# BIOLOGY GRADUATE STUDENT SYMPOSIUM 2021

**Department of Biology**

**University of Saskatchewan**

**Program and Abstract Book**

UNIVERSITY OF SASKATCHEWAN

# Welcome to the Biology 990 Symposium, our showcase of graduate student research

The 2021 Graduate Symposium is being held remotely for the second time. At this time last year I think none of us knew what was in store for us and few recognized the length of time that we would be apart. In welcoming you back to our second remote symposium I want to thank all of the students, staff, and faculty members that have worked diligently on behalf of the Biology Department to keep offering a quality learning experience for our students. It has been long and difficult and your efforts are very much appreciated.

For this year students were asked to pre-record an oral presentation or prepare a poster and record a short explanation. We will be playing the presentations "live" during the sessions and the presenting students will be available for questions afterward. For the poster sessions, all of our posters are available through the Biology 990 Canvas site and the students have a 20 minute session for you to drop in and discuss them. If you are unable to access the Canvas posters, please let me know and we will work to rectify that.

We will wrap up with a short awards session on Tuesday afternoon at 4:15 p.m. Unfortunately, we will be unable to hold the Biology 990 BBQ for the second year in a row, but it will give us all the more to celebrate when we are able to gather together again safely. Until then we will continue to stay physically separate, but socially connected. Enjoy the presentations and congratulations to all of our student presenters for their hard work.

Chris Todd

**Biology 990 Schedule**

**Monday April 12**

| | | |
|---|---|---|
| 1:30-2:30 p.m. | Welcome and Oral Presentation Session 1 | Abstracts - p. 4 |
| 2:45-3:45 p.m. | Oral Presentation Concurrent Session 2a | Abstracts - p. 6 |
| | Oral Presentation Concurrent Session 2b | Abstracts - p. 8 |
| 4:00-5:00 p.m. | Poster Session | Abstracts - p. 16 |
| | Posters will be made available in advance and each poster presenter will have their own WebEx room available for discussion | |

**Tuesday April 13**

| | | |
|---|---|---|
| 1:30-2:30 p.m. | Oral Presentation Concurrent Session 3a | Abstracts – p. 10 |
| | Oral Presentation Concurrent Session 3b | Abstracts – p. 12 |
| 2:45-3:45 p.m. | Oral Presentation Session 4 | Abstracts – p. 14 |

4:15-5:00 p.m. Wrap up and Graduate Student Awards

**Monday April 12**

**Session 1 –** Session 1 Link

| | Speaker | Evaluators |
|---|---|---|
| 1:30 | Ruth Greuel | J. Lane, I. Phillips |
| | Mercy Harris | S. Niyogi, J. Hudson |
| | Akaash Bansal | P. McLoughlin, C. Trick |

**Session 2a –** Session 2a Link

| | Speaker | Evaluators |
|---|---|---|
| 2:45 | Prashani Dilushika | S. Niyogi, A. Davis |
| | Dominic Olver | C. Carvalho, C. Morrissey |
| | Ita Rivera-Hernandez | J. Lane, J, Benson |

**Session 2b–** Session 2b Link

| | Speaker | Evaluators |
|---|---|---|
| 2:45 | Dale Barks | D. Chivers, J. Hudson |
| | Ana Diaz | K. Wiebe, C. Trick |
| | MD Noim Imtiazy | D. Chivers, P. McLoughlin |

**Poster Session – please click on individual student's links**

| | Speaker | Evaluators | |
|---|---|---|---|
| 4:00 | Adrian Diaz-Sanchez | H. Cota-Sanchez, C. Carvalho | Adrian's Link |
| | Alex Preagola | S. Niyogi, J. Hudson | Alex's Link |
| | Michelle Sawatzky | J. Lane, N. Chilton | Michelle's Link |
| 4:20 | Devon Ireland | A. Davis, Y. Wei | Devon's Link |
| | Edgar Mangwende | S. Clark, B. Ham | Edgar's Link |
| | Anastasia Nykoneko | D. Chivers, C. Morrissey | Anastasia's Link |
| 4:40 | Lia Le Brun Robles Gil | P. McLoughlin, C. Trick | Lia's Link |
| | Jory Litt-Jukes | K. Wiebe, M. Ferrari | Jory's Link |
| | Michelle Vanderwel | T. Marchant, J. Chedrese | Michelle's Link |

**Tuesday April 13**

**Session 3a–** Session 3a Link

| | Speaker | Evaluators |
|---|---|---|
| 1:30 | Himal Thapa | C. Morrissey, J. Gray |
| | Sinan Zhang | T. Marchant, J. Benson |
| | Mohammad Amini | Y. Wei, K. Wilson |

**Session 3b–** Session 3b Link

| | Speaker | Evaluators |
|---|---|---|
| 1:30 | Ahmad Ghobeishavi | M. Angrini, K. Wiebe |
| | Aaron Bell | N. Chilton, S. Prager |
| | Mahesh Rachamalla | M. Angrini, J. Chedrese |

**Session 4–** Session 4 Link

| | Speaker | Evaluators |
|---|---|---|
| 2:45 | Iqra Azam | T. Marchant, K. Wilson |
| | Muhammad Sarwar | B. Ham, Y. Wei |
| | Atefeh Najafi | J. Chedrese, M. Angrini |

4:15 **990 Wrap up Ceremony and Graduate Student Awards -** End Session Link

**Monday April 12**

**Session 1 -** Session 1 Link

| | **Speaker** |
|---|---|
| 1:30 | Ruth Gruel |
| | Mercy Harris |
| | Akaash Bansal |

**RUTH J. GREUEL[1], MASON R. STOTHART[2], JOCELYN POISSANT[2] & PHILIP D. MCLOUGHLIN[1]. Dietary breadth of Sable Island horses- a pilot study.** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK. [2]Faculty of Veterinary Medicine, University of Calgary, Calgary, AB.

