CELEBRATION OF

27th Annual

STUDENT SCHOLARSHIP

2023 Program of Events

Northern Michigan University

Thursday April 20, 2023
9:00 AM - 4:00 PM
Jamrich Hall

The Celebration of Student Scholarship is an annual event held on the NMU campus to recognize the academic contributions of undergraduate and graduate students in all disciplines. Students share their work with the NMU and Marquette communities by presenting research posters and oral presentations.

Opening Ceremony - 9:00 am

Welcome - Dr. Lisa Eckert
The Importance of Research - President Brock Tessman
Presentation of Awards
Celebration of Student Scholarship Posters- Tesse Sayen
Student Technology Innovation - Rick Mengynan
3MT - Janelle Taylor
Closing Remarks - Dr. Lisa Eckert

Oral Presentations Jamrich 1320 10:00 am - 11:45 am

Lunch - 12:00 pm to 2:00 pm

Oral Presentations Jamrich 1320 - 2:00 pm - 2:45 pm

Poster and Oral Presentations - 10:00 am - 4:00 pm

*Please remember to vote for the People's Choice Award. This QR code can be found on the last page of this program.

Land Acknowledgement

Northern Michigan University is located on the ancestral homelands of the Anishinaabe, Three Fires Confederacy, an honored alliance of the Ojibwe, Odawa, and Bodewadmik (Potowatomi) peoples. Before this land is was called Marquette, it was known as Gichi-namebini Ziibing.

Thank You

Office of the President
College of Graduate Studies & Research
College of Arts & Sciences
College of Business
College of Health Science & Professional Studies
Library & Instructional Support
University Marketing & Communications
Dining Services
Global Campus
Academic Affairs
Higher Love of Marquette

Oral Presentation Schedule

Jamrich 1320

10:00 Kathleen Durham, Senior, Anthropology, Dr. Jane Harris
Calculating Maggot Masses in Covered and Uncovered Human Remains

10:15 Jessica Laxo, Graduate, Early Childhood Education, Cindy Basse
Play is Possible

10:30 Marissa Burkman, Senior, Biology, Dr. Angie Mohrman
Predictors of NMU Student Success in STEM Courses Related to Campus-Provided Resources

10:45 Nathan Joyal, Graduate, Integrated Biosciences, Dr. Leslie Putman
A Study of the Relative Commercial Viability of Cannabis Indica in an Organic "Super-Soil" Mycorrhizal Ecosystem

11:00 Sydney Chrome, Sophomore, Biology- Botany concentration, Dr. Adam Naito
Biomass and Carbon Sequestration in the Dead River Community Forest

Lunch 11:45 am - 2:00 pm

2:00 Matthew Bourne, Senior, Electrical Engineering Technology, Seth Norberg
Electrical Ice Fishing System

2:15 Micah Benjamin, Senior, Nursing, Dawn Lundin
COVID-19 VS. Higher Education: Understanding the Exigencies Through Students' Perspectives in Online Learning

2:30 Elisheba J. Petersen, Graduate - Graduate degree in Early Childhood Education, Cindy Basse
Advocacy Speech for Playfulness in Kindergarten

Oral Presentations

Calculating Maggot Masses in Covered and Uncovered Human Remains

Kathleen R. Durham, Senior - Anthropology
Faculty Mentor: Dr. Jane Harris - Sociology & Anthropology

The blowfly life cycle is often used in death investigation to estimate time since death, also known as postmortem interval (PMI). The rate of growth and development of blowfly larvae is highly dependent on temperature. Traditionally, when assessing PMI based on the blowfly life cycle, temperature has been documented according to a local weather station or publicly available National Weather Service climate data. Maggot masses, however, are known to generate their own heat, which may result in the body temperature being different from the ambient temperature, and which may affect calculations of PMI based on insect development too. This study seeks to determine whether maggot mass temperatures are significantly higher than the ambient temperature for decomposing human remains. Collection of temperature data was derived from multiple maggot masses and surface temperatures of two different human donors in different dispositions. One donor was wrapped in a blue plastic tarp, while the other was left uncovered, which allowed the researcher to evaluate maggot mass temperatures in two different conditions. The quantitative data from this study is to better understand maggot mass temperatures, and how maggots affect temperature. Data in the study shows that temperatures are significantly higher than the control in each donor. Findings from this study have the potential to impact the interpretation of PMI estimates when maggot masses are present.

Play is Possible

Jessica L. Laxo, Graduate - Early Childhood Education
Faculty Mentor: Cindy Basse - Education, Leadership & Public Service

Many people think that kindergarten is still all about play; unfortunately, that is not the case. There are a lot of academic standards and a lot of pressure for these five- and six-year olds to be ahead of their peers. This can make it feel impossible to still have play in the classroom setting. It is completely doable to still have play in the kindergarten classroom while embedding academic standards. It is important for our youngest learners in school to learn in a way that will engage them and cultivate their curiosity. Kindergarten students and teachers are able to have fun while meeting the standards that the state has set. Upon completing a literature investigation it became apparent to me that I need to advocate for our youngest learners. I will give several examples of how to meet those standards within play and discuss why it is important that we protect play for young children.

Predictors of NMU Student Success in STEM Courses Related to Campus-Provided Resources

Marissa A. Burkman, Senior - Biology
Faculty Mentor: Dr. Angie Mohrman - Biology

Contemporary pedagogical research shows that peer-led teaching improves grade averages and learning outcomes for students of all ages (Greenwood et al. 1984). One resource available to all students on campus at Northern Michigan University (NMU) is the walk-in All Campus Tutoring Center. Limited research has examined usage levels of campus resources such as All Campus Tutoring and any correlation with the demographics of students using these resources, even though literature demonstrates that consistent use of drop-in tutoring centers correlates with an average enhanced GPA of 0.2 when compared to students who do not use tutoring centers with the same consistency or at all (Cooper, 2010). We are interested in exploring what demographic and sociopolitical circumstances act as predictors of overall student resource usage here at Northern Michigan University, specifically in STEM foundational courses. We developed a short, online survey to explore tutoring center usage at NMU's campus in an effort to determine usage rates, self reported GPA, and demographic predictors of use. We hypothesize that the primary predictors of tutoring center usage will be ethnic origin and age, given that the main tutoring center is located in a dormitory classroom, with main representation being non-minority groups of

freshman and sophomore-aged students who live on campus. We hope that the results of this study provide avenues to improve student resource usage by gaining insight into groups that may be overrepresented and providing points where adjustments may be made to highlight the benefit of such resources to underrepresented groups on campus.

A Study of the Relative Commercial Viability of Cannabis Indica in an Organic "Super-Soil" Mycorrhizal Ecosystem

Nathan A. Joyal, Graduate - Integrated Biosciences
Faculty Mentors: Dr. Leslie Putnam - Chemistry, Dr. Donna Maki - Biology, Dr. Matt Van Grinsven - Earth, Environmental & Geographical Sciences

A study to evaluate the relative viability of Cannabis for commercial purposes using a growing medium composed of a living ecosystem containing a variety of strains of mycorrhizal fungus and fertilized only with compounds harvested from nature. This is in contrast to contemporary commercial farming techniques which focus on salt-based fertilizers, either in an outdoor field or in hydroponics. The experiment will compare plants grown in this super-soil to plants grown using contemporary hydroponic farming techniques and also plants grown in topsoil with commercial fertilizer, side by side under identical environmental conditions. All plants compared side-by-side in this study will be genetically identical clones produced from cuttings taken from a single source plant. A variety of data will be collected, but ultimately yield per dollar spent will be reported. Additionally, the health and vigor of each plant will be studied qualitatively by measuring its size and growth, and by recording observations of pathogens, chlorosis, and senescence. The final data will be reported in terms familiar to potential industry partners, quantifying key results in terms of yield produced per unit of cost for the various methods considered.

Biomass and Carbon Sequestration in the Dead River Community Forest

Sydney H.Chrome, Sophomore - Biology- Botany concentration
Faculty Mentor: Dr. Adam Naito - Earth, Environmental & Geographical Sciences

Carbon sequestration is an important ecosystem service of forests. Estimates of aboveground biomass provide insights into carbon sequestration potential and overall ecosystem health. While the relationship between biomass and carbon sequestration potential is well-known, efforts to characterize this relationship in the Upper Peninsula of Michigan have been limited. As part of a larger collaborative effort between Northern Michigan University and the Upper Peninsula Land Conservancy (UPLC), we assessed species diversity and carbon sequestration potential in the recently-acquired Bayous Parcel of the Dead River Community Forest. We used the point-centered-quarter method on four transects to collect data on species composition and diameter measurements of individual trees in September and October of 2022. This data was used to develop rank abundance curves, estimate importance values, and inform aboveground biomass estimates using species-specific allometric equations. The total aboveground biomass in the studied area was 283 metric tons. Sugar maple (Acer saccharum Marsh.) was the most abundant and biomass-dominant tree species, and also had the highest importance values (greatest dominance). While far less abundant, Eastern white pine (Pinus strobus L.) was the second most biomass-dominant species. These preliminary analyses will inform the UPLC's initiative to characterize forest composition and develop a climate change mitigation strategy for the Dead River Community Forest. Atmospheric carbon is a significant contributor to climate change, and the conservation of climate-resilient tree species with high carbon sequestration potential will be critical to a management strategy.

Electrical Ice Fishing System

Matthew R. Bourne, Senior - Electrical Engineering Technology, Steven A. Williamson, Senior - Electrical Engineering Technology
Faculty Mentor: Seth Norberg - Technology & Occupational Sciences (Jacobetti Complex Programs)

Ice fishing systems on the market today rely solely on mechanical processes to catch fish. This type of system can use too much force and they are not always the best for small fish. Introducing electronics to the system will help improve reliability and performance. The engineering design process was used to come up with this system. The conceptual design phase helped define a clear set of design objectives and engineering characteristics that the product will satisfy. These changed over time until the final design was reached. The final product is an all-in-one automated ice fishing system capable of detecting the smallest of fish bites. The electronics used will be programmed to allow for precise control over the entire system. Key interfaces such as the motor reel interface and rod holder will tie the system together. The rod can be pulled out of the system at any time to manually reel in a fish which keeps the conventional thrill of ice fishing. In the future, this product will become a universal system into which any rod and reel combination can be placed.

COVID-19 VS. Higher Education: Understanding the Exigencies Through Students' Perspectives in Online Learning

Micah Y. Benjamin, Senior - Nursing
Faculty Mentor: Dawn Lundin - Nursing

The Coronavirus Disease 2019 (COVID-19) pandemic has impacted how students learn. The sudden shift to the emergency remote learning format during the COVID-19 pandemic has impacted students' mental health, well-being, and educational resources. A survey conducted by Active Minds concluded that 38% of students reported difficulty focusing on their academics, and 74% found it challenging to stick to a regimen (Covid-19: Student Survey 2021). This study intends to highlight resources that aid students when academic courses in higher education are transformed from face-to-face to an emergency remote learning, online learning, or hybrid learning format. The findings of this study will enhance academic faculty members' understanding of which course components are essential when navigating a pandemic in higher education. Students enrolled in AH 202: Nutrition for Health Care Professionals II completed a voluntary questionnaire regarding Northern Michigan University courses being converted to emergency remote online learning in winter 2020. Voluntary questionnaires were provided to students during winter 2020, summer 2020, fall 2020, winter 2021, summer 2021, and winter 2022 semesters. Students were also presented with a voluntary follow-up questionnaire at the end of each semester. The student responses from both surveys were compared to analyze the anticipated and actual challenges students experienced during emergency remote learning, online learning, and hybrid learning. The results provide knowledge and a unique perspective from the student’s point of view in higher education.

Advocacy Speech for Playfulness in Kindergarten

Elisheba J. Petersen, Graduate - Graduate degree in Early Childhood Education
Faculty Mentor: Cindy Basse - Education, Leadership & Public Service

Would you rather; color in the bubbles on a picture worksheet for words that start with the “t” sound, or pop a real bubble for every word you can say that starts with the “t” sound? Play is important! Playfulness in kindergarten has benefits of active learning, exploration, and inquiry. Kindergarten teachers, school principals, superintendents, and school board members all could use the reminder of the learning impact that play can have in our classrooms. This speech calls on the audience to pop the normal bubbles of Kindergarten assessment and promote play observations as a means for assessment.

Poster Exhibits

A New Collection of Freshwater Crabs from Northern Madagascar that Includes a Possible New Species (Brachyura: Potamoidea: Deckeniidae)

Grace E. Robinson, Freshman - Biology
Faculty Mentor: Dr. Neil Cumberlidge - Biology

The purpose of this project is to describe the results of a new collection of over 80 specimens of freshwater crabs from northern Madagascar collected between 2020 and 2022 by Dr. S. M. Goodman of the Field Museum of Natural History, Chicago, IL. The collections were made from four different localities and included five species in three genera: Hydrothelphusa agilis, Hydrothelphusa madagascariensis, Hydrothelphusa sp., Madagapotamon humberti, and Vahatra ambohitra. The first area surveyed was in Protégé d'Ambohitra'Antsingy, Montagne des Francais in the Dr. Diana Region in dry deciduous forest with tsingy formations where three species were found (H. madagascariensis, M. humberti, and V. ambohitra). The second area was in the Dr. Diana Region of Antsiranana in dry deciduous tsingy forest where M. humberti and V. ambohitra were collected. The third area was in Antsiranana in the Sava Region in evergreen montane forest where H. madagascariensis and Hydrothelphusa sp. were collected. The fourth area was the Parc National de Mantadia in Antsiranana in the Sava Region in largely undisturbed lowland forest where only H. agilis was collected. Specimens were identified based on their morphological characters and photographed in detail. A possible new species of Hydrothelphusa was discovered among them. In order to test this hypothesis, tissue samples were taken from 15 specimens representing all five taxa and sent to a molecular laboratory for DNA sequencing. If supported by our morphological and molecular data, the new species will be described and a manuscript prepared for submission to a scientific journal.

16S Sequencing to Determine the Bacterial Microbiome Composition of Marquette Area Waters

Allison R. Baldwin, Senior - Biology/Physiology, Jaiden R. Cunningham, Junior - Biology/Microbiology, Rose M. Goltz, Junior - Clinical Laboratory Science
Faculty Mentor: Dr. Josh Sharp Biology

The focus of this research was to examine the microbiome of various water sources around Marquette, with a special interest in the bacterial genus Legionella. Exposure to pathogenic species of Legionella cause a respiratory infection known as Legionnaire's Disease. In recent years, cases of Legionnaire's Disease have seen increases in Michigan's lower peninsula. One of the suspected factors causing this uptick is the warming of Michigan waters and subsequent bacterial proliferation caused by climate change. Little has been done to study the microbiomes of Upper Peninsula waters, leading to the premise of this research. The studies began with water sample collection, DNA isolation, and then digital-droplet polymerase chain reaction (ddPCR) that probed for Legionella specific 23S rDNA. For samples that tested positive for the 23S gene, 16S sequencing was done to identify the different bacterial genera and species that were present and in what amounts. 16S sequencing is done to identify bacteria present in complex mixtures such as environmental or gut samples. The 16S gene is unique to bacteria and contains variable sequences that can be used to identify the family, genus, and/or species. The studies revealed that Legionella make up a very small portion of the bacterial populations among water sources in Marquette, with 7 non-pathogenic species being found numerous times. Other bacterial genera including Brachyspirae and Leptospirae were also found in some water sources, with some of their species being known to cause lung infections and dysentery.

Abundance in the Forest: Bobcat, Coyote, and the Eastern Cottontail

Molly R. Ferris, Senior - Environmental Science: Natural Resources
Faculty Mentor: Dr. Diana Lafferty - Biology, Laura Whipple - Biology

Boreal forests are full of carnivorous and omnivorous predators, such as the bobcat (Lynx rufus) and the coyote (Canis latrans). Predators are key in ecosystems; they act as a source of checks and balances among prey species. Both bobcats and coyotes compete for prey items, with the Eastern cottontail (Sylvilagus floridanus) being one shared prey species. By studying how changes in forest cover affects the relative abundance of bobcat and coyote competing for the eastern cottontail, we can rule which species may better adapt to change in climate. This information can then be used to inform possible habitat restoration projects, study genetic variation among cottontails in relation to a dominant predator species, and project potential species migrations. The objective of my research project is to investigate how bobcat, coyote, and eastern cottontail may be impacted by climate change within forest landscapes by comparing the relative abundance of each species in areas with above average and below average forest cover. From these results, predictions as to what other species may be affected by percent forest cover and how can be inferred. Data used to calculate which species performs best under different percent forest cover conditions was collected through Snapshot USA's camera trap data. Snapshot's data allowed species relative abundance to be calculated in both above average percent forest cover, and below average. Results show that bobcats perform best in above average forest cover, coyotes are well adaptive to both, and the eastern cottontail performs best under below average forest cover.

Activity Pattern Analysis of Competing Predators and a Shared Prey

Mira A. Goemaere, Senior - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

Coyotes (Canis latrans) and red foxes (Vulpes vulpes) are frequently sympatric carnivores with similar dietary niches. Because coyotes are larger than foxes and frequently travel in groups, encounters between the two species can be dangerous or lethal for red foxes. While both predators hunt Eastern cottontails (Sylvilagus floridanus) with some frequency, both also seem to prefer mice. Because Eastern cottontails are not favored prey and coyote and red fox diets are so varied, competition is likely to be present but relatively low-stakes. The goal of my research was to identify differentiations in the activity patterns of coyotes, red foxes, and the Eastern cottontail in regions where all three species are known to be present using Snapshot USA camera trap data from 2019 to 2021. This will provide insight into how predators in similar niches carry out resource partitioning when one is a trophic level above the other. In doing this research, I seek to test three hypotheses about the subject species' activity. I expect that peak red fox activity patterns will avoid peak coyote activity periods, and be less active overall during the coyotes' active periods. Because of pressure from two different predators, I expect that Eastern cottontails will be most active during the hours that coyotes and red foxes are less active.

Acute effects of different cupping therapies on ankle range of motion

Alex N. Schaub, Graduate - Exercise Science
Faculty Mentor: Dr. Megan Nelson - Health & Human Performance

Cupping therapy involves lifting and separating fascial tissue to facilitate stretching and promote blood flow. Although cupping is a common treatment modality for pain, various protocols exist and studies are inconsistent in regards to whether cupping improves other outcomes, including range of motion. PURPOSE: We aimed to determine the acute effect of different methods of cupping therapy on ankle dorsiflexion in generally healthy adults. METHODS: Thirty adults (33% female; age: 22±4.60 y; BMI: 25.4±6.7 kg/m2) with no previous exposure to cupping therapy were randomized and blinded to one of four different cupping therapies (static, dynamic, static sham, dynamic sham). Four cups were placed on the gastrocnemius, attached with athletic tape and were left on the skin for 10 minutes after creating a negative pressure for all therapies. A small hole was poked in sham cups so negative pressure could be simulated but did not hold. Ankle dorsiflexion was be measured pre- and immediately post-intervention. A 2x4 mixed ANOVA was used to determine whether there were pre-to-post differences in ankle ROM between the treatment groups. RESULTS: There was no time by treatment interaction ($F(3,26)=1.2$,

p=0.33). There was a significant main effect for time ($F(1,26)=27.0$, $p<0.001$), such that on average, participants increased ankle ROM regardless of treatment modality (pre=34.2±4.2°, post=38.1±5.1°). CONCLUSION: Cupping therapy, regardless of the treatment protocol used, may be effective for acutely improving ankle ROM in generally healthy adults. The presence of a placebo effect may be one mechanism for improvements in acute ankle ROM after cupping therapy.

