming and precipitation affected the number of seeds dispersed and seed dispersal distance by ants. After six hours, we found an effect of warming on seed removal by ants that depended on the precipitation treatment. While ants removed more seeds from ambient than warmed treatments in the historical precipitation treatment, they removed more seeds from warmed than ambient mesocosms in the higher magnitude, less frequent precipitation treatment. Higher seed dispersal under ambient temperature and historical precipitation may be partially explained by a greater number of ants active outside their nests in ambient than warmed mesocosms. Although we found differences in the number of seeds dispersed initially, this effect was gone by 24 hours and we also did not find an effect of warming or precipitation treatment on seed dispersal distance. Taken together, these results suggest that warming effects on seed dispersal by ants may be dependent on simultaneous changes to precipitation.

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PLATFORM PRESENTATION:

Shifting Focus toward Holistic Watershed Management: Effects of Spatially Targeted Stream Restoration on Watershed-Scale Flood Dynamics

Goodman, L.M.* [1,2], *Federman, C.*[3], *Scott, D.T.*[1], *Hester, E.T.*[3]

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[2] School of Public and International Affairs, Virginia Tech
[3] Department of Civil and Environmental Engineering, Virginia Tech

Severe flooding, exacerbated by heightened anthropogenic pressures (e.g., climate change, urbanization, land use change), often degrades riverine systems, negatively impacting human and environmental health, as well as local, regional, and even global economies. Floods provide beneficial ecosystem services (e.g., water quality benefits, supporting biodiversity), but they can also damage infrastructure and result in loss of life. To address flooding issues facing riverine systems, focus has shifted to watershed-scale management plans. However, quantifying the cumulative impacts of multiple stream restoration projects within a watershed on flood dynamics remains challenging. We address this by modeling various floodplain restoration techniques within a 4th-order watershed that is generally based on the Chesapeake Bay watershed. To our knowledge, our study is the first to evaluate how these different floodplain restoration practices affect flood dynamics at the watershed scale during more frequent storm events (i.e., 2-, 1-, 0.5-year, and monthly). By varying restoration length and location, we found that restoration practices with lower streambanks (Stage 0), especially in smaller rivers (2nd-order), can be particularly effective at enhancing flood attenuation and floodplain inundation both locally and downstream. Our study demonstrates the importance of restoring watersheds in a spatially strategic manner to encourage hydrologic exchange from the channel into the floodplains during smaller storm events. Additionally, the incremental benefits of an individual restoration project depend heavily on the watershed context, particularly project location. Overall, spatially targeted restoration can reduce the severity of downstream flooding and potentially improve water quality by allowing water to access highly reactive floodplain soils.

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PLATFORM PRESENTATION:

Colder temperatures augment bacterial pathogen persistence on bird feeders

Teemer, S.R.* [1], *Tulman, E.R.*[2], *Arneson, A.G.*[1], *Geary, S.J.*[2], *Hawley, D.M.*[1]

[1] Department of Biological Sciences, Virginia Tech
[2] Department of Pathobiology and Veterinary Science, University of Connecticut

Seasonal variation in temperature is associated with altered transmission rates of many infectious diseases. House finches (Haemorhous mexicanus) can experience fall and winter outbreaks of mycoplasmal conjunctivitis, caused by the bacterial pathogen Mycoplasma gallisepticum (MG). At colder temperatures, birds often rely on feeders to meet increased energy demands, potentially depositing MG onto surfaces as they feed. Despite the importance of feeder-based transmission in this system, it remains unknown how ambient temperature affects MG viability on feeders. We assessed such temperature effects using two experiments. We first pipetted equal MG doses onto replicate feeders held at one of two temperatures representing summer (27°C) versus winter (4°C). We then allowed MG to incubate for 0, 1, 2, 4, or 7 days at a given temperature and collected remaining inocula from individual feeders at each time point. In the first experiment, we implemented culture-based methods and found higher MG viability on feeders kept at colder versus warmer temperatures. In the second study, we used feeder swabs from each treatment to inoculate naïve birds and found that MG on feeder surfaces remained infectious to birds for significantly longer when incubated in colder versus warmer ambient temperatures. Further, MG on feeder surfaces remained infectious for longer than previously hypothesized. Overall, our results suggest a key role of ambient temperature in driving fomite transmission in this system and likely many others.