The diet of large herbivores is shaped by many factors including physiological condition of the animal, as well as characteristics intrinsic to the vegetation, including availability and palatability. Vegetation communities on Sable Island, Nova Scotia, are diverse and subject to intense climatic conditions including fog, wind, nutrient limitation, and salt stress, as well as grazing by an unmanaged population of feral horses. High-protein forbs such as beach pea (*Lathyrus japonicus*) and sandwort (*Honckenya peploides*) are restricted to certain areas of the island, and consumption of these may be limited by seasonal availability and toxicity. I will use DNA metabarcoding of individual-linked fresh horse fecal samples ($n$ = 86) collected in 2014, alongside vegetation plot data ($n$ = 113) to determine relative use versus availability and quantify diet breadth. These data will be used to explore questions related to the impacts on diet of maternal status, seasonality, location, vegetative nutrient status, water source, and band status at several scales. Following this pilot study, further questions will be addressed using samples from other years to examine inter- and intra-annual variation among individuals. This study is a step towards understanding grazing dynamics and vegetation and landscape change on a unique barrier island landscape.

**MERCY E. HARRIS[1], CHRISTY A. MORRISSEY[1,2], KEITH A. HOBSON[3]. Diet, foraging, and land use effects on aerial insectivore neonicotinoid exposure in Saskatchewan's agroecosystems.** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]School of Environment and Sustainability, University of Saskatchewan, Saskatoon, SK; [3]Department of Biology, University of Western Ontario, London, ON.

Populations of farmland-breeding aerially insectivorous birds have declined significantly across Canada, but the causes of these losses are unclear. Though chronic dietary insecticide exposure has been proposed as a driver of declines, pesticide exposure in this guild is largely unstudied. This project quantifies the neonicotinoid insecticide exposure of two declining aerial insectivores, the Barn Swallow (*Hirundo rustica*) and the Tree Swallow (*Tachycineta bicolor*), in Saskatchewan agroecosystems, and examines whether foraging location, diet, or local land use affect exposure. In 2020, I worked at 13 farm sites south of Saskatoon to collect foraging data from adult swallows (Barn Swallow *n*=26, Tree Swallow *n*=33) using Pinpoint GPS tags. I collected blood samples (Barn Swallow *n*=101, Tree Swallow *n*=56) to assess neonicotinoid exposure, and fecal samples (Barn Swallow *n*=83, Tree Swallow *n*=70) to evaluate diet through DNA metabarcoding. Using resource selection functions, I identified that foraging habitat differed between species, with Tree Swallows exhibiting selection for wetlands, whereas Barn Swallows selected against cropland. Analysis of diet composition and neonicotinoid exposure is still pending. When complete, this project will increase our understanding of insecticide fate in agroecosystems and improve our ability to predict insecticide exposure risk in aerial insectivores.

**AKAASH BANSAL[1], JOHN-MARK DAVIES[2], ARTHUR ZASTEPA[3] & JEFF HUDSON[1]. The impact of cyanobacteria on ecosystem function: do they affect the phosphorus cycle in lakes?** [1]Department of Biology, University of Saskatchewan, Saskatoon SK; [2]Water Security Agency, Saskatoon SK; [3]Environment and Climate Change Canada, Burlington, ON.

The global increase in cyanobacterial biomass in lakes has been a topic of growing concern. Research has largely focused on the factors that promote cyanobacterial blooms and their associated health impacts to humans, livestock, and wildlife. However, the impact of cyanobacteria on ecosystem function has received less attention. There is mounting evidence that cyanobacteria have significant effects on other planktonic organisms through numerous avenues (e.g., allelopathy, inedibility, food quality and toxicity) and these effects may be of a magnitude to alter ecosystem processes (e.g., pelagic nutrient cycling). We tested this hypothesis with a diverse set of lakes (i.e., from Saskatchewan to Ontario, including Lake Erie and Lake of the Woods) that represented a gradient in cyanobacterial biomass (0 to 75% of all algal biomass). We predicted that phosphorus cycling would be less efficient in lakes that had a greater proportion of algal biomass in cyanobacteria. However, our results suggest that increasing cyanobacterial biomass did not affect the turnover of P in the pelagic food webs in the study lakes (n=20, p=0.73). There are a set of potential explanations for this outcome that will be tested in the upcoming 2021 field season.

**Session 2a –** Session 2a Link

| | **Speaker** |
|---|---|
| 2:45 | Prashani Dilushika |
| | Dominic Olver |
| | Ita Rivera-Hernandez |

**PRASHANI D. W. ARACHCHILAGE[1], DOUGLAS P. CHIVERS[1], MAUD C. O. FERRARI[1,2] CHRISTY A. MORRISSEY[1]** **Effects of Imidacloprid Exposure on Learned Recognition of Predatory Stimuli by Larvae *Enallagma sp* (Odonata: Zygoptera).** [1] Department of Biology, University of Saskatchewan, Saskatoon, Canada; [2] Department of Veterinary Biomedical Sciences, University of Saskatchewan, Saskatoon, Canada.

