BIOLOGY GRADUATE STUDENT SYMPOSIUM 2022

DEPARTMENT OF BIOLOGY

UNIVERSITY OF SASKATCHEWAN

PROGRAM AND BOOK OF ABSTRACTS

UNIVERSITY OF SASKATCHEWAN

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

This is the third graduate student symposium occurring during the pandemic. In welcoming you back again, both in person and remotely, I want to thank all 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.

This year we are having both in-person and remote oral and poster presentations. Students were asked their preference of how to present and we will be offering both in-person and remote oral and poster presentations. Monday's in-person talks will also be shared as a livestream via Zoom. In another first, our in-person posters will be shown on the electronic display screens around CSRB on Monday afternoon to allow students to present a digital version of a traditional poster. Tuesday afternoon will showcase remote talks and posters/

We will wrap up with a short awards session on Tuesday at 4:15 p.m. Once again, we will not be meeting afterwards for a BBQ, preferring instead to do that when we are all ready to gather safely together. Until then, please continue to take care of yourselves and look out for each other. Enjoy the symposium.

Chris Todd

SYMPOSIUM SCHEDULE

Day 1 – Monday April 11th, 2022

	ORAL PRESENTATIONS – THORVALDSEN 159 (CLICK FOR ZOOM LINK)		
	9:55 a.m.	***Welcome***	**Page # of Abstract**
1.	**10:00 a.m.**	Litt-Jukes, Jory	5
2.	**10:15 a.m.**	Sawatzky, Michelle	5
3.	**10:30 a.m.**	Diaz Sanchez, Adrian	6
4.	**10:45 a.m.**	Schindler, Alec	6
	11:00-11:15 a.m.	***Break***	
5.	**11:15 a.m.**	Olver, Dominic	7
6.	**11:30 a.m.**	Mangwende, Edgar	7
7.	**11:45 a.m.**	Nykonenko, Anastasiia	8

	POSTER PRESENTATIONS – CSRB DISPLAY SCREENS			
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8.	**1:45-2:15 p.m.**	Abrams, Joseph	F1 LOBBY R	8
9.		McEvoy, Delanie	F1 LOBBY L	9
10.		Hartl, Raylene	F2 LOBBY R	9
11.		Kardynal, Kevin	F2 LOBBY L	10
12.		Ulrich, Jacob	F3 BY ELEVATOR	10
13.		Walters, Clay	CSRB 315	10
14.	**2:25-2:55 p.m.**	Butler-Siemens, Scout	F1 LOBBY R	11
15.		Griebel, Ilsa	F1 LOBBY L	11
16.		Racioppa, Marie	F2 LOBBY R	12
17.		Caruso, Kayla	F2 LOBBY L	12
18.		Putnala, Sravan	F3 BY ELEVATOR	13
19.	**3:05-3:35 p.m.**	Howell, Christina	F1 LOBBY R	13
20.		Wotton, Carter	F1 LOBBY L	14
21.		Carlson, Lindsay	F2 LOBBY R	14
22.		Fattahi, Neda	F2 LOBBY L	15
23.		Bent, Lynsey	F3 BY ELEVATOR	15

BIOL 990 SCHEDULE CONT.

Day 2 – Tuesday April 12th, 2022

	REMOTE ORAL PRESENTATIONS (VIA ZOOM)		
			Page # of Abstract
24.	**1:45 p.m.**	Najafi, Atefeh	16
25.	**2:00 p.m.**	Vanderwel, Michelle	16
26.	**2:15 p.m.**	Rachmalla, Mahesh	17
27.	**2:30 p.m.**	Le Brun Robles Gil, Lia	17

	REMOTE POSTERS (VIA ZOOM BREAKOUT ROOMS)		
			Page # of Abstract
28.	**3:00-3:45 p.m.**	De Silva, Wathmini	18
29.		Ren, Shuqi	18
30.		Ho, Tom	19
31.		Sabeti, Amir	19
	4:15 p.m.	***Wrap up and awards via Zoom***	

ABSTRACTS FOR APRIL 11 PRESENTATIONS

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

Light is essential in regulating the behavioural and physiological processes required for successful avian migration. Light pollution, however, has been shown to affect reproduction but little is known about the impact on migration phase of the annual cycle. Light pollution may impact nocturnal migrants by altering migratory pathways and changing activity behaviour and energetics of foraging and flight. I conducted a series of captive experiments in spring, summer and fall 2021 on migratory (*Zonotrichia leucophrys* and *Z. albicolis*) and non-migratory sparrows (*Passer domesticus)* to determine if exposure to artificial light at night (0.15, 0.5, 1.5, 10 lux) alters the propensity for these individuals to migrate relative to dark. With light at night exposure, migrants demonstrated increased activity at night through all seasons – increasing light levels causing increased activity compared to dark – though non-migrants did not. Migratory specific behaviours showed a biphasic response to light at night; low light increased expression of migratory-specific behaviours, while more light decreased expression. Overall, total 24-hr activity and food consumption did not vary, indicating an energetic limit that may affect the bird's ability to cope with light pollution. Altering the behaviour of these populations may have unknown consequences on migration success and survival.