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POSTER VIEWING: AFTERNOON SESSION

Predicted prophages of bacterial isolates collected from amphibian skin

Bueren, E.K.* [1], *Wax N.*[1], *Haak D.C.*[2], *Walke J.B.*[3], *Belden L.K.*[1]

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[3] Department of Biology, Eastern Washington University, Cheney, WA

Host-associated communities of microorganisms (microbiomes) can influence the health of their hosts. For example, the bacterial skin microbiome of amphibians can mediate the outcome of amphibian exposure to the fungal pathogen, Batrachochytrium dendrobatidis (Bd). However, the influence bacterial viruses (bacteriophages) have on the amphibian skin community is currently unknown. For part of their replication cycles, some bacteriophages integrate within bacterial genomes as prophages. In this state, the prophage may carry genes that benefit their bacterial host, such as competitive toxins, resistance to other bacteriophages, or auxiliary metabolic genes. To better understand how prophages may influence the bacterial community within the amphibian skin microbiome, we completed a bioinformatic survey of 46 bacterial genomes, representing 14 different genera isolated from the skin of Virginia amphibians. A total of 72 unique prophages were predicted. The median number of prophages per genome varied between genera, with Hafnia spp. and Stenotrophomonas spp. containing the most prophages. Some prophages, predicted from various hosts, may encode potential metabolic genes, such as phosphoadenosine phosphosulfate reductases. Other prophages, primarily found in Janthinobacterium lividium, appear to encode putative chitinases, a previously proposed mechanism of Bd inhibition. While the relationship between prophages and Bd inhibition remains unclear, this study highlights several possible roles of prophages in the amphibian skin microbiome.

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POSTER VIEWING: AFTERNOON SESSION

Feeding birds but not FeederWatching: barriers to participation

Pototsky, P.C.* [1], *Dayer, A.*[1], *and Langhans, K.*[1]

[1] Department of Fish and Wildlife Conservation, Virginia Tech

Project FeederWatch is a participatory science project administered by the Cornell Lab of Ornithology and Birds Canada, where participants identify and count birds that visit the area around their home using a standardized protocol, particularly focused around bird feeders. Bird feeding is a popular outdoor recreation activity in the United States, with around 37 million people purchasing wild bird food in 2022. Despite the popularity of this activity and its similarities to Project FeederWatch, there are participation gaps between the general public that feed birds and Project FeederWatch participants. This is a common issue in participatory science, with recent research on demographics suggesting that participation does not reflect the demographics of the United States population. Understanding the root causes for the lack of participation can help inform interventions and outreach to broaden participation. Using a demographically representative sample of the general population of Americans who feed wild birds, we explored interest in and barriers to participation in Project FeederWatch. Over 70% of survey respondents had never participated in any participatory science project in a sustained fashion. However, interest was high, with over 60% of respondents reporting moderate to extreme interest in participating in a project involving feeding birds and recording their observations. Less than 20% of respondents faced no barriers to participation, with the top barriers being lack of bird identification skill, time, and financial cost. These findings suggest that Project FeederWatch could better support people in bird identification through free trainings and exploring means to support participation costs.

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POSTER VIEWING: AFTERNOON SESSION

Canadian hydroelectricity imports to the U.S.; Modeling of hourly carbon emissions reduction in New England

Gazar, A.* [1], *Calder, R.*[1], *Howarth, R.B.*[2], *Jackson, C.*[3], *Mavrommati, G.*[3]

[1] Population Health Sciences, Virginia Tech University
[2] Department of Environmental Studies, Dartmouth College
[3] School for the Environment, University of Massachusetts Boston