Prey organisms learn to recognize local predation risk based on chemical stimuli associated with predators. Aquatic organisms are highly responsive to the slightest changes in the physicochemical nature of the aquatic environment and various pollutants, including insecticides, could affect their ability to learn predators. Imidacloprid is one such insecticide which was widely used in agricultural industry. With extensive use, contamination of aquatic environments has become a major concern and pests and non-target insects are equally affected by this neonicotinoid insecticide. In this experiment, we will investigate the effect of exposure to environmentally realistic concentration (0, 0.01µg/l, 0.1µg/l, 2.0µg/l) of imidacloprid on learned recognition of predatory stimuli by *Enallagma sp* larvae. Damselfiles will be conditioned to recognize risk by exposing them to crayfish odour combined with conspecific damage-released alarm cues or a control of dechlorinated water. Learned recognition of predatory stimulus will be assessed by quantifying the change in feeding bites performed after injection of crayfish odour. Damselflies that learn to recognize the predator based on pairing with alarm cues should reduce their activity. If imidacloprid impairs learning, no significant decrease in feeding frequency is expected of imidacloprid exposed damselfly larvae compared to control exposed larvae.

Dominic Olver[1], Estefania Paredes[2], James D Benson[1]. **Sea urchin oocyte Damage Modelling: Advancements in chill injury and cytotoxicity modelling.** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK. [2]Department of Ecology and Marine Biology & Marine Biological Resources Functional Preservation Service at ECIMAT marine Station, University of Vigo, Vigo, Spain

Cryopreservation protocols frequently require high concentrations of extracellular and intracellular cryoprotectants. High concentrations of cryoprotectants can cause toxicity effects and damage cells. Some cells, like the sea urchin oocyte, are chill sensitive, such that low temperatures (in the absence of ice) result in damage known as chill injury. Here, we define and test a novel model for chill injury and combine this model with two models of toxicity damage. We exposed sea urchin oocytes to three temperatures (room temperature, 10 °C and 4 °C), in seawater supplemented with 0, 0.5, 1.0, and 1.5 M dimethyl sulfoxide, for exposure times of 2, 6, 15, 30, 50, 75, and 90 minutes (three replicates of >100 individual oocytes each). After treatment, oocytes were fertilized and developed to 4-arm-pluteous stage with survival assessed by the number of individuals reaching this stage. The chill injury model was found to be time independent (p-value<0.05) but was dependent on temperature ($_{adj}R^2$=0.98). The novel membrane damage threshold model ($_{adj}R^2$=0.94, AIC= -46.1, BIC= -31.2) outperformed the classical cytotoxicity model ($_{adj}R^2$=0.75, AIC= 76.00, BIC= 86.0) across time and temperature. Combined with past work of time dependent osmotic damage, new computer optimized protocols can be defined with accounting for exposure time.

**ITA A.E. RIVERA-HERNÁNDEZ[1] & MAUD C.O. FERRARI[2]**. **The role of embryo-mediated risk cues in wood frogs *Lithobates sylvaticus***. [1]. Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]. Veterinary Biomedical Sciences, WCVM, University of Saskatchewan, Saskatoon, SK.

Predation is an important selective force that varies in space and time. Predation can influence prey life-history, morphology, physiology, and behaviour. For prey to accurately mitigate their current predation risk, it is vital that they obtain reliable and updated information from their environment. Chemical information, such as alarm cues and disturbance cues are known to play an important role in risk assessment for aquatic species. Alarm cues are chemicals released by a prey that have been attacked by a predator, while disturbance cues are released by uninjured, distressed prey. Both cues are detected during the embryonic and post embryonic stages and have a role in the learning and recognition of novel predators, predator inspection and local risk assessment. Alarm cues can be produced in the embryonic stage and can affect the morphology and hatching time of embryos. However, the effect of embryonic stage alarm cues on post-embryonic behaviour is unknown, as well as the production of disturbance cues by embryos. Using Wood frog (*Lithobates sylvaticus*) embryos, I will explore the existence of embryonic disturbance cues and its effect on morphology, hatching time and post-embryonic behaviour, as well as the effect of embryonic alarm cues on post-hatch behaviour.

**Session 2b**– Session 2b Link

| | **Speaker** |
|---|---|
| 2:45 | Dale Barks |
| | Ana Diaz |
| | MD Noim Imtiazy |

**DALE BARKS & DR. PHILIP MCLOUGHLIN. Ecological Invasion by Boreal-Dwelling White-Tailed Deer and the Risk of Chronic Wasting Disease Transmission to Woodland Caribou Populations.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Chronic Wasting Disease (CWD) is a fatal neurodegenerative prion disease affecting cervid species. Its rapid global spread has caused concerns regarding its potential impact on cervid populations and human well-being, yet relatively little is known about CWD's ecological effects. Of special concern is the potential infection of threatened woodland caribou (*Rangifer tarandus caribou*) populations via transmission from boreal-dwelling white-tailed deer (*Odocoileus virginianus*). Although no known cases of CWD exist in North American caribou, the 2016 discovery of infected reindeer in Norway highlights the potential threat to Canadian caribou. As white-tailed deer ranges expand from Saskatchewan's resource-rich boreal-fringe zone into regions frequented by woodland caribou they may pose a significant infection risk. I captured and GPS-collared $n$ = 34 white-tailed deer in Saskatchewan's CWD-infected boreal-fringe zone throughout 2020/2021. Using location data from these individuals, I will determine habitat-selection patterns of boreal white-tailed deer, comparing their habitat use to known woodland caribou habitat to examine the risk of disease transfer via spatial or temporal overlap of these species. Additionally, genomic analysis of the resistance-conferring PRNP gene will provide novel information on CWD resistance within the Saskatchewan boreal white-tailed deer gene pool, thereby further refining the assessment of risk presented by these populations.

