



Inaugural

INSPIRE RESEARCH SYMPOSIUM

Inspiring new voices in STEM and Sustainability

Abstract Book

October 9, 2026

Talley Student Union

Coastal Ballroom

North Carolina State University

WISE

Women In Science & Engineering

EcoVillage

NC STATE University Housing

NC STATE Environmental First Year Program

INSPIRE RESEARCH SYMPOSIUM ABSTRACT BOOK 2026

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Abstracts

By Poster Session

Poster Session 1

(12:00-1:00 PM)

Poster 3

Illuminating a Unique Bacterial Nitrogen Pathway Using Transcriptomics

Authors: **Adrien Noel** and Dr. Micaela Robson*

Primary Mentor: Dr. Micaela Robson, BIT SURE, Biotechnology Program

Heterotrophic Nitrification-Aerobic Denitrification (HNAD) is a unique nitrogen metabolism that several species of bacteria are thought to perform for the removal of inorganic nitrogen (specifically NH_4^+). Much is still unknown about the metabolic mechanisms of HNAD and how the pathway may differ between species. We aim to elucidate the potential steps of this metabolism in the NH_4^+ removing bacterium *Acinetobacter calcoaceticus* LEN_RS_1 through a transcriptomics approach. Previous work demonstrated that a key route of NH_4^+ removal in LEN_RS_1 is assimilation into amino acids, suggesting nitrogen removal is tightly coupled with carbon metabolism. To examine this, LEN_RS_1 was grown on different carbon sources (acetate, succinate, citrate, and glucose) with ammonium (NH_4^+) as the sole nitrogen source and RNA-sequencing performed on samples collected at various time points over a 24 hour period. We did not perform RNA-sequencing on citrate and glucose samples as LEN_RS_1 was entering log phase around 24 hours. Analysis of our results revealed that specific genes in both TCA and assimilatory nitrogen pathways were found to be differentially expressed under each carbon source, providing insight into preferences and regulation of the assimilatory branch of HNAD.

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Names in bold indicate student presenters.

Poster 5

Effects of Organic vs. Inorganic Inputs on Soil Biological Health in Northern Temperate Forests

Authors: **Francesca Gervase**, Meredith Mann*, Dr. Christine Sprunger*

Primary Mentor: Dr. Christine Sprunger, Associate Professor of Soil Health, Principal Investigator, Michigan State University

Forest soils play a pivotal role in global carbon cycling and represent roughly half of the terrestrial carbon pool. As the trend of fertilizer use increases in commercial forest, questions remain about how fertilizer additions influence forest soil health, especially in subsurface soils from a biological perspective. This study examines the effects of organic versus inorganic inputs on soil biological health in northern temperate forests. We collected soil cores from the Detrital Input and Removal Treatments (DIRT) site at the University of Michigan Biological Station in 2025. We selected the Control, Double Litter, Double Litter + Fertilizer, and Fertilizer only Treatments for analysis. From the replicate cores, we subsampled the O horizon and five additional depth intervals of mineral soils (0-10-20-30-50-100 cm). Soil biological health was assessed by running the following assays: permanganate oxidizable carbon (POXC) and autoclaved-citrate extractable (ACE) protein. Additionally, soil was physically fractionated into particulate organic matter (POM) and mineral-associated organic matter (MAOM) to assess soil organic matter stabilization. Despite expectations that a larger input of fresh organic matter would stimulate a priming effect, inorganic nitrogen inputs exhibited greater soil health. Surface soil health varied more between treatments than subsurface soil health, and the Double Litter + Fertilizer plots were greatest in surface soil health down to 30 cm.

Poster 7

Characterization of Bile Salt Hydrolases from the Gut Microbiota

Authors: **Addison R. Wright**, Dr. Noah S. Lyons and Dr. Casey M. Theriot*

Primary Mentor: Dr. Casey Theriot, College of Veterinary Medicine, Department of Population Health and Pathobiology

Clostridioides difficile is a Gram-positive, spore-forming anaerobic bacterium responsible for *C. difficile* infection (CDI), resulting in over 500,000 cases annually. CDI is normally treated with antibiotics but these drugs alter the gut microbiota and metabolome, disrupting microbial mechanisms of colonization resistance. One such mechanism is bile acid (BA) mediated disruption of *C. difficile*. Specifically, host-derived primary BAs such as glycocholate and taurocholate are associated with increased spore germination and growth of *C. difficile*, while