An Assessment of Flea Diversity in Pikas of Mongolia and North America

Cassie M.Stitzman, Senior - Fisheries and Wildlife Management, Hannah M. Blank, Sophomore - Biology, Hilary H. Rinsland, Graduate - Biology
Faculty Mentor: Dr. Kurt Galbreath - Biology

Fleas are ectoparasites that serve as vectors for blood-borne pathogens that infect wildlife. Understanding the relationship between ectoparasites and their hosts is crucial to understanding how pathogens spread in wildlife populations. We are studying the fleas of pikas, which are small lagomorphs that can be found in the Palearctic and Nearctic regions. Pikas originated in Asia, and it is likely that many parasites of pikas, including fleas and the pathogens that they transmit, originated there as well. Previous work described flea diversity in American pikas. Additionally, the blood-borne bacterial pathogen, Bartonella, has been shown to occur in fleas associated with pikas. Our research is investigating flea communities of pikas in Asia and North America to establish a foundation for understanding the relationships between fleas, Bartonella, and their pika hosts. We will describe the diversity of fleas acquired from collections of pikas in Central Asia (Mongolia) to complement previous work on pika flea diversity conducted in North America. To do this, we will first extract DNA from fleas to preserve the capacity to do molecular systematic analyses, and then temporarily slide-mount the flea exoskeletons to identify them to species using dichotomous keys based on morphological characteristics. For example, the Megarthroglossus spenceri can be distinguished from other fleas by its undeveloped eyes and asymmetrical apex of the labial palp. Understanding the distribution and diversity of flea species is crucial in understanding their evolutionary and ecological roles in the dissemination of vector-transmitted pathogens.

Aphasia

Chloe S. Billington, Freshman - Speech Language and Hearing Sciences
Faculty Mentor: Dr. Maryam Khaledi

My name is Chloe Billington, and I chose to do research with Dr. Maryam Khaledi in the Speech, Language, and Hearing Sciences program. The research analyzes the narratives, or recitation of a fairytale, from individuals with fluent Aphasia through the Aphasia Bank (McWhinneyet al., 2011). The study examines the nature of fluency, morphological, and syntactic damage in individuals with Aphasia compared to individuals without Aphasia.

The study is conducted through speech samples on Aphasia Bank. There are twenty-eight patients, and the research aims to examine all of them. Analyzed speech samples are from patients reciting Cinderella either by memory or with a picture book. Utterances then break down the speech sample. Finally, the utterances go into a chart for further analysis of the sentence structure.

The chart breaks down the syntactic arrangement of an utterance. In the chart, the utterances are divided into twenty categories, some including the number of nouns, pronouns, and verbs; the number of narrative and open words; and the AUX score or auxiliary score. The AUX score marks a verb that adds meaning to the main verb in a clause. Each column will calculate results from the data entered in the chart.

The results will be compared with patients for similarities to improve treatment options. The research strives to help Speech and Language Pathologists develop more efficient treatment plans for their patients with fluent Aphasia. The results will be submitted for a conference presentation and publication to assist Speech and Language Pathologists worldwide.

Applications of 16S rRNA Sequencing in Forensic Science

Callan M. Herst, Graduate - Biology, Amanda (Mandy) L. Joslyn, Graduate - Biology
Faculty Mentors: Dr. Joshua Sharp - Biology, Dr. Jane Harris - Sociology & Anthropology

The average human body houses over 10,000 different microbial species. Bacterial composition in your body can show many characteristics about your life, like: diet, medications, and location- among others. Even after death, forensic microbiologists can tell where/how you lived by studying the bacteria found around your body.
Recently, forensic scientists are using microorganisms as physical evidence due to their abundance in the environment and unique communities. To quantify and identify these microorganisms, many forensic microbiologists use 16S rRNA gene sequencing (16S).
Forensic samples used in 16S sequencing include DNA isolated/purified from blood, soil, muscle tissue, or swabs of body locations. Then, scientists use PCR to amplify the variable four (V4) region of the conserved 16S gene. DNA fragments from PCR are then grouped into operational taxonomic units (OTUs) based on similarity. The relative number of OTUs combined with taxonomic information can reveal the identity and relative quantity of bacteria in each sample.
At NMU's Forensic Research Outdoor Station (FROST), 16s sequencing is presently used to study microbiomes in muscle, oral swabs, and soil. The composition of these samples, when related to temperature and time since death, will tell us the story of how the microbiome changes throughout human decomposition. Since microbes are abundant in the environment and humans, understanding how the necrobiome changes could be a reliable source of evidence for death investigations. Continuing research suggests that microbes could better estimate the time since death, and more research in the new field of forensic microbiology is needed.

Artifact Analysis: French Bay, Beaver Island

Emory A. Fouch, Freshman - Anthropology
Faculty Mentor: Dr. Scott Demel - Sociology & Anthropology

The study and process of archaeology provides a chance to investigate the past. It offers another line of inquiry into the history of a place and its people, and it gives the chance for stories to be retold through the study and analysis of material culture that was left behind. This narrative can be shared with the public through exhibitions and publications. French Bay, on the west side of Beaver Island, has a long history of occupation by Native Americans, Mormons, French fur traders, and Euro-Americans. For my fellowship research project, I am investigating a group of historical artifacts that were recovered from an initial archaeological survey of the French Bay Site. This project will shed light on the history of a circa 1900 lumber camp that was uncovered during an initial archaeological survey. By applying the research techniques and methodologies I have learned during my short time in the NMU archaeology lab, I am able to contribute the results of my artifact analysis to the island's history. All of my research findings will be added into a preliminary report of investigations, which will be edited by my professor and mentor, Dr. Scott J. Demel, and sent to the State Archaeology Program at the Michigan History Center. These reports are required for working on State land and will be used for research and reference in future archaeological inquiries and endeavors.

Assessing the effects of forest land cover change on nine-banded armadillo (Dasypus novemcinctus), bobcat (Lynx rufus), and coyote (Canis latrans) populations in the southeastern United States

Mary M. Kelly, Junior - Environmental Science
Faculty Mentor: Dr. Diana Lafferty - Biology

Nine-banded armadillos (Dasypus novemcinctus), bobcats (Lynx rufus), and coyotes (Canis latrans) inhabit forests in the southeastern United States. This project explores whether differences in percent forest land cover influence the relative abundance (RAI) of nine-banded armadillo, bobcat, and coyote in the southeastern United States. While land cover change impacts wildlife habitat in warmer climates, few studies have investigated potential impacts of percent forest cover on the RAI of these three species.

Snapshot USA camera trap data was utilized to assess the effects of percent forest land cover change on RAI. A t-test to calculate RAI resulted in no significant difference between sites with above- and below-average forest cover for bobcat and coyote. The difference in RAI between sites was significant for nine-banded armadillo, with higher RAI at sites with below-average forest cover. Coyote detections averaged 4 per 100 trap nights in areas of above-average forest cover, while areas of below-average cover averaged 4.9 detections. Similarly, bobcat detections averaged 1.20 per 100 trap nights in areas of above-average forest cover, while areas of below-average cover averaged 1.80 detections. Nine-banded armadillo detections averaged 1 per 100 trap nights in areas of above-average forest cover, while areas of below-average cover averaged 4.80 detections. RAI of all three species appears to increase in areas of below-average forest cover, suggesting that environmental factors such as predator-prey interactions could contribute to RAI. This study illustrates the need for ecosystem managers to conserve forested areas to protect wildlife habitat across the United States.

Attack of the Invasive Species

Paige M. Conners, Senior - Biology, Alexis M. Ostrander, Junior - Data Science, Haley M. VanNuck, Junior - Biology, Mira A. Goemaere, Senior - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

Over 180 aquatic invasive species (AIS) have invaded the Laurentian Great Lakes. While not all invasive species are immediately harmful to the ecosystem, many have devastating impacts on native flora and fauna as well as the overall economy of the Great Lakes region. Though many local anglers are aware of the threats posed by AIS, myriad stakeholders could be doing more to mitigate the spread of invasive species. If uncontrolled, invasive species could permanently damage the Great Lakes, causing declines in sport fish populations, increases in algae blooms, and changes of the pH of the lake water. These outcomes would severely impact the economies of small lakeside towns that rely on tourism from sport fishing and recreation. Our goal is to make the public aware of the threats imposed by these invasive species and what the average person can do to help protect the native ecosystem. Once they learn how easy it is to make an impact, we expect the public to be more likely to take action. It can be as simple as crushing a zebra mussel.

Biting Off More Than You Can Chew

Tarah R. Gates, Senior - Zoology, Talia E. Georgelos, Sophomore - Biology, Caleigh M. Dahn, Senior - Biology, Amelia B. Meares, Senior - Ecology
Faculty Mentor: Dr. Diana Lafferty - Biology

Americans throw away 119 billion pounds of food every year. To put that in perspective, the Great Wall of China weighs 116 billion pounds. This amounts to more than 400,000 blue whales worth of waste! College campuses in the United States alone waste 22 million pounds of food, averaging to 142 pounds per student per year. Food waste makes up 24% of landfills, more than any other material. Northern Michigan University is no exception and contributes to the food waste problem. However, we have the opportunity to start a societal shift beginning with our campus. Our goal is to educate the NMU community on how to reduce food waste. In order to accomplish this goal, we will teach our peers about refreshing leftovers and composting. We hypothesize that a large portion of food waste comes from a lack of education. If our hypothesis is correct, then educating NMU's populace on the impact of food waste will reduce our contribution to landfills. We plan on attaining these goals through an informational poster and by developing recipes that instruct students on how to refresh their leftovers. By informing individual households, we can start a societal shift towards less leftovers ending in the trash.

Bluespotted salamander migration at Marquette's Presque Isle Park: Preliminary Findings Gathered Through Citizen Science

Anna J. Hill, Junior - Biology, concentration in Ecology, Kaitlyn M. Smith, Senior - Biology, Luke N. Childs, Senior - Fisheries and Wildlife Management concentration in Law Enforcement
Faculty Mentor: Dr. Jill Leonard - Biology

Blue Spotted salamanders (Ambystoma laterale) are a common amphibian found in northeastern North America, including the Great Lakes. The species is known for its annual springtime migration where individuals of both sexes emerge from underground, often navigating snow, to move to nearby wetlands to breed. In Marquette, MI, a population of A. laterale occurs on Presque Isle Park and makes annual migrations across a park road. Early work showed substantial vehicle mortality which led to a springtime road closure. Since that time, the migration has become a focal point for the community, which in turn has attracted nationwide attention. In this poster, we present preliminary information on the timing of the reproductive migration based on a Citizen Science project where the public conducts field counts of animals during the migration. The data characterize the evening onset of migration and help define the environmental conditions during which the salamanders migrate. Spring 2022 data also suggests that the A. laterale migration is more extended than previously suggested. Interestingly, the data also describes the public visitorship to the migration site. Future plans include establishment of a parallel data collection program with NMU students, inclusion of camera trapping, and assessment of differences in migratory timing between A. laterale and their unisexual hybrid species (A. laterale x A. jeffersonianum) that co-occur in this population.

Can Religious Faith Predict Overall Satisfaction?

Anna E. Beckstrom, Senior - Mathematics & Computer Science, Kayla M. Bittenbinder, Senior - Mathematics & Physics, Trinity E. Hinshaw, Senior - Biology/Ecology
Kiersten L. Terhune, Senior - Data Science
Faculty Mentor: Dr. Linda Lawton - Math & Computer Science

Can religious faith predict overall satisfaction? Using data from the 2016 Panel Study of Income Dynamics (PSID) Wellbeing and Daily Life surveys conducted by the Institute for Social Research at the University of Michigan, we investigate perceived religious importance and satisfaction and its effect on perceived quality of life. A sample of 8341 men and women aged 30 to 97 were surveyed on satisfaction in various aspects of life, as well as their perception of their own character. We anticipate higher rates of overall satisfaction, increased mood, and an increased perception of positive contributions to the lives of others in those who rate religion as of high importance and who are highly satisfied with their religion. Using Analysis of Variance (ANOVA), we will investigate these satisfaction factors for those with and without significant religious faith.

Chemical Inhibitor of Methanogenesis: How does geography influence chemical inhibition of methanogenesis?

Connor C. O'Loughlin, Senior - Environmental Science
Faculty Mentor: Dr. Susy Ziegler - Earth, Environmental & Geographical Sciences

Methane is considered to be one of the main contributors to the current greenhouse effect warming our planet. Many environments (wetlands, estuaries, rumen of cattle, lacustrine/riverine, etc.) readily allow for the production of methane (methanogenesis), all of which have innate geographical differences in their

methane production. With rising global average temperature, methane production is increasing, making the discovery of solutions urgent. Molecules that lower the efficiency of methanogenesis, are particularly promising, because they can decrease methane emissions (i.e. from the rumens of cattle). In summer of 2022, I conducted research at Argonne National Laboratory. I studied whether a certain molecule—9,10-Anthraquinone-2-carboxylic acid (hereafter referred to as AQC)—could inhibit microbial methanogenesis when exposed to environments in different places. I observed how AQC interacted with samples of substrate collected from wetlands in different places in the lower 48 states. We found that AQC is able to inhibit methanogenesis in a variety of substrates, which were collected from a diverse range of wetlands. We also studied whether or not variations in concentration could impact the inhibitory effects of AQC. We found concentrations above 10-4 mol L-1 were the most effective. What makes these findings so remarkable is that previous studies have not identified if the inhibitory effects of AQC are impacted by different substrates, which could lead to AQC being used as a more common methane inhibitor. One such application would be in the rumen of cattle to reduce methane emissions and lessen the effects of methane on climate change.

Comparative analysis between colorimetric LAMP and RPA diagnostic methods to detect IDH1 R132H mutation in GBM

Jason C. Andary, Freshman - Clinical Laboratory Technology

Faculty Mentors: Dr. Paul Mann - Clinical Laboratory Sciences, Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Robert Winn - Biology

Glioblastoma multiforme (GBM) is the most common, and deadly form of brain cancer with a life expectance of approximately16 months. The standard of care for GBM is radiotherapy, chemotherapy and surgical resection. The IDH1 (isocitrate dehydrogenase 1)R132H gene mutation is a prognostic indicator for life that, provided an aggressive surgical resection of an IDH1 R132H tumor, increases the life expectancy of the patient five-fold. Detection of this mutation within the surgical window has the potential to allow surgeons to be more aggressive during surgery. This study compares two molecular techniques developed in our laboratory, PNA-LAMP (Peptide Nucleic Acid – Loop Mediated Isothermal Amplification) and RPA (Recombinase Polymerase Amplification) for detection of the IDH1 R132H mutation. Utilizing each of these molecular techniques, I detected the R132H mutation from synthetic DNA, DNA purified from cultured cells, and DNA from tumor samples. The PNA-LAMP technique allowed for a visual confirmation detecting the R132H mutation in tumor samples within 45 minutes in the absence of a DNA extraction. The RPA methodology rapidly detects the IDH1 R132H mutation within 8 minutes, however, visualization of detection is currently limiting compared to the PNA-LAMP technique as it requires gel electrophoresis for confirmation. With each of these viable technologies, additional work to improve tie to detection and visualization of positive results is warranted.

Comparing Effectiveness and Preference of Numerical and Narrative Feedback when Learning Clinical Skills

Logan D. Zupko, Senior - Psychology, Darian R. Grear, Senior - Applied Behavior Analysis / Psychology

Faculty Mentors: Dr. CoryToegel - Psychological Sciences, Dr. Forrest Toegel - Psychological Sciences

Delivering feedback is an important component in teaching a person new skills. Feedback provides the person learning the skills with information about which steps were completed correctly and how to improve steps that were completed incorrectly. The present study evaluates the effectiveness of and

participant preference for numerical versus narrative feedback. Narrative feedback provides participants with information about performance in written, qualitative statements (e.g., praise and tips for improvement). Numerical feedback provides participants with information about performance in written, quantitative summaries (e.g., percent correct). College students attended a laboratory session where they received instructions describing how to complete different clinical tasks with a confederate experimenter. During Phase 1, participants performed the two distinct tasks three times each in a counterbalanced order. A second experimenter recorded the steps that were completed correctly and incorrectly. After performing each task, the second experimenter provided feedback about the performance. Narrative feedback was provided after one of the tasks, and numerical feedback was provided after the other. During Phase 2, participants received instructions describing how to complete a third task, and were able to choose the kind of feedback they would receive. This phase allowed an assessment of participants' preferred feedback type and whether participant preferences correlated with the type of feedback that was most effective in Phase 1. These results will be presented and discussed. This research will provide insights into effective and preferred strategies to facilitate training of common clinical tasks.

Comparing soil carbon and organic matter among burn severity classes for the 2021 Brittle Fire, Michigan, USA

Claire E. Burtrum, Senior - Environmental Science
Faculty Mentors: Dr. Matthew VanGrinsven - Earth, Environmental & Geographical Sciences, Dr. Adam T.Naito - Earth, Environmental & Geographical Sciences

Wildfires are significant ecological events that modify soil and vegetation characteristics of forest ecosystems. Organic (O) and topsoil (A) soil horizons are affected by wildfires where the intensity of the wildfire can have a variable influence on the degree of organic matter degradation. Wildfires cause long-lasting effects on soil organic matter (SOM) content and carbon within O and A horizons. Because SOM plays a crucial role in soil health, nutrient cycling, and vegetation growth, wildfires have a long-lasting influence on vegetation succession within forest ecosystems. This study compared soil organic matter and carbon estimates among burn severity classes within the perimeter of the Brittle Fire in the Huron-Manistee National Forests, MI, USA. Pre-fire and post-fire Landsat satellite imagery was used to determine the normalized burn ratio and define two burn severity classes. Soil samples were subsequently collected from the uppermost soil horizon along transects within each burn severity class. Results will be presented to examine the influence of burn severity on SOM content and soil carbon. Mean SOM was highest in the low burn severity class at 17.5% compared with the moderate-low (9.9%) and unburned (14.5%) severity classes, although mean SOM did not significantly differ among classes. Understanding the influence of wildfire burn severity on SOM and soil carbon can assist pre and post-fire land management decisions.

Comparison of relative abundance values of Canis lupus, Vulpes vulpes, and Canis latrans in sites with high and low amounts of human modification

Madacyn M. Helstein, Junior - Biophysiology
Faculty Mentor: Dr. Diana Lafferty - Biology

Gray wolf (Canis lupus), Red fox (Vulpes vulpes), and Coyote (Canis latrans) mortality rates have been found to increase greatly through human influence in previous studies. The three mammalian predators typically reside in forests near residential areas and are therefore impacted by human actions. Interactions between these predators and humans can have significant effects on the environment and this study aims to find out whether or not human modification influences Gray wolf, Red fox, and Coyote relative abundances. The study was conducted using camera trap data from Snapshot USA and an

unpaired t-test to compare the relative abundance of the three predators at sites with above and below average human modification. The three species' relative abundances were found to not be significantly impacted by human modification. The results of this study suggest that Gray wolves, Red foxes, and Coyotes are adapting to human modification. This may lead to increased interactions between the three species and humans, which could raise the likelihood of the spread of disease. Human-wildlife interactions should therefore be managed by reducing human modification in forests, and further research should be done to better understand the relationship between predators and humans.