2. **MICHELLE L. SAWATZKY & PHILIP MCLOUGHLIN. Density dependence in habitat selection of plains bison at Grasslands National Park.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

In recent decades interest in reintroduction and expansion of plains bison (*Bison bison bison*) herds has increased due to their role as a keystone species and ecosystem engineer. However, the consequences of changes in population density on space use and habitat selection of plains bison remain unknown. Density-dependent habitat selection theory predicts that selection for higher quality habitat will decrease while selection for lower quality habitat will increase as population density increases. Using GPS collar data collected by Grasslands National Park (GNP) over 15 years I aim to test whether habitat selection in plains bison is density-dependent. I will examine resource selection of the bison herd during an 8-year period during which the population increased by 476% by modelling resource selection functions including population density as well as biotic and abiotic variables known to influence bison resource selection. I will also directly compare resource selection of the herd in alternating years of high and low population density over a 9-year period when 30–40% of the population was removed biennially using latent selection difference functions including the same explanatory variables. This research will inform management of the bison herd at GNP as well as other conservation herds.

3. **ADRIAN A. DÍAZ-SÁNCHEZ & NEIL B. CHILTON. Does the centre-periphery hypothesis explain the distributional range limits of parasites?** Department of Biology, University of Saskatchewan, Saskatoon, SK.

The 'centre–periphery' hypothesis (CPH) is a major biogeographical paradigm that aims to provide a general explanation as to what limits species distributions. However, no study has determined if the CPH is applicable to ixodid ticks, particularly the American dog tick (*Dermacentor variabilis*) is expanding its distributional range in western Canada. Our ultimate goal is to determine the genetic structure, diversity, and divergence of *D. variabilis* populations throughout its range in North America and Mexico, and test the validity of the CPH. In this study, we compare the genetic variation in two mitochondrial genes, 16S rRNA and the cytochrome *c* oxidase subunit 1 (*cox*1), for 632 *D. variabilis* adults collected from 26 localities in Manitoba, to assess their suitability as markers for our large-scale population genetic studies. We detected only five 16S haplotypes among 189 ticks collected from seven localities. Most (>95%) of these ticks belonged to haplotype 1; hence, this gene provides limited population genetic information. In contrast, 57 *cox*1 haplotypes were detected among 632 adult *D. variabilis*, and the two most common haplotypes only occurred at frequencies of 23-37%. Differences in genetic diversity among ticks from different localities suggest that *cox*1, in combination with other targets (e.g., microsatellite loci), have significant potential to test if the CPH provides an explanation as to what limits the distributional range of *D. variabilis*.

4. A full annual cycle approach to quantifying environmental drivers of migratory bird abundance
Alec Schindler

Environmental conditions experienced throughout the year, including during breeding, migration, and wintering phases, play critical roles in driving changes in migratory bird populations. Our understanding of these mechanisms of population change are further complicated when birds aggregate into multiple distinct subpopulations. We evaluated drivers of subpopulation dynamics in a migratory bird of conservation concern, the Greenland white-fronted goose (*Anser albifrons flavirostis*). We identified common trends in abundance among all Greenland white-fronted goose flocks (i.e., subpopulations) and quantified how extreme climatic events and land cover changes experienced throughout the year affected abundance. We found three common population trends among flocks that followed a spatial gradient across the wintering range, with southwestern flocks in steepest decline, central flocks in less steep decline, and northeastern flocks relatively stable. Landcover changes in the wintering range were most important in explaining variation in abundance. Our findings suggest a potential range shift is occurring as birds increasingly winter in the northeastern part of the wintering range. Future efforts to increase wintering food availability and quality may help maintain the current extent of the wintering range. We anticipate our analysis will be widely applicable and help improve conservation planning for a variety of taxa.

5. DOMINIC J OLVER, IQRA AZAM, JAMES D BENSON. Meta-analysis and experimental re-evaluation of the Boyle van 't Hoff relation with osmoregulation modelled by linear elastic principles and ion-osmolyte leakage. Department of Biology, University of Saskatchewan, Saskatoon, SK.

In this study we challenge the paradigm of using the Boyle van 't Hoff (BvH) relation to relate cell size as a linear function of inverse extracellular osmotic pressure for short time periods (~5 to 30 mins). We present alternative models that account for mechanical resistance (turgor model) and ion-osmolyte leakage (leak model), which is not accounted for by the BvH relation. To test the BvH relation and the alternative models, we conducted a meta-analysis of published BvH datasets, as well as new experiments using a HepG2 cell line. Our meta-analysis showed that the BvH relation may be assumed of the hypertonic region but cannot be assumed *a priori* over the hyper- and hypotonic region. Both alternative models perform better than the BvH relation but are nearly indistinguishable when plotted. The return to isotonic conditions plot indicated neither alternative model accurate predicts return volumes for HepG2 cells. However, a combined turgor-leak model accurately predicts both the BvH plot and the return to isotonic conditions plot. Moreover, this turgor-leak model provides a facile method to estimate the membrane-cortex Young's modulus and the cell membrane permeability to intracellular ions/osmolytes during periods of osmotic challenge.

6. MANGWENDE EDGAR & WEI YANGDOU. Recruitment of glycosylphosphatidylinositol-anchored proteins at the papilla for penetration resistance against non-adapted powdery mildew fungus. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Callose together with pectin, phenolics and reactive oxygen species (ROS) have been shown as common material deposited at the papilla. However, recent biophysiological studies also suggest involvement of lipid rafts to fortify the cell wall as a physical barrier against pathogen ingress. Lipid rafts are nanodomains, enriched with sterols and sphingolipids, that significantly accumulate several classes of glycosylphosphatidylinositol (GPI)-anchored proteins (APs). The GPI anchor is a glycolipid structure with a conserved phosphatidylinositol (PI) core that attach proteins via a phosphoethanolamine bridge and expose them to the outer surface of the plasma membrane facing the apoplast. Given the importance of the outer boundary of the cell surface in plant defence, it is reasonable to believe that many membrane proteins anchored to the cell surface by a GPI anchor could play a role in penetration resistance against plant pathogens. We investigated the contribution of GPI-APs to the fortification of *Arabidopsis thaliana* cell walls challenged with a nonadapted powdery mildew pathogen (*Blumeria graminis* f. sp. *hordei* (*Bgh*)). Furthermore, mechanisms involved in targeting and recruitment of GPI-APs to the papilla upon pathogen attack were investigated.