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secondary BAs such as deoxycholate can suppress *C. difficile* growth and toxin activity. Deconjugation of primary BAs is carried out by microbially encoded bile salt hydrolases (BSH). These enzymes remove glycine/taurine and a sterol core from host-derived primary BAs, allowing for downstream production of secondary BAs. We hypothesize that BSHs are the rate-limiting step in transforming the BA pool to facilitate colonization resistance against *C. difficile*. To address this, we recombinantly produced and characterized two BSHs from the commensal bacteria, *Lactobacillus ingluviei* and *Clostridium hiranonis*. Using a ninhydrin assay we found that both enzymes prefer glycine as opposed to taurine conjugates. By characterizing the substrate preference and activity of BSHs predicted to be associated with colonization resistance, this work contributes to rational design of live biotherapeutic products for diseases including CDI.

Poster 16

Multi-locus ID of *Colletotrichum* species and QoI resistance

Authors: **Madison Michael**, Sarah Cochran-Murray* and Dr. Frank Louws*

Primary Mentor: Dr. Frank Louws, College of Agriculture and Life Sciences, Department of Entomology and Plant Pathology

Colletotrichum is a genus of destructive fungal pathogens that causes anthracnose in cucurbit and pepper crops. Anthracnose produces dark, sunken fruit lesions that can lead to fruit rot, reduced postharvest marketability, and significant economic losses. Although fungicides are commonly used for management, North Carolina growers have reported increased disease severity and reduced fungicide efficacy in recent years. To investigate *Colletotrichum* species diversity and potential fungicide resistance, 107 isolates were collected from five North Carolina counties during the 2024 and 2025 growing seasons. Isolates were identified to species level using internal transcribed spacer (ITS), glyceraldehyde-3-phosphate dehydrogenase (GAPDH), actin (ACT), and calmodulin (CAL) gene sequences. To assess potential resistance to quinone outside inhibitor (QoI) fungicides, isolates were screened for resistance-associated mutations in the cytochrome b (cytb) gene. Thirteen *Colletotrichum* species were identified, with *C. siamense* being the most frequently recovered. Screening for resistance-associated mutations revealed the presence of the G143A mutation, which is associated with high levels of QoI fungicide resistance. These findings improve our understanding of *Colletotrichum* diversity in North Carolina and provide insight into the potential distribution of fungicide resistance within pathogen populations.

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Diverse Non-Rhizobial Bacteria May Impact the Soybean Nitrogen Cycle

Authors: **Lucinda Lietz**, Jane Handa, Angie Petrichenko* and Dr. Reid Longley*

Primary Mentor: Dr. Reid Longley, College of Agriculture and Life Sciences, Department of Crop and Soil Science

Plants that form nitrogen-fixing symbioses, including legumes, perform a vital role in the nitrogen cycle and contribute to nutrient availability. Soybean (*Glycine max*) is an important example, which utilizes nitrogen-fixing bacteria in specialized nodules to convert unusable atmospheric nitrogen gas (N₂) into ammonia (NH₃), which can be used by plants. This process is vital in agriculture, where overfertilization and nutrient leaching can be detrimental to soil health. The most prominent bacterial genus located in soybean nodules is nitrogen-fixing *Bradyrhizobium*. Rhizobia trigger nodule formation in soybeans and establish a symbiosis between the plant and bacteria. Other bacterial genera have been found in soybean root and nodule microbiomes, but their roles in nitrogen cycling remain largely unknown. To more fully understand the bacterial presence in soybean nodules, 600+ bacterial taxa were isolated from soybean-associated rhizosphere soils, roots, and nodules collected from soybean fields in North Carolina and Michigan. After isolation, DNA was extracted and used in 16S marker gene sequencing. In addition, isolates from the *Bacillus* genus were selected for whole genome sequencing, which identified important roles in the nitrogen cycle, including denitrification. Identifying these bacteria and assessing their functional potential allows us to understand what non-rhizobia microbes are living in soybean roots, nodules, and soils, and how they might impact nitrogen fixation.