Corrections Officer Turnover at Marquette Branch Prison during the COVID-19 Pandemic

Amanda N. Bonesteel, Graduate - Sociology/Public Administration
Faculty Mentor: Dr. Yan Ciupak - Sociology and Anthropology

During the course of the COVID-19 pandemic, many businesses and organizations saw significant turnover rates, and in the field of corrections, the situation was no different. This case study will review and interpret the work environmental factors that led to the resignation of corrections officers at the Marquette Branch Prison between April 1, 2020, and April 1, 2022, as there was a significant increase in resignations as well as violent assaults on employees during this time. The objective of this study is to explore the perspectives and experiences of resigned corrections officers to identify the reasoning behind their resignations and to suggest possible strategies to reduce turnover rates, improve employee working conditions, and improve the wellbeing of corrections officers at Marquette Branch Prison. This project is significant because it gives corrections officers who left their jobs a chance to talk about their experience, identify factors that lead to poor working conditions and decreased employee well-being, and it allows for suggestions of ways to improve work environment conditions, job satisfaction, and employee wellness. There are few similar studies available, and this will be the first research that looks at turnover at a specific prison facility during the COVID-19 pandemic. Marquette Branch Prison is a large employer in its community, and understanding the effect that its work environment has on employees—who are community members—and their families is essential.

Covid-19 and Diverse Families' Impacts and Coping Mechanisms

Molly S. Miller, Senior - Social Work
Faculty Mentor: Caroline Cheng - Social Work

This is an ongoing study that includes interviews with individuals and a literature review on this topic. The literature review aims to identify challenges faced by service providers and marginalized populations as well as coping mechanisms employed to mitigate those challenges during the pandemic. Some of the challenges that have been identified include in the literature review process include isolation and loneliness, increasing incidence of intimate partner violence, limited access to health care, reduction in social service provision, financial stressors, access of accurate information related to Covid-19, interruption of education for students, increasing incidence of drug overdose, and mental health concerns. On the other hand, research has highlighted effective coping mechanisms such as staff training, public funding for healthcare and employment, health equity practices, spirituality and cultural practices, women's representation in leadership and forming supportive relationships. Although the studies in this review are from various countries around the world, the findings discussed in this review could be applicable to health and social service provision in the local context. It also provides significant background information on the common themes of challenges people face as well as some creative, workable measures in combating issues brought forth by the pandemic. The analysis of the literature review has informed the action research- the individual interview in this research project.

Cytoplasmic Localization of Isocitrate Dehydrogenase in CRISPR-Induced Mutant Immortalized Glioblastoma Multiforme Cell Line U87MG

Kristian A. Choate, Graduate - Biology
Faculty Mentors: Dr. Erich Ottem - Biology, Dr. Robert Belton - Biology, Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Paul Mann- Clinical Laboratory Sciences, Dr. Evan Pratt - Chemistry

Isocitrate Dehydrogenase 1 (IDH1) is a prognostic biomarker in glioma that provides patients with an extended survival time when paired with more aggressive surgical resection. Despite this, few published methods are capable of determining IDH1 status before the time of surgery. The formation of IDH1 mutant and wildtype heterodimers results in the production of a characteristic oncometabolite (D)-2-hydroxyglutarate ((D)-2-HG). We aim to develop a sensor capable of predicting patient IDH1 status based on the (D)-2-HG composition of body fluids (blood plasma, CSF, urine) as a tool for preoperative diagnosis. Using an immortalized glioblastoma cell line (U87MG) with a CRISPR-induced IDH1-R132H mutation, we sought to assess the co-expression and localization of IDH using immunocytochemistry and antibodies specific to the wild-type and mutant enzymes. Heterodimer formation of these enzymes, and subsequently (D)-2-HG production, is critical to accurate sensor development using this cell line as a model.

Description of two new species of freshwater crabs from the Democratic Republic of the Congo and Rwanda, Central Africa (Brachyura: Potamoidea: Potamonautidae)

Grace E. Krajenka, Senior - Biology
Faculty Mentor: Dr. Neil Cumberlidge - Biology

The purpose of this project is to prepare a formal zoological description for two new species of freshwater crabs from the Democratic Republic of the Congo and Rwanda in Central Africa. These species were collected from the Congo River basin and the African Rift Valley in the 1960s. Detailed studies of the morphological characters of a series of preserved museum specimens of African freshwater crabs were made using a Keyence 5000 digital microscope. The specimens were compared with a number of similar species that have already been described from the Congo basin from material that is either held in the Cumberlidge Crustacean Systematics Laboratory and Museum at NMU, or described in the literature. The results of our studies indicated that the specimens belonged to two different genera and to two species that were new to science. The new species are described as Longipotamonautes bolobo n. sp. and Rotundopotamonautes rwanda n. sp. and diagnoses, illustrations, and a distribution map are provided. The resulting species descriptions have been submitted for publication in the taxonomic journal Zootaxa, and are currently under review.

Discrimination Reversal Task Training in C57 and CD1 mice strains

JD D. Payne, Senior - Behavioral & Cognitive Neuroscience, Ender M. Harris, Junior - Cognitive Neuroscience, Lily Briggs, Junior - Interdisciplinary Psychology, Brandon L. Godin, Junior - Psychology, Nicole Marion, Graduate - Non-degree graduate student
Faculty Mentors: Dr. CoryToegel - Psychological Sciences, Dr. Amber LaCrosse - Psychological Sciences, Dr. Forrest Toegel - Psychological Sciences

Discrimination reversal training is a common laboratory model used to evaluate cognitive flexibility. In this model, animals learn to discriminate when the current environmental contingences have changed and

adjust their behavioral accordingly. The model can provide a behavioral baseline of cognitive flexibility from which to then study cognitive deficits produced when an individual undergoes chemotherapy. However, no studies to date have demonstrated that mice can acquire these cognitively focused discriminations. The present experiment provides an evaluation of the degree to which two strains of mice – C57BL/6 and CD1IGS – can learn using this cognitive flexibility task. These two strains of mice differ in their genetic code. C57BL/6 mice are commonly used in behavioral and pharmacological research because they have been inbred to decrease genetic diversity and potentially allow for less variation in experimental results. Despite this apparent advantage, some researchers consider these mice themselves to be models of cognitive impairment, thus their utility in cognitive flexibility procedures could be low relative to outbred mice. The high genetic diversity of CD1IGS mice make them a viable comparison strain for performance under cognitive flexibility tasks. The CD1IGS mice are an outbred strain with high genetic diversity, which can make them more representative of the human population than the C57BL/6 strain. Our goal is to compare speed and degree of acquisition of the task for both strains. The results will allow the selection of a useful strain to use while studying deficits in cognitive flexibility that may be induced by chemotherapy in future experiments.

Effect of Eccentric Nordic Hamstring Exercise on Fascicle Length in Females

Sarah J. Triemstra, Graduate - Exercise Science
Faculty Mentor: Dr. Megan Nelson - Health & Human Performance, Dr. Matthew Kilgas - Health & Human Performance

The eccentric Nordic hamstring exercise (NHE) may be useful for increasing fascicle length (FL) of the bicep femoris long head and reduce the risk of hamstring strain injury. Compared to changes in hamstring strength, FL has been shown to reduce the risk of injury to a greater extent. While previous studies have investigated the eccentric NHE on FL, many lack control groups, female participants, and have not measured performance outcomes. Our aim was to examine the effect of 6-weeks of NHE on FL and measures of performance in females. Seven recreationally active females (age: 22.43 ± 2.99 years; BMI: 20.8 ± 4.14 kg/m2), were allocated into either a concentric only (control, n=2) or eccentric only (n=5) NHE group and completed 6-weeks of twice weekly NHE training. Outcome measures were assessed at baseline and post-intervention and included: bicep femoris FL and pennation angle (measured via 2D ultrasound), lower body isokinetic strength, and countermovement jump height. Independent samples Mann-Whitney U test were used to assess whether the change in the outcome variables pre-to-post intervention were different between the groups. Although not statistically significant ($p>0.05$), the eccentric group demonstrated increases in FL (median=1.24cm) and decrease in pennation angle (median=-0.73°) compared to females in the control concentric group who showed a decrease in FL (median=-0.61cm) and increase in pennation angle (median=1.38°). Additionally, there were non-statistically significant changes in isokinetic strength and countermovement jump for both groups pre-to-post intervention. Our findings suggest the eccentric NHE may be effective for increasing FL in females.

Effect of Fatigue on Shoulder Dynamic Stability in Overhead and Non-Overhead Athletes: A Research Proposal

Abby M. Knight, Graduate - Exercise Science
Faculty Mentor: Dr. Matthew Kilgas - Health & Human Performance

Participation in overhead sports comes with an increased risk of shoulder injury as a result of repetitive motion. During the overhead motion, the core and scapular muscles provide dynamic stability for the shoulder. Studies have shown muscular fatigue can decrease shoulder dynamic stability which increases

the risk of injury. Therefore, the purpose of this study is to determine the effect of an upper body fatiguing workout on shoulder dynamic stability of overhead athletes and non-overhead athletes. This study will consist of 12 participants divided into two groups: overhead athletes and non-overhead athletes. Dynamic stability will be measured using the Upper Quarter Y-Balance Test (UQYBT). All participants will go through a supervised upper body fatigue protocol. Dynamic stability will be re-assessed at 1, 5, and 10 minutes after completion of the upper body fatigue protocol. It is hypothesized that 1) dynamic stability will decrease in both overhead and non-overhead athletes following an upper body fatiguing workout, and 2) the overhead group will experience quicker recovery of dynamic stability following the upper body fatiguing workout.

Effect of Italian Urbanization on Local Fauna

Karl R. Mohr, Sophomore - Biology & French
Faculty Mentor: Dr. Diana Lafferty - Biology, Rylee Jensen - Biology

Italy is one of the oldest homes of urbanization, and today, wildlife such as Canis lupus (grey wolf), Capreolus capreolus (European roe deer), and Cervus elaphus (red deer) roam near the streets of Rome and in the mountains far from cities. We know from previous studies that urbanism has many negative effects on these organisms, and protecting these species is imperative in a world of growing human needs. By finding RAIs (Relative Abundance Indexes) of all three species, we can better understand the effect of an urban environment on their relative abundances. The experiment used camera trap data from Snapshot Europe to track the 3 species' abundances, as well as an unpaired t-test was utilized to compare these relative abundances in 11 Snapshot Europe camera sites in Italy with the above average vs below average values of urban landcover in the environment where the camera traps were set up. The resulting data found that the above-average urban environment affected one species' abundance, the popular game animal the red deer. However, grey wolves and European roe deer showed no change in their abundance relative to the environment's percentage of the urban landscape. This data seemed contradictory to previous studies, perhaps due to the low sample size. Overall, there is a need for more camera sites to increase the sample size. Regardless, it was found that red deer have a much lower abundance in more urban habitats, and this information can help conservation efforts.

Effect of Positive Imagery on Self Efficacy

Garret W. Lundteigen, Graduate - Psychology
Faculty Mentor: Dr. Vincent Jeevar - Psychological Sciences

Alpine ski racing is a complex motor movement that requires excellent technique and muscular coordination to perform correctly. Different mental strategies have been used to facilitate performance in alpine skiing such as self talk, emotion regulation and imagery training. While imagery training is often used as a memorization tactic within the sport of alpine skiing, imagery's effect on self efficacy is not strongly investigated. The purpose of this study was to further develop the relationship between positive mental imagery training and self efficacy. Twelve athletes from Northern Michigan University's alpine ski team were recruited for this study. The twelve participants were randomly assigned to the control or experimental group. Both groups completed the Athletes Self Efficacy Scale at the beginning of the study, after three weeks, and finally after six weeks. The experimental group was given the positive mental imagery training exercises to be conducted three times per week for the full six weeks of the study. Upon completion of the study it would be expected that self efficacy increased due to the mental imagery intervention when compared with controls. In conclusion, positive mental imagery training can significantly impact feelings of perceived self efficacy in alpine skiers.

Effect of shaking on burbot embryonic development in microplate environments

Emma G. Lefave, Junior - Biology, Andrew Shapiro, Graduate - Biology
Faculty Mentor: Dr. Jill Leonard - Biology

Burbot (Lota lota) naturally spawn in rivers, lakes, and streams in the Great Lakes region; the spawning season is in the winter months in water that is 1-4°C. This species is very fecund and each female can produce over 100,000 embryos annually. The embryos are externally fertilized and, because of their very small size (~1mm), are drifted by currents. Recently, we have begun experimentally growing burbot embryos in microplate wells under refrigeration, allowing us to track individual embryo success. The aim of this study was to define a relationship between shaking the microplate, mimicking current movements, and the hatching time of burbot eggs. Burbot embryos were separated into two groups. One group was shaken at 1.5 rpm while the other was kept still; both groups were reared at 2oC. The shaken embryos started hatching two days earlier than the unshaken embryos. There was little difference in survival to the end of the yolk-sac stage. This study suggests that shaking (movement) is a relevant environmental variable that can affect hatch timing in burbot.

Effects of COVID-19 Protocols on Athletic Training Burnout

Harrison C. Garcia, Graduate - Exercise Science
Faculty Mentor: Dr. Megan Nelson - Health & Human Performance

Burnout is a psychological condition consisting of emotional exhaustion, depersonalization, and a decreased sense of personal accomplishment and identity. Since the start of the pandemic, a significant increase in burnout has been reported by healthcare professionals, however, there is little known regarding the experiences of athletic trainers (ATs). PURPOSE: The purpose of our study was to investigate the association between burnout and COVID-19 related factors among ATs. METHODS: An electronic survey grouped by the Maslach Burnout Inventory – Human Services Survey, COVID-19 related workplace policies, and demographics was sent to 1,000 ATs through the National Athletic Trainer's Association email listserv; participants were also recruited via a social media link. Pearson correlations or Kendall's tau non-parametric correlations were used to measure the strength of the association between burnout and COVID-19 job-related items. One-way ANOVA was used to determine any differences between burnout scores across demographic factors. RESULTS: 81 ATs (age: 34.72 ± 11.27 y; career experience: 11.7 ± 10.6 y) across the US completed the survey (6% response rate). Emotional exhaustion depersonalization (EEDP) burnout was identified among 33.3% of the respondents. Correlations were found between EEDP burnout and poor financial compensation for increased responsibilities (n= 81; r=.212, p=.042), work hour alterations (n=78; r=.217, p=.037) and workload changes (n=78; r=.158, p=.128). CONCLUSIONS: Our findings support the COVID-19 pandemic changed the AT profession in novel ways. Moving forward, researchers should aim for a better understanding on the long-term effects of COVID-19 and effective strategies in alleviating burnout in the larger population of ATs.

Effects of Effort on the Value of Timeout from Money-Loss Avoidance

Kimberlyn S. Bartlett, Senior - Psychology
Faculty Mentors: Dr. ForrestToegel - Psychological Sciences, Dr. CoryToegel - Psychological Sciences

Some behavior functions to prevent ("avoidance") or eliminate ("escape") aversive events. This type of behavior can work in our favor, keeping us safe from injuries and social blunders. If this behavior prevents an individual from normal engagement with their environment however, it can be considered maladaptive (e.g., severe anxiety). Little research has evaluated escape and avoidance using human laboratory models. In the present study, humans played a game-like computer simulation in which they learned to avoid money losses (5 cents) by engaging in an arbitrary response (clicking on pictures of a ghost). Across portions of the experimental session, the difficulty of engaging in avoidance was manipulated by changing the size of the response targets (large, medium, and small). Across sessions, the frequency of scheduled money losses was changed (fast, medium, and slow). In addition to avoidance, participants could earn a short, paid timeout (i.e., escape) by clicking a separate button located on another portion of

the screen. To evaluate how valuable these timeouts were, the number of responses required to earn timeouts was raised following each timeout. Results from the present study will be discussed in relation to prior work on escape and avoidance. We hypothesize that the value of timeouts will increase as the task is made more difficult. We hope to shed light on how response difficulty alters these important behavioral phenomena.

Effects of Transcranial Direct Current Stimulation on Prefrontal Cortex Hemodynamics and Handgrip Endurance: A Research Proposal

Eric P. Naugle, Graduate - Masters of Exercise Science
Faculty Mentors: Dr. Matthew Kilgas - Health & Human Performance, Dr. Lukus Klawitter - Health & Human Performance, Dr. JoshuaCarlson - Psychology

Age-related changes to the neuromuscular system can have a negative effect on motor function and performance, which gradually constrains daily activities and independent living in older adults. Research efforts have been devoted to developing effective interventions which improve the health, well-being, and independence of adults as they age. Transcranial direct current stimulation (tDCS) is an intervention strategy that has been growing in the field of neurorehabilitation. By increasing neuronal excitability and strengthening synaptic connections, tDCS has been linked to improvements in motor function and performance. Additionally, various measures of handgrip strength have been used to assess additional attributes of neural and motor system dysfunction, and are non-invasive and non-fatiguing making it a practical assessment in clinical populations. Furthermore, it has been suggested that changes in brain hemodynamics may mediate the relationship between handgrip strength and cognitive performance. This study aims to investigate the potential effects of tDCS on handgrip time to failure (TTF) in 10 healthy adults. In this SHAM-controlled crossover study participants will perform a maximal voluntary contraction (MVC) by squeezing a handgrip dynamometer until failure (inability to maintain 75% of MVC). Prefrontal Cortex (PFC) hemodynamics will be measured via near-infrared spectroscopy at 25, 50, 75, and 100% TTF to examine potential changes in cortical blood flow. Following the TTF task subjects will perform 4 post-test MVCs (immediately after, 1-, 5-, and 10-minutes post-test) as a measure of subsequent recovery. It is hypothesized that tDCS will improve handgrip TTF and alter PFC hemodynamics.

Effects of Urbanization on the Relative Abundances of an Apex Predator and Mesocarnivore and its Implications

Cassie M. Stitzman, Senior - Fisheries and Wildlife Management, Nessa L.D. Weld, Senior - Fisheries and Wildlife Management, Tarah R. Gates, Senior - Zoology, Sydney M., Romps, Junior - Zoology, Bre G. Ireland, Junior - Fish and Wildlife Management, Miranda J. Miller, Junior - Zoology
Faculty Mentor: Dr. Diana Lafferty - Biology

Human-wildlife interactions have become increasingly prevalent as urbanization alters landscapes and wildlife communities. Apex predators are facing habitat and food loss, so mesocarnivores are entering spaces where apex predator populations are declining. Two species of interest in urban landscapes are the American black bear (Ursus americanus) and the Northern raccoon (Procyon lotor). The American black bear is an apex predator recently observed within more urban landscapes. At the same time, the Northern raccoon is a mesocarnivore known to be abundant in urban areas. Studies have shown these two species, when occupying urban systems, will utilize human resources more often than populations inhabiting rural landscapes. In light of this, this study aims to assess how the relative abundances of the American black bear and Northern raccoon differ in rural and urban systems in the Great Lakes States. To

do this, SnapshotUSA camera trap data from 2021 will be analyzed using relative abundance equations and a t-test. Our findings may provide insight into improving human-wildlife conflicts and provide a better understanding of environmental changes due to anthropogenic development.