7. **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.

Social relationships within animal societies are tightly associated with individual fitness and may be scaled up for their influence on population-level dynamics. While long-lasting social bonds between females in feral horses (*Equus feral caballus*) enhance their individual reproductive success and survival, female-female competition may take place during breeding, encouraging male mate choice. Using behavioural observations of Sable Island feral horses, I will first investigate patterns of social affiliations between adult females and their effect on individual fitness and reproductive success at the individual level (focal mares within bands). I will then assess factors contributing to the creation and maintenance of social bonds between females, including age, kinship, dominance rank, and boldness. Using average scores of social cohesion between mares for each band, I will then explain larger scale variation in band- and population-level parameters relative to limiting factors such as population density, habitat quality, and adult sex ratio. Finally, tracking the interactions between mares and a harem stallion, I aim to investigate patterns of same-sex competition for mates and mate choice at the individual level and in relation to differences in population density, adult sex ratio (including multimale bands), and habitat gradient at the population scale.

8. JOSEPH S. ABRAMS & JAMES D. BENSON. Translation of Non-Invasive Measurement of Biomechanics to Agent-Based Models. Department of Biology, University of Saskatchewan, Saskatoon, SK

The modelling of biological tissues continues to advance with increasing computational power and sophistication; however, difficulty in measuring the biomechanical properties of cells within tissue hampers the accuracy of these models. Biomechanical accuracy allows biologists to search for and develop new cryopreservation protocols that minimize tissue damage. In recent work, we show the importance of understanding tissue mechanics at a cell-to-cell level when using models to develop these optimal cryopreservation protocols. Bayesian force inference is an experimentally validated technique that has newly emerged to capture these parameters from microscopy images. Here we show how Bayesian force inference captures the tension and pressure of cells undergoing rapid mass transport. We show how this technique can inform an agent-based model that includes cell-level morphology. We demonstrate the accurate measurement of mammalian turgor, the measurement of viscoelastic force constants, and the successful simulation of experimentally observed tissue gap development which occurs during cryopreservation protocols.

9. **DELANIE MCEVOY & CHRIS AMBROSE. The Feedback Between Cell Shape and Microtubule Dynamics on Cell Division Over Time in *Arabidopsis*.** Department of Biology, University of Saskatchewan Saskatoon, SK.

The plant epidermis functions as a barrier and gatekeeper between internal tissues and the environment. In the epidermal layer of *Arabidopsis thaliana* leaves, pavement cells have interdigitated sidewalls to provide structural support, whereas guard cells surround a stomatal pore to control gas exchange with the environment. While these cell types differ in shape and function, they descend from common precursor cells that undergo highly regulated cell divisions, the orientation of which characterize the fate of resulting daughter cells.

My project investigates the relationship between the patterns of cell division and expansion. I found that the orientation and placement of a new cell wall following a previous division creates the initial cue driving the interdigitated pattern in pavement cells. Conversely, the wall's curvature, in turn, defines subsequent cell division planes. Both the division plane and cell wall curvature are regulated by bands of microtubules beneath the cell membrane. Using transgenic Arabidopsis lines with epidermis specific fluorescently tagged microtubules, I will observe how microtubule banding patterns can lead to cell divisions or the induction/alteration of wall curvature. All concerning cell division, expansion, and how these coordinate to determine whether a cell becomes a pavement cell or a guard cell.

10. RAYLENE M. HARTL Sublethal consequences at the intersection of climate change and eutrophication for cognitive ability in a freshwater snail (*Lymnaea stagnalis*).

Anthropogenic climate change is predicted to increase the frequency of hot weather events and warmer conditions for freshwater ecosystems. Higher water temperatures have already been demonstrated to affect the growth, reproduction, metabolism and long-term memory formation in freshwater snails. However, heat waves are not the only stressor freshwater snails contend with, as concurrent human stressors such as eutrophication may further affect the ability for freshwater snails to thrive in their habitats. Increasing use of agricultural fertilizer and consequent concentrations of nutrients in freshwater ecosystems can result in larger amounts of algal growth, reduce the amount of oxygen in freshwater, and be generally toxic to organisms. Very few studies have considered both heat and nutrient pollution in conjunction. I will be studying how these two events will act together to alter the memory formation and survival behaviours in the globally found pond snail *Lymnaea stagnalis.* I will expose snails to a 2x2 experimental treatment, the presence or absence of a heat wave and nutrients over a 10-day period. I will measure feeding, locomotion, predator response, and memory of the snails to determine if both factors combined change the ability of snails to survive.

11. **KEVIN J. KARDYNAL[1,2] & KEITH A. HOBSON[1,2]. Trade-offs in Living Near Water: Fatty Acid and Mercury Effects on Boreal Passerines.** [1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]Wildlife Research Division, Environment & Climate Change Canada, Prairie and Northern Wildlife Research Centre, Saskatoon, SK.