United States' hydroelectricity imports from Canada have increased by > 1 TWh per year between 2007 and 2021. This occurs as policymakers in the U.S. try to ramp up the deployment of new carbon free electricity generation and transmission infrastructure. Furthermore, recent modeling in the northeast U.S. demonstrates that Canadian hydroelectricity will play a significant role in New England's least-cost decarbonization scenario. Additionally, decarbonization targets are well-defined in all states within the New England region, making it a priority. Consequently, it is anticipated that more hydroelectricity will flow from Canada into New England, resulting in the expansion of transborder electricity interconnections. To characterize the costs and benefits of such projects as compared to alternatives, a high-resolution simulation (i.e., hourly) of the electric grid is needed. In this study, we utilize the U.S. Environmental Protection Agency's dataset on hourly electricity generation and carbon emissions. Using pre-established decarbonization scenarios, we can calculate the precise reduction in greenhouse gas and air pollutant emissions for each scenario. Our preliminary results demonstrate that the scenario projection for 2026–2027 by New England ISO, which involves a combination of Canadian hydroelectric imports (2100 MW summer, 826 MW winter), new wind (308 MW summer and 682 MW), and solar (92 MW summer, 28 MW winter) generation commitments, can effectively offset carbon emissions in New England. These results further support the current decarbonization policy, which relies on a diversified mix of carbon free electricity sources.

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POSTER VIEWING: AFTERNOON SESSION

Assessment of nest predators for a declining tidal marsh songbird in Virginia

Re, B.* [1], *Hunter, E.*[1,2]

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Tidal marsh birds have adapted to their environment by tightly synchronizing nest initiation after flooding events, but the behavioral response to increased frequency of flooding (placing nests higher above ground) is restricted by the perceived threat of predators. For Saltmarsh Sparrows (Ammospiza caudacuta; SALS), a tidal marsh songbird experiencing rapid population declines, whether nesting females can assess the trade-offs between flooding and depredation risk could be important for fledging success. However, we do not know how SALS assess depredation risk. We aimed to investigate the potential cues SALS use to assess depredation risk through a multi-year study. During the 2023 breeding season from May to August, we generated a list of potential nest predators via camera trapping. We deployed camera traps on active SALS nests throughout six marshes in Accomack County, VA. We determined likely nest predators based on captured nest interactions. We found direct evidence of red fox (Vulpes vulpes) and European starling (Sturnus vulgaris) depredating nests and indirect evidence of nest depredation by five other species. We concluded that while there was no single dominant nest predator, depredation was a larger source of nest loss compared to flooding. Furthermore, we found evidence of potential nest abandonment and depredation of nesting females which warrants further investigation.

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Riparian-stream connections and the role of disturbance governing the frequency and intensity of forest insect pest outbreaks

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Invasive forest insect pests (FIPs) have killed millions of trees worldwide and continue to spread. The interaction among changing climate, forest loss, and fragmentation have made the spread and magnitude of invasive forest insect pest outbreaks (FIPOs) a conservation concern as new FIP species continue to kill trees. Yet, less is known about overall effects FIPOs have on riparian areas that support water quality and provide resources for various species, including humans. Riparian-stream connections are hotspots of carbon and nutrient exchange that support watershed diversity and productivity. Still, invasive FIP management rarely extends into riparian areas. In this paper, we compare possible ecosystem responses to common riparian natural and anthropogenic disturbances. We review other well-studied disturbances to identify areas of potentially greatest concern in riparian-stream connections from FIPOs. Because FIPs fluctuate in time from climate and spread is facilitated by riparian corridors and land use, synthesizing research on invasive FIPs in stream riparian corridors will support a better understanding of how to sustain healthy forests and maintain water quality.

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Using phylogenetics to predict bat species' adaptability to White-Nose Syndrome

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Global changes, including rising temperatures and the spread of zoonotic diseases, have forced species to adapt or perish. Understanding species' capacity to respond physiologically to new ecological challenges is essential to understanding their constraints and biological limitations to evolve and adapt to changing environments.

Evolution leaves a clear phylogenetic signal on a species' physiological and ecological diversification. A species' phylogenetic history provides important information on its potential to adapt to its environment in the future. However, most studies on a phylogenetic scale have examined morphological traits while ignoring important physiological characteristics that are also tied to the environment. Studies that integrate physiological, behavioral, and morphological characters with phylogenetic approaches could help the development of better predictions of species adaptations.

My research seeks to address the macroevolutionary predictability of hibernating bats' responses to novel physiological threats. We aim to predict species susceptibility to the spreading fungal disease (White-nose syndrome) in bats caused by the fungus Pseudogyymnoascus destructans across the western United States. This study will address the gap in knowledge relating to the phylogenetic predictability of susceptibility to pathogenic diseases in New World bats and species' susceptibility to the spreading fungal infections.