Lake RRRaleigh: A Short Term Study

Authors: **Jessica Eubanks**, Natalie Hanna and Dr. Angela Allen*

Primary Mentor: Dr. Angela Allen, College of Natural Resources, Forestry and Environmental Resources

Lake Raleigh is an important site for both recreation and environmental research. Until 1927, it served as Raleigh's primary water source. However, this lake hasn't been monitored before. Limited long-term monitoring has created a significant knowledge gap regarding the lake's overall physical, chemical, and biological health. The goal of this study is to examine the impact of anthropological activities on the water quality of Lake Raleigh. To determine these potential

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impacts, we will focus on various water parameters such as dissolved oxygen, pH, specific conductivity, temperature, and nutrients. Three locations have been identified as testing sites based on their use: recreational, residential, and rural. Twice a week, a YSI Multimeter and HACH ® are used to measure basic parameters, and every other week, E. coli is measured using the IDEXX method to measure bacteria. A previous short-term study evaluated patterns in water quality for an initial baseline. This work will extend the baseline study by adding a third location. These parameters will help quantify how human activity can contribute to the environment of the lake.

Poster 22

Hydrological Variance in Relation to A Long Term Drought

Authors: **Sydney Clemons**, Kaitlyn Hogarth, Johnny Boggs, Dr. Matthias Sprenger*, Dr. Zakiya Leggett

Primary Mentor: Dr. Matthias Sprenger, College of Natural Resources, Department of Forestry and Environmental Resources

Hydrological data is important not only in a sense of water scarcity and the amount of water available but also to detect trends of relationships between temperature and precipitation. These parameters can give insight towards growing plans for farmers, flood and drought management, as well as creation of environmental policies. Researching and analyzing hydrological changes in North Carolina (NC) can give better insight into the environmental impacts of a long term drought. This study compares meteorological data during the 2025-2026 drought to the long-term records collected between 2007 and 2026 at Hill Demonstration Forest in the Piedmont of NC. Data from the meteorological station, including air temperature, relative humidity, dewpoint, wind speed, gust speed, and solar radiation, were analyzed in ten minute intervals. Results indicate that the 2025-2026 drought conditions differed substantially from the mean baseline of other years. This implies that a drought event can impact not only the precipitation but also impacts the temperature of the area. It is important to research the effects of drought so land managers can plan for resource management and environmental stress.

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Using Stable Isotopes to Reconstruct Trophic Networks in the Arundel Clay Formation

Authors: **Abbigail Robertson**, Emily Cross*, Dr. Lindsay Zanno*

Primary Mentor: Dr. Lindsay Zanno, College of Sciences, Department of Biological Sciences

This project aims to generate a high-resolution reconstruction of trophic networks and ecological interactions among vertebrates preserved within the Arundel Clay Formation. Despite its rich vertebrate assemblage, direct behavioral evidence is minimal. As a result, ecological relationships within this Early Cretaceous system remain largely inferred from morphology rather than directly tested. By applying stable isotope analysis to well-preserved vertebrate material, this study will provide quantitative geochemical data to clarify patterns of resource use, trophic level differentiation, and niche partitioning within this paleo-community. Furthermore, the Arundel Clay Formation serves as an important proxy for terrestrial Appalachian ecosystems, particularly given the limited preservation and sampling of comparable units in the region. As such, this research has implications beyond a single formation. The resulting trophic model may inform broader reconstructions of Appalachian paleo-ecosystems, contribute to understanding faunal provinciality across eastern North America, and clarify how insular or semi-isolated landmasses structured vertebrate communities during this interval.

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Poster Session 2

(1:00-2:00 PM)

Poster 1

Bluewater Bioaccumulators: Evaluating Critical Mineral Accumulation in Offshore Sargassum

Authors: **Bailey Meyer**, Dr. Lindsay Dubbs* and George Bonner, P.E.*

Primary Mentor: George Bonner, P.E., College of Engineering, North Carolina Renewable Ocean Energy Program