Habitat-mediated trophic interactions have nutritional and physiological implications for individuals through intra-habitat differences in food quantity and quality including fatty acid (FA) intake and mercury exposure. 'Essential' omega-3 FAs including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) generally benefit consumers with potential impacts on offspring growth, neurological development and success and opposite effects for methylmercury. Aquatic ecosystems including wetlands, lakes and streams are key drivers of spatial and temporal heterogeneity, productivity, and diversity at local and landscape scales in the boreal forest including for birds with likely variation by habitat type, allocthonous inputs, consumer resource use and species. In 2022-2023, we will conduct field-based sampling of insects and passerine bird blood during the temperate breeding season in the Boreal Plains of Saskatchewan to assess how concentrations or ratios of essential fatty acids and total mercury vary by habitat type and distance from water for a suite of insect groups and bird species. These data will also be used to develop "nutritional" and "mercury" landscapes by modeling collected data against detailed forest resource inventories. Understanding the trophic interactions and mechanisms that influence nutritional quality among habitats and the potential consequences to wildlife will help inform conservation actions in the boreal forest.

12. **JACOB C. ULRICH[1], DOUGLAS P. CHIVERS[1], MAUD C. O. FERRARI[2]. The effect of anthropogenic change on the predation efficiency of predaceous diving beetle larvae (*Dytiscus alaskensis*).** [1]Department of Biology, University of Saskatchewan, Saskatoon, Canada; [2]Department of Veterinary Biomedical Sciences, University of Saskatchewan, Saskatoon, Canada.

Predation efficiency is subject to improve via learning from repeated exposures to prey items in similar environments. With humans continuously encroaching on select habitats, the environment in which predators find themselves will change drastically and have a degree of novelty to the predation process. The ectothermic larvae of the predaceous diving beetle are voracious predators that have significant influences on seasonal amphibians and aquatic invertebrate populations. Given that they detect prey using chemical, vibrational, and visual cues, anthropogenic changes to the larvae's environment have the capacity to reduce predation efficiency via sense interference or drastically increase predation with increasing water temperatures. To assess these abiotic effects, I will expose larvae and prey items to control, low, and high ranges of these stimuli for 10-minute survival trials. During these trials, larvae and prey will be assess for speed and distance, number of encounters with each other, number of strikes at the prey, time of prey death, and the distance at which strikes are made. The predicted decreases in efficiencies, resulting from one or multiple measured variables being affected by different abiotic interferences, will further support necessary actions to limit anthropogenic encroachment on native wetlands and provide future frameworks for similar abiotic interference experiments in insects and other arthropods.

13. Clay Walters

No Abstract Given

14. SCOUT B. BUTLER-SIEMENS[1,2] & IAIN D. PHILLIPS[1,2,3] Riparian and aquatic biodiversity consequences of grazing beef cattle access to freshwater ecosystems. [1]Department of Biology, University of Saskatchewan, SK., Canada, [2]Troutreach Sask., Sask. Wildlife Federation, Moose Jaw, SK., Canada; [3]Water Security Agency of Saskatchewan, Canada.

In extensive grazing programs throughout Canada, it is common practice to allow cattle access to ponds as a water source and treat cattle with deworming drugs to manage internal parasite loads. Without rotational grazing systems, beef cattle spend more time grazing in and around riparian zones than on adjacent grasslands, often depositing manure in and around water bodies. Riparian areas are also vulnerable to degradation by cattle at high stocking densities with impacts ranging from increased soil erosion, alteration of vegetation communities, and loss of buffering capacity. Hydrophobic anthelmintic drug residues are excreted in cattle manure and have also been shown to exert non-target effects on invertebrate fauna that encounter dung as a part of their lifecycle. In this study, we explored the impacts of cattle on terrestrial and aquatic invertebrate assemblages associated with riparian areas. First, we determined how the alteration of soil and vegetation from cattle activity is impacting riparian ground beetle (Coleoptera: Carabidae) assemblages. Second, we determined which macroinvertebrates colonize manure in aquatic systems and how it alters rates of decomposition of manure deposited into water. Third, we assessed the implications of anthelmintic use in beef cattle on manure breakdown and colonization by macroinvertebrates in aquatic ecosystems.

15. ILSA A. GRIEBEL & MITCH D. WEEGMAN. Quantifying the influence of American black duck behavior and movements throughout the full annual cycle on subsequent productivity using state-of-the-art tracking devices. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Animal movement is closely linked to fitness and therefore robust study of these relationships requires location and behavioural data to quantify the value of landscapes to individuals. The American black duck (hereafter black duck; *Anas rubripes*) is valued by hunters and a flagship species for tidal marshes in eastern North America. Populations decreased by 50% between the 1950s and 1980s, then stabilized, but have not recovered to historic levels. Black ducks are an excellent candidate to explore how movement of individuals can be used to inform future wildlife management. Past research on black ducks focused on more accessible southern locations and thus, little is known of breeding ecology in the northeastern boreal region. I will use state-of-the-art tracking technology (Global Positioning System and tri-axial acceleration [GPS-ACC] devices) to remotely collect spatiotemporal data to make two major contributions in basic and applied ecology: (1) determine previously unknown reproductive metrics (e.g., full-term incubation and brood-rearing) in the boreal breeding area, and (2) quantify drivers of reproductive metrics during the breeding season and throughout the full annual cycle, including carry-over effects. My project will improve conservation of black ducks throughout the annual cycle by prioritizing landscapes that contribute most to productivity.