Utilizing data from empirical studies on the affected east coast bats, we used cross-validating models and found a strong phylogenetic signal to species' susceptibility. We then used phylogenetic models to make predictions on bats in the western United States not yet infected.

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Wildfire and prescribed burn effects on soil microbial community structure, function, and diversity

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Prolonged drought in forests managed under a fire suppression regime can lead to larger and more severe wildfire events. This is an increasing concern in Southern Appalachia as climate change intensifies hydroclimate variability. To mitigate wildfire activity, prescribed burns are used for fuel management and to promote fire-tolerant plant species. As fire activity is projected to increase on the Southern Appalachian landscape, it is important to investigate how biogeochemical cycles and ecosystem processes are impacted. Soil microbial communities are essential drivers of biogeochemical change following disturbance and provide insight into ecosystem function. To observe the effects of wildfire and managed fire disturbance on soil microbial communities, we collected samples from four watersheds in the U. S. Nantahala National Forest (North Carolina): a prescribed burned, one impacted by wildfire, and two corresponding reference sites. We measured microbial extracellular enzyme activity, soil physicochemical properties, and determined bacterial community composition using 16S amplicon sequencing. The prescribed burned and its reference watershed bacterial communities were not significantly different from one another, potentially indicating resilience to low-severity fire effects. Principal components analysis of enzyme activity in wildfire, prescribed burn, and prescribed burn reference sites revealed that carbon and nitrogen enzyme acquisition rates were similar when corrected for microbial biomass, despite higher dissolved organic carbon and ammonium levels in burned watersheds. This result, coupled with higher respiration rates in burned watersheds indicates a response to resource availability. Our results show prescribed burns do not significantly change microbial community structure but may alter ecosystem function.

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Dissemination of antimicrobial resistance (AMR) upstream and downstream of a wastewater treatment plant in rural Southwest Virginia, USA

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The global dissemination of antimicrobials, antibiotic-resistant bacteria (ARB), and antibiotic-resistance genes (ARGs) from human and animal waste into the environment significantly threatens public health. The prevalence of antimicrobial resistance (AMR) determinants in rural surface waters is often attributed to inadequate wastewater treatment, agricultural runoff, and overuse of antibiotics in healthcare. To understand AMR dynamics within rural environments, we investigated ARB and ARG levels in surface water samples collected upstream and downstream of a rural wastewater treatment plant (WWTP) in Southwest Virginia. We evaluated seasonal and location-specific variations in microbial communities and ARGs. Quarterly (summer, fall, winter, spring) grab samples were collected from eight surface water locations between September 2022 and September 2023. DNA was extracted and sequenced via Illumina HiSeq 2500 with 2 × 100 “bp” paired-end reads. Collected sequences were analyzed using Kraken2 for taxonomy classification, Bracken for relative abundance estimation, and Kraken Tools to determine alpha diversity. DIAMOND and DeepARG, both reliant upon the CARD database, were used for ARG classification. As expected, we observed changes in both microbial diversity and the make-up of the resistome as a function of season and sampling location. To illustrate location-based differences the collected results will be compared to those obtained in an urban watershed. This work provides insight into AMR dissemination in rural environments.

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Annual survival and steroid hormones in birds

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Understanding the mechanisms that influence vertebrate survival is key for any conservation plans aiming to address global change issues. The role of steroid hormones in the survival of avian species has not been widely explored despite available measurements of hormonal levels and survival rates. For example, empirical evidence has found that increasing levels of corticosterone can increase survival while decreasing reproductive fitness during environmental challenges. Other studies have found that testosterone can enhance reproductive efforts at the cost of survival in male birds. However, such studies have generally focused on single species, and it is unclear if the relationships between steroids and survival are consistent across species. We performed a meta-analysis to determine if species-level variation in testosterone and corticosterone levels can explain annual survival rates in birds. We used publicly available databases for 573 records on testosterone and corticosterone levels and the annual survival probability of 98 species of birds. We found a negative correlation between corticosterone and estimates of annual survival probability within the order Passeriformes. However, the analysis of all species did not support this relationship, and nor did measurements of testosterone influence survival rates in any group of birds. Given the variation between lab and field protocols, the negative relationship between corticosterone and annual survival probability in the order Passeriformes is probably even stronger than described, but such a relationship remains unclear in other groups of birds. Hormones can support condition measurements of multiple species, but it is necessary to account for ecological and phylogenetic variables.