Estimating Host And Parasite Transberingian Colonization History With Catenotaenia Tapeworms And Their Hosts

Catie G. Glodowski, Senior - Biology
Faculty Mentor: Dr. Kurt Galbreath - Biology

Many genera of voles have developed a close host relationship with Catenotaenia tapeworms, including the meadow voles (Microtus), the red-backed voles (Myodes), and the flat-headed voles (Alticola). During Pleistocene glacial periods, these voles and many other terrestrial species resided in various refugia across Asia and North America until they could expand northward when the glaciers retreated. One of these refugia, Beringia, created a land bridge that was a colonization highway between Asia and North America for both terrestrial animals and their parasites. Previous studies on these vole host genera have demonstrated gradual, pre-glacial diversification and dispersal, and a parasite's biogeographic history can often enhance our understanding of the timing of host diversification and colonization history across datasets. To understand the history between Catenotaenia and its hosts, we addressed the following questions: (i) How many transberingian colonization events have occurred in Catenotaenia? (ii) Did these events occur during Pleistocene glaciation? Previously, our dataset has been limited by inaccessibility to Asian Catenotaenia DNA extracts and sequences, and by an inability to sequence nuclear gene regions. To answer our questions, we have worked to expand our dataset by collecting new samples of Catenotaenia and designing primers to obtain sequences from multiple nuclear gene regions. We conducted clock-calibrated phylogenetic analyses to infer the timing of colonization and dispersal events. We added seven Catenotaenia specimens from recent sampling in Central Asia, and an additional genetic marker to our dataset. Our analyses demonstrated a single colonization of North America that precedes the Pleistocene glaciations.

Evaluating Cognitive Deficits Associated with Cisplatin Chemotherapy in Mouse Models

Brandon L. Godin, Junior - Psychology, Ender M. Harris, Junior - Cognitive Neuroscience, Lily Briggs, Junior - Psychology, JD D. Payne, Senior - Behavioral and Cognitive Neuroscience, Nicole Marion, Graduate - Non Degree Graduate Student
Faculty Mentors: Dr. Amber LaCrosse - Psychological Sciences, Dr. CoryToegel - Psychological Sciences

Cancer is an ever-present pathology impacting people across the globe. Of available therapeutic options, the platinum-based chemotherapy drug cisplatin remains a common option for many cancers. Cisplatin initiates cell death through various methods: including DNA damage during cell replication and the production of damaging pro-inflammatory cytokines. This can result in long-term chemotherapy-related cognitive impairment (CRCI), which includes deficits across short-term memory, long-term memory, and executive functions such as cognitive flexibility. Animal models have been used to study CRCI; however, the literature does not report standard doses necessary to induce CRCI. Additionally, the behavioral tasks used are hippocampus based, whereas cognitive flexibility is a prefrontal cortex-dependent function. The aim of our study is to close this gap in the literature by assessing a range of cisplatin doses in mice performing a cognitive flexibility task. A reversal-discrimination task will be used to model cognitive flexibility. Mice will receive two rounds of

cisplatin treatment for five consecutive days followed by five days of rest (without cisplatin) in between the rounds. Doses of cisplatin will range between 1 mg/kg to 4 mg/kg administered intraperitoneally. Control mice will be treated with saline. The data produced will create a dose-response curve of CRCI specific to cisplatin and cognitive flexibility. Following this experiment, immunohistochemistry will be performed to assess for increases in inflammatory markers and decreases in BDNF: a molecule important for neurogenesis and synaptic maintenance in the prefrontal cortex. This research is an important first step in identifying novel therapeutic options to reduce CRCI.

Evaluating Human Operant Performance Methodology on The Study of Renewal

Abi A. Connolly, Graduate - Applied Behavior Analysis
Faculty Mentors: Dr. Cory Toegel - Psychological Sciences, Dr. Forrest Toegel - Psychological Sciences

Renewal can create problematic setbacks or completely reverse positive treatment outcomes, particularly for the reemergence of substance abuse, obsessive-compulsive disorders, or destructive behavior. Most renewal research is conducted with animal laboratory models or in settings with humans undergoing clinical treatment. Recent research studying renewal in the human laboratory is typically arranged three phases. In Phase 1, participants are exposed to a specific stimulus context (Context A) and they can earn rewards by responding on a specific response option. In Phase 2, participants are exposed to a new stimulus context (Context B) and rewards can no longer be earned from responding. Phase 3 combines elements of Phases 1 and 2: the participant is re-exposed to Context A, but there is no consequence arranged for responding. The ideal classic effect is that, in Phase 3, responding reemerges for a short time (renewal) before dropping again to the near-zero levels observed in Phase 2. Concerningly, recent human laboratory research has failed to replicate the classic effects from the animal laboratory. The present study evaluated three kinds of criteria used to change phases: two time-based, and one behaviorally based. Our findings suggest that behavioral criteria are better at producing the classic effects than time-based criteria, but that some problems may still need to be solved. The results will be discussed in the context of current human laboratory research investigating behavioral relapse.

Foster Care and Juvenile Incarceration Time

Cassidy M. Medyk, Junior - Social Work, Madeline A. Hock, Sophomore - Social Work, Kaitlyn J. Koss, Junior - Social Work, Carly A. Lang, Junior - Social Work, Alexia L. Bordeau, Junior - Social Work
Faculty Mentor: Dr. Yan Ciupak - Sociology & Anthropology

The present project uses a correlational research design to examine the link between the foster care system and juvenile incarceration time for the state of Michigan. Current research shows an association between being in the system and the likelihood of being incarcerated and the long-term effects it has on our youth today. Less than 10% of the general youth population has a legal charge as compared to youth in the foster care system have about 41% of charges by a police officer (Bala, N., Finlay, J., De Filippis, R., & Hunter, K., 2015). Research has also found an overlap between child welfare and the juvenile justice system, suggesting that between 7% and 30% of teens in the foster care system enter the juvenile system later in life (Huang, H., RDr. Yan, J. P., Sappleton, A., & Chiu, Y.-L., 2015). Therefore, we hypothesize to see a significant conclusion that the foster care system leads to a higher risk of juvenile incarceration.

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Gambling: Tolerance within a Session

Isaac B.Pifer, Junior - Psychology
Mentor: Dr. Jacob Daar - Psychological Sciences

Gambling, a common practice in the modern world, has been detrimental to many lives when practiced to the point of addiction. One of the phenomena that incentives someone to continue gambling is the “Hot Hands” phenomenon in which a person continues to gamble after winning believing they will continue to win. However, a gambler does not always continue to win and this could be a rather large issue if the gambler spends a dangerous amount of money. This experiment’s purpose is to identify whether one’s tolerance within a session is affected by a prior win streak. Participants in this study will be randomly assigned to two groups, both groups will begin by playing 10 hands of regular electronic blackjack to learn the game. Then the first group will play 25 hands of blackjack with an 80% win rate and then play 25 more hands with a 20% win rate. The second group will only play 25 hands with the 20% win rate. A preliminary study has already shown that there was no significant difference in the first and second groups betting patterns. However, this is likely due to the original program obviously skewing the cards drawn thus acting as an external influence on the participants. Overall, we believe that this study will show that tolerance within a session can be affected by previous session experience and more importantly could be dangerous to someone with a gambling addiction.

Genetic Alterations Associated with Attention Deficit Hyperactivity Disorder

Nicole C. Thomas, Graduate - Psychology, Bella Enger, Sophomore - Neuroscience, Peyton Osborn, Sophomore - Biology, Rebecca Balinski, Senior - Psychology
Faculty Mentor: Dr. Amber LaCrosse - Psychological Sciences

Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder affecting children. Children with ADHD may have difficulty with maintaining focus and appropriate activity levels as well as controlling compulsive behaviors. Currently, the diagnostic criteria for ADHD is subjective and leads to frequent misdiagnosis and the subsequent use of prescription amphetamines which may lead to long term developmental cognitive alterations. Previous literature has identified ST3 Beta-Galactoside Alpha-2,3-Sialyltransferase 3 (ST3GAL3) as a possible genetic component underlying ADHD. This study uses Loop Mediated Isothermal Amplification (LAMP) to amplify the wild type of the ST3GAL3 gene in two groups of participants: one with ADHD and one without. The current study has two aims: To replicate findings that show participants with ADHD test negative for ST3GAL3 and (2) To further investigate the influence of anxiety and depression, two highly comorbid disorders with ADHD.

Geometric Investigations of Mandelbrot Orbit Combinatorics

Gwendaline B. Murray, Senior - Mathematics
Faculty Mentor: Dr. Joshua Thompson - Math & Computer Science

The Mandelbrot set is a heavily studied fractal within complex dynamics. Recently, this set is being studied for its potential in Combinatorics and Topology; our study aims to expand upon this research.

First, we describe the sequence of bulbs along the Cardioid in relation to the corresponding equipotential curves as it relates to our research. Next, we discuss the parameters, formulas, and geometric graphs we generate using the data from these relations. Lastly, we discuss the respective properties of Mandelbrot bulbs reflected in the graphs produced and what this means for our future research.

Greater Sampling Across Geography and Genomes Improves Resolution of a History of Intercontinental Colonization by Pikas

Cora M. Siuda, Junior - Biology, concentration in Zoology
Faculty Mentor: Dr. Kurt Galbreath - Biology

Pikas, small lagomorphs that live at high elevations across western North America and Central Asia, have a complex history of intercontinental exchange. Earlier work on the tapeworms (genus Schizorchis) of pikas suggested that there were two separate waves of colonization into North America from Asia. However, this previous study of pikas and their Schizorchis parasites lacked a complete sampling of Schizorchis diversity present in Asia, and was based on a single genetic locus, limiting the potential for phylogenetic resolution of historical relationships among species. I am working to address this shortcoming by acquiring new DNA sequences from additional genetic loci, and from new collections of Schizorchis specimens acquired in Mongolia. I designed primers for 11 nuclear loci, and sequenced these loci from specimens representing all known major clades (groups that share a common ancestor) as well as from the newly acquired samples. I am using these data to complete phylogenetic analysis using software such as STARBEAST and IQTree to resolve the relationships between the new Asian samples and the North American diversity. I anticipate that these extensive analyses will support results from the previous analyses - demonstrating two separate waves of colonization – but will provide a more robust estimate of the timing of major divergence events.

Green Synthesis of a Coumaran Derivative from Cinnamyl Alcohol

Richard E. Johnson, Senior - Chemistry (ACS certified)
Faculty Mentor: Dr. Sebastien Inagaki - Chemistry

Green chemistry is the design of chemical products and processes that reduce or eliminate resources and the use or generation of hazardous substances. A green synthesis of a coumaran derivative has been developed emphasizing atom economy and the use of environmentally friendly reagents and solvents. Coumaran is a common building block found in a multitude of medicinal compounds, including those with potential anti-tubercular and anti-melanoma properties. The designed pathway prepares the coumaran derivative from cinnamyl alcohol in four steps: an esterification, a coupling reaction, a Claisen rearrangement, and an oxidative cyclization. Herein, the reaction conditions of the cyclization step were explored in an effort to apply as many green chemistry principles as possible while optimizing the reaction yield.

How % agriculture Landcover affects the relative abundance of white-tailed deer, coyotes, and bobcats.

Kai A. Johnson, Senior - Biology
Faculty Mentors: Diana Lafferty - Biology

The presence of agriculture in an area can have a significant impact on how humans and the surrounding wild-life interact with each other. Agriculture drastically alters the environment for many species, decreasing biodiversity and suitable habitat, but it also represents a food source during harvest season. One species known to take advantage of this fact is white-tail deer

(Odocileus virginianus). White-tailed deer are a foundation species with a large population and are an important source of food to many native predators, including bobcats (Lynx rufus) and coyotes (Canis latrans). My research looks at the effects of agriculture on the relative abundance of white-tailed deer, bobcats, and coyotes. The data used is from Snapshot USA, a collaborative camera trapping project. Photos were taken from camera traps located in North Dakota, South Dakota, Minnesota, Iowa, Wisconsin, and Michigan during September and October from 2019-2021. An unpaired t-test was used to determine relative abundance at Snapshot USA sites located in areas with above and below average agriculture cover for all three species. No statistic correlation between agriculture cover and relative abundance was found for white-tailed deer or coyotes, but the data suggests a negative correlation between bobcats and agriculture cover. If agriculture is expanding in an area, conservationist may want to keep in mind the impact it could have on the bobcat population, as a top-level consumer, its absence in an ecosystem can have cascading effects down the trophic levels.

How Does Human Decomposition Affect the Soil Microbiome?

Amanda (Mandy) L. Joslyn, Graduate - Biology
Faculty Mentors: Dr. Josh Sharp - Biology, Dr. Jane Harris - Sociology & Anthropology

One gram of soil has around 8.3 million species of bacteria, which can contain up to several billion bacteria. The soil microbiome represents a large portion of microbial biomass on Earth, and changes in this community can be affected by different events. Human decomposition on soil causes a nutrient bloom and can change the soil pH and moisture content; human microbes also invade the soil. Shifts in soil chemistry and increased competition from human microbes can cause soil microbes to die out or thrive. The flow of these microbiome changes can tell us the story of decomposition and help us predict the post-mortem interval (PMI). Forensic microbiology is increasingly researched and used in death investigation because microbes are abundant in the environment, and microbiome changes are becoming a reliable source of PMI estimation. These effects on the soil microbiome are detectable up to 430 days after decomposition, even without a body present, which provides a unique advantage over other PMI estimation methods. This present research aims to study the changes in biodiversity and abundance of forensically significant microbes in the soil during decomposition. Bacterial DNA was extracted/purified from soil collected around decomposing human remains at NMU's Forensic Research Outdoor Station (FROST) and identified/quantified using 16S rRNA sequencing. The taxa data, along with weather data, will be used to visualize/analyze soil microbiome changes related to time, temperature, and sample location. This study provides a baseline for future forensic microbiology research to understand the decomposition process better.

How Nutrition Affects Mental Health

Alexis A. Cutler, Senior - Social Work, Natalie L. Willyerd, Junior - Social Work & Political Science, Nina C. Moir, Senior - Social Work, Beau H. Dicus, Junior - Social Work, Alyssa C. Szabo, Senior - Political Science
Faculty Mentor: Dr. Yan Ciupak - Sociology & Anthropology

The purpose of this project intends to examine the effect of nutrition on mental health. The poster addresses three main areas. We first report how nutrition affects mental health conditions such as anxiety and depression. Next, we focused on how nutrition affects the mental health of the pregnant woman as well as during the postnatal period. Lastly, we included a focus on the intersectionality of socioeconomic status in regards to access to nutrition. This creates a base for this research to be applied to public policy increasing accessibility of nutritional food options. A thorough literature review indicates that inadequate

nutrition negatively affects cognitive processing. These findings suggest that increasing access to nutrition for vulnerable populations through public policy and programs benefits mental health.

How Temperature Influences of Climate Change Affect the Relative Abundance of Northern Raccoon, Eastern Fox Squirrel, and Red Fox

Paige M. Whaley, Senior - Environmental Science, concentration in Water Resources
Faculty Mentor: Laura Whipple - Biology

As climate change continues to show its presence in the current climate, temperature is varying unlike it has for recent history on Earth, making species susceptible to having to adapt to extreme temperatures in their suitable habitat. Temperature could be affecting these species in a positive way because some of the populations are in close proximity to anthropogenic resources, making food more easily accessible, but at a potential cost of lessened fitness, health, and reproductivity. Factors of climate change can play a role in driving species to extinction or forcing species to move habitats. This research project will decipher whether above average and below average annual temperatures have an affect on the relative abundance of Northern raccoon (Procyon lotor), Eastern fox squirrel (Sciurus niger), and red fox (Vulpes vulpes) through the analyses of camera trap data from the Snapshot USA data pool. The data used in this study was obtained through camera trapping in Minnesota, Wisconsin, Michigan, and Illinois. The data showed that there was no difference in the relative abundance of Eastern red squirrel in above average and below average temperature areas, but there was a positive correlation of red fox and Northern raccoon relative abundance in above average temperature areas. The Northern raccoon and red fox are tolerant of above average temperatures, making it easier to survive the increasing global temperature associated with climate change and help maintain structure in being carnivores within the food web.

Human modification and its effect on North America's Bobcat, Red Fox, and Coyote relative abundance rates.

Martin J. Wolmarans, Sophomore - Biology
Faculty Mentors: Dr. Diana Lafferty - Biology, Laura Whipple - Biology

With the increase in human population size, and the consistent encroachment on wild habitat zones, how has human modification affected keystone species' relative abundance rates of mid-sized predators such as Bobcats (Lynx rufus), Coyotes (Canis latrans), and Red Foxes (Vulpes vulpes)? The significance being the sensitivity of hypercarnivores, such as bobcats, to environmental disturbance. As well as the resilience that mid-sized omnivores, such as coyotes and foxes, have to environmental disturbance. What might the implications of co-existing with these species in an anthropogenic setting be? I hypothesize that there will be a significant difference in abundance rates of species in human-modified zones and unmodified zones. Using Snapshot USA camera trap data, I created a T-statistic table on the desired species' abundance rates across the US. My data used was gathered from Snapshot USA which used camera traps set up in different locations across the US. It was found that the relative abundance rates of Bobcats, Coyotes, and Red Foxes, were not significantly different in areas with more human modification vs less human modification, therefore we failed to reject the null hypothesis. This result is significant in that it provides hope for coexistence between these species and humans, however, it also raises the question of possible disease spread to humans. Future research could look into which diseases humans might be at risk of contracting from these animals and how more measures could be taken to create a more peaceful coexistence between these predators and humans.

Human Modification May Negatively Affect the Travel Route and Habitats of the Mule Deer, Red Fox, and Coyote.

Jacey L. Johnson, Junior - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

Human modifications of the landscape, such as roads, are a key factor that can have significant impacts on wildlife populations. Certain infrastructures cause barriers that result in habitat fragmentation, and this can lead to blocking the migration routes of populations. Mule deer (Odocoileus hemionus), coyotes (Canis latrans), and red foxes (Vulpes vulpes) are three species in the state of Montana that share mountains and the foothills of the mountains for their habitats and resources. The effects that human modification can have on these three species could lead to harmful outcomes over time. The goal of this research project is to study the relative abundance of these three mammals using camera trapping to investigate if human modification negatively affects the populations of these species. This study was conducted using data from the Snapshot camera trap project, which has cameras distributed throughout the United States and Europe. This study used data from twelve different camera traps in the state of Montana. My results indicate that there is no significant difference in the relative abundance of the three species between areas with above-average and below-average human modification. These results may indicate that these species have adapted to human-modified landscapes. Future research could focus on how specific forms of human-made disturbances may affect the mule deer, coyote, and red fox.

