Ecology & Evolutionary Biology
UNIVERSITY OF TORONTO

Undergraduate Research Fair 2025

Program Guide

Table of Contents

Welcome

Thank you for joining us for the 2025 EEB Undergraduate Research Fair! We are so excited that you will be joining us for a showcase that highlights the incredible fourth-year research projects students have worked on during the Fall/Winter 2024-2025 term. The fair is a great way to experience the diversity of exciting undergraduate research in EEB, to hear about new scientific discoveries made by students, and interact with undergraduates and peers.

The students participating in the fair are competing for the *Corey A. Goldman Prize for Best Research Poster in Ecology and Evolutionary Biology*. The prize is named after former EEB Undergraduate Associate Chair Corey A. Goldman, and recognizes the top students within the department for excellence in their fourth-year independent research projects. Cash prizes will be awarded to the best research poster in each category.

Check out our website at https://eebuoft.weebly.com.

Event Details

Date: Friday, April 4th, 2025
Time: 2:00PM - 4:00PM EST
Location: Hallways outside ESC2050 & ESC3050

Event Schedule

2:00pm - 3:45pm	The Research Fair is open! Student researchers will be available to answer questions about their research.
3:45pm - 4:00pm	Brief closing remarks by Shelby Riskin and announcement of winners and honourable mentions.

Research Categories

Student	Supervisor(s)	Project Title
Category: Global Change		
Judges: Njal Rollinson & Eric Hagen		
Emily Boersema	Chelsea Rochman	Assessing the Fate and Bioaccumulation Potential of Microplastics in Yellow Perch
Elen Misura	Don Jackson	Assessing the Effects of Climate Change on Smallmouth Bass (*Micropterus dolomieu*) Bioenergetics and Distribution in Northern Ontario Lakes
Katie Wang	Shelby Riskin	Hope vs Urgency: Evolving Sentiment Trends in News Media Coverage of Biodiversity Issues
Madeline Ho	Chelsea Rochman	Rolling in Road Dust: Global Patterns of Microplastic in Road Runoff
Madeline Ramsden	Donald Jackson	Identifying Drivers of Fish Community Structure at Large Spatial Scales
Samuel Dumas	Martin Krkosek	Bayesian Modelling of Salmon Productivity in Viner Sound Creek
Category: Urban Ecology & Species Monitoring		
Judges: Chelsea Rochman & Damian Hernandez		
Kaylie Borntraeger	Don Jackson	Acoustic Monitoring and Analysis of Bird Diversity at Urban Stormwater Ponds
Naveen David	Shelby Riskin	Effects of salt on sediment phosphorous release in urban stormwater ponds
Majd Khayat	Marie-Josée Fortin & Jonathan Ruppert	Urban Conservation Planning for Roadkill in the Greater Toronto Area
Gabrielle Diez	Shelby Riskin	Monitoring Diversity, Abundance and Phenologies of Anurans in Urban Stormwater Ponds
Diane Lin	Soren Brothers	Correlation Between Stream Metabolism, CO2, and Salinity in an Urban Stream
Bruce Zhang	Shelby Riskin	Automated Vocalization Recognition of Frogs and Toads
Category: Ecophysiology & Biogeography		
Judges: Micah Freedman & Mathieu Videlier		
Claire Abbasi	John Stinchcombe	Investigating the Genetic Basis and Geographic Distribution of the 5-Lobed Leaf Phenotype in *Ipomoea hederacea* (ivy-leaf morning glory)
Jack Stoodley	Martin Krkosek	Evaluating the Transcriptomic Heat Stress Response of Juvenile Coho Salmon and Spawning Pink Salmon in Warming Rivers
Rana Fineman	Njal Rollinson	Condition affects density-dependent dispersal in juvenile Atlantic salmon
Erin Huang	Njal Rollinson	Bergmann's rule in non-avian reptiles revisited: Turtles still follow it, lizards and snakes don't reverse it
Drin Brown	Megan Frederickson	Are Extrafloral Nectaries Under-Represented on Oceanic Islands
Shahd Daoud	Santiago Claramunt	The Influence of Wing Morphology on Bird-Aircraft Collision Risk

Student	Supervisor(s)	Project Title
Category: Behaviour & Species Interactions		
Judges: Adriana Bravo Ordonez & Garth Covernton		
Jessica Bullock	Helen Rodd	Parental care and responses of juvenile cichlids to maternal signals in *Apistogramma atahualpa*
Lauren Rego	Njal Rollinson	Do Turtles Vocalize on a Diel Cycle?
Jerry Yu	Megan Frederickson	The Role of Microbial Symbionts in Plant's Range Expansion under Field Conditions
Silas Peters	Rosalind Murray	Emergence of Endangered Salamander and Invertebrate Prey
Mia Bantas	Megan Bontrager	Morphology and Anthocyanin Pigmentation as Signs of Phytoplasma Infection in *Trillium grandiflorum*
Category: Evolution & Phylogenetics		
Judges: Matthew Osmond & Jessie Wang		
Jamie Chew	Aneil Agrawal	What is the Genetic Basis of Mate Harm in Fruit Flies?
Hudson Wentzell	Belinda Chang	Molecular evolution of cetacean phototransduction and visual cycle genes
Alexander Ling	Donald Jackson	Phylogenetic Signal in Salinity Tolerance of North American Freshwater Fish
Emile Watanabe	Rowan Sage	Enhancement of Aminotransferase Activity as a Key Step in the Evolutionary Origin of C4 photosynthesis
Michael Marmash	Tomomi Parins-Fukuchi	Biotic or Abiotic Influences On the Diversity Dynamics of Ancient Reefs?