Sargassum, a genus of brown macroalgae, has gained widespread notoriety among coastal communities due to its growing impacts on public health, coastal economies, and marine ecosystems. In recent years, free-floating (pelagic) Sargassum populations have expanded dramatically across the tropical Atlantic, increasing the frequency of Sargassum Inundation Events (SIEs) wherein mats wash ashore along coastlines. These mats smother shallow-water ecosystems and release toxic gases as they rot on the beach. Mat removal is expensive, and options for repurposing are currently limited by available research. The polysaccharide-rich composition of Sargassum cell walls enables passive adsorption and accumulation of dissolved metals from seawater. Thus, to support ongoing efforts to valorize Sargassum waste, this study uses ICP-MS to analyze Rare Earth Element (REE) concentrations in Sargassum samples collected from the Gulf Stream off the coast of North Carolina between 2014 and 2024. These REEs are highly valuable as raw materials for electronics and are critical to a clean energy transition, but lack viable domestic sources. By evaluating Sargassum as a source of REEs, this study aims to integrate otherwise harmful Sargassum into the circular blue economy, with marine energy systems potentially powering collection and processing at a significant reduction to overall cost, reducing cleanup burdens while contributing to emerging critical mineral supply chain needs.

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Poster 6

Data-Driven Human Trafficking Resource Allocation

Authors: **Ellie Tracy**, Dr. Maria Mayorga*, Dr. Osman Ozaltin and Vasuki Garg

Primary Mentor: Dr. Maria Mayorga, College of Engineering, Industrial and Systems Engineering

An estimated 200,000 American children are at risk for trafficking into the sex industry and 14,500 to 17,500 foreign nationals are trafficked into the US every year. Human trafficking cases in the US are steadily on the rise and barriers to prosecution and conviction make it harder than ever to put away criminals in charge of these heinous acts. This study identifies and analyzes the primary factors driving these investigative difficulties via a targeted survey. We categorize over 40 distinct variables related to Human Trafficking into five categories: definitional, institutional, attitudinal, environmental, and victim factors. Survey questions were developed based on Large Language Model (LLM) analysis of previously-recorded interviews as well as factors commonly seen in current literature. The analysis of responses from key stakeholders in the process of investigating and prosecuting a Human Trafficking case inform the standings of each variable in a case. By establishing a relative importance and ranking of these variables, this research provides a framework for resource allocation and case prioritization. Finally, we demonstrate a novel application of these findings in a mathematical knapsack problem, using the established factor rankings as weights. This presents a data-driven approach to allocating and distributing investigative and prosecutorial resources.

Poster 8

Highly Networked Chitosan Soft Dendritic Colloid Coatings

Authors: **Alejandra Diaz**, Marisa Thompson*, Dr. Orlin D. Velev*

Primary Mentor: Dr. Orlin Velev, College of Engineering, Department of Chemical and Biomolecular Engineering

Biopolymers are sustainable alternatives to conventional plastics, with diverse applications in packaging, electronics, and biosensing. Recent advances in shear driven nanomaterial fabrication enable precise control over biopolymer morphology, directly influencing material properties. This project leverages these techniques to investigate hierarchically branched chitosan soft dendritic colloids (SDCs), as a novel basis for sustainable coatings. The chitosan SDCs were synthesized via multiphase fluidic shear under turbulent conditions. To evaluate their performance in porous networked coatings, multiple deposition techniques including drop casting, Mayer rod coating, and convective assembly (CA), were used to identify optimal conditions for forming uniform coatings on glass substrates. Among these methods, CA

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produced the most uniform coatings due to its controlled deposition conditions. Deposition volume, translation speed, and SDC concentration were varied to assess their effects on network structure. Optical microscopy was then employed to observe network connectivity and spatial distribution with surface area quantified by image processing in ImageJ. Results showed that the resulting coating network density is dependent on CA deposition rate: faster speeds produce dense, interconnected coverage while slower speeds yield sparse networks. This behavior is opposite to latex particle CA methods, which we attributed to the adhesiveness of SDCs.

Poster 10

The Fisheries Reform Act of 1997: Success or Failure?