**ANA M. DIAZ[1], CHRISTY A. MORRISSEY[1], KEITH A. HOBSON[1,2]. Effects of landscape composition on nestlings' diet and quality: A comparative study between two sympatric species of aerial insectivores in the Saskatchewan agroecosystems."[1]** Dept. of Biology, University of Saskatchewan, Saskatoon; [2] Environment and Climate Change Canada, Science and Technology Branch, 11 Innovation Boulevard, Saskatoon, SK.

Over the last decades, the populations of several species of aerial insectivores have declined steeply. Critical transformations of land-use and increasing agricultural intensification coincide with these population trends. However, the link of landscape structure changes, prey availability and key demographic drivers such as nestling condition and survival has not yet been well understood. In this project, we are conducting a comparative study between Barn Swallows (*Hirundo rustica*) and Tree Swallows (*Tachycineta bicolor)*, two sympatric species of aerial insectivores found in Saskatchewan agricultural landscapes. Our main objective is to compare how landscape composition of natal areas affects nestlings' diet and condition through a scale-of-effect analysis. By using stable isotope analysis ($\delta^{2}H$) and monitoring the condition of nestlings we will test if: *i*) higher proportion of row crops and reduction in wetland density affect nestling condition and growth; *ii*) the contribution of aquatic prey in the nestling's diet varies between species and across the land use gradient, and *iii*) greater reliance on aquatic resources contributes to better nestling quality, chick growth and post-fledging survival in both species. With this study, we hope to establish which agricultural landscape features in prairie agroecosystems have the greatest impact on early life stages of aerial insectivores.

**MD NOIM IMTIAZY & JEFF HUDSON. Investigating dissolved organic matter (DOM) properties of a large reservoir in Canadian prairies: Influence of hydrological flow conditions on the variation in DOM concentrations and quality.** Department of Biology, University of Saskatchewan, Saskatoon SK.

Numerous reservoirs have been built worldwide to utilize the freshwater resources due to climate changes. Dissolved organic matter (DOM) is a major water quality parameter affecting numerous aquatic processes. DOM is of particular concern in reservoirs that are used for drinking water because it can affect drinking water quality. However, understanding on DOM dynamics is limited in Lake Diefenbaker (LD), a large multi-purpose reservoir in Canadian prairies. Flow condition in LD is affected by varying inflow rates from the South Saskatchewan River (SSR). Therefore, we analyzed the spatial and temporal variation in DOM properties in LD and their relationship with inflow rates with an 8-year (2011-2018) dataset. While dissolved organic carbon (DOC) concentrations did not exhibit significant variation (linear mixed-effect modeling, $p>0.08$), dissolved organic nitrogen (DON) concentrations varied temporally with a negative association with inflow rates ($p<0.001$). Inflows also had apparent effects on DOM quality. Increases in inflow rate resulted in increases in allochthonous DOM from SSR characterized with aromatic, high molecular weight, less bioavailable DOM (indicated by absorbance indices, $p<0.01$). Hence, inflows from the SSR had much stronger effects on DOM quality than quantity, and these patterns may have important implications for the reservoir management in future climate changes.

**Tuesday April 13**

**Session 3a–** Session 3a Link

| | **Speaker** |
|---|---|
| 1:30 | Himal Thapa |
| | Sinan Zhang |
| | Mohammad Amini |

**HIMAL THAPA[1], ADAM CRANE[1], MICHAEL S. POLLOCK[2] & MAUD C.O. FERRARI[2]. Can tadpoles generalize learned response between different ontogenic stages of predators?** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK, Canada. [2]Department of Biomedical Sciences, WCVM, University of Saskatchewan, Saskatoon, SK, Canada.

Living with a diverse array of predators makes it difficult for prey to learn and retain information about each predator they encounter. Interestingly, some prey use generalization of predator recognition to respond to a novel predator based on previous experience with a closely related or visually similar predator. However, it is still unknown whether prey can generalize learned response to a different ontogenic stages of a predator, which might pose a differential risk. We conducted two experiments to see the extent of generalization of wood frog tadpoles (*Lithobates sylvaticus*) between different life stages of two different predators: (1) diving beetle (*Dytiscus* sp.) and (2) tiger salamander (*Ambystoma tigrinum*). We conditioned tadpoles with alarm cue (chemicals eliciting an innate fear response) and larval or adult predator odour to recognize the odour as risky. Later, we tested them with larval or adult predator odour to see if they can generalize the learned response between two different stages of the predator. The results show that the tadpoles were able to generalize between larval and adult beetle odour. However, they failed to generalize between larval and adult salamander odour. These results suggest that a predator's ontogenic switch might affect generalization by prey.

**SINAN ZHANG & JOHN R. GRAY. Population Coding of Locust Motion-Sensitive Neurons Encodes Changes in Object Trajectory and Velocity.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Locusts can perform complicated flying maneuvers, which relies on rapid detection of moving objects present in the surroundings to generate appropriate behavioural responses. An identified neural pathway, comprised of the LGMD (lobula giant motion detector) and the DCMD (descending contralateral motion detector), responds preferentially to approaching objects. LGMD receives retinotopic inputs from ipsilateral ommatidia and generates spikes at a 1:1 ratio in the DCMD, which synapses with multiple locomotion-related neurons. As an angular threshold detctor, the DCMD has been implicated as critical for initiating evasive behaviours, although its specific role remains to be fully described. Importantly, numerous other motion-sensitive neurons have also been identified in locusts. These neurons have distinct firing properties and response preferences. Information from these neurons likely contributes to production of avoidance behaviour. However, few studies have investigated the contribution of these neurons on a neural population level. To better understand how visual information is perceived by locusts, we constructed a multichannel recording system within an existing flight simulator and presented various complex visual stimuli to rigidly tethered locusts. Preliminary analyses have identified functional units that responded to visual stimuli. Common trends, which reflect the activity of neural ensembles, were extracted from these functional units.