16. Profiling the Eastern Mallard

Mallards (*Anas platyrhynchos*) have become the most abundant and harvested waterfowl in the Atlantic Flyway but in the northeast US breeding mallards have steadily declined by 1% annually since the 90s. Population trends are determined with data from hunter harvest, banding programs, and breeding bird surveys. These are integral data pieces that feed into management strategies but fail to address the mechanisms behind varying population trends. High-resolution GPS and accelerometer (ACC) data have incredible power address biases in these datasets and link variables like environmental conditions, genetics, and morphology to individual decisions and behaviours. We aim to use GPS and ACC data to quantify demography, survival, reproduction, and habitat, comparing subpopulations in the northeastern US and Eastern Canada. Seasonal movements are also of interest to determine the efficacy of banding programs to represent mallard populations. The expansion of mallards across North America coincided with large (>50%) decline of black ducks (*Anas rubripes*). We are interested in overlaying mallard and black duck habitat selection models to assess competition between the species. Habitat selection models will also be incorporated into a spatial prioritization to identify priority habitat across the annual cycle.

17. **KAYLA CARUSO[1], CHRISTY MORRISSEY[1] & ANN E. MCKELLAR[2]. Evaluating changes in shorebird population trends in relation to climate and lake habitat characteristics**

[1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, Saskatoon, SK.

Many shorebird populations are in steep decline, threatened by climate change, disturbance and habitat alteration. Shorebirds migrate thousands of kilometers from their wintering grounds to breeding grounds and often rely on a restricted set of high-quality staging sites to rest and refuel. Birds migrating through the interior of North America rely on saline wetlands and lakes opportunistically as stopovers, but this region has historically received less focus than coastal stopover sites. This project aims to assess spatial and temporal changes in shorebird populations by revisiting lakes in Saskatchewan with historically high shorebird numbers. The specific objectives of this project are to 1) understand changes in shorebird populations by comparing current and historic counts; 2) evaluate changes in populations in relation to wet-dry cycles and surrounding land-use to understand effects on shorebird habitat suitability; 3) evaluate the effectiveness of drone technology to more efficiently survey shorebirds. 4) determine current shorebird abundances in Saskatchewan lakes to see if they meet thresholds for potential nomination under the Western Hemispheric Shorebird Reserve Network (WHSRN). With shorebird populations declining globally, this project will provide critical information about how climate and land use change alters lake habitats that are critical staging areas for migrating shorebirds.

18. SRAVAN KUMAR PUTNALA & SOM NIYOGI, Department of Biology, University of Saskatchewan, Saskatoon, SK.

Arsenic is a non-essential and highly toxic element which has emerged as a global priority pollutant because of the serious risk it poses to both human and ecological health. Recent work in our lab has demonstrated that chronic environmentally relevant exposure to arsenic can cause reproductive impairment and developmental toxicity in zebrafish. However, the molecular and physiological underpinnings of these adverse effects remain poorly understood. Thus, the first objective of my research will be to investigate whether chronic exposure to arsenic causes reproductive toxicity in zebrafish by disrupting the hypothalamic-pituitary-gonadal (HPG) axis and/or by causing structural and functional damage to reproductive tissues *via* oxidative damage. The second objective of my research will be to examine whether embryonic exposure to arsenic causes larval deformities and behavioral alterations in early life stages of zebrafish by inducing oxidative stress and disrupting neurogenesis and brain development. An important component of my second objective will be to differentiate the developmental effects of maternal transfer of arsenic to the offspring *via* eggs *vs.* post-fertilization (< 6 h) exposure to arsenic. The findings of this research are expected to enhance our understanding of the impacts of arsenic contamination in aquatic ecosystems.

19. Evaluating influences of migratory connectivity on contaminant burdens in Horned Grebes nesting in Saskatchewan and the Northwest Territories

Based on data from the North American Breeding Bird Survey and the Christmas Bird Count, the continental populations of North American Horned Grebes (*Podiceps auritus*) have been in decline since the 1970s, yet there are knowledge gaps concerning migration and contaminant exposure in this species, and drivers of the decline remain unknown. Using two breeding populations of Horned Grebes, this study will deploy external tracking devices and collect biological samples in an effort to address these knowledge gaps. Migration patterns and winter provenance of individuals will be determined using geolocators and stable isotope values derived from feathers. To assess contaminant burdens acquired throughout the annual life-cycle, blood samples will be analyzed for heavy metals, fecal samples for pesticides, and egg samples for persistent organic pollutants. Based on previous studies of White-winged Scoters and other grebe species, I anticipate significant variation in migratory connectivity between breeding populations, as well as elevated contaminant burdens among Prairie breeding and Atlantic wintering individuals. Data collected in this study will create a more complete picture of the annual life cycle of Horned Grebes to allow for better informed conservation decisions for this species and their critical habitats.

20. **CARTER R. WOTTON & CHRISTOPHER D. TODD. Effects of the ureide allantoin in response to salt stress in *Arabidopsis thaliana.*** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Purine degradation is a metabolic pathway that plants use to recycle nitrogen from the adenine and guanine bases. These are converted to xanthine, which is metabolized through ureide intermediates. One of these intermediates, allantoin, has been shown to confer a generalized abiotic stress tolerance when provided exogenously, or in Arabidopsis mutants which lack the enzyme allantoinase that is responsible for metabolizing it. The mechanism of how has yet to be described. I hypothesize that one of these mutants, called *aln-3,* accumulates allantoin in a wide range of cells and tissues inducing a phytohormone such as ABA or JA to activate antioxidant mechanisms and provide stress tolerance. I will confirm salt tolerance using a salt stress assay where the *aln-3* mutants are used as a control compared to Col-0, their wild type progenitor strain. I expect that Col-0 plants will increase allantoin concentration and decrease allantoinase gene expression in response to salt stress. Using the results, I will determine the cellular localization of this response, using a promoter::reporter construct driving green fluorescent protein expression from the allantoinase promoter. This second experiment will provide a spatial map of where allantoin accumulates, providing a clue to how it confers stress tolerance.