Poster Abstracts

Category: Global Change

Judges: Njal Rollinson & Eric Hagen

Emily Boersema (Supervisor: Chelsea Rochman)

Assessing the Fate and Bioaccumulation Potential of Microplastics in Yellow Perch

Abstract: Microplastics are ubiquitous in the environment, yet the fate of microplastics in fish remains less certain. The potential for microplastics to bioaccumulate has yet to be fully assessed across different organs within a controlled, natural environment. To help fill these gaps, 20 yellow perch (*Perca flavescens*) were sampled from the IISD-Experimental Lakes Area (IISD-ELA) where they were exposed to microplastics for a year and a half via a full lake experiment. Their gastrointestinal tracts, livers, and muscles were dissected and digested to quantify and characterize the microplastics within each. To assess whether we observed bioaccumulation, we used mass as a proxy for age and compared this to the amount of microplastics found within each individual organ. There was no statistically significant difference between the abundance of microplastics within each organ and we did not observe bioaccumulation. This suggests that the yellow perch are either not ingesting many microplastics or they don't remain long in the body.

Elen Misura (Supervisor: Don Jackson)

Assessing the Effects of Climate Change on Smallmouth Bass (*Micropterus dolomieu*) Bioenergetics and Distribution in Northern Ontario Lakes

Abstract: Climate change is expected to alter the distribution and physiology of freshwater fish species, including smallmouth bass (*Micropterus dolomieu*), by increasing water temperatures and modifying seasonal dynamics. This study investigates how rising temperatures will affect smallmouth bass bioenergetics, and potential species range distribution in northern Ontario. Future climate conditions were assessed using air temperature projections from the Climate Atlas of Canada (10 km × 10 km resolution), then used to estimate lake temperatures. The study projected temperature changes for 2021–2050 and 2051–2080 under SSP2-4.5 and SSP5-8.5. Climate data were obtained for 22 lakes by simulating lake conditions with varying morphologies to predict temperature regimes. Physiological responses of smallmouth bass to changing water temperatures were modeled using bioenergetic frameworks adapted from Shuter et al. (1980) and Shuter & Post (1990). Results show that smallmouth bass exhibit a thermal optimum at 29°C, above which growth declines, with maximum weights reaching 42g by 2051-2080 under sustained warming conditions. Importantly, lake temperatures remained below the thermal optimum (maximum: 22.4°C), indicating continued growth across all study lakes. Warmer conditions could enhance growth through multiple pathways: (1) increased metabolic efficiency leading to greater food consumption, (2) extended growing seasons that allow attainment of larger body sizes before winter, and (3) reduced winter fasting mortality through decreased ice cover duration. These bioenergetic advantages translate into significant ecological impacts. Smallmouth bass demonstrated consistently superior performance compared to native species due to their higher prey consumption rates and ability to exploit warming habitats. The simulations predict this physiological superiority will facilitate ongoing northward range expansion, and potentially the colonization of adjacent Manitoba watersheds. These findings highlight the critical importance of monitoring programs to track bass expansion and developing conservation measures to protect vulnerable native fish communities in northern lakes.

Katie Wang (Supervisor: Shelby Riskin)

Hope vs Urgency: Evolving Sentiment Trends in News Media Coverage of Biodiversity Issues

Abstract: Public perception of biodiversity issues is influenced by the tone that news articles are written with. A positive tone can increase hope and action taken, but a tone that is too positive can lead to complacency and reduced urgency. A negative tone can increase urgency, but being too negative can lead to hopelessness and decreased action. To investigate sentiment over time of news media coverage for one science-focused (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, IPBES) and one policy-focused (Convention on Biological Diversity, CBD) international bodies for biodiversity conservation, we performed sentiment analysis on a dataset of 1118 news articles with two lexicon-based methods (AFINN and SentiWordNet) and one LLM-based few shot classification method (gpt 4-o). We found that the sentiment over time of news media covering the science-focused body (IPBES) became significantly more negative, whereas the sentiment of news media covering the policy-focused body (CBD) became significantly more positive over time. These divergent trends could be due to a focus on international cooperation rather than policy implementation for the CBD, with the IPBES focusing more on the science and statistics of biodiversity loss. In any case, identifying these sentiment trends for biodiversity news media coverage can help inform future communication strategies that might encourage more action towards biodiversity conservation.

Madeline Ho (Supervisor: Chelsea Rochman)

Rolling in Road Dust: Global Patterns of Microplastic in Road Runoff

Abstract: Urban environments are major contributors to microplastic pollution, with human activity driving plastic production and waste generation. Microplastic concentrations and composition in road dust vary regionally, influenced by factors such as population density, land use, traffic volume, and climate. This study aims to quantify global patterns of microplastics in road dust by analyzing samples collected from 10 cities worldwide, linking urban indicators to microplastic concentration and composition. Microplastic extraction from road dust samples involved chemical digestion, density separation, and microscopic picking. Particles were characterized by size, colour, and morphology for analysis. The results indicate that geographic and economic factors play a crucial role in shaping microplastic pollution — (1) Microplastic abundance is positively correlated with population density and GDP per capita, and (2) Population density has a stronger influence on rubber particles, while GDP per capita more stronger influences fibers and fragments. Understanding these relationships can help develop targeted mitigation strategies tailored to specific urban regions or cities.