Authors: **Alannah Anderson** and Dr. Louis Daniel*

Primary Mentor: Dr. Louis Daniel, College of Agriculture and Life Sciences, Adjunct Professor; Applied Ecology

Twenty nine years after this North Carolina legislation was passed in 1997, the Fisheries Reform Act (FRA) is still a controversial topic amongst coastal fishing communities. The purpose of the act was to address issues like overfishing and sustainable harvest, aiming to better protect and enhance these natural resources. At present, the state of North Carolina manages thirteen state fisheries and twenty-one interjurisdictional species. The objective of this project was to determine if the FRA was a success or failure. The primary objective was to extract data and insight from the fishery management plan (FMPs) and then visualize stock and spawning statuses. Even though they have few pages in the FRA, FMPs provide the critical foundation for the research focus. This project considered commercial and recreational landings data, the spawning abundance or spawning stock biomass, and current regulations. The main findings of this research were that five out of my ten species are considered collapsed with stock statuses either as unknown or overfishing is occurring. Majority of the state stocks are considered unknown, yet are not being managed with a precautionary approach. In addition, only one species is above the spawning stock biomass threshold while the rest are in decline or unknown. This suggests that the current management of these species is failing to meet the original goals of the FRA.

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Poster 12

Water Distribution Systems: Designing Under Uncertainty

Authors: **Allison Haslam**, Ruby Blue, James Gardiner, Parker Calloway, and Dr. Emily Berglund*

Primary Mentor: Dr. Emily Berglund, College of Engineering, Department of Civil, Construction, and Environmental Engineering

The Battle of the Water Futures (BWF) is an international competition where participants are challenged to design and operate an urban water system. One of the biggest challenges in designing a water distribution system is doing so under deep uncertainty. Major factors that cause uncertainty include population growth, supply and demand, service reliability, affordability, and equity. While we can predict how these factors fluctuate, there is no guarantee that the predictions are accurate due to external factors, such as pump construction taking longer than expected, external conflicts, and climate catastrophes. This year's BWF challenge had participants rework the current water distribution system across the twelve provinces of the Netherlands to keep it operational for the next fifty years. We were tasked with updating the system under uncertainty, which meant predicting factors such as population growth, demand growth, service reliability, affordability, and equity. These factors varied across the twelve provinces. Using current pattern data, we developed a model and ran simulations for each year based on our predictions, identified where our model produced unsatisfactory results for either demand or financial costs, and reworked systems to meet those standards in that year.

Poster 15

The Effect of Beaver Dams on Avian Diversity and Community Composition in Urban Systems

Authors: **Mia Reilly** and William Garcia*

Primary Mentor: Mr. William Garcia, Senior Lecturer, UNC Charlotte Department of Earth, Environmental, and Geographical Sciences

Beavers are ecosystem engineers whose dams promote habitat heterogeneity and create niches for a variety of organisms. Beaver reintroductions and stream restoration projects are increasing, so it is important to understand the impact of dams on ecosystems in order to make responsible policy decisions. Research shows that the presence of beaver dams increases bird diversity, however, few studies occur within urban areas with high human disturbance. This project examines these trends in urban streams, the range of impact upstream and downstream, and the impact on community composition. Birds were surveyed using repeated

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point counts every 100m along transects adjacent to a stream. All birds heard and seen within a 50m radius during a ten minute interval were recorded. Two streams with active beaver dams and one without beavers were sampled. Species abundance, richness, diversity, and community composition were analyzed as a function of distance from the beaver pond, and NMDS was used to analyze community composition. While richness did not increase within sites with increased proximity to beaver ponds, it was higher at sites with beavers and at points with more deadwood and human disturbance. Increasing richness and disturbance aligns with the Intermediate Disturbance Hypothesis, implying that in urban systems human disturbance is more significant than beaver disturbances. This study can help restoration teams and urban planners make informed designs and management decisions.

Poster 17

Transfer Learning with DeepForest for Tree Crown Identification from Drone Imagery

Authors: **Lillian Williams** and Dr. Susan Cohen*

Primary Mentor: Dr. Susan Cohen, Director, CARDNL Carolina Drone Lab

This project investigates machine learning approaches for analyzing high-resolution drone imagery in forestry under limited-data conditions. The primary goal is to automatically detect and count individual tree crowns to support more efficient forest monitoring and density estimation. High-resolution drone imagery will be preprocessed and divided into uniform tiles before a subset of trees is manually annotated for training and evaluation. DeepForest will be fine-tuned using this limited dataset and evaluated using precision, recall, and intersection over union (IoU). The project will examine how transfer learning and careful data preparation can improve tree detection while reducing the time and effort required for manual forest analysis.