21. LINDSAY G CARLSON[1], JOSÉE LEFEBVRE[2], JAMES O. LEAFLOOR[3], FRANK B. BALDWIN[3], MARC DUNN[4], ERNEST RABBITSKIN[4], FANNY NOISETTE[5], MELANIE-LOUISE LEBLANC[6], THEODORE C. NICHOLS[7], JOSHUA C. STILLER[8], SCOTT G. GILLILAND[9], ALAN HANSON[9], STUART M. SLATTERY[10], KENNETH F. ABRAHAM[11], MITCH D. WEEGMAN[1] Ascribing the importance of Atlantic brant staging areas for holistic conservation planning.

1 Department of Biology, University of Saskatchewan, Saskatoon, SK; 2 Canadian Wildlife Service, Québec Region, Québec, QC; 3 Canadian Wildlife Service, Prairie Region, Winnipeg, MB; 4 Niskamoon Corporation, Montréal, QC; 5 Institut des Sciences de la Mer, Université du Québec à Rimouski, Rimouski, QC; 6 Department of Natural Resource Sciences, McGill University, Ste-Anne-de-Bellevue, QC; 7 New Jersey Division of Fish and Wildlife, Woodbine, NJ; 8 New York State Department of Environmental Conservation, Albany, NY; 9 Canadian Wildlife Service, Atlantic Region, Sackville, NB; 10 Ducks Unlimited Canada, Stonewall, MB; 11 Ministry of Natural Resources and Forestry, Peterborough, ON

Atlantic brant (Branta bernicla hrota) are an Arctic-nesting goose iconic to the Atlantic Flyway, but a population that is poorly understood despite its high priority for conservation planning. The population fluctuates dramatically – ranging from 40,835 to 265,688 individuals. These large fluctuations in population size are due to “booms” and “busts” in annual productivity, which are often attributed to food availability and environmental conditions on the breeding grounds. While breeding ground conditions certainly have a direct effect on productivity, carry-over effects from events and processes experienced by an individual during the wintering and staging periods may significantly impact fitness in subsequent periods. In turn, individual-level carry-over effects can cascade to cross-seasonal effects at the population level to explain variations in productivity and demography. With technological advancements in tracking devices, we can target areas for conservation planning where productivity is most influenced by bird decision-making. As such, our objectives are to 1) use locational and behavioral data to describe the behavior of brant in critical wintering and staging areas (e.g., the proportion of time feeding versus resting) and link variation in vegetation quality and distribution; furthermore to 2) assess the relationship between migration attributes (e.g., eelgrass quality on staging areas, movements and behavior on staging versus wintering areas) and productivity for a full annual cycle perspective.

22. Neda Fattahi & Chris Todd. Accumulation of allantoin in response to combined stress in Arabidopsis (*Arabidopsis thaliana*). Department of Biology, University of Saskatchewan, Saskatoon, SK.

Plants are exposed to a variety of physical or chemical environmental factors, including low or elevated temperature, high salinity, heavy metals, and changing water availability. These abiotic stresses pose a threat to agriculture, leading to crop yield loss, costing the global economy. Allantoin is a nitrogen-rich compound produced by the ureide catabolic pathway responsible for recycling nitrogen from purine bases in plants and other organisms. Previous work demonstrated that accumulation of allantoin in plants enhances abiotic stress tolerance by inducing the expression of stress-related genes that respond to reactive oxygen species, resulting in mitigation of oxidative damage in Arabidopsis. My research will apply a biochemical and molecular approach to address the effect of combined salt and high light stress on ureide metabolism and its accumulation in response to combination of abiotic stress. Further, I will explore the link between allantoin accumulation and the ABA signaling pathway, using a genetic approach, combining mutations lacking allantoinase (*aln*) or allantoinase overexpression constructs (*oxALN*) with known ABA mutations (*aba, abi, nced3*). Characterizing these plants' response to abiotic stress, transcript level of antioxidant genes, allantoin content, enzyme activity and stress tolerance will help identify how allantoin and ABA signaling interact.

23. LYNSEY C. BENT[1], JIM P. BAHR[2], KIRSTY E. B. GURNEY[3]. Evaluating lead exposure in scavenging species linked to big-game hunting in Saskatchewan, Canada. [1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]School of Natural Resources and Built Environment, Saskatchewan Polytechnic, Prince Albert, SK; [3]Environment and Climate Change Canada, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK.

For free-ranging animals, chronic exposure to lead, a toxic heavy metal, can manifest in discrete physiological changes, alter behaviours, and contribute to increased mortality. In Canada, although lead ammunition has been banned for hunting waterfowl, carrion contaminated with lead fragments from bullets used in rifle-hunting remains a potential source of exposure for wildlife, particularly scavenging species. Data to quantify lead exposure in these species related to hunting activities in most of Canada, however, are lacking. The overarching goals of my research is therefore to evaluate the extent to which scavenging species are at risk of lead exposure due to big game hunting in Saskatchewan by addressing two main questions: (i) to what extent are remains of hunted white-tailed deer contaminated with lead and (ii) what is the composition of the scavenging community that feeds on these remains. Under the carrion contamination hypothesis, I expect all remains will contain measureable concentrations of lead. I expect the scavenging community, as well as the dominant scavenger species to be variable among sites depending on habitat. My findings will provide Saskatchewan specific data to assist in the continuous assessment of terrestrial lead and its potential impact on wildlife species.