Madeline Ramsden (Supervisor: Donald Jackson)

Identifying Drivers of Fish Community Structure at Large Spatial Scales

Abstract: Fish communities give important insights into the health of the ecosystem they exist in. It is generally understood that fish are affected by a combination of water chemistry, terrestrial environment, biotic interactions, and ability to disperse. However, the major factors in patterns of community structure, especially across large distances, is poorly understood. The United States Environmental Protection Agency (USEPA) collects data on fish communities in streams across the United States, including the Appalachian Mountain range. This area is a hotspot for freshwater biodiversity and has a wide range of ecosystems and human impacts, including mining, valley filling, logging, and urbanization. Additionally, little of the area is protected land, and the large spatial scale may provide insights not seen more locally. However, the patterns of differences between these communities were poorly explained a suite of water chemistry variables and terrestrial environment metrics. This indicates that there are likely different major drivers for fish communities across

watersheds and wider regions. It also may suggest a need for improvements to current statistical methods or novel ways to investigate large-scale ecological studies.

Samuel Dumas (Supervisor: Martin Krkosek)

Bayesian Modelling of Salmon Productivity in Viner Sound Creek

Abstract: In recent years, Pacific salmon populations have experienced unprecedented declines, which is largely attributed to a decrease in productivity (i.e., ratio of recruits to spawners). In 2023, Murdoch et al. explored a wide variety of environmental covariates and their impact on Pacific salmon, finding that sea surface temperatures played an important role in productivity. However, recent efforts have highlighted that disturbance from forestry industries (e.g., lumber), which are particularly present along the Pacific Coast, may also contribute to the decline in productivity. Despite these hypotheses, there have been difficulties in successfully extracting the effect of forestry on productivity in relation to other environmental covariates. To study this relationship, we analyzed data from the Viner Sound Creek watershed in British Columbia, which has experienced both extensive deforestation and salmon population declines. We then use Bayesian modelling to fit the productivity data using two models: one a linear regression in terms of number of spawners, the effect of forestry, sea surface temperatures, and the North Pacific Gyre Oscillations, and the other, a time-varying productivity model with the effect of forestry. We largely predict that the time-varying model will have a greater success at capturing the effects of forestry on productivity. Through this study, we may better understand the mechanisms that drive productivity and further conservation practices with respect to our forestry practices.

Category: Urban Ecology & Species Monitoring

Judges: Chelsea Rochman & Damian Hernandez

Kaylie Borntraeger (Supervisor: Don Jackson)

Acoustic Monitoring and Analysis of Bird Diversity at Urban Stormwater Ponds

Abstract: With the loss of a majority of natural wetlands in the Greater Toronto Area, stormwater ponds (SWPs) are engineered structures designed to reduce flooding and contaminants flowing into local stream systems. Many birds are residents or use these artificial ponds as ‘stop over points’ during their migration because they offer habitat patches in an otherwise urbanized area. The inconsistency in design and varying habitat quality between SWPs makes the impact of environmental characteristics on bird communities relatively unknown. We continuously recorded acoustic data from 17 sites in Brampton Ontario, Canada from April 11th to July 2nd and analyzed them through the use of BirdNet, Raven, Merlin and manual verification to identify the presence or absence of bird species. We assessed habitat characteristics qualitatively based on land use and vegetation structure, and quantified how these features may impact bird communities throughout time and space using principal coordinate analysis (PCoA), distance based redundancy analysis (dbRDA) and PERMANOVA. 145 species of birds were identified with 9 being species at risk (SAR). Migrant species were the largest driver of differences in community composition suggested by three distinct time period groupings. Selected habitat characteristics were marginally non-significant predictors suggesting the influence of unevaluated characteristics such as biotic interactions. The results of this study emphasise the importance of these SWPs as green spaces and important habitats for migrant and resident birds especially SAR and hopes to inform design and management of these ponds in the future.

Naveen David (Supervisor: Shelby Riskin)

Effects of salt on sediment phosphorous release in urban stormwater ponds

Abstract: Phosphorous (P) is a limiting nutrient in aquatic ecosystems, and excessive inputs result in eutrophication. Urban stormwater ponds, which are designed to capture runoff from urban sources, are relatively inefficient at sequestering P in sediment. Evidence suggests that increased salt concentration might increase phosphorus release from sediments in two ways: It can exacerbate low dissolved oxygen at depth, leading to P release through the reduction of iron compounds, and chloride ions may compete with P for sediment binding sites. In this study, we investigate the influence of salt on phosphorous release from urban stormwater pond sediment, with a focus on which mechanisms are responsible. We established 15 microcosms, each with urban stormwater pond sediment and deionized water with three treatments of varying salt concentrations. We kept the microcosms stable and in the dark to prevent photosynthesis and mixing, and we analyzed phosphate P in the water. We found that phosphate concentrations increased over time in all microcosms and all treatments independent of salt concentrations, suggesting that anoxia, and not salinity, drove the release of P from the sediments. In-situ results from Brampton stormwater ponds also showed that P concentrations were independent of salt concentrations. These findings help clarify the mechanisms by which salt influences phosphorous internal loading. Given that phosphorous runoff contributes to eutrophication, this could help inform stormwater and wastewater management practices.