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Does climate mediate changes in zooplankton succession in a eutrophic reservoir?

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Much research on plankton dynamics has focused on glacially-formed, north temperate lakes, leaving a gap in our understanding of the variability and community succession of zooplankton in reservoirs. Zooplankton play a central role in freshwater food webs, and thus changes in their communities can have cascading effects on other freshwater organisms. While it is widely expected in glacially-formed lakes that zooplankton communities follow predictable patterns of succession within a year, reservoirs may exhibit less predictable patterns given that they have larger catchments and greater management influence, especially as climate change exacerbates variability. To identify the predictability of zooplankton succession, we collected monthly zooplankton samples from May-September over six years in a eutrophic reservoir. We used multivariate approaches to compare the trajectory of zooplankton succession among cladoceran, copepod, and rotifers each year. Our goals were to: 1) determine whether zooplankton followed similar patterns of succession and 2) identify environmental drivers of zooplankton succession. We found that zooplankton communities followed predictable patterns of succession in some years, but observed high variability in zooplankton density and community composition from year-to-year. Additionally, dissolved oxygen and nutrient concentrations were associated with variability between months and years. Ultimately, our data suggest that zooplankton succession in reservoirs inconsistently follows expected patterns from glacially-formed lakes, and this seasonal variability may further increase in the future due to climate change.

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Low-dose lead exposure alters gene expression in the songbird brain during a critical period of development

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Exposure to lead during development can have lifelong consequences. Lead is acutely toxic to brain cells at high levels. However, the mechanism by which lead affects the brain at lower doses is unclear, although exposure is associated with lasting disruptions to cognition and behavior. Lower levels of lead might impact the brain through the immune system, as lead can induce inflammation. Disruptions of the immune system, such as early life infections, can impair later life cognition, behavior, and susceptibility to stress. Therefore, developmental lead exposure might alter brain function via early activation of the inflammatory response in the brain. We explored the impact of lead on inflammation and cell death in captive zebra finches, a model system with rapid post-hatching brain growth. We dosed birds with 1 ug/g (low-dose), 5 ug/g (high-dose), or 0 ug/g (control) lead during a critical period of post-hatching brain development and measured the expression of genes associated with inflammation and programmed cell death in the brain and liver following exposure. In brain tissue, birds in the low-dose group had elevated expression of one marker of inflammation (interleukin-6) and two markers of cell death (caspase-3 and caspase-9) compared to control birds. Those in the high-dose group did not differ from controls. None of the markers tested were elevated in liver. This work provides preliminary evidence of a neuroimmune response to low-dose lead. Understanding the lasting impacts of lead on the brain is crucial to the development of appropriate public health measures, environmental monitoring, and mitigation strategies.

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Tradeoffs in acoustic detection error for invasive and native anurans in the southwestern US

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Consistent and accurate detection of invasive and threatened species is a critical part of protecting biodiversity in threatened environments, including aquatic ecosystems. Optimizing detection methods for both species presents challenges and potential tradeoffs. For example, false negative detections present different problems and management outcomes for invasive vs threatened species. Bioacoustic monitoring is an effective method for monitoring distributions of vocalizing species, yet potential tradeoffs in detection precision have largely been unexplored, especially at fine spatiotemporal scales. We used bioacoustic monitoring to detect the presence of the invasive American bullfrog (Lithobates catesbeianus) and native Arizona treefrog (Hyla wrightorum) across multiple locations, at daily intervals, in the southwestern United States during the summer of 2021. We deployed an array of acoustic recorders at 50 ponds throughout a 50 square kilometer region of southern Arizona. First, we built a high-precision “test-pond” dataset for which we manually identified calls across a subset of sites. Second, we used a simple classifier to identify likely bullfrog and treefrog calls based on reference recordings. This allowed us to calculate a precise detection error rate for both species. We were able to detect treefrogs more accurately than bullfrogs (8% vs 23% error rate of detection, respectively) and found significant tradeoffs in the overall error rate of detection when minimizing Type I vs Type II error. Overall, we found that efforts to minimize one type of error could increase the other, highlighting the need to carefully consider management goals in acoustic monitoring study design.