**MOHAMMAD AMINI & JAMES D. BENSON. Liver Cell and Tissue Cryopreservation by Ultra-Rapid Cooling under High Hydrostatic Pressure.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Cryopreservation can be defined as preserving cells and tissues in low temperatures and expecting them to be alive upon warming. In order to achieve sustainability in liver cell transplantation, the development of a liver cell and tissue bank is critical. Cryopreservation is a practical method to facilitate access to liver cells and tissues in clinical centers. Conventional methods for cryopreservation often result in significantly reduced cell and tissue viability. Chemical and biological materials, called cryoprotectant agents (CPAs), have been crucial in decreasing damage due to ice formation. However, a high concentration of CPAs is toxic to cells and tissues. To reduce the concentration of CPA and avoid ice crystallization, one approach is the use of ultrarapid cryopreservation. To achieve this aim, the method of solid surface cooling, in which a sample contacts a cooled surface with high thermal conductivity, is being used in this research. Another approach to reduce the required CPA concentration is to apply pressure. By applying the high hydrostatic pressure, it would be possible to reach low temperatures with minimal ice formation. Here I present the design, building, testing, and initial data for a new device that can apply the high cooling rate and high pressure simultaneously.

**Session 3b**– Session 3b Link

| | **Speaker** |
|---|---|
| 1:30 | Ahmad Ghobeishavi |
| | Aaron Bell |
| | Mahesh Rachamalla |

**AHMAD GHOBEISHAVI; MAUD C.O. FERRARI; DOUGLAS .P. CHIVERS.**

**Effects of sound exposure on learning and neurotransmitters levels in Zebrafish (*Danio rerio*).**

Department of Biology, University of Saskatchewan, Saskatoon, SK.

As a result of human population growth and industrial bloom over the past few centuries, the planet has been increasingly exposed to human-made (anthropogenic) stressors. One of these stressors is anthropogenic noise, and according to the World Health Organization, environmental noise exposure represents an increasing polluting agent of global concern. Anthropogenic noise can affect different aspects of fish biology like physiology, behaviour, and learning. To evaluate the effects of noise on fish learning, we will expose adult zebrafish to two white noise treatments with different intensities. Each sound treatment will be played back in two patterns; regular and irregular, for 15 minutes. To evaluate the effect of noise on memory, two tests; associative learning and novel object recognition; will be performed to assess the long term and short term memory respectively. Furthermore, to elucidate the possible molecular mechanisms underlying the neuro-behavioural effects of different noise treatments, two primary neurotransmitters that are involved in learning, GABA and Glutamate, will be measured in the brain. This study will help to have a better perspective of how anthropogenic noise can affect learning process in fish and what are the effects on a molecular scale in the brain.

**AARON J. BELL[1,2], DAVID A. WARDLE[3], & IAIN D. PHILLIPS[1,2,4]. Is the conservation of pyrophilic insects, or lack thereof, a cause for concern?** [1]Department of Biology, University of Saskatchewan, #112 Science Place, Saskatoon, Saskatchewan, Canada, S7N 5E2; [2]Troutreach Saskatchewan, Saskatchewan Wildlife Federation, #9 Lancaster Road, Moose Jaw, Saskatchewan, Canada, S7J 1M8; [3]Asian School of the Environment, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore; [4]Water Quality Services, Integrated Water Services, Water Security Agency of Saskatchewan, #101-108 Research Drive, Saskatoon, Saskatchewan, Canada, S7N 3R3.

Many insects are drawn to the heat, ash, and smoke produced by forest fires and arrive in large numbers at recent burns, often when the fire is still active. Although this adaptation to exploit recently burned areas is well-studied in some insect groups (e.g., metallic wood-boring beetles from the genus *Melanophila*), much of our knowledge of pyrophilic species is limited to studies and observations of individual species, or important information on their natural history is simply unknown. Ongoing changes in fire behaviour due to human-influenced climate change, large-scale fire suppression activities, and industrial forestry are fundamentally altering the way fire interacts with terrestrial biomes. If, and to what extent, these changes impact pyrophilic insects is currently unknown. In this presentation, I discuss the ecology, natural history, and behaviour of pyrophilic insects and present several hypotheses that seek to explain why and how this peculiar adaptation has evolved. I also attempt to identify whether species are obligate (i.e., fire-dependent) or facultative (i.e., disturbance-adapted) pyrophiles and why this distinction is important for the long-term conservation of fire-dependent species.

**MAHESH RACHAMALLA & SOM NIYOGI. Reproductive, behavioural and developmental effects of chronic dietary arsenic exposure in adult zebrafish (*Danio rerio*).** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Arsenic (As) is a priority aquatic pollutant because of its ubiquitous nature and high toxicity to marine organisms, including fish. Literature suggests that dietborne As has severe chronic toxicity than waterborne, and its underlying mechanisms are unexplored. Objective of present study to investigate the reproductive and developmental effects of chronic dietary exposure to As in adult zebrafish (*Danio rerio*). For this study, adult fish were exposed to environmentally relevant concentrations of dietary As (control, 30, 60 and 100 µg/g dry weight) for 60 days. Following exposure, over two weeks period several reproductive endpoints (fecundity, egg size, hatching success, spawning frequency) were assessed. Morphological deformities and survival rates were assessed in produced larva. Group of As-exposed fish examined for cognitive performance using a latent learning paradigm in a complex maze. Subsequently, As accumulation will be measured in whole fish and eggs produced for maternal transfer along with mRNA expression of several marker genes for antioxidant, neurological, and reproductive functions will be assessed in several organs like liver, brain and gonads. Preliminary data indicates fish exposed to 60 and 100 µg/g dry weight were shown to have impaired cognitive learning, reproductive performance and developmental deformities in offspring when compared to control group.