Majd Khayat (Supervisors: Marie-Josée Fortin & Jonathan Ruppert)

Urban Conservation Planning for Roadkill in the Greater Toronto Area

Abstract: Roadkill can contribute to a large portion of urban wildlife mortality and exacerbate population decline yet little is known about its patterns throughout the Greater Toronto Area (GTA) and how it impacts wildlife populations. We used roadkill data from the Toronto and Region Conservation Authority (TRCA), iNaturalist, and the City of Toronto 311 records over 10 years divided into five geographic regions representing varying degrees of urbanization to perform multivariate regression tree analysis. Landcover data, road metrics, and hot spots of live animal sightings were used as explanatory variables of roadkill. Explanatory variables were measured as a percentage occupied within a 5km buffer around each roadkill. Only live animal sightings of the same taxonomic class as a point of roadkill were used to determine the presence of live animal sighting hot spots around it. Amphibia represented 83% of all roadkill incidents, Reptilia 5.6%, Aves 3.2%, and Mammalia 8.2%. Across all five regions and all three datasets, live animal presence data had the best predictive power of roadkill incidents while surrounding landcover and road density were second and third in their predictive power respectively. Understanding the drivers of road mortality in the Greater Toronto Area can help urban planners identify probable vehicle-wildlife collision zones, which this study suggests can be done preliminarily through readily available citizen science data.

Gabrielle Diez (Supervisor: Shelby Riskin)

Monitoring Diversity, Abundance and Phenologies of Anurans in Urban Stormwater Ponds

Abstract: Stormwater ponds (SWPs) are artificial structures designed to receive stormwater runoff but can also serve as unintended habitats for wildlife. However, SWPs may also pose risks to wildlife due to their potential to accumulate contaminants from roads and other human land uses. We examined how abiotic conditions drive anuran (frog and toad) calling phenology and chorus intensity across 10 urban stormwater ponds in Brampton Ontario with passive acoustics and a machine learning algorithm (BirdNet). Examined abiotic conditions included water chemistry parameters, pond morphology and climatic factors. Preliminary results indicate poor water quality may reduce anuran chorus intensity and diversity in these ponds. Our findings reveal the capacity for SWPs to support a diversity of anurans, and

additionally, that environmental characteristics, especially water quality metrics, could be managed by municipalities to improve the abilities of SWPs to support amphibians in urban landscapes.

Diane Lin (Supervisor: Soren Brothers)

Correlation Between Stream Metabolism, CO2, and Salinity in an Urban Stream

Abstract: Inland waters such as lakes and streams can be major sources of the greenhouse gas carbon dioxide (CO2) for the atmosphere. However, aquatic CO2 emissions are variable, responding to uptake by aquatic primary production and increases due to respiration. These biological processes may potentially be affected by human-controlled factors such as salinity, which may impact ecosystem dynamics, and thus aquatic metabolism. I investigated the relationship between aquatic metabolism, CO2 concentrations, and salinity dynamics in an urban stream network in the City of Toronto (Black Creek). Data collected from summer 2024 to spring 2025 indicated a significant correlation between pCO2 and salinity at these sites. Aquatic metabolism measurements from December 2024 to February 2025 additionally demonstrated net heterotrophy.

Bruce Zhang (Supervisor: Shelby Riskin)

Automated Vocalization Recognition of Frogs and Toads

Abstract: Anurans (frogs and toads) play a crucial role in ecosystems worldwide, yet their populations have been declining due to environmental changes and habitat loss. This issue is particularly pressing in highly urbanized regions of the United States and Canada, highlighting the need for efficient and comprehensive monitoring methods. In this study, I developed a machine learning-based call recognition program to enhance anuran detection and identification in eastern North America and Canada. I extracted frog and toad calls from online databases, identified them to species, and segmented the recordings into 3-second snippets. I accumulated at least 100 samples per each of the 49 species as the training dataset. Using the BirdNet platform, I trained an audio recognition model. Following training the model, I tested the model with full-length recordings containing multiple species obtained from online resources and field recordings. I then compared the program's accuracy to existing identification methods. The results indicate that the model has a slightly lower accuracy than existing models but can recognize a broader range of species. Sensitivity analysis revealed that setting the minimum confidence parameter to either 45% or 50% minimizes Type I and Type I errors most effectively, whereas variations in the sensitivity parameter had no significant impact on error rates. Overall, the capability to identify a wide range of species demonstrates the program's potential to enhance large-scale anuran monitoring and act as a valuable tool for anuran conservation efforts.

Category: Ecophysiology & Biogeography

Judges: Micah Freedman & Mathieu Videlier

Claire Abbasi (Supervisor: John Stinchcombe)

Investigating the Genetic Basis and Geographic Distribution of the 5-Lobed Leaf Phenotype in *Ipomoea hederacea* (ivy-leaf morning glory)

Abstract: *Ipomoea hederacea* (ivy leaf morning glory) exhibits intraspecific variation in leaf shape, with a 5-lobed phenotype being present in the species. However, the genetic basis, geographic range and ecological implications of the 5-lobed phenotype remain unknown. This study investigated the genetic basis of the 5-lobed leaf shape through a genome wide association study (GWAS) on whole genome sequencing data from 133 individuals across 77 populations from the Eastern United States. The

distribution of the 5-lobed phenotype was mapped using sampled populations and supplemented with iNaturalist data. We also examined if the 5-lobed phenotype is correlated with multiple ecophysiological traits and growth metrics. No significant single nucleotide polymorphisms were identified in the GWAS. Unlike other *Ipomoea hederacea* leaf shapes there was no latitudinal cline observed in the sequenced individuals with the 5-lobed leaf shape. The 5-lobed phenotype showed no correlation with multiple ecophysiological and growth metrics. These results indicate that the 5 lobed phenotype may not have a genetic basis, or is the product of complex gene-environment interactions, and does not show clinal patterns consistent with selection.