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The role of parental care and parental investment in sexual dichromatism

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In birds not all adult individuals of the same species are similarly colored. This is a result of sexual dichromatism, where one sex is different in color than the other sex. One of the leading hypotheses behind this coloration difference is that female birds evolved cryptic coloration to avoid predation while rearing offspring (Wallace, 1891). This hypothesis contrasts with the theory of sexual selection, where the inequality in color between sexes is driven by females selecting for brighter, more colorful males through mate choice (Darwin, 1871). Is sexual dichromatism primarily driven by a loss of color in females, or due to an increase in male color? We theorize that monochromatism is ancestral to Aves with both sexes equal in color and parental care, and that sexual dichromatism arises in birds due to unequal investment in offspring between the sexes resulting in different selection pressures on the parent's color. Using the book "All the Birds of the World" by Lynx publishing we collected the sexual dichromatism data of approximately 3,000 species of birds, labeling them as monochromatic or dichromatic, and ranking their degree of dichromatism. We then compared these data with the parental behavior of incubation and offspring feeding, determining if these two behaviors were male biased, female biased, or bi-parental.

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Flood-Pulse Effects on the Growth of Pseudoplatystoma fasciatum in the Amazon Basin

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Fish growth is a fundamental process driven by a multitude of intrinsic and extrinsic factors that underpin individual fitness and population dynamics. Interannual variability in river hydrology regarding the intensity and duration of floods and droughts can induce interannual variations in the biotic and abiotic variables that regulate fish growth. However, understanding of how variability in river hydrology affects fish growth remains limited for most species and ecosystems. We evaluated how inter-annual hydrological variations within the Amazon basin influence the growth of the catfish P. fasciatum. Our research questions were: Do floods lead to faster, and droughts lead to slower growth of P. fasciatum?, and do floods and droughts affect all age-classes in the same manner? . We fitted linear mixed-effects models to test the relationship between growth increments and hydrological indices age, and basins and Fish ID. We found an inverse relationship between increment width in fish hard parts and hydrological indices. That is, intense floods and droughts negatively affected growth rates. Our results showing that the growth of P. fasciatum was slower in years of intense droughts are supported by those of previous studies in the Amazon basin and elsewhere. However, our results showing for the first time that the growth of P. fasciatum is slower in years of intense flooding is the opposite of patterns found in other studies. These results thus suggest that the growth of P. fasciatum is maximized within an optimum range of hydrological conditions, where neither floods nor droughts are intense.

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Venturing into the Virtual Wild: Innovations in Ecological Modeling with Virtual Species and Rarity Frameworks

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Conservation research increasingly relies on ecological models to predict occurrences of cryptic or rare organisms. Existing methodologies face challenges in accurately assessing model performance for data-poor species. This study aims to refine model evaluation and calibration, enhancing predictive accuracy. By creating virtual species representing Rabinowitz's seven forms of rarity, we seek to assess model effectiveness for rare species. While calibration techniques for ecological niche and species distribution models have progressed, a predominant focus remains on geographic space (G-space) when partitioning evaluation and calibration data. There is limited literature discussing the differentiation of data in the environmental space (E-space) and G-space. The objective of this study is to scrutinize the efficacy of partitioning evaluation and calibration data across both E-space and G-space. Our hypothesis is that partitioning data in E-space will facilitate more effective variable selection, leading to a reduction in spatial, temporal, and environmental bias and resulting in divergent model outcomes compared to partitioning in G-space. In addition, this research introduces a methodology for simulating occurrences of rare species based on Rabinowitz's rarity framework. Through creating virtual species, we aim to establish a robust separation of rarity ranks independent of sampling efforts. Model performance will be rigorously evaluated using statistical metrics, with an emphasis on minimizing environmental correlations and enhancing variable selection. This study aims to advance ecological niche and species distribution modeling techniques focusing on addressing rarity challenges. By shedding light on these complexities, our findings may offer valuable insights for refining conservation strategies and practices.