Poster 19

Acoustic Monitoring of Pollinator Activity Using an Automated tool, Buzz Detect

Authors: **Lucas Hall**, Joseph Guillemette*, Dr. Bradley Metz*, and Dr. Hannah Levenson*

Primary Mentor: Dr. Hannah Levenson, College of Agriculture and Life Sciences, Department of Entomology and Plant Pathology

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Pollinators play an important role in agricultural and natural ecosystems, yet traditional monitoring methods can be labor-intensive and limited in temporal coverage. This project evaluates the use of passive acoustic monitoring and automated detection software to quantify pollinator activity from environmental audio recordings. Audio data collected from field recording units were analyzed using BuzzDetect and BuzzR to identify insect buzz events and calculate detection rates through time. Detection data will be organized into time bins to examine temporal patterns in pollinator activity and assess variation among recording locations. Preliminary results indicate that automated bioacoustic methods can successfully detect pollinator-associated acoustic signals and reveal changes in activity across sampling periods. These findings demonstrate the potential of bioacoustic monitoring as a scalable and easier approach for studying pollinator behavior and supporting ecological research and conservation efforts.

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Poster Session 3

(2:00-3:00 PM)

Poster 2

Bless Your Heart: Rural Health Insights Using Suttontown EMS Call Data

Authors: **Clara Pinella** and Katerina Vilkomir*

Primary Mentor: Ms. Katerina Vilkomir, College of Engineering, Department of Computer Science

Rural America faces persistent health inequities, including limited primary care access, geographic isolation, and poverty. Suttontown EMS is a volunteer emergency medical service serving rural Sampson County, North Carolina. As part of a SECU Public Fellows Internship, 1,777 Suttontown EMS calls from 2017-2025 were analyzed and grouped into eight categories: service/nonemergency, pregnancy/childbirth, psychiatric, trauma, medical illness, neurologic, respiratory, and cardiac. Sampson County census data were used as a proxy to contextualize Suttontown EMS call volume trends relative to population changes. Although the county population remained relatively stable, Suttontown EMS call volume fluctuated over time, and several notable patterns emerged. During the COVID-19 pandemic, calls categorized as 'traffic accidents' and 'breathing problems' increased, while 'assault' calls declined. Trends in 'fall victim,' 'psychiatric problems,' and 'transfer/interfacility/palliative care' calls suggest additional relationships with environmental and community-level factors that warrant further investigation. Longitudinal analysis of rural EMS data may help identify changing community health needs and inform EMS education, preparedness, and resource allocation.

Poster 4

Species-Specific Trends in Foraminiferal Size and Abundance in the Santa Barbara Basin (1993-2023)

Authors: **Emma Doty** and Dr. Catherine Davis*

Primary Mentor: Dr. Catherine Davis, College of Sciences, Marine, Earth, and Atmospheric Sciences

Planktonic foraminifera are vital bioindicators of oceanographic change. This study presents an analysis of planktonic foraminifera in the Santa Barbara Basin, CA, utilizing sediment trap

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samples collected over a 30-year span (1993-2023) to evaluate long-term trends in size-normalized weight (SNW), test size, and abundance of *Globigerina bulloides* and *Turborotalita quinqueloba*. While preliminary modeling executed in R revealed an unexpected disconnect between bulk calcium carbonate (CaCO₃) flux and metrics like size-normalized weight and test abundance, further calculations confirmed that foraminifera represent a minor (~3%) contribution to total CaCO₃ flux in Santa Barbara Basin. However, further analysis uncovered a strong coupling between changes in individual test size and abundance in the two most abundant species. Specifically, *T. quinqueloba* test size and abundance remained relatively static over the 30-year record, while *G. bulloides* exhibited a statistically significant decline in both test size and overall abundance over the same period. These findings highlight a stark, species-specific divergence in how key calcifiers within the same ecosystem undergo biological shifts in response to long-term oceanographic changes.