Human-Wildlife Interactions in the context of Population Density: A Study of Three Species

Teni T. Ajayi, Sophomore - Biology, concentration in Physiology
Faculty Mentors: Dr. Diana Lafferty - Biology, Laura Whipple - Biology

Human population growth and expansion have significant impacts on wildlife populations, affecting their relative abundance and distribution. In this study, I highlighted the influence of human population density on the relative abundance of three distinct species: Odocoileus virginianus (White Tail Deer), Ursus arctos (Brown Bear), and (Canis lupus familiaris) Domestic Dog. My central research question is: How does human population density affect the relative abundance of White Tail Deer, Brown Bear, and Domestic Dog populations? This research provides a unique contribution to the field by examining the relationship between human population density and wildlife abundance in a comparative analysis of three species. While previous studies have explored the effects of human activities on individual species, my study contributes to a broader understanding of how human population growth affects different species and their coexistence. Therefore, I used camera trap data from Snapshot USA to perform an unpaired t-test to examine the relationship between human population density and the relative abundance of each species. We expect to find that as human population density increases, the relative abundance of White Tail Deer and Brown Bear populations will decrease, while the relative abundance of Domestic Dog populations will increase. These results highlight the importance of mitigating the negative impacts of human activities on wildlife populations. In conclusion, this study provides valuable insights into the relationship between human population density and the relative abundance of wildlife populations. By understanding the factors that contribute to changes in wildlife abundance, we can develop effective strategies to promote coexistence between humans and wildlife.

Impact of Instagram on the Outreach of the NMU McNair Scholars Program

Emma Illes, Freshman - Art and Design with a concentration in Graphic Design
Staff Mentor: Lee Xiong

Social media is a quickly growing tool that businesses and organizations can use to engage other followers.

Instagram boasts a potential reach of nearly 2 billion individuals. Social media is a quickly growing tool for businesses to help reach their target markets and as well as the younger demographic as they become consumers in the market.

Instagram was first launched in 2010 as a social networking app. As of 2013 Instagram had a total of 110 million active users and at the end of 2023 is estimated to grow to 2.35 billion users. The two largest demographic of active users on the app is in the age range of 18-24 and 25-34. The McNair Scholars program is a federally funded TRIO program that works to increase graduation rates and post-baccalaureate success among first generation-low income students and students who come from a minority population that is underrepresented in graduate education.

McNair Scholars at Northern has had a social media presence since 2017 and as of March 31st has a total of 157 posts. I started consistently posting to Instagram since September, totaling in 33 of the 157 posts. We have seen an increase in followers and account interaction, increasing our visibility. We have used Instagram as a tool for recruitment and displaying our program.

Social media, especially Instagram, is a tool to be utilized by businesses as a tool of the future.

Interrogation of CB1 and CB2 Receptor Signaling in Living Mammalian Cells

Colton J. Gschwandtner, Senior - Medicinal Plant Chemistry
Faculty Mentor: Dr. Evan Pratt - Chemistry

Stimulation of the CB1 or CB2 receptor leads to activation of two major cell signaling pathways. One signaling pathway involves the conversion of ATP into cyclic AMP (cAMP), a well-known second messenger system that leads to activation of two proteins: EPAC and PKA. The second signaling pathway involves phosphorylation of a protein kinase known as extracellular signal-regulated kinase 1/2 (ERK). A direct comparison was performed on CB1 and CB2 receptor-mediated cAMP and ERK signaling in MIN6 cells, a mouse cell line that natively expresses both receptors. To study ERK phosphorylation, we treated MIN6 cells with the synthetic cannabinoid receptor agonist WIN 55,212-2 and performed immunoblotting. To interrogate the role of the CB1 and CB2 receptor, cells were treated with the antagonists AM251 or AM630, respectively. We found that both receptors play an important and possibly equivalent role in cannabinoid-induced ERK phosphorylation in MIN6 cells. Using a FRET-based cAMP biosensor, we measured cAMP dynamics in response to WIN 55,212-2 in the presence or absence of the antagonists. We found that activation of cannabinoid receptors elicited a decrease in cAMP levels and this was dampened by inhibition of either receptor. Thus, both the CB1 and CB2 receptors are required for ERK and cAMP signaling in response to WIN 55,212-2. While there is evidence that autophagy can be controlled by cAMP and ERK signaling, neither signaling pathway has been implicated downstream of cannabinoid receptor activation. My main hypothesis is that cannabinoid-induced autophagy in MIN6 cells is mediated by cAMP and ERK signaling pathways.

Investigating Activity in the Medial Prefrontal Cortex and Prosocial Behavior after Exposure to Nature

Haylee V. Snyder, Graduate - Psychology
Faculty Mentor: Dr. Jon Barch - Psychological Sciences

Previous studies suggest exposure to nature may increase prosociality yet little is known about the neurological mechanisms by which this happens (Castelo et al., 2021; Zhang et al., 2014). The medial prefrontal cortex (mPFC) is suggested to be related to prosociality and be more active during

self-referential tasks (Kelley et al., 2002; Rameson et al., 2012). The goal of this study is to investigate the role of the mPFC in the relationship between nature exposure and prosocial behavior. This study will look at undergraduate students who will be randomly assigned to one of three rooms (Nature room or no nature room and control room). Participants will then be told that they can complete greeting cards for nursing home residents while they wait for the Functional Near Infrared Spectroscopy (fNIRS) machine to "calibrate". The number of cards the participants complete will serve as the measure of prosociality. The nature room will contain houseplants and the non-nature room will contain human-made decorations in place of house plants, the control room will not have plants or human-made decorations. The results gathered from fNIRS will be analyzed to interpret a change in activity in the mPFC. It is hypothesized that the participants who are exposed to nature will show decreased activity in the mPFC, and complete more greeting cards. This study will contribute to the existing literature on the neurological relationship between nature and prosocial behavior.

Investigating Bartonella prevalence as a potential stressor in American pika populations

Hilary H. Rinsland, Graduate - Biology
Faculty Mentor: Dr. Kurt Galbreath - Biology

The American Pika (Ochotona princeps) is a cold-adapted lagomorph that is disproportionately vulnerable to climate change impacts. Range reduction and habitat fragmentation for thermo-restricted pikas may make them more susceptible to novel disease spillover resulting from new species interactions in a changing landscape. Therefore, understanding the distribution and diversity of pika-associated pathogens has conservation implications for pikas. Bartonella is a bacterial genus that has recently been discovered in fleas associated with American pikas, with potential implications for the health of pika populations. This study used a geographically extensive sample of DNA extractions collected from fleas representing the five O. princeps lineages. Bartonella grahamii was identified in fleas in 16 of 36 of the localities distributed across the entirety of the O. princeps lineages. Of these positives, Bartonella prevalence was disproportionally highest in the pika-associated flea Amphalius runatus necopimus, suggesting it may act as the reservoir for pika-associated Bartonella grahamii. The minimal genetic variation across the sampling distribution indicates a recent expansion by the bacterium throughout the O. princeps range, occurring well after the second North American colonization of pikas from Asia during the Pleistocene.

Investigating Self-Controlled Choice in Rats

Hunter E. Bault, Senior - Neuroscience, Mackenzie Baranski, Graduate - Psychology
Faculty Mentors: Dr. ForrestToegel - Psychological Sciences, Dr. Cory Toegel - Psychological Science

Impulsivity, or lack of self-controlled decision-making, is a key feature of addiction, and is characterized by a preference for short-term over long-term rewards. Understanding the point at which a large reward is outweighed by a smaller but more immediate reward can assist researchers attempting to curb impulsive behavior. Four experimentally naive Sprague-Dawley rats completed a Delayed Discounting Task in which they made repeated choices between immediate and smaller rewards and delayed but larger rewards. In some trials, subjects were presented with only one option to ensure recent exposure to each consequence. After experiencing both consequences, rats were provided with the option to choose to produce either of the two consequences by pressing the lever uniquely associated with it. Across trials, the delay to the larger reward was systematically varied from 0 to 64 seconds. We hypothesize that raising the delay to the larger reward will increase choice of the smaller, more immediate reward. Thus, we predict that the highest proportion of choice of the larger reward will occur when the delay to the larger reward is shortest (i.e., 0 s). From there, we predict that preference for the larger delayed reward will

decrease systematically as the delay is raised. Reversal to a smaller but more immediate reward when a long delay precedes a larger reward can relate to impulsive behavior in which an organism will compromise quality and quantity for immediacy. Future studies will evaluate a parallel analysis in which choices can result in both rewarding and aversive consequences.

Investigating the Phylogeographic History of Paranoplocephala jarrelli in Northern Mongolia

Trinity E. Hinshaw, Senior - Biology/Ecology, Kenzie A.Grover, Graduate - Master's in Biology
Faculty Mentor: Dr. Kurt Galbreath - Biology

Beginning approximately 2.6 million years ago, during the Pleistocene, climatic oscillations and glacial cycles in Central Asia led to geographic isolation and population structure shifts in various taxa. The Holarctic-distributed tapeworm species, Paranoplocephala jarrelli, which includes populations in northern Mongolia, provides an opportunity to examine the forces that shaped their evolutionary history. This study aims to investigate the influence of spatial and geographic barriers on the population structure of P. jarrelli, hypothesizing that regional isolation in glacial refugia has driven diversification within the species, leading to non-overlapping lineages organized across geographic space.
Earlier work based on DNA sequences of the mitochondrial COI gene shows 5 distinct clades, however relationships in this phylogeny are not strongly supported. To construct more robust phylogenies, nuclear loci will be incorporated into phylogenetic analyses. I am testing 23 nuclear primer sets to identify at least five loci that will be sequenced for available P. jarrelli samples. Sequences for each locus will be aligned, and suitable models of nucleotide evolution will be determined. Bayesian analysis using BEAST2 will reconstruct the phylogenetic relationships of the population based on these independent loci.
The study will focus on the potential barriers within the Mongolian distribution, such as the possibility of a dispersal barrier across the dry steppe separating western, central, and eastern boreal habitats. This research will contribute to a better understanding of how climatic changes of the past glacial cycles have influenced population size and structure in parasites associated with northern rodents.

Lights Out: The Threat of Light Pollution on Migratory Species

Mia S. Rucoba, Junior - Biology, Lea M. Kemle, Senior - Biology, Catie G. Glodowski, Senior - Biology, Ariana R. Zimney, Junior - Environmental Science
Faculty Mentor: Dr. Diana Lafferty Biology

Illuminating the night allows humans to expand the bounds of work, play, exploration, and everyday life, but lighting the night has consequential impacts for species who depend on darkness for survival. High levels of artificial light at night (ALAN) can negatively impact species' behavioral and physiological patterns, as well as migratory pathways; these repercussions can be damaging and fatal to many migratory species. However, little awareness of light pollution's impacts on migratory species is provided for the public. Light pollution affects much more than just birds in cities; it has been linked to be detrimental to a variety of species such as amphibians, turtles, insects, bats, and more that are sensitive to light or use light cues. Our goal is to raise awareness about effects of light pollution on migratory species and encourage a change in human behavior to minimize effects of artificial light at night. We have reviewed many literature sources examining the extent of which these animals are affected by intense light pollution, as well as potential solutions to achieve our goals. We hope to bring this momentum to the city level and implement positive changes to benefit the community and creatures we live with. The sheer impact of light pollution that humans have caused across the world has massive effects on at-risk species and in turn can alter the ecology of entire ecosystems.

Machismo culture in impoverished communities in Latin America

Bethany E. Beavers, Senior - Biology & Spanish
Faculty Mentor: Dr. Timothy Compton - Languages, Literatures & International Studies

The topic of machismo is prevalent in every aspect of central and South American culture, and therefore shows up in day to day life. Machismo culture allows the men in the Latin American community to be unfaithful and at times outright harmful to the women of the culture in a socially acceptable manner, thus perpetuating these ideals through demonstrating broken relationships to their children. This ideal was normalized and continued following the conquest and colonization of Latin America through the objectification of women of all different social classes as well as using offspring as peace offerings. Anything holding this much gravity in a community would without a doubt be relevant to understanding the community, and machismo is no different.
The goal of this research was to analyze how machismo impacts Latin American culture and harms the women involved. Studies show that machismo culture impacts female employment, including lower wages, a lack of true equality of opportunity, and a constant increase of the numbers of women living in poverty. This paper also talks about legislation in the last 30 years that serves to counteract machismo culture and protect women, including the 1995 Act of Sexual Harassment in the Workplace and Education Establishments, and laws attempting to put an end to catcalling. For all that has been done, there is still much more to do in order to truly protect and serve Latin American Women, however, this paper attempts to convey an understanding of the problem from which continued advocacy can be born.

Manipulation of C5a signaling utilizing cannabidiol to modulate glioblastoma multiforme invasiveness in immortalized cell lines

Veda A. Gunia, Senior - Neuroscience, Renae E. Cox, Freshman - Clinical Laboratory Science
Faculty Mentors: Dr. Robert Winn - Biology, Dr. Paul Mann - Clinical Laboratory Sciences, Dr. Matthew Jennings - Clinical Laboratory Sciences

In primary glioblastoma multiforme (GBM) cell models, prior research has shown that tumor mesenchymal stemlike cells are recruited to a tumor microenvironment and release complement protein C5a. This component would interact with GBM cells via C5aR1 to activate p38 MAPK, ultimately leading to an upregulation of ZEB1, which resulted in an increase in GBM migration. This current study further explored this phenomenon by treating immortalized cell lines with rhC5a to examine if they exhibited the phenotype induced by C5a. Wound-Healing and Transwell assays were performed to investigate the C5a's effect on U87-WT cell migration. Transwell assays were prepared for analysis using ethanol as a fixative and giemsa staining techniques. Quantitative and qualitative analyses were performed. Cells treated with incremental concentrations of rhC5a in comparison to a negative control exhibited a positive linear relationship. Results from Wound-Healing assays were inconclusive. Follow-up Transwell assays were performed with the inclusion of cannabidiol (CBD), which has been proposed as a potential disruptor of the previously described C5a/p38/ZEB1 axis. Combinatorial treatment of rhC5a and CBD showed a decrease in GBM migration in comparison to an ethanol negative control; however, high concentrations of CBD induced cytotoxic effects independent from C5a induced upregulation in migration. With these results, further experimentation is required to determine CBD's IC50 and to investigate if its reduction of migration in the presence of C5a is induced through disruption of the C5a/p38/ZEB1 axis, or if its effects are independent of this pathway.

Microbial Database

Marisa A. Hoover, Sophomore - Clinical Laboratory Science
Faculty Mentor: Professor EmilyMatthys - Clinical Laboratory Sciences

Without proper field experience in microbiology studies, students lack something tangible, something they can use as a reference to guide them in applying ideas. When microbiology students learn about microorganisms, they can face difficulty finding high quality images that are accompanied by useful information. In order to create an efficient way to access this information, we created a succinct tool for future microbiology students. To accomplish this, we took images of microorganisms, labeled them, added pertinent information, and placed them all in an accessible place online, to keep in touch with a growing dependence on technology for ease of access. Our result was a spreadsheet with hyperlinked images leading directly to images taken of these microorganisms. In addition, the spreadsheet is filled with important information describing each microorganism, such as the biohazard safety level, and morphological characteristics. From a learning perspective, this is a vital resource for future microbiology students to use in conjunction with what they learn in lecture. Overall, it serves to bridge what they've been taught in preparation for what they will encounter in internships and future jobs. For future applications, this method could be applied to other careers and subjects. For example, in hematology, a future database could be created to provide students with exposure to things such as anemias in a convenient and singular place.

Mood Disorders and Effective Treatments

Alyssa M. Fulton, Junior - Social Work, Elizabeth L. Moberg, Junior - Communication Studies, Nathan M. Zaremba, Senior - Social Work, Tehya E. Campbell, Senior - Sociology
Faculty Mentor: Dr. Yan Ciupak Sociology & Anthropologyy

Mood disorders have been professionally acknowledged as serious, detrimental conditions for the last two decades, yet they remain labeled as common illnesses among adults and adolescents populations today. For the last ten years, the demand and need for mental health services has increased by nearly fifteen percent nationwide. Nearly half of people who have mental illness go undiagnosed or cannot find an effective treatment due to lack of services, availability, unaffordable, etc. and will continue to to not receive treatment. There is a significant misunderstanding as to the effects of mood disorders on individuals, as well as how effective treatments truly are. In his project, we will conduct a literature review and survey research to examine effects of four different mood disorders, as well as effective care and treatment methods. This report will provide policy and practice recommendations for Anxiety, Depression, PTSD and Bipolar Disorder.

NAMPT inhibition in glioma cells as a potential therapeutic target in IDH1 R132H mutant tumors

Mason M. Granger, Junior - Neuroscience, Mariah K. Mattson, Senior - Neuroscience
Faculty Mentor: Dr. Matthew Jennings - Clinical Laboratory Sciences

Glioblastoma Multiforme or GBM, is the grade four astrocytoma tumor of the central nervous system, occurring primarily in the brain. GBM is the most aggressive form of CNS cancers with a life expectancy of approximately 15 months after diagnosis. The most common mutation among GBMs is a gain of function mutation in the Isocitrate Dehydrogenase 1 (IDH1) enzyme of the cell's citric acid cycle which results in the oncometabolite; 2-Hydroxyglutarate. The primary treatments for GBM include radiation,

surgical resection, and the use of the chemotherapeutic Temozolomide (TMZ), a DNA guanine methylation drug. The PARP (poly-ADP ribose polymerase) mediated DNA repair enzyme MGMT (O6 -methylguanine DNA methyltransferase) corrects the DNA damage caused by TMZ. PARP and IDH1 uses cellular energy in the form of Nicotinamide Adenine Dinucleotide (NAD+), opening the possibility of a potential target for treatment. Nicotinamide phosphoribosyltransferase (NAMPT) is an enzyme involved in NAD+ biosynthesis and inhibition of this enzyme would result in decreased NAD+ levels and a subsequent reduction in proliferation of GBM tumors. In this study, we explore the cytotoxic effects of two NAMPT inhibitors, FK866 and GPP78. The NAMPT inhibitors are used to treat GBM cell lines, U87MG and U87MG CRISPR modified cells containing the mutant IDH1 R132H mutation. Initial results demonstrate a cytotoxicity of the NAMPT inhibitors to the GBM cell lines and garner further investigation into the mechanisms of the NAMPT inhibitors are required.

Native and Non-Native Prey Consumption in Two Ecotypes of Lake Trout

Tarah R. Gates, Senior - Zoology
Faculty Mentor: Dr. Diana Lafferty - Biology

Within the Laurentian Great Lakes, there are more than 180 established non-native species (28 fish and 61 invertebrates). Of the Great Lakes, Lake Superior is the least impacted by non-native species, due to its colder water temperatures and low nutrient availability. In Lake Superior non-native species occur most frequently in shallower habitats. The large width and depth of Lake Superior allows the examination of different exposures to nonnative prey species based on predator habitat use. In Lake Superior, lake trout (Salvelinus namaycush) are opportunistic top predators, comprising two main ecotypes: the siscowet and the lean. Siscowets are prevalent in deep environments whereas lean lake trout occupy shallower waters. I hypothesize that there is a difference in the proportion of non-native prey consumed by lean and siscowet lake trout. Specifically, lean lake trout occur closer to the shore and in shallower water compared to siscowet providing higher overlap to forage on non-native species. Stomachs were collected from lean and siscowet lake trout to compare diet composition between ecotypes. In the laboratory, stomachs were dissected, with prey species identified, enumerated, and measured (i.e., weight (g) and length(mm)). The data was examined to identify overlaps in diet between the two ecotypes by creating diet composition plots. A better understanding of the consumption of non-native prey by lake trout will guide management practices. Specifically, managers could focus on preserving the original native diet, monitoring competition and food web interactions.