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A Tale of Two Pine-Savannahs: Case Studies on Mixed Flocking Behavior

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Animal behavior field studies often require substantial time and effort to pinpoint ecological drivers of observed phenomena. Additionally, findings from behavioral variation case studies often fail to apply to broader sites, given the number of covariates that can alter ecological effects. My study focuses on avian mixed species flocking at two sites in the pine-savannah of central and eastern North Carolina. These sites have notable contrasts in forest structure, habitat homogeneity, and management regimes. My research show site differences in mixed flock size, diversity, and recruitment, as well as avian predator frequencies and patterns. Brown-headed nuthatches (Sitta pusilla) appear to act as frequent mixed flock leaders, which has not been described in other studies. My foraging and anti-predatory behavior data on this species reveal a site-wise difference in nuthatch reaction to predator call playback. Additionally, brown-headed nuthatches appear to reduce their mixed flocking behavior when feeding on pine seeds, most demonstrably in the shoulder seasons and at the low predator site. I argue that these observed differences in mixed flock foraging are ultimately impacted by habitat and management differences. However, mixed flocks are proximately driven by seasonal changes which alter optimal foraging strategies. As climate changes and nuthatches expand into new regions, I suggest that shifts in habitat will continue to drive mixed species flocking characteristics, as well as nuthatch behaviors and fitness.

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An Analytical, Ecological and Molecular Approach to Assess Responses of Freshwater Bivalves to Anti-Inflammatory Pharmaceuticals

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Contaminants of emerging concern such as pharmaceuticals are detected frequently in freshwater ecosystems since the increase in manufacturing in decades past. Pharmaceutical compounds in freshwater systems threaten the health and fitness of non-target organisms like freshwater bivalves. Bivalves provide beneficial ecosystem services such as biofiltration and nutrient cycling that are at risk of diminishing due to persistent biodiversity loss throughout North America. This dissertation investigates freshwater bivalve response to anti-inflammatory pharmaceutical (AIP) exposure by integrating several methodologies to understand the dynamics of pharmaceutical accumulation and organismal response. Liquid-chromatography mass spectrometry (LCMS) methodology is utilized to quantify AIP concentrations within water, sediment and bivalve tissue. To identify if exposure to AIPs elicits differences in behavioral responses, a data collection instrument will be constructed using Hall sensors and a microcontroller. The Hall sensors detect how frequently the bivalves will open and close their valves over time to filter feed, indicating possible changes in behavior after exposure to AIPs. Lastly, to understand responses occurring at the cellular level that influencing behavior, a transcriptomic approach will be utilized by extracting mRNA from tissue samples and sequencing transcriptional response pathways using an Illumina Next Generation Sequencing platform. The resulting transcriptomic data will be analyzed to identify significant changes in cellular pathway expression. This methodological design provides a framework to holistically understand the responses and environmental implications of bivalve exposure to AIPs. Understanding bivalve response to commonly found AIPs in freshwater will assist in efforts to conserve this ecologically important organism.

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Spatiotemporal changes in dissolved organic matter across a reservoir watershed

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Dissolved organic matter (DOM) plays an essential role in freshwater ecosystem functioning and aquatic carbon cycling, motivating a need to understand the magnitude of variation in both DOM quantity and quality across ecosystem gradients. DOM processing can vary spatially throughout a watershed, but it remains unresolved the magnitude of variability in DOM quantity and quality processing across the headwaters of a reservoir watershed to its dam. To examine variation in DOM across a watershed, we monitored DOM quantity and composition spatially across a warm monomictic reservoir watershed located in Roanoke, Virginia, USA that experienced variable hydrology from 2021-2023. Stream sites showed greater variability in DOM quantity and composition than the pelagic sites in our study reservoir, with stream DOM concentrations ranging from 0.8 - 5.5 mg/L and a fluorescence index (FI) ranging from 1.4 - 1.8, with higher values indicating a larger pool of autochthonous-like DOM in fall months. The pelagic reservoir site had lower variability in DOM (2.1 - 3.5 mg/L) with the largest changes occurring after fall turnover when concentrations increased by over 1.1 mg/L. Differences in DOM quantity and quality between the streams and pelagic sites highlight the important role reservoirs play in processing DOM. These results highlight the need to study spatial changes in DOM quantity and quality to improve our understanding of how the entire reservoir watershed processes DOM, which has implications for the role of reservoirs in global carbon budgets.

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