**Session 4–** Session 4 Link

| | **Speaker** |
|---|---|
| 2:45 | Iqra Azam |
| | Muhammad Sarwar |
| | Atefeh Najafi |

**IQRA AZAM & JAMES D. BENSON. Silymarin Mediated Osmotic Responses and Damage in Cultured Hepatocytes.** Department of Biology, University of Saskatchewan, Saskatoon, SK

Osmotic tolerance limits are considered a critical determinant of cell survival after cryopreservation. Here we tested the hypotheses that hepatocytes behave as ideal osmometers, and that osmotic damage during cryopreservation can be reduced by silymarin, a flavanoid derived from *Silybum marianum*. In our first experiment, cell volume and osmotic permeability parameters were measured for adherent HepG2 cells resulting in a linear Boyle-van 't Hoff plot. In the next experiment, hepatocytes were exposed to a series of anisotonic solutions and the effect of this treatment was measured by assessing trypan blue exclusion and metabolic activity. Adherent HepG2 cells preincubated with silymarin, when exposed to extreme hypotonic conditions (DI water) for 10 min, showed a 77% increase in viability with silymarin ($10^{-5}$ M) and 27% increase with silymarin ($10^{-4}$ M) as compared to untreated control. Similarly in hypertonic conditions (2000 mOsm), a 20% and 50% increase in metabolic activity was observed with silymarin $10^{-5}$ M and $10^{-4}$ M respectively. Additionally, in suspended cells resistance to osmotic damage and significant increase (11%) in membrane integrity was observed. Our study concludes that the addition of silymarin leads to elevated osmotic resistance and a potential increase in the cryosurvival of HepG2 cells.

**MUHAMMAD K. SARWAR & JAMES D. BENSON. Cryoprotocol, lipidome and membrane protein interactions in bovine sperm.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Cryopreservation of bull sperm is of keen interest for researchers due to its role in the strategic management of valuable genetic lines as well as the maximization of production and profit. However, post thaw recovery is only around 60% and thus there is considerable incentive to improve cryopreservation protocols. This project is founded on the hypothesis that bull sperm lipidome and proteome are important indicators for rational media design leading to optimized cryopreservation. To test this hypothesis, we will combine stopped flow cell volume kinetics studies with mass spectroscopy informed lipidomics and fluorescence based aquaporin densities that correspond to either bulls who typically have high post thaw motility— "good freezers"—or bulls with low post thaw motility —"bad freezers". We will then use a Langmuir balance and Brewster angle microscopy to study interactions of membrane lipids with different cryoprotectants in relation to membrane phase transitions and membrane transport kinetics. In combination this study will move beyond existing data on the correlation of lipid and protein densities and post thaw motility, and give clues to mechanisms that key lipids and the abundance of transport proteins provide to increase post-thaw recovery, leading to rational media design for bull sperm cryopreservation.

**ATEFEH NAJAFI &JAMESD. BENSON. A mathematical framework for developing freezing protocols for the cryopreservation of ovarian tissue.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

In 2020 an estimated 110, 000 Canadian women were expected to be diagnosed with cancer. While recent success in cancer screening, diagnosis, and treatment has lengthened lives for patients with cancer, these lifesaving measures are associated with iatrogenic ovarian failure and female infertility. To address this need, the only option currently available for such patients is to cryopreserve ovarian tissue. Researchers have successfully cryopreserved ovarian tissue; however, the incomplete understanding of the molecular mechanisms underlying the cell injury makes the development of optimal cryoprotocols extremely challenging. One approach to address this shortcoming in cryopreservation success is the use of mathematical modeling, where damage models can be combined with chemical and physical models to predict possible tissue responses to cryopreservation protocols. Therefore, to provide a critical ovarian tissue cryopreservation optimization framework, the objectives of this study are to model cryoprotectant diffusion into ovarian tissue and associated osmotically and chemically cryoprotectant induced damage, to determine and mathematically model the effect of cryoprotectant exposure and vitrification on ovarian tissue viability, oxidative status, DNA damage and epigenetic profile alteration; and identify the relationship between epigenetic alteration and cryo-induced oxidative stress and DNA damage. The outcome of this research will be a rationally optimized vitrification approach producing an experimentally validated facile ovarian tissue cryopreservation protocol.

**Poster Session – April 12**

| | **Speaker** |
|---|---|
| 4:00 | Adrian Diaz-Sanchez |
| | Alex Preagola |
| | Michelle Sawatzky |
| 4:20 | Devon Ireland |
| | Edgar Mangwende |
| | Anastasia Nykoneko |
| 4:40 | Lia Le Brun Robles Gil |
| | Jory Litt-Jukes |
| | Michelle Vanderwel |