Jack Stoodley (Supervisor: Martin Krkosek)

Evaluating the Transcriptomic Heat Stress Response of Juvenile Coho Salmon and Spawning Pink Salmon in Warming Rivers

Abstract: Climate change is driving rising water temperatures in freshwater ecosystems, placing migratory fish species like Pacific salmon at increasing risk. This increase in risk is partially due to their freshwater migration into aquatic environments, which climate change can disproportionately affect. This study investigates the transcriptomic responses of Coho (*Oncorhynchus kisutch*) and Pink (*Oncorhynchus gorbuscha*) salmon to heat stress in natural environments. By comparing gene expression in gill tissue and environmental RNA (eRNA) samples collected from "hot" and "cold" river conditions, we aim to identify transcriptomic markers indicative of heat stress. Differential gene expression analyses will focus on heat shock proteins, metabolic regulators, immune response genes, and osmoregulatory pathways across juvenile and spawning life stages. Other planned analyses involve a gene ontology analysis to identify the up- or downregulation of entire pathways between conditions and the identification of key heat-stress biomarkers via a machine learning approach. This research uniquely leverages in situ sampling rather than laboratory-controlled stress conditions, enhancing ecological relevance by eliminating laboratory effects commonly seen in transcriptomic heat stress studies. Additionally, validating eRNA as a reliable tool for non-invasive heat stress monitoring could improve conservation efforts and provide a valuable method for monitoring fish health in stressed ecosystems. Heat-stress-correlated biomarkers and pathways identified could be mechanistically tested in vitro to enhance the understanding of salmon physiology. In the short term, the findings will contribute to understanding salmonid resilience to climate change, aiding in the development of monitoring and management strategies for vulnerable populations.

Rana Fineman (Supervisor: Njal Rollinson)

Condition affects density-dependent dispersal in juvenile Atlantic salmon

Abstract: Dispersal is a significant event that has implications for individual fitness as well as population distribution and persistence. Previous studies have determined that dispersal is multifactorial and context-dependent, and internal condition interacts with environmental factors to produce a dispersal phenotype. In crowded environments, low-condition individuals may be more motivated to disperse than high-condition individuals, due to high-condition individuals having greater competitive ability. To test this prediction, we released juvenile Atlantic salmon (*Salmo salar*) into nine streams and tracked their dispersal distance and growth, using the initial egg mass of the salmon as a proxy for condition. We found that as egg mass decreased, dispersal distance increased, and as dispersal distance increased, growth rate increased. These results suggest that low-condition salmon disperse more than high-condition salmon and receive a fitness benefit from doing so. In addition, in streams with lower habitat quality, egg mass had a greater effect size on dispersal distance. This may have occurred because sites with high habitat quality can support all individuals, while sites with low habitat quality drive out low-condition individuals first. Our results provide evidence for negative condition-dependent dispersal, a

phenomenon that is rarely found in dispersal studies, and provide insight into the complex interactions that influence dispersal.

Erin Huang (Supervisor: Njal Rollinson)

Bergmann's rule in non-avian reptiles revisited: Turtles still follow it, lizards and snakes don't reverse it

Abstract: Bergmann's rule is defined as an interspecific tendency for an increasing body size with increasing latitude or decreasing environmental temperature. Mammals and birds have shown wide support for this, but reptiles show much more variation in body size trends. Ashton & Feldman (2003) attempted to clarify these trends by conducting a vote-counting analysis of 38 species of chelonians and 139 species of squamates. They concluded that chelonians follow Begmann's rule and squamates reverse it. Since then, vote-counting analysis has been found to be an inadequate method of analysis in its simplification of data and lack of account for magnitude and sample size. To rectify this, we reconducted this analysis in the form of a meta-analysis with a total of 24 papers across 26 species with effect sizes. We confirmed that chelonians follow Bergmann's rule but squamates do not. Lizards showed a significant difference to chelonian trends and snakes showed no significant difference. Instead, snakes seem to tend towards following Bergmann's rule. This suggests other mechanisms may be present for these patterns and further investigation is necessary to establish body clines in squamates.