Neuromuscular Electrical Stimulation in Comparison to Heat Therapy as a Modality to Enhance Skeletal Muscle Recovery

Diana Dzasezeva, Graduate - Exercise Science
Faculty Mentors: Dr. Lukus Klawitter - Health & Human Performance, Dr. Megan Nelson - Health & Human Performance, Dr. Julie Rochester - Health & Human Performance

Muscle fatigue is a common problem among athletes, often leading to decreased strength and impaired athletic performance. Inadequate recovery after exercise can limit optimal athletic performance, potentially causing tissue injury or overtraining syndrome. Both Neuromuscular Electrical Stimulation (NMES) and Heat Therapy (HT) are widely used for clinical purposes and have the potential to promote and accelerate recovery rates following fatiguing exercise. However, there is a lack of research on the combined effects of these two modalities and the use of HT as a post-exercise recovery modality. The purpose of this study is to determine if NMES and HT have an effect on the recovery rate of skeletal muscle, as measured by force output, blood oxygen saturation, and rate of perceived exertion (RPE). The study will involve four groups: NMES, HT, NMES and HT, and passive recovery as a control group. 48

participants aged 18-35 will be instructed to perform maximal isometric contractions in the high hang pull position with a clean grip and a knee angle fixed at 45 degrees. AMTI force plates will measure force output, and a fingertip pulse oximeter will measure blood oxygen saturation. It is predicted that NMES and HT will decrease recovery time, increase blood oxygen saturation, and decrease RPE. The results could provide an innovative solution to enhance post-exercise recovery in athletic populations, promoting injury prevention, improving physical capacity, and increasing quality of life. The results from this study will be presented at the national annual meeting of the American College of Sports Medicine.

New DNA Sequence of Two Candidate UDP-Glycosyltransferases from Atropa belladonna

Julia N. Drexel, Freshman - Chemistry
Faculty Mentor: Dr. Alexander Wilson - Chemistry

Enzymes called UDP-Glycosyltransferases (UGTs) transfer sugars from UDP-linked sugars to various small molecules. Littorine is a tropane alkaloid intermediate in the formation of the anticholinergic drug scopolamine. Glycosides of littorine have been identified in the medicinal plant Atropa belladonna. The purpose of this project was to characterize candidate genes from A. belladonna that may encode UGTs which can transfer glucose from UDP-Glucose to the alkaloid littorine. A recently published gene expression heatmap was used to determine which UGTs are expressed in the same locations as the chemicals of interest (Qiu et. al., 2020). We selected two candidates: Ab116165 (UGT76 family, group H) and Ab10677 (UGT85 family, group G) by cross-referencing this information with a UGT phylogeny and a phylogenomic analysis data set containing different UGT families and their sugar acceptors (Qiu et. al., 2020; Wilson and Tian, 2019). We also identified candidate UTGs with homologous sequences to these candidates from A. belladonna in Datura stramonium, which has a sequenced genome and is known to have similar biosynthetic pathways. By comparing these sequences, an estimation of the full sequence lengths of the A. belladonna candidates was proposed. Having extracted and purified mRNA from A. belladonna fruit and seeds, we performed 3’ and 5’ Rapid Amplification of cDNA Ends (3’5’RACE PCR), and then cloned and sequenced the PCR products. This has supplied us with new sequence information about these two candidates.

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Optimization of Lysis for Detection of Staphylococcus aureus via Loop-Mediated Isothermal Amplification

Kristian A. Choate, Graduate - Biology
Faculty Mentor: Dr. Danny LeBert - Biology, Dr. Josh Sharp - Biology, Dr. Paul Mann - Clinical Laboratory Sciences

Staphylococcus aureus is a species of gram-positive bacteria that resides naturally in soil and water in addition to human skin and external mucous membranes. S. aureus is resistant to commonly practiced bacterial lysis techniques such as lysozyme due to the modification of its peptidoglycan by O-acetylation at the C-6 position of the N-acetyl muramic acid. Other standard lysis methods, including lysostaphin, are

prohibitively expensive, especially for large-scale or frequent lysis procedures. To determine the feasibility of efficient and cost-effective lysis strategies, we tested various methods, including TENT buffer, Triton-X-100, and two common household detergents.
Loop-mediated isothermal amplification (LAMP) of DNA is a sensitive and highly efficient method for detecting specific sequences within a complex sample at a single temperature. The ability to amplify DNA without a preliminary nucleic acid extraction and purification step makes LAMP an advantageous method for detecting target DNA in rough lysates. We tested several lysis methods of S. aureus and their subsequent ability to amplify with Colorimetric LAMP, which utilizes a phenol red pH indicator to allow for visual interpretation of results. Colorimetric results showed that household detergents and cost-effective buffers are sufficient for lysis and subsequent analysis of S. aureus bacteria and were validated with agarose gel electrophoresis.

Ovarian development of Lake Superior burbot (Lota lota)

Lars B. Anderson, Freshman - Biology, Michael J. Woodworth, Graduate - Biology
Faculty Mentor: Dr. Jill Leonard - Biology

Burbot (Lota lota) are native to all of the Laurentian Great Lakes, where they are top predators and important food sources for lake trout (Salvelinus namaycush). Burbot are the sole freshwater representative of the Order Gadiformes, which consists of marine cod species. Recently, an increasing recreational fishery has led to concerns about the lack of management within the Michigan waters of Lake Superior. Researching ovarian development is a critical step in understanding the reproductive ecology of Lake Superior burbot. Fish generally follow two distinct ovarian developmental strategies, which result in two types of spawning events: batch spawning or synchrony. This project evaluated the development of oocytes, relative to position in the ovary, to determine the spawning strategy used by burbot. Burbot were captured and euthanized from a tributary of Lake Superior. Following capture, ovaries were removed from each fish and cut into four equal sized sections starting at the posterior of the fish and moving towards the anterior. A sample of oocytes was obtained from each section using a catheter. Oocyte samples were characterized according to predefined oocyte maturation staging system and measured for size (diameter). Maturation stage within an individual’s ovary did not differ between sections. Additionally, oocyte sizes within a single ovary displayed very little variation across all individuals (<0.015mm). Results from this project show evidence for synchrony in the development of oocytes within a single ovary. Our findings suggest burbot reproduce in a single spawning event, making access to mates and suitable habitat critical for offspring success.

Patronage Networks and their Impact on Conflicts in UkrainePoster

Madison L. Christie, Senior - International Studies
Faculty Mentor: Dr. Petra Hendrickson - Political Science

This research centers around the conflicts of Ukraine, which was prompted by the start and escalation of the Ukraine-Russia war that began in 2022. The main question I look to answer in this research is how internal and external patronage networks have played a role in Ukraine's conflicts over the last decade. Much research has been conducted on patronage networks and the Ukraine conflicts individually, but little research exists on how they coincide, hence my investigation into the topic. For my research, I examined peer-reviewed academic articles, journals, and books that covered both Ukrainian conflicts and patronage networks. I conducted this research as a case study, looking at the broader phenomenon of patronage networks and comparing it to the case of Ukraine. Specific dimensions that I examine are the different types of patronage, the benefits of patronage, and the consequences of patronage. After investigating the broader phenomenon of patronage as well as the specific case of patronage in Donbas, I conclude that

the 2014 Donbas war and the current Russian-Ukraine war are the results of patronage networks established by Russia and subnational elites under Russian influence. Without these networks and the acceptance of external influence within them, these conflicts would not have occurred or the consequences of them would not have been as severe as they have been to date.

Polymerase Spiral Reaction

Olivia S. Brill, Junior - Biochemistry
Faculty Mentor: Dr. Paul Mann - Clinical Laboratory Sciences

Polymerase spiral reaction (PSR) is a novel DNA amplification technique that shows promise for the rapid detection of infectious disease-causing microorganisms. This technique is isothermal, meaning it is performed at 65 degrees Celsius and thus can be performed in a simple water bath or a thermos. As a result, PSR based assays hold promise for detection of infectious disease organisms in austere settings where conventional molecular biology equipment is not available. Additionally, the method doesn't require a nucleic acid extraction step but rather can be performed directly using crude lysates. We aim to develop PSR reactions that detect important infectious diseases. Initially we will design a PSR reaction designed to detect Staphylococcus aureus, the bacteria that causes community acquired MRSA infections, a pressing public health concern. The performance of the PSR assay for S. aureus was evaluated against a well characterized Loop Mediated Isothermal Amplification (LAMP) assay previously developed by a former McNair scholar. The advantage of PSR over LAMP is the use of two rather than 6 primer binding sites, reducing the need for complicated bioinformatics-based primer design tools. Polymerase chain reaction primers can be modified for use in PSR by the addition of 5' tab sequences that are the reverse of each other. Thus, PSR is theoretically easier to develop. If successful, the knowledge gained in this project may allow for the future development of a rapid, simple methods of detecting infectious disease organisms in the event of an outbreak or pandemic.

Presence of Anthropogenic Items Found in Predator Fish of Lake Superior

Marissa L. Symons, Senior - Fish & Wildlife Management
Faculty Mentor: Dr. Diana Lafferty - Biology

People are known to have a significant impact on the environment throughout the world. In many cases, these are negative impacts. In the Great Lakes, people recognize Lake Superior as being one of the most clean and pristine large bodies of water. Pollution occurs in many forms and can impact ecosystems. Lake charr are known to be opportunistic feeders and consume diet items from anywhere in the water column which can be used to detect the extent of pollution. Natural resource agencies conduct routine fish surveys to examine fish diets and monitor food web health. This project used data from multiple surveys which utilized benthic gill nets, bottom trawls, and angler contributions from 1992 to 2022. Stomachs were processed and analyzed by NMU students through the Marquette Fisheries Research Station in Marquette, Michigan. My hypothesis is that in areas with high human activity, anthropogenic items will be detected in lake charr stomachs. The geolocation of where fish were collected was plotted on a map and the distance to human activity was evaluated. It was found that anthropogenic items were present in proximity to human activities such as tourism, angler sites, and shipping lanes.

This project measures the incidence of anthropogenic items found in the stomach of predator fishes in Lake Superior, and assesses its relationship to human activities. What does this say for the future of Lake Superior and what can be done to help keep this Great Lake clean for future generations?

Prevalence of Bartonella in the American pika

Margaret L. Lorenz, Senior - Biology, Hilary Rinsland, Graduate - MS Biology
Faculty Mentor: Dr. Kurt Galbreath - Biology

The American pika (Ochotona princeps) is a lagomorph in western North America that is restricted to high elevations due to its thermal sensitivity. Climate change may result in elevational range shifts by various species, which could create new interspecies interactions between pikas and other mammals. Such contact may lead to the spillover of fleas and associated blood-borne pathogens into pika populations. Bartonella is a genus of facultative Gram-negative pathogenic bacteria that infects red blood cells, endothelial cells, and some immune cells of its hosts, and has been found in fleas of American pikas. To confirm the presence of Bartonella in pikas, themselves, and to understand the geographic scope of Bartonella infection in pikas, we are investigating Bartonella prevalence in American pikas collected from across the geographic distribution of the species. To date, 403 individual pikas have been screened for Bartonella using the ultra-sensitive technique of digital droplet PCR. Seventeen pikas distributed across the five lineages in 13 of 32 localities have tested positive for Bartonella. The strains are most closely related to B. grahamii and B. taylorii. Four pikas that tested positive for Bartonella had fleas that tested positive in a complementary study. Though the prevalence of infection is low, our results demonstrate that Bartonella infection does occur in pikas, and should be considered a potential stressor that could influence population viability as climate warming continues.

Protect the Pets: Looking Into the Exotic Pet Trade

Katelyn R. Younglove, Junior - Biology, Danielle L. Schlecht, Senior - Biology, Eleanor J. Tiziani, Senior - Biology, Taylor R. Slone, Senior - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

What would you think if we told you that any animal you own that is not your average domesticated cat, dog, or farm animal is an exotic pet? Exotic pets may be more common than one would assume. In fact, nearly 28 million US households own 205 million exotic pets. The exotic pet trade is a $300 billion industry, with nearly $20 billion attributed to the illegal pet trade. Although various illegal outcomes regarding the pet trade exist, legal actions can be taken by an individual if they want to own an exotic pet. Regardless of legality, properly caring for and understanding these animals is still crucial. If not taken seriously, negative outcomes can arise. Releasing unwanted exotic pets could contribute to invasive species, as well as intensify the loss of threatened, endangered, or at-risk species. Exotic pets can also adversely impact everyday life by introducing zoonotic diseases and causing unnecessary injuries. However, there is much more behind the scenes than what people see on the internet, which has become a significant aspect of today's society. Our goal is to educate the public and increase awareness of the exotic pet trade via informative social media posts on Facebook, Instagram, and Twitter. To accomplish this goal, we are creating a social media campaign and poster to inform the public about the exotic pet trade and how social media can impact this issue. This is an important topic because misinformation can harm millions of pets along with those around them.

Psychoactive Treatments in a Mouse Model of PTSD

Megan A. Wells, Graduate - Psychological Sciences, Weiland R. Dyer, Senior - Psychology & English, Nicole C. Thomas, Graduate - Psychological Sciences, Nicole A. Marion, Graduate - Non-degree graduate, Brandon L. Godin, Junior - Psychology
Faculty Mentor: Dr. Amber LaCrosse - Psychological Sciences

Post-traumatic stress disorder (PTSD) causes deficits in cognitive, behavioral, and social functioning as well as in one's emotional well-being. This study assesses the effect of ketamine in mice using a

fear-conditioning and open-field procedure to determine if this novel treatment can reduce symptoms of PTSD and/or generalized anxiety disorder (GAD). Current treatments include psychotherapy, exposure-based therapy, and medications such as selective serotonin reuptake inhibitors. Current treatment efficacy is around 50%, this low rate has inspired research into various psychoactive substances as novel treatments for acute stress disorders, including ketamine. Ketamine has displayed antidepressant effects and was recently approved by the FDA for treatment-resistant depression. Research within this field supports ketamine as a potential novel treatment for PTSD. This study uses C57 mice randomly assigned to either a control or treatment group. The mice in the control group receive one injection of saline and the experimental groups receive one of three isomers of ketamine, (R-ketamine, S-ketamine, and R/S-ketamine), at 10 mg/kg given intraperitoneally. Injections are administered one time, 4 hours after the shock stimuli. 24 hours following the fear-conditioned assay mice are placed back in the operant chamber and observed for freezing behavior as a symptom of PTSD. We also assess for the onset of GAD post fear conditioning, using an open-field test. We predict that the different isomers of ketamine will vary in effect on symptoms of PTSD/GAD, and that the behaviors will correlate with protein expression in the Bed Nucleus Stria Terminalis and the CA1 region of the hippocampus.

Quality Assessment of DNA Extracted from FFPE Tissue using the Roche MagNA Pure 2.0 Instrument by Endpoint PCR and Real-Time PCR

Saralynn G. Delwiche, Junior - Biochemistry, Brett C. Cromell, Sophomore - Biochemistry

Faculty Mentors: Dr. Robert Winn, Dr. PaulMann - Clinical Laboratory Sciences, Dr. Matthew Jennings - Clinical Laboratory Sciences

Glioblastoma multiforme (GBM) is the most common primary brain tumor and tissue samples obtained from patient biopsies and/or surgical resections are often saved for further molecular testing. The need to preserve and store such specimens remains a critical step in the development of therapeutic drugs, diagnostic testing, and experimental research. A primary method for accomplishing this preservation is by fixing the tissue with formalin followed by embedment in paraffin, which are appropriately known as formalin-fixed paraffin-embedded (FFPE) specimens. The formalin fixation process presents a challenge since macromolecules within the cells become cross-linked. Extraction and purification of nucleic acids from FFPE tissues has the potential to result in fragmented DNA that can compromise downstream molecular applications such as PCR and/or Next Generation Sequencing. In the present study, we extracted and evaluated DNA from FFPE samples of various tissues using protocols to include mineral oil, hot water, and xylene. The quality of the DNA was assessed between the different extraction techniques using amplification of the housekeeping gene, beta actin. Using endpoint PCR and real-time PCR, we evaluated the DNA extracted from FFPE by generating PCR products ranging in length from 100 to 600 base pairs. Together, these analyses provide data as to which methodology will be implemented in our laboratory to generate DNA from the FFPE samples to be used in downstream diagnostic applications.

Rapid Colorimetric Peptide Nucleic Acid Loop-Mediated Isothermal Amplification of IDH1-R132H in Patient-Derived Tumor Samples

Kristian A. Choate, Graduate - Biology

Faculty Mentors: Dr. Paul Mann - Clinical Laboratory Sciences, Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Robert Belton - Biology, Dr. Robert Winn - Biology

Gliomas constitute a severe form of brain cancer characterized by poor prognosis and low quality of life. Studies suggest that brain tumors harboring the IDH1 mutation offer a better prognosis with a median overall survival of 3.8 years compared to 1 year for patients with wild-type IDH1. The difference in survival benefit is associated with the maximal surgical resection of tumors with the IDH1 mutation. Thus, knowledge of a patient's mutational status during surgical resection is beneficial but is not currently practical. Unfortunately, there are no published methods for determining a patient's IDH1 status intraoperatively. We present a novel methodology for rapidly detecting the IDH1 mutation in tumor samples using peptide nucleic acid loop-mediated isothermal amplification (PNA-LAMP). Current approaches utilize time-consuming procedures to obtain the IDH1 mutational status and cannot be completed during surgery. Implementation of PNA-LAMP in an intraoperative setting has the potential to guide the extent of surgical resection, providing patients with an IDH1 mutation an opportunity for extended survival.

Rapid Detection of the IDH1 R132H Mutation in Glioblastoma

Collin P. Smith, Graduate - Biology
Faculty Mentors: Dr. Robert Winn - Biology, Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Paul Mann - Clinical Laboratory Sciences

Glioblastoma is the most common form of brain cancer. Patients diagnosed with glioblastoma live for about a year. Northern Michigan University developed an assay to improve treatment, with the potential to extend life expectancy up to 10 years. The future of cancer treatment is personalized diagnostics. If we can characterize cancer then treatments can be more effective. Our assay identifies the status of the IDH1 R132H mutation which results in slower growing tumors. Surgery requires a delicate balance between resecting more of the tumor and not taking the healthy tissue. Surgical resection should be minimized to reduce debilitating risks and because maximal resections do not benefit regular tumors. However, more aggressive surgical resection of tumors improves survival rates among carriers of the mutation. Currently, when the surgeon extracts some tumor tissue it takes about 2 weeks for labs to test and identify the status of this mutation. NMU developed a life changing assay that uses recombinase polymerase amplification (RPA) to identify this mutation in 8 minutes. Our assay is practical for cancer diagnostics because of its simplicity, specificity, and sensitivity. The isothermal nature of the reaction adds to its simplicity. We have designed highly specific primers with locked nucleic acids to discriminate between regular and tumor tissue. We have optimized our assay to detect low copies, 10,000 bp, of tumor DNA. Our assay will framework future research at the Upper Michigan Brain Tumor Center as we study other mutations and their impact on human health.