Poster 9

Evolution and Loss of Sporulation in Haplosporidians

Authors: **Jordan Molis**, **Gracie Faulkner**, and Dr. Tal Ben-Horin*

Primary Mentor: Dr. Tal Ben-Horin , College of Veterinary Medicine, Department of Clinical Sciences

The project “Evolution and Loss of Sporulation in Haplosporidians” in collaboration with Dr. Tal Ben-Horin at CMAST (Center of Marine Science and Technology) focuses on investigating the evolutionary relationships between oyster parasites in the genera *Bonamia* and *Haplosporidium* and among species of *Bonamia*. We investigated these relationships to help explain the ability between *Bonamia* species to reproduce through sporulation or direct transmission. We compared the life cycles of 5 species in Phylum Haplosporidia: *Haplosporidium nelsoni*, *Haplosporidium costale*, *Bonamia exitiosa*, *Bonamia ostreae*, and *Bonamia perspora*. A BLAST 18S phylogenetic tree was created using NIH’s GenBank. We used a reference sequence of *Bonamia perspora* which was entered into GenBank by Dr. Ryan B. Carnegie. Other sequences added to the phylogenetic tree were collected from the 2015 paper written by Isabella Arzul and Ryan B. Carnegie. Our final phylogenetic tree indicated that *Bonamia* species could represent adaptive evolution which can affect their mode of reproduction from spore formation to direct transmission and vice versa. We inferred from our 18S phylogenetic tree that the genetic machinery to produce spores seen in *Bonamia perspora* may also be present in other *Bonamia* species. These differences could be a result of differing environmental conditions. More work is needed to confirm that *Bonamia* species can in fact shift reproductive strategies based on environmental circumstances.

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Names in bold indicate student presenters.

Hybrid Inviability in Cross-Karyotype Cichlid Fish

Authors: **Olivia Read** and Dr. Reade Roberts*

Primary Mentor: Dr. Reade Roberts, College of Sciences, Department of Biological Sciences

Hybrid inviability-when offspring from a cross of different species fail to survive or develop normally-is a major force in shaping how new species form. One way this happens is through differences in chromosome number, which can disrupt early development. To explore how chromosome differences influence survival, we studied the second generation (F2) of a cross between an *Astatotilapia burtoni* female and a Lake Malawi hybrid male with 20 and 22 chromosome pairs respectively. Our goal is to map patterns of survival and growth in these F2 hybrids to identify developmental outcomes that may reflect incompatible genetic combinations. We raised multiple broods (batches of siblings) under controlled conditions, tracked survival from the egg to juvenile stage and photographed at five months of age. We found that most embryos died before hatching, indicating strong early hybrid inviability. Among the surviving juveniles, we are seeing striking size variation within broods: some fish are noticeably larger and resemble the paternal lineage, while others are smaller and more similar to the maternal species. These patterns suggest that different genetic combinations may influence both survival and growth. Together, these results highlight the potential for chromosome differences to shape hybrid outcomes across early development.

Balancing Elasticity and Responsiveness in Soft Ferromagnetic Materials for Medical Applications

Authors: **Talia Flood** and Dr. Jie Yin*

Primary Mentor: Dr. Jie Yin, College of Engineering, Mechanical and Aerospace Engineering

Our study investigates methods to improve the usability of ferromagnetic soft material capsules for use in medical capacities. These capsules deliver non-invasive, non-surgical assistance while providing precise, localized care. This capsule delivery method greatly decreases exposure to pathogens and lowers the risk for post-procedure infection. The flexible, biocompatible nature allows the capsule to be deformed inside the body, without harming the patient or compromising the integrity of the capsule. The non-invasive nature of the process can also lead to shorter operation times and less intensive recovery. Numerous compositions of two-part EcoFlex 00-50 silicone rubber and Neodymium Iron Boron powder (NdFeB) have been tested to determine the ideal composition that creates a capsule that can be easily guided by

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magnets and made to disperse medicine through both water and an alginate-based hydrogel. The elasticity of these capsules determines their ability to be manipulated by the conditions of the body without rupturing and dispersing the medication at the incorrect location. With more NdFeB there is increased responsiveness, but decreased elasticity that compromises function. The study of ferromagnetic soft materials in medical applications is in its infancy, which leaves opportunities for much more research into increasing the effectiveness of these capsules.