Drin Brown (Supervisor: Megan Frederickson)

Are Extrafloral Nectaries Under-Represented on Oceanic Islands

Abstract: There is a global spatial pattern of biodiversity where species richness decreases moving from the equator to the poles. Mechanisms responsible for this latitudinal diversity gradient (LDG) remain under debate, but include hypotheses that examine both biotic and abiotic drivers of diversity that vary with latitude. In their recent Nature paper, Delavaux et al showed that mutualisms are a significant driver of the LDG, because by limiting colonization on oceanic islands, mutualisms weaken the latitudinal diversity gradient on islands. This finding held true for mycorrhizal associations, nitrogen fixer associations, and biotic pollination. Here we examine whether plants bearing extrafloral nectaries (EFN), and their visiting ant partners, are over- or under-represented on oceanic islands. Extrafloral nectaries are a generalized, facultative, and defensive mutualism that are hypothesized to increase diversity and also promote range expansions. We use databases of global ant and plant trait and occurrence data to measure relationships between species richness on pairs of oceanic islands and their nearest equivalent-latitude mainland. We use five datasets to determine whether EFN-bearing plants and their EFN-visiting ant partners are over- or under-represented on oceanic islands. We regressed the log response ratio (LRR) of island to mainland species richness against EFN trait statuses of plants and ants, as well as biogeographical variables such as island area and distance from the mainland. We found that EFNs and their ant partners are neither under- nor over-represented on islands. We also found that there was no latitudinal pattern in their representation. This is counter to the Delavaux et al study which found that mutualisms were particularly under-represented closer to the equator. In the case of the generalized ant-extrafloral nectary association, where co-colonization is not required for establishment, mutualism is not driving the LDG.

Shahd Daoud (Supervisor: Santiago Claramunt)

The Influence of Wing Morphology on Bird-Aircraft Collision Risk

Abstract: Bird collisions with aircraft pose significant financial, ecological, and human safety concerns worldwide. However, the biological factors influencing species-specific collision risks remain poorly

understood. This study examines how wing morphology—specifically aspect ratio and wing loading—affects bird-aircraft collision risk while accounting for local species abundance. Given that lower wing loading and aspect ratio enhance aerial maneuverability, we hypothesized that species with these traits would exhibit reduced collision frequencies. To test this, we analyzed bird strike data from the U.S. Federal Aviation Administration (FAA) at Dallas Fort Worth International Airport, extracted local abundance estimates from eBird, and obtained wing morphology measurements from literature sources and museum specimens at the Royal Ontario Museum. We used phylogenetic generalized least-squares (PGLS) models to assess the relationship between wing morphology and collision likelihood. Results indicate that local species abundance, aspect ratio, and wing loading contribute to collision risk, overall. However, abundance had the strongest effect, with higher-abundance species experiencing more collisions. Aspect ratio was positively associated with collisions, suggesting that birds with longer, narrower wings are at higher risk. Contrary to expectations, wing loading had a non-significant negative effect on collision risk. These findings contrast with previous studies suggesting that higher maneuverability increases collision risk. Overall, our results highlight the importance of incorporating local abundance into risk assessments and suggest that species with specific wing morphologies may be more vulnerable to aircraft strikes. Understanding these relationships can refine aviation wildlife management strategies and contribute to conservation efforts in increasingly human-modified landscapes.

Category: Behaviour & Species Interactions

Judges: Adriana Bravo Ordonez & Garth Covernton

Jessica Bullock (Supervisor: Helen Rodd)

Parental care and responses of juvenile cichlids to maternal signals in *Apistogramma atahualpa*
Abstract: Unavailable

Lauren Rego (Supervisor: Njal Rollinson)

Do Turtles Vocalize on a Diel Cycle?
Abstract: Across the diel (24-hour) cycle, animals respond to environmental and biological cues which influence their behaviour and communication. In many taxa, acoustic communication is often linked to specific behaviours that occur over the diel cycle, such as foraging, social interactions, and mating. Despite growing recognition of acoustic communication in turtles, the diel variation in turtle vocalizations remains largely unexplored. We hypothesized that the common snapping turtle (*Chelydra serpentina*) exhibits variation in vocal activity over the diel cycle. To assess temporal patterns in acoustic signaling, we recorded underwater audio of 17 individuals of *C. serpentina* in Algonquin Park over 24-hour periods. Spectrograms and waveforms of acoustic data were inspected, and sounds were annotated and categorized using Raven Pro software. Manual annotations were then used to train a deep learning model (BirdNET). Our findings reveal a peak in vocal activity of *C. serpentina* around midday, with similar patterns observed with both manual and automatic annotations. This provides novel insights into diel patterns of acoustic signaling in freshwater turtles, serving as a foundation for determining the function and ecological context of these vocalizations. Our research demonstrates the potential for passive acoustic monitoring as a non-invasive tool for chelonian acoustic assessment and future conservation applications.

Jerry Yu (Supervisor: Megan Frederickson)

The Role of Microbial Symbionts in Plant's Range Expansion under Field Conditions

Abstract: Microbial symbionts that are closely associated with their host plants can benefit host plant colonization success during range expansion by increasing host fitness. How different communities of microbial symbionts alter host invasion growth rates in the introduced habitat remains largely untested. Here, we tested the growth of duckweeds (*Lemna japonica*) introduced into a pond either with their microbial symbionts removed, or inoculated with a microbial community that is local or non-local to the introduced habitat. We found that without their microbial symbionts, local plants had the highest growth rates, while non-local plants grew the slowest. Non-local plants grew faster when inoculated with either microbial community compared to when they were left without microbes. In contrast, local plants inoculated with non-local microbes showed reduced growth rates over time. Additionally, 16S rRNA sequencing of duckweed-associated microbes during colonization showed that, although observed microbial richness was higher in native KSR samples, Shannon and Simpson diversity indices did not differ significantly between treatments. Microbial communities across treatments converged by the fifth day of the experiment, while plant growth rates continued to vary across treatments, suggesting a priority effect of early-colonizing microbes. This study underscores the role of microbial symbionts in host range expansion and supports the presence of local adaptation among plants, microbial symbionts, and the environment.