Reconstructing Pika Colonization History Using Parasite Phylogenies

Nolan J. Stewart, Senior - Biology & Zoology
Faculty Mentor: Dr. Kurt Galbreath - Biology

Parasites can provide information of the histories of their host species. Pikas are small lagomorphs (relatives of rabbits) that host many parasite species. Pikas can be found in high elevation habitats of North America and Asia, and many of their endoparasitic worms are not known to colonize other mammals. Therefore, the history of these parasites has a high likelihood of reflecting important events that have shaped the distribution and diversity of the pikas, themselves. Investigations of parasites of pikas have yielded insight into the biogeographic histories of the hosts. For example, studies on tapeworms uncovered evidence of two colonizations from Asia to North America via the Bering Land Bridge (Beringia). The pinworm genus, Cephaluris, includes a diversity of lineages that occur in Asia and North America, but its colonization history across Beringia is not clearly established. Cephaluris provides an opportunity to test hypotheses about pika colonization between Asia and North America. I am using a

multi-locus approach to reconstruct the phylogeny of Cephaluris, including specimens sampled from Asia and North America. With 3 sequenced genetic loci representing 223 Cephaluris individuals, I am using maximum likelihood analysis and Bayesian methods to recover the phylogenetic relationships among major lineages. These analyses provide insight into the relative timing of the lineage diverging events, and also allow inferences of the number and direction of dispersal events across Beringia.

Red fox activity patterns & overlap coefficients in response to the presence of coyotes in rural & urban sympatric areas

Louis E.Good, Junior - Fisheries & Wildlife Management
Faculty Mentor: Dr. Diana Lafferty - Biology

Coyote (Canis latrans) and red fox (Vulpes vulpes) are common mesocarnivores that range across the United States. Mesocarnivores play an important role by providing gain for a healthy ecosystem. Coyote and red fox compete for similar resources and habitat. While there is evidence that mesocarnivore species coexist, the objective of this study was to determine if red fox activity patterns vary in response to the presence of coyotes at rural & urban sympatric areas, while estimating activity overlap coefficients. To determine my objective, I used 2021 Snapshot USA camera trap data to sort red fox detections into four categories: urban sympatric, urban allopatric, rural sympatric, rural allopatric. Using my categorized data, I determined if red fox displayed different activity patterns using a chi-squared test. Additionally, I estimated activity overlap of red fox in urban and rural areas (sympatric vs allopatric). I calculated the overlap coefficient, $\triangle 1$ and $\triangle 4$, and estimated 95% confidence intervals for urban and rural areas. Understanding mesocarnivore activity patterns can give insight on ecological niches in urban and rural areas. My results suggest that the presence of coyotes, in urban and rural areas, does not change red fox activity patterns. However, activity overlap in urban & rural areas where coyotes were present compared to where coyotes were absent, had a higher overlap coefficient in rural areas. Potential reasons behind these findings could be due to larger spatial habitat for coyote and red fox to coexist at sympatric sites, while urban locations have less area due to human presences.

Reducing Stigma Toward People Engaging in Substance Use

Monica C. Eriksen, Senior - RN to BSN Program
Faculty Mentor: Jeannette Stableton - Nursing

This poster presentation is a capstone project for the RN to BSN program. The purpose is to raise awareness of stigma towards substance use within the health care and community setting. The poster provides education and background on the importance of recognizing stigma and creating buy-in for using “Words that Work.” The poster presentation sheds light on the maltreatment of individuals and their potential subsequent unwillingness to receive healthcare services outside of crisis situations, which affects the key nursing principles of patient centered care as well as teamwork and collaboration, and also has implications in the community setting.

The presentation includes a review of the most up to date, evidence-based practice on stigma reduction. At the center of this project is a Words that Work infographic. An example of this Words that Work campaign is the title of this poster presentation. Instead of using the stigmatizing word “addict,” use a more positive, person-first, strength-based “person engaging in substance use” or “person with a substance use disorder.” This shift in wording creates a more inclusive environment, the importance of which will be further explained and discussed within the poster.

The poster will be geared toward community members and will include the “Words that Work” infographic that will be available for the attendees to take home. The poster presentation will also include an action step for attendees to sign an Anti-Stigma Pledge developed by Johns Hopkins University to become Anti-Stigma ambassadors, if they so choose.

Relative Abundance of Black Bears, Bobcats, and Coyotes in Relation to Human Modification

Skylar Grubb, Sophomore - Zoology
Faculty Mentor: Dr. Diana Lafferty - Biology

Black bears (Ursus americanus), coyotes (Canis latrans), and bobcats (Lynx rufus), often occupy the same geographical region and have overlapping diets creating interference competition between the species. Black bears are apex carnivores that influence the distribution of mesocarnivores, such as coyotes and bobcats . Human modification expressed as changes to the landscape, like road development, influences movement patterns of these carnivores as it provides more efficient travel but also increases human encounters where each species emphasizes the avoidance of humans over other competing species. The goal of this project is to determine how increased human modification changes the relative abundance of black bears, coyotes, and bobcats in the Great Smoky Mountain region using data from Snapshot USA. Data was collected in the Great Smoky Mountain region using camera traps deployed by Snapshot USA. An unpaired t-test was used to compare the relative abundances of each species in areas with above and below average human modification. The relative abundance of each species had no difference between sites with above and below average human modification. A possible explanation could be that each species has the ability to resource partition making increased co-occurrences between the species that resulted from increased human modification to have a nonsignificant impact on their relative abundances. It is important to study and understand how these species are being impacted by numerous anthropomorphic and environmental factors as black bears shape ecosystems through top-down effects, in addition each species are carnivores and maintain prey populations through predation.

Say ‘Bye’ to Bycatch: The Effects of Bycatch and How We Can Mitigate Them

Emily J. Hilbelink, Sophomore - Biology, concentration in Ecology, Allison C. Peck, Senior - Biology, concentration in Ecology, Cecelia L. Hogan, Senior - Environmental Studies and Sustainability, Sarah R. Stovern, Junior - Environmental Science
Faculty Mentor: Dr. Diana Lafferty - Biology

Irresponsible fishing corporations kill millions of marine animals every year because of unethical fishing practices. Bycatch is a major problem caused by poor regulation and control, especially in less governed areas. A primary challenge is that it is difficult to regulate the fishing industry due to differences in restrictions and practices among countries. In addition, consumers are often unaware of which seafood products are ethically sourced or cannot afford them. This project aims to persuade governing bodies and large fishing corporations to institute universal regulations, convince consumers to purchase ethically sourced seafood, and hold corporations accountable for violations of bycatch regulations. To accomplish this, we reviewed current literature to investigate the laws and regulations in place to protect marine life from bycatch and unethical fishing practices, proposed possible solutions for governing bodies, and encouraged consumers to commit to choosing sustainably sourced seafood. Following the analysis of these sources, we determined that there are gaps and inconsistencies throughout global fishing industry regulations. These changes are essential for biodiversity conservation, bolstering small

businesses that ethically source their product, and ensuring the continuation of healthy ocean systems for future generations.

Scientific Research and Community Science Unite to Predict Fisher (Pekania pennanti) Spatial Distribution

Laura S. Whipple, Graduate - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

Global biodiversity has declined at an alarming rate over the past century due to many complex human-induced environmental changes. Standardized surveys have historically been used to identify drivers of species declines, but such studies are often resource-intensive, resulting in significant spatial and temporal data gaps when researchers lack the resources necessary to maintain long-term, large-scale standardized studies. One promising solution for overcoming gaps in standardized survey data is the integration of species observations by community members (e.g., community science). Using fisher (Pekania pennanti) as a model species that is of particular cultural, economic, and ecological significance, we sought to determine if the integration of standardized survey data with community observations generates more accurate species distribution models (SDMs) than models developed with either dataset alone when predicting the environmental factors that influence species spatial distributions. We used fisher observation data from Snapshot USA, a standardized nation-wide camera trap survey, and iNaturalist, an online community science platform, to compare the predicted environmental covariate effects on fisher distribution of SDMs created with integrated, Snapshot USA, and iNaturalist datasets. We found that the predicted covariate effects of the integrated and iNaturalist SDMs were closely aligned, while there was a large disparity between the integrated and Snapshot USA SDMs. Our results suggest that integrated SDMs may better identify critical environmental factors associated with the distributions of species of conservation concern than SDMs developed with standardized survey data alone. Thus, integrated SDMs may be better suited to inform wildlife management plans.

Simulates Urine Cultures

Grace P. Wisniewski, Sophomore - Clinical Laboratory Sciences
Faculty Mentor: Professor Emily Matthys - Clinical Laboratory Sciences

The purpose of this research project was to create realistic looking urine cultures as part of a simulated laboratory course at Northern Michigan University. Many hospital laboratories around the country have consolidated their microbiology testing into centralized reference labs in order to maintain efficiency. Locally this has created training gaps for NMU Clinical Laboratory (CLT) students who are required to complete a practicum as part of the CLT program. To address this issue, faculty have developed a university-based microbiology simulated lab course. From previous work we have been able to create positive and negative looking urine cultures with little difficulty. In this project, we were trying to create simulated urine cultures that weren't so easy to interpret, and more reflective in appearance to real patient samples that students would encounter in a clinical microbiology lab. Many techniques were attempted but the use of isotonic saline and turbidity meters to measure different levels of Klebsiella Pneumoniae and Micrococcus Lutueas was found to be the most successful. The two different cultures were streaked on top of each other and placed in a 35 degree celsius ambient incubator before the colonies were counted. The techniques we have developed will be used to prepare for CLS 244 Lab Simulation this summer (2023). We hope to share our "recipes" with peers at other institutions that are facing similar challenges creating high quality clinical microbiology labs for students.

Social Media, Emotions, and Stress

Katie J. Burgess, Graduate - Psychology, Victoria D. Mattson, Graduate - Psychology
Faculty Mentor: Dr. Vincent Jeevar - Psychological Sciences

Social media has integrated into our lives over the past decade, opening new pathways for communication and opportunities to share knowledge. News hits our phones within seconds of an event occurring, and we have access to a wealth of information. In recent years, social media has recently undergone harsh scrutiny, and researchers have examined its adverse effects on mental health. However, the relationship between social media and mental health is complex and multifaceted. The current study intended to examine social media's positive aspects and ability to connect socially with others and create a sense of community. More specifically, this study investigated if exposure to positive content through a social media platform influenced an emotional response, stress, or the type of content participants posted compared to exposure to more neutral content using the social media platform "MeWe." Through a randomized control study, participants were assigned to either a perceived "positive" or "neutral" group, where the researchers acted as fellow participants and posted the appropriate content to each group over a two-week period. Participants did not know which group they were assigned to during the study, nor were they aware of the experimenters actively posting. This study is still ongoing, and results have not yet been determined; however, the researchers expect that the participants receiving more positive content will have a more positive emotional response, have a lower self-reported level of stress, and contribute more positive content to their social media group compared to the neutral group.

Success Rate of Various Treatments For Those With High ACE Scores

Hannah M. Brown, Freshman - Social Work, Anna I. Galbenski, Junior - Social Work, Delaney C. Thunell, Freshman - Social Work, Avery I. Bassage, Junior - Social Work, Merle Richter, Junior - Social Work
Faculty Mentor: Dr. Yan Ciupak - Sociology & Anthropology

Childhood development is essential to an individual’s physical, mental, and overall well being. Some individuals during the stage of their early childhood, have experienced negative life events that puts them at risk for high adverse childhood experience scores as an adult. Adverse childhood experiences (ACEs) refers to those who have been exposed to detrimental events as a child and experience several mental, physical, and social health problems throughout their lives as a result. The purpose of this proposed experimental research is to compare the effectiveness of the various coping mechanisms and treatments that are available to individuals that have high ACEs scores through a questionnaire. During the intake screening, we will evaluate the ACE scores of the participants as well as their physical and mental health history leading up to adulthood. The participants will then be randomly assigned into treatment groups for a year including, Cognitive Behavioral Therapy, EMDR, yoga, play therapy, mindfulness and so forth will be some of the treatments available. We will be using secondary research data analysis to compare and contrast to our findings. After a year of consistent treatment we will conduct a post test to evaluate the effectiveness of the various treatments for those same participants. After receiving both sets of data, we can conclude whether or not the treatment is proven to be effective.

Sustainability Views of Northern

Grace A. Listopad, Junior - Sustainable Business & Enterprise Creation
Faculty Mentor: Dr. Jessica Thompson - Business

The sustainability survey of October 2022 aimed to see how Northern Michigan University's campus felt towards sustainability and Northern's administration was making changes. This survey has been sent out every three years. It measures the changes in sustainability feelings around campus. From 2016 to 2022, there have been quite a few changes, mainly decreases in the feelings that NMU is sustainable. These changes have been seen all around, but from students specifically. Since 2016, people have become more aware of sustainable practices and how much the environment matters. In 2022, 49% of students said they were aware of sustainability efforts on campus, whereas, in 2016, 54% said they did. This 5% change may not seem like a lot, but a statistical change is a statistical change that stands to be analyzed. My research project compares all of the years and the statistical changes with graphs, accompanied by some short explanation of why the changes may happen and how to improve sustainability on NMU's campus for the future. It will also include ways to get involved in sustainability on campus, which will help students understand the improvements NMU is making in sustainability.

Take driving to heart: how heart rate is affected by driving conditions

Anna A. Nagy, Senior - Neuroscience, Hunter E. Bault, Senior - Neuroscience
Faculty Mentor: Dr. Lin Fang - Psychological Sciences

Having an abrupt increase in heart rate while driving can be dangerous to drivers, passengers, and pedestrians. This study attempts to determine what conditions induce a stress response while driving, specifically situations that increase heart rate. It is hypothesized that participants will more often than not indicate that their stress response is more mild or lasted for a shorter period of time than it actually did. If this experiment supports this prediction, the information can be used to provide drivers with a better understanding of the impact of stressful events during the commute, which could then be used to explore compensatory measures of stress, leading to safer and calmer driving. Participants in the study will be asked to wear a heart rate monitor while completing rest and driving trials in order to measure differences in heart rate across conditions. The heart rate data was collected and analyzed to determine where the increases in heart rate specifically occur. The results from this study supported the original hypothesis that heart rate would increase when participants were in a stressful driving environment as shown by a One-Way Repeated Measures ANOVA. This research advances knowledge regarding distracted driving prevention methods.

Temozolomide and Levetiracetam Effectiveness on Glioblastoma Cells

Alex M. Hopper, Freshman - Biology
Faculty Mentors: Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Robert Winn - Sociology & Anthropology, Dr. Paul Mann -.Clinical Laboratory Sciences

Glioblastoma is a highly aggressive form of cancer that affects the brain. The standard of care for the treatment of glioblastoma includes a combination of radiotherapy, resection, and chemotherapy. This presents challenges in treatment due to the difficulty of brain surgery and limited drug penetration of the chemotherapeutic agent Temozolomide (TMZ) through the blood-brain barrier. Recent studies have identified the anticonvulsant agent, levetiracetam (Keppra), as a promising adjunct to temozolomide, enhancing its ability to induce cell death. However, the efficacy of this combination in specific glioblastoma remains uncertain. The goal of my project is to identify the mechanism by which levetiracetam enhances TMZ activity.

Temporal Partitioning of the American Black Bear and Brown Bear in Areas of Sympatry and Allopatry

Sydney M. Romps, Junior - Biology concentration in Zoology
Faculty Mentor: Dr. Diana Lafferty - Biology

The brown bear [Ursus arctos] and American black bear [Ursus americanus] co-occur in the northern and middle regions of the Rocky Mountains. Past research has shown that both species have significant daily activity patterns, but little research has shown shifts in temporal partitioning in areas of sympatry. The aim of this research project was to see whether interspecific competition between brown bears and American black bears influence the daily activity patterns of the two species. It was hypothesized that the daily activity patterns of brown bears and American black bears will differ in areas of sympatry and allopatry due to interspecific competition. Using occurrences in camera trap images from Snapshot USA, bar graphs of the daily activity patterns of each species in areas where they co-occur and do not co-occur were created. Results show that the brown bear and American black bear both follow a crepuscular activity pattern in areas of allopatry. In areas of sympatry, the brown bear exhibits a nocturnal activity pattern and the American black bear exhibits no significant activity pattern (cathemeral). This project did not consider ursid population densities across sites or the influence of other competitors. It is suggested that further research includes investigating bear activity patterns across all seasons, and including data on resource availability and diets would provide further insight on how the two species partition resources in areas where they co-occur. However, this project showcases the effectiveness of non-invasive research methods in advancing our understanding of the ecologies of well-studied, large mammals.

The Activity Patterns of a Common Mesocarnivore in Urban and Rural Systems

Cassie M. Stitzman, Senior - Fisheries & Wildlife Management
Faculty Mentor: Dr. Diana Lafferty - Biology

The North American raccoon (Proycon lotor) is an opportunistic mesocarnivore that is increasingly prevalent in urban spaces. Increasing raccoon presence is likely due to the abundance of food resources available from trash bins and unattended human food sources. While raccoons are typically nocturnal, the aim of this study was to determine if raccoons displayed different activity patterns in rural landscapes compared to urban spaces where access to abundant human food sources are available. To achieve this aim, I classified raccoon activity patterns as nocturnal, diurnal and crepuscular across the United States using 2021 Snapshot USA camera trap data and subsequently categorized camera trap locations into two categories: rural and urban. To visualize these data, I developed stacked bar graphs to display raccoon activity patterns relative to camera trap locations. Shifts in wildlife activity patterns associated with urbanization may influence occurrences of human-wildlife conflict. Thus, understanding changes in raccoon ecology associated with urbanization may provide insight on how anthropogenic resources impact wildlife. My results indicate that raccoons displayed predominantly nocturnal activity patterns in both rural and urban spaces. Chi-square and p-values also reject the null hypothesis.

The Effect of Human Population on the Relative Abundance of Sylvilagus floridanus, Vulpes vulpes, and Odocoileus virginianus

Jillian A. Willette, Senior - Biology, concentration in Botany
Faculty Mentor: Dr. Diana Lafferty - Biology

The purpose of this project was to look at the relative abundance of three species: Sylvilagus floridanus, Vulpes vulpes, and Odocoileus virginianus, and how they are affected by the presence of different levels of human population in their surrounding environment. By using Snapshot USA and reviewing their

camera trap data and methods, these three species provided substantial information about how they not only interact with each other, but also when exposed to different levels of the human population. Snapshot USA is a nationwide program that uses camera traps to keep track of the varying species across the country. Snapshot USA provides significant data to researchers and community scientists throughout the country to help them develop programs and infrastructure that can help the progress and growth of different species found on their camera traps throughout the United States. This project has opened up different questions and opportunities for further research to help find answers as to why these species are impacted differently when it comes to the presence of varying levels of the human population.