Poster 14

Genetic Basis of Behavior in the Cichlid *Tropheops tropheops*

Authors: **Claire Braswell** and Dr. Reade Roberts*

Primary Mentor: Dr. Reade Roberts, College of Sciences, Department of Biological Sciences

The genetic basis of behavior is still not fully understood, especially regarding how behavior evolves. The hundreds of cichlid fish species from Lake Malawi have evolved rapidly with respect to evolutionary time, leading to both speciation and differences in behavior and habitat use among species. Some species prefer rocky habitats, where they can hide from predators. Others show bolder behavior by swimming into open water or building sand structures, called bowers, to attract mates. Previous work in the Roberts Lab identified a specific A/G genetic polymorphism that may be associated with behavioral differences. The AA genotype is commonly found in rock-dwelling species, while the GG genotype is more common in sand-dwelling species. Species that live in intermediate habitats often have both alleles, including the AG genotype. One intermediate species, *Tropheops tropheops*, is being studied in the lab to determine if genotype relates to territorial behavior or habitat use. Each fish is genotyped using sequencing to determine if it has the AA, AG, or GG genotype. Tank behavior will be assessed through various behavioral assays, including a microcosm assay with rock and sand habitats. Tank behavior will be scored via video to quantify how each fish behaves in the microcosm environment, to test differences in behavior by genotype. Overall, this study aims to better understand how genetic differences can influence complex behaviors that play a role in evolution and speciation.

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Centerbody Design Optimization for a Methane-Oxygen RDRE

Authors: **Miranda Waggoner**, Dr James Braun*, Eduardo Malvezzi Leite de Moraes
Primary Mentor: Dr. James Braun, College of Engineering, Mechanical and Aerospace Engineering

Rotating Detonation Rocket Engines (RDREs) present a great alternative to conventional deflagration based propulsion. They utilize continuous, supersonic detonation waves to achieve higher efficiency. However, there are many factors that contribute to the efficiency of this machine and maintaining stable waves. One of which is the geometry and throat constriction of the center body. While centerbody-less designs have a fully circular cross-section, incorporating a centerbody constrains the detonation wave to an annular channel. This study investigates the design and geometric optimization of the centerbody for a small-scale methane/oxygen RDRE. Various centerbody profiles were modeled with geometric constraints and a strict area-reduction threshold to model these effects on efficiency. With this, special emphasis was placed on comparing “slow-rise” versus “fast-rise” ramp profiles. These geometries were iteratively refined based on inner chamber diameters, throat constrictions, and the injector-to-throat axial distance to ensure that the estimated detonation wave height and refill zone do not expand past the throat. Also an automated high-speed optical analysis script was developed in MATLAB to quantify experimental wave dynamics of these geometries.

Observing Immobilized Carbonic Anhydrase Activity under Confocal Microscopy using pH-Sensitive Dyes

Authors: **Fatemeh Heydari**, Joshua Enoch, Dr. Priyabrata Biswal, Dr. Sonja Salmon, Dr. Zsofia Bognar, Dr. Mariusz Zareba, and Dr. Jialong Shen*
Primary Mentor: Dr. Jialong Shen, Wilson College of Textiles,

Mitigating atmospheric CO₂ levels is a major concern for scientists working to avoid negative consequences of climate change. Carbonic Anhydrase (CA), a zinc-containing metalloenzyme, is a promising technology for CO₂ management as it catalyzes the hydration reaction of CO₂ with water to produce HCO₃⁻ and H⁺. A local pH-induced fluorescence resulting from the released proton can be used to determine the enzyme's location when the enzyme is attached to a pH-sensitive dye. Due to the proton being a byproduct of the enzyme-catalyzed reaction, detection of fluorescence can also be used to determine retained CA activity after immobilization. Samples tested in this study included Histidine-tagged CA enzymes additionally

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tagged with a pH-sensitive dye immobilized through metal coordination on Nickel-NTA beads, and CA enzymes tagged with pH-sensitive dyes immobilized on a chitosan-coated cotton textile. The samples were imaged using confocal laser scanning microscopy (CLSM) under 10% CO₂ gas conditions. A gradual increase in fluorescence was observed over a 15-minute CO₂ exposure and imaging period. Control experiments were conducted by adding CA inhibitors to the samples, resulting in a significantly reduced fluorescence, proving that the increase in fluorescence intensity originated from enzyme activity. The successful observation of this spatiotemporal fluorescence signifies the successful immobilization, location, general orientation, and activity of the immobilized CA.

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