Silas Peters (Supervisor: Rosalind Murray)

Emergence of Endangered Salamander and Invertebrate Prey

Abstract: Amphibian populations worldwide are facing threats ranging from predation to habitat loss. *Ambystoma jeffersonianum*, a species of mole salamanders, are considered endangered in Canada. Found in Ontario, these populations are isolated and at the northern range limit. *A. jeffersonianum* were first found in Mississauga, Ontario in 1976. Since this time, the population has gone unstudied. In order to understand the dynamics of this population, we are examining the emergence phenology of the salamanders and their invertebrate prey in these breeding vernal pools. Along with understanding the relationship between prey and salamander emergence, this study will help us assess whether prey availability poses a threat to this population. From July to August 2024, metamorph salamander emergence from one vernal pool was monitored using pitfall traps. Alongside this work, from May to August 2024, aquatic invertebrate samples were taken using dipnets and emerged invertebrate samples were taken using malaise traps. Samples were sorted in the lab to Order or Family and both wet and dry mass were taken. We used a generalized linear model (GLM) to assess the influence of aquatic and emerged invertebrates on metamorph emergence. We have preliminarily found that aquatic invertebrate biomass has a significant effect on metamorph emergence, but emerging invertebrates do not. Further work focused on environmental factors and Family-level aquatic invertebrate abundance data will help us understand what other factors may be influencing this relationship. Ultimately, this research will guide further conservation of this endangered species.

Mia Bantas (Supervisor: Megan Bontrager)

Morphology and Anthocyanin Pigmentation as Signs of Phytoplasma Infection in *Trillium grandiflorum*

Abstract: Phenotypic variation in plants is not uncommon but significant deviation from the wild type can often indicate disease, stress or infection. In the flowering plant *Trillium grandiflorum*, recent sightings of flowers with virescence and purple colouring along with abnormal morphology including elongated sepals and increased leaf number have been found in Southern Ontario. Previous studies have associated similar phenotypes in other plants to the subspecies of bacteria, '*Candidatus* phytoplasma', an obligate parasite that inhabits the phloem sieve cells of a variety of plants inducing

phenotypes such as yellowing, virescence, stunting, leaf curling and witches broom (an abnormal proliferation of buds on woody plants). Through DNA extraction and PCR using phytoplasma specific primers, this study aims to understand whether anthocyanin pigmentation (red/purple colouring of petals and leaves) and morphological differences in *T. grandiflorum* is associated with phytoplasma presence. Our preliminary findings show that Trillium samples with morphological changes, anthocyanin colouring or not, were positive for phytoplasma presence. On the other hand, anthocyanin pigmentation did not appear to be a reliable indicator of phytoplasma infection. This implies that morphological differences such as extra leaves and sepal elongation can be possible identifiers for phytoplasma infection. Whether or not purple colouring alone is a possible identifier needs further exploration. These findings can aid in tracking phytoplasma spread in populations of *T. grandiflorum* and would benefit from future studies on the phytoplasma's long term effects.

Category: Evolution & Phylogenetics

Judges: Matthew Osmond & Jessie Wang

Jamie Chew (Supervisor: Aneil Agrawal)

What is the Genetic Basis of Mate Harm in Fruit Flies?

Abstract: Male harm is a phenomenon in many sexual organisms, in which the fitness of a female is reduced by their respective male mate. In previous research, the genetic basis of male harm has been typically attributed to interlocus sexual conflict, where sexually antagonistic alleles exist at different sites between the sexes. However, it has not been clearly demonstrated yet that male harm does not also depend on intralocus sexual conflict, which occurs when sexually antagonistic alleles occur on the same genetic locus. In order to investigate whether intralocus sexual conflict has any bearing on male harm, an assay was performed using male-limited (ML) and female-limited (FL) *Drosophila melanogaster* males from ongoing sex-limited lab populations. These lab populations were maintained by restricting chromosome 3 to only be selected for within each sex so that males and females could independently evolve to their respective trait optima. Males carrying the ML chromosome and FL chromosome were allowed to mate with females from a separate ancestral population and male harm effects were measured by the fecundity and survival rates of the females. The maternal survival data did not show any statistically significant differences between those exposed to ML and FL males. The fecundity data, however, indicated promising results, showing that females exposed to ML males had a statistically significant reduction in fecundity when compared to females exposed to FL males. These results support the notion that intralocus sexual conflict is a genetic basis for male harm in *Drosophila*, as the male and female optima for traits on chromosome 3 seem to be different and impact male harm.