The Effects of Culverts on the Health of Whetstone Brook in Marquette, MI

Lillian G. Zolman, Senior - Environmental Science
Faculty Mentor: Dr. Matt VanGrinsven - Earth, Environmental & Geographical Sciences

Whetstone Brook in Marquette, MI is a vital stream for the community it occupies as it is the main drainage basin for the city's stormwater and flows into Lake Superior. Ensuring the water that enters Lake Superior is clean is important because it is a source of water for the city and has an important role in its economy (Superior Watershed, 2002). In order for this stream to flow freely several culverts are used to allow it to flow under roadways. Culverts can be problematic as sediment tends to accumulate in and around the culvert. Combined with runoff from nearby roads this can cause excess sedimentation immediately downstream from culverts. Excess sedimentation can have negative effects on aquatic macroinvertebrates changing their behavior and decreasing their populations. The purpose of this project is to determine if excess sedimentation around culverts has negative effects on the health of Whetstone Brook. To determine what affects culverts have on this brook total dissolved solids (TDS), salinity, and turbidity will be measured upstream and downstream of three culvert road crossings along Whetstone Brook. Aquatic macroinvertebrates will also be collected in these locations; they will then be identified and recorded to their order so that any changes in populations can be observed and water quality determined using the MIcorp water quality ranking system. It is expected that there will be a higher concentration of sediments in the downstream locations compared to their upstream counterparts causing macroinvertebrate populations to change indicating decreased water quality.

References

Superior Watershed Partnership. (2002). Whetstone Brook and Orianna Creek Watershed Management Plan.

The Effects of Poisonous Plants on Honeybees: Can Tropane Alkaloids Transfer Into Honey?

Dominick F. Dotson, Senior - Medicinal Plant Chemistry, Blake A. Goodale, Senior - Medicinal Plant Chemistry, Delaney Anderson, Senior - Medicinal Plant Chemistry, Sophia R. Pezze, Senior - Medicinal Plant Chemistry, Bio-Analytical Concentration, Rev Derek M. Balayut, Senior - Medicinal Plant Chemistry
Faculty Mentor: Dr. Maris Cinelli - Chemistry

Honey that is produced by Apis mellifera, the honey bee, has the potential to become contaminated based on the species of flora in the environment. While most flowering plants can be pollinated without adverse effects, not all flowering plants are beneficial for bee health and behavior. Datura metel is a member of the Solanaceae family that is known to produce tropane alkaloids such as hyoscyamine and scopolamine. D. metel is often cultivated in gardens, used commonly as an ornamental, and its wild relatives are invasive weeds. There is a significant lack of information pertaining to the direct effects of

tropane alkaloids on bee behavior, the preference of bees when it comes to native and non-native plants, and the correlation between alkaloids in plant nectar and pollen and those that appear in honey. The relationship between D. metel and bee behavior was assessed through the use of three different enclosed bee hives and three different groups of plants, where some trends for forage preference were observed. The tropane alkaloids present in the pollen and nectar were profiled through the use of high resolution mass spectrometry and we are working on extraction and analysis techniques for the honey, pollen, and nectar samples that were gathered over the course of this study. Our goal is to quantify the degree of possible alkaloid transfer from the Datura pollen and nectar into the honey using liquid chromatography coupled with mass spectrometry.

The Effects of Urbanization on the Relative Abundance of Primarily Nocturnal Mammal Species in the Northeastern United States

Anna J. Hill, Junior - Biology, concentration in Ecology
Faculty Mentor: Dr. Diana Lafferty - Biology

Virginia Opossum (Didelphis virginiana), North American Porcupine (Erethizon dorsatum), and Northern Raccoons (Procyon lotor) are three primarily nocturnal mammal species that reside in the Northeastern United States. As urbanization spreads, the dark landscape they once called home now has new conditions, bright artificial lights, constant human activity, and infrastructure all pose a potential threat to the way of life these creatures once traveled. We know that these factors have already played a role in changing the daily cycles of many animal species including nocturnal creatures. This study aimed to take a look at how urban cover has affected the relative abundance of these three nocturnal mammals using camera trap data. We hypothesized that an increase in urban cover will have a negative effect on the abundance of these species. The data was collected by Snapshot USA researchers using camera traps set up following standardized guidelines across the entire Northeastern United States. I then analyzed the average relative abundance of these three species in above and below-average situations regarding the percentage of urban land cover. We were then able to conduct a T-test to determine if the hypothesis was supported. The results rejected our hypothesis.

The Impact of Urban Landcover on Coyotes (Canis latrans), Red Foxes (Vulpes Vulpes), and Eastern Cottontails (Sylvilagus floridanus) Within the Northeast Region of the U.S.

Calandral Bungart, Junior - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology

The relative abundance of predator and prey species, such as the coyote [Canis latrans], the red fox [Vulpes vulpes], and the eastern cottontail [Sylvilagus floridanus] is ecologically important when attempting to understand the effects of urban landcover on their habitat range. The eastern cottontail experiences predation from both the coyote and the red fox, which share a competitive relationship. These dynamics can influence their habitat range; the presence of a predator within a certain area may contribute to a decrease in the abundance of local prey. The goal of this research project is to measure the influence of urban landcover on the relative abundance of the coyote, red fox, and eastern cottontail throughout the Northeast region of the United States, using camera traps as a method for data retrieval. The data used in this project was collected by the Snapshot USA team, who deployed camera traps and provided the number of occurrences for each species in their respective camera trap locations. Using this information, an unpaired t-test was conducted to determine the relative abundance of each species at sites with above average and below average urban landcover. The percentage of urban landcover had a significant impact on the relative abundance of the eastern cottontail only, while the opposite was true for

the red fox and the coyote. Future research can further explore the dynamics of these three species, more specifically, whether or not the eastern cottontail is inhabiting areas with high urban landcover as a strategy for escaping predation.

The Importance of Carnivore Biodiversity in the Upper Great Lakes Region and the Effects of Recreation

Emilee L. Gooch, Senior - Environmental Science & Fisheries & Wildlife Management, Silas G. Pickhardt, Sophomore - Fisheries & Wildlife Management, Anthony J. Clyne, Junior - Fisheries & Wildlife Management, Gabrielle J. Castagna, Senior - Biology & Ecology

Faculty Mentor: Dr. Diana Lafferty - Biology

Biodiversity of predator and prey species is crucial to the health of an ecosystem. A decline in the number of species may harm the overall success of an ecological community. In the Northern Great Lakes Region, carnivore species, ranging from black bears to wolves, have a historically complex relationship with humans throughout history. Currently, humans and carnivore species coexist with varying levels of conflict. As the population and number of visitors in this region continues to increase, strain will be continuously added to this relationship. The goal of this project is to recognize this conflict, and educate both hunters, recreationists, and the general public on the importance of coexistence with carnivores. It is crucial to inform these groups of the role that the upper Midwest plays as a stronghold for these species. The importance of protecting these resources for future recreational use benefits hunters and conservationists alike. In pursuing this goal, a wide variety of perspectives surrounding wildlife management, recreation, and ecosystem health were explored. The objective of this campaign is to develop a mutual understanding between sportsmen and conservationists. Thus, mitigating negative human-animal conflicts, while promoting greater understanding of necessary carnivore biodiversity. The resulting growth in carnivore variety will result in greater biodiversity throughout the ecosystem, improving the health of Northern Great Lakes ecosystems, and adding countless recreational opportunities.

The Relative Abundance of Gray Wolves, Coyotes, and Red Foxes in Urbanized Areas of the Great Lakes

Leah E. Gibbons, Senior - Biology

Faculty Mentor: Dr.Diana Lafferty - Biology, Rylee Jensen - Biology

The Great Lakes of North America are home to many species such as gray wolves (Canis lupus), coyotes (Canis latrans), and red foxes (Vulpes vulpes). Wolves are an important predatory species while coyotes and red foxes are mesopredators that co-inhabit wolf territories. As humans continue to urbanize more land, the disturbance of species richness and the frequency of relative abundance of these predators could be affected. My goal is to analyze how urban areas in the Great Lake regions affect the abundance of gray wolves, coyotes, and foxes. Data from Snapshot USA was used to document the above and below average percent of urbanization at different sites to analyze gray wolf, coyote, and red fox relative abundance in the urban area. The impact of urbanization had a greater effect on the relative abundance of red foxes than initially hypothesized. There was no significant difference in relative abundance in either above- or below-average sites for gray wolves or coyotes. These results matter because we need to mediate how much we urbanize land where these canids reside. If we preserve more of our wild lands in the Great Lakes, these species can continue to persist in the future.

Thermal decarboxylation of cannabigerolic acid (CBGA) with analysis of reaction kinetics and quantification of decomposition products using LC-MS/MS

Sophia R. Pezze, Senior - Medicinal Plant Chemistry, Bio-analytical concentration
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Olivetolic acid is the precursor to cannabigerolic acid (CBGA) which acts as the “parent” compound for many cannabinoids synthesized in Cannabis sativa L., including delta-9 tetrahydrocannabinolic acid (delta-9-THCA) and cannabidiolic acid (CBDA). C. sativa has unique oxidoreductases such as THCA synthase which converts CBGA to delta-9 tetrahydrocannabinol (delta-9-THC) following the biosynthetic pathway. In the growing plant, cannabinoids are synthesized as carboxylic acids and with post harvest modifications such as drying, aging, heating or combustion, the cannabinoids convert to their neutral forms through the process of decarboxylation in which a molecule of carbon dioxide is released. The decarboxylation of delta-9-THCA and CBDA yields the more well-known compounds, delta-9-THC and cannabidiol (CBD), respectively, which have historically been the most desirable cannabinoids for their psychoactive and/or therapeutic effects. More recently, there has been increased consumer demand for products containing other cannabinoids, including cannabigerol (CBG), the decarboxylation product of CBGA. While the kinetics of the decarboxylation of delta-9-THCA and CBDA have been studied for decades, less attention has been paid to the decarboxylation of CBGA. In this research the activation energies and rate constants were determined for the decarboxylation of CBGA to CBG using sealed reactors containing neat standard preparations of CBGA in ethanol and 2-octanol which demonstrated first-order reactions. This work is unique from the published literature which describes experiments involving C. sativa extracts, hemp seed oil or unprocessed plant material all of which contain additional plant constituents which have been reported to catalyze the reaction.

Thioflavin T-Induced Fluorescence Methods for Detecting Nucleic Acid Structures

Chloe E. Patterson, Sophomore - Biology
Faculty Mentor: Dr. Philip Yangyuoru - Chemistry

Thioflavin T (THT) is a fluorescent molecule that has the ability to bind certain proteins and nucleic acid structures and thus serves as a versatile molecular probe for sensitive detection of targets including protein aggregation and G-quadruplex nucleic acid structures (G4s). G4s are extremely important in human cells as high numbers of G4 structures have been detected in both cancer and normal cells and also shown to interact with many proteins and protein factors. In this project, we will develop simple, label-free, and sensitive methods using thioflavin T for the detection of nucleic acid secondary structures with the goal of developing a ThT-based fluorescence biosensor for G4 nucleic acid structures. Monitoring THT fluorescence in the presence of potential G4-forming oligos (short nucleic acid sequences which may or may not form the G4 structure), will enable us to observe changes in the fluorescence intensity of THT as a result of the interaction with the formed nucleic acid structure(s). By varying either the oligo or THT concentrations in solution, we are working towards designing a biosensor to detect even small changes within DNA’s structure and collect data on when fluorescence peaks in the presence of G4 structures. We are also able to measure the wavelength that the fluorescence peaks and compare the accuracy between trials. It is important to design a biosensor to detect G4s to better understand the importance of these structures in the human body, and determine possible ways they can interact with drugs for therapeutic purposes.

Uncovering the Personal Lives of Orcas: A Research-Informed Poetry Collection

Taryn E. Johnson, Senior - English Writing
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Orcinus orca (killer whales) are some of the most emotionally complex mammals on the planet, complete with their own dialects, code of ethics, and complex inner-pod relationships. Despite their jarring nickname, they have rich cultures and personal lives. My research involves scholars' observations of orca social practices, and the consequences of orcas living in captivity for the purpose of performing. This has led me to write an informed poetry collection that explores the "human" characteristics that have been attributed to the species. I identified parallels between humans and orcas: navigating grief, childrearing, and coping with loneliness. These common experiences are explored through my poetry collection. My creative-research approach is intended to display the presence of humanlike tendencies in the orca species and where the line between human and animal is drawn. But more so, to invite readers to ruminate on where humanity starts and stops.

Urbanization in the Southwest and Its Effects on the Relative Abundance of Competing Species and Their Prey

Gabriela C. Moreno, Freshman - Biology
Faculty Mentor: Dr. Diana Lafferty - Biology, Rylee Jensen - Biolog

Urbanization is an environmental factor that has an impact on many species and the way they interact with one another around the nation. There is an increase in urbanization in the Southwest region of the United States, and with that comes effects on the native species. Bobcats (Lynx rufus) and coyotes (Canis Latrans) are two common predators in this region that share a common prey, the desert cottontail (Sylvilagus audubonii). Biologists and ecologists around the country have been interested in studying the competition between these two predators as it is shifting throughout time due to factors like climate change and urbanization. The goal of this project is to explore the effects of urbanization by using data from Snapshot USA's camera traps to calculate the relative abundance of the three species mentioned in the Southwest. Each camera used in this study collected 400 camera nights of effort, and were all uniformly placed. An unpaired t-test was conducted that compared the relative abundances of each species in areas with above average and below average urbanization. Based on this t-test, the null hypothesis failed to be rejected and it was found that there was no significant difference in relative abundance between the above and below average sites in each of the species. This suggests that there must be another environmental factor influencing the relative abundances of these species. This study or other future studies can be used to help find this factor as well as to regulate the population densities of these species.

Using Radula complanata Extract to Inhibit Glioblastoma Multiforme (GBM) Cells In Vitro

Ryan Nixon, Junior - Medicinal Plant Chemistry, Darren Simmons, Graduate - Medicinal Plant Chemistry
Faculty Mentors: Dr. Alexander Wilson - Chemistry, Dr. Matthew Jennings - Clinical Laboratory Sciences, Dr. Robert Winn - Clinical Laboratory Sciences

Radula complanata from the family Radulaceae, is renowned for the dorsal bi-lobed leaves of the gametophyte. When reproducing, branches terminate in sporangia that emerge from a squared perianth. The genus Radula is distinctive because the plants produce various sesquiterpenes and bibenzyls

(including cannabinoids and bis-bibenzyls)1. Many of these compounds have previously been shown to have bioactivity. For example, the cannabinoid bibenzyl cis-Perrottetinene (cis-PET) has shown to be a bioactive cannabinoid and CB1R partial agonist2. Glioblastoma multiforme (GBM) is the most predominant and lethal form of glioma brain tumor afflictions3. There is evidence of cannabinoids having an effect on GBM cancer cells in vitro. An extract of R. complanta applied to U87MG GBM cells in vitro demonstrated cytotoxicity. Here, I present data demonstrating the cytotoxic effect of the extract on U87MG cells relative to ethanol (EtOH) and no treatment (media only) controls. Further investigation into the mechanism of the extract's effect on GBM cells is warranted. The crude extract was also characterized using GC-MS and LC-MS/MS analysis using a qualitative and semi-quantitative approach.

Utilizing Digital Droplet PCR to Detect Mpox Virus in Wastewater

Christina J. Ferrera, Senior - Biology, concentration in Physiology, Anne C. Carrier, Freshman - Biology, concentration in Microbiology
Faculty Mentor: Dr. Josh Sharp - Biology

Mpox, previously referred to as monkeypox, raced through the United States and many other non-endemic countries starting May 2022. Due to the outbreak, a total of 30,262 cases were identified in the United States, including 38 deaths. The disease is caused by infection of mpox, an enveloped double-stranded DNA virus in the Orthopoxvirus genus and the Poxviridae family. Clinical symptoms may first present with fever and flu-like symptoms and is characterized by lesions which develop among hands, feet, face, or genitals. Transmission readily occurs by close contact with lesions, respiratory droplets, or contaminated objects. Individuals are infectious until a new layer of skin develops over the lesions contributing to the public health concern this virus raises. Mpox has an incubation period of 3-17 days, while the disease lasts two to four weeks. Due to the long incubation period and even longer duration of illness, wastewater epidemiology can be an important tool to monitor current and future outbreaks of mpox. Wastewater testing provides insight in community levels of mpox much faster than waiting for individual diagnosis, results, and reporting.

This research study aimed to test the specificity of viral mpox detection in wastewater samples by digital droplet polymerase chain reaction (ddPCR). Sewer samples collected from the Marquette area were condensed and extracted mpox DNA was used. After nucleic acid extraction, ddPCR was performed selecting for mpox. Multiple other viral nucleic acids were tested and compared. Overall, mpox was able to be specifically detected in wastewater by ddPCR.

Utilizing Digital Droplet PCR to Detect Respiratory Syncytial Virus in Wastewater

Anne C.Carrier, Freshman - Biology, concentration in Microbiology, Christina J. Fererra, Senior - Biology concentration in Physiology
Faculty Mentor: Dr. Josh Sharp - Biology

RSV, respiratory syncytial virus, when contracted, typically only results in a mild cold, but it can be serious for children and the elderly. RSV Infections can cause bronchiolitis (inflammation of airways) and/or pneumonia1. Due to the mild or asymptomatic nature of RSV infection in most age groups, it is difficult to track the spread of RSV cases. Similar to recent advancements in SARS-Cov-2 monitoring, RSV can also be detected through screening of wastewater samples2. Utilizing this time and cost-effective method allows movement away from individual testing and allows detection of those cases which do not self-report. Although asymptomatic individuals may not feel ill, they still pose a threat of spreading infection. Wastewater monitoring allows a better estimation of RSV levels in a community and can prepare health officials for potential increases in case numbers.

Wastewater from several locations throughout Marquette was collected. These samples went through nucleic acid extraction and analyzed by ddPCR (digital droplet polymerase chain reaction). This process targeted primers and fluorescent probes to specific gene sequences unique to RSV. The PCR reaction is dispersed into nanodroplets of oil. The more RSV nucleic acid present in the PCR reaction, the higher the fluorescence of individual droplets. The fluorescence of each droplet is quantified and used to determine how much RSV is in a sample. Data presented here includes results from samples collected July 2022-March 2023. It was expected to see increases in RSV levels as seasons shift from summer to fall/winter due to seasonal spread of this virus.

Waterbody Type as a Determinant of Contiguous Balsam Fir Growth Rate

Brady C. Rudh, Senior - Fisheries and Wildlife Management
Faculty Mentor: Dr. Jill Leonard - Biology

Surface freshwater is a fundamental component of many terrestrial ecosystems. Therefore, the characteristics and dynamics of surface water systems have large implications for the composition of ecological communities across Michigan's Upper Peninsula, and much of the world. Here, I investigate the effects that classes of surface water have on the growth rates and stand health of a local conifer, the balsam fir (Abies balsamea). Balsam fir are intrinsically linked to water as they require a great deal of it, making them a choice organism for this sort of study. By measuring the density of 18 stands and growth rates of 144 trees across three sites (a representative lake, wetland, and river), I attempt to determine whether local surface water has some regulatory influence with regard to large plant productivity. Results of this study suggest that this is indeed the case; with some sites being significantly more conducive to balsam fir growth than others. This has great implications for forest and wildlife managers alike, who may consider restructuring their efforts in response to the waterways and species' needs in their particular stand. These results require a follow-up study using a far greater array of sites, and spanning several species to be supported enough that they may stand as guidance for managers. Nonetheless, this work serves as a beneficial proof of concept that should be verified further in order to increase our understanding of both balsam fir and the ecology of the riparian corridor.

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