24. EXOGENOUS MELATONIN AMELIORATES THE NEGETIVE EFFECT OF OSMOTIC STRESS IN HUMAN AND BOVINE OVARIAN STROMAL CELLS.

Atefeh Najafi, Ebrahim Asadi, James D. Benson
Department of biology, University of Saskatchewan, Saskatoon, SK

Ovarian tissue cryopreservation transplantation (OTCT) is the most flexible option to preserve fertility in women. However, OTCT is associated with follicle loss and an accompanying short lifespan of the grafts. Cryopreservation induced damage could be due to CPA toxicity and osmotic shock. Therefore, one way to avoid this damage is to maintain the cell volume within osmotic tolerance limits (OTLs). Here, we aimed to determine for the first time the OTLs of ovarian stromal cells (OSCs) and its relationship with ROS and mitochondrial respiratory chain activity (MRCA) of OSCs. We evaluated the effect of an optimal dose of melatonin (antioxidant) on OTLs, viability, MRCA, ROS and total antioxidant capacity (TAC) of both human and bovine OSCs in plated and suspended cells. The OTLs of OSCs were between 200 and 375 mOsm in bovine and between 150 and 500 mOsmol in human. Melatonin expands OTLs of OSCs. Furthermore, melatonin significantly reduced ROS and improved TAC, MRCA and viability. Due to the narrow osmotic window of OSCs, it is important to optimize the current protocols of OTCT to maintain enough stromal cells alive which are necessary for follicles development and graft longevity. Addition of melatonin to cryopreservation media could be an option.

25. K. MICHELLE VANDERWEL[1], MAUD C.O. FERRARI[2] & DOUGLAS P. CHIVERS[1]. Do Some Like it Hot? Effects of Temperature and Predation Risk on Behavioural Syndromes in Crayfish.

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Climate change is increasing water temperatures in freshwater systems. Aquatic ectotherms inhabiting shallow waters may experience rapid increases in temperature, resulting in behavioural responses such as increased activity levels. Individuals vary in their response to such temperature changes. Studying behavioural responses to temperature at the individual level will then lead to insights into how climate change will impact aquatic populations. In addition to temperature, individuals must respond appropriately to risk of predation. Many aquatic species innately react to alarm cues. These chemical cues signal the injury of a nearby conspecific. Individuals that reduce activity in response to alarm cues may be less likely to be observed by a predator. Higher temperatures, then, drive aquatic prey species in one direction while predation risk exerts the opposite effect. We will investigate inter-individual differences in behavioural traits in relation to temperature and predation risk in the virile crayfish, *Faxonius virilis*. We predict that individuals will increase boldness and exploratory behaviour with higher temperatures. Bolder crayfish are predicted to resume activity more quickly under increased predation risk than shyer individuals. This work will increase our understanding of how climate change may alter behaviour of ectotherms and how populations experiencing different temperature regimes may respond.

26. **MAHESH RACHAMALLA & SOM NIYOGI.** Cognitive impairment in adult zebrafish during chronic dietary exposure to arsenic. Department of Biology, University of Saskatchewan, Saskatoon, SK.

The present study was designed to investigate the neurobehavioral effects of chronic exposure to environmentally relevant concentrations of dietary arsenic (As) in zebrafish. Adult zebrafish were exposed to 3 different concentrations of dietary As (30, 60, or 100 µg As/g dry weight; as arsenite) in addition to control for 60 days. Cognitive performance of fish was then evaluated using a latent learning paradigm in a complex maze, which showed a dose-dependent effect of As in all of the latent learning parameters evaluated in this study. Since oxidative stress is a key driver of neurotoxicity, the antioxidative balance in the brain of experimental fish was assessed. A significant decrease in thiol redox and a significant increase in lipid peroxidation were recorded in As-treated fish relative to control, along with the altered expression of enzymatic antioxidant genes. Dopaminergic neurotransmission in the brain regulates important fish behaviors including learning, memory, and reward-motivated behaviors. In the present study, a significant increase in dopamine level and an altered expression of several dopaminergic genes were also observed in the brain of As-treated fish. Overall, it appears that As causes cognitive impairment in zebrafish, likely by inducing oxidative stress and disrupting dopaminergic signaling in the brain.

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

When females are dispersed such that a dominant male cannot defend access to them, scramble competition mating systems may arise. In this mating system, the search for potential mates occurs before mating. In male North American red squirrels (*Tamiasciurus hudsonicus*), competitive mate searching requires travel beyond their defended food-based territories to locate estrous females. Males will then chase estrous females in what is called a mating chase. Males willing to travel farther to participate in these mating chases generally have higher reproductive success. However, what influences variation in searching behaviours is poorly known. Previous research has established that red squirrels have distinct exploration-related personalities and that individual personality can influence home range size outside of the mating season.

Therefore, I propose to: (1) assess how boldness, activity, and aggression influence the distance males will travel to participate in mating chases; and (2) examine whether boldness, activity, and aggression influence male reproductive success indirectly as a consequence of their influence on male mate search effort. For this research, I will use personality tests, radiotelemetry, behavioural observations, and paternity analyses to collect personality data, male reproductive behaviour data, and male reproductive success. As such, the proposed project will establish not only whether male mate search effort is influenced by personality, but also whether this connection has consequences formale reproductive success.

28. WATHMINI DE SILVA[1], ANN MCKELLAR[1,2] & CHRISTY MORRISSEY[1]. Investigation of shorebird foraging ecology in relation to water management regimes for sodium sulphate production on Chaplin Lake, Saskatchewan. [1]Department of Biology, University of Saskatchewan, Saskatoon, SK; [2]Environment and Climate Change Canada, Saskatoon, SK.