Hudson Wentzell (Supervisor: Belinda Chang)

Molecular evolution of cetacean phototransduction and visual cycle genes

Abstract: The sensory systems of cetaceans have undergone dramatic evolutionary changes over the course of their transition from a terrestrial to an aquatic habitat. In particular, cetacean visual systems have adapted extensively to the dim and blue-shifted spectrum of visible light available deep underwater; this has enabled cetaceans to obtain food more effectively by diving. While past molecular-evolutionary studies of cetacean visual genes have identified key changes that likely contributed significantly to this adaptation, these have been focused only on the genes encoding rhodopsin and rod arrestin. There are hundreds of other genes involved in vision and eye development; sequence changes in any number of these genes may have also played a critical role in this adaptation. Here, we use computational methods of comparative sequence analysis to infer patterns of selection on 59

phototransduction and visual cycle genes in 35 cetacean species. We find that 8 visual genes exhibit significant signatures of positive selection throughout the cetacean phylogeny. Unexpectedly, despite cetaceans having rod-dominated retinas, we find that cone phototransduction genes are overrepresented, and rod genes underrepresented, among the positively selected genes. The most significant gene, OPN1SW, encodes the blue light-sensitive cone opsin; one codon site in this gene with a high posterior probability of positive selection is a known spectral tuning site of this opsin. We also find that 21 genes show significant differences in selective pressure between odontocetes (toothed whales) and mysticetes (baleen whales); this may reflect their differences in diet and feeding mode. Altogether, our findings confirm our hypothesis that changes in visual genes other than those encoding rhodopsin and rod arrestin have been subject to positive selection in cetaceans. These results represent a significant step towards identifying and understanding the molecular changes that have driven the adaptation of cetacean visual systems to their aquatic environments.

Alexander Ling (Supervisor: Donald Jackson)

Phylogenetic Signal in Salinity Tolerance of North American Freshwater Fish

Abstract: Freshwater salinization, driven by road salt application, mining, and agriculture, is an escalating environmental challenge that threatens aquatic biodiversity. While the U.S. and Canada have regulatory water quality guidelines for ions like chloride, these thresholds may not fully protect freshwater species due to limited taxonomic representation in laboratory-based experiments. To address this gap, I compiled field-reported maximum chloride and conductivity values for 546 freshwater fish species using data from the U.S. EPA and the Canadian Fish Biodiversity Database. I then constructed a phylogenetic tree and assessed phylogenetic signal in salinity tolerance using Pagel's λ and Blomberg's K. Pagel's λ revealed strong phylogenetic signals for both chloride (λ = 0.788) and conductivity tolerance (λ = 0.816), indicating that closely related species tend to have similar salinity tolerances. In contrast, Blomberg's K did not detect significant signals (K = 0.053 for chloride, K = 0.051 for conductivity), likely due to its greater sensitivity to how trait variance is distributed within versus among clades. Overall, phylogenetic signal analysis in salinity tolerance helps improve tolerance predictions for understudied species and supports the development of more taxonomically representative and evolutionarily informed water quality guidelines that best support the conservation of freshwater ecosystems and fish.

Emile Watanabe (Supervisor: Rowan Sage)

Enhancement of Aminotransferase Activity as a Key Step in the Evolutionary Origin of C4 photosynthesis

Abstract: C4 photosynthesis has evolved independently over 60 times, reorganizing both C3 leaf anatomy and metabolism to do so. A C3-C4 intermediate pathway exists, termed C2 photosynthesis due to the shuttling of the 2-carbon molecule glycine from the mesophyll to the bundle sheath cell mitochondria. Glycine decarboxylase localized in the bundle sheath mitochondria produces NH3 during the conversion of glycine to CO2, creating a nitrogen imbalance between mesophyll and bundle sheath cells in C2 plants. To solve this imbalance, I hypothesize that C3-C4 intermediate plants upregulate alanine aminotransferase (Ala-AT) and aspartate aminotransferase (Asp-AT) activities to return nitrogen to the mesophyll cell as amino acids. My study is the first systematic survey of Ala-AT and Asp-AT activity across seven lineages of plants, *Homolepis, Alternanthera, Mollugo, Steinchisma, Portulaca, Blepharis,* and *Moricandia*. I found that Asp-AT appears to be upregulated in all C2 species as compared to C3 species, although this trend was not significant statistically. Exceptionally, Mollugo species did not follow this trend. Ala-AT does not appear to be upregulated between related C2 and C3 species. C2 species thus appear to upregulate portions of the C4 photorespiratory nitrogen metabolism, indicating that the

upregulation of Asp-AT may be a key step in facilitating the evolution of C4 photosynthesis. Overall, studying C3-C4 intermediates allows us to better understand the stepwise transition from C3 to C4, and elucidates potential traits that may act as precursors to C4 evolution.

Michael Marmash (Supervisor: Tomomi Parins-Fukuchi)

Biotic or Abiotic Influences On the Diversity Dynamics of Ancient Reefs?

Abstract: Two hypotheses exist for explaining what influences patterns of diversification over long time scales. The first is that biological interactions such as competition determine the fitness and survival of taxa. The second is that abiotic factors like environmental changes and mass extinctions control rates of diversification and extinction for taxa over long time scales. This project attempts to measure whether biotic or abiotic factors had a stronger influence on the replacement of corals by the rudist bivalves which occurred globally throughout the Cretaceous. The abundance of corals decreased significantly during the Cretaceous, while rudist bivalves achieved a global 'dominance', though it is not clear whether this change is due to a competitive replacement of corals by rudists or environmental factors affecting each group differentially. I evaluated biological variables such as abundance, diversity, speciation and extinction to see if these variables might be associated with observed diversity patterns. I also compared these with environmental factors such as sea level or paleotemperature. Finally, I evaluated if co-occurrence in the two groups demonstrated statistically significant patterns of exclusion. Results indicate the correlations between biotic factors are stronger than those between environmental factors. This suggests that biological influences still influence patterns of evolutionary change on long timescales, and environmental changes alone are not responsible for influencing patterns of speciation and extinction.