**ADRIAN A. DÍAZ-SÁNCHEZ & NEIL B. CHILTON. Genetic variation and divergence among populations of the American dog tick,** *Dermacentor variabilis* **– A test of the 'central-peripheral' hypothesis.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Hard ticks (Ixodidae) are obligate blood-feeding ectoparasites of mammals, birds, and reptiles, which are globally important vectors of pathogens that impact both human and animal health. They harbor and transmit a wider variety of pathogens than any other blood-sucking arthropod, including bacteria, protozoa, and viruses. Some tick species have been expanding their geographic ranges in recent decades largely due to global climate change. The 'centre–periphery' hypothesis is a major biogeographical paradigm that aims to provide a general explanation as to cause limits species distributions. The aim of the present study is to determine the genetic structure, diversity, and divergence of populations of *Dermacentor variabilis* throughout its geographical range in Canada, eastern United States and Mexico. The validity of the 'centre–periphery' hypothesis with respect to parasitic arthropods will be tested using *Dermacentor variabilis* as the model. The information obtained from this study, will provide important insights into the predominant forces shaping the genetic composition and adaptive potential of peripheral populations of *Dermacentor variabilis* to expand northwards into the Boreal Transition ecoregion. The findings of this study will have important implications for the development of effective strategies to control parasitic arthropods and the pathogens they transmit.

**ALEXYZ A. PREAGOLA[1] & MAUD C.O. FERRARI[2]. What's going on: The role of ecological uncertainty in the expression and maintenance of neophobia in larval wood frogs (*Lithobates sylvatica*).** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]Biomedical Sciences, WCVM, University of Saskatchewan, Saskatoon, SK.

Prey experiencing high uncertainty and high levels of risk tend to exhibit neophobia, or the fear of novel stimuli. This phenotype is hypothesized to provide survival benefits to naïve prey exposed to unknown threats. Thus, understanding the role of ecological uncertainty in prey decision-making is of key interest. Such a nebulous concept can be examined through the lens of its parts, for example, temporal predictability of risk and reliability of risk assessment cues. Using wood frog (*Lithobates sylvaticus*) tadpoles, we propose two experiments to study how ecological uncertainty affects the onset and loss of neophobic phenotypes. For the first experiment, we will test whether tadpoles exposed to conspecific injured cues and 'safe' novel odour for the same total number of exposures elicit stronger neophobia towards novel predator cues when they are encountered in an unpredictable versus predictable manner. For the second experiment, we will use risk cues from different species to test the hypothesis that the onset, intensity, and duration of neophobia is reduced when it is triggered by unreliable cues. Given that conspecific injured cues convey the most reliable (i.e. least uncertain) information about risk, we predict that tadpoles will exhibit stronger neophobia when they experience less reliable risk cues owing to its quality and source.

**MICHELLE L. SAWATZKY & PHILIP D. MCLOUGHLIN. Effects of fire-grazing interaction on habitat heterogeneity and biodiversity in northern mixed-grass prairie.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Northern mixed-grass prairie in Canada has been largely altered and fragmented since European settlement. Remaining native mixed-grass has suffered the removal of two essential ecosystem processes; wildfire and grazing. These remnants are managed to support rare plant and wildlife communities, including several species at risk. To support high species diversity conservation lands must be managed to provide a variety of habitat types. The fire-grazing interaction has been studied extensively in tallgrass prairie as a tool for increasing habitat heterogeneity. However, little is known about these combined disturbances and their effect on habitat heterogeneity or biodiversity in mixed-grass prairie. The objective of this project is to determine the strength of the fire-grazing interaction by assessing bison site selection following fire and to quantify the response of vegetation structure and biodiversity to these disturbances in the northern mixed-grass prairie of Southern Saskatchewan. I will apply a resource selection function to GPS bison data and explanatory variables including fire history to test the hypothesis that bison preferentially graze recently burned areas. Additionally, I will test the hypothesis that focal grazing of burns will increase landscape scale heterogeneity in vegetation structure and composition as well as vertebrate and invertebrate biodiversity.

**DEVON IRELAND & CHRIS AMBROSE. Live Imaging of Actin Filament Organization and Dynamics During Spongy Mesophyll Cell Development in *Arabidopsis*.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

The mesophyll is the photosynthetic tissue of leaves and produces organic molecules that are foundational to terrestrial food chains, making it ecologically and agriculturally important. Despite its importance, until recently our understanding of mesophyll cell morphogenesis was limited to a small number of studies that used fixed tissues and static timepoints. These studies suggest that microtubules and actin filaments play a role in shaping spongy mesophyll cells as they transform from small isodiametric shapes into large cells with vast networks of branching protrusions. Recent studies have used live cell imaging at high temporal and spatial resolutions to confirm that microtubules play a role in mesophyll morphogenesis. However, actin's role remains a mystery. To rectify this, we have constructed a mesophyll-specific actin marker, which we will use to characterize patterns of actin at all stages of mesophyll development. Following characterization, we will use our marker with actin-related mutants and drug treatments to determine actin's function at each developmental stage. If actin is involved in the secretion of enzymes that modify cell wall properties, we expect actin-enriched sites will predict formation of intercellular spaces. Finally, we will investigate how and when microtubules and actin crosstalk to cooperatively shape developing mesophyll cells.

**EDGAR MANGWENDE & YANGDOU WEI. Dynamics of the GPI-anchored pathway during penetration resistance in Arabidopsis against fungal invasion.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Powdery mildew is a devastating foliar disease of many crop and plant species caused by Ascomycete fungal pathogens. In recent years, there has been interest in practical applications of nonhost resistance as a long lasting and effective means of crop protection. The key to the success of this approach relies on a thorough understanding of defense mechanisms. The non-compatible interaction between *Arabidopsis thaliana* (L.) Heynh. and non-adapted barley powdery mildew pathogen, *Blumeria graminis* f. sp. *hordei* Ém. Marchal (Bgh), will be adopted in our studies to understand some of the mechanisms of penetration resistance. Several compounds including callose, lignin-like autofluorescence materials, ROS and proteins have been shown to be deposited below the attempted penetration site. The cellular trafficking pathways associated with accumulation of these protein molecules at the penetration site are not clear, and further studies are needed for better understanding of their role in penetration resistance. It has been recently shown that the membrane domain is enriched in glycosylphosphatidylinositol anchored proteins (GPI-AP), and we hypothesise that these regions are actively involved in the accumulation of protein and lipid molecules below the sites of attempted fungal penetration and play key roles in plant penetration resistance.