Staging sites are critically important for shorebird conservation as large flocks rely on them for rest and refueling during migration. Chaplin Lake is a saline lake and a site of hemispheric importance for shorebirds as a staging area, where an active sodium sulphate mine manages water levels within sub-basins, providing apparently ideal conditions for migrating shorebirds. Little is known about the availability and importance of brine shrimp (*Artemius* spp.) or other prey and how water management activities for brining influence shorebird abundance and foraging ability in Chaplin Lake. Our main objective is to characterize water quantity and quality in relation to prey availability and shorebird use at Chaplin Lake. Across the 10 sub-basins, measurements of water depth, temperature, salinity and nutrients as well as abundance of prey and shorebird densities will be assessed twice weekly from May to August. Fecal eDNA and stable isotope ratios from Sanderling (*Calidris alba*) blood plasma and red blood cells will be used to assess changes in the diet composition over time and the importance of brine shrimp for migratory refueling. Results will identify the optimal lake conditions for benefiting shorebirds that depend on reliable staging sites and resources in the face of changing climate.

29. SHUQI REN. Exposure, Repellency, and Learned Aversion to Neonicotinoid Treated Seeds in Granivorous Songbirds. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Neonicotinoids are the most widely used class of insecticides, commonly used as seed treatment applications to reduce invertebrate pests in various farmed crops. Their use has been observed to pose serious threats to vertebrate wildlife, especially wild birds as they are prone to exposure from ingesting neonicotinoid-treated seeds. We will evaluate the exposure and effects of neonicotinoid seed treatments to granivorous songbirds foraging on farmlands and assess whether wild birds will acquire learned aversion to neonicotinoids-treated seeds through repeated exposure to simulated seed spills. This study will be conducted on up to five pre-seeding croplands in Saskatchewan during the spring sowing season with 3 phases for each site: capture and release (2 days), treatment period (3 weeks), and non-treatment period (1 week). 4 bait stations will be installed on each site with 2 containing clothianidin-treated wheat seeds while the rest containing untreated wheat seeds. Starting from the treatment period, camera traps, RFID tags, nanotags, and omni-antenna stations will be used to monitor birds' behavior and activity pre- and post-seed consumption to observe repellency and learned aversion. During the non-treatment period, we will observe any long-lasting effects of clothianidin toxicity post contaminant removal.

30. **TONG JYUN HO & BYUNG-KOOK HAM. Functional studies of phosphate-stress-induced ribonucleoprotein complexes involved in phloem-mediated systemic signaling.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Phosphate (Pi) is an essential macronutrient for plant growth and is pervasive in many biological processes, including in the formation of adenosine triphosphate, phospholipids, carbohydrates and in protein regulation through phosphorylation. Phosphate deficiency generally leads to primary root arrest, lateral root initiation, shoot reduction and accumulation of reactive oxygen species (ROS). To maintain whole-plant level Pi homeostasis, plants utilize a systemic Pi sensing and signaling mechanism; Pi-stress signals, derived from the root system, are transported to the shoots via the xylem to induce phosphate starvation responses in various tissues and shoot tissues perceive these Pi-stress signals to generate phloem-mediated long-distance signals (e.g. diverse species of RNAs, proteins, metabolites etc.). During the response to phosphate (Pi)-starvation stress, many mRNAs are differentially delivered to the target sink tissues; it has been hypothesized that mobile mRNAs are bound by RNA-binding proteins (RBPs) to form ribonucleoprotein (RNP) complexes and transported through the phloem. Using cucumber as the model system, we profiled phloem-mobile proteins upregulated under Pi stress, in order to identify potential RBPs involved in modulating reactive oxygen species (ROS) under Pi deficient conditions. After identifying candidate RBPs, we will examine their roles in ROS signaling under Pi-starvation stress.

31. **Amir Sabeti & Carlos Carvalho. Characterizing a novel neuronal-specific *hif-1* transcript in C. elegans.** Department of Biology, University of Saskatchewan, Saskatoon, SK.

Hypoxia Inducible Factor-1 (HIF-1) is a conserved protein family of transcription factors in metazoans that evolved to cope with hypoxic stress by activating expression of genes required for adaptation to low oxygen levels. Among animal cells, neurons are particularly susceptible to hypoxia-induced damage. Thus, unraveling how neurons differentially manage the challenges of hypoxia via HIF-1 activation is of particular clinical relevance. We identified the first neuron-specific *hif-1* transcript in the model *C. elegans* which is expressed by internal promoter in intron 4 of the worm *hif-1* locus.

Characterizing novel *hif-1* transcripts in *C. elegans* may lead to a better understanding of tissue-specific adaptations to hypoxia and reveal conserved transcriptional mechanisms in humans where hypoxia-associated neuronal defects during embryonic development are associated with several complex neurological disorders. The aim of this study is to a) characterize the neuronal-specific *hif-1* transcript and expression timeline b) identify the transcriptional machinery acting in neurons to transactivate *hif-1* and c) determine the function(s) of neuronal-specific HIF-1 isoforms in the context of hypoxia-induced gene expression and its sensitivity to oxygen-dependent degradation. I predict that this research will reveal a novel regulatory strategy that evolved in worms to tackle the particular challenges of developing neurons to hypoxia.

The Department of Biology expresses gratitude to all Associate & Adjunct faculty, and their institutions, for supporting the 2022 Biology 990 Symposium.

Thank you also to all the graduate students for their patience and hard work throughout yet another challenging year

Thanks also to the staff in the biology main office who assisted in putting the symposium together and for all they do year round. Our successes are built on a foundation of your hard work.

C. Todd – April 2022