**ANASTASIIA NYKONENKO & DR. PHILIP MCLOUGHLIN. Causes and consequences of social cohesion in Sable Island horses: from the individual to the population level.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Sociality traits, while often associated with individual fitness, are rarely examined for their scaled-up influences on population-level dynamics. Social bonds play an important role in equids (*Equus* spp.), and long-term social affiliations between animals have been shown to enhance individual reproduction and survival. Using data collected from the long-term, individual-based study of Sable Island feral horses, I will investigate how social relationships explain variation in life histories of individuals and population-level dynamics. At the individual level (focal mares within the bands), I will explain variation in the formation and maintenance of social bonds among females quantifying the strength of these bonds among dyads by rates of affiliative and agonistic interactions between individuals and time spent in proximity. Predictor variables will include age, kinship score, status in the dominance hierarchy, and boldness as a personality trait (flight initiation distance). At a larger scale (bands in the population), I will use multivariate statistics to derive composite variable(s) of band cohesion (related to social bond scores among band members) to then explain variation in band-level parameters (band size and productivity, year-over-year breakup rate) and population-level parameters (local population growth rate) relative to limiting factors such as population density, habitat quality, adult sex ratio.

**LIA LE BRUN ROBLES GIL & JEFFREY E. LANE. Effects of personality variation on the reproductive behaviours of male North American red squirrels (*Tamiasciurus hudsonicus*).** Department of Biology, University of Saskatchewan, Saskatoon, SK.

In scramble competition mating systems, competitive mate searching acts as the primary source of intrasexual selection as opposed to combat. For male North American red squirrels (*Tamiasciurus hudsonicus*), who defend food-based territories, this requires travelling beyond their territories to locate females. Upon locating a female in estrous, males will chase her in what is called a mating chase. Males who are willing to travel further to participate in these mating chases generally have greater reproductive success. Previous research has established that red squirrels have distinct exploration-related personalities, and that personality can influence home range size. However, whether personality directly impacts male reproductive strategies and mating chases remains unclear. Therefore, I propose to (1) assess which traits determine the distance males will travel to participate in mating chases and (2) examine whether personality plays a role in determining what mating chases males will attend and which offspring will be sired. To do this, I will use radiotelemetry, behavioural observations, personality tests, and paternity analyses to collect male reproductive behaviour data and mating chase attendance. As such, the proposed project will establish not only whether mating chase attendance and mate choice are interconnected, but also whether they are influenced by personality.

**JORY E. LITT-JUKES. Migration in the spotlight: A comparative investigation of behavioural and physiological consequences of artificial light a night in nocturnal migratory and non-migratory songbirds.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Artificial light at night (ALAN) is a global pollutant. Affected taxa are growing daily in numbers and in diversity of effects. One particularly vulnerable group are nocturnal migratory birds. ALAN can impair migratory flight, stopover selection, and stopover behaviour. Notable changes in migratory restlessness (indicator of migratory departure and flight) could represent immediate and long-term fitness consequences through alterations in flight and stopover timing. Here, I will conduct a series of captive experiments to identify the physiological mechanism responsible for behavioural changes induced by ALAN in a nocturnal migrant songbird (white-crowned sparrow, *Zonotrichia leucophrys*) compared to a resident species (house sparrow, *Passer domesticus*), during both migratory and stationary periods. I will assess both corticosterone and melatonin, both known regulators of diurnal activity patterns. I predict that migrants exposed to ALAN will have elevated corticosterone and decreased melatonin from normal, which may correspond to increased nocturnal restless activity. I predict reduced effects in the resident. I will monitor body condition and energy expenditure of songbirds to characterize any fitness consequences incurred from ALAN exposure. This project will shed new light on why migrants are impacted by ALAN during migration and provide insight into the mechanisms that may disproportionately affect migratory species.

**K. MICHELLE VANDERWEL[1], DOUGLAS P. CHIVERS[1] & MAUD C.O. FERRARI[2]. The Spread of an Invasive Species: Effects of Behavioural Syndromes and Abiotic Conditions.** [1] Department of Biology, University of Saskatchewan, Saskatoon, SK; [2] Department of Biomedical Sciences, WCVM, University of Saskatchewan, SK.

Invasive species are a main driver of global biodiversity declines. Until recently, most models developed to predict the success of an invasion have been based on physiological, morphological, or behavioural characteristics of the species. However, such models have not been sufficient to predict whether an invasion succeeds.

Invasion success may depend on behavioural decision-making of individuals within the introduced population, based on their interactions with the environment and with each other. Several authors have suggested that we need to consider the behaviour of individuals in the context of invasions.

We will investigate inter-individual differences in behavioural traits, in relation to environmental factors, in a species known to have become invasive in several regions of the world, the fathead minnow, *Pimephales promelas*. Specifically, we hypothesize that individuals will differ in their boldness and sociability under different conditions of temperature, water clarity and dissolved oxygen levels.

These results will be used in further studies to examine the relationships between environmental conditions, behavioural traits, and tendency to disperse. Results will be used to parameterise a model to predict the spread of a potential invasion event based on the environment and the mix of behavioural types present in the introduced population.

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